Česká republika – Ministerstvo životního prostředí

Česká republika – Česká inspekce životního prostředí

Správa Krkonošského národního parku

Správa Národního parku Podyjí

Správa Národního parku Šumava

Státní fond životního prostředí České republiky

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Simac Technik ČR, a.s.

KUPNÍ SMLOUVA

TATO KUPNÍ SMLOUVA (dále jen „**Smlouva**") je uzavřena ve smyslu ustanovení § 2079 a násl. zákona č. 89/2012 Sb., občanský zákoník, ve znění pozdějších předpisů (dále jen „**Občanský zákoník**"),

MEZI TĚMITO SMLUVNÍMI STRANAMI:

Česká republika – Ministerstvo životního prostředí

se sídlem:	Vršovická 1442/65, 100 10 Praha 10
IČO:	00164801
bankovní spojení:	Česká národní banka
číslo účtu:	7628001/0710
jednající:	Ing Janou Vodičkovou, ředitelkou odboru informatiky
zástupce pro věcná jednání:	Ing. Milan Soldát, e-mail: milan.soldat@mzp.cz, tel.: xxxxxxxxxx

(dále též „**Kupující č. 1**")

jednající jako centrální zadavatel na základě příslušné smlouvy o centralizovaném zadávání jménem a na účet svůj a následujících pověřujících zadavatelů:

Česká republika – Česká inspekce životního prostředí

se sídlem:	Na Břehu 267/1a, 190 00 Praha 9
IČO:	41693205
bankovní spojení:	Česká národní banka
číslo účtu:	9126101/0710
jednající:	Ing. Erikem Geussem, Ph.D., ředitelem
zástupci pro věcná jednání:	Ing. František Volech, e-mail: frantisek.volech@cizp.cz, tel.: xxxxxxxxxx, a Ing. Jiří Hofman, e-mail: jiri.hofman@cizp.cz, tel.: xxxxxxxxxx

(dále též „**Kupující č. 2**")

a

Správa Krkonošského národního parku

se sídlem:	Dobrovského 3, 543 11 Vrchlabí
IČO:	00088455
bankovní spojení:	Česká národní banka
číslo účtu:	5830601/0710
jednající:	PhDr. Robinem Böhnischem, ředitelem
zástupci pro věcná jednání:	David Havel, e-mail: dhavel@krnap.cz, tel.: +420 499 456 234, xxxxxxxxxx, a Radek Hofman, e-mail: rhofman@krnap.cz, tel.: +420 499 456 235, xxxxxxxxxx

(dále též „**Kupující č. 3**")

a

Správa Národního parku Podyjí

se sídlem:	Na Vyhlídce 5, 669 02 Znojmo
IČO:	00837971
bankovní spojení:	Česká národní banka
číslo účtu:	35734741/0710
jednající:	Ing. Tomášem Rothröcklem, ředitelem
zástupce pro věcná jednání:	Bc. Martin Kouřil, e-mail: kouril@nppodyji.cz, tel.: +420 515 282 253, xxxxxxxxxx

(dále též „**Kupující č. 4**")

a

Správa Národního parku Šumava

se sídlem:	1. máje 260, 385 01 Vimperk
IČO:	00583171
bankovní spojení:	ČNB České Budějovice
číslo účtu:	2234281/0710
jednající:	Mgr. Pavlem Hubeným, ředitelem
zástupce pro věcná jednání:	Jiří Máček, e-mail: jiri.macek@npsumava.cz, tel.: xxxxxxxxxx

(dále též „**Kupující č. 5**")

a

Státní fond životního prostředí České republiky

se sídlem:	Kaplanova 1931/1, 148 00 Praha 11
korespondenční adresa:	Olbrachtova 2006/9, 140 00 Praha 4
IČO:	00020729
bankovní spojení:	Česká národní banka
číslo účtu:	9025001/0710
jednající:	Ing. Petrem Valdmanem, ředitelem
zástupci pro věcná jednání:	Jan Smrčina, e-mail: jan.smrcina@sfzp.cz, tel.: xxxxxxxxxx, a Filip Cabaj, e-mail: filip.cabaj@sfzp.cz, tel.: xxxxxxxxxx

(dále též „**Kupující č. 6**")

dále jednotlivě i společně též „**Kupující**"
NA STRANĚ JEDNÉ,

a

Simac Technik ČR, a.s.

se sídlem:	Radlická 740/113c, 158 00 Praha 5
IČO:	63079496
DIČ:	CZ63079496 (je plátcem DPH)
bankovní spojení:	Československá obchodní banka, a.s.
číslo účtu:	8010-0616133653/0300
jednající:	Ing. Dušanem Bruothem, předsedou představenstva,
	a Ing. Jaroslavem Šteflem, členem představenstva

zapsaná v obchodním rejstříku vedeném Městským soudem v Praze, sp. zn. B.3190

zástupce pro věcná jednání: Martina Jílková, e-mail: martina.jilkova@simac.cz, tel.: +420 283 061 281

dále jen „**Prodávající**"
NA STRANĚ DRUHÉ.

1. ÚVODNÍ USTANOVENÍ, ÚČEL A PŘEDMĚT SMLOUVY

1.1. Tato Smlouva je uzavírána mezi Prodávajícím a Kupujícími na základě výsledků centralizovaného zadávacího řízení dle zákona č. 134/2016 Sb., o zadávání veřejných zakázek, ve znění pozdějších předpisů (dále jen „**ZZVZ**"), za účelem realizace nadlimitní veřejné zakázky s názvem „Pořízení aktivních síťových prvků pro resort MŽP v roce 2018", ve Věstníku veřejných zakázek vedené pod ev. č.: Z2018-000161 (dále jen „**Veřejná zakázka**"), neboť nabídka Prodávajícího byla vyhodnocena jako nejvýhodnější.

1.2. Zkratkou „**Smluvní strany**" se rozumí vždy Prodávající a jednotliví Kupující.

1.3. Každému Kupujícímu vznikají z této Smlouvy práva a povinnosti samostatně a nezávisle na ostatních Kupujících. Jednotliví Kupující se stanou za podmínek upravených dále v této Smlouvě vlastníky příslušné části zboží a mohou tak jednotlivě uplatňovat veškerá práva (tj. zejména nároky z vad zboží, ze záruky apod.) k tomuto zboží vyplývající z této Smlouvy.

1.4. Předmětem této Smlouvy je povinnost Prodávajícího dodat Kupujícím komponenty včetně jejich příslušenství dle specifikace uvedené v Příloze č. 1 této Smlouvy (dále jen „**Zboží**"), toto Zboží nainstalovat, nakonfigurovat, otestovat a případně zaškolit obsluhu, a dále k němu poskytovat záruku a případnou podporu a servis za podmínek upravených v zadávacích podmínkách na Veřejnou zakázku, v nabídce podané Prodávajícím v rámci zadávacího řízení na Veřejnou zakázku a za podmínek uvedených dále v této Smlouvě a jejích přílohách.

1.5. Předmětem této Smlouvy je dále závazek Kupujících převzít příslušné části Zboží a zaplatit za ně Kupní cenu za podmínek stanovených dále v této Smlouvě.

1.6. Prodávající tímto prohlašuje, že:

- Zboží pochází z oficiálních distribučních kanálů,

- záruky a servis budou garantovány výrobcem Zboží a budou u tohoto výrobce registrovány jménem konkrétních Kupujících,

- všechny požadované funkce systému jsou v den podání nabídky Prodávajícím v rámci zadávacího řízení na Veřejnou zakázku v dodaném řešení a v zařízeních již plně implementovány a funkční.

1.7. V rámci požadavku na typy zařízení budou v rámci každého typu Zboží dodána totožná zařízení od jednoho výrobce.

2. DOBA A MÍSTO PLNĚNÍ

2.1. Prodávající je povinen Zboží dodat, nainstalovat, nakonfigurovat, otestovat a uvést do provozu nejpozději do 60 kalendářních dnů od nabytí účinnosti této Smlouvy. V případě Kupujícího č. 6 je Prodávající povinen ve lhůtě dle věty první tohoto odstavce též zaškolit obsluhu v rozsahu 16 hodin. V případě Kupujícího č. 2 je Prodávající povinen ve lhůtě dle věty první tohoto odstavce příslušnou část Zboží pouze dodat do místa plnění, přičemž instalace, konfigurace, testování a uvedení příslušné části Zboží do provozu bude provedena až na základě písemné výzvy Kupujícího č. 2, a to po dokončení realizace stavebních a přípravných prací ze strany jiného dodavatele na základě samostatné smlouvy.

2.2. Místem plnění jsou pro příslušné části Zboží sídla jednotlivých Kupujících uvedená výše v této Smlouvě, vyjma Kupujícího č. 6, kterému bude příslušná část Zboží dodána na korespondenční adresu a na další krajská pracoviště, která jsou uvedena v Příloze č. 2 této Smlouvy.

2.3. Každému Kupujícímu bude dodána do místa plnění pouze ta část Zboží, která mu přísluší dle Přílohy č. 1 této Smlouvy. Dodání Zboží jednoho Kupujícího jinému Kupujícímu či na jiné místo plnění nebude považováno za řádné plnění.

3. CENA A PLATEBNÍ PODMÍNKY

3.1. Celková kupní cena za Zboží dle čl. 1. této Smlouvy byla stanovena nabídkou Prodávajícího podanou na Veřejnou zakázku a činí 14.149.003,43 Kč bez daně z přidané hodnoty (dále jen „**DPH**"), DPH je stanovena ve výši 21 %, tj. 2.971.290,71 Kč. Celková kupní cena včetně DPH tedy bude činit 17.120.294,14 Kč (dále jen „**Celková cena**").

3.2. Podrobné složení Celkové ceny s kupními cenami pro jednotlivé Kupující (dále jen „**Kupní cena**") určuje následující tabulka:

Kupující č. 1 Ministerstvo životního prostředí	Počet kusů	Jednotková cena bez DPH	Cena bez DPH celkem	DPH 21 % v Kč	Cena s DPH celkem
switch interní DMZ	1	277.914,49	277.914,49	58.362,04	336.276,53
switch externí DMZ	1	193.494,60	193.494,60	40.633,86	234.128,46
centrální switch	2	1.367.525,86	2.735.051,72	574.360,86	3.309.412,58
patrový switch – rackovny	25	87.102,977	2.177.574,425	457.290,629	2.634.865,054
switch OVSS	9	60.073,837	540.664,533	113.539,551	654.204,084

switch ČGS k diskovému poli	1	108.347,61	108.347,61	22.753,-	131.100,61
SFP/GBIC – 10GB/s Fibre, Short Range, LC konektor, ne OEM	4	9.154,-	36.616,-	7.689,36	44.305,36
SFP/GBIC – 10GB/s Fibre, Long Range, LC konektor, ne OEM	6	9.154,-	54.924,-	11.534,04	66.458,04
Celkem za Kupujícího č. 1			6.124.587,378	1.286.163,34	7.410.750,718

Kupující č. 2 Česká inspekce životního prostředí	Počet kusů	Jednotková cena bez DPH	Cena bez DPH celkem	DPH 21 % v Kč	Cena s DPH celkem
pobočkový switch 1 GE	15	68.326,3575	1.024.895,36	215.228,03	1.240.123,39
centrální switch – 10 GE, Layer 3	2	126.896,09	253.792,18	53.296,36	307.088,54
SFP+/GBIC – 10GB/s Fibre, Short Range, LC konektor, ne OEM	4	21.740,75	86.963,-	18.262,23	105.225,23
SFP/GBIC – 1Gb/s Fibre, MM, LC konektor, ne OEM	40	4.370,-	174.800,-	36.708,-	211.508,-
Celkem za Kupujícího č. 2			1.540.450,54	323.494,62	1.863.945,16

Kupující č. 3 Správa Krkonošského národního parku	Počet kusů	Jednotková cena bez DPH	Cena bez DPH celkem	DPH 21 % v Kč	Cena s DPH celkem
firewall	2	151.473,-	302.946,-	63.618,66	366.564,66
Celkem za Kupujícího č. 3			302.946,-	63.618,66	366.564,66

Kupující č. 4 Správa Národního parku Podyjí	Počet kusů	Jednotková cena bez DPH	Cena bez DPH celkem	DPH 21 % v Kč	Cena s DPH celkem
switch	1	85.122,87	85.122,87	17.875,80	102.998,67
Celkem za Kupujícího č. 4			85.122,87	17.875,80	102.998,67

Kupující č. 5 Správa Národního parku Šumava	Počet kusů	Jednotková cena bez DPH	Cena bez DPH celkem	DPH 21 % v Kč	Cena s DPH celkem
FW na pobočky	3	374.411,80	1.123.235,40	235.879,43	1.359.114,83
Celkem za Kupujícího č. 5			1.123.235,40	235.879,43	1.359.114,83

Kupující č. 6 Státní fond životního prostředí ČR	Počet kusů	Jednotková cena bez DPH	Cena bez DPH celkem	DPH 21 % v Kč	Cena s DPH celkem
pobočkový firewall (včetně 2 ks rezervy)	15	71.074,2425	1.066.113,6375	223.863,8638	1.289.997,5013
centrální firewall/VPN koncentrátor	2	453.026,5025	906.053,005	190.271,131	1.096.324,136
L3 switch na ústředí	2	220.737,80	441.475,60	92.709,88	534.185,48
switch pro patrové rozvodny (včetně 1ks rezervy)	26	82.615,40	2.148.000,40	451.080,08	2.599.080,48
optický transceiver, 1 Gbit SX, konektory LC, ne OEM	12	5.035,50	60.426,-	12.689,46	73.115,46
optický transceiver, 10 Gbit SR, konektory LC, ne OEM	8	20.727,45	165.819,60	34.822,12	200.641,72
management switch ústředí	4	38.554,60	154.218,40	32.385,86	186.604,26
switch Kaplanova	1	30.554,60	30.554,60	6.416,47	36.971,07
Celkem za Kupujícího č. 6			4.972.661,2425	1.044.238,8648	6.016.920,1073

3.3. Celková cena i Kupní ceny pro jednotlivé Kupující jsou konečné, závazné a obsahují všechny případné náklady Prodávajícího včetně dopravy, podpory, instalace a všech poplatků, byť nebyly v nabídce Prodávajícího podané v rámci zadávacího řízení na Veřejnou zakázku výslovně uvedeny. V případě změny právních předpisů týkajících se DPH bude cena účtována s platnou výší DPH.

3.4. Kupní cenu za příslušné Zboží dle odst. 3.2 tohoto článku zaplatí každý Kupující Prodávajícímu zvlášť, a to bezhotovostním převodem na bankovní účet Prodávajícího uvedený výše v této Smlouvě na základě daňových dokladů (dále jen „**faktura**") vystavených Prodávajícím.

3.5. Prodávající vystaví fakturu zvlášť každému Kupujícímu dle dodávaného Zboží ke dni uskutečnění zdanitelného plnění, který je dnem podepsání protokolu o předání a převzetí Zboží bez vad (každým Kupujícím) dle čl. 4. odst. 4.1 této Smlouvy. V případě Kupujícího č. 2 je Prodávající oprávněn vystavit fakturu a Kupující se ji zavazuje uhradit již na základě dodání příslušné části Zboží Kupujícímu č. 2 dle čl. 2. odst. 2.1 věta třetí této Smlouvy.

Splatnost každé faktury je 30 dní ode dne jejího doručení příslušnému Kupujícímu. Povinnost Kupujících zaplatit Kupní ceny je splněna odepsáním příslušné částky z účtu Kupujících. Kupující neposkytují zálohy. Platby budou probíhat výhradně v Kč (CZK), rovněž veškeré cenové údaje na fakturách budou v této měně.

3.6.   Jednotliví Kupující za své závazky vzájemně neručí – každý je povinen zaplatit Prodávajícímu pouze za jemu určené a dodané Zboží.

3.7.   Každá faktura bude obsahovat náležitosti daňového a účetního dokladu podle zákona č. 563/1991 Sb., o účetnictví, ve znění pozdějších předpisů, a zákona č. 235/2004 Sb., o dani z přidané hodnoty, ve znění pozdějších předpisů (jedná se především o označení faktury a její číslo, identifikační údaje Smluvních stran, předmět Smlouvy [příslušné části Zboží rozepsané na jednotlivé položky dle tabulky uvedené v čl. 3. odst. 3.2 a přílohách této Smlouvy bez DPH a s DPH], bankovní spojení, fakturovanou částku bez/včetně DPH) a bude mít náležitosti obchodní listiny dle § 435 Občanského zákoníku. V případě Kupujícího č. 1 musí být faktura označena evidenčním číslem této Smlouvy z Centrální evidence smluv Kupujícího: 170347 (viz také záhlaví této Smlouvy).

3.8.   Každý Kupující je oprávněn vrátit fakturu do konce doby splatnosti, pokud bude obsahovat nesprávné náležitosti či údaje nebo pokud požadované náležitosti a údaje nebude obsahovat vůbec. V takovém případě se doba splatnosti vůči příslušnému Kupujícímu zastavuje a nová doba splatnosti počíná běžet ode dne doručení opravené nebo doplněné faktury konkrétnímu Kupujícímu. Kupující není v takovém případě v prodlení.

4. PŘEDÁNÍ A PŘEVZETÍ ZBOŽÍ, PŘECHOD VLASTNICTVÍ

4.1.   O předání a převzetí Zboží (i neúspěšném) a též o jeho následném zprovoznění bude vždy sepsán protokol podepsaný společně Prodávajícím a příslušným Kupujícím. V případě zjištěných nedostatků bude v tomto protokolu uvedena tato skutečnost s konkrétním vymezením zjištěných vad včetně způsobu a termínu jejich řešení. Fakturovat lze vždy až po podpisu protokolu bez vad oběma Smluvními stranami.

4.2.   Součástí protokolu o zprovoznění bude Technická dokumentace. Technická dokumentace bude popisovat technické parametry všech dodaných komponent a jejich vnitřní propojení a dále bude obsahovat způsob zapojení do stávající infrastruktury Kupujícího.

4.3.   Vlastnické právo ke Zboží přechází z Prodávajícího na Kupujícího až okamžikem převzetí Zboží bez vad Kupujícím.

5. SERVISNÍ A ZÁRUČNÍ PODMÍNKY, PRÁVA Z VAD

5.1.   Kupující požaduje a Prodávající se zavazuje poskytnout Kupujícímu záruku a podporu na všechny části a komponenty dodaného Zboží (HW, SW i licence) v rozsahu stanoveném Přílohou č. 1 této Smlouvy.

5.2.   Smluvní strany prohlašují, že původcem odpadu při realizaci této Smlouvy, tj. např. demontovaných zařízení nahrazovaných dodaným Zbožím, které si Kupující výslovně nepřeje ponechat, dále pak obalů zbylých po montáži Zboží, apod. je v souladu s § 4 odst. 1 písm. x) zákona č. 185/2001 Sb., o odpadech a o změně některých dalších zákonů, ve znění pozdějších předpisů (dále jen „**zákon o odpadech**"), je Prodávající, a má tak všechny povinnosti původce odpadů podle § 16 zákona o odpadech.

5.3. Vady musí Kupující uplatnit u Prodávajícího bez zbytečného odkladu poté, co se o nich dozví.

5.4. Prodávající je bezodkladně po nabytí účinnosti této Smlouvy povinen Kupujícím sdělit písemně telefonní číslo a další kontaktní údaje k využití podpory a řádnému nahlášení vady dle odst. 5.3 tohoto článku.

5.5. Kupující má právo na úhradu nutných nákladů, které mu vznikly v souvislosti s uplatněním práv z vad.

5.6. Za záruční vady nebudou považovány ty vady, které byly způsobeny nesprávnou obsluhou nebo údržbou Zboží nebo úmyslným poškozením Zboží Kupujícím. Odstranění takto zjištěných vad bude provedeno za úplatu.

5.7. Kupující má právo na dodání nového Zboží bez vady nebo dodání chybějícího Zboží, na odstranění vady opravou Zboží (pokud je vada opravitelná) nebo na přiměřenou slevu. O způsobu vyřízení záruky rozhoduje Kupující.

6. SANKCE

6.1. Při nedodržení doby dodání Zboží (a navazujících úkonů dle čl. 2. odst. 2.1 této Smlouvy) či v případě prodlení s nástupem na odstranění vady či samotným odstraněním vady Zboží je Prodávající povinen uhradit Kupujícímu smluvní pokutu ve výši 5.000,- Kč za každý i započatý den prodlení.

6.2. V případě zjištění dle čl. 7. odst. 7.2 této Smlouvy je Prodávající povinen zaplatit Kupujícímu č. 1 smluvní pokutu 50.000,- Kč za každé takové porušení.

6.3. V případě porušení jakékoliv další povinnosti Prodávajícího vyplývající z čl. 3., 4. a 5. této Smlouvy se stanovuje pokuta 1.000,- Kč za každé porušení, popř. každý den prodlení s plněním této povinnosti či každý den trvání závadného stavu.

6.4. Smluvní pokuta je splatná do 30 dnů ode dne doručení výzvy k jejímu zaplacení Prodávajícímu. Dnem zaplacení se rozumí den připsání příslušné částky na účet Kupujícího.

6.5. Uplatněním práv z vad či uplatněním smluvních pokut není dotčeno právo na náhradu škody v plné výši.

7. ODSTOUPENÍ OD SMLOUVY

7.1. V případě podstatného porušení této Smlouvy Prodávajícím může Kupující též odstoupit od této Smlouvy. Prodávající a Kupující se dohodli, že za podstatné porušení této Smlouvy bude považováno zejména:

- nemožnost odstranění vady dodaného Zboží, a to ani výměnou za nové Zboží;

- prodlení Prodávajícího s dodáním Zboží o více než 2 týdny;

- jestliže Prodávající ujistil Kupujícího, že Zboží má určité vlastnosti, zejména vlastnosti Kupujícím výslovně vymíněné, a toto ujištění se následně ukáže nepravdivým.

7.2. Kupující je dále oprávněn odstoupit od této Smlouvy, jestliže zjistí, že Prodávající:

- nabízel, dával, přijímal nebo zprostředkovával určité hodnoty s cílem ovlivnit chování nebo jednání kohokoliv, ať již státního úředníka nebo někoho jiného, přímo nebo nepřímo, v zadávacím řízení nebo při provádění této Smlouvy; nebo

- zkresloval jakékoliv skutečnosti za účelem ovlivnění zadávacího řízení nebo provádění této Smlouvy ke škodě Kupujícího, včetně užití podvodných praktik k potlačení a snížení výhod volné a otevřené soutěže.

7.3. Prodávající může od této Smlouvy odstoupit, pokud:

- je Kupující v prodlení s úhradou faktury Prodávajícího za dodané Zboží déle než 60 dní ode dne jejího doručení Kupujícímu, a zároveň

- byl Kupující na její neuhrazení písemně Prodávajícím upozorněn spolu s možným důsledkem odstoupení od této Smlouvy, a po tomto upozornění ji Kupující do 7 dní neuhradil.

7.4. Odstoupení od této Smlouvy musí být provedeno v písemné formě. Odstoupením se závazek založený touto Smlouvou zrušuje od počátku. Účinky odstoupení nastávají okamžikem doručení odstoupení od této Smlouvy druhé Smluvní straně. Odstoupení od této Smlouvy se nedotýká práva na náhradu škody vzniklého z porušení smluvní povinnosti, práva na zaplacení smluvní pokuty ta úroku z prodlení, ani ujednání o způsobu řešení sporů a volbě práva.

7.5. Odstoupit od této Smlouvy ze strany Prodávajícího je možno pouze ve vztahu ke konkrétnímu Kupujícímu, nikoliv této Smlouvě jako celku, a naopak.

7.6. V případě odstoupení jsou si Smluvní strany povinny zejména vrátit vše, co v souvislosti s plněním této Smlouvy obdržely, resp. provést vypořádání závazků dle § 2004 a násl. Občanského zákoníku.

7.7. Každý Kupující je oprávněn tuto Smlouvu ukončit písemnou výpovědí podanou i bez udání důvodu s tím, že výpovědní lhůta činí 30 dní a počíná běžet od prvního dne měsíce následujícího po doručení výpovědi na adresu druhé Smluvní strany.

8. ZÁVĚREČNÁ USTANOVENÍ

8.1. Tato Smlouva a právní vztahy založené touto Smlouvou se řídí právním řádem České republiky. Práva a povinnosti Smluvních stran, pokud nejsou upraveny touto Smlouvou, se řídí zejména Občanským zákoníkem, ZZVZ a předpisy souvisejícími.

8.2. Veškeré případné spory vzniklé mezi Smluvními stranami na základě nebo v souvislosti s touto Smlouvou budou primárně řešeny jednáním Smluvních stran. V případě, že tyto spory nebudou v přiměřené době vyřešeny, budou k jejich projednání a rozhodnutí příslušné obecné soudy České republiky.

8.3. V případě, že některé ustanovení této Smlouvy je nebo se stane v budoucnu neplatným, neúčinným či nevymahatelným nebo bude-li takovým shledáno příslušným orgánem, zůstávají ostatní ustanovení této Smlouvy v platnosti a účinnosti, pokud z povahy takového ustanovení nebo z jeho obsahu anebo z okolností, za nichž byla tato Smlouva uzavřena, nevyplývá, že jej nelze oddělit od ostatního obsahu této Smlouvy. Smluvní strany se zavazují bezodkladně nahradit neplatné, neúčinné nebo nevymahatelné ustanovení této Smlouvy ustanovením jiným, které svým obsahem a smyslem odpovídá nejlépe ustanovení původnímu a této Smlouvě jako celku.

8.4. Tato Smlouva může být měněna nebo doplňována pouze formou písemných vzestupně číslovaných dodatků odsouhlasených a podepsaných oběma Smluvními stranami. Ke změnám či doplnění neprovedeným písemnou formou se nepřihlíží.

8.5. Nedílnou součástí této Smlouvy je zadávací dokumentace, jakož i nabídka Prodávajícího podaná v rámci zadávacího řízení na Veřejnou zakázku, podle nichž budou posuzována práva a závazky Smluvních stran v této Smlouvě výslovně neupravené; pokud bude zjištěn rozpor mezi smluvními ujednáními a zadávací dokumentací, resp. nabídkou Prodávajícího, bude se obsah práv a závazků řídit vždy úpravou obsaženou v zadávací dokumentaci.

8.6. Smluvní strany na sebe přebírají nebezpečí změny okolností v souvislosti s právy a povinnostmi Smluvních stran vzniklými na základě této Smlouvy. Smluvní strany vylučují uplatnění ustanovení § 1765 odst. 1, § 1766 a § 2620 Občanského zákoníku na svůj smluvní vztah založený touto Smlouvou.

8.7. Prodávající je dále povinen umožnit kontrolu v místě plnění i kontrolu všech dokladů souvisejících s realizací předmětu plnění této Smlouvy, a to zejména v souladu se zákonem č. 320/2001 Sb., o finanční kontrole ve veřejné správě a o změně některých zákonů (zákon o finanční kontrole), ve znění pozdějších předpisů, zákonem č. 255/2012 Sb., o kontrole (kontrolní řád), ve znění pozdějších předpisů, a případně Nařízením Komise (ES) č. 438/2001, kterým se stanoví prováděcí pravidla k nařízení Rady (ES) č. 1260/1999, pokud jde o řídicí a kontrolní systémy pro pomoc poskytovanou ze strukturálních fondů. Tyto povinnosti trvají i po ukončení této Smlouvy. Prodávající souhlasí s tím, aby Kupující po dobu trvání této Smlouvy zpracovávali jeho osobní údaje uvedené v této Smlouvě pro účely archivace, případné kontrolní činnosti nebo pro účely vyplývající z právních předpisů.

8.8. Tato Smlouva nabývá platnosti dnem jejího podpisu všemi Smluvními stranami, resp. dnem podpisu poslední Smluvní strany, a účinnosti dnem jejího uveřejnění v Informačním systému Registr smluv (dále jen „**ISRS**") dle podmínek stanovených zákonem č. 340/2015 Sb., o zvláštních podmínkách účinnosti některých smluv, uveřejňování těchto smluv a o registru smluv (zákon o registru smluv), ve znění pozdějších předpisů. Prodávající bezvýhradně souhlasí s uveřejněním celého znění této Smlouvy v ISRS a na profilu zadavatele Kupujícího č. 1 (jakožto centrálního zadavatele), popř. na dalších místech, v souladu s příslušnými právními předpisy. Uveřejnění této Smlouvy v ISRS provede Kupující č. 1.

8.9. Tato Smlouva je vyhotovena v 8 stejnopisech, z nichž každý má hodnotu originálu, kdy Prodávající obdrží 1 stejnopis a každý Kupující obdrží po 1 stejnopise s výjimkou Kupujícího č. 1, který obdrží 2 stejnopisy.

8.10. Nedílnou součástí této Smlouvy jsou:

- Příloha č. 1 – Technická specifikace a podrobná cenová kalkulace;

- Příloha č. 2 – Seznam krajských pracovišť Kupujícího č. 6;

- Příloha č. 3 – Technické listy.

Prodávající a Kupující prohlašují, že tato Smlouva vyjadřuje jejich svobodnou, vážnou, určitou a srozumitelnou vůli prostou omylu. Prodávající a Kupující si tuto Smlouvu přečetli a s jejím obsahem souhlasí, což stvrzují vlastnoručními podpisy.

Za Kupující: **Za Prodávajícího:**

Za Kupujícího č. 1:

V Praze, dne 06. 06. 2018   V Praze, dne 04. 06. 2018

Ing. Jana Vodičková   Ing. Dušan Bruoth
ředitelka odboru informatiky   předseda představenstva
Česká republika – Ministerstvo životního prostředí   Simac Technik ČR, a.s.

Za Kupujícího č. 2:   Ing. Jaroslav Štefl
                                                            člen představenstva
V Praze, dne 22. 06. 2018   Simac Technik ČR, a.s.

Ing. Erik Geuss, Ph.D.
ředitel
Česká republika – Česká inspekce životního prostředí

Za Kupujícího č. 3:

Ve Vrchlabí, dne 08. 06. 2018

PhDr. Robin Böhnisch
ředitel
Správa Krkonošského národního parku

Za Kupujícího č. 4:

V Praze, dne 12. 06. 2018

Ing. Tomáš Rothröckl

ředitel

Správa Národního parku Podyjí

Za Kupujícího č. 5:

V Praze, dne 13. 06. 2018

Mgr. Pavel Hubený

ředitel

Správa národního parku Šumava

Za Kupujícího č. 6:

V Praze, dne 12. 06. 2018

Ing. Petr Valdman

ředitel

Státní fond životního prostředí České republiky

Technická specifikace a podrobná cenová kalkulace

Ministerstvo životního prostředí

1x switch interní DMZ

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	2x napájecí zdroj AC
	Kompatibilita s produkty Cisco, které jsou ve vlastnictví Kupujícího.
	5 let dopředné a zpětné kompatibility s produkty Cisco
Kapacitní požadavky a počty portů	48x 10/100/1000 Ethernet Ports
	min. 2x 10G SFP+ Uplink Ethernet
	1x console port
Výkonnostní parametry	min. výkon přeposílání (velikost paketu 64 bytů): 100 Mpps Přepojovací kapacita: 170 Gbps VLAN IDs available: 4000 Velikost MAC 32 000 záznamů
Požadované schopnosti	Přepojování na 2. vrstvě, podpora DHCP, automatické vyjednávání, podpora ARP, seskupování, podpora VLAN, auto-uplink (auto MDI/ MDI-X), IPv6 podpora, Podporuje Rapid Spanning Tree Protocol (RSTP), podpora MSTP (Multiple Spanning Tree Protocol, Trivial File Transfer Protocol (TFTP) podpora, Access Control List (ACL) podpora, podpora RADIUS, podpora Jumbo Frames, MLD snooping, Dynamic ARP Inspection (DAI), Unicast Reverse Path Forwarding (URPF), Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Podpora IPv4, Protokol LACP, Remote Switch Port Analyzer (RSPAN), NetFlow-Lite, QoS, Stacking IP routing – static routes, RIP, RIPv2, RIPng EIGRP, OSPF, IS-IS, BGPv4, VRF, PBR, PIM
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.3az, IEEE 802.1AX
	SNMP 1, RMON 1, RMON 2, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
SFP/GBIC	2x SFP/GBIC - 10GB/s Fibre, Short Range, LC konektor, ne OEM
Management	Plná správa zařízení pomocí jednotného SW nástroje
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C3650-48TD-E	Cisco Catalyst 3650 48 Port Data 2x10G Uplink IP Services	1,00	kus	158 594,97	158 594,97
CON-PSRT-WC3654UA	PRTNR SS 8X5XNBD Cisco Catalyst 3650 48 Port Data 2x10G U	1,00	kus	65 591,52	65 591,52
S3650UK9-36E	CAT3650 Universal k9 image	1,00	kus	0,00	0,00
PWR-C2-250WAC	250W AC Config 2 Power Supply	1,00	kus	0,00	0,00
PWR-C2-250WAC/2	250W AC Config 2 Secondary Power Supply	1,00	kus	5 060,00	5 060,00
CAB-TA-EU	Europe AC Type A Power Cable	2,00	kus	0,00	0,00
C3650-STACK-KIT	Cisco Catalyst 3650 Stack Module	1,00	kus	15 180,00	15 180,00
C3650-STACK	Cisco Catalyst 3650 Stack Module	4,00	kus	0,00	0,00
STACK-T2-50CM	50CM Type 2 Stacking Cable	2,00	kus	0,00	0,00
C3650-STACK-KIT=	Cisco Catalyst 3650 Stack Module Spare	1,00	kus	15 180,00	15 180,00
SFP-10G-SR=	10GBASE-SR SFP Module	2,00	kus	9 154,00	18 308,00

1x switch externí DMZ

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	2x napájecí zdroj AC
	Kompatibilita s produkty Cisco, které jsou ve vlastnictví Kupujícího.
	5 let dopředné a zpětné kompatibility s produkty Cisco
Kapacitní požadavky a počty portů	24x 10/100/1000 Ethernet Ports
	min. 2x 10G SFP+ Uplink Ethernet
	1x console port

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Výkonnostní parametry	min. výkon přeposílání (velikost paketu 64 bytů): 65 Mpps Přepojovací kapacita: 85 Gbps VLAN IDs available: 4000 Velikost MAC 32 000 záznamů
Požadované schopnosti	Přepojování na 2. vrstvě, podpora DHCP, automatické vyjednávání, podpora ARP, seskupování, podpora VLAN, auto-uplink (auto MDI/ MDI-X), IPv6 podpora, Podporuje Rapid Spanning Tree Protocol (RSTP), podpora MSTP (Multiple Spanning Tree Protocol, Trivial File Transfer Protocol (TFTP) podpora, Access Control List (ACL) podpora, podpora RADIUS, podpora Jumbo Frames, MLD snooping, Dynamic ARP Inspection (DAI), Unicast Reverse Path Forwarding (URPF), Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Podpora IPv4, Protokol LACP, Remote Switch Port Analyzer (RSPAN), NetFlow-Lite, QoS, Stacking IP routing – static routes, RIP, RIPv2, RIPng EIGRP, OSPF, IS-IS, BGPv4, VRF, PBR, PIM
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.3az, IEEE 802.1AX
	SNMP 1, RMON 1, RMON 2, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
SFP/GBIC	2x SFP/GBIC - 10GB/s Fibre, Short Range, LC konektor, ne OEM
Management	Plná správa zařízení pomocí jednotného SW nástroje
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C3650-24TD-E	Cisco Catalyst 3650 24 Port Data 2x10G Uplink IP Services	1,00	kus	102 566,97	102 566,97
CON-PSRT-WSC365TE	PRTNR SS 8X5XNBD Cisco Catalyst 3650 24 Port Data 2x10G U	1,00	kus	37 199,63	37 199,63
S3650UK9-36E	CAT3650 Universal k9 image	1,00	kus	0,00	0,00
PWR-C2-250WAC	250W AC Config 2 Power Supply	1,00	kus	0,00	0,00
PWR-C2-250WAC/2	250W AC Config 2 Secondary Power Supply	1,00	kus	5 060,00	5 060,00
CAB-TA-EU	Europe AC Type A Power Cable	2,00	kus	0,00	0,00

C3650-STACK-KIT	Cisco Catalyst 3650 Stack Module	1,00	kus	15 180,00	15 180,00
C3650-STACK	Cisco Catalyst 3650 Stack Module	4,00	kus	0,00	0,00
STACK-T2-50CM	50CM Type 2 Stacking Cable	2,00	kus	0,00	0,00
C3650-STACK-KIT=	Cisco Catalyst 3650 Stack Module Spare	1,00	kus	15 180,00	15 180,00
SFP-10G-SR=	10GBASE-SR SFP Module	2,00	kus	9 154,00	18 308,00

2x centrální switch

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	2 redundantní napájecí zdroje AC s výkonem minimálně 2500W
	6 slotů pro rozšiřující karty
	5 let dopředné a zpětné kompatibility s produkty stejné řady stejného výrobce
Kapacitní požadavky a počty portů	4x 10GE SFP+ uplink, line rate, L2-4 Jumbo Frame (až 9216 bytes)
	48 portů 10/100/1000 RJ-45, wire rate 1:1, s podporou 802.3az, IEEE 802.1AE, L2-4 Jumbo Frame (až 9216 bytes)
	48 portů SFP , podpora1G/100FX SFP line rate, podpora IEEE 802.1AE Fiber Encryption a Cisco TrustSec, L2-4 Jumbo Frame support (a6 9216 bytes)
	Minimálně 12 portů s podporou rychlosti 10GBASE-X, kapacita 24 gigabits na slot, podpora 10GBASE-X a 1GBASE-X (SFP) modulů, podpora L2-4 Jumbo Frame (až 9216 bytes)
	10/100/1000 RJ-45 konzole port a management port
Výkonnostní parametry	Kapacita celého systému min. 520 Gbps, kapacita systému na slot 48 Gbps
	Podpora Flexible NetFlow (FNF), minimálně 128,000 Flexible NetFlow záznamů v hardwaru
	Propustnost systému 225 Mpps pro protokol IPv4, 110 Mpps pro IPv6, 225 Mpps pro L2 Bridging
	Podpora celého systému až pro minimálně 240 portů 10/100/1000 Base-T
Minimální parametry	- počet IPv4 routing záznamů min. 12000, - počet IPv6 routing záznamů min. 8000, - Multicast routes min. 1000, - Security a QoS hardware záznamů min. 4000, - počet záznamů MAC adres min. 32000, - počet aktivních VLAN min. 4094, - počet Address Resolution Protocol (ARP) záznamů min. 8000, - počet Dynamic Host Configuration Protocol (DHCP) snooping záznamů min. 5000, - počet instancí Spanning Tree Protocol min. 128, - počet switched virtual interfaces (SVIs) min. 1024,

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	- podpora minimálně 128,000 Flexible NetFlow záznamů v hardwaru
Požadované schopnosti	- Detailní flexibilní definice „flow" dle L2,L3 i L4 parametrů - Statistiky určovány z každého paketu daného „flow" pro monitoring bezpečnosti a hrozeb - Sběr pro export TCP příznaků „flow" pro monitoring bezpečnostních hrozeb - Návaznost skriptů interpretovaných přepínačem po detekci daných parametrů „flow" - Zobrazení sbíraných informací o „flow" přímo v přepínači, i včetně „TopN" pohledu. - Export statistik „flow" selektivně na více kolektorů - 8 bidirectional line-rate Switched Port Analyzer/Remote SPAN (SPAN/RSPAN), - Network virtualization through Multi-Virtual Route Forwarding (VRF) technology for Layer 3 segmentation
Podpora IPv6	- Unicast a Multicast forwarding, - IPv6 výkon 110 Mpps, - IPv6 routing záznamů 6000, - podpora Dynamic Hardware Route Table allocations a MLD snooping pro IPv6, - podpora Unicast Reverse Path Forwarding Version 6 (URPFv6) Strict Mode
Standardy a protokoly	Ethernet: - IEEE 802.3, 10 Gigabit Ethernet: - IEEE 802.3ae, - IEEE 802.1D Spanning Tree Protocol, - IEEE 802.1w Rapid Reconfiguration of Spanning Tree, - IEEE 802.1s Multiple VLAN Instances of Spanning Tree, - IEEE 802.3ad LACP, - IEEE 802.1p CoS Prioritization, - IEEE 802.1Q VLAN, - IEEE 802.1X User Authentication, RMON I and II standards, - IEEE 802.3az
SFP/GBIC	16x SFP/GBIC - 10GB/s Fibre, Short Range, LC konektor, ne OEM 4x SFP/GBIC - 1GB/s Fibre, Short Range, LC konektor, ne OEM
Management	Plná správa zařízení pomocí jednotného SW nástroje
	Řídící software s podporou BGP v4, OSPF v2/3, ISIS, IPSLA, NSF, PBR, VRF,
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C4506-E	Cat4500 E-Series 6-Slot Chassis, fan, no ps	2,00	kus	63 512,97	127 025,94
CON-PSRT-C4506E	PRTNR SS 8X5XNBD Cat4500 E-Series 6-Slot Chassis, fan, no	2,00	kus	123 162,99	246 325,98
S45EUK9-S8-38E	CAT4500e SUP8e Universal Crypto Image	2,00	kus	0,00	0,00
C4K-SLOT-CVR-E	Catalyst 4500 E-Series Family Slot Cover	4,00	kus	0,00	0,00
C4500E-IP-ES	Paper IP to Ent Services License	2,00	kus	91 726,30	183 452,60
WS-X45-SUP8L-E	Catalyst 4500 E-Series Supervisor 8L-E	2,00	kus	110 080,30	220 160,60
CAB-AC-2800W-EU	Europe Power Cord	4,00	kus	0,00	0,00
WS-X4748-SFP-E	Catalyst 4500 E-Series 48-Port GE (SFP)	2,00	kus	321 195,00	642 390,00
WS-X4748-RJ45-E	Catalyst 4500 E-Series 48-Port 10/100/1000 Non-Blocking	2,00	kus	64 195,30	128 390,60
WS-X4712-SFP+E	Catalyst 4500 E-Series 12-Port 10GbE (SFP+)	2,00	kus	391 161,00	782 322,00
PWR-C45-2800ACV	Catalyst 4500 2800W AC Power Supply (Data and PoE)	2,00	kus	19 274,00	38 548,00
PWR-C45-2800ACV/2	Catalyst 4500 2800W AC Power Supply (Data and PoE)	2,00	kus	18 354,00	36 708,00
SFP-10G-SR=	10GBASE-SR SFP Module	32,00	kus	9 154,00	292 928,00
GLC-SX-MMD=	1000BASE-SX SFP transceiver module, MMF, 850nm, DOM	8,00	kus	4 600,00	36 800,00

25x patrový switch – rackovny

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	1 napájecí zdroj AC
	Kompatibilita s produkty Cisco, které jsou ve vlastnictví Kupujícího.
	5 let dopředné a zpětné kompatibility s produkty Cisco
Kapacitní požadavky a počty portů	48x 10/100/1000 Ethernet Ports

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	min. 4x 1G SFP Uplink Ethernet
	1x console port
Výkonnostní parametry	min. výkon přeposílání (velikost paketu 64 bytů): 100 Mpps Přepojovací kapacita: 200 Gbps VLAN IDs available: 4000, 1000 active VLANs
Požadované schopnosti	Přepojování na 2. vrstvě, podpora DHCP, automatické vyjednávání, podpora ARP, seskupování, podpora VLAN, auto-uplink (auto MDI/ MDI-X), IPv6 podpora, Podporuje Rapid Spanning Tree Protocol (RSTP), podpora MSTP (Multiple Spanning Tree Protocol, Trivial File Transfer Protocol (TFTP) podpora, Access Control List (ACL) podpora, podpora RADIUS, podpora Jumbo Frames, MLD snooping, Dynamic ARP Inspection (DAI), Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Podpora IPv4, Protokol LACP, Remote Switch Port Analyzer (RSPAN), NetFlow-Lite, QoS
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.3az, IEEE 802.1AX
	SNMP 1, RMON 1, RMON 2, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
SFP/GBIC	4x SFP/GBIC – 1Gb/s Fibre, MM, LC konektor, ne OEM
Management	Plná správa zařízení pomocí jednotného SW nástroje
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího č. 1, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C2960X-48TS-L	Catalyst 2960-X 48 GigE, 4 x 1G SFP, LAN Base	25,00	kus	51 923,27	1 298 081,75
CON-PSRT-WSC248TS	PRTNR SS 8X5XNBD Catalyst 2960-X 48 GigE, 4 x 1G SFP, LAN	25,00	kus	16 779,7075	419 492,6875
CAB-ACE	AC Power Cord (Europe), C13, CEE 7, 1.5M	25,00	kus	0,00	0,00
GLC-SX-MMD=	1000BASE-SX SFP transceiver module, MMF, 850nm, DOM	100,00	kus	4 600,00	460 000,00

9x switch OVSS

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	1 napájecí zdroj AC
	Kompatibilita s produkty Cisco, které jsou ve vlastnictví Kupujícího.
	5 let dopředné a zpětné kompatibility s produkty Cisco
Kapacitní požadavky a počty portů	48x 10/100/1000 Ethernet Ports
	min. 2x 1G SFP Uplink Ethernet
	1x console port
Výkonnostní parametry	min. výkon přeposílání (velikost paketu 64 bytů): 100 Mpps Přepojovací kapacita: 100 Gbps VLAN IDs available: 4000, 64 active VLANs
Požadované schopnosti	Přepojování na 2. vrstvě, podpora DHCP, automatické vyjednávání, podpora ARP, podpora VLAN, auto-uplink (auto MDI/ MDI-X), IPv6 podpora, Podporuje Rapid Spanning Tree Protocol (RSTP), podpora MSTP (Multiple Spanning Tree Protocol, Trivial File Transfer Protocol (TFTP) podpora, Access Control List (ACL) podpora, podpora RADIUS, podpora Jumbo Frames, MLD snooping, Dynamic ARP Inspection (DAI), Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Podpora IPv4, Protokol LACP, Remote Switch Port Analyzer (RSPAN),
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.3az, IEEE 802.1AX
	SNMP 1, RMON 1, RMON 2, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
Management	Plná správa zařízení pomocí jednotného SW nástroje
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího č. 1, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C2960X-48TS-LL	Catalyst 2960-X 48 GigE, 2 x 1G SFP, LAN Lite	9,00	kus	46 492,97	418 436,73
CON-PSRT-WSC296X4	PRTNR SS 8X5XNBD Catalyst 2960-X 48 GigE, 2 x 1G SFP, LAN	9,00	kus	13 580,8675	122 227,8075
CAB-ACE	AC Power Cord (Europe), C13, CEE 7, 1.5M	9,00	kus	0,00	0,00

1x switch ČGS k diskovému poli

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	1 napájecí zdroj AC
	Kompatibilita s produkty Cisco, které jsou ve vlastnictví Kupujícího.
	5 let dopředné a zpětné kompatibility s produkty Cisco
Kapacitní požadavky a počty portů	48x 10/100/1000 Ethernet Ports
	min. 2x 10G SFP+ Uplink Ethernet
	1x console port
Výkonnostní parametry	min. výkon přeposílání (velikost paketu 64 bytů): 100 Mpps Přepojovací kapacita: 200 Gbps VLAN IDs available: 4000, 1000 active VLANs
Požadované schopnosti	Přepojování na 2. vrstvě, podpora DHCP, automatické vyjednávání, podpora ARP, seskupování, podpora VLAN, auto-uplink (auto MDI/ MDI-X), IPv6 podpora, Podporuje Rapid Spanning Tree Protocol (RSTP), podpora MSTP (Multiple Spanning Tree Protocol, Trivial File Transfer Protocol (TFTP) podpora, Access Control List (ACL) podpora, podpora RADIUS, podpora Jumbo Frames, MLD snooping, Dynamic ARP Inspection (DAI), Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Podpora IPv4, Protokol LACP, Remote Switch Port Analyzer (RSPAN), NetFlow-Lite, QoS
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.3az, IEEE 802.1AX
	SNMP 1, RMON 1, RMON 2, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
SFP/GBIC	2x 10GB/s Fibre, Short Range, LC konektor (ne OEM) + 2x 5m optický kabel MM, LC
Management	Plná správa zařízení pomocí jednotného SW nástroje
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C2960X-48TD-L	Catalyst 2960-X 48 GigE, 2 x 10G SFP+, LAN Base	1,00	kus	66 732,97	66 732,97

CON-PSRT-WSC298DL	PRTNR SS 8X5XNBD Catalyst 2960-X 48 GigE, 2 x 10G SFP+, L	1,00	kus	22 339,44	22 339,44
CAB-ACE	AC Power Cord (Europe), C13, CEE 7, 1.5M	1,00	kus	0,00	0,00
SFP-10G-SR=	10GBASE-SR SFP Module	2,00	kus	9 154,00	18 308,00
HDDBBC-5M0	Propojovací kabel LC/PC-LC/PC MM 50/125 duplex 1,7mm High-End Class H+S - 5m	2,00	kus	483,60	967,20

SFP/GBIC Datacentrum/DMZ

4x SFP/GBIC - 10GB/s Fibre, Short Range, LC konektor, ne OEM
6x SFP/GBIC - 10GB/s Fibre, Long Range, LC konektor, ne OEM

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
SFP-10G-SR=	10GBASE-SR SFP Module	4,00	kus	9 154,00	36 616,00
SFP-10G-LRM=	10GBASE-LRM SFP Module	6,00	kus	9 154,00	54 924,00

Česká inspekce životního prostředí

15x pobočkový switch 1 GE

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	1 napájecí zdroj AC
	Kompatibilita s produkty Cisco, které jsou ve vlastnictví Kupujícího.
	5 let dopředné a zpětné kompatibility s produkty Cisco
Kapacitní požadavky a počty portů	48x 10/100/1000 Ethernet Ports
	min. 4x 1G SFP Uplink Ethernet
	1x console port
Výkonnostní parametry	min. výkon přeposílání (velikost paketu 64 bytů): 100 Mpps Přepojovací kapacita: 200 Gbps VLAN IDs available: 4000, 1000 active VLANs
Požadované schopnosti	Přepojování na 2. vrstvě, podpora DHCP, automatické vyjednávání, podpora ARP, seskupování, podpora VLAN, auto-uplink (auto MDI/ MDI-X), IPv6 podpora, Podporuje Rapid Spanning Tree Protocol (RSTP), podpora MSTP (Multiple Spanning Tree Protocol, Trivial File Transfer Protocol (TFTP) podpora, Access Control List (ACL) podpora, podpora RADIUS, podpora Jumbo Frames, MLD snooping, Dynamic ARP Inspection (DAI, Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Podpora IPv4, Protokol LACP, Remote Switch Port Analyzer (RSPAN), NetFlow-Lite, QoS
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.3az, IEEE 802.1AX
	SNMP 1, RMON 1, RMON 2, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
Management	Plná správa zařízení pomocí jednotného SW nástroje
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C2960X-48TS-L	Catalyst 2960-X 48 GigE, 4 x 1G SFP, LAN Base	15,00	kus	51 546,65	773 199,75

CON-PSRT-WSC248TS	PRTNR SS 8X5XNBD Catalyst 2960-X 48 GigE, 4 x 1G SFP, LAN	15,00	kus	16 779,7075	251 695,6125
CAB-ACE	AC Power Cord (Europe), C13, CEE 7, 1.5M	15,00	kus	0,00	0,00

2x centrální switch – 10 GE, Layer 3

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	1 napájecí zdroj AC
	Kompatibilita s produkty Cisco, které jsou ve vlastnictví Kupujícího.
	5 let dopředné a zpětné kompatibility s produkty Cisco
Kapacitní požadavky a počty portů	48x 10/100/1000 Ethernet Ports
	min. 2x 10G SFP+ Uplink Ethernet min. 2x 1G SFP Uplink Ethernet
	1x console port
Výkonnostní parametry	min. výkon přeposílání (velikost paketu 64 bytů): 100 Mpps Přepojovací kapacita: 170 Gbps VLAN IDs available: 4000, 250 active VLANs
Požadované schopnosti	Přepojování na 2. vrstvě, podpora DHCP, automatické vyjednávání, podpora ARP, seskupování, podpora VLAN, auto-uplink (auto MDI/ MDI-X), IPv6 podpora, Podporuje Rapid Spanning Tree Protocol (RSTP), podpora MSTP (Multiple Spanning Tree Protocol, Trivial File Transfer Protocol (TFTP) podpora, Access Control List (ACL) podpora, podpora RADIUS, podpora Jumbo Frames, MLD snooping, Dynamic ARP Inspection (DAI), Unicast Reverse Path Forwarding (URPF), Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Podpora IPv4, Protokol LACP, Remote Switch Port Analyzer (RSPAN), NetFlow-Lite, QoS, Stacking IP routing – static routes
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.3az, IEEE 802.1AX
	SNMP 1, RMON 1, RMON 2, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
Management	Plná správa zařízení pomocí jednotného SW nástroje
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C3650-48TD-L	Cisco Catalyst 3650 48 Port Data 2x10G Uplink LAN Base	2,00	kus	81 306,35	162 612,70
CON-PSRT-WS6548DL	PRTNR SS 8X5XNBD Cisco Catalyst 3650 48 Port Data 2x10G U	2,00	kus	30 409,74	60 819,48
S3650UK9-36E	CAT3650 Universal k9 image	2,00	kus	0,00	0,00
PWR-C2-250WAC	250W AC Config 2 Power Supply	2,00	kus	0,00	0,00
CAB-TA-EU	Europe AC Type A Power Cable	2,00	kus	0,00	0,00
PWR-C2-BLANK	Config 2 Power Supply Blank	2,00	kus	0,00	0,00
C3650-STACK-KIT	Cisco Catalyst 3650 Stack Module	2,00	kus	15 180,00	30 360,00
C3650-STACK	Cisco Catalyst 3650 Stack Module	4,00	kus	0,00	0,00
STACK-T2-50CM	50CM Type 2 Stacking Cable	2,00	kus	0,00	0,00

SFP/GBIC

4x SFP+/GBIC - 10GB/s Fibre, Short Range, LC konektor, ne OEM
40x SFP/GBIC – 1Gb/s Fibre, MM, LC konektor, ne OEM

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
GLC-SX-MMD=	1000BASE-SX SFP transceiver module, MMF, 850nm, DOM	40,00	kus	4 370,00	174 800,00
SFP-10G-SR=	10GBASE-SR SFP Module	4,00	kus	21 740,75	86 963,00

2x FW

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	1 napájecí zdroj AC
Kapacitní požadavky a počty portů	Počet síťových rozhraní copper, RJ45 10/100/1000 - min 20x.
	Počet SFP: 2 x GbE SFP.
	1x console port
Výkonnostní parametry HW	RIP, BGP, OSPF, IS-IS. Policy routing. Traffic Shaping, QoS s podporou DSCP markování a ToS. Bezdrátový kontrolér, podpora vytváření inteligentní bezdrátové sítě, funkce ARRP (Automatic Radio Resource Provisioning), možnost detekce a reportování tzv. Rogue AP), bezdrátová sítě je založená na principu tenkých AP s inteligentní správou kontrolerem. Podpora VoIP, SIP včetně zabezpečení, rate limitingu, analýzy protokolu. WAN optimalizace (Explicitní Proxy, WCCP). Podpora silné autentizace uživatelů - integrovaná podpora dvoufaktorové autentizace, podpora certifikátů pro ověření uživatelů. Propustnost FW (stavové filtrování, paket o velikosti 1518 B/512 B/ 64B UDP - min 7 Gbps/7 Gbps/4 Gbps. Latence firewallu (64 B UDP paket) – max. 5μs. Výkon firewall – min. 6 Mpps. Počet naráz otevřených spojení - min 2 Milion. Počet nových spojení za sekundu - min. 30 000. Propustnost IPSEC VPN (512 B paket) - min. 4 Gbps. Propustnost SSL VPN min 250 Mbps. Propustnost IPS (IMIX) - min 500 Mbps. Podpora virtualizace (min 10 virtuálních kontextů). Podpora funkce bezdrátový kontrolér – min 32 AP.
Funkce L2/L3	Režim vysoké dostupnosti, L2, Active, Active Passive, full mesh HA, VRRP, synchronizace stavové tabulky mezi nódy v clustery. Režim fungování L2 - transparentní režim, L3 - NAT/Router. Podpora multicast, vytváření politiky pro multicast routování.
Podpora VPN	SSL VPN (portálový režim, tunelový režim), IPSEC (IKE, manual key, certifikát, gateway to gateway, hub and spoke, dial up
Firewall funkcionality	Možnost nastavovat firewall politiku na základě geografických údajů. Podpora Identity based policy - nastavení bezpečnosti uživateli na základě členství ve skupině na doménovém kontroléru. Funkce Load Balancing - možnost rozdělování zátěže směrující na virtuální

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	IP na reálně servery, podpora healt check funkcí, podpora SSL offload.
	UTM funkce:
	Antivirus pro vybrané protokoly, možnost volby různých databází, podpora archivace škodlivého obsahu, možnost detekce tzv. Grayware (rootkit, malware, spywave, keylogger, atd).
	E-mail filter - jednoduchá antispamová a antivirová inspekce elektronické pošty.
	Intrusion Protection System - detekce útoků založena na signaturové části a na anomálním filtru, možnost vytvářet vlastní signatury.
	Web Filter - založená na kategorizaci webového obsahu, možnost monitorování navštívených kategorii na uživatele či skupinu, možnost kvóty - uživatel může navštěvovat určitou kategorii jen po určitou dobu během dne.
	Data Leak Prevention s funkcí document fingerprinting.
	Application Control - detekce, monitoring, povolení či zakázání aplikací na základě signatury dané aplikace, nikoliv dle portu.
	Deep scanning - možnost kontroly komunikace v SSL šifrovaných protokolech (HTTPS, IMAPS, POP3S,…).
	DoS Policy prevence proti základním útokům typu DoS, syn proxy.
	Endpoint Control a monitoring - kontrola připojené pracovní stanice na patch level, instalovaný vhodný service pack, antivirový software, personální firewall či jiný software.
	Ověřování uživatelů LDAP, Active Directory, Radius, Ověřování na základě certifikátu, Dynamické profily - možnost přiřadit konkrétní profil uživateli na základě jeho ověření.
Management	Plná správa zařízení pomocí PRTG SW (SNMPv 1,2,3)
	Support cluster boxů s full UTM supportem celkem na 3 roky.
	Podpora včetně AV/AS, IPS, App. Control a Webfiltering, BotNet, AntiSpam.
	Možnost logování a uchování logů po dobu nejméně 6 měsíců.
	Možnost vytváření vlastních reportů z provozu firewallu a chování uživatelů.
Podpora	Záruka výrobce na 3 roky s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
FG-100E-BDL-950-36	Fortinet, FortiGate, FortiGate 100E, HW + 24x7 UTM Protection 3YR	2,00	kus	122 958,00	245 916,00
FC-10-FG1HE-131-02-36	Fortinet, FortiGate, FortiGate 100E, FortiCloud analysis and log retention 3YR	2,00	kus	25 515,00	51 030,00

	všechny potřebné licence pro provoz (licence pro HW, SW)	1,00	kus	0,00	0,00
	všechny instalační a konfigurační práce do předání díla	1,00	kus	4 000,00	4 000,00
	technická podpora po dobu 3 let	1,00	kus	0,00	0,00
	servisní zajištění po dobu 3 let v režimu 5x7 NBD	1,00	kus	2 000,00	2 000,00

Správa Národního parku Podyjí

1 x switch

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku
	1 napájecí zdroj AC
	Kompatibilita s produkty Cisco, které jsou ve vlastnictví Kupujícího.
	5 let dopředné a zpětné kompatibility s produkty Cisco
Kapacitní požadavky a počty portů	48x 10/100/1000 Ethernet Ports
	min. 2x 1G SFP Uplink Ethernet, včetně modulu 2x SFP-1G-LRM (ne OEM)
	1x console port
Výkonnostní parametry	min. výkon přeposílání (velikost paketu 64 bytů): 100 Mpps Přepojovací kapacita: 100 Gbps VLAN IDs available: 4000, 64 active VLANs
Požadované schopnosti	Přepojování na 2. vrstvě, podpora DHCP, automatické vyjednávání, podpora ARP, seskupování, podpora VLAN, auto-uplink (auto MDI/ MDI-X), IPv6 podpora, Podporuje Rapid Spanning Tree Protocol (RSTP), podpora MSTP (Multiple Spanning Tree Protocol, Trivial File Transfer Protocol (TFTP) podpora, Access Control List (ACL) podpora, podpora RADIUS, podpora Jumbo Frames, MLD snooping, Dynamic ARP Inspection (DAI), Unicast Reverse Path Forwarding (URPF), Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), Podpora IPv4, Protokol LACP, Auto QoS
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.3az, IEEE 802.1AX
	SNMP 1, RMON 1, RMON 2, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
Management	Plná správa zařízení pomocí jednotného SW nástroje
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
WS-C2960X-48TS-LL	Catalyst 2960-X 48 GigE, 2 x 1G SFP, LAN Lite	1,00	kus	53 234,00	53 234,00

CON-PSRT-WSC296X4	PRTNR SS 8X5XNBD Catalyst 2960-X 48 GigE, 2 x 1G SFP, LAN	1,00	kus	13 580,87	13 580,87
CAB-ACE	AC Power Cord (Europe), C13, CEE 7, 1.5M	1,00	kus	0,00	0,00
GLC-LH-SMD=	1000BASE-LX/LH SFP transceiver module, MMF/SMF, 1310nm, DOM	2,00	kus	9 154,00	18 308,00

Správa Národního parku Šumava

3x FW na pobočky

Požadavek na funkcionalitu každého FW	Minimální požadavky
Základní vlastnosti	HW appliance - montáž do 19" racku
	1 napájecí zdroj AC
Kapacitní požadavky a počty portů	Počet fyzických síťových rozhraní, min. 6x1GB eth
	Možnost dalšího rozšíření o 4x1Gb eth rozhraní
	Dedikovaný management port (console port)
	Disk s min. celkovou kapacitou 250 GB
Výkonnostní parametry	Propustnost L3 inspekce min. 1Gbps per port
	Propustnost L7 inspekce min. 120 Mbps
	Propustnost L7 inspekce včetně TLS inspekce min. 80 Mbps
Požadovaná funkčnost	FW řešení podporující technologii stavového paketového filtru i aplikačních proxy bran firewallu tj. spojení je terminováno na FW
	Podpora NAT / PAT
	Možnost řízení komunikace volitelně na síťových vrstvách L3 až L7
	Integrovaná VPN brána - podpora VPN (IPsec, OpenVPN)
	Licenčně neomezený počet konkurenčních VPN spojení
	Detailní VPN log
	Monitoring a reporting aktivit VPN uživatelů
	Antivirová kontrola provozu pro HTTP, HTTPs, SMTP, POP3, IMAP4, FTP
	Anti-malware řešení s pravidelně aktualizovanou databází signatur
	IPS (Intrusion Prevention System) ochrana stanic a uživatelů, možnost definice vlastních IPS signatur
	Webový filtr s databází rizikových webových stránek
	Schopnost nastavit specifické URL na white/black list
	Podpora řízení a filtrace protokolů HTTP, HTTPS v transparentním i netransparentním režimu
	Možnost volitelné HTTPS inspekce per konkrétní uživatel, ip adresa, cílový server, URL apod.
	Možnost editace důvěryhodných CA
	Podpora VLAN
	Podpora IPv6
	Podpora ICAP rozhraní
	Podpora SNMP
	Podpora Syslog
	Synchronizace času pomocí NTP
	Blokování na základě seznamu IP (ACL - access control list)
	Možnost vytváření virtuálních síťových rozhraní (segmentů) na FW
	Řízení přístupu a provozu na FW přes neomezený počet připojených síťových segmentů (zón)
	Podpora QoS – nastavení pravidel podle IP adresy, uživatele, portu, typu souboru

Požadavek na funkcionalitu každého FW	Minimální požadavky
	Podpora aplikační proxy pro protokoly: HTTP, HTTPS, FTP, SMTP, DNS, SIP
	Podpora autentizace (Kerberos, NTLM, LDAP, RADIUS)
	Podpora Integrace s Microsoft Active Directory včetně řízení dle skupin uživatelů a podpory SSO
	Výjimky z autentizace dle zdrojové nebo cílové IP adresy, nebo user agenta
	Podpora automatické detekce proxy WPAD
	Možnost ukončení TLS / SSL komunikace na FW s prováděním všech kontrol v šifrovaném provozu a to jak v provozu na server i klienta včetně rozšifrování a zašifrování spojení – https inspekce
Management	Plnohodnotné grafické a CLI rozhraní pro administraci systému
	Podpora aplikace nových pravidel v konfiguraci bez ukončení probíhajících datových spojení (bez-výpadkově)
	Podpora paralelní instalace více verzí firmware – safe upgrade (možnost okamžitého návratu k poslední funkční verzi).
	Řešení musí uchovávat záznamy o veškerých změnách konfigurace, možnost porovnání změn mezi dvěma konfiguracemi, vedení administračního deníku, možnost návratu k libovolné verzi konfigurace.
	Administrační rozhraní musí umožnovat vytvářet uživatele minimálně na úrovni administrátora a auditora (plný přístup nebo pouze přístup ke čtení konfigurace a logu, bez možnosti provádění změn)
	Periodicky generované statistiky provozu a nástroj pro monitoring událostí
	SSH přístup na konzoli zařízení
Podpora	Záruka výrobce na 5 let s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, s reakční dobou na servisní zásah 8x5 Next-Business-Day (reakční doba do následujícího pracovního dne od nahlášení, s hlášením možným 8 hodin denně/5 dnů v týdnu), s opravou/výměnnou v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
UTM-APL-200	Kernun UTM 200	3,00	kus	72 000,00	216 000,00
UTM-ASL-200	Subscription UTM 400 - 1Y	12,00	kus	15 840,00	190 080,00
UTM-CP60-ZAS210	HW Care Pack NBD on-site po dobu 60 měsíců	3,00	kus	14 685,80	44 057,40
UTM-KCW-100	Modul Kernun Clear Web - 1y	3,00	kus	20 300,00	60 900,00
UTM-KCW-SUB-100	Subscription KCW - 1Y	12,00	kus	9 164,00	109 968,00

UTM-APL-AVK-200	Modul Antivirus pro appliance 200 - 1Y	15,00	kus	5 162,00	77 430,00
UTM-APL-IPS-200	Modul IPS/IDS pro appliance 200 - 1Y	15,00	kus	6 960,00	104 400,00
TCS-IMP-IND	Služba Instalace a implementace Kernun UTM 200 (2,4MD)	7,20	kus	12 000,00	86 400,00
KSP-9x5-IND	Rozšířená technická podpora pro Kernun UTM 200 v režimu NBD, Diagnostika/Oprava/Výměna/Obnova konfigurace vzdáleně i v místě sídla zákazníka, monitoring dostupnosti - 5Y	3,00	kus	78 000,00	234 000,00

Specifické požadavky zpracování předimplementační analýzy:

1) zmapování současného stavu infrastruktury;

2) návrh migračního plánu včetně případné optimalizace – předpokládá se migrace za plného provozu, tedy v několika krocích, kde nové a stávající aktivní prvky a jejich konfigurace budou muset koexistovat (odtud pramení požadavek na kompatibilitu se současnými aktivními prvky Kupujícího). Výstupem tohoto migračního plánu by tedy měly být následující kroky:

   a) integrace nových aktivních prvků do stávající infrastruktury Kupujícího;

   b) návrh nového adresního plánu s rezervací IP adres;

   c) postupná migrace (přepojování koncových bodů) na nové aktivní prvky – předpokládá se migrace za provozu, s minimálními výpadky, tudíž maximální utilizace "klidových hodin" – tj. mimo pracovní hodiny (tj. pondělí až pátek 17:00 – 8:00) a víkendy;

   d) dekonfigurace a demontáž současných aktivních prvků Kupujícího;

   e) časová náročnost jednotlivých migračních kroků;

   f) dokumentace skutečného zapojení a konfigurací prvků.

Specifické požadavky na dodávku řešení:

V rámci plnění je nutné fyzicky navštívit všechny rozvodny SFŽP na korespondenční adrese Olbrachtova 2006/9, 140 00 Praha 4, aby bylo možné naplánovat vhodný harmonogram výměny síťových prvků.

SFŽP poskytne dokumentaci aktuálního stavu zapojení krajských pracovišť.

Na všechna krajská pracoviště SFŽP bude nutné v pracovních hodinách (Po-Pá 9-15) doručit nový nakonfigurovaný prvek a přepojit jej za původní.

15x pobočkový firewall (včetně 2 kusů rezervy)

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	1 napájecí zdroj AC
	Kompatibilita s produkty, které jsou ve vlastnictví Kupujícího (Cisco ASA, unmanaged switche Zyxel a TrendNet)
	5 let dopředné a zpětné kompatibility s produkty stejné řady stejného výrobce
Kapacitní požadavky a počty portů	Minimálně 8 portů, minimálně 10/100 baseT Ethernet, RJ-45 (integrovaný switch)
	1x 10/100 baseT Ethernet RJ-45 management port
	1x RJ-45 konzole port (EIA/TIA-232)
Výkonnostní parametry	Minimální propustnost: 150 Mb/s
	Minimální propustnost IPS: 70 Mb/s
	Minimální počet současných relací: 10 000
	Počet nových relací za sekundu: 4 000
	Minimální počet IPsec site-to-site tunelů: 10
Požadované schopnosti	Minimální počet VLAN: 20 Podpora 3DES/AES (AES-128, AES-192, AES-256), IKEv2, MD5, SHA Minimální počet uživatelů: 50

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	Podpora L3 (routovaného) módu s podporou NAT a PAT
Podpora IPv6	Podpora filtrace a inspekce IPv4 a IPv6
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.3ad (LACP), SNMP 1, SNMP 3, SNMP 2c
Management	SSH, HTTPS
Podpora	Záruka výrobce na 5 let na díly i servis s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, oprava/výměna zařízení do 24 hodin od nahlášení, 7 dnů v týdnu (24x7), v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
ASA5506-FTD-BUN	ASA 5506-X Firepower Threat Defense Chassis and Subs. Bundle	1,00	kus	0,00	0,00
ASA5506-FTD-K9	ASA 5506-X with Firepower Threat Defense, 8GE, AC	15,00	kus	48 036,35	720 545,25
CON-PSUP-ASAK506F	PRTNR SUP 24X7X4 ASA 5506-X with Firepower Threat Defense	15,00	kus	13 285,8925	199 288,3875
SF-ASA-TD6.2.2-K9	Cisco Firepower Threat Defense software v6.2.2 for ASA5500-X	15,00	kus	0,00	0,00
ASA5506-SSD	ASA 5506-X SSD	15,00	kus	0,00	0,00
ASA5506-PWR-AC	ASA 5506-X Power Adaptor	15,00	kus	0,00	0,00
CAB-ACE	AC Power Cord (Europe), C13, CEE 7, 1.5M	15,00	kus	0,00	0,00
L-ASA5506T-T=	Cisco ASA5506 Threat Defense Threat Protection License	15,00	kus	0,00	0,00
L-ASA5506T-T-5Y	Cisco ASA5506 Threat Defense Threat Protection 5Y Subs	15,00	kus	9 752,00	146 280,00

2x centrální firewall / VPN koncentrátor

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	1 napájecí zdroj AC
	Montáž do 19" racku, maximálně 1U
	Podpora Active/Standby nebo Active/Active High Availability (HA)

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	Kompatibilita s produkty, které jsou ve vlastnictví Kupujícího (Cisco ASA, HPE 5930, Catalyst 4500, unmanaged switche Zyxel a TrendNet)
	5 let dopředné a zpětné kompatibility s produkty stejné řady stejného výrobce
Kapacitní požadavky a počty portů	Minimálně 6 portů 10/100/1000 baseT Ethernet, RJ-45, s podporou 802.3ab, 802.3ac, 802.3u
	1x 10/100 baseT Ethernet RJ-45 management port
	1x RJ-45 konzole port (EIA/TIA-232)
Výkonnostní parametry	Minimální propustnost (reálný provoz): 1 Gb/s
	Minimální propustnost IPS: 500 Mb/s
	Minimální propustnost VPN: 250 Mb/s
	Minimální počet současných relací: 250 000
	Počet nových relací za sekundu: 15 000
	Minimální počet IPsec site-to-site tunelů: 250
	Minimální počet clientless VPN klientů: 250
Požadované schopnosti	- Minimální počet VLAN: 100 - Podpora clientless SSL VPN (minimálně pětiletá licence) - Podpora připojení VPN pomocí integrovaného klienta OS Microsoft Windows 7 a vyšší - Podpora 3DES/AES (AES-128, AES-192, AES-256), IKEv2, MD5, SHA - Neomezený počet uživatelů (LAN) - Podpora L3 (routovaného) módu s podporou NAT a PAT) - Podpora stateful failover - Podpora dynamického routování (OSPF, OSPFv3) - Podpora filtrace a inspekce IPv4 a IPv6 - Podpora autentizačních mechanizmů: lokální databáze na FW, RADIUS, Windows NT LAN Manager (NTLM), Active Directory Kerberos, RSA softID, RSA securID, Lightweight Directory Access Protocol (LDAP), digitální certifikáty (X.509)
Podpora IPv6	Podpora filtrace a inspekce IPv4 a IPv6
Standardy a protokoly	IEEE 802.3, IEEE 802.3u, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.3ad (LACP), SNMP 1, SNMP 3, SNMP 2c
	Stateful inspekce minimálně těchto aplikačních protokolů: HTTP, FTP, Instant Messenger, File Sharing, SIP, H.323, SCCP, SMTP, ESMPT, DNS, RPC, CIFS, MSRPC, NETBIOS
Management	SSH, HTTPS
Podpora	Záruka výrobce na 5 let na díly i servis s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, oprava/výměna zařízení do 24 hodin od nahlášení, 7 dnů v týdnu (24x7), v místě Kupujícího, servisním technikem (on-site).

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
ASA5525-FPWR-BUN	ASA 5525-X with FirePOWER Svcs. Chassis and Subs. Bundle	1,00	kus	0,00	0,00
ASA5525-FPWR-K9	ASA 5525-X with FirePOWER Services, 8GE, AC, 3DES/AES, SSD	2,00	kus	124 396,35	248 792,70
CON-PSUP-A25FPK9	PRTNR SUP 24X7X4 ASA 5525-X with FirePOWER Services, 8GE,	2,00	kus	128 625,4875	257 250,9750
CAB-ACE	AC Power Cord (Europe), C13, CEE 7, 1.5M	2,00	kus	0,00	0,00
SF-ASA-X-9.8.2-K8	Cisco ASA 9.8.2 Software image for ASA Spyker/Saleen	2,00	kus	0,00	0,00
SF-ASA-FP6.2.2-K9	Cisco FirePOWER Software v6.2.2 for ASA 5500-X	2,00	kus	0,00	0,00
ASA5525-CTRL-LIC	Cisco ASA5525 Control License	2,00	kus	0,00	0,00
ASA-IC-B-BLANK	ASA 5525-X Interface Card Blank Slot Cover	2,00	kus	0,00	0,00
ASA5500X-SSD120INC	ASA 5512-X through 5555-X 120GB MLC SED SSD (Incl.)	2,00	kus	0,00	0,00
ASA5525-MB	ASA 5525 IPS Part Number with which PCB Serial is associated	2,00	kus	0,00	0,00
ASA5500-ENCR-K9	ASA 5500 Strong Encryption License (3DES/AES)	2,00	kus	0,00	0,00
L-ASA5525-TA=	Cisco ASA5525 FirePOWER IPS License	2,00	kus	0,00	0,00
L-ASA5525-TA-5Y	Cisco ASA5525 FirePOWER IPS 5YR Subscription	2,00	kus	92 920,00	185 840,00
L-AC-APX-LIC=	Cisco AnyConnect Apex Term License, Total Authorized Users	250,00	kus	0,00	0,00
L-AC-APX-5Y-S3	Cisco AnyConnect Apex License, 5YR, 250-499 Users	250,00	kus	552,00	138 000,00

FS-VMW-10-SW-K9	Cisco Firepower Management Center,(VMWare) for 10 devices	2,00	kus	18 400,00	36 800,00
CON-PSBU-VMW10	PSS SWSS UPGRADES-Cisco Firepower Management CenterVMWare	2,00	kus	19 684,665	39 369,33

2x L3 switch na ústředí

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku, maximálně 1U
	2x napájecí zdroj AC
	Kompatibilita s produkty, které jsou ve vlastnictví Kupujícího (Cisco ASA, HPE 5930, Catalyst 4500, unmanaged switche Zyxel a TrendNet)
	5 let dopředné a zpětné kompatibility s produkty stejné řady stejného výrobce
Kapacitní požadavky a počty portů	Minimálně 48x 10/100/1000 baseT Ethernet Ports RJ-45, s podporou 802.3ab, 802.3ac, 802.3u
	Minimálně 6x 10 Gbit SFP+ Uplink Interfaces
	1x RJ-45 console port (EIA/TIA-232)
	1x 10/100 baseT Ethernet RJ-45 management port
Výkonnostní parametry	Minimální požadované parametry: - Switching bandwidth: 200 Gbps - VLAN IDs available: 4000 (1000 aktivních) - Forwarding Rate: 160 Mpps - Počet MAC address: 30 000 - Počet SVI: 1000 - L2-4 Jumbo Frame (až 9216 bytes)
Požadované schopnosti	- Stohování: redundantní propojení prvků do virtuálního stohu, minimální kapacita stohovacího propoje 20 Gbit. Stoh se chová jako jedno zařízení. - Routing: OSPFv2 a OSPFv3, PBR, statické směrování - Bezpečnost: MAC-based VLAN assignment, 802.1x Monitor Mode, and RADIUS Change of Authorization, Port Security, Dynamic, ARP Inspection, IP Source Guard, DHCP snooping, Private VLANs, Access Control Lists (ACLs) for IPv6 and IPv4 for security and QoS, VLAN ACLs, Router ACLs define security policies, Port-based ACLs for Layer 2, Secure Shell (SSH) Protocol, and Simple Network Management Protocol Version 3 (SNMPv3), Port Mirroring, TACACS+ or RADIUS authentication, IEEE 802.1AE - MACsec - Konektivita: MAC Address Notification, Multilevel security on console access, Bridge protocol data unit (BPDU) Guard, Spanning Tree Root Guard (STRG or similar function), IGMP filtering, Dynamic VLAN assignment, Cross-stack EtherChannel, IEEE 802.1s/w Rapid Spanning Tree Protocol (RSTP), Autonegotiation on all ports, Link Aggregation Control Protocol (LACP), Automatic media-dependent interface crossover (MDIX), Link status monitoring (UDLD, DLDP or similar protocol), MVRP nebo VTP - Upgrade OS přepínače bez narušení provozu (ISSU). Podpora skriptovatelné reakce na asynchronní událost. Podpora skriptování v jazyce Python nebo TCL

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	– lokální interpret jazyka v přepínači.
	- IP SLA nebo alternativní způsob monitorování provozu a dostupnosti služeb s možnou návazností na automatické konfigurační změny systému pro zajištění zachování dostupnosti služeb. Zařízení funguje jako IP SLA iniciátor.
	- Local Proxy Address Resolution Protocol (ARP), Voice VLAN, Port Mirroring, Remote Monitoring (RMON) software, Trivial File Transfer Protocol (TFTP), Network Timing Protocol (NTP)
	- Quality of Service: Traffic prioritization (IEEE 802.1p), Simplified quality of service (QoS) configuration, Class of Service (CoS), Layer 4 prioritization
Standardy a protokoly	- IEEE 802.1s - IEEE 802.1w - IEEE 802.1x - IEEE 802.3ad - IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports - IEEE 802.1D Spanning Tree Protocol - IEEE 802.1p CoS prioritization - IEEE 802.1Q VLAN - IEEE 802.3 10BASE-T specification - IEEE 802.3u 100BASE-TX specification - IEEE 802.3ab 1000BASE-T specification - IEEE 802.3z 1000BASE-X specification - RMON I a II standardy - SNMPv1, SNMPv2c, and SNMPv3
Management	SSH, HTTPS, SNMP (v1/v2c/v3)
Podpora	Záruka výrobce na 5 let na díly i servis s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, oprava/výměna zařízení do 24 hodin od nahlášení, 7 dnů v týdnu (24x7), v místě Kupujícího, servisním technikem (on-site). Jsou požadovány software aktualizace (nové verze programového vybavení) v minimální délce 5 let. Je požadovaná technická podpora výrobce po dobu 5 let.

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
JH146A	HPE 5510 48G 4SFP+ HI Swch	2,00	kus	128 004,85	256 009,70
U0TZ1E	HPE 5Y FC 4H Exch HPE 5510 48G 4SFP+ SVC	2,00	kus	57 560,30	115 120,60
JD362B	HPE X361 150W AC Power Supply	4,00	kus	5 057,10	20 228,40
JH157A	HPE 5130/5510 10GbE SFP+ 2p Module	2,00	kus	21 813,00	43 626,00

JH693A	HPE X240 10G SFP+ SFP+ 0.65m DAC C-Cable	2,00	kus	3 245,45	6 490,90

26x switch pro patrové rozvodny (včetně 1ks rezerva)

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku, maximálně 1U
	1 napájecí zdroj AC
	Kompatibilita s produkty, které jsou ve vlastnictví Kupujícího (Cisco ASA, HPE 5930, Catalyst 4500, unmanaged switche Zyxel a TrendNet)
	5 let dopředné a zpětné kompatibility s produkty stejné řady stejného výrobce
Kapacitní požadavky a počty portů	Minimálně 48x 10/100/1000 baseT Ethernet Ports RJ-45, s podporou 802.3ab, 802.3ac, 802.3u
	Minimálně 4x 10 Gbit SFP+ Uplink Interfaces
	1x RJ-45 console port (EIA/TIA-232)
Výkonnostní parametry	Minimální požadované parametry: - Forwarding bandwidth: 170 Gbps - Počet VLAN ID: 4000 (1000 aktivních) - Forwarding Rate: 130 Mpps - Počet MAC address: 15 000
Požadované schopnosti	- Stohování: Možnost propojení prvků do virtuálního stohu. Minimální kapacita stohovacího propoje 20 Gbit. Stoh se chová jako jedno zařízení. - Bezpečnost: MAC-based VLAN assignment, 802.1x Monitor Mode, and RADIUS Change of Authorization, Port Security, Dynamic, ARP Inspection, IP Source Guard, DHCP snooping, Private VLANs, Access Control Lists (ACLs) for IPv6 and IPv4 for security and QoS, VLAN ACLs, Router ACLs define security policies, Port-based ACLs for Layer 2, Secure Shell (SSH) Protocol, and Simple Network Management Protocol Version 3 (SNMPv3), Port Mirroring, TACACS+ or RADIUS authentication, - Konektivita: MAC Address Notification, Multilevel security on console access, Bridge protocol data unit (BPDU) Guard, Spanning Tree Root Guard (STRG or similar function), IGMP filtering, Dynamic VLAN assignment, Cross-stack EtherChannel, IEEE 802.1s/w Rapid Spanning Tree Protocol (RSTP), Autonegotiation on all ports, Link Aggregation Control Protocol (LACP), Automatic media-dependent interface crossover (MDIX), Link status monitoring (UDLD, DLDP or similar protocol), MVRP nebo VTP - Podpora skriptovatelné reakce na asynchronní událost. Podpora skriptování v jazyce Python nebo TCL – lokální interpret jazyka v přepínači. - IP SLA nebo alternativní způsob monitorování provozu a dostupnosti služeb s možnou návazností na automatické konfigurační změny systému pro zajištění zachování dostupnosti služeb. Zařízení funguje jako IP SLA iniciátor. - Local Proxy Address Resolution Protocol (ARP), Voice VLAN, Port Mirroring, Remote Monitoring (RMON) software, Trivial File Transfer Protocol (TFTP), Network Timing Protocol (NTP) - Quality of Service: Traffic prioritization (IEEE 802.1p), Simplified quality of service (QoS) configuration, Class of Service (CoS), Layer 4 prioritization
Standardy a protokoly	- IEEE 802.1s - IEEE 802.1w - IEEE 802.1x

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	- IEEE 802.3ad
	- IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports
	- IEEE 802.1D Spanning Tree Protocol
	- IEEE 802.1p CoS prioritization
	- IEEE 802.1Q VLAN
	- IEEE 802.3 10BASE-T specification
	- IEEE 802.3u 100BASE-TX specification
	- IEEE 802.3ab 1000BASE-T specification
	- IEEE 802.3z 1000BASE-X specification
	- RMON I a II standardy
	- SNMPv1, SNMPv2c, and SNMPv3
Management	SSH, HTTPS, SNMP (v1/v2c/v3)
Podpora	Záruka výrobce na 5 let na díly i servis s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, oprava/výměna zařízení do 24 hodin od nahlášení, 7 dnů v týdnu (24x7), v místě Kupujícího, servisním technikem (on-site). Jsou požadovány software aktualizace (nové verze programového vybavení) v minimální délce 5 let. Je požadovaná technická podpora výrobce po dobu 5 let.

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
JG934A	HPE 5130 48G 4SFP+ EI Switch	26,00	kus	64 384,55	1 673 998,30
U7QS9E	HPE 5Y FC 4H Exch 513048G 4SFP EI Sw SVC	26,00	kus	18 230,85	474 002,10

12x optických transceiverů

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	1 Gbit SX, konektory LC
	originální, od výrobce daných aktivních prvků, ne OEM
	kompatibilní s výše uvedenými patrovými i L3 switchi

8x optických transceiverů

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	10 Gbit SR, konektory LC
	originální, od výrobce daných aktivních prvků, ne OEM
	kompatibilní s výše uvedenými patrovými i L3 switchi

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
JD118B	HPE X120 1G SFP LC SX Transceiver	12,00	kus	5 035,50	60 426,00
JD092B	HPE X130 10G SFP+ LC SR Transceiver	8,00	kus	20 727,45	165 819,60

4x management switch ústředí

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku, maximálně 1U
	1 napájecí zdroj AC
	Kompatibilita s produkty, které jsou ve vlastnictví Kupujícího (Cisco ASA, HPE 5930, Catalyst 4500, unmanaged switche Zyxel a TrendNet)
	5 let dopředné a zpětné kompatibility s produkty stejné řady stejného výrobce
Kapacitní požadavky a počty portů	Minimálně 24x 10/100/1000 baseT Ethernet Ports RJ-45, s podporou 802.3ab, 802.3ac, 802.3u
	Minimálně 2x SFP Uplink Interfaces
	1x RJ-45 console port (EIA/TIA-232)
Výkonnostní parametry	Minimální požadované parametry: - Forwarding bandwidth: 50 Gbps - Počet VLAN ID: 4000 - Forwarding Rate: 40 Mpps - Počet MAC address: 8 000
Požadované schopnosti	- Bezpečnost: MAC-based VLAN assignment, 802.1x Monitor Mode, and RADIUS Change of Authorization, Port Security, Dynamic, ARP Inspection, IP Source Guard, DHCP snooping, Access Control Lists (ACLs) for IPv6 and IPv4 for security and QoS, VLAN ACLs, Router ACLs define security policies, Port-based ACLs for Layer 2, Secure Shell (SSH) Protocol and Simple Network Management Protocol Version 3 (SNMPv3), QoS, TACACS+ or RADIUS authentication, - Konektivita: MAC Address Notification, Multilevel security on console access, Bridge protocol data unit (BPDU) Guard, Spanning Tree Root Guard (STRG or similar function), IGMP filtering, Dynamic VLAN assignment, Cross-stack EtherChannel, IEEE 802.1s/w Rapid Spanning Tree Protocol (RSTP), Autonegotiation on all ports, Link Aggregation Control Protocol (LACP), Automatic media-dependent interface crossover (MDIX), Link status monitoring (UDLD, DLDP or similar protocol), - Address Resolution Protocol (ARP), Voice VLAN, Port Mirroring, Remote Monitoring (RMON) software, Trivial File Transfer Protocol (TFTP), Network Timing Protocol (NTP) - Quality of Service: Traffic prioritization (IEEE 802.1p), Simplified quality of service (QoS) configuration, Class of Service (CoS), Layer 4 prioritization
Standardy a protokoly	- IEEE 802.1s

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
	- IEEE 802.1w
	- IEEE 802.1x
	- IEEE 802.3ad
	- IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports
	- IEEE 802.1D Spanning Tree Protocol
	- IEEE 802.1p CoS prioritization
	- IEEE 802.1Q VLAN
	- IEEE 802.3 10BASE-T specification
	- IEEE 802.3u 100BASE-TX specification
	- IEEE 802.3ab 1000BASE-T specification
	- IEEE 802.3z 1000BASE-X specification
	- RMON I a II standardy
	- SNMPv1, SNMPv2c, and SNMPv3
Management	SSH, HTTPS, SNMP (v1/v2c/v3)
Podpora	Záruka výrobce na 5 let na díly i servis s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, oprava/výměna zařízení do 24 hodin od nahlášení, 7 dnů v týdnu (24x7), v místě Kupujícího, servisním technikem (on-site). Jsou požadovány software aktualizace (nové verze programového vybavení) v minimální délce 5 let. Je požadovaná technická podpora výrobce po dobu 5 let.

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
JE074B	HPE 5120 24G SI Switch	4,00	kus	28 405,00	113 620,00
U6LE4E	HPE 5Y FC NBD Exch HPE 5120 24G SI S SVC	4,00	kus	10 149,60	40 598,40

1x switch Kaplanova

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Základní vlastnosti	Montáž do 19" racku, maximálně 1U
	1 napájecí zdroj AC
	Kompatibilita s produkty, které jsou ve vlastnictví Kupujícího (Catalyst 4500, unmanaged switche Zyxel a TrendNet)
	5 let dopředné a zpětné kompatibility s produkty stejné řady stejného výrobce
Kapacitní požadavky a počty portů	Minimálně 24x 10/100/1000 baseT Ethernet Ports RJ-45, s podporou 802.3ab, 802.3ac, 802.3u
	Minimálně 2x SFP Uplink Interfaces
	1x RJ-45 console port (EIA/TIA-232)

Požadavek na funkcionalitu každého přepínače	Minimální požadavky
Výkonnostní parametry	Minimální požadované parametry: - Forwarding bandwidth: 50 Gbps - Počet VLAN ID: 4000 - Forwarding Rate: 40 Mpps - Počet MAC address: 8 000
Požadované schopnosti	- Bezpečnost: MAC-based VLAN assignment, 802.1x Monitor Mode, and RADIUS Change of Authorization, Port Security, Dynamic, ARP Inspection, IP Source Guard, DHCP snooping, Access Control Lists (ACLs) for IPv6 and IPv4 for security and QoS, VLAN ACLs, Router ACLs define security policies, Port-based ACLs for Layer 2, Secure Shell (SSH) Protocol, and Simple Network Management Protocol Version 3 (SNMPv3), Port Mirroring, TACACS+ or RADIUS authentication, - Konektivita: MAC Address Notification, Multilevel security on console access, Bridge protocol data unit (BPDU) Guard, Spanning Tree Root Guard (STRG or similar function), IGMP filtering, Dynamic VLAN assignment, Cross-Stack EtherChannel, IEEE 802.1s/w Rapid Spanning Tree Protocol (RSTP), Autonegotiation on all ports, Link Aggregation Control Protocol (LACP), Automatic media-dependent interface crossover (MDIX), Link status monitoring (UDLD, DLDP or similar protocol), - Address Resolution Protocol (ARP), Voice VLAN, Port Mirroring, Remote Monitoring (RMON) software, Trivial File Transfer Protocol (TFTP), Network Timing Protocol (NTP) - Quality of Service: Traffic prioritization (IEEE 802.1p), Simplified quality of service (QoS) configuration, Class of Service (CoS), Layer 4 prioritization
Standardy a protokoly	- IEEE 802.1s - IEEE 802.1w - IEEE 802.1x - IEEE 802.3ad - IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports - IEEE 802.1D Spanning Tree Protocol - IEEE 802.1p CoS prioritization - IEEE 802.1Q VLAN - IEEE 802.3 10BASE-T specification - IEEE 802.3u 100BASE-TX specification - IEEE 802.3ab 1000BASE-T specification - IEEE 802.3z 1000BASE-X specification - RMON I a II standardy - SNMPv1, SNMPv2c, and SNMPv3
Management	SSH, HTTPS, SNMP (v1/v2c/v3)
Podpora	Záruka výrobce na 5 let na díly i servis s registrací na jméno Kupujícího a ověřitelnou na webu výrobce, oprava/výměna zařízení do 24 hodin od nahlášení, 7 dnů v týdnu (24x7), v místě Kupujícího, servisním technikem (on-site). Jsou požadovány software aktualizace (nové verze programového vybavení) v minimální délce 5 let. Je požadovaná technická podpora výrobce po dobu 5 let.

Podrobná položková a cenová kalkulace:

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH
JE074B	HPE 5120 24G SI Switch	1,00	kus	20 405,00	20 405,00
U6LE4E	HPE 5Y FC NBD Exch HPE 5120 24G SI S SVC	1,00	kus	10 149,60	10 149,60

Název položky (Part Number)	Popis	Množství	Jednotka	Cena za jednotku v Kč bez DPH	Cena celkem v Kč bez DPH

Seznam krajských pracovišť Kupujícího č. 6

KRAJSKÉ PRACOVIŠTĚ	SÍDLO	JMÉNO A PŘÍJMENÍ KONTAKTNÍ OSOBY	E-MAIL	TELEFON
Praha	Kaplanova 1931/1, 148 00 Praha	Jan Smrčina Filip Cabaj	jan.smrcina@sfzp.cz filip.cabaj@sfzp.cz	xxxxxxxxxx
Ústecký kraj	Mírové náměstí 3129/36, 400 01 Ústí nad Labem	Jana Choutková	jana.choutkova@sfzp.cz	xxxxxxxxxx
Karlovarský kraj	Majakovského 707/29, 360 05 Karlovy Vary	Lenka Lásková	lenka.laskova@sfzp.cz	xxxxxxxxxx
Plzeňský kraj	Kopeckého sady 11, 306 32 Plzeň	Václav Laxa	vaclav.laxa@sfzp.cz	xxxxxxxxxx
Jihočeský kraj	Mánesova 3a, 371 03 České Budějovice	Hana Tomášková	hana.tomaskova@sfzp.cz	xxxxxxxxxx
Liberecký kraj	U Jezu 525/4, 460 01 Liberec	Michal Machačný	michal.machacny@sfzp.cz	xxxxxxxxxx
Pardubický kraj	Pernerova 168 (budova Chemingu), 530 02 Pardubice	Tomáš Goga	tomas.goga@sfzp.cz	xxxxxxxxxx
Královehradecký kraj	ul. Třída ČSA 383, 500 03 Hradec Králové	Jan Machek	jan.machek@sfzp.cz	xxxxxxxxxx
Moravskoslezský kraj	Českobratrská 7, 702 00 Ostrava 2	Martina Breuerová	martina.breuerova@sfzp.cz	xxxxxxxxxx
Olomoucký kraj	Wellnerova 7, 779 00 Olomouc	Marie Melničuková	marie.melnicukova@sfzp.cz	xxxxxxxxxx
Zlínský kraj	Budova 51, J. A. Bati 5645, 760 01 Zlín	Miroslav Zmeškal	miroslav.zmeskal@sfzp.cz	xxxxxxxxxx
Jihomoravský kraj	Kotlářská 51, 602 00 Brno	Monika Špačková	monika.spackova@sfzp.cz	xxxxxxxxxx
Vysočina	Havlíčkova 111, 586 02 Jihlava	Martin Kotěra	martin.kotera@sfzp.cz	xxxxxxxxxx

Příloha č. 3

Technické listy

Cisco Catalyst 2960-X and 2960-XR Series Switches

Product Overview

Cisco® Catalyst® 2960-X and 2960-XR Series Switches are fixed-configuration, stackable Gigabit Ethernet switches that provide enterprise-class access for campus and branch applications (Figure 1). They operate on Cisco IOS® Software and support simple device management as well as network management. The Cisco Catalyst 2960-X and 2960-XR Series provide easy device onboarding, configuration, monitoring, and troubleshooting. These fully managed switches can provide advanced Layer 2 and Layer 3 features as well as optional Power over Ethernet Plus (PoE+) power. Designed for operational simplicity to lower total cost of ownership, they enable scalable, secure, and energy-efficient business operations with intelligent services. The switches deliver enhanced application visibility, network reliability, and network resiliency.

Figure 1.   Cisco Catalyst 2960-X Series Switches

Product Highlights

Cisco Catalyst 2960-X and 2960-XR Series Switches feature:

- 24 or 48 Gigabit Ethernet ports with line-rate forwarding performance
- 4 fixed 1 Gigabit Ethernet Small Form-Factor Pluggable (SFP) uplinks or 2 fixed 10 Gigabit Ethernet SFP+ uplinks
- PoE+ support with a power budget of up to 740W and Perpetual PoE
- Cisco IOS LAN Base[1] or LAN Lite[1] and Cisco IOS IP Lite[2]
- Device management with web UI, over-the-air access via Bluetooth, Command-Line Interface (CLI), Simple Network Management Protocol (SNMP), and RJ-45 or USB console access
- Network management with Cisco Prime®, Cisco Network Plug and Play, and Cisco DNA™ Center
- Stacking with FlexStack-Plus and FlexStack-Extended
- Layer 3 features with routed access (Open Shortest Path First [OSPF]), static routing, and Routing Information Protocol (RIP)
- Visibility with Domain Name System as an Authoritative Source (DNS-AS) and Full (Flexible) NetFlow
- Security with 802.1X, Serial Port Analyzer (SPAN) and Bridge Protocol Data Unit (BPDU) Guard

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[1] 2960-X Series only.
[2] 2960-XR Series only.

- Reliability with higher Mean Time Between Failures (MTBF) and Enhanced Limited Lifetime Warranty (E-LLW)
- Resiliency with optional dual field-replaceable power supplies[2]

Power Supply

An external redundant power supply option is supported on the Cisco Catalyst 2960-X Series Switches. These switches come with one fixed power supply and an option for an external redundant power supply (Cisco Redundant Power System [RPS] 2300).

Dual redundant power supplies are supported on the Cisco Catalyst 2960-XR Series Switches. These switches ship with one power supply by default. The second power supply can be purchased at the time of ordering the switch or as a spare. These power supplies have built-in fans to provide cooling (Figure 2).

Figure 2. Cisco Catalyst 2960-XR Series power supply

Table 1 shows the different power supplies available in the 2960-XR Series switches and the available PoE power. Table 2 lists the PoE and PoE+ power capacity for the Cisco Catalyst 2960-X and 2960-XR Series. Table 3 gives the available PoE and switch power for the 2960-XR Series with different power supply combinations.

Table 1. Cisco Catalyst 2960-XR Series default power supply configurations

Product ID	Default power supply	Available PoE power
WS-C2960XR-24TS-I WS-C2960XR-48TS-I WS-C2960XR-24TD-I WS-C2960XR-48TD-I	PWR-C2-250WAC	–
WS-C2960XR-24PD-I WS-C2960XR-48LPD-I WS-C2960XR-24PS-I WS-C2960XR-48LPS-I	PWR-C2-640WAC	370W
WS-C2960XR-48FPD-I WS-C2960XR-48FPS-I	PWR-C2-1025WAC	740W

Table 2. Cisco Catalyst 2960-X and 2960-XR Series PoE and PoE+ power capacity

Model	Maximum number of PoE+ (IEEE 802.3at) ports[*]	Maximum number of PoE (IEEE 802.3af) ports[*]	Available PoE power (single PS source)
Cisco Catalyst 2960X-48FPD-L	24 ports up to 30W	48 ports up to 15.4W	740W
Cisco Catalyst 2960X-48LPD-L	12 ports up to 30W	24 ports up to 15.4W	370W
Cisco Catalyst 2960X-24PD-L	12 ports up to 30W	24 ports up to 15.4W	370W
Cisco Catalyst 2960X-48FPS-L	24 ports up to 30W	48 ports up to 15.4W	740W
Cisco Catalyst 2960X-48LPS-L	12 ports up to 30W	24 ports up to 15.4W	370W
Cisco Catalyst 2960X-24PS-L	12 ports up to 30W	24 ports up to 15.4W	370W

Model	Maximum number of PoE+ (IEEE 802.3at) ports[*]	Maximum number of PoE (IEEE 802.3af) ports[*]	Available PoE power (single PS source)
Cisco Catalyst 2960X-24PSQ-L	3 ports up to 30W	7 ports up to 15.4W	110W
Cisco Catalyst 2960XR-48FPD-I	24 ports up to 30W	48 ports up to 15.4W	740W
Cisco Catalyst 2960XR-48LPD-I	12 ports up to 30W	24 ports up to 15.4W	370W
Cisco Catalyst 2960XR-24PD-I	12 ports up to 30W	24 ports up to 15.4W	370W
Cisco Catalyst 2960XR-48FPS-I	24 ports up to 30W	48 ports up to 15.4W	740W
Cisco Catalyst 2960XR-48LPS-I	12 ports up to 30W	24 ports up to 15.4W	370W
Cisco Catalyst 2960XR-24PS-I	12 ports up to 30W	24 ports up to 15.4W	370W

[*] Intelligent power management allows flexible power allocation across all ports.

Table 3. Cisco Catalyst 2960-XR Series available PoE and switch power capabilities with different combinations of power supplies

Primary power supply	Secondary power supply	Available power for PoE+	Switch power redundancy	Available PoE power when one PS fails
PWR-C2-250WAC	–	–	No	–
PWR-C2-250WAC	PWR-C2-250WAC	–	Yes	–
PWR-C2-640WAC	–	370W	No	–
PWR-C2-640WAC	PWR-C2-640WAC	370W	Yes	370W
PWR-C2-1025WAC	–	740W	No	–
PWR-C2-1025WAC	PWR-C2-1025WAC	740W	Yes	740W

Switch Models and Configurations

Cisco Catalyst 2960-X Series Switches include a single, fixed power supply and are available with either the Cisco IOS LAN Base or LAN Lite feature set. Cisco Catalyst 2960-XR Series Switches include a field-replaceable modular power supply and can accommodate a second power supply. The 2960-XR Series is available only with the Cisco IOS IP Lite feature set. Tables 4 and 5 list the configurations of the 2960-X and 2960-XR Series, respectively.

Table 4. Cisco Catalyst 2960-X Series configurations

Model	10/100/1000 Ethernet ports	Uplink interfaces	Cisco IOS Software image	Available PoE power	FlexStack-Plus and FlexStack-Extended capability
Cisco Catalyst 2960X-48FPD-L	48	2 SFP+	LAN Base	740W	Y
Cisco Catalyst 2960X-48LPD-L	48	2 SFP+	LAN Base	370W	Y
Cisco Catalyst 2960X-24PD-L	24	2 SFP+	LAN Base	370W	Y
Cisco Catalyst 2960X-48TD-L	48	2 SFP+	LAN Base	–	Y
Cisco Catalyst 2960X-24TD-L	24	2 SFP+	LAN Base	–	Y
Cisco Catalyst 2960X-48FPS-L	48	4 SFP	LAN Base	740W	Y
Cisco Catalyst 2960X-48LPS-L	48	4 SFP	LAN Base	370W	Y
Cisco Catalyst 2960X-24PS-L	24	4 SFP	LAN Base	370W	Y
Cisco Catalyst 2960X-24PSQ-L	24 (8 PoE)	2 SFP, 2 10/100/1000BT	LAN Base	110W	–
Cisco Catalyst 2960X-48TS-L	48	4 SFP	LAN Base	–	Y
Cisco Catalyst 2960X-24TS-L	24	4 SFP	LAN Base	–	Y
Cisco Catalyst 2960X-48TS-LL	48	2 SFP	LAN Lite	–	–
Cisco Catalyst 2960X-24TS-LL	24	2 SFP	LAN Lite	–	–

Table 5.   Cisco Catalyst 2960-XR Series configurations

Model	10/100/1000 Ethernet ports	Uplink interfaces	Cisco IOS Software image	Available PoE power	Power supply	FlexStack-Plus and FlexStack-Extended capability
Cisco Catalyst 2960XR-48FPD-I	48	2 SFP+	IP Lite	740W	1025WAC	Y
Cisco Catalyst 2960XR-48LPD-I	48	2 SFP+	IP Lite	370W	640WAC	Y
Cisco Catalyst 2960XR-24PD-I	24	2 SFP+	IP Lite	370W	640WAC	Y
Cisco Catalyst 2960XR-48TD-I	48	2 SFP+	IP Lite	–	250WAC	Y
Cisco Catalyst 2960XR-24TD-I	24	2 SFP+	IP Lite	–	250WAC	Y
Cisco Catalyst 2960XR-48FPS-I	48	4 SFP	IP Lite	740W	1025WAC	Y
Cisco Catalyst 2960XR-48LPS-I	48	4 SFP	IP Lite	370W	640WAC	Y
Cisco Catalyst 2960XR-24PS-I	24	4 SFP	IP Lite	370W	640WAC	Y
Cisco Catalyst 2960XR-48TS-I	48	4 SFP	IP Lite	–	250WAC	Y
Cisco Catalyst 2960XR-24TS-I	24	4 SFP	IP Lite	–	250WAC	Y

Software

All Cisco Catalyst 2960-X and 2960-XR Series Switches use a single universal Cisco IOS Software image for all SKUs. Depending on the switch model, the Cisco IOS image automatically configures the LAN Lite, LAN Base, or IP Lite feature set.

Note that each switch model is tied to a specific feature level; LAN Lite cannot be upgraded to LAN Base, and LAN Base cannot be upgraded to IP Lite.

For more information about the features included in the LAN Lite, LAN Base, and IP Lite feature sets, refer to Cisco Feature Navigator: https://tools.cisco.com/ITDIT/CFN/jsp/index.jsp.

Switch Management

Cisco Catalyst 2960-X and 2960-XR Series Switches support the following on-device management features:

- **Web UI** via Cisco Configuration Professional. Configuration Professional provides a user interface for day-zero provisioning, which enables easy onboarding of the switch. Configuration Professional also has an intuitive dashboard for configuring, monitoring, and troubleshooting the switch (Figure 3). For more information about Cisco Configuration Professional, please refer to: https://www.cisco.com/c/en/us/products/cloud-systems-management/configuration-professional/index.html?dtid=osscdc000283.

Figure 3.   Cisco Configuration Professional web UI for the Cisco Catalyst 2960-X and 2960-XR Series
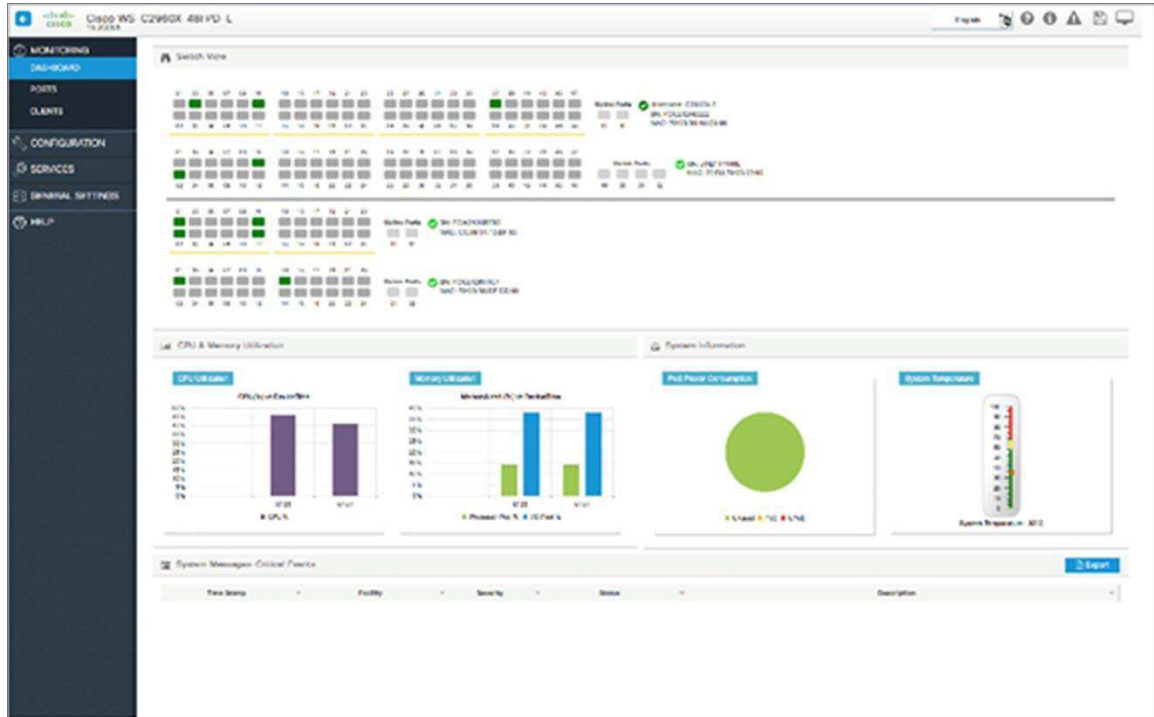
- **Bluetooth** for over-the-air access. The switches support an external Bluetooth dongle that plugs into the USB port on the switch and allows a Bluetooth-based RF connection with an external laptops and tablets (Figure 4). Laptops and tablets can access the switch CLI using a Telnet or Secure Shell (SSH) client over Bluetooth. The GUI can be accessed over Bluetooth with a browser.

Figure 4.   Over-the-air switch access using Bluetooth

Network Management

The Cisco Catalyst 2960-X and 2960-XR Series Switches offer a superior CLI for detailed configuration and administration. The switches are also supported by the full range of Cisco network management solutions.

- **Cisco DNA Center** on the Cisco Catalyst 2960-X and 2960-XR Series Switches provides a simple web user interface to enterprise network customers for day-zero plug and play, switch discovery and management, topology visualization, and software image management. For details on Cisco DNA Center features, please refer to dnac.cisco.com.
- **Cisco Network Plug and Play** is supported using the Cisco Application Policy Infrastructure Enterprise Module (APIC-EM) and DNA Center on Cisco Catalyst 2960-X and 2960-XR Series Switches. This provides a simple, secure, unified, and integrated offering for enterprise network customers to ease new branch or campus device rollouts or for provisioning updates to an existing network with a near zero-touch deployment experience. For detailed information about APIC-EM-based Plug-and-Play capabilities, please refer to Cisco Network Plug and Play.

Cisco Prime Infrastructure provides comprehensive network lifecycle management, including an extensive library of easy-to-use features to automate the initial and day-to-day management of your Cisco network. Cisco Prime technology integrates hardware and software platform expertise and operational experience into a powerful set of workflow-driven configuration, monitoring, troubleshooting, reporting, and administrative tools. For detailed information about Cisco Prime, visit https://www.cisco.com/c/en/us/products/cloud-systems-management/prime.html.

Licenses have to be purchased for using the Cisco Prime Infrastructure, Cisco Network Plug and Play, or Cisco DNA Center network management solution.

Stacking

Cisco FlexStack-Plus provides stacking of up to eight Cisco Catalyst 2960-X or 2960-XR Series Switches with the optional FlexStack-Plus module (Figure 5).

The FlexStack-Plus module is hot swappable and can be added to any Cisco Catalyst 2960-X or 2960-XR Series Switch with a FlexStack-Plus slot. Switches connected to a stack will automatically upgrade to the stack's Cisco IOS Software version and transparently join the stack without additional intervention.

To provide investment protection, FlexStack-Plus is backward compatible with FlexStack. Cisco Catalyst 2960-X LAN Base switches equipped with a FlexStack-Plus module can be stacked with Cisco Catalyst 2960-S and 2960-SF LAN Base switches equipped with a FlexStack module (see Table 6). Table 7 lists the scalability and performance of FlexStack with the various software images.

Table 6. FlexStack and FlexStack-Plus supported combinations

Stack member	2960-XR IP Lite	2960-X LAN Base	2960-S/SF LAN Base
2960-XR IP Lite	Yes	–	–
2960-X LAN Base	–	Yes	Yes
2960-S or 2960-SF LAN Base	–	Yes	Yes

Table 7.   FlexStack-Plus scalability and performance

Stack member	Stack bandwidth	Stack limit	Cisco IOS feature set
2960-XR IP Lite	80 Gbps	8	IP Lite
2960-X LAN Base	80 Gbps	8	LAN Base
2960-X LAN Base mixed with 2960-S/SF LAN Base	40 Gbps	4	LAN Base

Figure 5.   Cisco FlexStack-Plus switch stack

Cisco FlexStack-Extended enables a long-distance out-of-the wiring-closet stack option (floor to floor). It allows back-panel stacking of up to eight Cisco Catalyst 2960-X or 2960-XR Series Switches. FlexStack-Extended can be added to a Cisco Catalyst 2960-X or 2960-XR Series Switch with a back-panel stacking slot. Table 8 lists the switch combinations supported with FlexStack-Extended, and Table 9 lists the scalability and performance with the various software images. FlexStack-Extended is supported in Cisco IOS 15.2(6)E or later and is available in two module configurations: a fiber module and a hybrid module.

The hybrid module has a copper port that enables short-reach connectivity across a local stack of switches (Figure 6). It provides investment protection and compatibility with FlexStack-Plus through the copper port, while the SFP+ port supports distance stacking. The fiber module has two SFP+ ports supporting long-reach out-of-the wiring-closet stacking (Figure 7).

Please refer to Table 18 for information about transceiver and cable compatibility with FlexStack-Extended.

Cisco FlexStack-Plus, FlexStack-Extended, and Cisco IOS Software offer true stacking, with all switches in a stack acting as a single switch unit. FlexStack-Plus and FlexStack-Extended provide a unified data plane, unified configuration, and single IP address for switch management. The advantages of true stacking include lower total cost of ownership and higher availability through simplified management as well as cross-stack features including EtherChannel, SPAN, and Flex Links.

Table 8.   FlexStack-Extended supported combinations

Stack member	2960-XR IP Lite	2960-X LAN Base
2960-XR IP Lite	Yes	–
2960-X LAN Base	–	Yes

Table 9.   FlexStack-Extended scalability and performance

Stack member	Stack bandwidth	Stack limit	Cisco IOS feature set
2960-XR IP Lite	40 Gbps	8	IP Lite
2960-X LAN Base	40 Gbps	8	LAN Base

Figure 6.   Cisco FlexStack-Extended: Hybrid module

Figure 7.   Cisco FlexStack-Extended: Fiber module

Application Visibility and Control (AVC)

Full (Flexible) NetFlow and NetFlow Lite are both supported on the Cisco Catalyst 2960-X and 2960-XR Series Switches, thereby enabling IT teams to understand the mix of traffic on their network and identify anomalies by capturing and recording specific packet flows. NetFlow Lite supports flexible sampling of the traffic and exports flow data in the NetFlow Version 9 format for analysis on a wide range of Cisco and third-party collectors.

NetFlow Lite is included on all 2960-X and 2960-XR Series LAN Base and IP Lite models.

Flexible NetFlow is the next generation in flow visibility technology, allowing optimization of the network infrastructure, reducing operation costs, and improving capacity planning and security incident detection with increased flexibility and scalability. The Cisco Catalyst 2960-X and 2960-XR Series Switches are capable of up to 8000 flow entries in hardware.

Full (Flexible) NetFlow is included on all 2960-X and 2960-XR Series Switches and requires a Cisco ONE™ Foundation license per switch or a Cisco DNA Essentials license per switch.

More details about Flexible NetFlow are available at
https://www.cisco.com/en/US/prod/collateral/iosswrel/ps6537/ps6555/ps6601/ps6965/product_data_sheet0900aecd804b590b.html.

The Domain Name System as an Authoritative Source (DNS-AS) feature (AVC with DNS-AS) provides a centralized means of controlling the identification and classification of trusted network traffic in an organization. It accomplishes this by using network metadata stored in a DNS server that is authoritative to the domain in question to identify applications, and Modular Quality-of-Service (QoS) CLI (MQC) to classify the corresponding traffic and apply suitable policies.

DNS-AS is included on all Cisco Catalyst 2960-X and 2960-XR Series Switches and requires a Cisco ONE Foundation license per switch or a Cisco DNA Essentials license per switch.

Layer 3 Features

The Cisco hardware architecture delivers the following high-performance IP routing features in the Cisco Catalyst 2960-X and 2960-XR Series Switches:

- **Advanced IP unicast routing protocols (OSPF for Routed Access)** are supported for load balancing and constructing scalable LANs. IPv6 routing (OSPFv3) is supported in hardware for maximum performance.
- **Protocol Independent Multicast (PIM)** for IP multicast is supported, including PIM Sparse Mode (PIM SM), PIM Dense Mode (PIM-DM), PIM Sparse-Dense Mode, and Source Specific Multicast (SSM).
- **Policy-Based Routing (PBR)** allows superior control by facilitating flow redirection regardless of the routing protocol configured (for both IPv4 and IPv6).
- **IP unicast routing protocols (static and RIPv1 and v2)** are supported for network routing applications.

Additionally the Cisco hardware architecture delivers the following high-performance IP routing features in the Cisco Catalyst 2960-XR Series Switches:

- **IP unicast routing protocols (RIPng and Enhanced Interior Gateway Routing Protocol [EIGRP] Stub)** are supported for network routing applications.
- **EIGRPv3 Stub and PIMv6 Stub are supported as a part of the IPv6 routing suite.**
- **Equal-cost routing** facilitates Layer 3 load balancing and redundancy across the stack.
- **Hot Standby Routing Protocol (HSRP) and Virtual Router Redundancy Protocol (VRRP)** provide dynamic load balancing and failover for routed links.

Intelligent PoE+

IEEE 802.3af PoE and IEEE 802.3at PoE+ (up to 30W per port) are both supported on Cisco Catalyst 2960-X and 2960-XR Series Switches to lower the total cost of ownership for deployments that incorporate Cisco IP phones, Cisco Aironet® wireless access points, or other standards-compliant PoE and PoE+ end devices. PoE removes the need to supply wall power to PoE-enabled devices and eliminates the cost of adding electrical cabling and circuits that would otherwise be necessary in IP phone and WLAN deployments. The Cisco Catalyst 2960-X and 2960-XR Series PoE power allocation is dynamic, and power mapping scales up to a maximum of 740W of PoE+ power.

Perpetual PoE is supported on the Cisco Catalyst 2960-X and 2960-XR Series. With Perpetual PoE, the PoE+ power is maintained during a switch reload. This is important for critical endpoints such as medical devices and for Internet of Things (IoT) endpoints such as PoE-powered lights, so that there is no disruption during a switch reboot.

Network Security

Cisco Catalyst 2960-X and 2960-XR Series Switches provide a range of security features to limit access to the network and mitigate threats, including:

- **MAC-based VLAN assignment,** enabling different users to authenticate on different VLANs. This feature enables each user to have a different data VLAN on the same interface.
- **Cisco TrustSec**®, which uses Security Group Exchange Protocol (SXP) to simplify security and policy enforcement throughout the network. For more information about Cisco TrustSec security solutions, visit https://www.cisco.com/c/en/us/solutions/enterprise-networks/trustsec/index.html.
- **Comprehensive 802.1X** features to control access to the network, including Flexible Authentication, 802.1X monitor mode, and RADIUS Change of Authorization.

- **IPv6 First-Hop Security** enhances Layer 2 and Layer 3 network access for proliferating IPv6 devices, especially BYOD devices. It protects against rogue router advertisements, address spoofing, fake Dynamic Host Configuration Protocol (DHCP) replies, and other risks introduced by IPv6 technology.
- **Device sensor and device classifier,** enabling seamless versatile device profiles, including BYOD devices. They also enable the Cisco Identity Services Engine (ISE) to provision identity-based security policies. This feature is available on both the 2960-X and 2960-XR Series switches.
- **Cisco Trust Anchor Technology,** enabling easy distribution of a single universal image for all models of the 2960-X and 2960-XR Series by verifying the authenticity of Cisco IOS Software images. This technology allows the switch to perform Cisco IOS integrity checks at boot-up by verifying the signature, verifying the trusted asset under management, and authenticating the license.
- **Cisco Threat Defense** features, including Port Security, Dynamic ARP Inspection (DAI), and IP Source Guard.
- **Private VLANs** that restrict traffic between hosts in a common segment by segregating traffic at Layer 2, turning a broadcast segment into a nonbroadcast multiaccess-like segment. This feature is available in the IP Lite feature set only.
  ◦ **Private VLAN Edge** to provide security and isolation between switch ports, which helps ensure that users cannot snoop on other users' traffic.
- **Unicast Reverse Path Forwarding (uRPF)** to help mitigate problems caused by the introduction of malformed or forged (spoofed) IP source addresses into a network by discarding IP packets that lack a verifiable IP source address. This feature is available in the IP Lite feature set only.
- **Multidomain Authentication** to allow an IP phone and a PC to authenticate on the same switch port while being placed on appropriate voice and data VLANs.
- **Access Control Lists (ACLs)** for IPv6 and IPv4 for security and QoS ACL elements (ACEs).
  ◦ **VLAN ACLs** on all VLANs to prevent unauthorized data flows from being bridged within VLANs.
  ◦ **Router ACLs that** define security policies on routed interfaces for control-plane and data-plane traffic. IPv6 ACLs can be applied to filter IPv6 traffic.
  ◦ **Port-based ACLs** for Layer 2 interfaces to allow security policies to be applied on individual switch ports.
  ◦ **Downloadable ACLs (dACLs)** to download ACLs from a RADIUS server during 802.1X authentication.
- **SSH, Kerberos, and SNMPv3,** providing network security by encrypting administrator traffic during Telnet and SNMP sessions. SSH, Kerberos, and the cryptographic version of SNMPv3 require a special cryptographic software image because of U.S. export restrictions.
- **SPAN**, with bidirectional data support, to allow Cisco Intrusion Detection System (IDS) to take action when an intruder is detected.
- **TACACS+ and RADIUS authentication** to facilitate centralized control of the switch and restrict unauthorized users from altering the configuration.
- **MAC address Notification** to notify administrators about users added to or removed from the network.
- **Multilevel security on console access** to prevent unauthorized users from altering the switch configuration.
- **BPDU Guard** to shut down Spanning-Tree Port Fast-enabled interfaces when BPDUs are received to avoid accidental topology loops.

- **Spanning Tree Root Guard (STRG)** to prevent edge devices that are not in the network administrator's control from becoming Spanning Tree Protocol (STP) root nodes.
- **Internet Group Management Protocol (IGMP) filtering** to provide multicast authentication by filtering out nonsubscribers and to limit the number of concurrent multicast streams available per port.
- **Dynamic VLAN assignment** through implementation of VLAN Membership Policy Server client capability to provide flexibility in assigning ports to VLANs. Dynamic VLAN facilitates the fast assignment of IP addresses.
- **Cisco Identity Services Engine (ISE)** support to enable the 2960-XR Series switches to offer security management for all connected devices.

Enhanced QoS

The Cisco Catalyst 2960-X and 2960-XR Series Switches offer intelligent traffic management that keeps everything flowing smoothly. Flexible mechanisms for marking, classification, and scheduling deliver superior performance for data, voice, and video traffic, all at wire speed. Primary QoS features include:

- Up to **eight egress queues** per port and strict priority queuing so that the highest-priority packets are serviced ahead of all other traffic.
- **Shaped Round Robin** (SRR) scheduling and **Weighted Tail Drop** (WTD) congestion avoidance.
- **Flow-based rate limiting** and up to 256 aggregate or individual policers per port.
- **802.1p Class of Service** (CoS) and **Differentiated Services Code Point** (DSCP) classification, with marking and reclassification on a per-packet basis by source and destination IP address, MAC address, or Layer 4 TCP/UDP port number.
- **Cross-stack QoS** to allow QoS to be configured across a stack of 2960-X and 2960-XR Series switches.
- **Cisco Committed Information Rate (CIR)** function, providing bandwidth in increments as low as 8 Kbps.
- **Rate limiting** based on source and destination IP address, source and destination MAC address, Layer 4 TCP/UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps.

Scalability

Switching Database Manager (SDM) templates for LAN Base and IP Lite licenses allow the administrator to automatically optimize the Ternary Content-Addressable Memory (TCAM) allocation to the desired features based on deployment-specific requirements, including MAC, routing, security, and QoS scalability numbers, depending on the type of template used in the switch.

Please refer to the Configuring SDM Templates page for more information:
https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst2960x/software/15-0_2_EX/system_manage/configuration_guide/b_sm_152ex_2960-x_cg/b_sm_152ex_2960-x_cg_chapter_0100.html.

Table 10 lists the scalability for the LAN Lite and LAN Base licenses on the 2960-X Series. Table 11 lists the scalability for the IP Lite license on the 2960-XR Series.

Table 10. Cisco Catalyst 2960-X Series LAN Lite and LAN Base scalability

Resource	LAN Lite (default)	LAN Base (default)
Unicast MAC addresses	16,000	16,000
ARP Entries	8000	8000
IPv4 unicast direct routes	320	2000
IPv4 unicast indirect routes	32	1000
IPv6 unicast direct routes	256	2000
IPv6 unicast indirect routes	0	1000
IPv4 multicast routes and IGMP groups	1000	1000
IPv6 multicast groups	1000	1000
IPv4 QoS ACEs	384	500
IPv6 QoS ACEs	256	500
IPv4 security ACEs	256	600
IPv6 Security ACEs	256	600

Table 11. Cisco Catalyst 2960-XR Series IP Lite scalability

Resources	Default (IP Lite)	VLAN (IP Lite)	IPv4 (IP Lite)
Unicast MAC addresses	16,000	32,000	16,000
IPv4 unicast direct routes	4000	250	16,000
IPv4 unicast indirect routes	1250	250	8000
IPv6 unicast direct routes	4000	250	0
IPv6 unicast indirect routes	1250	250	0
IPv4 multicast routes and IGMP groups	1000	1000	1000
IPv6 multicast groups	1000	1000	0
IPv4 QoS ACEs	500	500	500
IPv6 QoS ACEs	250	500	0
IPv4 security ACEs	1000	1000	875
IPv6 security ACEs	500	500	0
IPv4 policy-based routing ACEs	500	0	375

Redundancy and Resiliency

Cisco Catalyst 2960-X and 2960-XR Series Switches offer a number of redundancy and resiliency features to prevent outages and help ensure that the network remains available:

- **Cross-stack EtherChannel** provides the ability to configure Cisco EtherChannel technology across different members of the stack for high resiliency.
- **Flex Links** provide link redundancy with a convergence time of less than 100 milliseconds.
- **IEEE 802.1s/w Rapid Spanning Tree Protocol (RSTP) and Multiple Spanning Tree Protocol (MSTP)** provide rapid spanning-tree convergence independent of spanning-tree timers and also offer the benefit of Layer 2 load balancing and distributed processing. Stacked units behave as a single spanning-tree node.
- **Per-VLAN Rapid Spanning Tree (PVRST+)** allows rapid spanning-tree reconvergence on a per-VLAN spanning-tree basis, without requiring the implementation of spanning-tree instances.
- **Cisco HSRP** is supported to create redundant, fail-safe routing topologies in 2960-XR Series IP Lite SKUs.

- **Switch-port auto-recovery (Error Disable)** automatically attempts to reactivate a link that is disabled because of a network error.
- **Power redundancy** with an optional second power supply on 2960-XR Series models, or with an external redundant power supply (RPS) on 2960-X Series models.

Operational Efficiency

Cisco Catalyst SmartOperations is a comprehensive set of capabilities that simplify LAN planning, deployment, monitoring, and troubleshooting. Deploying SmartOperations tools reduces the time and effort required to operate the network and lowers Total Cost of Ownership (TCO).

- **Cisco AutoConfig** services determine the level of network access provided to an endpoint based on the type of device. This feature also permits hard binding between the end device and the interface.
- **Cisco Smart Install** services enable minimal-touch deployment by providing automated Cisco IOS Software image installation and configuration when new switches are connected to the network. This enables network administrators to remotely manage Cisco IOS Software image installs and upgrades.
- **Cisco Auto SmartPorts** services enable automatic configuration of switch ports as devices connect to the switch, with settings optimized for the device type, for zero-touch port-policy provisioning.
- **Cisco Auto-QoS** automatically configures QoS, allowing the switch to manage QoS policies based on traffic types, resulting in zero-touch traffic engineering. Auto-QoS supports eight egress queues in the 2960-X and 2960-XR Series.
- **Cisco Smart Troubleshooting** is an extensive array of diagnostic commands and system health checks within the switch, including Smart Call Home. The Cisco Generic Online Diagnostics (GOLD) and online diagnostics on switches in live networks help predict and detect failures faster.

For more information about Cisco Catalyst SmartOperations, visit cisco.com/go/SmartOperations.

Operational Simplicity

- **Cisco AutoSecure provides** a single-line CLI to enable baseline security features (Port Security, DHCP snooping, DAI). This feature simplifies security configurations.
- **DHCP** auto configuration of multiple switches through a boot server eases switch deployment.
- **Stacking master configuration management** with Cisco FlexStack-Plus and Cisco FlexStack-Extended technology helps ensure that all switches are automatically upgraded when the master switch receives a new software version. Automatic software version checking and updating help ensure that all stack members have the same software version.
- **No configuration is required** to use Cisco **FlexStack-Plus** and Cisco **FlexStack-Extended** modules for stacking (Plug and Play).
- **Autonegotiation** on all ports automatically selects half- or full-duplex transmission mode to optimize bandwidth.
- **Dynamic Trunking Protocol (DTP)** facilitates dynamic trunk configuration across all switch ports.
- **Port Aggregation Protocol (PAgP)** automates the creation of Cisco Fast EtherChannel groups or Gigabit EtherChannel groups to link to another switch, router, or server.
- **Link Aggregation Control Protocol (LACP)** allows the creation of Ethernet channeling with devices that conform to IEEE 802.3ad. This feature is similar to Cisco EtherChannel technology and PAgP.

- **Automatic Media-Dependent Interface Crossover (MDIX)** automatically adjusts transmit and receive pairs if an incorrect cable type (crossover or straight-through) is installed.
- **Unidirectional Link Detection Protocol (UDLD)** and Aggressive UDLD allow unidirectional links caused by incorrect fiber-optic wiring or port faults to be detected and disabled on fiber-optic interfaces.
- **SDM** templates for access, routing, and VLAN deployment allow the administrator to easily maximize memory allocation to the desired features based on deployment-specific requirements.
- **Local Proxy ARP** works in conjunction with Private VLAN Edge to minimize broadcasts and maximize available bandwidth.
- **VLAN1 minimization** allows VLAN1 to be disabled on any individual VLAN trunk.
- **Smart Multicast with Cisco FlexStack-Plus and FlexStack-Extended technology** allows the Cisco Catalyst 2960-X and 2960-XR Series to offer greater efficiency and support for more multicast data streams such as video by putting each data packet onto the backplane only once.
- **IGMP** Snooping for IPv4 and IPv6 and Multicast Listener Discovery (MLD) v1 and v2 Snooping provide fast client joins and leaves of multicast streams and limit bandwidth-intensive video traffic to only the requesters.
- **Multicast VLAN Registration (MVR)** continuously sends multicast streams in a multicast VLAN while isolating the streams from subscriber VLANs for bandwidth and security reasons.
- **Per-port broadcast, multicast, and unicast storm control** prevents faulty end stations from degrading overall system performance.
- **Voice VLAN** simplifies telephony installations by keeping voice traffic on a separate VLAN for easier administration and troubleshooting.
- **Cisco VLAN Trunking Protocol (VTP)** supports dynamic VLANs and dynamic trunk configuration across all switches.
- **Remote Switch Port Analyzer (RSPAN)** allows administrators to remotely monitor ports in a Layer 2 switch network from any other switch in the same network.
- For enhanced traffic management, monitoring, and analysis, the embedded **Remote Monitoring (RMON)** software agent supports four RMON groups (history, statistics, alarms, and events).
- **Layer 2 trace route** eases troubleshooting by identifying the physical path that a packet takes from source to destination.
- **Trivial File Transfer Protocol (TFTP)** reduces the cost of administering software upgrades by downloading from a centralized location.
- **Network Time Protocol (NTP)** provides an accurate and consistent timestamp to all intranet switches.

Power Management

The Cisco Catalyst 2960-X and 2960-XR Series Switches offer a range of industry-leading features for effective energy efficiency and energy management. They are the greenest switches in the industry.

Switch Hibernation Mode (SHM) is an industry first and available on all 2960-X and 2960-XR Series switches. This feature puts the switch in ultra-low-power mode during periods of nonoperation such as nights or weekends. SHM on the 2960-X and 2960-XR Series switches can be scheduled using Cisco EnergyWise® compliant management software.

IEEE 802.3az EEE (Energy Efficient Ethernet) enables ports to dynamically sense idle periods between traffic bursts and quickly switch the interfaces into a low-power idle mode, reducing power consumption.

Cisco EnergyWise policies can be used to control the power consumed by PoE-powered endpoints, desktop and data-center IT equipment, and a wide range of building infrastructure. Cisco EnergyWise technology is included on all Cisco Catalyst 2960-X and 2960-XR Series Switches.

For more information about Cisco EnergyWise, visit cisco.com/go/energywise.

Technical Specifications

Table 12.   Cisco Catalyst 2960-X and 2960-XR Series hardware

Hardware specifications	
Flash memory	128 MB for LAN Base and IP Lite SKUs, 64 MB for LAN Lite SKUs
DRAM	512 MB for LAN Base and 256 MB for LAN Lite
CPU	APM86392 600 MHz dual core
Console ports	USB (Type B), Ethernet (RJ-45)
Storage interface	USB (Type A) for external flash storage
Network management interface	10/100 Mbps Ethernet (RJ-45)

Table 13.   Cisco Catalyst 2960-X and 2960-XR Series performance

Performance and scalability			
	2960-X LAN Lite	2960-X LAN Base	2960-XR IP Lite
Forwarding bandwidth	50 Gbps	108 Gbps	108 Gbps
Switching bandwidth*	100 Gbps	216 Gbps	216 Gbps
Maximum active VLANs	64	1023	1023
VLAN IDs available	4096	4096	4096
Maximum Transmission Unit (MTU)-L3 packet	9198 bytes	9198 bytes	9198 bytes
Jumbo frame - Ethernet frame	9216 bytes	9216 bytes	9216 bytes

* Switching bandwidth is full-duplex capacity.

Table 14.   Cisco Catalyst 2960-X and 2960-XR Series forwarding performance

Forwarding rate: 64-byte Layer 3 packets	
2960-X models	
Cisco Catalyst 2960X-48FPD-L	130.9 Mpps
Cisco Catalyst 2960X-48LPD-L	130.9 Mpps
Cisco Catalyst 2960X-24PD-L	95.2 Mpps
Cisco Catalyst 2960X-48TD-L	130.9 Mpps
Cisco Catalyst 2960X-24TD-L	95.2 Mpps
Cisco Catalyst 2960X-48FPS-L	107.1 Mpps
Cisco Catalyst 2960X-48LPS-L	107.1 Mpps
Cisco Catalyst 2960X-24PS-L	71.4 Mpps
Cisco Catalyst 2960X-24PSQ-L	71.4 Mpps
Cisco Catalyst 2960X-48TS-L	107.1 Mpps
Cisco Catalyst 2960X-24TS-L	71.4 Mpps
Cisco Catalyst 2960X-48TS-LL	104.2 Mpps
Cisco Catalyst 2960X-24TS-LL	68.5 Mpps

Forwarding rate: 64-byte Layer 3 packets	
2960-XR models	
Cisco Catalyst 2960XR-48FPD-I	130.9 Mpps
Cisco Catalyst 2960XR-48LPD-I	130.9 Mpps
Cisco Catalyst 2960XR-24PD-I	95.2 Mpps
Cisco Catalyst 2960XR-48TD-I	130.9 Mpps
Cisco Catalyst 2960XR-24TD-I	95.2 Mpps
Cisco Catalyst 2960XR-48FPS-I	107.1 Mpps
Cisco Catalyst 2960XR-48LPS-I	107.1 Mpps
Cisco Catalyst 2960XR-24PS-I	71.4 Mpps
Cisco Catalyst 2960XR-48TS-I	107.1 Mpps
Cisco Catalyst 2960XR-24TS-I	71.4 Mpps

Table 15. Cisco Catalyst 2960-X Series mechanical specifications

Model	Dimensions		Weight	
	Inches (H x D x W)	**Centimeters (H x D x W)**	**Pounds**	**Kilograms**
WS-C2960X-48FPD-L	1.75 x 14.5 x 17.5	4.5 x 36.8 x 44.5	12.9	5.8
WS-C2960X-48LPD-L	1.75 x 14.5 x 17.5	4.5 x 36.8 x 44.5	12.9	5.8
WS-C2960X-48TD-L	1.75 x 11.0 x 17.5	4.5 x 27.9 x 44.5	9.6	4.3
WS-C2960X-24PD-L	1.75 x 14.5 x 17.5	4.5 x 36.8 x 44.5	12.7	5.7 g
WS-C2960X-24TD-L	1.75 x 11.0 x 17.5	4.5 x 27.9 x 44.5	8.9	4.0
WS-C2960X-48FPS-L	1.75 x 14.5 x 17.5	4.5 x 36.8 x 44.5	12.9	5.8
WS-C2960X-48LPS-L	1.75 x 14.5 x 17.5	4.5 x 36.8 x 44.5	12.9	5.8
WS-C2960X-48TS-L	1.75 x 11.0 x 17.5	4.5 x 27.9 x 44.5	9.4	4.2
WS-C2960X-24PS-L	1.75 x 14.5 x 17.5	4.5 x 36.8 x 44.5	12.8	5.8
WS-C2960X-24PSQ-L	1.73 x 11.03 x 17.5	4.45 x 28.0 x 44.5	12.8	5.8
WS-C2960X-24TS-L	1.75 x 11.0 x 17.5	4.5 x 27.9 x 44.5	8.9	4.0
WS-C2960X-48TS-LL	1.75 x 11.0 x 17.5	4.5 x 27.9 x 44.5	8.9	4.0
WS-C2960X-24TS-LL	1.75 x 11.0 x 17.5	4.5 x 27.9 x 44.5	8.2	3.7

Table 16. Cisco Catalyst 2960-XR Series mechanical specifications

Model	Dimensions		Weight	
	Inches (H x D x W)	**Centimeters (H x D x W)**	**Pounds**	**Kilograms**
WS-C2960XR-48FPD-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	14.6	6.6
WS-C2960XR-48LPD-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	14.0	6.4
WS-C2960XR-48TD-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	13.3	6.1
WS-C2960XR-24PD-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	13.6	6.2
WS-C2960XR-24TD-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	13.0	5.9
WS-C2960XR-48FPS-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	14.7	6.7
WS-C2960XR-48LPS-I	1.75 x 16.0x 17.5	4.45 x 40.8 x 44.5	14.2	6.4
WS-C2960XR-48TS-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	13.2	6.0
WS-C2960XR-24PS-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	13.7	6.2
WS-C2960XR-24TS-I	1.75 x 16.0 x 17.5	4.45 x 40.8 x 44.5	13.0	5.9

The power supplies could add up to 3.1 in. (7.9 cm) to the depth of the 2960-XR Series chassis.

Table 17. Cisco Catalyst 2960-X and 2960-XR Series environmental specifications

Environmental ranges				
	Fahrenheit		**Centigrade**	
Operating temperature up to 5000 ft (1500 m)	23º to 113ºF		-5º to 45ºC	
Operating temperature up to 10,000 ft (3000 m)	23º to 104ºF		-5º to 40ºC	
Short-term exception at sea level*	23º to 131ºF		-5º to 55ºC	
Short-term exception up to 5000 feet (1500 m)*	23º to 122ºF		-5º to 50ºC	
Short-term exception up to 10,000 feet (3000 m)*	23º to 113ºF		-5º to 45ºC	
Short-term exception up to 13,000 feet (4000 m)*	23º to 104ºF		-5º to 40ºC	
Storage temperature up to 15,000 feet (4573 m)	-13º to 158ºF		-25º to 70ºC	
	Feet		**Meters**	
Operating altitude	Up to 10,000		Up to 3000	
Storage altitude	Up to 13,000		Up to 4000	
Operating relative humidity	10% to 95% noncondensing			
Storage relative humidity	10% to 95% noncondensing			
Acoustic noise				
Measured per ISO 7779 and declared per ISO 9296. PoE output of 185W or less where applicable.				
Bystander positions operating mode at 77°F (25°C) ambient.				
Model	**Sound pressure**		**Sound power**	
	LpA (typical)	**LpAD (maximum)**	**LwA (typical)**	**LwAD (maximum)**
Cisco Catalyst 2960X-48FPD-L **Cisco Catalyst 2960X-48LPD-L** **Cisco Catalyst 2960X-24PD-L**	39 dB	43 dB	4.9 B	5.3 B
Cisco Catalyst 2960X-48TD-L **Cisco Catalyst 2960X-24TD-L**	42 dB	46 dB	5.1 B	5.5 B
Cisco Catalyst 2960X-48FPS-L **Cisco Catalyst 2960X-48LPS-L** **Cisco Catalyst 2960X-24PS-L**	39 dB	43 dB	4.9 B	5.3 B
Cisco Catalyst 2960X-24PSQ-L	N/A	N/A	N/A	N/A
Cisco Catalyst 2960X-48TS-L **Cisco Catalyst 2960X-24TS-L**	42 dB	46 dB	5.1 B	5.5 B
Cisco Catalyst 2960X-48TS-LL **Cisco Catalyst 2960X-24TS-LL**	42 dB	46 dB	5.1 B	5.5 B
Cisco Catalyst 2960XR-48FPD-I	40 dB	43 dB	5.2 B	5.5 B
Cisco Catalyst 2960XR-48LPD-I	40 dB	43 dB	5.2 B	5.5 B
Cisco Catalyst 2960XR-24PD-I	40 dB	43 dB	5.2 B	5.5 B
Cisco Catalyst 2960XR-48TD-I	22 dB	25 dB	3.3 B	3.6 B
Cisco Catalyst 2960XR-24TD-I	22 dB	25 dB	3.3 B	3.6 B
Cisco Catalyst 2960XR-48FPS-I	40 dB	43 dB	5.2 B	5.5 B
Cisco Catalyst 2960XR-48LPS-I	40 dB	43 dB	5.2 B	5.5 B
Cisco Catalyst 2960XR-24PS-I	40 dB	43 dB	5.2 B	5.5 B
Cisco Catalyst 2960XR-48TS-I	22 dB	25 dB	3.3 B	3.6 B
Cisco Catalyst 2960XR-24TS-I	22 dB	25 dB	3.3 B	3.6 B
Predicted reliability				
Model	**MTBF in hours**[**]			
Cisco Catalyst 2960X-48FPD-L	233,370			

Environmental ranges	
Cisco Catalyst 2960X-48LPD-L	277,960
Cisco Catalyst 2960X-24PD-L	325,780
Cisco Catalyst 2960X-48TD-L	445,460
Cisco Catalyst 2960X-24TD-L	569,520
Cisco Catalyst 2960X-48FPS-L	232,610
Cisco Catalyst 2960X-48LPS-L	276,870
Cisco Catalyst 2960X-24PS-L	324,280
Cisco Catalyst 2960X-24PSQ-L	462,680
Cisco Catalyst 2960X-48TS-L	442,690
Cisco Catalyst 2960X-24TS-L	564,910
Cisco Catalyst 2960X-48TS-LL	476,560
Cisco Catalyst 2960X-24TS-LL	622,350
Cisco Catalyst 2960X-STACK	17,128,090
Cisco Catalyst 2960XR-48FPD-I	231,590
Cisco Catalyst 2960XR-48LPD-I	275,430
Cisco Catalyst 2960XR-24PD-I	322,740
Cisco Catalyst 2960XR-48TD-I	440,880
Cisco Catalyst 2960XR-24TD-I	561,890
Cisco Catalyst 2960XR-48FPS-I	230,860
Cisco Catalyst 2960XR-48LPS-I	274,380
Cisco Catalyst 2960XR-24PS-I	321,290
Cisco Catalyst 2960XR-48TS-I	438,130
Cisco Catalyst 2960XR-24TS-I	557,320
PWR-C2-250WAC	1,000,000
PWR-C2-640WAC	1,000,000
PWR-C2-1025WAC	1,000,000

[*] Not more than the following in a 1-year period: 96 consecutive hours, or 360 hours total, or 15 occurrences.

[**] Currently estimates; later will be based on Telcordia SR-332 Issue 2 methodology.

Table 18. Connectors and interfaces

Connectors and interfaces
Ethernet interfaces
• 10BASE-T ports: RJ-45 connectors, 2-pair Category 3, 4, or 5 unshielded twisted pair (UTP) cabling • 100BASE-TX ports: RJ-45 connectors, 2-pair Category 5 UTP cabling • 1000BASE-T ports: RJ-45 connectors, 4-pair Category 5 UTP cabling • 1000BASE-T SFP-based ports: RJ-45 connectors, 4-pair Category 5 UTP cabling
SFP and SFP+ interfaces
For information about supported SFP and SFP+ modules, refer to the Transceiver Compatibility matrix tables at cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.
Indicator LEDs
• Per-port status: Link integrity, disabled, activity, speed, and full duplex • System status: System, RPS, stack link status, link duplex, PoE, and link speed
Stacking interfaces
Cisco Catalyst 2960-X and 2960-XR Series FlexStack-Plus and FlexStack-Extended (hybrid module only) stacking cables: • CAB-STK-E-0.5M stacking cable with a 0.5 m length • CAB-STK-E-1M stacking cable with a 1.0 m length

Connectors and interfaces
• CAB-STK-E-3M stacking cable with a 3.0 m length

Console
Cisco Catalyst 2960-X and 2960-XR Series console cables: • CAB-CONSOLE-RJ45 Console cable 6 ft. with RJ-45 • CAB-CONSOLE-USB Console cable 6 ft. with USB Type A and mini-B connectors

Power
• The internal power supply is an auto-ranging unit and supports input voltages between 100 and 240V AC • Use the supplied AC power cord to connect the AC power connector to an AC power outlet • The Cisco RPS connector offers connection for an optional Cisco RPS 2300 that uses AC input and supplies DC output to the switch • Only the Cisco RPS 2300 (model PWR-RPS2300) should be attached to the redundant-power-system receptacle

Table 19. Management and standards support

Category	Specification	
Management	• BRIDGE-MIB • CISCO-CABLE-DIAG-MIB • CISCO-CDP-MIB • CISCO-CLUSTER-MIB • CISCO-CONFIG-COPY-MIB • CISCO-CONFIG-MAN-MIB • CISCO-DHCP-SNOOPING-MIB • CISCO-ENTITY-VENDORTYPE-OID-MIB • CISCO-ENVMON-MIB • CISCO-ERR-DISABLE-MIB • CISCO-FLASH-MIB • CISCO-FTP-CLIENT-MIB • CISCO-IGMP-FILTER-MIB • CISCO-IMAGE-MIB • CISCO-IP-STAT-MIB • CISCO-LAG-MIB • CISCO-MAC-NOTIFICATION-MIB • CISCO-MEMORY-POOL-MIB • CISCO-PAGP-MIB • CISCO-PING-MIB • CISCO-POE-EXTENSIONS-MIB • CISCO-PORT-QOS-MIB • CISCO-PORT-SECURITY-MIB • CISCO-PORT-STORM-CONTROL-MIB • CISCO-PRODUCTS-MIB • CISCO-PROCESS-MIB • CISCO-RTTMON-MIB • CISCO-SMI-MIB • CISCO-STP-EXTENSIONS-MIB • CISCO-SYSLOG-MIB	• CISCO-TC-MIB • CICSO-TCP-MIB • CISCO-UDLDP-MIB • CISCO-VLAN-IFTABLE • RELATIONSHIP-MIB • CISCO-VLAN-MEMBERSHIP-MIB • CISCO-VTP-MIB • ENTITY-MIB • ETHERLIKE-MIB • IEEE8021-PAE-MIB • IEEE8023-LAG-MIB • IF-MIB • INET-ADDRESS-MIB • OLD-CISCO-CHASSIS-MIB • OLD-CISCO-FLASH-MIB • OLD-CISCO-INTERFACES-MIB • OLD-CISCO-IP-MIB • OLD-CISCO-SYS-MIB • OLD-CISCO-TCP-MIB • OLD-CISCO-TS-MIB • RFC1213-MIB • RMON-MIB • RMON2-MIB • SNMP-FRAMEWORK-MIB • SNMP-MPD-MIB • SNMP-NOTIFICATION-MIB • SNMP-TARGET-MIB • SNMPv2-MIB • TCP-MIB • UDP-MIB • ePM MIB • CISCO-STACKWISE-MIB (2960-X)
	For an updated list of supported MIBs, refer to the MIB Locator at cisco.com/go/mibs	
Standards	• IEEE 802.1D Spanning Tree Protocol • IEEE 802.1p CoS Prioritization • IEEE 802.1Q VLAN • IEEE 802.1s • IEEE 802.1w • IEEE 802.1X • IEEE 802.1ab (LLDP)	• IEEE 802.3 10BASE-T • IEEE 802.3u 100BASE-TX • IEEE 802.3ab 1000BASE-T • IEEE 802.3z 1000BASE-X • RMON I and II standards • SNMP v1, v2c, and v3 • IEEE 802.3az

Category	Specification	
	• IEEE 802.3ad • IEEE 802.3af and IEEE 802.3at • IEEE 802.3ah (100BASE-X single/multimode fiber only) • IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports	• IEEE 802.3ae 10 Gigabit Ethernet • IEEE 802.1ax
RFC compliance	• RFC 768 - UDP • RFC 783 - TFTP • RFC 791 - IP • RFC 792 - ICMP • RFC 793 - TCP • RFC 826 - ARP • RFC 854 - Telnet • RFC 951 - Bootstrap Protocol (BOOTP) • RFC 959 - FTP • RFC 1112 - IP Multicast and IGMP • RFC 1157 - SNMP v1 • RFC 1166 - IP Addresses • RFC 1256 - Internet Control Message Protocol (ICMP) Router Discovery • RFC 1305 - NTP • RFC 1492 - TACACS+ • RFC 1493 - Bridge MIB • RFC 1542 - BOOTP extensions • RFC 1643 - Ethernet Interface MIB • RFC 1757 - RMON • RFC 1901 - SNMP v2C	• RFC 1902-1907 - SNMP v2 • RFC 1981 - Maximum Transmission Unit (MTU) Path Discovery IPv6 • FRC 2068 - HTTP • RFC 2131 - DHCP • RFC 2138 - RADIUS • RFC 2233 - IF MIB v3 • RFC 2373 - IPv6 Aggregatable Addrs • RFC 2460 - IPv6 • RFC 2461 - IPv6 Neighbor Discovery • RFC 2462 - IPv6 Autoconfiguration • RFC 2463 - ICMP IPv6 • RFC 2474 - Differentiated Services (DiffServ) Precedence • RFC 2597 - Assured Forwarding • RFC 2598 - Expedited Forwarding • RFC 2571 - SNMP Management • RFC 2865 - RADIUS • RFC 3046 - DHCP Relay Agent Information Option • RFC 3376 - IGMP v3 • RFC 3580 - 802.1X RADIUS

Table 20. Voltage and power ratings

Input voltage and current			
Model	**Voltage (auto ranging)**	**Current**	**Frequency**
Cisco Catalyst 2960X-48FPD-L	100 to 240 VAC	9A to 4A	50 to 60 Hz
Cisco Catalyst 2960X-48LPD-L		5A to 2A	
Cisco Catalyst 2960X-24PD-L		5A to 2A	
Cisco Catalyst 2960X-48TD-L		1A to 0.5A	
Cisco Catalyst 2960X-24TD-L		1A to 0.5A	
Cisco Catalyst 2960X-48FPS-L		9A to 4A	
Cisco Catalyst 2960X-48LPS-L		5A to 2A	
Cisco Catalyst 2960X-24PS-L		5A to 2A	
Cisco Catalyst 2960X-24PSQ-L		2A to 4A	
Cisco Catalyst 2960X-48TS-L		1A to 0.5A	
Cisco Catalyst 2960X-24TS-L		1A to 0.5A	
Cisco Catalyst 2960X-48TS-LL		1A to 0.5A	
Cisco Catalyst 2960X-24TS-LL		1A to 0.5A	
Cisco Catalyst 2960XR-48FPD-I	100 to 264 VAC	10A to 5A	50 to 60 Hz
Cisco Catalyst 2960XR-48FPS-I		10A to 5 A	
Cisco Catalyst 2960XR-48LPD-I	90 to 264 VAC	6A to 3 A	50 to 60 Hz
Cisco Catalyst 2960XR-24PD-I		6A to 3 A	
Cisco Catalyst 2960XR-48TD-I		1A to 0.5 A	
Cisco Catalyst 2960XR-24TD-I		1A to 0.5 A	

Input voltage and current			
Cisco Catalyst 2960XR-48LPS-I		6A to 3 A	
Cisco Catalyst 2960XR-24PS-I		6A to 3 A	
Cisco Catalyst 2960XR-48TS-I		1A to 0.5 A	
Cisco Catalyst 2960XR-24TS-I		1A to 0.5 A	
Power rating (switch maximum consumption values)			
Cisco Catalyst 2960X-48FPD-L	0.89 kVA		
Cisco Catalyst 2960X-48LPD-L	0.48 kVA		
Cisco Catalyst 2960X-24PD-L	0.47 kVA		
Cisco Catalyst 2960X-48TD-L	0.049 kVA		
Cisco Catalyst 2960X-24TD-L	0.034 kVA		
Cisco Catalyst 2960X-48FPS-L	0.89 kVA		
Cisco Catalyst 2960X-48LPS-L	0.49 kVA		
Cisco Catalyst 2960X-24PS-L	0.49 kVA		
Cisco Catalyst 2960X-24PSQ-L	0.16 kVA		
Cisco Catalyst 2960X-48TS-L	0.051 kVA		
Cisco Catalyst 2960X-24TS-L	0.039 kVA		
Cisco Catalyst 2960X-48TS-LL	0.46KVA		
Cisco Catalyst 2960X-24TS-LL	0.035KVA		
Cisco Catalyst 2960XR-48FPD-I	0.89KVA		
Cisco Catalyst 2960XR-48LPD-I	0.48KVA		
Cisco Catalyst 2960XR-24PD-I	0.46KVA		
Cisco Catalyst 2960XR-48TD-I	0.047KVA		
Cisco Catalyst 2960XR-24TD-I	0.039KVA		
Cisco Catalyst 2960XR-48FPS-I	0.89KVA		
Cisco Catalyst 2960XR-48LPS-I	0.47KVA		
Cisco Catalyst 2960XR-24PS-I	0.46KVA		
Cisco Catalyst 2960XR-48TS-I	0.046KVA		
Cisco Catalyst 2960XR-24TS-I	0.038KVA		

DC input voltages (RPS input) –2960-X LAN Base switches only		
	12V	**53V**
Cisco Catalyst 2960X-48FPD-L	4A	15A
Cisco Catalyst 2960X-48LPD-L	4A	8A
Cisco Catalyst 2960X-24PD-L	3A	8A
Cisco Catalyst 2960X-48TD-L	4A	N/A
Cisco Catalyst 2960X-24TD-L	3A	N/A
Cisco Catalyst 2960X-48FPS-L	4A	15A
Cisco Catalyst 2960X-48LPS-L	4A	8A
Cisco Catalyst 2960X-24PS-L	3A	8A
Cisco Catalyst 2960X-24PSQ-L	N/A	N/A
Cisco Catalyst 2960X-48TS-L	5A	N/A
Cisco Catalyst 2960X-24TS-L	4A	N/A

Note: The wattage rating on the power supply does not represent actual power draw. It indicates the maximum power draw possible by the power supply. This rating can be used for facility capacity planning. For PoE switches, cooling requirements are smaller than total power draw, as a significant portion of the load is dissipated in the endpoints.

Table 21. Power consumption[3]

Measured power consumption in watts[4]				
Model	**0% traffic[5]**	**10% traffic**	**100% traffic**	**Weighted average**
Cisco Catalyst 2960X-48FPD-L	50.8	65.9	66.7	66.0
Cisco Catalyst 2960X-48LPD-L	45.7	61.1	62.0	61.2
Cisco Catalyst 2960X-24PD-L	44.7	52.3	53.1	52.3
Cisco Catalyst 2960X-48TD-L	32.9	47.0	47.8	47.1
Cisco Catalyst 2960X-24TD-L	24.9	32.2	33.1	32.3
Cisco Catalyst 2960X-48FPS-L	51.9	66.6	66.8	66.6
Cisco Catalyst 2960X-48LPS-L	46.7	60.8	61.1	60.9
Cisco Catalyst 2960X-24PS-L	41.4	49.0	49.2	49.0
Cisco Catalyst 2960X-24PSQ-L	28.5	32.8	34.8	33.0
Cisco Catalyst 2960X-48TS-L	34.9	49.5	49.7	49.5
Cisco Catalyst 2960X-24TS-L	28.0	36.8	37.1	36.9
Cisco Catalyst 2960X-48TS-LL	31.4	44.3	44.5	44.4
Cisco Catalyst 2960X-24TS-LL	25.2	32.0	32.0	32.0
Cisco Catalyst 2960XR-48FPD-I	46.7	61.8	62.5	61.9
Cisco Catalyst 2960XR-48LPD-I	40.7	54.6	55.9	54.8
Cisco Catalyst 2960XR-24PD-I	36.1	42.9	43.7	43.0
Cisco Catalyst 2960XR-48TD-I	29.7	44.7	45.6	44.8
Cisco Catalyst 2960XR-24TD-I	29.3	37.2	38.1	37.3
Cisco Catalyst 2960XR-48FPS-I	44.8	58.5	58.8	58.5
Cisco Catalyst 2960XR-48LPS-I	37.9	52.8	53.0	52.9
Cisco Catalyst 2960XR-24PS-I	36.5	43.2	43.4	43.2
Cisco Catalyst 2960XR-48TS-I	30.0	44.8	45.0	44.8
Cisco Catalyst 2960XR-24TS-I	28.8	36.0	36.2	36.0

Table 22. Safety and compliance

Specification	Description
Safety	UL 60950-1 Second Edition
	CAN/CSA-C22.2 No. 60950-1 Second Edition
	EN 60950-1 Second Edition
	IEC 60950-1 Second Edition
	AS/NZS 60950-1

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[3] Disclaimer: All power consumption numbers were measured under controlled laboratory conditions and are provided as estimates.

[4] ATIS methodology.

[5] All traffic measured with EEE enabled.

Specification	Description
EMC – emissions	47CFR Part 15 (CFR 47) Class A AS/NZS CISPR22 Class A CISPR22 Class A EN55022 Class A ICES003 Class A VCCI Class A EN61000-3-2 EN61000-3-3 KN22 Class A CNS13438 Class A
EMC – immunity	EN55024 CISPR24 EN300386 KN24
Environmental	Reduction of Hazardous Substances (RoHS) including Directive 2011/65/EU
Telco	Common Language Equipment Identifier (CLEI) code
US government certifications	USGv6 and IPv6 Ready Logo

Cisco Enhanced Limited Lifetime Hardware Warranty

Cisco Catalyst 2960-X and 2960-XR Series Switches come with an Enhanced Limited Lifetime Warranty (E-LLW). The E-LLW provides the same terms as Cisco's standard limited lifetime warranty but adds next-business-day delivery of replacement hardware, where available, and 90 days of 8x5 Cisco Technical Assistance Center (TAC) support.

Your formal warranty statement, including the warranty applicable to Cisco software, appears in the Cisco information packet that accompanies your Cisco product. We encourage you to review carefully the warranty statement shipped with your specific product before use.

Cisco reserves the right to refund the purchase price as its exclusive warranty remedy. For further information about warranty terms, visit https://www.cisco.com/go/warranty.

Warranty Terms

Cisco enhanced limited lifetime hardware warranty	
Device covered	Applies to all Cisco Catalyst 2960-X and 2960-XR Series Switches.
Warranty duration	As long as the original end user continues to own or use the product.
End-of-life policy	In the event of discontinuance of product manufacture, Cisco warranty support is limited to five (5) years from the announcement of discontinuance.
Hardware replacement	Cisco or its service center will use commercially reasonable efforts to ship a Cisco Catalyst 2960-X or 2960-XR Series replacement part for next-business-day delivery, where available. Otherwise, a replacement will be shipped within ten (10) working days after the receipt of the RMA request. Actual delivery times may vary depending on customer location.
Effective date	Hardware warranty commences from the date of shipment to customer (and in case of resale by a Cisco reseller, not more than ninety [90] days after original shipment by Cisco).
TAC support	Cisco will provide, during customer's local business hours, 8 hours per day, 5 days per week basic configuration, diagnosis, and troubleshooting of device-level problems for up to 90 days from the date of shipment of the originally purchased Cisco Catalyst 2960-X or 2960-XR Series product. This support does not include solution or network-level support beyond the specific device under consideration.
Cisco.com access	Warranty allows guest access only to Cisco.com.

Technical Support and Services

Table 23. Technical services available for Cisco Catalyst 2960-X and 2960-XR Series Switches

Technical services
Cisco Smart Net Total Care™ Service • Around-the-clock, global access to the Cisco TAC • Unrestricted access to the extensive Cisco.com knowledge base and tools • Next-business-day, 8x5x4, 24x7x4, or 24x7x2 advance hardware replacement and onsite parts replacement and installation available[1] • Ongoing operating system software updates within the licensed feature set[2] • Proactive diagnostics and real-time alerts on Smart Call Home enabled devices
Cisco Smart Foundation Service • Next-business-day advance hardware replacement as available • Access to SMB TAC during business hours (access levels vary by region) • Access to Cisco.com SMB knowledge base • Online technical resources through Smart Foundation Portal • Operating system software bug fixes and patches
Cisco Smart Care Service • Network-level coverage for the needs of small and medium-sized businesses • Proactive health checks and periodic assessments of Cisco network foundation, voice, and security technologies • Technical support for eligible Cisco hardware and software through Smart Care Portal • Cisco operating system and application software updates and upgrades[2] • Next-business-day advance hardware replacement as available, 24x7x4 option available[1]
Cisco SP Base Service • Around-the-clock, global access to the Cisco TAC • Registered access to Cisco.com • Next-business-day, 8x5x4, 24x7x4, and 24x7x2 advance hardware replacement. Return to factory option available[1] • Ongoing operating system software updates[2]
Cisco Focused Technical Support Services Three levels of premium, high-touch services are available: • Cisco High-Touch Operations Management Service • Cisco High-Touch Technical Support Service • Cisco High-Touch Engineering Service Valid Cisco Smart Net Total Care or SP Base contracts are required on all network equipment

[1] Advance hardware replacement is available in various service-level combinations. For example, 8x5xNBD indicates that shipment will be initiated during the standard 8-hour business day, 5 days a week (the generally accepted business days within the relevant region), with Next-Business-Day (NBD) delivery. Where NBD is not available, same-day shipping is provided. Restrictions apply; please review the appropriate service descriptions for details.

[2] Cisco operating system updates include the following: maintenance releases, minor updates, and major updates within the licensed feature set.

Cisco ONE Software

Cisco ONE Software for Access Switching is available for the Cisco Catalyst 2960-X and 2960-XR Series Switches.

Cisco ONE Software offers a simplified consumption model, centered on common customer scenarios in the data center, WANs, and LANs.

Cisco ONE Software and services provide customers with four primary benefits:

- Software suites that address typical customer use scenarios at an attractive price
- Investment protection for their software purchase through software services-enabled license portability
- Access to ongoing innovation and new technology with Cisco Software Support Service (SWSS)
- Flexible licensing models to smoothly distribute customers' software spending over time

For ordering information for Cisco ONE Software for the Cisco Catalyst 2960-X and 2960-XR Series Switches, go to https://www.cisco.com/c/en/us/products/software/one-access/switching-part-numbers.html.

Cisco DNA Subscription Licensing

Cisco Catalyst 2960-X and 2960-XR Series Switches support term-based Cisco DNA Essentials licenses (DNA-E).

Ordering and managing licenses with smart accounts: Creating smart accounts by using the Cisco Smart Software Manager (SSM) enables you to order devices and licensing packages and also to manage your software licenses from a centralized website. You can set up Cisco SSM to receive daily email alerts and to be notified of expiring add-on licenses that you want to renew. When the license term expires, you can either renew the add-on license to continue using it or deactivate the add-on license and then reload the switch to continue operating with the base license capabilities.

Table 24.   Features supported in Cisco DNA Essentials for Cisco Catalyst 2960-X and Cisco Catalyst 2960-XR Series

Category	Features
Network visibility	DNS-AS, Full Flexible NetFlow
Day-zero network bring-up automation	Cisco Network Plug-and-Play application
Cisco DNA Center	Discovery, inventory, topology, software image management
Network monitoring	Device 360

Table 25.   Cisco Catalyst 2960-X product IDs for Cisco DNA Essentials licenses

Ports	Product ID	Description
24	C2960X-DNA-E-24=	C2960X DNA Essentials, 24-port term licenses
	C2960X-DNA-E-24-3Y	C2960X DNA Essentials, 24-port, 3-year term licenses
	C2960X-DNA-E-24-5Y	C2960X DNA Essentials, 24-port, 5-year term licenses
48	C2960X-DNA-E-48=	C2960X DNA Essentials, 48-port term licenses
	C2960X-DNA-E-48-3Y	C2960X DNA Essentials, 48-port, 3-year term licenses
	C2960X-DNA-E-48-5Y	C2960X DNA Essentials, 48-port, 5-year term licenses

Table 26.   Cisco Catalyst 2960-XR product IDs for Cisco DNA Essentials licenses

Ports	Product ID	Description
24	C2960XR-DNA-E-24=	C2960XR DNA Essentials, 24-port term licenses
	C2960XR-DNA-E-24-3	C2960XR DNA Essentials, 24-port, 3-year term licenses
	C2960XR-DNA-E-24-5	C2960XR DNA Essentials, 24-port, 5-year term licenses
48	C2960XR-DNA-E-48=	C2960XR DNA Essentials, 48-port term licenses
	C2960XR-DNA-E-48-3	C2960XR DNA Essentials, 48-port, 3-year term licenses
	C2960XR-DNA-E-48-5	C2960XR DNA Essentials, 48-port, 5-year term licenses

Software Policy

Customers with Cisco IOS IP Lite, LAN Base, or LAN Lite software feature sets will be provided with maintenance updates and bug fixes designed to maintain the compliance of the software with published specifications, release notes, and industry standards as long as the original end user continues to own or use the product or up to 1 year from the end-of-sale date for this product, whichever occurs earlier.

This policy supersedes any previous warranty or software statement and is subject to change without notice.

Ordering Information

Table 27. Cisco Catalyst 2960-X Series Switches ordering information

Part number	10/100/1000 Ethernet interfaces	Uplink interfaces	Cisco IOS Software feature set	Available PoE power	FlexStack-Plus, FlexStack-Extended
WS-C2960X-48FPD-L	48	2 SFP+	LAN Base	740W	Optional
WS-C2960X-48LPD-L	48	2 SFP+	LAN Base	370W	Optional
WS-C2960X-24PD-L	24	2 SFP+	LAN Base	370W	Optional
WS-C2960X-48TD-L	48	2 SFP+	LAN Base	-	Optional
WS-C2960X-24TD-L	24	2 SFP+	LAN Base	-	Optional
WS-C2960X-48FPS-L	48	4 SFP	LAN Base	740W	Optional
WS-C2960X-48LPS-L	48	4 SFP	LAN Base	370W	Optional
WS-C2960X-24PS-L	24	4 SFP	LAN Base	370W	Optional
WS-C2960X-24PSQ-L	24	2 SFP, 2 10/100/1000BT	LAN Base	110W	No
WS-C2960X-48TS-L	48	4 SFP	LAN Base	-	Optional
WS-C2960X-24TS-L	24	4 SFP	LAN Base	-	Optional
WS-C2960X-48TS-LL	48	2 SFP	LAN Lite	-	No
WS-C2960X-24TS-LL	24	2 SFP	LAN Lite	-	No

Table 28. Cisco Catalyst 2960-XR Series Switches ordering information

Part number	10/100/1000 Ethernet interfaces	Uplink interfaces	Cisco IOS Software feature set	Available PoE power	Second FRU power supply option	FlexStack-Plus, FlexStack-Extended
WS-C2960XR-48FPD-I	48	2 SFP+	IP Lite	740W	1025W	Optional
WS-C2960XR-48LPD-I	48	2 SFP+	IP Lite	370W	640W	Optional
WS-C2960XR-24PD-I	24	2 SFP+	IP Lite	370W	640W	Optional
WS-C2960XR-48TD-I	48	2 SFP+	IP Lite	–	250W	Optional
WS-C2960XR-24TD-I	24	2 SFP+	IP Lite	–	250W	Optional
WS-C2960XR-48FPS-I	48	4 SFP	IP Lite	740W	1025W	Optional
WS-C2960XR-48LPS-I	48	4 SFP	IP Lite	370W	640W	Optional
WS-C2960XR-24PS-I	24	4 SFP	IP Lite	370W	640W	Optional
WS-C2960XR-48TS-I	48	4 SFP	IP Lite	–	250W	Optional
WS-C2960XR-24TS-I	24	4 SFP	IP Lite	–	250W	Optional

Table 29.   Accessories

Part number	Description
C2960X-STACK	FlexStack-Plus hot-swappable stacking module
C2960X-FIBER-STK	FlexStack-Extended Fiber stacking module
C2960X-HYBRID-STK	FlexStack-Extended Hybrid module, with one copper and one fiber port
CAB-STK-E-0.5M	Stacking cable with a 0.5 m length
CAB-STK-E-1M	Stacking cable with a 1.0 m length
CAB-STK-E-3M	Stacking cable with a 3.0 m length
CAB-CONSOLE-RJ45	Console cable 6 feet with RJ-45
CAB-CONSOLE-USB	Console cable 6 feet with USB Type A and mini-B connectors
PWR-CLP	Power cable restraining clip
RCKMNT-1RU-2KX=	Spare rack-mount kit for Cisco Catalyst 2960-X and 2960-XR Series for 19-inch racks
RCKMNT-REC-2KX=	1 RU recessed rack-mount kit for Cisco Catalyst 2960-X and 2960-XR Series

Table 30.   Cisco Catalyst 2960-X Series redundant power supply options

Part number	Description
PWR-RPS2300	Cisco Redundant Power System 2300 and blower, no power supply
BLNK-RPS2300=	Spare bay insert for Cisco Redundant Power System 2300 for Cisco Catalyst 2960-X Series Switches
CAB-RPS2300-E=	Spare RPS 2300 cable for Cisco Catalyst 2960-X Series Switches
BLWR-RPS2300=	Spare 45 CFM blower for RPS 2300
C3K-PWR-750WAC=	RPS 2300 750W AC power supply spare for Cisco Catalyst 2960-X Series

For more information about the RPS 2300, visit cisco.com/en/US/products/ps7130/index.html.

Table 31.   Cisco Catalyst 2960-XR Series power supply options

Part number	Description
PWR-C2-250WAC[6]	Second FRU power supply and fan for all non-PoE 2960-XR switches, provides 250W AC of power
PWR-C2-640WAC[4]	Second FRU power supply and fan for all 370W PoE+ 2960-XR switches, provides 640W AC of power
PWR-C2-1025WAC[4]	Second FRU power supply and fan for all 740W PoE+ 2960-XR switches, provides 1025W AC of power
PWR-C2-250WAC=	Spare FRU power supply and fan for all non-PoE 2960-XR switches, provides 250W AC of power
PWR-C2-640WAC=	Spare FRU power supply and fan for all 370W PoE+ 2960-XR switches, provides 640W AC of power
PWR-C2-1025WAC=	Spare FRU power supply and fan for all 740W PoE+ 2960-XR switches, provides 1025W AC of power

Table 32.   Cisco Catalyst 2960-X and 2960-XR Series SFP and SFP+ modules

SFP and SFP+ modules
For the list of supported SFP and SFP+ modules, visit https://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

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[6] The first FRU power supply and fan module is configured automatically when the switch is ordered. The second redundant FRU power supply and fan module is an option while configuring the order.

Table 33. Power cords for Cisco Catalyst 2960-X Series

Part number	Description
CAB-16AWG-AC	AC power cord, 16AWG
CAB-ACE	AC power cord (Europe), C13, CEE 7, 1.5M
CAB-L620P-C13-US	Power cord, 250VAC, 15A, NEMA L6-20 to C13, US
CAB-ACI	AC power cord (Italy), C13, CEI 23-16, 2.5m
CAB-ACU	AC power cord (UK), C13, BS 1363, 2.5m
CAB-ACA	AC power cord (China/Australia), C13, AS 3112, 2.5m
CAB-ACS	AC power cord (Switzerland), C13, IEC 60884-1, 2.5m
CAB-ACR	AC power cord (Argentina), C13, EL 219 (IRAM 2073), 2.5m
CAB-ACC	CORD, PWR, CHINA, 10A, IEC 320, C13 (APN=CS-PWR-CH)
CAB-JPN-12A	CABASY, POWER CORD, JAPAN 2P, PSE, 12A @125VAC
CAB-L620P-C13-JPN	Power cord, 250VAC, 15A, NEMA L6-20 to C13, JAPAN
CAB-IND	Power cord for India
CAB-C15-ISR	Power cord for Israel
CAB-ACSA	Power cord for South Africa
CAB-AC15A-90L-USA	15A AC power cord, right angle (United States)
CAB-ACE-RA	Power cord Europe, right angle
CAB-ACI-RA	Power cord Italy, right angle
CAB-ACU-RA	Power cord UK, right angle
CAB-ACC-RA	Power cord China, right angle
CAB-ACA-RA	Power cord, Australia, right angle
CAB-ACS-RA	Power cord for Switzerland, right angle
CAB-ACR-RA	Power cord, Argentina, right angle
CAB-JPN-RA	Power cord, Japan, right angle
CAB-C15-CBN	Cabinet jumper power cord, 250 VAC 13A, C14-C15 connectors
CAB-ACBZ-12A	AC power cord (Brazil) 12A/125V BR-3-20 plug for less than 12A device

Table 34. Power cords for Cisco Catalyst 2960-XR Series

Part number	Description
CAB-TA-NA=	AC power cord for Cisco Catalyst 2960-XR (North America)
CAB-TA-AP=	AC power cord for Cisco Catalyst 2960-XR (Australia)
CAB-TA-AR=	AC power cord for Cisco Catalyst 2960-XR (Argentina)
CAB-TA-SW=	AC power cord for Cisco Catalyst 2960-XR (Switzerland)
CAB-TA-UK=	AC power cord for Cisco Catalyst 2960-XR (United Kingdom)
CAB-TA-JP=	AC power cord for Cisco Catalyst 2960-XR (Japan)
CAB-TA-250V-JP=	Japan 250VAC power cord for Cisco Catalyst 2960-XR (Japan)
CAB-TA-EU=	AC power cord for Cisco Catalyst 2960-XR (Europe)
CAB-TA-IT=	AC power cord for Cisco Catalyst 2960-XR (Italy)
CAB-TA-IN=	AC power cord for Cisco Catalyst 2960-XR (India)
CAB-TA-CN=	AC power cord for Cisco Catalyst 2960-XR (China)
CAB-TA-DN=	AC power cord for Cisco Catalyst 2960-XR (Denmark)

Part number	Description
CAB-TA-IS=	AC power cord for Cisco Catalyst 2960-XR (Israel)
CAB-C15-CBN=	Cabinet jumper power cord, 250 VAC 13A, C14-C15 connectors
CAB-C15-CBN-JP=	Japan Cabinet Jumper Power Cord, 250 VAC 13A, C14-C15
CAB-TA-JP-RA=	Japan AC Right Angled Power Cord for Cisco Catalyst 2960XR

Optics Compatibility Information

The Cisco Catalyst 2960-X and 2960-XR Series Switches support a wide range of optics. Because the list of supported optics is updated on a regular basis, consult the tables available here for compatibility information: Optics Compatibility.

Contact Cisco

For more information about Cisco products, contact:

- Phone: +1 800 553-NETS (6387)
- Worldwide Product Support
- Company website: Cisco.com

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Cisco Capital® can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.

Cisco Catalyst 3650 Series Switches

The Cisco® Catalyst® 3650 Series is the next generation of enterprise-class standalone and stackable access-layer switches that provide the foundation for full convergence between wired and wireless on a single platform. The 3650 Series is built on the advanced Cisco StackWise®-160, and takes advantage of the new Cisco Unified Access™ Data Plane (UADP) application-specific integrated circuit (ASIC). This switch can enable uniform wired-wireless policy enforcement, application visibility, flexibility, application optimization, and superior resiliency. The 3650 Series switches support full IEEE 802.3at Power over Ethernet Plus (PoE+), Cisco Universal Power over Ethernet (Cisco UPOE®) on the Cisco Catalyst 3650 Series multigigabit switches, and offer modular and field-replaceable redundant fans and power supplies. The 3650 Series switches also come in a 12-inch lower depth form factor so that you can deploy them in tight wiring closets in remote branches and offices where depth of the switch is a concern. In addition, the 3650 multigigabit switches support current and next-generation wireless speeds and standards (including 802.11ac Wave 2) on existing cabling infrastructure. The 3650 Series switches help increase wireless productivity and reduce TCO.

Product Overview

- Integrated wireless controller capability with:
  - Up to 40G of wireless capacity per switch (48-port models)
  - Support for up to 50 access points and 1000 wireless clients on each switching entity (switch or stack)
- 24 and 48 10/100/1000 data and PoE+ models with energy-efficient Ethernet (EEE) supported ports
- 24 and 48 100-Mbps and 1-, 2.5-, 5-, and 10-Gbps (multigigabit) Cisco UPOE and PoE+ models with EEE[1]
- Five fixed-uplink models with four Gigabit Ethernet, two 10 Gigabit Ethernet, four 10 Gigabit Ethernet, eight 10 Gigabit Ethernet, or two 40 Gigabit Ethernet Quad Small Form-Factor Pluggable Plus (QSFP+) ports
- 24-port and 48-port 10/100/1000 PoE+ models with lower noise and reduced depth of 11.62 inches for shallow depth cabinets in enterprise, retail, and branch-office environments
- Optional Cisco StackWise-160 technology that provides scalability and resiliency with 160 Gbps of stack throughput
- Dual redundant, modular power supplies and three modular fans providing redundancy[2]
- Support for external power system RPS 2300 on the 3650 mini SKUs for power redundancy
- Full IEEE 802.3at (PoE+) with 30W power on all ports in 1 rack unit (RU) form factor

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[1] 3650 multigigabit switches use different power supplies than the non-multigigabit models. Please refer to Table 3.

[2] 3650 mini SKUs (WS-C3650-24PDM and WS-C3650-48FQM) support fixed power supply and fans only. They also support RPS2300 for redundancy. RPS 2300 is not supported on other SKUs.

- Cisco UPOE with 60W power per port in 1 rack unit (RU) form factor
- IEEE 802.3bz (2.5GBASE-T and 5GBASE-T) to go beyond 1 Gbps with existing Category 5e and Category 6
- IEEE 802.1ba Audio Video Bridging (AVB) built in to provide a better AV experience, including improved time synchronization and quality of service (QoS)
- Software support for IPv4 and IPv6 routing, multicast routing, modular QoS, Flexible NetFlow (FNF) Version 9, and enhanced security features
- Single universal Cisco IOS® Software image across all license levels, providing an easy upgrade path for software features
- Enhanced limited lifetime warranty (E-LLW) with next business day (NBD) advance hardware replacement and 90-day access to Cisco Technical Assistance Center (TAC) support

Switch Models and Configurations

All Cisco Catalyst 3650 Series Switches have fixed, built-in uplink ports and ship with one power supply. Tables 1 through 5 provide further details. Figure 1 is an image of the Cisco Catalyst 3650 Series Switches.

Figure 1.   Cisco Catalyst 3650 Series Switches

Table 1 shows the Cisco Catalyst 3650 Series configurations.

Table 1.   Cisco Catalyst 3650 Series Configurations

Models	Fixed Uplinks	Total 10/100/1000 Ethernet Ports	Default AC Power Supply	Available PoE Power
WS-C3650-24TS	4 x Gigabit Ethernet with Small Form-Factor Pluggable (SFP)	24	250 WAC	-
WS-C3650-48TS		48		
WS-C3650-24PS		24 PoE+	640 WAC	390 W
WS-C3650-48PS		48 PoE+		
WS-C3650-48FS		48 PoE+	1025 WAC	775 W
WS-C3650-24TD	2 x 10 Gigabit Ethernet with SFP+ and 2 x 1 Gigabit Ethernet with SFP	24	250 WAC	
WS-C3650-48TD		48		
WS-C3650-24PD		24 PoE+	640 WAC	390 W
WS-C3650-24PDM		24 PoE+	Fixed 640 WAC	390 W
WS-C3650-48PD		48 PoE+	640 WAC	390 W
WS-C3650-48FD		48 PoE+	1025 WAC	775 W
WS-C3650-8X24PD		24 PoE+ (with 8 100-Mbps and 1-, 2.5-, 5-, and 10-Gbps ports)	715 WAC	435 W
WS-C3650-12X48FD		48 PoE+ (with 12 100-Mbps and 1-, 2.5-, 5-, and 10-Gbps ports)	1100 WAC	660 W

Models	Fixed Uplinks	Total 10/100/1000 Ethernet Ports	Default AC Power Supply	Available PoE Power
WS-C3650-48TQ	4 x 10 Gigabit Ethernet with SFP+ or 4 x Gigabit Ethernet with SFP	48	250 WAC	
WS-C3650-48PQ		48 PoE+	640 WAC	390 W
WS-C3650-48FQ		48 PoE+	1025 WAC	775 W
WS-C3650-48FQM		48 PoE+	Fixed 975 WAC	775 W
WS-C3650-8X24UQ		24 UPOE (with 8 100-Mbps and 1-, 2.5-, 5-, and 10-Gbps ports)	1100 WAC	820 W
WS-C3650-12X48UQ		48 UPOE (with 12 100-Mbps and 1-, 2.5-, 5-, and 10-Gbps ports)	1100 WAC	660 W
WS-C3650-12X48UR	8 x 10 Gigabit Ethernet with SFP+ or 8 x Gigabit Ethernet with SFP	48 UPOE (with 12 100-Mbps and 1-, 2.5-, 5-, and 10-Gbps ports)	1100 WAC	660 W
WS-C3650-12X48UZ	2 x 40 Gigabit Ethernet with QSFP+	48 UPOE (with 12 100-Mbps and 1-, 2.5-, 5-, and 10-Gbps ports)	1100 WAC	660 W

Fixed Uplinks

All Cisco Catalyst 3650 Series Switches have fixed, built-in uplink ports. Customers can choose from five types of uplink ports at the time of the switch purchase:

- Four Gigabit Ethernet with Small Form-Factor Pluggable (SFP)
- Two 10 Gigabit Ethernet with SFP+ and two 10 Gigabit Ethernet with SFP or four Gigabit Ethernet with SFP
- Four 10 Gigabit Ethernet with SFP+ or four Gigabit Ethernet with SFP
- Eight 10 Gigabit Ethernet with SFP+ or eight Gigabit Ethernet with SFP
- Two 40 Gigabit Ethernet with QSFP+

The SFP+ interface supports both 10 Gigabit Ethernet and Gigabit Ethernet ports. Refer to Table 1 for a description of the basic switch models and the corresponding uplink ports. Refer to Table 2 for a description of the various uplink port interface options.

Table 2.   1 and 10 Gigabit Fixed Uplink Configurations

	Interface Options	
Fixed Uplink Ports	**10 Gigabit Ethernet SFP+ Ports**	**Gigabit Ethernet SFP Ports**
4 x Gigabit Ethernet fixed uplink ports	0	4
4 x Gigabit Ethernet or 2 x 10 and 2 x 1 Gigabit Ethernet fixed uplink ports	2	0
	0	4
	2	2
4 x Gigabit Ethernet and 4 x 10 Gigabit Ethernet fixed uplink ports	4	0
	0	4
	2	2
	3	1
	1	3
8 x Gigabit Ethernet or 8 x 10 Gigabit Ethernet fixed uplink ports	8	0
	0	8
	Any combination of 10 Gigabit Ethernet and remaining 1 Gigabit Ethernet uplink ports	

Dual Redundant Modular Power Supplies and External RPS2300

The Cisco Catalyst 3650 Series Switches support dual redundant power supplies (see Figure 2). The switch ships with one power supply by default, and the second power supply can be purchased at the time of ordering the switch or at a later time. If only one power supply is installed, it should always be in power supply bay 1. The switch also ships with three field-replaceable fans.

Figure 2.   Redundant Power Supplies

Table 3 shows the different power supplies available in these switches and available PoE power.

Table 3.   Switch Models and Corresponding Default Power Supplies

Models	Default Power Supply	Available PoE Power	Support Secondary Power Supply
24-port data switch	PWR-C2-250WAC	-	Yes
48-port data switch			Yes
24-port PoE switch	PWR-C2-640WAC	390 W	Yes
48-port PoE switch			Yes
48-port full PoE switch	PWR-C2-1025WAC	775 W	Yes
24-port mini PoE switch	Fixed 640 WAC	390W	No, but supports RPS 2300
48-port mini PoE switch	Fixed 975 WAC	775W	No, but supports RPS 2300
24-port Multigigabit PoE switch	PWR-C1-715WAC	435 W	Yes
24-port Multigigabit UPOE switch	PWR-C1-1100WAC	820 W	Yes
48-port Multigigabit full PoE switch			
48-port Multigigabit UPOE switch		660 W	Yes

The multigigabit switches support a different set of power supplies than the non-multigigabit switches. In addition the PWR-C1-350WAC is **not** supported on the multigigabit switches. In addition to the power supplies listed in Table 3, a 640W DC power supply is available at the time of order or as a spare on all non-multigigabit switch models. The DC power supply also delivers PoE capabilities for maximum flexibility (refer to Table 4 for available PoE budget with DC power supplies). Customers can mix and match the AC and DC power supplies in the two available power supply slots. Any of these power supplies can be installed in any of the switches.

Table 4.   Available PoE with DC Power Supply

Model	Number of DC Power Supplies	Total Available PoE Budget
24-port or 48-port PoE Switch (non-multigigabit)	1	390 W
	2	780 W
24-port PoE Switch (Multigigabit)	1	160 W
	2	600 W
48-port PoE Switch (Multigigabit)	1	0 W
	2	440 W

Power over Ethernet Plus (PoE+)

The Cisco Catalyst 3650 Series Switches support both PoE (IEEE 802.3af) and PoE+ (IEEE 802.3at standard), which provide up to 30 W of power per port. PoE removes the need for wall power to each PoE-enabled device and eliminates the cost for additional electrical cabling and circuits that would otherwise be necessary in IP phone and WLAN deployments. The 3650 Series can provide a lower TCO for deployments that incorporate Cisco IP phones, Cisco Aironet® wireless LAN (WLAN) access points, or any IEEE 802.3at-compliant end device. Table 5 shows the power supply combinations required for different PoE needs.

Table 5.   Minimum Power Supply Requirements for Full PoE and PoE+

	24-Port PoE Switch	48-Port PoE Switch
PoE on All Ports (15.4 W per port)	One PWR-C2-640 WAC	One PWR-C2-1025WAC or Two PWR-C2-640 WAC
PoE+ on All Ports (30 W per port)	One PWR-C2-1025WAC or Two PWR-C2-640 WAC	Two PWR-C2-1025 WAC

Cisco Universal Power over Ethernet (Cisco UPOE)

Cisco UPOE is a breakthrough technology, offering the following services and benefits:

- 60W per port to enable a variety of end devices such as Samsung VDI client, BT IP turret systems in trading floors, Cisco Catalyst compact switches in retail and hospitality environments, personal Cisco TelePresence® systems, and physical access control devices
- High availability for power and guaranteed uninterrupted services, a requirement for critical applications (e911)
- Lower OpEx by providing network resiliency at lower cost by consolidating backup power into the wiring closet
- Faster deployment of new campus access networking infrastructures by eliminating the need for a power outlet for every endpoint

The Cisco UPOE capability is available only on select multigigabit models.

Table 6 shows the power supply requirements for Cisco UPOE.

Table 6.   Power Supply Requirements for Cisco UPOE

	24-Port Multigigabit Cisco UPOE Switch	48-Port Multigigabit Cisco UPOE Switch
Cisco UPOE (60W per port) on all (24-port switch) or max. 29 ports (48-port switch)	One 1100W and one 715W power supplies or two 1100W power supplies	Two 1100W power supplies

Cisco Catalyst Multigigabit Technology

Cisco Multigigabit Ethernet is a unique innovation to the new Cisco Catalyst Ethernet access switches. With the enormous growth of 802.11ac and new wireless applications, wireless devices are promoting the demand for more network bandwidth. This creates a need for a technology that supports speeds higher than 1 Gbps on all cabling infrastructure. Cisco multigigabit technology allows you to achieve bandwidth speeds from 1 Gbps through 10 Gbps over traditional Category 5e (Cat 5e) cabling or above. In addition, the multigigabit ports on select Cisco Catalyst switches support Cisco UPOE, which is increasingly important for next-generation workspaces and Internet of Things (IoT) ecosystems.

Cisco multigigabit technology offers significant benefits for a diverse range of speeds, cable types, and PoE power. The benefits can be grouped into three different areas:

- **Multiple speeds:** Cisco Catalyst Multigigabit Technology supports autonegotiation of multiple speeds on switch ports. The supported speeds are 100 Mbps, 1 Gbps, 2.5 Gbps, and 5 Gbps on Cat 5e cable and up to 10 Gbps over Cat 6a cabling
- **Cable type:** The technology supports a wide range of cable types, including Cat 5e, Cat 6, and Cat 6a or above
- **PoE power:** The technology supports PoE, PoE+, and Cisco UPOE for all the supported speeds and cable types

Cisco Catalyst 3650 Mini Switches

The Cisco Catalyst 3650 Series adds new mini switches to the existing 3650 family of switches. These switches are less than 12" deep and quieter than the existing 3650 switches, making them perfect to deploy in tight wiring cabinets, racks, or user spaces where depth of the switch is a concern. You can avoid replacing the cabinets or mounting the switch at an angle and as a result reduce downtime to the network. These switches enable the same uniform wired-wireless policy enforcement, application visibility, flexibility, application optimization, and superior resiliency as the existing 3650 switches. They come in 24- and 48-port 10M/100M/1000M switch SKUs (WS-C3650-24PDM and WS-C3650-48FQM) and support all the same features as the existing 3650 switches except that they come with fixed fans, fixed power supplies, and support for external RPS2300 for redundancy. These PoE switches support both PoE (IEEE 802.3af) and PoE+ (IEEE 802.3at standard), providing up to 30W of power for 12 ports for a total of 390W on the 24-port model and up to 30W of power for 24 ports for a total of 775W on the 48-port model. The 24-port switch has 2x1 Gigabit Ethernet SFP and 2x10 Gigabit Ethernet SFP+ uplinks; the 48-port switch has 4x10 Gigabit Ethernet SFP+ uplinks to support any high-bandwidth application. These switches support stacking and can stack with each other or the existing 3650 switches using the same Cisco StackWise-160 technology. The 3650 mini and 3650 use the same software and thus can be deployed and managed using the same policies, configuration, and so on as the existing 3650 switches. Some use cases for the 3650 mini are the following:

Small Offices and Branches

Many small branches and satellite offices where there are few employees do not have larger wiring closets because of space constraints. A typical office like this has smaller cabinets and would need a switch that can serve few employees, provide PoE support, can manage wired-wireless networks, and applies the same consistent policies as a bigger branch or office. Because of its less than 12" depth, lower noise, and support for 10G uplinks along with stacking, advanced security, and wired-wireless convergence, the 3650 mini is the perfect switch for this type of space.

Education

The 3650 mini switch extends access to labs, classrooms, and other training rooms from the central/floor distribution rooms, reducing cost of cabling and providing superior quality of service with enhanced security, wired-wireless convergence, and enterprise network features. Because of its shallow depth and lower noise, these switches are ideally suited for classrooms or confined areas.

Retail

A typical retail outlet needs to serve customers at multiple sales points, each with a POS machine, access points, phone, printer, video display with network, and some PoE powering. These retail outlets connect to the access router that connects them to the outside network and typically need switches that fit in shallow depth cabinets. Because of the 12" depth of these switches along with advanced security and networking features, they can help retailers efficiently utilize space and save on real estate cost.

Benefits

Converged Wired plus Wireless Access

The Cisco Catalyst 3650 Series is a standalone and stackable access switching platform that enables wired plus wireless services on a single Cisco IOS XE Software-based platform. With this, Cisco has pioneered a host of rich capabilities such as high availability based on stateful switchover (SSO) on stacking, granular QoS, security, and Flexible NetFlow (FNF) across wired and wireless in a seamless fashion. Also, the wired plus wireless features are bundled into a single Cisco IOS Software image, which reduces the number of software images that users have to qualify/certify before enabling them in their network. The single console port for command-line interface (CLI) management reduces the number of touch points to manage for wired plus wireless services, thereby reducing network complexity, simplifying network operations, and lowering the TCO to manage the infrastructure.

Converged wired plus wireless not only improves wireless bandwidth across the network but also the scale of wireless deployment. Each 48-port Cisco Catalyst 3650 provides 40 Gbps of wireless throughput (20 Gbps on the 24-port model). This wireless capacity increases with the number of members in the stack. This makes sure that the network can scale with current wireless bandwidth requirements, as dictated by IEEE 802.11n-based access points and with future wireless standards such as IEEE 802.11ac. Additionally, the Cisco Catalyst 3650 distributes the wireless controller functions to achieve better scalability. Each Cisco Catalyst 3650 switch/stack can operate as the wireless controller in two modes:

- **Mobility agent (MA):** This is the default mode in which the Cisco Catalyst 3650 switch ships. In this mode the switch is capable of terminating the CAPWAP tunnels from the access points and providing wireless connectivity to wireless clients. Maintaining wireless client databases and configuring and enforcing security and QoS policies for wireless clients and access points can be enforced in this mode. No additional license on top of IP Base is required to operate in the mobility agent mode.

- **Mobility controller (MC):** In this mode, the Cisco Catalyst 3650 switch can perform all the mobility agent tasks in addition to mobility coordination, radio resource management (RRM), and Cisco CleanAir® coordination within a mobility subdomain. The mobility controller mode can be enabled on the switch CLI. IP Base license level is required when the Cisco Catalyst 3650 switch is acting as the mobility controller. A centrally located Cisco 5508 Wireless LAN Controller (WLC 5508), Cisco Wireless Services Module 2 (WiSM2) (when running AireOS Version 7.3), and Wireless LAN Controller 5760 can also perform this role for larger deployments.

  With mobility agents located in the wiring closets providing 40 Gbps of wireless per switch (**n** x 40 Gbps for a stack of **n** switches) and mobility controllers managing some of the central wireless functions, the converged access-based wireless deployment provides best-in-class scalability for wireless and significantly improved wireless throughput.

Figure 3.   Mobility Controller (MC) and Mobility Agent (MA)
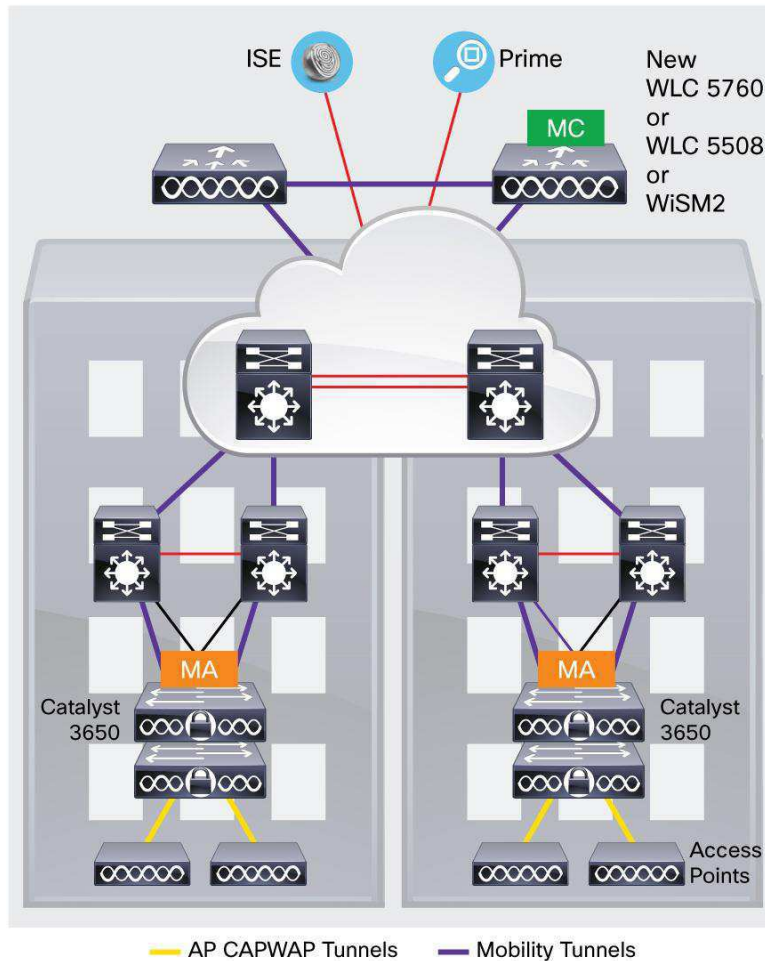
Distributed Intelligent Services

Flexible NetFlow (FNF)

Full visibility into the wired plus wireless traffic is achieved because of the access point Control and Provisioning of Wireless Access Points (CAPWAP) tunnel termination on the switch. This helps identify users and user traffic flows in order to identify potential attackers and take corrective action at the access layer before the attack penetrates further into the network. This is achieved using FNF, which monitors every single flow entering and exiting the switch stack for wired and wireless users. It also helps identify the top wired/wireless talkers and enforce appropriate bandwidth provisioning policies.

QoS

The 3650 switch has advanced wired plus wireless QoS capabilities. It uses the Cisco modular QoS command line interface (MQC). The switch manages wireless bandwidth using unprecedented hierarchical bandwidth management starting at the per-access-point level and drilling further down to per-radio, per-service set identification (SSID), and per-user levels. This helps manage and prioritize available bandwidth between various radios and various SSIDs (enterprise, guest, and so on) within each radio on a percentage basis. The switch is also capable of automatically allocating equal bandwidth among the connected users within a given SSID. This makes sure that all users within a given SSID get a fair share of the available bandwidth while being connected to the network. The UADP ASIC enables the hierarchical bandwidth management and fair sharing of bandwidth, thereby providing hardware-based QoS for optimized performance at line-rate traffic.

In addition to these capabilities, the switch is able to do class of service (CoS) or differentiated services code point (DSCP) based queuing, policing, shaping, and marking of wired plus wireless traffic. This enables users to create common policies that can be used across wired plus wireless traffic. The 3650 also supports downloadable policy names from the Cisco Identity Services Engine (ISE) when a user successfully authenticates to the network using the ISE.

Security

The Cisco Catalyst 3650 provides a rich set of security features for wired plus wireless users. Features such as IEEE 802.1x, Dynamic Host Configuration Protocol (DHCP) snooping, IP Source Guard and control plane protection, wireless intrusion prevention systems (WIPSs), and so on enable protection against unauthorized users and attackers. With a variety of wired plus wireless users connecting to the network, the switch supports session-aware networking, in which each device connected to the network is identified as one session, and unique access control lists (ACLs) and/or QoS policies can be defined and applied using the ISE for each of these sessions, providing better control on the devices connecting to the network.

Resiliency

Cisco StackWise-160 Technology

The Cisco Catalyst 3650 supports an optional stacking module that is based on the Cisco StackWise-160 technology. Cisco StackWise-160 technology is built on the highly successful industry-leading StackWise technology, which is a premium stacking architecture. StackWise-160 has a stack bandwidth of 160 Gbps. StackWise-160 uses Cisco IOS Software SSO for providing resiliency within the stack. The stack behaves as a single switching unit that is managed by an "active" switch elected by the member switches. The active switch automatically elects a standby switch within the stack. The active switch creates and updates all the switching/routing/wireless information and constantly synchronizes that information with the standby switch. If the active switch fails, the standby switch assumes the role of the active switch and continues to the keep the stack operational. Access points continue to remain connected during an active-to-standby switchover. A working stack can accept new members or delete old ones without service interruption. StackWise-160 creates a highly resilient single unified system of up to nine switches, providing simplified management using a single IP address, single Telnet session, single CLI, auto-version checking, auto-upgrading, auto-configuration, and more. StackWise-160 also enables local switching in Cisco Catalyst 3650 Series Switches. (See Figure 4.)

Figure 4.   StackWise-160 Kit with Stack Adapters and Cables

Foundation for Open Network Environment

The heart of the Cisco Catalyst 3650 is the UADP ASIC with programmability for future features and intelligence with investment protection. The new ASIC provides the foundation for converged APIs across wired and wireless, Cisco Open Network Environment, software-defined networking (SDN) readiness and OnePK SDK through software updates over the product lifetime.

Software Features and Services on Cisco Catalyst 3650 Series Switches

Software services supported on the Cisco Catalyst 3650 Series Switches can be classified into five broad categories:

- Ease of operations
- Advanced security features
- Resiliency
- Application visibility and control
- Audio Video Bridging (AVB)

Ease of Operations

The Cisco Catalyst 3650 helps reduce the operating costs through:

- Cisco Catalyst Smart Operations
- Easy-to-use deployment and control features
- Efficient switch operations
- Network management tools

Cisco Catalyst Smart Operations

Cisco Catalyst Smart Operations are a comprehensive set of capabilities that simplify LAN deployment, configuration, and troubleshooting. In addition to adaptive, always-on technologies such as StackWise-160, Cisco Catalyst Smart Operations enable zero-touch installation and replacement of switches, fast upgrade, and ease of troubleshooting with reduced operational cost. Cisco Catalyst Smart Operations are a set of features that includes Smart Install, Auto Smartports, Smart Configuration and Smart Troubleshooting to enhance operational excellence:

- Cisco Smart Install is a transparent plug-and-play technology to configure the Cisco IOS Software image and switch configuration without user intervention. Smart Install utilizes dynamic IP address allocation and the assistance of other switches to facilitate installation, providing transparent network plug and play.
- Cisco Auto Smartports provide automatic configuration as devices connect to the switch port, allowing auto-detection and plug and play of the device onto the network.

- Cisco Smart Troubleshooting is an extensive array of debug diagnostic commands and system health checks within the switch, including Generic Online Diagnostics (GOLD) and Onboard Failure Logging (OBFL).
- Embedded Event Manager (EEM) is a powerful and flexible feature that provides real-time network event detection and onboard automation. Using EEM, customers can adapt the behavior of their network devices to align with their business needs. This feature requires the IP Base feature set.

Easy-to-Use Deployment and Control Features

- User experience:
  - IP service-level agreements (SLAs) enable customers to assure new business-critical IP applications, as well as IP services that utilize data, voice, and video, in an IP network. This feature requires the IP Services feature set.
  - DHCP autoconfiguration of multiple switches through a boot server eases switch deployment.
  - Automatic QoS (AutoQoS) simplifies QoS configuration in voice over IP (VoIP) networks by issuing interface and global switch commands to detect Cisco IP phones, classify traffic, and help enable egress queue configuration.
  - Autonegotiation on all ports automatically selects half- or full-duplex transmission mode to optimize bandwidth.
  - Automatic media-dependent interface crossover (MDIX) automatically adjusts transmit and receive pairs if an incorrect cable type (crossover or straight through) is installed.
- Simplified configuration and connectivity:
  - Dynamic Trunking Protocol (DTP) facilitates dynamic trunk configuration across all switch ports.
  - Port Aggregation Protocol (PAgP) automates the creation of Cisco Fast EtherChannel groups or Gigabit EtherChannel groups to link to another switch, router, or server.
  - Link Aggregation Control Protocol (LACP) allows the creation of Ethernet channeling with devices that conform to IEEE 802.3ad. This feature is similar to Cisco EtherChannel technology and PAgP.
  - Unidirectional Link Detection Protocol (UDLD) and aggressive UDLD allow unidirectional links caused by incorrect fiber-optic wiring or port faults to be detected and disabled on fiber-optic interfaces.
  - Cisco VLAN Trunking Protocol (VTP) Version 3 supports dynamic VLANs and dynamic trunk configuration across all switches.
- Efficient switch operation:
  - Switching database manager (SDM) templates, VLAN template (specific to LAN Base license level), and advanced template allow the administrator to automatically optimize the ternary content-addressable memory (TCAM) allocation to the desired features based on deployment-specific requirements.
  - Local proxy Address Resolution Protocol (ARP) works in conjunction with private VLAN edge to minimize broadcasts and maximize available bandwidth.
  - Stacking master configuration management with Cisco StackWise-160 technology helps make sure that all switches are automatically upgraded when the master switch receives a new software version. Automatic software version checking and updating help ensure that all stack members have the same software version.

- Trivial File Transfer Protocol (TFTP) reduces the cost of administering software upgrades by downloading from a centralized location.
- Network Timing Protocol (NTP) provides an accurate and consistent timestamp to all intranet switches.
- Multicast:
  - Optimized multicast for wired plus wireless: Cisco Catalyst 3650 offers greater multicast efficiency by receiving only one multicast stream and replicating it for all connected wired plus wireless devices connected to that switch.
  - Internet Group Management Protocol (IGMP) v1, v2, v3 snooping for IPv4: multicast listener discovery (MLD) v1 and v2 snooping provides fast client joins and leaves of multicast streams and limits bandwidth-intensive video traffic to only the requestors.
- Monitoring:
  - Remote Switch Port Analyzer (RSPAN) allows administrators to remotely monitor ports in a Layer 2 switch network from any other switch in the same network.
  - For enhanced traffic management, monitoring, and analysis, the Embedded Remote Monitoring (RMON) software agent supports four RMON groups (history, statistics, alarms, and events).
  - Layer 2 traceroute eases troubleshooting by identifying the physical path that a packet takes from source to destination.
  - Wireless RF management provides both real-time and historical information about RF interference affecting network performance across controllers using systemwide Cisco CleanAir technology integration.

Efficient Switch Operation

Cisco Catalyst 3650 Series Switches, designed and engineered by Cisco, provide optimum power-saving, EEE, low-power operations for industry best-in-class power management and power consumption capabilities. The Cisco Catalyst 3650 ports are capable of reduced power modes so that ports not in use can move into a lower power utilization state. Other efficient switch operation features are:

- Cisco Discovery Protocol Version 2 allows the Cisco Catalyst 3650 Series Switches to negotiate a more granular power setting when connecting to a Cisco powered device such as IP phones or access points than what is provided by IEEE classification.
- Per-port power consumption command allows customers to specify a maximum power setting on an individual port. Per-port PoE power sensing measures actual power being drawn, enabling more intelligent control of powered devices.
- The PoE MIB provides proactive visibility into power usage and allows customers to set different power-level thresholds.

Environmentally Responsible

Organizations may choose to turn off access point radios to reduce power consumption during off-peak hours. The integrated wireless LAN controller avoids the deployment of additional devices in the network.

Network Management Tools

The Cisco Catalyst 3650 Series Switches offer both a superior CLI for detailed configuration and Cisco Prime™ infrastructure for unified wired plus wireless management. Cisco Prime infrastructure provides day 0 and ongoing provisioning, ongoing monitoring and maintenance, configuration templates, and device and user 360-degree views and serves as the FNF collector for user traffic views using the Cisco Prime Assurance Manager module.

For detailed information about Cisco Prime infrastructure, go to http://www.cisco.com/en/US/products/ps12239/index.html.

Advanced Security Features

Cisco Catalyst 3650 Series Switches support advanced security features including but not limited to:

- Protection against attackers:
    - Port security secures the access to an access or trunk port based on MAC address. It limits the number of learned MAC addresses to deny MAC address flooding.
    - DHCP snooping prevents malicious users from spoofing a DHCP server and sending out bogus addresses. This feature is used by other primary security features to prevent a number of other attacks such as ARP poisoning.
    - Dynamic ARP inspection (DAI) helps ensure user integrity by preventing malicious users from exploiting the insecure nature of ARP.
    - IP source guard prevents a malicious user from spoofing or taking over another user's IP address by creating a binding table between the client's IP and MAC address, port, and VLAN.
    - The Unicast Reverse Path Forwarding (RPF) feature helps mitigate problems caused by the introduction of malformed or forged (spoofed) IP source addresses into a network by discarding IP packets that lack a verifiable IP source address.
    - Bidirectional data support on the SPAN port allows the Cisco intrusion detection system (IDS) to take action when an intruder is detected.
- User authentication:
    - Flexible authentication that supports multiple authentication mechanisms, including 802.1X, MAC authentication bypass, and web authentication using a single, consistent configuration.
    - RADIUS change of authorization and downloadable calls for comprehensive policy management capabilities.
    - Private VLANs restrict traffic between hosts in a common segment by segregating traffic at Layer 2, turning a broadcast segment into a nonbroadcast multiaccess like segment. Private VLAN edge provides security and isolation between switch ports, which helps ensure that users cannot snoop on other users' traffic.
    - Multidomain authentication allows an IP phone and a PC to authenticate on the same switch port while placing them on appropriate voice and data VLAN.
    - MAC address notification allows administrators to be notified of users added to or removed from the network.
    - Mobility and security for secure, reliable wireless connectivity and consistent end-user experience. Increased network availability through proactive blocking of known threats.

- IGMP filtering provides multicast authentication by filtering out nonsubscribers and limits the number of concurrent multicast streams available per port.
- ACLs:
  - Cisco security VLAN ACLs on all VLANs prevent unauthorized data flows from being bridged within VLANs.
  - Cisco standard and extended IP security router ACLs define security policies on routed interfaces for control-plane and data-plane traffic. IPv6 ACLs can be applied to filter IPv6 traffic.
  - Port-based ACLs for Layer 2 interfaces allow security policies to be applied on individual switch ports.
- Device access:
  - Secure Shell (SSH) Protocol, Kerberos, and Simple Network Management Protocol Version 3 (SNMPv3) provide network security by encrypting administrator traffic during Telnet and SNMP sessions. SSH Protocol, Kerberos, and the cryptographic version of SNMPv3 require a special cryptographic software image because of U.S. export restrictions.
  - TACACS+ and RADIUS authentication facilitates centralized control of the switch and restricts unauthorized users from altering the configuration.
  - Multilevel security on console access prevents unauthorized users from altering the switch configuration.
- Bridge protocol data unit (BPDU) Guard shuts down Spanning Tree PortFast-enabled interfaces when BPDUs are received to avoid accidental topology loops.
- Spanning Tree Root Guard (STRG) prevents edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes.
- Wireless end-to-end security offers CAPWAP-compliant DTLS encryption to make sure of encryption between access points and controllers across remote WAN/LAN links.

Resiliency

Borderless networks enable enterprise mobility and business-grade video services. Industry's first unified network (wired plus wireless) location services enable tracking of mobile assets and the users of those assets for both wired plus wireless devices. The true borderless experience is enabled by the following feature sets in the Cisco Catalyst 3650 Series Switches:

- High availability
- High-performance IP routing
- Superior QoS

High Availability

In addition to StackWise-160, the Cisco Catalyst 3650 Series supports high-availability features including but not limited to the following:

- Cross-Stack EtherChannel provides the ability to configure Cisco EtherChannel technology across different members of the stack for high resiliency.
- Flexlink provides link redundancy with convergence time less than 100ms.
- IEEE 802.1s/w Rapid Spanning Tree Protocol (RSTP) and Multiple Spanning Tree Protocol (MSTP) provide rapid spanning-tree convergence independent of spanning-tree timers and also offer the benefit of Layer 2 load balancing and distributed processing. Stacked units behave as a single spanning-tree node.

- Per-VLAN Rapid Spanning Tree (PVRST+) allows rapid spanning-tree reconvergence on a per-VLAN spanning-tree basis, without requiring the implementation of spanning-tree instances.
- Switch-port autorecovery (Err-disable) automatically attempts to reactivate a link that is disabled because of a network error.

High-Performance IP Routing

The Cisco Express Forwarding hardware routing architecture delivers extremely high-performance IP routing in the Cisco Catalyst 3650 Series Switches:

- IP unicast routing protocols (static, Routing Information Protocol Version 1 [RIPv1], and RIPv2, RIPng, Enhanced Interior Gateway Routing Protocol [EIGRP] stub) are supported for small-network routing applications with the IP Base feature set. Limited static routing with the LAN Base feature set. Equal-cost routing facilitates Layer 3 load balancing and redundancy across the stack.
- Advanced IP unicast routing protocols (Open Shortest Path First [OSPF], EIGRP, Border Gateway Protocol Version 4 [BGPv4], and Intermediate System-to-Intermediate System Version 4 [IS-ISv4]) are supported for load balancing and constructing scalable LANs. IPv6 routing (OSPFv3, EIGRPv6) is supported in hardware for maximum performance. OSPF for routed access is included in the IP Base image. The IP Services feature set is required for full OSPF, EIGRP, BGPv4, and IS-ISv4.
- Policy-based routing (PBR) allows superior control by facilitating flow redirection regardless of the routing protocol configured. Virtual routing and forwarding (VRF)-Lite enables a service provider to support two or more VPNs, with overlapping IP addresses. The IP Base feature set is required.
- Protocol-independent multicast (PIM) for IP multicast routing is supported, including PIM sparse mode (PIM-SM), PIM dense mode (PIM-DM), PIM sparse-dense mode, and source-specific multicast (SSM). The IP Services feature set is required.
- IPv6 addressing is supported on interfaces with appropriate show commands for monitoring and troubleshooting.

Superior QoS

The Cisco Catalyst 3650 Series offers Gigabit Ethernet speed with intelligent services that keep traffic flowing smoothly, even at 10 times the normal network speed. Industry-leading mechanisms for cross-stack marking, classification, and scheduling deliver superior performance for data, voice, and video traffic, all at wire speed.

The following are some of the QoS features supported in the Cisco Catalyst 3650 Series Switches:

- Granular wireless bandwidth management and fair sharing use Cisco's proven Cisco IOS Software and UADP ASIC technology to provide hierarchical bandwidth management at line rate (per access point, per radio, per SSID, per client-based policies). Fair sharing across the users within an SSID makes sure that no single user is starved because of other heavy-hitting users. Fair sharing is automatically enabled for wireless at user level as well as SSID level.
- 802.1p CoS and DSCP field classification is provided, using marking and reclassification on a per-packet basis by source and destination IP address, MAC address, or Layer 4 Transmission Control Protocol/User Datagram Protocol (TCP/UDP) port number.

- Shaped round robin (SRR) scheduling helps ensure differential prioritization of packet flows by intelligently servicing the ingress queues and egress queues. Weighted tail drop (WTD) provides congestion avoidance at the ingress and egress queues before a disruption occurs. Strict priority queuing helps ensure that the highest priority packets are serviced ahead of all other traffic.
- The Cisco committed information rate (CIR) function provides bandwidth in increments as low as 8 Kbps.
- Rate limiting is provided based on source and destination IP address, source and destination MAC address, Layer 4 TCP/UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps.
- Eight egress queues per port for wired traffic and four egress queues for wireless help enable differentiated management of different traffic types across the stack for wired traffic. Up to 2000 aggregate policers are available per switch.

Application Visibility and Control Using Flexible NetFlow (FNF)

Cisco IOS Software FNF is the next generation in flow visibility technology, allowing optimization of the network infrastructure, reducing operation costs, and improving capacity planning and security incident detection with increased flexibility and scalability. The Cisco Catalyst 3650 provides optimized application visibility with FNF across wired plus wireless. The switch is capable of 48,000 flow entries on 48-port models and 24,000 flow entries on 24-port models across wired and wireless. With UADP ASIC, Cisco Catalyst 3650 delivers next-generation flow technology with unprecedented flexibility and comprehensive visibility extending from Layer 2 (MAC and VLAN) to Layer 4 (TCP/UDP) flags and so on across wired plus wireless traffic. The Cisco Catalyst 3650 switch is medianet capable to provide visibility and troubleshooting capabilities across wired plus wireless video traffic. Specific medianet features will be enabled in future software updates.

The flow data collected by FNF can be exported to an external collector for analysis and reporting or tracked by the EEM. The Cisco Catalyst 3650 enables powerful on-box and customizable event correlation and policy actions with EEM, allowing the switches to trigger customized event alarms or policy actions when the predefined condition is met. With no external appliance required, customers are able to use existing infrastructure to perform traffic monitoring, making traffic analysis economical even on a large IP network.

Details about Cisco FNF are available at
http://www.cisco.com/en/US/prod/collateral/iosswrel/ps6537/ps6555/ps6601/ps6965/product_data_sheet0900aecd804b590b.html.

The Cisco Catalyst 3650 supports Wireshark, the world's foremost network protocol analyzer, and is ideal for proactive debugging, troubleshooting and network performance monitoring. Using Wireshark, a user can capture control and data wired and wireless packets, easily displaying and analyzing them on a screen or a Wireshark GUI. Using Flexible NetFlow and Embedded Event Manager, a Wireshark packet capture can be initiated in events such as SYN flood attacks or abnormal bandwidth usage by specific users.

High-performance video over wireless integrates Cisco VideoStream technology to optimize the delivery of video applications across the WLAN.

Wired plus wireless IP telephony supports unified communications for improved collaboration through messaging, presence, and conferencing and supports all Cisco Unified Communications wireless IP phones for cost-effective, real-time voice service.

Audio Video Bridging

With Cisco IOS® XE Software Release 16.3, select* Cisco Catalyst 3650 Series models support the IEEE 802.1 AVB standard. This standard provides the means for highly reliable delivery of low-latency, time-synchronized AV streaming services through Layer 2 Ethernet networks. The standard also makes it easier to integrate new services and for AV equipment from different vendors to interoperate. Whether the AV endpoint connections are analog or are inflexible digital one to one, the network transport enables many-to-many transparent plug-and-play connections for multiple AV endpoints.

Benefits:

- Improves quality of experience by lowering jitter and latency for time-synchronized delivery of high-quality AV
- Provides scalability of applications across networked deployments, including expansive and complex AV infrastructure
- Lowers total cost of ownership (TCO) with reduced cabling (lowers CapEx) and no license fees (lowers OpEx)

*For more details about AVB and specific models supported, check http://www.cisco.com/go/avb.

Deployment Options

Campus

In a campus-type deployment, operating the Cisco Catalyst 3650 in the mobility agent mode and centralizing the mobility controller functionality in a WLC 5760, WLC 5508, or WiSM2 helps achieve better scalability and performance. The Cisco Catalyst 3650 provides CAPWAP termination for access points, uniform policy enforcement for wireless clients, better wireless bandwidth, and uniform Cisco IOS Software-based configuration and monitoring for wired plus wireless features. The mobility controller provides central mobility, RRM, and CleanAir coordination.

Backward compatibility with traditional centralized wireless deployment mode on the WLC 5508, WiSM2, and WLC 5760 helps ensure that customers can migrate to the Cisco Catalyst 3650-based converged access approach in phases, providing a continued controller for existing access points. This migration also provides investment protection on the existing wireless controller infrastructure. A phased adoption of the new Cisco Catalyst 3650 helps ensure that migration to the converged access mode of wireless is seamless. Figure 5 shows the Cisco Catalyst 3650 in a campus deployment.

Figure 5.   Deploying Cisco Catalyst 3650 in a Branch Environment
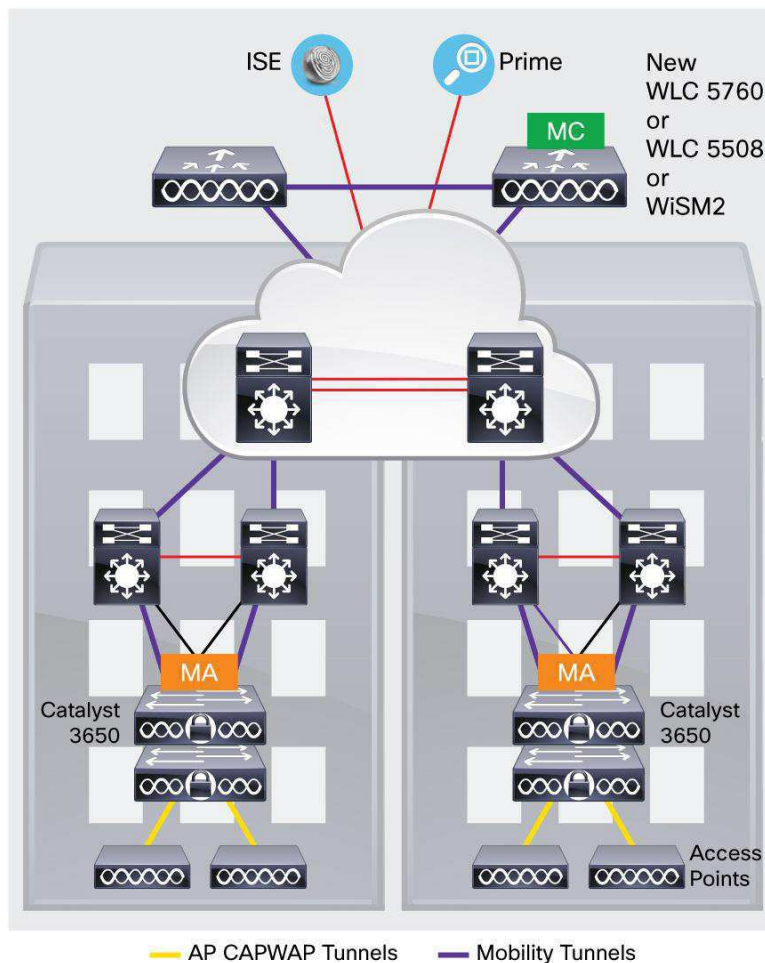
Branch

3650 is optimized for branch deployments when it operates in mobility controller mode. In this mode, not only can the switch terminate CAPWAP tunnels from the access points and provide client connectivity, it can also manage mobility within the branch. This eliminates the need for a local controller in every branch in addition to the access-layer switches. Also, complete visibility into the wired plus wireless traffic means that the WAN router can prioritize the right wired plus wireless traffic in and out of the branch. Figure 6 shows the Cisco Catalyst 3650 in a branch deployment.

Figure 6.   Deploying Cisco Catalyst 3650 in a Branch Location
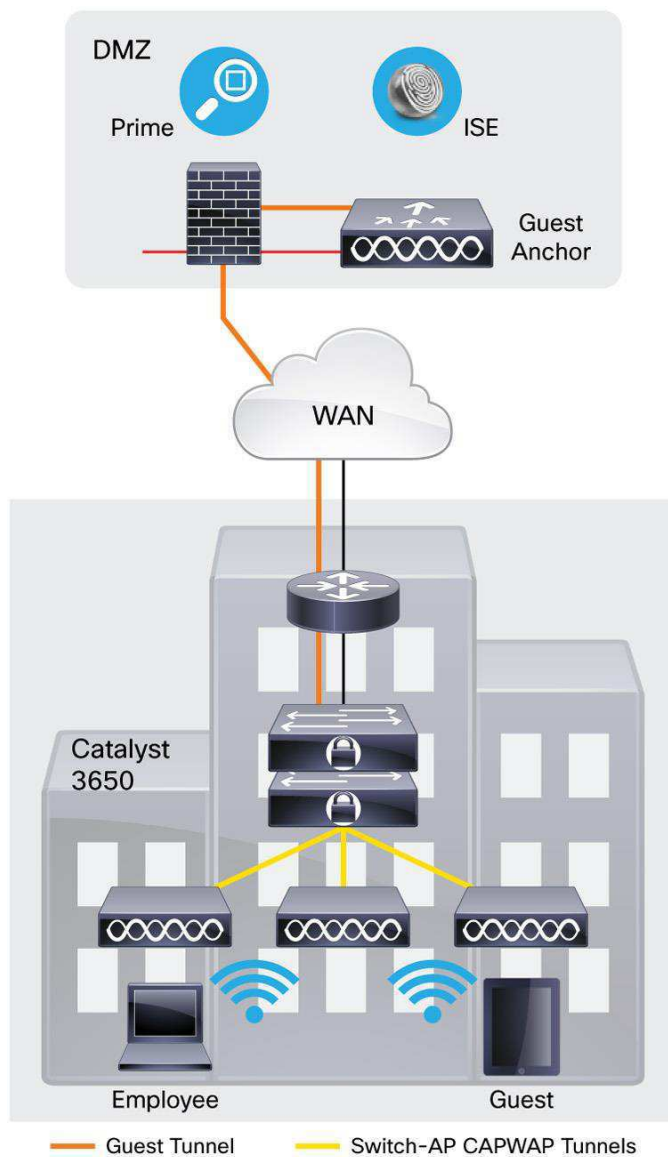
Cisco Catalyst 3650 Series Specifications
Switch Performance

Table 7 shows Cisco Catalyst 3650 Series Switches performance specifications.

Table 7.   Cisco Catalyst 3650 Performance Specifications

Performance Numbers for All Switch Models	
Switching capacity	176 Gbps on 48-port models (non-multigigabit models)
	92 Gbps on 24-port models (non-multigigabit models)
	254 Gbps on 24-port Multigigabit models with 2x10G uplink
	272 Gbps on 24-port Multigigabit models with 4x10G uplink
	392 Gbps on 48-port Multigigabit models with 4x10G uplink
	472 Gbps on 48-port Multigigabit models with 8x10G uplink
	472 Gbps on 48-port Multigigabit models with 2x40G uplink

Performance Numbers for All Switch Models	
Stacking bandwidth	160 Gbps
Total number of MAC addresses	32,000
Total number of IPv4 routes (ARP plus learned routes)	24,000
FNF entries	48,000 flow on 48-port models 24,000 flows on 24-port models
DRAM	4 GB
Flash	2 GB (non-Multigigabit models) and 4GB (Multigigabit models)
VLAN IDs	4,094
Total switched virtual interfaces (SVIs)	1,000
Jumbo frame	9198 bytes
Total routed ports per 3650 stack	208
Wireless	
Number of access points per switch/stack	25
Number of wireless clients per switch/stack	1000
Total number of WLANs per switch	64
Wireless bandwidth per switch	Up to 40 Gbps on 48-port models Up to 20 Gbps on 24-port models
Supported Aironet access point series	3700, 3600, 3500, 2600, 1600, 1260, 1140, 1040
Forwarding Rate of Switch Models	
Model	**Forwarding Rate**
4 x 1 Gigabit Ethernet Uplink-Models	
3650-24TS	41.66 Mpps
3650-24PS	
3650-48TS	77.37 Mpps
3650-48PS	
3650-48FS	
2 x 10 Gigabit Ethernet Uplink-Models	
3650-24TD **3650-24PD** **3650-24PDM**	68.45 Mpps
3650-48TD **3650-48PD** **3650-48FD**	104.16 Mpps
3650-8X24PD	172.61 Mpps
3650-12X48FD	261.90 Mpps
4 x 10 Gigabit Ethernet Uplink-Models	
3650-48TQ **3650-48PQ** **3650-48FQ** **3650-48FQM**	130.95 Mpps
3650-8X24UQ	202.38 Mpps
3650-12X48UQ	291.66 Mpps
8 x 10 Gigabit Ethernet Uplink-Models	
3650-12X48UR	351.19 Mpps
2 x 40 QSFP+ Uplink-Models	
3650-12X48UZ	351.19 Mpps

Dimensions, Weight, Acoustic, Mean Time between Failures, and Environmental Range Specifications for Cisco Catalyst 3650 Series Switches

Table 8 shows dimensions, weight, acoustic, mean time between failure (MTBF), and environmental range. Weight includes the chassis assembly as it is shipped: three fans, two StackWise adapters, and one power supply blank. The weight also includes the default power supply that is shipped with the unit.

Table 8. Dimensions, Weight, Acoustic, MTBF, and Environmental Range

Dimensions (H x W x D)	Inches	Centimeters
WS-C3650-24T WS-C3650-24P WS-C3650-48T WS-C3650-48P	1.73 x 17.5 x 17.625	4.4 x 44.5 x 44.8
WS-C3650-8X24PD		
WS-C3650-48F WS-C3650-8X24UQ WS-C3650-12X48UQ WS-C3650-12X48UR WS-C3650-12X48UZ	1.73 x 17.5 x 19.125	4.4 x 44.5 x 48.6
WS-C3650-12X48FD		
WS-C3650-24PDM WS-C3650-48FQM	1.73 x 17.5 x 11.625	4.4 x 44.5 x 29.6
Weight	**Pounds**	**Kilograms**
WS-C3650-24T	15.15	6.87
WS-C3650-24P	16.00	7.26
WS-C3650-24PDM	12.26	5.56
WS-C3650-8X24PD	16.60	7.53
WS-C3650-8X24UQ	16.71	7.58
WS-C3650-48T	15.90	7.21
WS-C3650-48P	16.75	7.60
WS-C3650-48F	17.20	7.80
WS-C3650-12X48FD	17.75	8.05
WS-C3650-12X48UQ	17.75	8.05
WS-C3650-12X48UR	17.80	8.08
WS-C3650-12X48UZ	17.80	8.08
WS-C3650-48FQM	12.65	5.74
STACK-T2-BLANK	0.1	0.05
C3650-STACK-KIT	0.25	0.11
MTBF Hours		
WS-C3650-24T	661,800	
WS-C3650-24P	528,280	
WS-C3650-8X24PD	335,930	
WS-C3650-8X24UQ	233,780	
WS-C3650-24PDM (with power supply)	304,860	
WS-C3650-48T	527,580	
WS-C3650-48P	383,760	
WS-C3650-48F	383,760	

Dimensions (H x W x D)	Inches	Centimeters
WS-C3650-12X48FD	227,490	
WS-C3650-12X48UQ	203,130	
WS-C3650-12X48UR	201,680	
WS-C3650-12X48UZ	203,190	
WS-C3650-48FQM (with power supply)	272,260	
PWR-C2-250WAC	751,642	
PWR-C2-640WAC	693,692	
PWR-C2-1025WAC	570,259	
PWR-C2-640WDC	706,759	
PWR-C1-715WAC	664,055	
PWR-C1-1100WAC	392,174	
FAN-T1	16,661,470	
Environmental Ranges		
With AC Power Supply **Operating Environment and Altitude**	Normal operating temperature[*] and altitudes: -5ºC to +45ºC, up to 5000 feet (1500m) -5ºC to +40ºC, up to 10,000 feet (3000m) -5ºC to +35ºC, up to 13,000 feet (4000m) -5ºC to +30ºC, up to 16,400 feet (5000m) [*] Minimum ambient temperature for cold start is 32°F (0°C).	
	Short-term[*] exceptional conditions: -5ºC to +50ºC, up to 5000 feet (1500m) -5ºC to +45ºC, up to 10,000 feet (3000m) -5ºC to +40ºC, up to 13,000 feet (4000m) -5ºC to +35ºC, up to 16,400 feet (5000m) -5ºC to +45ºC, at sea level with single fan failure [*] Not more than following in one-year period: 96 consecutive hours, or 360 hours total, or 15 occurrences.	
With AC Power Supply **Operating Environment and Altitude for WS-C3650-24PDM and WS-C3650-48FQM**	Normal operating temperature[*] and altitudes: -5ºC to +45ºC, up to 5000 feet (1500m) -5ºC to +45ºC, up to 10,000 feet (3000m) [*] Minimum ambient temperature for cold start is 32°F (0°C).	
	Short-term[*] exceptional conditions: -5ºC to +50ºC, up to 5000 feet (1500m) -5ºC to +50ºC, up to 10,000 feet (3000m) [*] Not more than following in one-year period: 96 consecutive hours, or 360 hours total, or 15 occurrences.	
With DC Power Supply **Operating Environment and Altitude (NEBS)**	Normal operating temperature and altitudes: -5ºC to +45ºC, up to 6000 feet (1800m) -5ºC to +40ºC, up to 10,000 feet (3000m) -5ºC to +35ºC, up to 13,000 feet (4000m) -5ºC to +30ºC, up to 16,400 feet (5000m)	
	Short-term[*] exceptional conditions: -5ºC to +55ºC, up to 6000 feet (1800m) -5ºC to +50ºC, up to 10,000 feet (3000m) -5ºC to +45ºC, up to 13,000 feet (4000m) -5ºC to +40ºC, up to 16,400 feet (5000m) -5ºC to +45ºC, at sea level with single fan failure [*] Not more than following in one-year period: 96 consecutive hours, or 360 hours total, or 15 occurrences.	
Relative Humidity	5% to 96%, noncondensing	

Dimensions (H x W x D)	Inches	Centimeters
Acoustic Noise **Measured Per ISO 7779 and Declared Per ISO 9296** **Bystander Positions Operating to an Ambient Temperature of 25°C**	With AC or DC power supply (with 16 PoE+ ports loaded): LpA: 45dB typical, 48dB maximum 42dB typical, 45dB maximum for WS-C3650-24PDM and WS-C3650-48FQM LwA: 5.5B typical, 5.8B maximum 5.3B typical, 5.6B maximum for WS-C3650-24PDM and WS-C3650-48FQM Typical: Noise emission for a typical configuration Maximum: Statistical maximum to account for variation in production	
Storage Environment	Temperature: -40 to 158º F (-40 to 70º C) Altitude: 16,400 ft (5,000 m)	
Vibration	Operating: 0.41Grms from 3 to 500Hz with spectral break points of 0.0005 G2/Hz at 10Hz and 200Hz 5dB/octave roll off at each end. Nonoperating: 1.12Grms from 3 to 500Hz with spectral break points of 0.0065 G2/Hz at 10Hz and 100Hz 5dB/octave roll off at each end.	
Shock	Operating: 30G, 2ms half sine Nonoperating: 55G, 10ms trapezoid	

Connectors for Cisco Catalyst 3650 Series

Table 9 shows connectors.

Table 9.   Connectors

Connectors and cabling	• 1000BASE-T ports: RJ-45 connectors, 4-pair Cat-5E UTP cabling • 1000BASE-T SFP-based ports: RJ-45 connectors, 4-pair Cat-5E UTP cabling • 100BASE-FX, 1000BASE-SX, -LX/LH, -ZX, -BX10, DWDM and CWDM SFP transceivers: LC fiber connectors (single-mode or multimode fiber) • 10GBASE-SR, LR, LRM, CX1 (v02 or higher) SFP+ transceivers: LC fiber connectors (single-mode or multimode fiber) • Cisco StackWise-160 stacking ports: copper-based Cisco StackWise cabling • Ethernet management port: RJ-45 connectors, 4-pair Cat-5 UTP cabling • Management console port: RJ-45-to-DB9 cable for PC connections
Power connectors	• Customers can provide power to a switch by using the internal power. The connectors are located at the back of the switch • Internal power supply connector: The internal power supply is an auto-ranging unit. The internal power supply supports input voltages between 100 and 240VAC. Use the supplied AC power cord to connect the AC power connector to an AC power outlet

Management and Standards Support for Cisco Catalyst 3650 Series Switches

Table 10 shows management and standards support for the Cisco Catalyst 3650 Series.

Table 10. Management and Standards Support for the Cisco Catalyst 3650 Series

Description	Specification	
Management	BRIDGE-MIB	CISCO-SNMP-TARGET-EXT-MIB
	CISCO-AUTH-FRAMEWORK-MIB	CISCO-STACKMAKER-MIB
	CISCO-BGP4-MIB, BGP4-MIB	CISCO-MEMORY-POOL-MIB
	CISCO-BRIDGE-EXT-MIB	CISCO-STP-EXTENSIONS-MIB
	CISCO-BULK-FILE-MIB	CISCO-SYSLOG-MIB
	CISCO-CABLE-DIAG-MIB	CISCO-TCP-MIB
	CISCO-CALLHOME-MIB	CISCO-UDLDP-MIB
	CISCO-CEF-MIB	CISCO-VLAN-IFTABLE-RELATIONSHIP-MIB
	CISCO-CIRCUIT-INTERFACE-MIB	CISCO-VLAN-MEMBERSHIP-MIB
	CISCO-ENTITY-VENDORTYPE-OID-MIB	CISCO-VTP-MIB
	CISCO-CONTEXT-MAPPING-MIB	EtherLike-MIB
	CISCO-DEVICE-LOCATION-MIB	HC-RMON-MIB
	CISCO-DHCP-SNOOPING-MIB	IEEE8021-PAE-MIB
	CISCO-EIGRP-MIB	IEEE8023-LAG-MIB
	CISCO-EMBEDDED-EVENT-MGR-MIB	IF-MIB
	CISCO-ENTITY-FRU-CONTROL-MIB	IGMP-MIB
	CISCO-ENTITY-SENSOR-MIB	IGMP-STD-MIB
	ENTITY-MIB	IP-FORWARD-MIB
	CISCO-ERR-DISABLE-MIB	IP-MIB
	CISCO-CONFIG-COPY-MIB	IPMROUTE-STD-MIB
	CISCO-FLOW-MONITOR-MIB	LLDP-EXT-MED-MIB
	CISCO-FTP-CLIENT-MIB	LLDP-MIB
	CISCO-HSRP-EXT-MIB	NOTIFICATION-LOG-MIB
	CISCO-HSRP-MIB	OLD-CISCO-MEMORY-MIB
	CISCO-IETF-ISIS-MIB	CISCO-CDP-MIB
	CISCO-IF-EXTENSION-MIB	POWER-ETHERNET-MIB
	CISCO-IGMP-FILTER-MIB	RMON2-MIB
	CISCO-CONFIG-MAN-MIB	RMON-MIB
	CISCO-IP-CBR-METRICS-MIB	SNMP-COMMUNITY-MIB
	CISCO-IPMROUTE-MIB	SNMP-FRAMEWORK-MIB
	CISCO-IP-STAT-MIB	SNMP-MPD-MIB
	CISCO-IP-URPF-MIB	SNMP-NOTIFICATION-MIB
	CISCO-L2L3-INTERFACE-CONFIG-MIB	SNMP-PROXY-MIB
	CISCO-LAG-MIB	SNMP-TARGET-MIB
	CISCO-LICENSE-MGMT-MIB	SNMP-USM-MIB
	CISCO-MAC-AUTH-BYPASS-MIB	SNMPv2-MIB
	CISCO-MAC-NOTIFICATION-MIB	SNMP-VIEW-BASED-ACM-MIB
	CISCO-MDI-METRICS-MIB	TCP-MIB
	CISCO-FLASH-MIB	UDP-MIB
	CISCO-OSPF-MIB	CISCO-IMAGE-MIB
	CISCO-OSPF-TRAP-MIB	CISCO-STACKWISE-MIB
	CISCO-PAE-MIB	AIRESPMACE-WIRELESS-MIB
	CISCO-PAGP-MIB	CISCO-LWAPP-IDS-MIB
	CISCO-PIM-MIB	CISCO-LWAPP-AP-MIB
	CISCO-PING-MIB	CISCO-LWAPP-CCX-RM-MIB
	CISCO-PORT-QOS-MIB	CISCO-LWAPP-CLIENT-ROAMING-MIB
	CISCO-PORT-SECURITY-MIB	CISCO-LWAPP-DOT11-CCX-CLIENT-DIAG-MIB
	CISCO-PORT-STORM-CONTROL-MIB	CISCO-LWAPP-DOT11-CCX-CLIENT-MIB
	CISCO-POWER-ETHERNET-EXT-MIB	CISCO-LWAPP-DOT11-CLIENT-CCX-REPORTS-MIB

Description	Specification	
	CISCO-PRIVATE-VLAN-MIB CISCO-PROCESS-MIB CISCO-PRODUCTS-MIB CISCO-RF-MIB CISCO-RTP-METRICS-MIB CISCO-RTTMON-MIB CISCO-SMART-INSTALL-MIB	CISCO-LWAPP-DOT11-CLIENT-MIB CISCO-LWAPP-DOT11-MIB CISCO-LWAPP-DOWNLOAD-MIB CISCO-LWAPP-LINKTEST-MIB CISCO-LWAPP-MFP-MIB CISCO-LWAPP-MOBILITY-EXT-MIB CISCO-LWAPP-QOS-MIB CISCO-LWAPP-REAP-MIB CISCO-LWAPP-ROGUE-MIB CISCO-LWAPP-RRM-MIB CISCO-LWAPP-SI-MIB CISCO-LWAPP-TSM-MIB CISCO-LWAPP-WLAN-MIB CISCO-LWAPP-WLAN-SECURITY-MIB
Standards	IEEE 802.1as IEEE 802.1s IEEE 802.1w IEEE 802.11 IEEE 802.1x IEEE 802.1x-Rev IEEE 802.3ad IEEE 802.3af IEEE 802.3at IEEE 802.3bz IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports IEEE 802.1D Spanning Tree Protocol IEEE 802.1p CoS prioritization IEEE 802.1Qat Stream Reservation Protocol IEEE 802.1Qav IEEE 802.1Q VLAN IEEE 802.3 10BASE-T specification IEEE 802.3u 100BASE-TX specification IEEE 802.3ab 1000BASE-T specification IEEE 802.3z 1000BASE-X specification	RMON I and II standards SNMPv1, SNMPv2c, and SNMPv3

Power Supply Specifications

Table 11 lists the power specifications for the Cisco Catalyst 3650 Series based on the kind of power supply used.

Table 11.   Power Specifications for Cisco Catalyst 3650 Series

Description	Specification				
	PWR-C2-1025 WAC	**PWR-C2-640 WAC**	**PWR-C2-250 WAC**	**PWR-C2-640 WDC**	**WS-C3650-24PDM/WS-C3650-48FQM Switches**
Power Supply Rated Maximum	1025W	640W	250W	640W	975W
Total Output BTU (Note: 1000 BTU per hr = 293 W)	3497 BTU/hr, 1025W	2183 BTU/hr, 640W	853 BTU/hr, 250W	2188 BTU/hr, 640W	3326.8 BTU/hr, 975W
Input-Voltage Range and Frequency **(Note: ±10% of "Input-Voltage Range")**	115-240VAC, 50-60 Hz	100-240VAC, 50-60 Hz	100-240VAC, 50-60 Hz	-36VDC to -72VDC	100-240VAC, 50-60 Hz
Input Current	12-6A	8-4A	4-2A	21 - 10.5 A	12-5A

Description	Specification				
	PWR-C2-1025 WAC	PWR-C2-640 WAC	PWR-C2-250 WAC	PWR-C2-640 WDC	WS-C3650-24PDM/WS-C3650-48FQM Switches
Output Ratings	12V @ 20.83A -54V @ 14.6A	12V @ 20.83A -54V @ 7.36A	12V @ 20.83A	12V @ 20.83A -54V @ 7.36A	12V @ 16.66A -54V @ 14.3A
Output Holdup Time	10 ms minimum @ 102.5VAC	16.7 ms minimum @ 100VAC	16.7 ms minimum @ 100VAC	> 2ms@-48VDC	20 ms minimum @ 100VAC
Power-Supply Input Receptacles	IEC 320-C16 (IEC60320-C16)	IEC 320-C16 (IEC60320-C16)	IEC 320-C13 (IEC60320-C13)	Terminal strip	IEC 320-C16 (IEC60320-C16)
Power Cord Rating	13A	13A	10A	20A @ 100VDC	15A
Physical Specifications	(H x W x D): 1.58 X 3.75 X 13.25 in (4.0 x 9.5 x 33.7 cm) Weight: 3.55 lb (1.61 kg)	(H x W x D): 1.58 X 3.75 X 11.75 in (4.0 x 9.5 x 29.8 cm) Weight: 3.1 lb (1.41 kg)	(H x W x D): 1.58 X 3.75 X 11.75 in (4.0 x 9.5 x 29.8 cm) Weight: 2.55 lb (1.16 kg)	(H x W x D): 1.58 X 3.75 X 11.75 in (4.0 x 9.5 x 29.8 cm) Weight: 2.75 lb (1.25 kg)	N/A
Operating Temperature	For the operating temperature ranges at various altitudes of AC and DC power supply module powered switches, see Table 1.				
Storage Temperature	-40 to 158°F (-40 to 70°C)				
Relative Humidity Operating and Nonoperating Noncondensing	5 to 96% noncondensing				5 to 95% noncondensing
Altitude	16,400 ft. (5,000 meters)				10,000 ft. (3,000 meters)
MTBF	Calculated MTBF must be greater than 300,000 using Telcordia SR-332, Method 1, Issue 3. Demonstrated MTBF is 500,000 hr (with 90% confidence level).				
EMI and EMC Compliance	"AC OK": Input power to the power supply is OK "PS OK": Output power from the power supply is OK				
Safety Compliance	For the operating temperature ranges at various altitudes of AC and DC power supply module powered switches, see Table 1.				
LED Indicators	-40 to 158°F (-40 to 70°C)				N/A

Description	Specification	
	PWR-C1-1100WAC	PWR-C1-715WAC
Power supply rated maximum	1100W	715W
Total output BTU (Note: 1000 BTU/hr = 293W)	3793 BTU/hr, 1100W	2465 BTU/hr, 715W
Input-voltage range and frequency	115-240VAC, 50-60 Hz	100-240VAC, 50-60 Hz
Input current	12-6A	10-5A
Output ratings	-56V at 19.64A	-56V at 12.8A
Output holdup time	10 ms minimum at 102.5VAC	16.7 ms minimum at 100VAC
Power-supply input receptacles	IEC 320-C16 (IEC60320-C16)	IEC 320-C16 (IEC60320-C16)
Power cord rating	13A	13A
Physical specifications	(H x W x D): 1.58 X 3.25 X 13.7 in Weight: 3 lb (1.4 kg)	(H x W x D): 1.58 X 3.25 X 12.20 in Weight: 2.8 lb (1.3 kg)

Description	Specification	
	PWR-C1-1100WAC	**PWR-C1-715WAC**
Operating temperature	23 to 113°F (-5 to 45°C)	
Storage temperature	-40 to 158°F (-40 to 70°C)	
Relative humidity operating and nonoperating noncondensing	5 to 90% noncondensing	
Altitude	10,000 ft. (3000 meters), up to 45°C	
MTBF	Calculated MTBF must be greater than 300,000 using Telcordia SR-332, Method 1, Case 3. Demonstrated MTBF is 500,000 hr (with 90% confidence level).	
EMI and EMC compliance	FCC Part 15 (CFR 47) Class A ICES-003 Class A EN 55022 Class A CISPR 22 Class A AS/NZS 3548 Class A BSMI Class A (AC input models only) VCCI Class A EN 55024, EN300386, EN 50082-1, EN 61000-3-2, EN 61000-3-3 EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN 61000-6-1	
Safety compliance	UL 60950-1, CAN/CSA-C22.2 No. 60950-1, EN 60950-1, IEC 60950-1, CCC, CE Marking	
LED indicators	"AC OK": Input power to the power supply is OK "PS OK": Output power from the power supply is OK	

Power Consumption of Standalone Cisco Catalyst 3650 Series Switches

Table 12 shows power consumption of standalone Cisco Catalyst 3650 Series Switches based on Alliance for Telecommunications Industry Solutions (ATIS) testing using IMIX distribution stream traffic, with input voltage of 115VAC @ 60 Hz, Energy Efficient Ethernet (EEE) enabled, and no PoE loading. The values given are the maximum possible power consumption numbers under the respective test scenarios.

Table 12. Power Consumptions (in Watts) of Standalone Cisco Catalyst 3650 Series

Model	Fixed Uplink	Power Consumption (Watts) (No More Than)			
		0% Traffic	10% Traffic	100% Traffic	Weighted Average
WS-C3650-24TS	4 x Gigabit Ethernet with Small Form-Factor Pluggable (SFP)	43.9	56.4	57.1	55.21
WS-C3650-48TS		61.1	85.1	86.4	82.85
WS-C3650-24PS		53.8	65.3	65.9	64.18
WS-C3650-48PS		81.4	98.7	99.5	97.09
WS-C3650-48FS		90.8	108.7	109.4	106.98
WS-C3650-24TD	2 x 10 Gigabit Ethernet with SFP+ and 2 x 10 Gigabit Ethernet with SFP+ or 4 x Gigabit Ethernet with SFP	54.0	60.8	63.0	60.35
WS-C3650-48TD		73.3	90.9	93.9	89.40
WS-C3650-24PD		61.1	68.3	70.1	67.75
WS-C3650-24PDM		63.8	72.3	76.2	71.9
WS-C3650-48PD		80.3	99.1	101.5	97.45
WS-C3650-48FD		88.8	106.5	109.4	105.03
WS-C3650-8X24PD		103	107.8	111.5	107.7
WS-C3650-12X48FD		158.7	168.6	172.7	168

Model	Fixed Uplink	Power Consumption (Watts) (No More Than)			
		0% Traffic	10% Traffic	100% Traffic	Weighted Average
WS-C3650-48TQ	4 x 10 Gigabit Ethernet with SFP+ or 4 x Gigabit Ethernet with SFP	73.0	91.9	96.7	90.47
WS-C3650-48PQ		86.4	103.4	107.4	102.10
WS-C3650-48FQ		96.6	116.2	120.5	114.69
WS-C3650-48FQM		74.1	89.2	95.8	88.4
WS-C3650-8X24UQ		110.0	115.3	123.3	115.6
WS-C3650-12X48UQ		170.4	179.9	186.6	179.7
WS-C3650-12X48UR	8 x 10 Gigabit Ethernet with SFP+ or 8 x Gigabit Ethernet with SFP	174.5	184.9	195.7	184.9
WS-C3650-12X48UZ	2 x 40 Gigabit Ethernet with Quad Small Form-Factor Pluggable+ (QSFP+)	162.4	173.7	184.0	173.6

Safety and Compliance

Table 13 lists the safety and compliance information for the Cisco Catalyst 3650 Series.

Table 13.　Safety and Compliance Information for Cisco Catalyst 3650 Series

Description	Specification
Safety Certifications	UL 60950-1 Second Edition CAN/CSA-C22.2 No. 60950-1 Second Edition EN 60950-1 Second Edition IEC 60950-1 Second Edition GOST NOM (obtained by partners and distributors)
Electromagnetic Emissions Certifications	47CFR Part 15 (CFR 47) Class A (FCC Part 15 Class A) AS/NZS CISPR22 Class A CISPR22 Class A EN55022 Class A ICES003 Class A VCCI Class A EN61000-3-2 EN61000-3-3 KN22 Class A KCC CNS13438 Class A EN55024 CISPR24 KN24
Environmental	Reduction of Hazardous Substances (ROHS) 5
Noise Specifications	Office Product Spec: 48dBA at 25°C (refer to ISO 7779)
Telco	Common Language Equipment Identifier (CLEI) Code

Cisco Enhanced Limited Lifetime Hardware Warranty

The Cisco Catalyst 3650 Series Switches come with an E-LLW that includes NBD delivery of replacement hardware where available and 90 days of 8x5 Cisco TAC support.

Your formal warranty statement, including the warranty applicable to Cisco software, appears in the Cisco information packet that accompanies your Cisco product. We encourage you to review carefully the warranty statement shipped with your specific product before use.

Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

For further information on warranty terms, visit http://www.cisco.com/go/warranty. Table 14 provides information about the E-LLW.

Table 14.   E-LLW Details

	Cisco E-LLW
Device Covered	Applies to Cisco Catalyst 3650 Series Switches.
Warranty Duration	As long as the original customer owns the product.
EoL Policy	In the event of discontinuance of product manufacture, Cisco warranty support is limited to 5 years from the announcement of discontinuance.
Hardware Replacement	Cisco or its service center will use commercially reasonable efforts to ship a replacement for NBD delivery, where available. Otherwise, a replacement will be shipped within 10 working days after receipt of the RMA request. Actual delivery times might vary depending on customer location.
Effective Date	Hardware warranty commences from the date of shipment to customer (and in case of resale by a Cisco reseller, not more than 90 days after original shipment by Cisco).
TAC Support	Cisco will provide during business hours, 8 hours per day, 5 days per week basic configuration, diagnosis, and troubleshooting of device-level problems for up to a 90-day period from the date of shipment of the originally purchased Cisco Catalyst 3650 product. This support does not include solution or network-level support beyond the specific device under consideration.
Cisco.com Access	Warranty allows guest access only to Cisco.com.

Licensing for Cisco Catalyst 3650 Series Switches

The three feature sets available with all Cisco Catalyst 3650 Series Switches are:

- LAN Base: Enterprise access layer 2 switching features
- IP Base: Enterprise access layer 3 switching features
- IP Services: Advanced enterprise layer 3 switching (IPv4 and IPv6) features

The LAN Base feature set offers enhanced intelligent services that include comprehensive Layer 2 features, with up to 255 VLANs. The IP Base feature set provides entry-level enterprise services in addition to all LAN Base features, with 4094 VLANs. IP Base also includes the support for wireless controller functionality (mobility agent and mobility controller role; additional access point license required for mobility controller role), routed access, smart operations, FNF, and so on. The IP Services feature set provides full enterprise services that include advanced Layer 3 features such as EIGRP, OSPF, BGP, PIM, and IPv6 routing such as OSPFv3 and EIGRPv6. All software feature sets support advanced security and MQC-based QoS.

The Cisco Catalyst 3650 Series Switches with LAN Base feature set can only stack with other Cisco Catalyst 3650 Series LAN Base switches. The same applies to IP Base and IP Services as well. A mixed stack of LAN Base switch with IP Base or IP Services feature set is not supported.

Customers can transparently upgrade the software feature set in the Cisco Catalyst 3650 Series Switches through Cisco IOS Software CLI using the right to use (RTU)-based software upgrade process. Software activation enables the Cisco IOS Software feature sets. Based on the license's type, Cisco IOS Software activates the appropriate feature set. License types can be changed, or upgraded, to activate a different feature set.

Access Point License for Cisco Catalyst 3650

An access point license is required for Cisco Catalyst 3650 operating in mobility controller mode. No access point license is required for 3650 operating in mobility agent mode. This functionality is included in the IP Base feature set. Other devices that can act as mobility controller are the WLC 5760, WLC 5508, and WiSM2 wireless controllers. Access point licenses can be transferred only between two 3650 switches or between 3650 and 5760 controller and vice versa.

Software Policy for Cisco Catalyst 3650 Series Switches

Customers with Cisco Catalyst LAN Base and IP Base software feature sets will be provided with maintenance updates and bug fixes designed to maintain the compliance of the software with published specifications, release notes, and industry standards compliance as long as the original end user continues to own or use the product or up to one year from the end-of-sale date for this product, whichever occurs earlier. Customers with licenses for our IP Services software images require a service support contract such as Cisco Smart Net Total Care™ Service to download updates. This policy supersedes any previous warranty or software statement and is subject to change without notice.

Cisco and Partner Services for Next-Generation Cisco Catalyst Fixed Switches

Enable the innovative, secure, intelligent edge in the Borderless Network Architecture using personalized services from Cisco and our partners. Through a discovery process that begins with understanding your business objectives, we help you integrate the next-generation Cisco Catalyst fixed switches into your architecture and incorporate network services onto that platform. Sharing knowledge and leading practices, we support your success every step of the way as you deploy, absorb, manage, and scale new technology. Choose from a flexible suite of support services designed to meet your business needs and help you maintain high-quality network performance while controlling operational costs. (See Table 15.)

Table 15. Technical Services Available for Cisco Catalyst 3650 Switches

Technical Services
Cisco Smart Net Total Care Service • Around-the-clock, global access to the Cisco TAC • Unrestricted access to the extensive Cisco.com knowledge base and tools • Next-business-day, 8x5x4, 24x7x4, and 24x7x2 advance hardware replacement and onsite parts replacement and installation available • Ongoing operating system software updates within the licensed feature set • Proactive diagnostics and real-time alerts on Smart Call Home-enabled devices
Cisco Smart Foundation Service • NBD advance hardware replacement as available • Business hours access to SMB TAC (access levels vary by region) • Access to Cisco.com SMB knowledge base • Online technical resources through Smart Foundation Portal • Operating system software bug fixes and patches
Cisco SP Base Service • Around-the-clock, global access to the Cisco TAC • Registered access to Cisco.com • NBD, 8x5x4, 24x7x4, and 24x7x2 advance hardware replacement; return to factory option available[2] • Ongoing operating system software updates[1]

Cisco Focused Technical Support Services
• Three levels of premium, high-touch services are available:
  ◦ Cisco High-Touch Operations Management Service
  ◦ Cisco High-Touch Technical Support Service
  ◦ Cisco High-Touch Engineering Service
• Valid Cisco Smart Net Total Care or SP Base contracts on all network equipment are required

Notes:

[1] Cisco operating system updates include the following: maintenance releases, minor updates, and major updates within the licensed feature set.

[2] Advance hardware replacement is available in various service-level combinations. For example, 8x5xNBD indicates that shipment will be initiated during the standard 8-hour business day, 5 days a week (the generally accepted business days within the relevant region), with NBD delivery. Where NBD is not available, same day ship is provided. Restrictions apply; for details, review the appropriate service descriptions.

Ordering Information

Table 16 lists ordering information for the Cisco Catalyst 3650 Series. To place an order, visit the Cisco Ordering homepage at http://www.cisco.com/en/US/ordering/or13/or8/order_customer_help_how_to_order_listing.html.

Table 16.   Cisco Catalyst 3650 Series Ordering Information

Product Number	Product Description
Cisco Catalyst 3650 4x1G Uplink Series	
WS-C3650-24TS-L	Standalone with Optional Stacking 24 10/100/1000 Ethernet and 4x1G Uplink ports, with 250WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48TS-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 4x1G Uplink ports, with 250WAC power supply, 1 RU, LAN Base feature set
WS-C3650-24PS-L	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 640WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48PS-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 640WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48FS-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 1025WAC power supply, 1 RU, LAN Base feature set
WS-C3650-24TS-S	Standalone with Optional Stacking 24 10/100/1000 Ethernet and 4x1G Uplink ports, with 250WAC power supply, 1 RU, IP Base feature set
WS-C3650-48TS-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 4x1G Uplink ports, with 250WAC power supply, 1 RU, IP Base feature set
WS-C3650-24PS-S	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 640WAC power supply, 1 RU, IP Base feature set
WS-C3650-48PS-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 640WAC power supply, 1 RU, IP Base feature set
WS-C3650-48FS-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 1025WAC power supply, 1 RU, IP Base feature set
WS-C3650-24TS-E	Standalone with Optional Stacking 24 10/100/1000 Ethernet and 4x1G Uplink ports, with 250WAC power supply, 1 RU, IP Services feature set
WS-C3650-48TS-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 4x1G Uplink ports, with 250WAC power supply, 1 RU, IP Services feature set
WS-C3650-24PS-E	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 640WAC power supply, 1 RU, IP Services feature set
WS-C3650-48PS-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 640WAC power supply, 1 RU, IP Services feature set
WS-C3650-48FS-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x1G Uplink ports, with 1025WAC power supply, 1 RU, IP Services feature set
Cisco Catalyst 3650 2x10G and 2x1G Uplink Series	
WS-C3650-24TD-L	Standalone with Optional Stacking 24 10/100/1000 Ethernet and 2x10G Uplink ports, with 250WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48TD-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 2x10G Uplink ports, with 250WAC power supply, 1 RU, LAN Base feature set
WS-C3650-24PD-L	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 640WAC power supply, 1 RU, LAN Base feature set

Product Number	Product Description
WS-C3650-24PDM-L	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with fixed 640WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48PD-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 640WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48FD-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 1025WAC power supply, 1 RU, LAN Base feature set
WS-C3650-24TD-S	Standalone with Optional Stacking 24 10/100/1000 Ethernet and 2x10G Uplink ports, with 250WAC power supply, 1 RU, IP Base feature set
WS-C3650-48TD-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 2x10G Uplink ports, with 250WAC power supply, 1 RU, IP Base feature set
WS-C3650-24PD-S	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 640WAC power supply, 1 RU, IP Base feature set
WS-C3650-24PDM-S	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with fixed 640WAC power supply, 1 RU, IP Base feature set
WS-C3650-48PD-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 640WAC power supply, 1 RU, IP Base feature set
WS-C3650-48FD-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 1025WAC power supply, 1 RU, IP Base feature set
WS-C3650-24TD-E	Standalone with Optional Stacking 24 10/100/1000 Ethernet and 2x10G Uplink ports, with 250WAC power supply, 1 RU, IP Services feature set
WS-C3650-48TD-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 2x10G Uplink ports, with 250WAC power supply, 1 RU, IP Services feature set
WS-C3650-24PD-E	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 640WAC power supply, 1 RU, IP Services feature set
WS-C3650-24PDM-E	Standalone with Optional Stacking 24 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with fixed 640WAC power supply, 1 RU, IP Services feature set
WS-C3650-48PD-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 640WAC power supply, 1 RU, IP Services feature set
WS-C3650-48FD-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 2x10G Uplink ports, with 1025WAC power supply, 1 RU, IP Services feature set
WS-C3650-8X24PD-L	Standalone with Optional Stacking 24 (16 10/100/1000 and 8 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x10G Uplink ports, with 715WAC power supply, 1 RU, LAN Base feature set
WS-C3650-8X24PD-S	Standalone with Optional Stacking 24 (16 10/100/1000 and 8 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x10G Uplink ports, with 715WAC power supply, 1 RU, IP Base feature set
WS-C3650-8X24PD-E	Standalone with Optional Stacking 24 (16 10/100/1000 and 8 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x10G Uplink ports, with 715WAC power supply, 1 RU, IP Services feature set
WS-C3650-12X48FD-L	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x10G Uplink ports, with 1100WAC power supply, 1 RU, LAN Base feature set
WS-C3650-12X48FD-S	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x10G Uplink ports, with 1100WAC power supply, 1 RU, IP Base feature set
WS-C3650-12X48FD-E	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x10G Uplink ports, with 1100WAC power supply, 1 RU, IP Services feature set
Cisco Catalyst 3650 4x10G Uplink Series	
WS-C3650-48TQ-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 4x10G Uplink ports, with 250WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48PQ-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with 640WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48FQ-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with 1025WAC power supply, 1 RU, LAN Base feature set
WS-C3650-48FQM-L	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with fixed 975WAC power supply, 1 RU, LAN Base feature set

Product Number	Product Description
WS-C3650-48TQ-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 4x10G Uplink ports, with 250WAC power supply, 1 RU, IP Base feature set
WS-C3650-48PQ-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with 640WAC power supply, 1 RU, IP Base feature set
WS-C3650-48FQ-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with 1025WAC power supply, 1 RU, IP Base feature set
WS-C3650-8X24UQ-L	Standalone with Optional Stacking 24 (16 10/100/1000 and 8 100Mbps/1/2.5/5/10 Gbps) Ethernet and 4x10G Uplink ports, with 1100WAC power supply, 1 RU, LAN Base feature set
WS-C3650-8X24UQ-S	Standalone with Optional Stacking 24 (16 10/100/1000 and 8 100Mbps/1/2.5/5/10 Gbps) Ethernet and 4x10G Uplink ports, with 1100WAC power supply, 1 RU, IP Base feature set
WS-C3650-8X24UQ-E	Standalone with Optional Stacking 24 (16 10/100/1000 and 8 100Mbps/1/2.5/5/10 Gbps) Ethernet and 4x10G Uplink ports, with 1100WAC power supply, 1 RU, IP Services feature set
WS-C3650-12X48UQ-L	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 4x10G Uplink ports, with 1100WAC power supply, 1 RU, LAN Base feature set
WS-C3650-12X48UQ-S	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 4x10G Uplink ports, with 1100WAC power supply, 1 RU, IP Base feature set
WS-C3650-12X48UQ-E	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 4x10G Uplink ports, with 1100WAC power supply, 1 RU, IP Services feature set
WS-C3650-48FQM-S	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with fixed 975WAC power supply, 1 RU, IP Base feature set
WS-C3650-48TQ-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet and 4x10G Uplink ports, with 250WAC power supply, 1 RU, IP Services feature set
WS-C3650-48PQ-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with 640WAC power supply, 1 RU, IP Services feature set
WS-C3650-48FQ-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with 1025WAC power supply, 1 RU, IP Services feature set
WS-C3650-48FQM-E	Standalone with Optional Stacking 48 10/100/1000 Ethernet PoE+ and 4x10G Uplink ports, with fixed 975WAC power supply, 1 RU, IP Services feature set
Cisco Catalyst 3650 8x10G Uplink Series	
WS-C3650-12X48UR-L	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 8x10G Uplink ports, with 1100WAC power supply, 1 RU, LAN Base feature set
WS-C3650-12X48UR-S	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 8x10G Uplink ports, with 1100WAC power supply, 1 RU, IP Base feature set
WS-C3650-12X48UR-E	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 8x10G Uplink ports, with 1100WAC power supply, 1 RU, IP Services feature set
Cisco Catalyst 3650 2x40G Uplink Series	
WS-C3650-12X48UZ-L	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x40G Uplink ports, with 1100WAC power supply, 1 RU, LAN Base feature set
WS-C3650-12X48UZ-S	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x40G Uplink ports, with 1100WAC power supply, 1 RU, IP Base feature set
WS-C3650-12X48UZ-E	Standalone with Optional Stacking 48 (36 10/100/1000 and 12 100Mbps/1/2.5/5/10 Gbps) Ethernet and 2x40G Uplink ports, with 1100WAC power supply, 1 RU, IP Services feature set
Cisco Catalyst 3650 Bundles	
WS-C3650-24PWS-S	Cisco Catalyst 3650 24 Port PoE 4x1G Uplink w/5 AP licenses IPB
WS-C3650-24PWD-S	Cisco Catalyst 3650 24 Port PoE 2x10G Uplink w/5 AP licenses IPB
WS-C3650-48FWS-S	Cisco Catalyst 3650 48 Port FPoE 4x1G Uplink w/5 AP licenses IPB
WS-C3650-48FWD-S	Cisco Catalyst 3650 48 Port FPoE 2x10G Uplink w/5 AP licenses IPB
WS-C3650-48FWQ-S	Cisco Catalyst 3650 48 Port FPoE 4x10G Uplink w/5 AP licenses IPB
WS-C3650-48PWD-S	Cisco Catalyst 3650 48 Port PoE 2x10G Uplink w/5 AP licenses IPB
WS-C3650-48PWS-S	Cisco Catalyst 3650 48 Port PoE 4x1G Uplink w/5 AP licenses IPB

Product Number	Product Description
Cisco Catalyst 3650 Series Spare StackWise-160 Module, Cables and Blank	
C3650-STACK-KIT=	Cisco Catalyst 3650 Stack Module spare
STACK-T2-50CM=	Cisco StackWise-160 50CM Stacking Cable Spare
STACK-T2-1M=	Cisco StackWise-160 1M Stacking Cable Spare
STACK-T2-3M=	Cisco StackWise-160 3M Stacking Cable Spare
STACK-T2-BLANK=	Cisco Catalyst 3650 Stacking Blank Spare
Cisco Catalyst 3650 Series RTU Feature License and Software Options	
C3650-RTU=	Paper SW License for Cisco Catalyst 3650 Switches
C3650-48-L-E	Cisco Catalyst 3650 48-port LAN Base to IP Services Paper RTU License
C3650-24-S-E	Cisco Catalyst 3650 24-port IP Base to IP Services Paper RTU License
C3650-24-L-S	Cisco Catalyst 3650 24-port LAN Base to IP Base Paper RTU License
C3650-48-L-S	Cisco Catalyst 3650 48-port LAN Base to IP Base Paper RTU License
C3650-24-L-E	Cisco Catalyst 3650 24-port LAN Base to IP Services Paper RTU License
C3650-48-S-E	Cisco Catalyst 3650 48-port IP Base to IP Services Paper RTU License
L-C3650-RTU=	Electronic SW License for Cisco Catalyst 3650 Switches
L-C3650-48-S-E	Cisco Catalyst 3650 48-port Switch IP Base to IP Services Electronic RTU License
L-C3650-48-L-S	Cisco Catalyst 3650 48-port Switch LAN Base to IP Base Electronic RTU License
L-C3650-48-L-E	Cisco Catalyst 3650 48-port Switch LAN Base to IP Services Electronic RTU License
L-C3650-24-L-S	Cisco Catalyst 3650 24-port Switch LAN Base to IP Base Electronic RTU License
L-C3650-24-S-E	Cisco Catalyst 3650 24-port Switch IP Base to IP Services Electronic RTU License
L-C3650-24-L-E	Cisco Catalyst 3650 24-port Switch LAN Base to IP Services Electronic RTU License
Access Point Licenses	
L-LIC-CT3650-UPG	Primary upgrade license SKU for Cisco 3650 wireless controller (e-delivery)
L-LIC-CTIOS-1A	1 access point adder license for Cisco IOS Software based wireless controller (e-delivery)
LIC-CT3650-UPG	Primary upgrade license SKU for Cisco 3650 wireless controller (paper license)
LIC-CTIOS-1A	1 access point adder license for the Cisco IOS Software based wireless controller (paper license)
Cisco Catalyst 3650 Series Spare Power Supplies and Fan	
PWR-C2-250WAC=	250 WAC power supply spare
PWR-C2-640WAC=	640 WAC power supply spare
PWR-C2-1025WAC=	1025 WAC power supply spare
PWR-C2-640WDC=	640 WDC power supply spare
PWR-C1-715WAC=	715WAC power supply spare
PWR-C1-1100WAC=	1100WAC power supply spare
PWR-C1-440WDC=	440WDC power supply spare
PWR-C2-BLANK=	Power supply blank spare
FAN-T1=	Fan module spare
Cisco Catalyst 3650 Series Spare Power Cords	
CAB-TA-NA=	AC power cord for Cisco Catalyst 3650 (North America)
CAB-TA-AP=	AC power cord for Cisco Catalyst 3650 (Australia)
CAB-TA-AR=	AC power cord for Cisco Catalyst 3650 (Argentina)
CAB-TA-SW=	AC power cord for Cisco Catalyst 3650 (Switzerland)
CAB-TA-UK=	AC power cord for Cisco Catalyst 3650 (United Kingdom)
CAB-TA-JP=	AC power cord for Cisco Catalyst 3650 (Japan)
CAB-TA-250V-JP=	Japan 250VAC power cord for Cisco Catalyst 3650 (Japan)

Product Number	Product Description
CAB-TA-EU=	AC power cord for Cisco Catalyst 3650 (Europe)
CAB-TA-IT=	AC power cord for Cisco Catalyst 3650 (Italy)
CAB-TA-IN=	AC power cord for Cisco Catalyst 3650 (India)
CAB-TA-CN=	AC power cord for Cisco Catalyst 3650 (China)
CAB-TA-DN=	AC power cord for Cisco Catalyst 3650 (Denmark)
CAB-TA-IS=	AC power cord for Cisco Catalyst 3650 (Israel)
CAB-C15-CBN=	Cabinet jumper power cord, 250 VAC 13A, C14-C15 connectors
CAB-C15-CBN-JP=	Japan Cabinet Jumper Power Cord, 250 VAC 13A, C14-C15
Cisco Catalyst 3650 Series Spare Accessory and Rack Mount Kits	
ACC-KIT-T1=	Accessory kit for Cisco Catalyst 3650 Series
RACK-KIT-T1=	Rack mount kit for Cisco Catalyst 3650 Series
4PT-KIT-T1=	Extension rails and brackets for four-point mounting for Cisco Catalyst 3650 Series

Optics Compatibility Information

The Cisco Catalyst 3650 Series supports a wide range of optics. Because the list of supported optics is updated on a regular basis, consult the tables available here for the latest SFP compatibility information:
http://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

Cisco Capital

Financing to Help You Achieve Your Objectives

Cisco Capital® financing can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.

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Cisco Catalyst 4500 Series Line Cards

High-Performance, Mobile, and Secure User Experience

Product Benefits

Cisco® Catalyst® 4500 Series Switches enable borderless unified wired and wireless networks, providing high-performance, mobile, and secure user experiences through Layer 2-4 switching. Enabling security, mobility, application performance, video, and energy savings over your network infrastructure, the Cisco Catalyst 4500 Switch supports resiliency, virtualization, and automation, further improving the ease of network use. Cisco Catalyst 4500 Series Switches provide borderless performance, scalability, and services with reduced total cost of ownership (TCO) and superior investment protection.

The Cisco Catalyst 4500 Switch delivers predictable and scalable high performance, with advanced dynamic quality of service (QoS) capabilities and configuration flexibility for deploying borderless networks. Integrated resiliency features in both hardware and software maximize network availability, helping to ensure workforce productivity, profitability, and customer success. Its centralized, innovative, and flexible system design helps ensure smooth migration to wire-speed IPv6 and 10 Gigabit Ethernet (GE). The forward and backward compatibility between generations of the Cisco Catalyst 4500 Series extends deployment life, providing exceptional investment protection, while reducing the (TCO).

The Cisco Catalyst 4500E Series is a high-performance, next-generation extension to the Cisco Catalyst 4500 Series. The new E-Series is composed of the Cisco Catalyst 4500E Series supervisor engines, E-Series line cards, and E-Series chassis, which are designed for a high-performance, mobile, and secure user experience with superior backward and forward compatibility, delivering exceptional investment protection for organizations of all sizes.

Cisco Catalyst 4500E Series and Classic Line Cards

The Cisco Catalyst 4500 Series offers two classes of line cards: classic and E-Series. Classic line cards provide 6 gigabits of switching capacity per slot. E-Series line cards provide increased switching capacity per slot. This increase in per-slot switching capacity with the E-Series line cards requires the Cisco Catalyst 4500E Series chassis and the Cisco Catalyst 4500E Series Supervisor. Two types of E-Series line cards are available based on the per-slot switching capacity. E-Series line cards numbered 47xx operate at 48 gigabits per slot, while E-Series line cards numbered 46xx operate at 24 gigabits per slot. Classic line cards may be deployed in both classic and E-Series chassis with either classic Cisco Catalyst 4500 Series supervisor engines or with the Cisco Catalyst 4500E Series Supervisor Engine. With the E-Series supervisor engine, the per-slot switching capacity for classic line cards remains at 6 gigabits per slot. However, because of the centralized switching architecture of the Cisco Catalyst 4500, the classic line cards will adopt all of the new E-Series supervisor engine features such as eight queues per port, dynamic QoS, and hardware-based IPv6 routing. For more feature details, refer to the E-Series supervisor engine data sheet. Classic line cards and E-Series line cards may be mixed and matched within a Cisco Catalyst 4500E Series chassis with no performance degradation: classic line cards will operate at 6 gigabits per slot, and E-Series line cards operate at either 48 gigabits per slot or 24 gigabits per slot based on whether they belong to the 47xx or 46xx family of line cards. Table 1 summarizes the chassis and supervisor support for both classic and E-Series line cards.

Table 1.   Cisco Catalyst 4500 Line-Card Support Options

Line-Card Type	Per-Slot Bandwidth	Chassis Support	Supervisor Support
Cisco Catalyst 4500 47xx E-Series Line Cards	48 Gbps	Cisco Catalyst 4503-E, 4506-E, 4507R+E, and 4510R+E	Supervisor Engine 8-E, Supervisor Engine 8L-E, Supervisor Engine 7-E, Supervisor Engine 7L-E
Cisco Catalyst 4500 47xx E-Series Line Cards **Note:** WS-X4712-SFP+E and WS-X4748-12X48U+E are not supported on 4507R-E and 4510R-E	24 Gbps	Cisco Catalyst 4507R-E and 4510R-E	Supervisor Engine 8-E, Supervisor Engine 7-E, Supervisor Engine 7L-E
Cisco Catalyst 4500 46xx E-Series Line Cards	24 Gbps	Cisco Catalyst 4503-E, 4506-E, 4507R-E, 4507R+E, 4510R-E, and 4510R+E[1]	Supervisor Engine 8-E, Supervisor Engine 8L-E, Supervisor Engine 7-E, Supervisor Engine 7L-E, Supervisor Engine 6-E, Supervisor Engine 6L-E
Cisco Catalyst 4500 Series Classic Line Cards	6 Gbps	Cisco Catalyst 4503, 4506, 4507R, and 4510R Switches Cisco Catalyst 4503-E, 4506-E, 4507R-E, 4507R+E, 4510R-E, and 4510R+E Switches	Supervisor Engine 8-E[2], Supervisor Engine 7-E[3], Supervisor Engine 7L-E[4], Supervisor Engine 6-E, Supervisor Engine 6L-E[3], Supervisor Engine V-10GE

Power over Ethernet on Cisco Catalyst 4500E

The Cisco Catalyst 4500E Series offers line cards, power supplies, and accessories required to deploy and operate standards-based Power over Ethernet/Power over Ethernet Plus (PoE/PoEP) and Universal POEP (UPOE). PoE provides power over 100 m of standard unshielded twisted-pair (UTP) cables when an IEEE 802.3af/at-compliant or Cisco pre-standard powered device is attached to the PoE/PoEP and UPOE line-card port. Instead of requiring wall power, attached devices such as IP phones, wireless base stations, video cameras, and other IEEE-compliant appliances can use power provided from the Cisco Catalyst 4500 Series PoE/PoEP and UPOE line cards. For the regular DC (Direct Current) device that doesn't support PoE/PoEP natively, Cisco Catalyst 4500 Series provides the UPOE Power Splitter that enables an UPOE port to power a 12V DC power device and another PoE/PoEP appliance. This capability gives network administrators centralized control over power and eliminates the need to install outlets in ceilings and other out-of-the-way places where a powered device can be installed. Table 2 shows the PoE options for Cisco Catalyst 4500 Series line cards.

Although all references to "PoE/PoEP/UPOE," "inline power," and "voice" power supplies and line cards are synonymous, there are currently four versions: Cisco prestandard, IEEE 802.3af compliant, IEEE 802.3at compliant, and UPOE. Every Cisco Catalyst 4500 Series chassis and PoE power supply supports the IEEE 802.3af/at standard and the Cisco prestandard power implementation, helping ensure backward compatibility with existing devices powered by Cisco. UPOE line cards require E series chassis. All IEEE 802.3af/at-compliant and UPOE line cards can distinguish an IEEE or Cisco prestandard powered device from an unpowered network interface card (NIC), helping ensure power is applied only when an appropriate device is connected.

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[1] Slots 8-10 on 4510R-E and 4510R+E chassis do not support E-Series line cards with Supervisor Engine 6-E.
[2] Supervisor Engine 8-E does not support non-E-Series chassis: 4503, 4506, 4507R, and 4510R.
[3] Supervisor Engine 7-E does not support non-E-Series chassis: 4503, 4506, 4507R, and 4510R.
[4] Supervisor Engine 7L-E does not support non-E-Series chassis: 4503, 4506, 4507R, and 4510R.

Cisco Catalyst 4500E Series and Classic Gigabit Ethernet Copper Line Cards

The Cisco Catalyst 4500E Series 48-port Gigabit Ethernet line cards provide high-performance 10/100/1000 switching. Two types of E-Series line cards are available, based on the per-slot bandwidth: 47xx line cards that drive 48 Gbps per slot, and 46xx line cards that drive 24 Gbps per slot. The Cisco Catalyst 4500 48-port 10/100/1000 PoEP E-Series 47xx line card provides standard IEEE 802.3at PoEP support on all 48 ports simultaneously. All series 47xx line cards support standard IEEE 802.1AE encryption and Cisco TrustSec™ in hardware. The Cisco Catalyst 4500 48-port 10/100/1000/multigigabit line cards are available in five versions: Data Only, PoE, PoEP, UPOE, and UPOE with multigigabit support for 802.11ac Wave2.

Table 2.   Cisco Catalyst 4500 Line Card PoE Options

Line-Card Type	Data Only (No PoE)	PoE (802.3af)	PoEP (802.3at)	UPOE
Cisco Catalyst 4500 47xx E-Series Line Cards	Yes	Yes	Yes	Yes
Cisco Catalyst 4500 46xx E-Series Line Cards	Yes	Yes	Yes	-
Cisco Catalyst 4500 Series Classic Line Cards	Yes	Yes	Yes	-

Cisco Catalyst 4500 Classic Fast Ethernet Copper Line Cards

The Cisco Catalyst 4500 Series offers a variety of classic Fast Ethernet line cards with copper interfaces optimized for desktops and servers for enterprise and commercial switching solutions. The two varieties of fast Ethernet copper line cards are:

- Data only (no PoE)
- Standard IEEE 802.3af PoE

Cisco Catalyst 4500E Series 10 Gigabit Ethernet Fiber Line Cards

The Cisco Catalyst 4500E Series supports 10 Gigabit Ethernet Fiber line cards.

The Cisco Catalyst 4500E Series 12-port 10 Gigabit Ethernet line card (2.5:1 oversubscribed) can be deployed for high-performance and high-density 10 Gigabit Ethernet aggregation in the campus and in small to medium-sized networks as a core switch. The Cisco Catalyst 4500E Series 12-port 10 Gigabit Ethernet line card supports standard Small Form-Factor Pluggable Plus (SFP+) optics. The ports can be used interchangeably as Gigabit Ethernet and 10 Gigabit Ethernet to support phased migration from Gigabit Ethernet to 10 Gigabit Ethernet.

The Cisco Catalyst 4500E Series 6-port 10 Gigabit Ethernet line card (2.5:1 oversubscribed) can be deployed for high-performance/low-density 10 Gigabit Ethernet aggregation in the campus, in small to medium-sized networks as a core switch, or for high-performance wiring closets where additional 10 Gigabit Ethernet uplinks are required. The Cisco Catalyst 4500E Series 6-port 10 Gigabit Ethernet line card supports standard X2 optics as well as the Cisco TwinGig modules. The Cisco TwinGig Converter Module converts a single 10 Gigabit Ethernet X2 interface into two Gigabit Ethernet port slots, which can be populated with appropriate SFP optics, providing a total of 12 wire-speed Gigabit Ethernet ports if used in all six X2 interface slots.

The flexibility provided by the TwinGig Converter Module enables customers to aggregate Gigabit Ethernet and 10 Gigabit Ethernet LAN access switches on a single line card and also supports phased migration from Gigabit Ethernet to 10 Gigabit Ethernet. This capability further demonstrates the flexibility and the investment protection of the Cisco Catalyst 4500 Series architecture (Figure 1).

TwinGig modules convert a single X2 port into two Gigabit Ethernet SFP ports.

Figure 1.   TwinGig Module

Cisco Catalyst 4500E Series Gigabit Ethernet Fiber Line Cards

The Cisco Catalyst 4500E Series 24-port Gigabit Ethernet fiber line card (SFP based) and Cisco Catalyst 4500E Series 12-port Gigabit Ethernet fiber line card (SFP based) provide high-performance switching at 24 Gbps per slot (line rate). Both E-Series line cards are nonblocking and designed for high-performance 1 Gigabit Ethernet aggregation in the campus and to support Fiber to the Desktop (FTTD) applications.

The Cisco Catalyst 4500 Series offers oversubscribed Gigabit Ethernet fiber line cards optimized for FTTD and FTTH deployments. The Cisco Catalyst 4500 Series 48 module Gigabit line card (8:1 oversubscribed) provides switching at 6Gbps per slot and can be used for higher density deployments.

The Cisco Catalyst 4500E Series 40 module Gigabit line card (2:1 oversubscribed) provides switching at 24Gbps per slot and can be used for enterprise deployments that require higher density and lower oversubscription. This line card also supports a specialized BX optics (compact SFP) that doubles the density to 80 ports per line card using 40 module, making it attractive for the FTTH deployment. The CSFP is a dual bidirectional SFP type that has the same form factor as a regular SFP, but can support 2 users that use BX type of optics (Figure 2).

Figure 2.   Compact SFP

Cisco Catalyst 4500 Classic Fast Ethernet Fiber Line Cards

The Cisco Catalyst 4500 Series offers a variety of classic Fast Ethernet line cards with fiber interfaces optimized for desktops, branch office backbones, and servers for enterprise and commercial switching solutions and service provider metropolitan Ethernet networks. Fast Ethernet line cards include various densities of wire-speed 10/100, 100-FX, 100BASE-LX10, and 100BASE-BX-D options.

Features and Benefits

Functional Transparency

Cisco Catalyst 4500 Series Switches offer an extensive line of modules that support numerous speeds and physical media combinations. These line cards are functionally transparent; all the packet processing, queuing, buffering, and QoS occur in the supervisor engine. To that end, both classic and E-Series line cards acquire the features and capabilities of the installed supervisor engine. For example, a classic line card previously deployed with a classic supervisor engine using four queues per port will automatically have capability for eight queues per port if redeployed with a Supervisor Engine 8-E/7-E/6-E. This architecture enables customers to easily upgrade all Ethernet line cards on their Cisco Catalyst 4500 Series systems to higher layer switching functions by adding a new supervisor engine. The simple design of the line cards results in a very high mean time between failures (MTBF), helping ensure high availability for a single connection to an end user.

Modular Versatility

The Cisco Catalyst 4500 Series is a centralized architecture that is designed to provide dedicated wire-speed bandwidth to each line-card slot within the chassis. Each line card has a dedicated bandwidth to the supervisor engine for packet processing. All network data that flows into the Cisco Catalyst 4500 Series through the various line cards goes through the supervisor engine for processing, even in single-slot port-to-port communications. All line cards have some per-slot bandwidth that allows network administrators to design a system that offers full dedicated bandwidth-to-server and switch-to-switch applications and still provides high performance over subscribed gigabit to the desktop.

A modular centralized design allows customers to use their investment in high-performance line cards across the entire line of Cisco Catalyst 4500 Series chassis and supervisor engines. For example, line cards that shipped with the original Cisco Catalyst 4003 Switch in 1999 will work in the Cisco Catalyst 4500E Series chassis. Because of the centralized architecture of the Cisco Catalyst 4500, all line cards deployed in a chassis benefit from the enhanced features that the supervisor engine provides, including QoS, Layer 2/3/4 routing, and hardware-based IPv6.

Following are descriptions of line cards that are available for Cisco Catalyst 4500 Series Switches.

Cisco Catalyst 4500E Series 10 Gigabit Ethernet Fiber Line Card

Figure 3 shows the WS-X4712-SFP+E.

Figure 3.   WS-X4712-SFP+E Cisco Catalyst 4500E Series 12-Port 10 Gigabit Ethernet (SFP+)
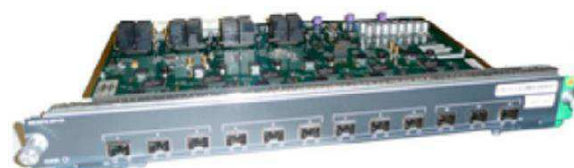
WS-X4712-SFP+E:

- 48 gigabits per-slot capacity

- Bandwidth is allocated across four 3-port groups, providing 12 Gbps per port group (2.5:1)

- Up to 12 ports 10GE SFP+ (10GBASE-R) or 12 ports GE SFP (1GBASE-X)

- SFP+ and SFP can be used simultaneously on the same line card without any restrictions

- Cisco IOS® XE Release 3.1.0SG or later

- IEEE 802.1AE and Cisco TrustSec capability in hardware

- L2-4 Jumbo Frame support (up to 9216 bytes)

- Enterprise and commercial: designed for high-speed backbone and switch-to-switch applications

- Service provider: 10GE/GE mix aggregation for DSLAM/PON/mobile data backhaul

- WS-X4712-SFP+E is not supported on 4507R-E and 4510R-E chassis

Figure 4 shows the WS-X4606-X2-E.

Figure 4.   WS-X4606-X2-E Cisco Catalyst 4500E Series 6-Port 10 Gigabit Ethernet (X2)
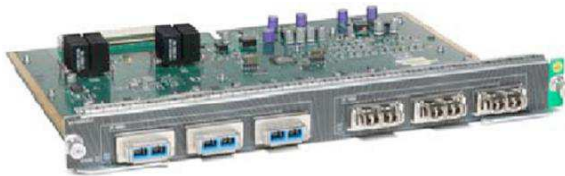
WS-X4606-X2-E:

- 24 gigabits per-slot capacity

- 24-gigabit bandwidth is allocated across six 10 Gigabit Ethernet ports (2.5:1)

- 10GBASE-X (X2) and 1GBASE-X (SFP)

- Up to 6 ports 10GE X2 or 12 ports GE SFP using TwinGig Converter Module

- TwinGig modules must be used in groups of three: ports 1-3 or ports 4-6

- Cisco IOS Software Release 12.2(40)SG or later

- L2-4 Jumbo Frame support (up to 9216 bytes)

- Enterprise and commercial: designed for high-speed backbone and switch-to-switch applications

- Service provider: 10GE/GE mix aggregation for DSLAM/PON/mobile data backhaul

Cisco Catalyst 4500E Series Gigabit Ethernet Fiber Line Card

Figure 5 shows the WS-X4748-SFP-E.

Figure 5.   WS-X4748-SFP-E

WS-X4748-SFP-E:

- 48-port nonblocking SFP line card, providing 48 gigabits per-slot capacity
- Cisco IOS Software Release IOS-XE3.5.0E/15.2(1)E or later
- Support 1G/100FX SFP (mix and match as well) at line rate
- IEEE 802.1AE Fiber Encryption and Cisco TrustSec capability in hardware
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Inherits Supervisor Engine QoS capability
- Supported on all 3, 6, 7 (R-E & R+E) and 10 (R-E & R+E) slot chassis
- Enterprise, mid-market, and commercial core and distribution deployments requiring line-rate capability
- Service provider: GE aggregation for DSLAM/PON/mobile data backhaul; Point-to-Point fiber to the home (FTTH) or building (FTTB) for residential and business applications
- Enterprise: Providing Fiber to the Desktop (FTTD), for deployments where non-blocking is mandatory requirement

Figure 6 shows the WS-X4724-SFP-E.

Figure 6.   WS-X4724-SFP-E

WS-X4724-SFP-E:

- 24-port nonblocking SFP line card, providing 24 gigabits per-slot capacity
- Cisco IOS Software Release IOS-XE3.5.0E/15.2(1)E or later
- Support 1G/100FX SFP (mix and match as well) at line rate
- IEEE 802.1AE Fiber Encryption and Cisco TrustSec capability in hardware
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Inherits Supervisor Engine QoS capability
- Supported on all 3, 6, 7 (R-E & R+E) and 10 (R-E & R+E) slot chassis
- Enterprise, mid-market, and commercial core and distribution deployments requiring line-rate capability
- Service provider: GE aggregation for DSLAM/PON/mobile data backhaul

Figure 7 shows the WS-X4712-SFP-E.

Figure 7.   WS-X4712-SFP-E

WS-X4712-SFP-E:

- 12 Port nonblocking SFP line card, providing 12 gigabits per-slot capacity
- Cisco IOS Software Release IOS-XE3.5.0E/15.2(1)E or later
- Support 1G/100FX SFP (mix and match as well) at line rate
- IEEE 802.1AE Fiber Encryption and Cisco TrustSec capability in hardware
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Inherits Supervisor Engine QoS capability
- Supported on all 3, 6, 7 (R-E & R+E) and 10 (R-E & R+E) slot chassis
- Enterprise, mid-market, and commercial core and distribution deployments requiring line-rate capability
- Service provider: GE aggregation for DSLAM/PON/mobile data backhaul

Figure 8 shows the WS-X4624-SFP-E.

Figure 8.   WS-X4624-SFP-E

WS-X4624-SFP-E:

- 24-port line-rate SFP line card, providing 24 gigabits per-slot capacity (1:1 oversubscribed)
- Cisco IOS Software Release 12.2(44)SG or later
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Inherits Supervisor Engine QoS capability
- Compatible only with E-Series supervisor engines
- Enterprise, mid-market, and commercial core and distribution deployments requiring line-rate capability
- Service provider: GE aggregation for DSLAM/PON/mobile data backhaul

Figure 9 shows the WS-X4612-SFP-E.

Figure 9.   WS-X4612-SFP-E

WS-X4612-SFP-E:

- 12 Port line-rate SFP line card, providing 12 gigabits per-slot capacity (1:1 oversubscribed)
- Cisco IOS Software Release 12.2(54)SG or later
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Inherits Supervisor Engine QoS capability
- Compatible only with E-Series supervisor engines
- Enterprise, mid-market, and commercial core and distribution deployments requiring line-rate capability
- Service provider: GE aggregation for DSLAM/PON/mobile data backhaul

Figure 10 shows WS-X4640-CSFP-E.

Figure 10.   WS-X4640-CSFP-E
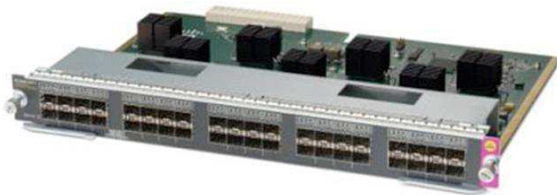
WS-X4640-CSFP-E:

- 40 modules of Gigabit SFP line card (1000BaseX), providing 24 gigabits per-slot capacity (SFP optional)
- 40 ports with Gigabit SFP (2:1 oversubscribed)
- 80 ports with Gigabit compact SFP (4:1 oversubscribed)
- Customers can mix and match Gigabit SFP and Gigabit compact SFPs
- 6E/6LE Supports WS-X4640-CSFP-E with IOS version 15.1.(1)SG
- 7E, 7L-E supports WS-X4640-CSFP-E from 15.0(2)SG1/3.2.0SG onwards
- Supported on 3, 6, and 7 slot chassis
- IEEE 802.3, IEEE 802.3ah, IEEE 802.3x flow control
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Inherits supervisor engine QoS capability
- Service Provider: Point-to-Point fiber to the home (FTTH) or building (FTTB) for residential and business applications
- Enterprise: Providing Fiber to the Desktop (FTTD), for deployments where non-blocking is not a mandatory requirement

Cisco Catalyst 4500E Series 10/100/1000/Multigigabit Line Cards

Figure 11 shows the WS-X4748-12X48U+E.

Figure 11. WS-X4748-12X48U+E Cisco Catalyst 4500E Series 48-Port (RJ-45) Line Card with 12 Multigigabit Ports and 36 10/100/1000 Ports with 802.3af PoE, 802.3at PoEP, and UPOE

WS-X4748-12X48U+E:

- 48 ports with 12 multigigabit ports and 36 10/100/1000 ports
- Campus ready for next-generation wireless connectivity to NBASE-TTM compatible endpoints such as 802.11ac Wave2 multigigabit access points, multigigabit switches, network interface cards (NICs), and adapters
- Speeds of 100/1000/2.5G/5G/10GBASE-T on the multigigabit ports and 10/100/100 on the other ports
- Three flexible software-configurable modes to optimize for 10/100/1000 or multigigabit operation
- Nonblocking up to 1000 Mbps on all ports
- RJ-45 support on all the ports
- Cisco IOS XE Release IOS-XE3.7.1E or later
- UPOE: capable of up to 60W per port up to 1440W
- Energy Efficient Ethernet 802.3az on all the 10/100/1000 ports
- IEEE 802.3af/at and Cisco prestandard PoE, IEEE 802.3x flow control
- IEEE 802.1AE and Cisco TrustSec capability in hardware
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Capable of up to 30W of inline power per port on all ports simultaneously
- Enterprise and commercial: designed to power next-generation IP phones, wireless access points, wireless base stations, video cameras, virtual desktop clients, and other PoE/UPOE devices
- Campus and branch applications requiring enhanced performance for large file transfers and network backups

Figure 12 shows the WS-X4748-UPOE+E.

Figure 12. WS-X4748-UPOE+E Cisco Catalyst 4500E Series 48-Port 802.3af PoE, 802.3at PoEP, and UPOE 10/100/1000 (RJ-45)

WS-X4748-UPOE+E:

- 48 ports nonblocking
- 10/100/1000 module (RJ-45)
- Cisco IOS XE Release 3.2.0SG or later
- UPOE: capable of up to 60 W per port up to 1440 W
- Energy Efficient Ethernet 802.3az
- IEEE 802.3af/at and Cisco prestandard PoE, IEEE 802.3x flow control
- IEEE 802.1AE and Cisco TrustSec capability in hardware
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Capable of up to 30 W of inline power per port on all ports simultaneously
- Enterprise and commercial: designed to power next-generation IP phones, wireless base stations, video cameras, virtual desktop clients, and other PoE/UPOE devices
- Campus and branch applications requiring enhanced performance for large file transfers and network backups

Figure 13 shows the WS-UPOE-12VPSPL.

Figure 13.   WS-UPOE-12VPSPL Cisco Power Splitter

WS-UPOE-12VPSPL:

- Receives both data and power from an UPOE (RJ45) connector
- Regular 12V DC connector
- 10/100/1000 RJ45 PoE/PoEP connector
- Provide integrated solution to PoE and regular DC power device from a single source

Figure 14 shows the WS-X4748-RJ45V+E.

Figure 14.   WS-X4748-RJ45V+E Cisco Catalyst 4500E Series 48-Port 802.3af PoE and 802.3at PoEP 10/100/1000 (RJ-45)

WS-X4748-RJ45V+E:

- 48 ports nonblocking
- 10/100/1000 module (RJ-45)
- Cisco IOS XE Release 3.1.0SG or later
- IEEE 802.3af/at and Cisco prestandard PoE, IEEE 802.3x flow control
- IEEE 802.1AE and Cisco TrustSec capability in hardware
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Capable of up to 30 W of inline power per port on all ports simultaneously
- Enterprise and commercial: designed to power next-generation IP phones, wireless base stations, video cameras, and other PoE devices
- Campus and branch applications requiring enhanced performance for large file transfers and network backups

Figure 15 shows the WS-X4748-RJ45-E.

Figure 15. WS-X4748-RJ45-E Cisco Catalyst 4500E Series 48-Port 10/100/1000 (RJ-45)

WS-X4748-RJ45-E:

- 48 ports nonblocking
- 10/100/1000 module (RJ-45)
- Cisco IOS XE Release 3.2.0SG or later
- Energy Efficient Ethernet 802.3az
- IEEE 802.1AE and Cisco TrustSec capability in hardware
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Enterprise and commercial: designed for data only user access
- Campus and branch applications requiring enhanced performance for large file transfers and network backups

Figure 16 shows the WS-X4648-RJ45V+E.

Figure 16. WS-X4648-RJ45V+E Cisco Catalyst 4500E Series 48-Port 802.3af PoE and 802.3at PoEP 10/100/1000 (RJ-45)

WS-X4648-RJ45V+E:

- 24 gigabits per-slot capacity
- 48 ports
- 10/100/1000 module (RJ-45)
- Cisco IOS Software Release 12.2(40)SG or later
- IEEE 802.3af/at and Cisco prestandard PoE, IEEE 802.3x flow control
- Bandwidth is allocated across eight 6-port groups, providing 3 Gbps per port group (2:1)
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Capable of up to 30 W of inline power per port on up to 24 ports simultaneously or 15W of inline power per port on up to 48 ports simultaneously
- Enterprise and commercial: designed to power next-generation IP phones, wireless base stations, video cameras, and other PoE devices
- Campus and branch applications requiring enhanced performance for large file transfers and network backups

Figure 17 shows the WS-X4648-RJ45V-E.

Figure 17. WS-X4648-RJ45V-E Cisco Catalyst 4500E Series 48-Port 802.3af PoE 10/100/1000 (RJ-45)

WS-X4648-RJ45V-E:

- 24 gigabits per-slot capacity
- 48 ports
- 10/100/1000 module (RJ-45)
- Cisco IOS Software Release 12.2(40)SG or later
- Bandwidth is allocated across eight 6-port groups, providing 3 Gbps per port group (2:1)
- L2-4 Jumbo Frame support (up to 9216 bytes)
- IEEE 802.3af and Cisco prestandard PoE, IEEE 802.3x flow control
- Enterprise and commercial: designed to power IP phones, wireless base stations, video cameras, and other IEEE-compliant powered devices
- Campus and branch applications requiring enhanced performance for large file transfers and network backups

Figure 18 shows the WS-X4648-RJ45-E.

Figure 18.   WS-X4648-RJ45-E Cisco Catalyst 4500E Series 48-Port Data-Only 10/100/1000 (RJ-45)

WS-X4648-RJ45-E:

- 24 gigabits per-slot capacity
- 48 ports
- 10/100/1000 module (RJ-45)
- Cisco IOS Software Release 12.2(50)SG or later
- Bandwidth is allocated across eight 6-port groups, providing 3 Gbps per port group (2:1)
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Enterprise campus, commercial collapsed core, and branch applications requiring enhanced performance for large file transfers and network backups
- Campus and branch applications requiring enhanced performance for large file transfers and network backups
- Service provider: GE/100M aggregation for DSLAM and PON

Cisco Catalyst 4500 Classic Line Cards

Classic 10/100/1000 Ethernet Line Cards

Figure 19 shows the WS-X4548-RJ45V+.

Figure 19.   WS-X4548-RJ45V+ Cisco Catalyst 4500 48-Port 802.3af PoE and 802.3at PoEP 10/100/1000 (RJ-45)

WS-X4548-RJ45V+:

- 48 ports
- 10/100/1000 (RJ-45)
- Cisco IOS Software Release 12.2(50)SG or later
- IEEE 802.3af/at and Cisco prestandard PoE, IEEE 802.3x flow control
- Bandwidth is allocated across six 8-port groups, providing 1 Gbps per port group
- Capable of up to 30 W of inline power per port on up to 24 ports simultaneously

- Enterprise and commercial: designed to power next-generation IP phones, wireless base stations, video cameras, and other PoE devices that require power up to 30 watts

Figure 20 shows the WS-X4548-GB-RJ45V.

**Figure 20.** WS-X4548-GB-RJ45V Cisco Catalyst 4500 PoE IEEE 802.3af 10/100/1000, 48 Ports (RJ-45)
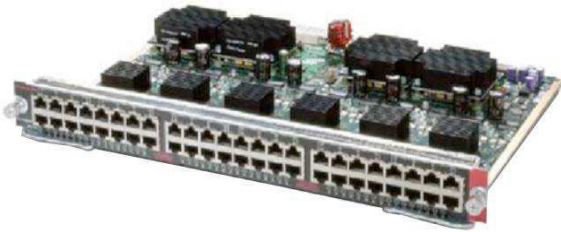
WS-X4548-GB-RJ45V:

- 48 ports
- 10/100/1000 (RJ-45)
- Cisco IOS Software Release 12.2(18)EW or later
- IEEE 802.3af and Cisco prestandard PoE, IEEE 802.3x flow control
- Bandwidth is allocated across six 8-port groups, providing 1 Gbps per port group
- Enterprise and commercial: designed to power IP phones, wireless base stations, video cameras, and other IEEE-compliant powered devices

Figure 21 shows the WS-X4548-GB-RJ45.

Figure 21. WS-X4548-GB-RJ45 Cisco Catalyst 4500 Enhanced 48-Port 10/100/1000 Module (RJ-45)
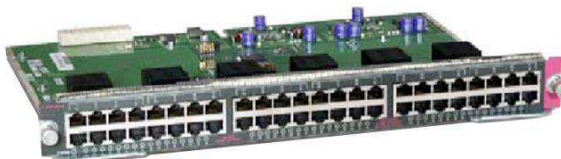
WS-X4548-GB-RJ45:

- 48 ports
- 10/100/1000 module (RJ-45)
- Cisco IOS Software Release 12.1(19)EW or later
- IEEE 802.3x flow control
- Bandwidth is allocated across six 8-port groups, providing 1 Gbps per port group
- Enterprise and commercial: designed for gigabit to the desktop

Classic Gigabit Ethernet Fiber Line Card (GBIC or SFP)

The Cisco Catalyst 4500 Series offers a variety of gigabit interface converter (GBIC) - or Small Form Factor Pluggable (SFP)-enabled gigabit solutions for high-performance Gigabit Ethernet uplinks and server farm connectivity. The five GBIC- or SFP-enabled gigabit line-card options for the Cisco Catalyst 4500 Series include 6-, 18-, and 48-port versions. GBIC or SFP technology allows customers to intermix intrabuilding multimode fiber (MMF) connections and long-distance single-mode connections simply by changing the GBIC or SFP type. (See Table 3 for more information.)

Figure 22 shows the WS-X4306-GB.

Figure 22.   WS-X4306-GB Cisco Catalyst 4500 Gigabit Ethernet Module, 6 Ports (GBIC)
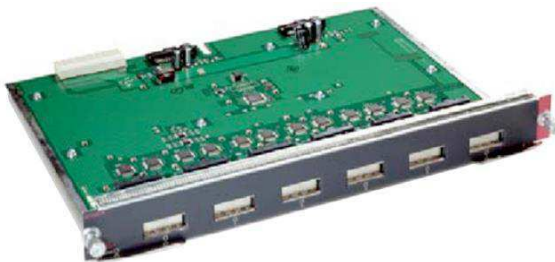
WS-X4306-GB:

- 6 ports
- 1000BASE-X (GBIC)
- Cisco IOS Software Release 12.1(8a)EW or later
- IEEE 802.3
- L2-4 Jumbo Frame support (up to 9216 bytes)
- Enterprise and commercial: designed for high-speed backbone, switch-to-switch applications, or small server farms
- Service provider: GE small aggregation for DSLAM/PON/mobile data backhaul

Figure 23 shows the WS-X4418-GB.

Figure 23.   WS-X4418-GB Cisco Catalyst 4500 Gigabit Ethernet Module, Server Switching 18 Ports (GBIC)
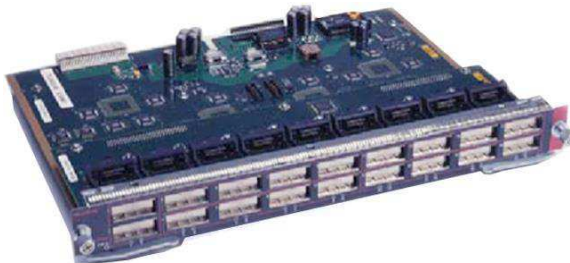
WS-X4418-GB:

- 18 ports
- 1000BASE-X (GBIC)
- Cisco IOS Software Release 12.1(8a)EW or later
- IEEE 802.3, IEEE 802.3x flow control
- 2 ports of wire-speed 1000BASE-X Gigabit Ethernet uplinks
- 16 ports: 4:1 oversubscribed
- Enterprise and commercial: designed for fiber to the desktop, switch-to-switch applications, or small server farms

Figure 24 shows the WS-X4448-GB-SFP.

Figure 24. WS-X4448-GB-SFP Cisco Catalyst 4500 Gigabit Ethernet Module, 48 Ports 1000X (SFP)
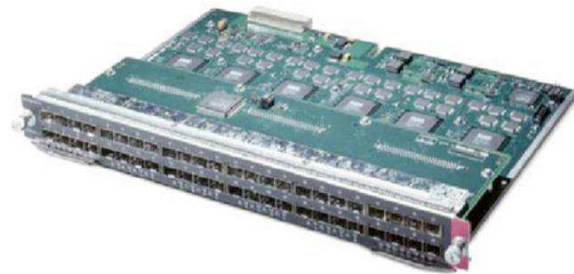
WS-X4448-GB-SFP:

- 48 ports
- 1000BASE-X (SFP)
- Customers can mix and match 1000BASE-X SFP optics on the same line card
- IEEE 802.3x flow control
- Service provider: Run point-to-point Gigabit Ethernet fiber to the home (FTTX)
- Enterprise and commercial: designed for server farms and switch-to-switch applications

Figure 25 shows the WS-X4506-GB-T.

Figure 25. WS-X4506-GB-T Cisco Catalyst 4500 6-Port 10/100/1000 RJ-45 PoE IEEE 802.3af and 1000BASE-X (SFP)

WS-X4506-GB-T:

- 6-port 10/100/1000 and 6-port SFP (any combination of up to 6 ports can be active at one time)
- 10/100/1000 RJ-45 PoE and 1000BASE-X (SFP)
- Cisco IOS Software Release 12.2(20)EWA
- PoE IEEE 802.3af and Cisco prestandard (RJ-45 only)

- Provides full line-rate gigabit switching on all ports

- L2-4 Jumbo Frame support (up to 9216 bytes)

- Designed to give customers the choice of RJ-45 with or without PoE and SFP without incurring extra costs

- Enterprise and commercial: high-performance desktop connectivity and server farms; designed to power IP phones, wireless base stations, video cameras, and other IEEE-compliant appliances

- Service provider: GE small aggregation for DSLAM/PON/mobile data backhaul

Classic 10/100 Ethernet Line Card

Figure 26 shows the WS-X4248-RJ45V.

Figure 26.   WS-X4248-RJ45V Cisco Catalyst 4500 PoE IEEE 802.3af 10/100, 48 Ports (RJ-45)
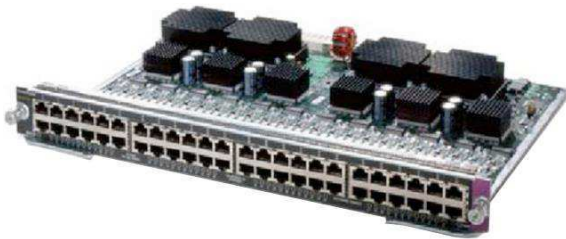
WS-X4248-RJ45V:

- 48 ports

- 10/100 (RJ-45)

- Cisco IOS Software Release 12.2(18)EW or later

- IEEE 802.3af PoE and Cisco prestandard

- Enterprise and commercial: designed to power IP phones, wireless base stations, video cameras, and other IEEE-compliant powered devices

Figure 27 shows the WS-X4148-RJ.

Figure 27.   WS-X4148-RJ Cisco Catalyst 4500 10/100 Module, 48 Ports (RJ-45)
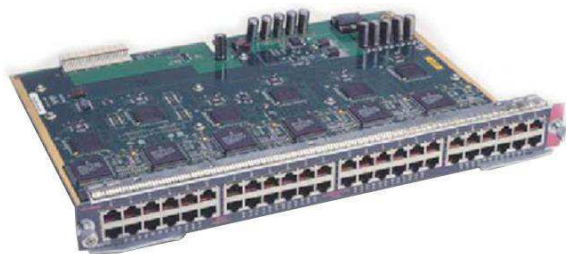
WS-X4148-RJ:

- 48 ports

- 10/100BASE-T module (RJ-45)

- Enterprise and commercial: high-port-density solution for desktop connectivity

Classic Fast Ethernet Fiber Line Card

Figure 28 shows the WS-X4248-FE-SFP.

Figure 28. WS-X4248-FE-SFP Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-Port 100BASE-X (SFP)

WS-X4248-FE-SFP:

- 48-port 100BASE-X (SFP optional)
- Customers can mix and match 100BASE-X SFP optics on the same line card
- IEEE 802.3, IEEE 802.3ah, IEEE 802.3x flow control
- Enterprise and commercial: fiber-to-the-desktop applications
- Service providers: running point-to-point Fast Ethernet to the home or business (FTTH)

Figure 29. WS-X4148-FX-MT Cisco Catalyst 4500 Gigabit Ethernet Module, 48-Port 100BASE-FX

WS-X4148-FX-MT:

- 48-port IEEE 802.3 100BASE-FX Fast Ethernet
- Connectors: MT-RJ
- Distance: 1.2 miles (2 km) over multimode fiber
- Status: green (operational), red (faulty)
- Link: green (operational), red (faulty)
- Standards: IEEE 802.3
- Service provider: Run point-to-point Fast Ethernet fiber to the home (FTTX)
- Enterprise and commercial: designed for server farms and switch-to-switch applications

Specification Summary

Table 3 summarizes product specifications.

Table 3.   Port Information for Line Cards

Line Card	Number of Ports	Port Speed	Port Type	Wire Rate	Cisco Catalyst 4500 Series Min/Max Ports		
					4503-E	4506-E/ 4507R-E/ 4507R+E	4510R-E/ 4510R+E
E-Series 10 Gigabit Ethernet Line Cards							
WS-X4712-SFP+E[5]	12	10GBASE-R	SFP+ or SFP	2.5-to-1 with SFP+ 1:1 with SFP	12/24[6]	12/60[5]	12/96[5]
WS-X4606-X2-E	6	10GBASE-X	X2 or SFP with TwinGig Converter Module	2.5-to-1 with X2 1:1 with SFP	6/12[5] 12/24[5]	6/30[5] 12/60[5]	6/30[5] 12/60[5]
E-Series 10/100/1000/Multigigabit Line Cards							
WS-X4748-12X48U+E	48	12 Multigigabit 100/1000/2.5G/5G/ 10GBASE-T ports and 36 10/100/1000 ports	RJ-45 UPOE IEEE 802.3at, IEEE 802.3af, Cisco prestandard	1:1 for speeds up to 1000Mbps on all ports Multigigabit ports for 10G speeds: Mode1: 10-to-1 Mode2[7]: 5-to-1 Mode3[7]: 2.5-to-1	48/96[6]	48/240[5,6]	48/384[5,6,8]
WS-X4748-UPOE+E	48	10/100/1000	RJ-45 UPOE IEEE 802.3at, IEEE 802.3af, Cisco prestandard	1:1	48/96[6]	48/240[6]	48/384[6,9]
WS-X4748-RJ45V+E	48	10/100/1000	RJ-45 PoE IEEE 802.3at, IEEE 802.3af, Cisco prestandard	1:1	48/96[6]	48/240[6]	48/384[6,9]
WS-X4748-RJ45-E	48	10/100/1000	RJ-45	1:1	48/96[6]	48/240[6]	48/384[6,9]
WS-X4648-RJ45V+E	48	10/100/1000	RJ-45 PoE IEEE 802.3at, IEEE 802.3af, Cisco prestandard	2-to-1	48/96[6]	48/240[6]	48/384[6,9]
WS-X4648-RJ45V-E	48	10/100/1000	RJ-45 PoE IEEE 802.3af, Cisco prestandard	2-to-1	48/96[6]	48/240[6]	48/384[6,9]
WS-X4648-RJ45-E	48	10/100/1000	RJ-45	2-to-1	48/96[6]	48/240[6]	48/384[6,9]

[5] WS-X4712-SFP+E and WS-X4748-12X48U+E are not supported on 4507R-E and 4510R-E chassis.
[6] E-Series line cards require E-Series chassis.
[7] In Mode2, ports 13-24 are inactive, in Mode3, ports 13-48 are inactive.
[8] Requires Supervisor Engine 8-E/7-E to support greater than 240 ports on 4510R+E chassis.
[9] Requires Supervisor Engine 8-E/7-E to support greater than 240 ports on 4510R+E and 4510R-E chassis.

Line Card	Number of Ports	Port Speed	Port Type	Wire Rate	Cisco Catalyst 4500 Series Min/Max Ports		
					4503-E	4506-E/ 4507R-E/ 4507R+E	4510R-E/ 4510R+E
E-Series Gigabit Ethernet SFP Line Cards							
WS-X4748-SFP-E	48	1GbE/100Mbps	Pluggables	1:1	48/96	48/240	48/384
WS-X4724-SFP-E	24	1GbE/100Mbps	Pluggables	1:1	24/48	24/120	24/192
WS-X4712-SFP-E	12	1GbE/100Mbps	Pluggables	1:1	12/24	12/60	12/96
WS-X4624-SFP-E	24	1000	Pluggables	1:1	24/48	24/120	24/168
WS-X4612-SFP-E	12	1000	Pluggables	1:1	12/28	12/64	12/100
WS-X4640-CSFP-E	40 with SFP 80 with CSFP	1000	Pluggables	2:1 with SFP 4:1 with CSFP	40/160	40/400	Not supported
Classic 10/100/1000 Line Cards							
WS-X4548-RJ45V+	48	10/100/1000	RJ-45 PoE IEEE 802.3at, IEEE 802.3af, Cisco prestandard	8-to-1[10]	48/96	48/240	48/384
WS-X4548-GB-RJ45V	48	10/100/1000	RJ-45 PoE IEEE 802.3af and Cisco prestandard	8-to-1	48/96	48/240	48/384
WS-X4524-GB-RJ45V	24	10/100/1000	RJ-45 PoE IEEE 802.3af and Cisco prestandard	4-to-1	24/48	24/120	24/168
WS-X4548-GB-RJ45	48	10/100/1000	RJ-45	8-to-1	48/96	48/240	48/384
Classic Gigabit Ethernet Fiber (GBIC or SFP) Line Cards							
WS-X4306-GB	6	1000BASE-X	GBIC	Yes	6/12	6/30	6/42
WS-X4418-GB	18	1000BASE-X	GBIC	2 ports full 16 ports 4-to-1	18/36	18/90	18/126
WS-X4448-GB-LX	48	1000BASE-LX	48 SFPs (included)	8-to-1	48/96	48/240	48/384
WS-X4448-GB-SFP	48	1000BASE-X	SFP	8-to-1	48/96	48/240	48/384
WS-X4506-GB-T	6 + 6	10/100/1000	1000BASE-X (SFP) RJ-45 PoE IEEE 802.3af and Cisco prestandard	Yes	6/12	6/30	6/42
Classic Fast Ethernet Fiber Line Cards							
WS-X4248-FE-SFP	48	100BASE-X	SFP	Yes	48/96	48/240	48/384
WS-X4248-FX-MT	48	100BASE-FX	MT-RJ	Yes	48/96	48/240	48/384
Classic 10/100 Ethernet Line Cards							
WS-X4148-RJ	48	10/100	RJ-45	Yes	48/96	48/240	48/384
WS-X4248-RJ45V	48	10/100	RJ-45 PoE IEEE 802.3af and Cisco prestandard	Yes	48/96	48/240	48/384

[10] The amount of oversubscription can be controlled by varying the number of ports used at 1000 Mbps. All ports can use Gigabit EtherChannel or IEEE 802.3ad for high-speed interconnection applications. All oversubscribed ports use the standard IEEE 802.1x flow control (PAUSE frame) mechanism to control Gigabit Ethernet host traffic.

Optics

Cisco Catalyst 4500 line cards provide a variety of optical port types and port speeds: SFP+, X2, SFP, GBIC, 100BASE-FX, and so on. For details about the different optical modules supported by each line card and the minimum Cisco IOS Software release required for each of the supported optical modules, visit www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

Product Specification

Table 4 lists product specifications.

Table 4.   Product Specifications

Feature	Description
Standards	• Gigabit Ethernet: IEEE 802.3z, IEEE 802.3x, IEEE 802.3ab, IEEE 803.3at, IEEE 802.3af, IEEE 802.3az • 1000BASE-X (GBIC), 1000BASE-SX, 1000BASE-LX/LH, 1000BASE-ZX, CWDM
EtherChannel Technology	• Gigabit EtherChannel: All 1000 Mbps ports • 10 Gigabit EtherChannel: All 10Gbps ports • IEEE 802.3ad (Link Aggregation Control Protocol): All 1000 Mbps ports • Port Aggregation Protocol (PagP): Yes • Number of ports per tuple: 8 • EtherChannel and IEEE 802.3ad technology across line cards: Yes
Physical Dimensions	• Occupies one slot in the Cisco Catalyst 4500 Series platform • Dimensions (H x W x D): 1.2 x 14.25 x 10.75 in. (3.0 x 36.2 x 27.3 cm)
Environmental Conditions	• Operating temperature: 32° to 104°F (0° to 40°C) • Storage temperature: -40° to 167°F (-40° to 75°C) • Relative humidity: 10 to 90%, noncondensing • Operating altitude: -60 to 3000m
Safety Conditions	Fiber optic lasers: Class 1 laser products
Safety Certifications	• UL 1950 • EN 60950 • CSA-C22.2 no 950 • IEC 950 • IEC 60950-1, 2nd Ed. EN 60950-1, 2nd Ed. UL 60950-1, 2nd Ed. CAN/CSA-C22.2 No. 60950-1 2nd Ed.[11]
Electromagnetic Emissions Certifications	• FCC 15J Class A • VCCI Class A • CE Marking • EN 55022 Class A • EN 55024 Class A • CISPR 22 Class A • AS/NZ 3548 • NEBS Level 3 (GR-1089-CORE, GR-63-CORE) • ETSI ETS-300386-2 • EN 50121-4
ROHS Compliance	ROHS5

[11] Applicable only to WS-X4748-12X48U+E.

Power and MTBF Information

Table 5 gives power and MTBF information for different line cards.

Table 5.   Power and MTBF Information

Part Number	Max Rated Power (W)	Rated MTBF (Hours)
WS-X4748-12X48U+E	118	524,630
WS-X4748-UPOE+E	75	140,696
WS-X4748-RJ45V+E	75	183,330
WS-X4748-RJ45-E	75	402,386
WS-X4712-SFP+E	90	387,172
WS-X4748-SFP-E	92	876,100
WS-X4724-SFP-E	40	1,139,510
WS-X4712-SFP-E	25	1,329,480
WS-X4624-SFP-E	45	591,109
WS-X4612-SFP-E	30	676,740
WS-X4640-CSFP-E	120	347,724
WS-X4648-RJ45-E	89	280,365
WS-X4648-RJ45V-E	92	280,365
WS-X4648-RJ45V+E	92	280,365
WS-X4606-X2-E	50	535,717
WS-X4548-GB-RJ45V	60	434,646
WS-X4548-RJ45V+	60	239,436
WS-X4548-GB-RJ45	60	171,356
WS-X4506-GB-T	30	392,098
WS-X4306-GB	35	570,262
WS-X4418-GB	80	355,330
WS-X4448-GB-SFP	65	290,732
WS-X4248-FE-SFP	53	687,828
WS-X4148-RJ	65	350,860
WS-X4248-RJ45V	60	187,594

Note: All power numbers shown in Table 5 are maximum values recommended for facility power and cooling capacity planning. These figures are not indicative of the actual power draw during operation. Typical power draw is about 20 percent lower than the maximum value shown.

Ordering Information

To place an order, visit the Cisco Ordering homepage. Table 6 gives ordering information.

Table 6.   Ordering Information

Part Number ("=" Indicates "Spare")	Product Name
WS-X4748-12X48U+E (=)	Cisco Catalyst 4500E Series 48-Port UPOE w/ 12p multigigabit and 36p 10/100/1000 (RJ-45)
WS-X4748-UPOE+E (=)	Cisco Catalyst 4500E Series 48-Port UPOE 10/100/1000 (RJ-45)
WS-UPOE-12VPSPL(=)	Cisco Catalyst 4500E Series UPOE Power Splitter
WS-X4748-RJ45V+E (=)	Cisco Catalyst 4500E Series 48-Port 802.3at PoEP 10/100/1000 (RJ-45)

Part Number ("=" Indicates "Spare")	Product Name
WS-X4748-RJ45-E (=)	Cisco Catalyst 4500E Series 48-Port 10/100/1000 (RJ-45)
WS-X4712-SFP+E (=)	Cisco Catalyst 4500E Series 12-Port 10 Gigabit Ethernet (SFP+)
WS-X4748-SFP-E (=)	Cisco Catalyst 4500E Series 48-Port GE (SFP)
WS-X4724-SFP-E (=)	Cisco Catalyst 4500E Series 24-Port GE (SFP)
WS-X4712-SFP-E (=)	Cisco Catalyst 4500E Series 12-Port GE (SFP)
WS-X4624-SFP-E (=)	Cisco Catalyst 4500E Series 24-Port GE (SFP)
WS-X4612-SFP-E (=)	Cisco Catalyst 4500E Series 12-Port GE (SFP)
WS-X4640-CSFP-E (=)	Cisco Catalyst 4500E Series 40 SFP/80 C-SFP Port 1000BaseX (SFPs Optional)
WS-X4648-RJ45-E (=)	Cisco Catalyst 4500E Series 48-Port 10/100/1000 (RJ-45)
WS-X4648-RJ45V-E (=)	Cisco Catalyst 4500E Series 48-Port 802.3af PoE 10/100/1000 (RJ-45)
WS-X4648-RJ45V+E (=)	Cisco Catalyst 4500E Series 48-Port 802.3af PoE and PoEP - 10/100/1000 (RJ-45)
WS-X4606-X2-E (=)	Cisco Catalyst 4500E Series 6-Port 10 Gigabit Ethernet (X2)
WS-X4548-GB-RJ45V(=)	Cisco Catalyst 4500 PoE IEEE 802.3af 10/100/1000, 48 Ports (RJ-45)
WS-X4548-RJ45V+(=)	Cisco Catalyst 4500 PoE IEEE 802.3af and PoEP-Ready 10/100/1000, 48 Ports (RJ-45)
WS-X4548-GB-RJ45(=)	Cisco Catalyst 4500 Enhanced 48-Port 10/100/1000 Module (RJ-45)
WS-X4506-GB-T(=)	Cisco Catalyst 4500 6-Port 10/100/1000 RJ-45 PoE IEEE 802.3af and 1000BASE-X (SFP)
WS-X4306-GB(=)	Cisco Catalyst 4500 Gigabit Ethernet Module, 6 Ports (GBIC)
WS-X4418-GB(=)	Cisco Catalyst 4500 Gigabit Ethernet Module, Server Switching 18 Ports (GBIC)
WS-X4448-GB-SFP(=)	Cisco Catalyst 4500 Gigabit Ethernet Module, 48-Port 1000X (SFP)
WS-X4248-FE-SFP (=)	Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-Port 100BASE-X (SFP)
WS-X4148-RJ(=)	Cisco Catalyst 4500 10/100 Module, 48 Ports (RJ-45)
WS-X4148-FX-MT(=)	Cisco Catalyst 4500 Series 48-Port 100BASE-FX Fast Ethernet Line Card (MT-RJ) for multimode fiber
WS-X4248-RJ45V(=)	Cisco Catalyst 4500 PoE IEEE 802.3af 10/100, 48 Ports (RJ-45)

Cisco Limited Lifetime Hardware Warranty

The Cisco limited lifetime hardware warranty (LLW) includes 10-day advance hardware replacement for as long as the original end user owns the product. Table 7 describes the limited lifetime hardware warranty.

Your formal warranty statement, including the warranty applicable to Cisco software, appears in the Cisco information packet that accompanies your Cisco product. We encourage you to review carefully the warranty statement shipped with your specific product before use.

For additional information on warranty terms, visit www.cisco.com/go/warranty.

Adding a Cisco technical services contract to your device coverage provides benefits not available with warranty, including access to the Cisco Technical Assistance Center (TAC), a variety of hardware replacement options to meet critical business needs, updates for licensed IOS software, and registered access to the extensive Cisco.com knowledge base and support tools. Table 8 describes the benefits and features of Cisco technical services.

For information about Cisco Technical Services, go to www.cisco.com/go/ts.

Table 7. Limited Lifetime Hardware Warranty

	Cisco Limited Lifetime Hardware Warranty[8]
Warranty Duration	As long as the original customer owns the product
EoL Policy	In the event of discontinuance of product manufacture, Cisco warranty support is limited to 5 years from the announcement of discontinuance
Hardware Replacement	Cisco or its service center will use commercially reasonable efforts to ship a replacement part within 10 business days after receipt of the RMA request and confirmation that a replacement part is appropriate response. Actual delivery times may vary depending on customer location
Effective Date	Hardware warranty commences from the date of shipment to the customer (and in case of resale by a Cisco reseller, not more than 90 days after original shipment by Cisco)
TAC Support	None
Cisco.com Access	Warranty allows guest access only to Cisco.com

[8] Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

Cisco and Partner Services

Enable the innovative, secure, intelligent edge in the Borderless Network Architecture using personalized services from Cisco and our partners. Through a discovery process that begins with understanding your business objectives, we help you integrate the next-generation Cisco Catalyst 4500-E Series Switches into your architecture and incorporate network services onto that platform. Sharing knowledge and leading practices, we support your success every step of the way as you deploy, absorb, manage, and scale new technology. Choose from a flexible suite of support services designed to meet your business needs and help you maintain high-quality network performance while controlling operational costs. Table 8 shows the Cisco technical services available for Cisco Catalyst 4500-E Series Switches.

For additional information about Cisco services, visit www.cisco.com/go/ts.

Table 8. Cisco Technical Services for Cisco Catalyst 4500-E Series Switches

Technical Services
Cisco SMARTnet Service • Around-the-clock, global access to the Cisco Technical Assistance Center (TAC) • Unrestricted access to the extensive Cisco.com resources, communities, and tools • Next-business-day, 8x5x4, 24x7x4, and 24x7x2 advance hardware replacement[9] and onsite parts replacement and installation available • Ongoing operating system software updates within the licensed feature set[10] • Proactive diagnostics and real-time alerts on Smart Call Home enabled devices
Cisco Smart Foundation Service • Next business day advance hardware replacement as available • Business hours access to SMB TAC (access levels vary by region) • Access to Cisco.com SMB knowledge base • Online technical resources through Smart Foundation Portal • Operating system software bug fixes and patches
Cisco Focused Technical Support Services Three levels of premium, high-touch services are available: • Cisco High-Touch Operations Management Service • Cisco High-Touch Technical Support Service • Cisco High-Touch Engineering Service Valid Cisco SMARTnet or SP Base contracts on all network equipment are required.

Footnotes:

[9] Advance hardware replacement is available in various service-level combinations. For example, 8x5xNBD indicates that shipment will be initiated during the standard eight-hour business day, five days a week (the generally accepted business days within the relevant region), with next business day (NBD) delivery. Where NBD is not available, same-day shipping is provided. Restrictions apply; review the appropriate service descriptions for details.

[10] Cisco operating system updates include the following: maintenance releases, minor updates, and major updates within the licensed feature set.

Cisco Capital

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Cisco Capital can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.

For More Information

For more information about the Cisco Catalyst 4500 Series line cards, visit www.cisco.com/en/US/products/hw/switches/ps4324/index.html or contact your local account representative.

For more information about Cisco transceiver modules compatible with Cisco Catalyst 4500 Series line cards, visit www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

Cisco Catalyst 4500E Supervisor Engine 8L-E: Enhanced Campus Access and Aggregation Supervisor Engine

Overview

The Cisco® Catalyst® 4500E Supervisor Engine 8L-E (Figure 1) is an enterprise-class campus access and price/performance aggregation supervisor engine designed to provide up to 560 Gbps per system with E-Series chassis. The Cisco Catalyst 4500E Supervisor Engine 8L-E provides 48 Gbps per slot with best in class features such as Flexible NetFlow (FNF), integrated Wireshark, TrustSec and MACSec security, and APIC-EM orchestration leading to reduced total cost of ownership (TCO) and industry-leading investment protection. These capabilities, along with four SFP/SFP+ uplinks and up to 240 Gigabit Ethernet Power over Ethernet (PoE), PoE Plus (PoEP), and Cisco Universal PoE (UPoE) ports, make this supervisor engine the leading Cisco Access low-scale supervisor engine in the Cisco Catalyst Family. The Supervisor Engine 8L-E is also built with price-performance aggregation deployments in mind, helping to enable denser Gigabit Ethernet and 10 Gigabit Ethernet fiber deployments with enterprise-class aggregation functions. The Supervisor Engine 8L-E facilitates user experiences for enterprise, public sector, midmarket, and commercial customer business-critical applications.

Cisco leadership in borderless networks is extended with important features: Cisco TrustSec®, Cisco MultiGig, Flexible NetFlow, Cisco EnergyWise®, Cisco UPoE, and many other feature enhancements offered by the Cisco Catalyst 4500E Supervisor Engine 8L-E. Backward and forward compatibility with most existing Cisco Catalyst 4500E line cards and power supplies helps assure deeper customer satisfaction with an industry-leading investment protection architecture. The Cisco Catalyst Supervisor Engine 8L-E is supported in Cisco Catalyst 4500 E-Series chassis.

The Supervisor Engine 8L-E offers important innovations, including:

- 560 Gbps total capacity with 4x SFP/SFP+ uplinks and a Quad Core, 1.8Ghz CPU
- Cisco Universal Power over Ethernet (UPOE) for unprecedented convergence to IP network infrastructure
- Campus ready for connectivity to next-generation NBASE-T™ compatible endpoints such as 802.11ac Wave2 multigigabit access points, multigigabit switches, network interface cards (NICs), and adapters
- Application visibility through Flexible NetFlow.
- Virtual Switching System (VSS) for operational simplicity and resiliency
- Cisco IOS® XE Software, which provides the ability to host third-party applications
- Energy efficiency with support for 802.3az Energy-Efficient Ethernet (EEE)-capable line cards
- Industry-leading resiliency through In-Service Software Upgrade (ISSU)
- First and only modular switch with 8 bidirectional line-rate Switched Port Analyzer/Remote SPAN (SPAN/RSPAN) sessions

Figure 1. Cisco Catalyst 4500E Supervisor Engine 8L-E
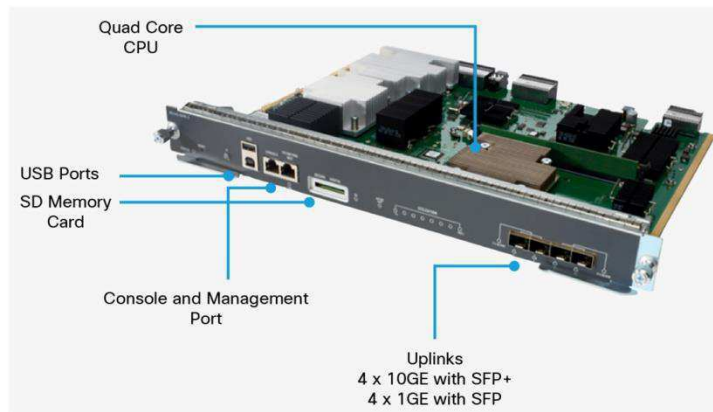
Cisco Catalyst 4500E Supervisor Engine 8L-E Feature Highlights

The Cisco Catalyst 4500E Supervisor Engine 8L-E builds on the widely deployed line of Cisco Catalyst 4500 supervisor engines and enhances its predecessors to provides nonblocking 48 Gbps per slot bandwidth with Flexible NetFlow for optimized application visibility. In addition, the enterprise-class Cisco Catalyst 4500E Supervisor Engine 8L-E offers the following:

- Performance and scalability:
  - 560-Gbps switching capacity with 225 Mpps of throughput
  - 4 nonblocking 10 Gigabit Ethernet uplinks (SFP+) or 4 nonblocking 1 Gigabit Ethernet uplinks (SFP)
  - Supported on 3-, 6-, and 7-slot Cisco Catalyst 4500E chassis
  - Supports a maximum of 240 ports of 10/100/1000 Base-T in a 7-slot chassis
  - 244 ports of nonblocking Gigabit Ethernet SFP in a 7-slot chassis (four uplinks ports plus 240 line card ports)
  - 64 ports of 10 Gigabit Ethernet SFP+ in a 7-slot chassis (four uplinks ports plus 60 line card ports)
  - Enables next-generation Universal Power Over Ethernet (UPOE, WS-X4748-UPOE+E) in addition to backward compatibility with other PoE standards
  - Power over Ethernet Plus (PoE+; 30 W) capabilities on all ports in a line card simultaneously
  - Enables Energy Efficient Ethernet (IEEE 802.3az)
  - 128,000 Flexible NetFlow entries in hardware
  - External USB and SD card support for flexible storage options
  - 10/100/1000 RJ-45 console and management port
  - 64,000/32,000 IPv4/IPv6 routing entries for campus access and aggregation deployments
  - IPv6 in hardware, providing wire-rate forwarding for IPv6 networks and support for dual stack with innovative resource usage
  - Dynamic hardware forwarding-table allocations for ease of IPv4-to-IPv6 migration
  - Scalable routing (IPv4, IPv6, and multicast) tables, Layer 2 tables, and access-control-list (ACL) and quality-of-service (QoS) entries to make use of 8 queues per port and comprehensive security policies per port

- Infrastructure services:
  - Cisco IOS XE Software, the modular open application platform for virtualized borderless services.
  - Maximum resiliency with redundant components, Nonstop Forwarding/Stateful Switchover (NSF/SSO), In-Service Software Upgrade (ISSU), and Virtual Switching System (VSS) support.
  - Ability to get up to 10 Gbps per port with Cat6, Cat6a cable and up to 5 Gbps per port with Cat5e cable with Cisco MultiGig support.
  - Network virtualization through Multi-Virtual Route Forwarding (VRF) technology for Layer 3 segmentation.
  - Flexible and future proofed uplinks with Field Programmable Gate Array (FPGA) to support next-generation protocol.
  - Automation through Embedded Event Manager (EEM), Cisco Smart Call Home, AutoQoS, and Auto SmartPorts for fast provisioning, diagnosis, and reporting.
  - Simplification of network configuration and provisioning through APIC-EM. The controller provides a low-risk, incremental approach to adopting software-defined networking (SDN) technologies in branch and campus environments. Using a policy-based approach, the controller automates provisioning of the end-to-end infrastructure to rapidly deploy applications and services.
- Cisco Services:
  - Optimized application performance through deep visibility with Flexible NetFlow supporting rich Layer 2/3/4 information (MAC, VLAN, TCP Flags) and synthetic traffic monitoring with IP service-level agreement (SLA)
  - Onboard troubleshooting with embedded Wireshark
  - Energy-efficient design with Cisco EnergyWise technology
- Investment protection and reduced total cost of ownership (TCO):
  - Full backward compatibility with 24 G, and 48 Gbps slot line cards with no performance degradation.
  - The Supervisor Engine 8L-E is compatible with certain classic Cisco Catalyst 4500 line cards and power supplies, providing full investment protection. It is not compatible with the classic Cisco Catalyst 4500 chassis. When you deploy the Supervisor Engine 8L-E with classic line cards, all of the new features except the 24- and 48-Gbps per-slot switching capacity are inherited.

Table 1 highlights the performance and scalability enhancements of the Cisco Catalyst 4500E Supervisor Engine 8L-E.

Table 1.   Cisco Catalyst 4500E Supervisor Engine 8L-E Performance and Scalability Features

Feature and Description	Supervisor Engine 8L-E
Centralized switching capacity	560 Gbps
Per-slot switching capacity	48 Gbps
Throughput	• 225 Mpps for IPv4 • 110 Mpps for IPv6 • 225 Mpps for L2 Bridging
IPv4 routing entries	64,000
IPv6 routing entries	32,000
Multicast routes	32,000
CPU	Quad core; 1.8 GHz

Feature and Description	Supervisor Engine 8L-E
CPU queues	64
Synchronous Dynamic RAM (SDRAM)	4 GB
Boot flash	2G
Security and QoS hardware entries	64,000
Dynamic Host Configuration Protocol (DHCP) snooping entries	12,000
MAC addresses	55,000
Active VLANs	4,094
Address Resolution Protocol (ARP) entries	47,000
Spanning Tree Protocol instances	12,000
Switched virtual interfaces (SVIs)	4,094
SPAN	8 bidirectional sessions (ingress and egress)

Continued Innovations Through Infrastructure Services

Modular Open Application Platform, Cisco IOS XE Software

Cisco IOS XE Software is the open service platform software operating system for the Cisco Catalyst 4500E Supervisor Engine 8L-E. Cisco continues to evolve Cisco IOS Software to support next-generation switching hardware and provide increased architectural flexibility to deliver borderless networks services. Cisco IOS XE Software provides the following customer benefits:

- Cisco IOS XE Software provides an enhanced operating system that can take advantage of the multicore CPU architecture of the Cisco Catalyst 4500E system.

- Cisco IOS XE Software provides customer investment protection in the existing Cisco IOS Software by keeping a consistent feature set and operational look and feel. This allows a transparent migration experience.

- Cisco IOS XE Software supports service virtualization capability that allows the Cisco Catalyst 4500E to host third-party applications in parallel with Cisco IOS Software. The hosted application can communicate with Cisco IOS Software to use its rich feature sets. This benefit allows a customer to quickly adopt new technologies using proven code, while keeping Cisco IOS Software simple and robust. Cisco IOS XE Software enables Cisco Catalyst 4500E to be an open service platform and is a primary anchor for future Cisco Borderless Networks innovations.

Best-in-Class Resiliency

The Cisco Catalyst 4500E Series is designed for excellent nonstop communications with uninterrupted hardware switching. With Cisco IOS XE Software, customers continue to reap the benefits of this best-in-class resiliency in various ways.

In addition to redundant power supplies, fans, and clock modules, the Cisco Catalyst 4507R+E and 4507R-E rev2 chassis support 1 + 1 supervisor-engine redundancy, using the Supervisor Engine 8L-E. The primary supervisor engine is active and is responsible for normal system operation. The secondary supervisor engine serves as a standby, monitoring the operation of the primary supervisor engine. The resiliency features of the Cisco Catalyst 4500E prevent network outages that could result in lost business and revenue.

ISSU allows you to upgrade or downgrade complete Cisco IOS Software images with minimal (less than 200 msec) to no disruption to the network when using a redundant Cisco Catalyst 4500E Series system with dual Supervisor Engines 8L-E.

Configuration and other control information between two supervisors is fully synchronized to allow a rapid failover mechanism by the standby supervisor in case of primary supervisor engine failure.

In addition to ease of management, ISSU dramatically improves the network reliability and availability in a Layer 2 or Layer 3 environment. NSF/SSO and ISSU are essential for business-critical applications such as voice over IP (VoIP) and virtual desktop infrastructure (VDI) environments.

Also, the Supervisor Engine 8L-E has resiliency built into its uplinks. Table 2 shows the uplink options on the Supervisor Engine 8L-E.

Table 2.   High-Availability and Uplink Options for Supervisor Engine 8L-E in Dual Supervisor Engine Mode

Cisco Virtual Switching Systems (VSS)

Any two Cisco Catalyst 4500E Series Switches with this supervisor engine can be pooled together into a VSS. The two switches are connected with 10/1 Gigabit Ethernet links called Virtual Switch Links (VSLs). These links are enabled through fiber as well as on copper connectivity. After a VSS is created, it acts as a single virtual Cisco Catalyst switch and delivers up to 1 terabit of aggregate bandwidth with 450 Mpps performance. The solution supports up to 480 ports of 1-Gbps and 124 ports of 10-Gbps systems deployed with VSS. Cisco VSS on the Cisco Catalyst 4500E provides the following primary benefits:

- Simplified network operations:
  - Providing a single point of management (with single IP address), it allows any updates, policy changes, and configurations to be synchronized between the two switches, eliminating error-prone manual synchronization.
  - Forming Multichassis EtherChannel (MEC) to the logical switch, Cisco VSS provides a loop-free topology, no longer needing to rely on Spanning Tree Protocol.
  - A single routing instance on the virtual switch eliminates the issues of managing, tuning, and troubleshooting first-hop routing protocols such as Hot Standby Router Protocol (HSRP) and Virtual Router Redundancy Protocol (VRRP).
  - Cisco Prime™ now enables users to centrally manage the pair of switches as a single virtual chassis.
- Resiliency:
  - Stateful failover between the supervisors on the two chassis provides subsecond failover and transparent failover even to delay-sensitive applications such as voice and video.
  - With EtherChannels extended across two physical chassis, it provides for increased resiliency. These links are configured as MEC, minimizing traffic disruption from switch or uplink failure.

- Increased system bandwidth:
  - The active-active MEC extended across two physical chassis provides for dual bandwidth utilization, increasing return on investment (ROI) and reducing additional capital expenditures (CapEx) to add capacity.

Simplified Operations Through Automation

As campus switching has grown to support increasing enterprise demands, so has the need to deploy and manage new and evolving technologies. Simplified operations are critical in meeting these challenges and achieving increased operational efficiency through proactive management and reduction in unplanned network downtime.

The Cisco Catalyst Supervisor Engine 8L-E offers the following rich set of capabilities for simplified operations:

- Auto-Install and AutoQoS for fast deployment
- Config rollback for improved config management
- EEM, Smart Call Home, Generic On-Line Diagnostics (GOLD), and Time Domain Reflectometry (TDR) for simplified operations
- FNF and IP SLA for enhanced visibility
- Cisco EnergyWise technology for simplified power management
- ISSU for simplified change management
- Plug and play capability for ease of deployment

Comprehensive Security with Cisco TrustSec

The Cisco Catalyst 4500E Supervisor Engine 8L-E can be transparently integrated into campus switching environments for a comprehensive security solution based on Cisco TrustSec. The Cisco Catalyst Supervisor Engine 8L-E is a foundational element of the Cisco TrustSec architecture with support for the following functionalities:

- **Device sensor:** The device sensor on the Cisco Catalyst 4500E Supervisor Engine 8L-E enables the ability to recognize the devices connected to the switch. This feature also interoperates with the Cisco Identity Services Engine, providing for a centralized view of all devices that access the network in a scalable manner. When combined with AutoSmartPorts (ASP), it also provides the ability to dynamically apply policies on the switch based on the device type. For more information, visit http://www.cisco.com/en/US/docs/ios-xml/ios/sec_usr_aaa/configuration/15-1sg/sec-dev-sensor.html.
- **Identity-based networking:** The Cisco Catalyst 4500E Supervisor Engine 8L-E has the most rich and robust set of IEEE 802.1X-based identity features to provide the right level of authenticated access to users. It also simplifies identity deployments with features such as Flexible Authentication, WebAuth, and MAC Authentication Bypass (MAB), as well as open mode for undisrupted operations while providing visibility of network access. The identity features also provide integrated support for IP telephony. It also provides for flexible authorization policies with VLAN assignment and dynamic ACLs. For more information, visit http://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst4500/XE3-8-0E/15-24E/configuration/guide/xe-380-configuration/dot1x.html.
- **Network device authentication:** Cisco TrustSec network device authentication provides for an authenticated network infrastructure, minimizing the risk of rogue access to the network using unauthorized network devices.

- **Data confidentiality and integrity:** The Cisco Catalyst 4500E Supervisor Engine 8L-E supports line-rate 10G MACsec encryption based on IEEE 802.1ae with no additional latency. It supports both switch-to-switch and host-to-switch hardware-based encryption on all uplink ports and all WS-X47XX series line cards. For more information, visit http://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst4500/XE3-8-0E/15-24E/configuration/guide/xe-380-configuration/swmacsec.html.
- **Role-based access control:** The Cisco Catalyst 4500E Supervisor Engine 8L-E has hardware support for Cisco TrustSec Secure Group Access (SGA). TrustSec SGA simplifies access control security by defining it in terms of user roles instead of topology-based IP access control lists (ACLs). The Cisco Catalyst 4500E Supervisor Engine 8L-E has hardware support for secure group tagging (SGT) for classifying traffic from users based on roles, as well as secure group access control lists (SGACLs), which are role-based ACLs to apply access control to traffic with the secure group tag. For more information, visit:

    http://www.cisco.com/go/trustsec

    http://www.cisco.com/en/US/docs/switches/lan/trustsec/configuration/guide/config.html

    http://www.cisco.com/en/US/netsol/ns744/networking_solutions_program_home.html

Optimized Application Visibility with Flexible NetFlow

Cisco IOS Flexible NetFlow is the next generation in flow monitoring technology, allowing optimization of the network infrastructure resources, reducing operation costs, and improving capacity planning and security incident detection with increased flexibility and scalability. The Cisco Catalyst 4500E Supervisor Engine 8L-E provides 128,000 Flexible NetFlow entries. Based on a custom-built application-specific integrated circuit (ASIC), the Cisco Catalyst 4500E Supervisor Engine 8L-E delivers unprecedented flexibility and comprehensive flow visibility extending from Layer 2 (MAC and VLAN) to Layer 4 (TCP, UDP flags, and so on).

The flow data collected by Flexible NetFlow can be exported to an external collector for analysis and reporting or tracked by EEM. The Cisco Catalyst 4500E Supervisor Engine 8L-E enables powerful on-box and customizable event correlation and policy actions with EEM, allowing the switches to trigger customized event alarms or policy actions when the predefined condition is met. With no external appliance required, customers are able to use existing infrastructure to perform traffic monitoring, making traffic analysis economical even on large IP networks.

Additional details about Cisco Flexible NetFlow are available at http://www.cisco.com/en/US/prod/collateral/iosswrel/ps6537/ps6555/ps6601/ps6965/product_data_sheet0900aecd804b590b.html.

Investment Protection with Chassis and Line-Card Support

Already-installed Cisco Catalyst 4500E chassis with E-Series line cards can take advantage of the new features and functions of the Supervisor Engine 8L-E on all ports with a simple supervisor-engine upgrade. However, to take advantage of the increased switching capacity of 48 Gbps per slot, the Cisco Catalyst 4500E Series chassis (including R+E chassis) and the select new E-Series line cards are required. You can mix and match Cisco Catalyst 4500E Series line cards and classic line cards in an E-Series chassis with no performance degradation to either line-card type. Table 3 shows the supervisor-engine and line-card slot-assignment options in the Cisco Catalyst 4500E Series chassis.

Table 3.   Cisco Catalyst 4500E Chassis Slot-Assignment Options

Chassis	Single Supervisor Slot Assignments	Redundant Supervisor Slot Assignments	E-Series Line-Card Slot Options	Classic Line-Card Slot Options
Cisco Catalyst 4503-E	Slot 1	-	Slots 2 and 3	Slots 2 and 3
Cisco Catalyst 4506-E	Slot 1	-	Slots 2 through 6	Slots 2 through 6
Cisco Catalyst 4507R+E	Slot 3 or 4	Slot 3 or 4	Slots 1, 2, and 5 to 7	Slots 1, 2, and 5 to 7
Cisco Catalyst 4507R-E[1]	Slot 3 or 4	Slot 3 or 4	Slots 1, 2, and 5 to 7	Slots 1, 2, and 5 to 7

[1] Cisco Catalyst 4507R-E Switch chassis requires hardware revision 2.0 or higher

Table 4 summarizes the performance capacities of the Supervisor Engine 8L-E on a per-chassis basis.

Table 4.   Cisco Catalyst 4500 Supervisor Engine 8L-E Bandwidth per Slot for Different Chassis

	Cisco Catalyst 4503-E Chassis	Cisco Catalyst 4506-E Chassis	Cisco Catalyst 4507R-E Chassis	Cisco Catalyst 4507R+E Chassis
Supervisor Engine 8L-E (WS-X45-Sup 8L-E)	48 Gbps/slot	48 Gbps/slot	24 Gbps/slot	48 Gbps/slot

IPv6 Support

IPv6 is critical for the expansion of IP address space and is being mandated by governments and enterprises worldwide. The Cisco Catalyst 4500 Supervisor Engine 8L-E supports IPv6 Unicast and Multicast in hardware for full line-rate forwarding performance of up to 110 Mpps. The Supervisor Engine 8L-E efficiently and dynamically allocates hardware table resources between IPv4 and IPv6 routes for optimal IPv4-to-IPv6 migration. The Supervisor Engine 8L-E supports Multicast Listener Discovery (MLD) snooping for IPv6, enhancing performance and reducing network traffic by allowing a switch to dynamically add hosts to and remove hosts from a multicast group.

Table 5 highlights the IPv6 capabilities of the Supervisor Engine 8L-E.

Table 5.   Summary of Supervisor Engine 8L-E IPv6 Capabilities

Feature and Description	Supervisor Engine 8L-E
IPv6 support	Unicast and Multicast forwarding done in hardware
IPv6 performance	110 Mpps
IPv6 routing entries	32,000
Dynamic Hardware Route Table allocations	Yes
MLD snooping for IPv6	Yes, in hardware
Unicast Reverse Path Forwarding Version 6 (URPFv6): Strict Mode	Yes, in hardware

Simplified and Scalable Network Virtualization with Easy Virtual Network (EVN)

Enterprise networks use single foundational infrastructure to build multiple logical overlay networks for diversified closed usergroups, regulatory, secure IT applications, and so on. On campuses the traditional Multi-VRF solution is widely adopted and deployed to solve such network segmentation challenges. The Cisco Catalyst 4500E Series platform simplifies virtual network operation and maximizes scalability with the Cisco campus end-to-end Easy Virtual Network (EVN) technology (Figure 2).
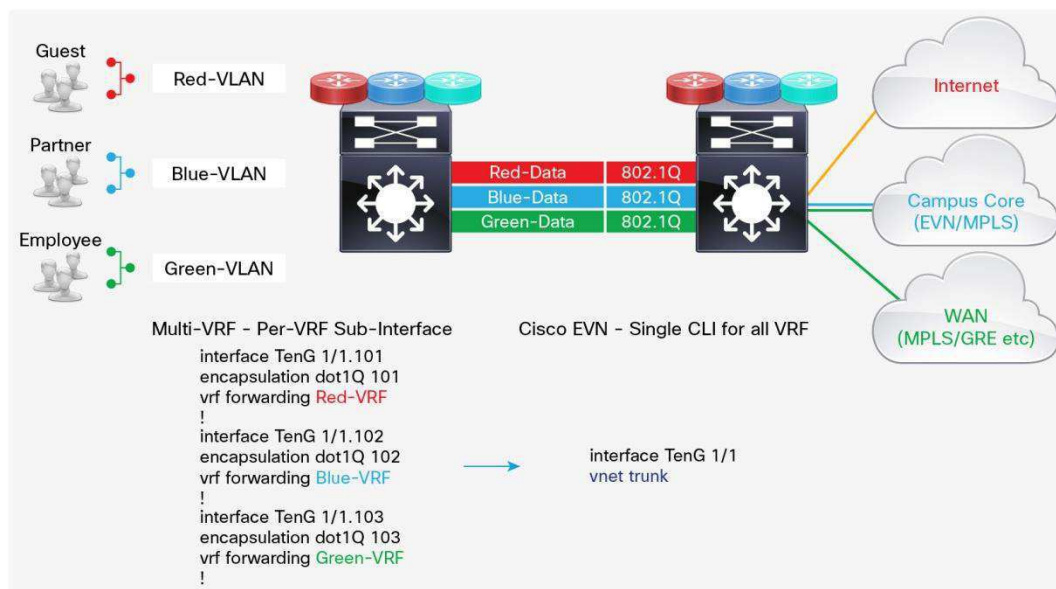
Cisco EVN is a successor solution that offers numerous advantages over traditional Multi-VRF technology:

- Simplified: To simplify campus virtual-network solutions, the Cisco EVN is designed with following three major components:
  - Virtual network (VNET) trunk: The Cisco EVN solution reduces 98 to 99 percent of configuration complexities.
  - Route replication: A simplified unicast and multicast route-leaking capability enables shared network and application services to virtual-network users. It replaces traditional Border Gateway Protocol (BGP)-based route-leaking mechanics.
  - Routing context: Simplified and optimized virtual-network operation and troubleshooting are supported on a per-VRF basis.
- Scalable: Cisco EVN enables flexibility to scale up to 32 virtual network solutions: operationally 4x virtual-network scalability capacity over Multi-VRF technology.
- Interoperable: Cisco EVN provides network topology isolation based on an RFC-defined control plane; for example, Enhanced IGRP (EIGRP), Open Shortest Path First (OSPF), Multicast, and so on. The data-plane security and protection are maintained through industry-standard IEEE 802.1Q. In addition, the Cisco EVN-supported system interoperates with peer Cisco EVN, Multi-VRF, and MPLS systems.

Features at a Glance

- Cisco IOS XE Software LAN Base: This image provides Layer 2 features for campus access.
- Cisco IOS XE Software IP Base: This image is upgradable with a software activation license (SAL). It includes all Layer 2 features and some basic Layer 3 features. ISSU/SSO is supported in this package.
- Cisco IOS XE Software Enterprise Services: This image is upgradable with a SAL; it supports full Layer 3 protocols and advanced features such as complete routing scalability, BGP, VRF, Policy-Based Routing, and so on.

These features can be enabled using the software-licensing mechanism. For details about software licensing, refer to the "Licensing" section later in this document or visit http://www.cisco.com/go/sa.

Industry Standards Supported

- Ethernet: IEEE 802.3
- 10 Gigabit Ethernet: IEEE 802.3ae
- IEEE 802.1D Spanning Tree Protocol
- IEEE 802.1w Rapid Reconfiguration of Spanning Tree
- IEEE 802.1s Multiple VLAN Instances of Spanning Tree
- IEEE 802.3ad LACP
- IEEE 802.1p CoS Prioritization
- IEEE 802.1Q VLAN
- IEEE 802.1X User Authentication
- RMON I and II standards

Supported Cisco Catalyst 4500E Series Line Cards and Modules

- WS-X4748-12X48U+E Cisco Catalyst 4500E Series 48-Port (RJ-45) Line Card with 12 Multigigabit Ports and 36 10/100/1000 Ports with 802.3af PoE, 802.3at PoEP, and UPOE
- WS-X4748-UPOE+E: Cisco Catalyst 4500E Series 48-port 10/100/1000 RJ-45 with 802.3af PoE, 802.3at PoEP, and UPoE
- WS-X4748-RJ45-E: Cisco Catalyst 4500E Series, 48-port 10/100/1000 (RJ-45)
- WS-X4748-RJ45V+E: Cisco Catalyst 4500E 48-Port with 802.3af PoE and 802.3at 10/100/1000 (RJ-45)
- WS-X4712-SFP+E: Cisco Catalyst 4500E Series 12-port 10 Gigabit Ethernet (SFP+)
- WS-X4748-SFP-E: Cisco Catalyst 4500E Series 48 port Gigabit Ethernet Fiber Line Card
- WS-X4724-SFP-E: Cisco Catalyst 4500E Series 24 port Gigabit Ethernet Fiber Line Card
- WS-X4712-SFP-E: Cisco Catalyst 4500E Series 12 port Gigabit Ethernet Fiber Line Card
- WS-X4648-RJ45V+E: Cisco Catalyst 4500E Series, 48-port 802.3af and 802.3at PoE 10/100/1000 (RJ-45)
- WS-X4648-RJ45-E: Cisco Catalyst 4500E Series, 48-port 10/100/1000 (RJ-45)
- WS-X4640-CSFP-E: Cisco catalyst 4500E Series, 40- and 80 port SFP/CSFP Gigabit line card
- WS-X4606-X2-E: Cisco Catalyst 4500E Series, 6-port 10 Gigabit Ethernet (X2)
- WS-X4624-SFP-E: Cisco Catalyst 4500E Series 24-port Gigabit Ethernet (SFP)
- WS-X4612-SFP-E: Cisco Catalyst 4500E Series 12-port Gigabit Ethernet (SFP)
- WS-X4148-FX-MT: Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-port 100BASE-FX multimode fiber (MMF)
- WS-X4148-RJ: Cisco Catalyst 4500 10/100 Module, 48 ports (RJ-45)
- WS-X4248-FE-SFP: Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-port 100BASE-X (SFP)
- WS-X4306-GB: Cisco Catalyst 4500 Gigabit Ethernet Module, 6 ports (GBIC)
- WS-X4448-GB-SFP: Cisco Catalyst 4500 Gigabit Ethernet Module, 48 ports 1000BASE-X (optional SFPs)

Supported Pluggables

For details about the different optical modules and the minimum Cisco IOS Software release required for each of the supported optical modules, visit http://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

Software Requirements

The Cisco Catalyst 4500E Series Supervisor Engine 8L-E is supported only in Cisco IOS Software and is not supported in the Cisco Catalyst Operating System Software. The minimum software version is Cisco IOS XE Software Release 3.8.1.

Environmental Conditions

- Operating temperature: 32 to 104ºF (0 to 40ºC)
- Storage temperature: -40 to 167ºF (-40 to 75ºC)
- Relative humidity: 10 to 90 percent, noncondensing
- Operating altitude: -60 to 3000m

Weight, Power and MTBF Information

Weight = 6.04 lb (2.94 kg)

Active supervisor power = 240W

Standby supervisor power = 120W

These results are not indicative of the actual power draw during operation but rather are the absolute maximum values recommended for facility power and cooling capacity planning. Typical power draw is about 20 percent lower than the maximum value shown.

MTBF = 491,750 hours

Regulatory Standards Compliance

Table 6 shows regulatory standards compliance information, and Table 7 provides ordering information.

Table 6.   Cisco Catalyst 4500 Supervisor Engine 8L-E Regulatory Standards Compliance

Specification	Standard
Regulatory compliance	CE marking
Safety	- UL 60950-1 - CAN/CSA-C22.2 No. 60950-1 - EN 60950-1 - IEC 60950-1 - AS/NZS 60950-1
EMC	47CFR Part 15 Class A - AS/NZS CISPR22 Class A - CISPR22 Class A - EN55022 Class A - ICES003 Class A - VCCI Class A - EN61000-3-2 - EN61000-3-3

Specification	Standard
	• EN55024
	• CISPR24
	• EN300386
	• KN22 Class A
	• KN24
Industry EMC, safety, and environmental standards	• SR-3580 NEBS level 3 GR-63-CORE, issue 3; GR-1089 CORE, issue 4
	• ETS 300 019-2-1, Class 1.2 Storage
	• ETS 300 019-2-2, Class 2.3 Transportation
	• ETS 300 019-2-3, Class 3.2 Stationary Use
ROHS compliance	• ROHS5

Table 7.   Ordering Information

Product Number	Description
WS-X45-SUP8L-E	Cisco Catalyst 4500E Series Supervisor Engine, 560 Gbps
S45EU-S8-38E	Cisco Catalyst 4500 Supervisor Engine 8L-E Cisco IOS Software XE release 3.8.1E
S45EUK9-S8-38E	Cisco Catalyst 4500 Supervisor Engine 8L-E Cisco IOS Software XE release 3.8.1E crypto universal
C4500E-LB	LAN BASE software license
C4500E-IPB	IP BASE software license
C4500E-LIC=	Base product ID for paper delivered software upgrade licenses
C4500E-LB-IPB	LAN BASE to IP BASE upgrade license (paper delivery)
C4500E-LB-ES	LAN BASE to Enterprise Services upgrade license (paper delivery)
C4500E-IP-ES	IP BASE to Enterprise Services upgrade license (paper delivery)
C4500E-LIC-PAK	Base product ID for paper delivered software licenses for spare Supervisor Engine 8L-E
C4500E-IP-ES-S	IP BASE to Enterprise Services upgrade license for spare Supervisor Engine 8L-E (paper delivery)
C4500E-IPB-S	IP BASE software license for spare Supervisor Engine 8L-E (paper delivery)
L-C4500-LIC=	Base product ID for electronically delivered software upgrade licenses
L-C4500E-LB-IP	LAN BASE to IP BASE upgrade license (electronically delivered)
L-C4500E-IP-ES	IP BASE to Enterprise Services upgrade license (electronically delivered)
L-C4500E-LB-ES	LAN BASE to Enterprise Services upgrade license (electronically delivered)
SD-X45-2GB-E	Cisco Catalyst 4500 2GB DRAM Memory for Sup 8L-E

Licensing

Software Activation Licensing

The Cisco Catalyst 4500E platform with Supervisor Engine 8L-E enables software activation licensing. Each Supervisor Engine 8L-E ships with a universal image containing all feature sets, LAN Base, IP Base, and Enterprise Services. The level of functions is determined by the license applied.

- Software activation licensing enables customers to:
  - Speed deployment and roll out new Cisco software activation feature sets across customers' global networks.
  - Centrally and more accurately manage and track software and license compliance.
  - Easily conduct software compliance audits to meet regulations without affecting network operations.

- Simplify operations:
  - Simplified upgrades and license transfers save time and improve productivity; you can add new capabilities simply by using a license file.
  - You can easily track software assets, licenses, and feature set status.
  - A single software image improves service delivery.
- Order easily:
  - "Try and buy" lets you use a temporary license to try and evaluate new Cisco IOS Software functions before purchasing.
  - Pay-as-you-grow software key enables new features incrementally without service calls.

For more information about Cisco software licensing, visit http://www.cisco.com/go/sa.

Cisco Limited Lifetime Hardware Warranty

The Cisco limited lifetime hardware warranty (LLW) includes 10-day advance hardware replacement for as long as the original end user owns the product. Table 8 describes the Cisco limited lifetime hardware warranty.

The formal warranty statement, including the warranty applicable to Cisco software, appears in the Cisco information packet that accompanies your Cisco product. We encourage you to review carefully the warranty statement shipped with your specific product before use.

For additional information on warranty terms, visit http://www.cisco.com/go/warranty.

Table 8.   Limited Lifetime Hardware Warranty

	Cisco Limited Lifetime Hardware Warranty[1]
Warranty duration	The warranty lasts as long as the original end user continues to own or use the product, except for the fan and power supply, which are limited to 5 years.
End-of-life policy	In the event of discontinuance of product manufacture, Cisco warranty support is limited to 5 years from the announcement of discontinuance.
Hardware replacement	Cisco or its service center will use commercially reasonable efforts to ship a replacement part within 10 business days after receipt of the RMA request and confirmation that a replacement part is the appropriate response. Actual delivery times may vary depending on customer location.
Effective date	Hardware warranty commences from the date of shipment to the customer (and in case of resale by a Cisco reseller, not more than 90 days after original shipment by Cisco).
Cisco Technical Assistance Center (TAC) support	None
Cisco.com access	Warranty allows guest access only to Cisco.com.

[1] Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

Adding a Cisco technical services contract to your device coverage provides benefits not available with warranty, including access to the Cisco TAC, a variety of hardware replacement options to meet critical business needs, updates for licensed Cisco IOS Software, and registered access to the extensive Cisco.com knowledge base and support tools. Choose from a flexible suite of support services designed to meet your business needs and help you maintain high-quality network performance while controlling operational costs. Table 9 describes the benefits and features of Cisco Technical Services.

For information about Cisco Technical Services, go to http://www.cisco.com/go/ts.

Table 9. Cisco Technical Services for Cisco Catalyst 4500-E Series Switches

Technical Services
Cisco Smart Net Total Care™ Service
• Around-the-clock, global access to the Cisco TAC
• Unrestricted access to the extensive Cisco.com resources, communities, and tools
• Next-business-day, 8 x 5 x 4, 24 x 7 x 4, and 24 x 7 x 2 advance hardware replacement[2] and onsite parts replacement and installation available
• Ongoing operating system software updates within the licensed feature set[1]
• Proactive diagnostics and real-time alerts on Smart Call Home-enabled devices
Cisco Smart Foundation Service
• Next business day (NBD) advance hardware replacement as available
• Business-hours access to TAC for small and medium-sized businesses (SMBs) (access levels vary by region)
• Access to Cisco.com SMB knowledge base
• Online technical resources through Smart Foundation Portal
• Operating system software bug fixes and patches
Cisco Focused Technical Support Services
Three levels of premium, high-touch services are available:
• Cisco High-Touch Operations Management Service
• Cisco High-Touch Technical Support Service
• Cisco High-Touch Engineering Service
Valid Cisco Smart Net Total Care or SP Base contracts on all network equipment are required.

Footnotes:

[1] Cisco operating system updates include the following: maintenance releases, minor updates, and major updates within the licensed feature set.

[2] Advance hardware replacement is available in various service-level combinations. For example, 8 x 5 x NBD indicates that shipment will be initiated during the standard 8-hour business day, 5 days a week (the generally accepted business days within the relevant region), with NBD delivery. Where NBD is not available, same-day shipment is provided. Restrictions apply; please review the appropriate service descriptions for details.

Cisco and Partner Services

Enable the innovative, secure, intelligent edge in the Borderless Network Architecture using personalized services from Cisco and our partners. Through a discovery process that begins with understanding your business objectives, we help you integrate the next-generation Cisco Catalyst 4500-E Series Switches into your architecture and incorporate network services onto that platform. Sharing knowledge and leading practices, we support your success every step of the way as you deploy, absorb, manage, and scale new technology.

For additional information about Cisco Services, visit http://www.cisco.com/go/services.

Cisco Capital

Financing to Help You Achieve Your Objectives

Cisco Capital® can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx, accelerate your growth, and optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.
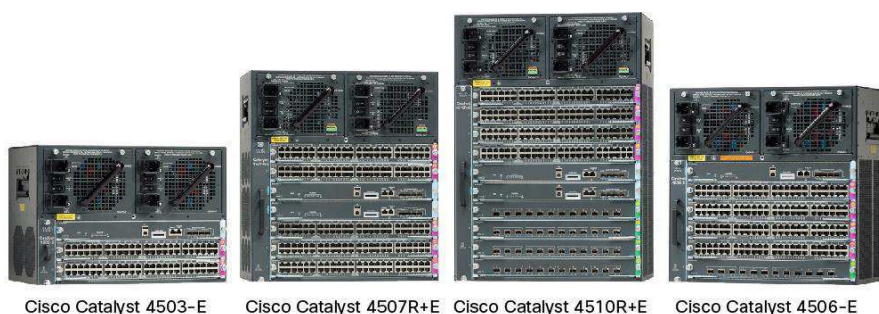
Cisco Catalyst 4500 Series Switch

Overview

The Cisco® Catalyst® 4500 Series Switches enable Borderless Networks, providing high performance, mobile, and secure user experiences through Layer 2-4 switching investments. They enable security, mobility, application performance, video, and energy savings over an infrastructure that supports resiliency, virtualization, and automation. Cisco Catalyst 4500 Series Switches provide borderless performance, scalability, and services with reduced total cost of ownership (TCO) and superior investment protection.

The Cisco Catalyst 4500 (Figure 1) has a centralized forwarding architecture that enables collaboration, virtualization, and operational manageability through simplified operations. With forward and backward compatibility spanning multiple generations, the new Cisco Catalyst 4500E Series provides exceptional investment protection and deployment flexibility to meet the evolving needs of organizations of all sizes. The Cisco Catalyst 4500E Series platform has 10 Gigabit Ethernet (GE) uplinks and supports Power over Ethernet Plus (PoE+) and Universal PoE (UPOE), enabling customers to future proof their network.

E-Series chassis come in four different form factors: 3-slot (4503-E), 6-slot (4506-E), 7-slot (4507R+E), and 10-slot (4510R+E). 4503-E, 4506-E, 4507R+E, and 4510R+E chassis are extremely flexible and support either 24 or 48 Gbps per line-card slot. Integrated resiliency in the Cisco Catalyst 4500E Series includes 1 + 1 supervisor engine redundancy (10-slot and 7-slot chassis only), redundant fans, software-based fault tolerance, and 1 + 1 power supply redundancy. Integrated resiliency in both hardware and software minimizes network downtime, helping to ensure workforce productivity, profitability, and customer success.

Figure 1. Cisco Catalyst 4500E Series

Cisco Catalyst 4503–E   Cisco Catalyst 4507R+E   Cisco Catalyst 4510R+E   Cisco Catalyst 4506–E

The Cisco Catalyst 4500E Series extends control to the network edge with intelligent network services, including sophisticated quality of service (QoS), predictable performance, advanced security, comprehensive management, and integrated resiliency. Scalability of these intelligent network services is made possible with dedicated, specialized resources known as ternary content-addressable memory (TCAM). Ample TCAM resources (up to 384,000 entries) enable "high feature capacity", which provides wire-speed routing and switching performance independent of provisioning of services such as QoS and security.

Cisco Catalyst 4500E Series Chassis

The Cisco Catalyst 4500E Series offers four chassis options and four supervisor engine options (Table 1). It provides a common architecture that can scale up to 388 ports. The Cisco Catalyst redundant R+E chassis offer high availability by supporting 1 + 1 redundant supervisor engines with subsecond failover time and full-image In-Service Software Upgrades (ISSUs). Nonstop forwarding with stateful switchover (NSF/SSO) and ISSU help ensure continuous packet forwarding during supervisor engine switchover to help ensure high availability for collaboration applications and voice over IP (VoIP). Using the same line cards as the widely deployed Cisco Catalyst 4000 Series Switches and classic Cisco Catalyst 4500 Series Switches, the Cisco Catalyst 4500E Series furthers Cisco's commitment to affordable enterprise and branch-office scalability.

Table 1.   Cisco Catalyst 4500E Series Chassis Features

Feature	Cisco Catalyst WS-C4503-E Chassis	Cisco Catalyst WS C4506-E Chassis	Cisco Catalyst WS C4507R+E Chassis	Cisco Catalyst WS C4510R+E Chassis
Total number of slots	3	6	7	10
Line-card slots	2	5	5	8
Supervisor engine slots	1[1]	1[1]	2[2]	2[3]
Dedicated supervisor engine slot numbers	1	1	3 and 4	5 and 6
Supervisor engine redundancy	No	No	Yes	Yes Supervisor Engines V-10GE, 6-E, 7-E, and 8-E)
Supervisor engines supported	Supervisor Engines 8-E, 8L-E, 7-E, 7L-E, 6-E, and 6L-E	Supervisor Engines 8-E, 8L-E, 7-E, 7L-, 6-E, and 6L-E	Supervisor Engines 8-E, 8L-E, 7-E, 7L-E, 6-E, and 6L-E	Supervisor Engines 8-E, 7-E, and 6-E[4]
Maximum PoE per slot	1500W	1500W	1500W	1500W slots 1 and 2; 750W slots 3, 4, and 7-10
Bandwidth scalability per line-card slot	Up to 48 Gbps on all slots	Up to 48 Gbps on all slots	Up to 48 Gbps on all slots[5]	Up to 48 Gbps on all slots[5]
Number of power supply bays	2	2	2	2
AC input power	Yes	Yes	Yes	Yes
DC input power	Yes	Yes	Yes	Yes
Integrated PoE	Yes	Yes	Yes	Yes
Minimum number of power supplies	1	1	1	1
Power supplies supported	• 1000W AC • 1400W AC • 1300W ACV • 2800W ACV • 4200W ACV • 6000W ACV • 9000W ACV • 1400W DC (triple input) • 1400W-DC-P	• 1000W AC • 1400W AC • 1300W ACV • 2800W ACV • 4200W ACV • 6000W ACV • 9000W ACV • 1400W DC (triple input) • 1400W-DC-P	• 1000W AC • 1400W AC • 1300W ACV • 2800W ACV • 4200W ACV • 6000W ACV • 9000W ACV • 1400W DC (triple input) • 1400W-DC-P	• 1400W AC • 2800W ACV • 4200W ACV • 6000W ACV • 9000W ACV • 1400W DC (triple input) • 1400W-DC-P
Number of fan-tray bays	1	1	1	1
Location of 19-inch rack-mount	Front	Front	Front	Front
Location of 23-inch rack-mount	Front (option)	Front (option)	Front (option)	Front (option)

[1] Slot 1 is reserved for supervisor engine only; slots 2 and higher are reserved for line cards.

[2] Slots 3 and 4 are reserved for supervisor engines only in Cisco Catalyst 4507R+E; slots 1-2 and 5-7 are reserved for line cards.

[3] Slots 5 and 6 are reserved for supervisor engines only in Cisco Catalyst 4510R+E; slots 1-4 and 7-10 are reserved for line cards.

[4] 6 Gbps only on slots 8-10.

[5] WS-C4507R+E and WS-C4510R+E chassis support up to 24 Gbps per line-card slot when used with Supervisor Engine 6-E.

Configuration Alternatives

The Cisco Catalyst 4500 Series offers a powerful and flexible network solution that can be built with eight supervisor engine alternatives. Each provides a high-performance, centralized, shared-memory switch fabric, protecting your line-card investment by supporting the addition of optional higher layer engines (Table 2).

Table 2.   Cisco Catalyst 4500E Series Supervisor Engine Support

Feature	Cisco Catalyst 4500 Series Supervisor Engine 6L-E	Cisco Catalyst 4500 Series Supervisor Engine 6-E	Cisco Catalyst 4500 Series Supervisor Engine 8-E, 7-E	Cisco Catalyst 4500 Series Supervisor Engine 8L-E, 7L-E
Cisco Catalyst WS-C4503-E chassis	24 Gbps/slot	24 Gbps/slot	48 Gbps/slot	48 Gbps/slot
Cisco Catalyst WS-C4506-E chassis	24 Gbps/slot	24 Gbps/slot	48 Gbps/slot	48 Gbps/slot
Cisco Catalyst WS-C4507R+E chassis	24 Gbps/slot	24 Gbps/slot	48 Gbps/slot	48 Gbps/slot
Cisco Catalyst WS-C4510R+E chassis	Not supported	24 Gbps/slot (slot 1-7) 6 Gbps/slot (slot 8-10)	48 Gbps/slot	Not supported

The Cisco Catalyst 4500 Series has flexible interface types and port densities that allow you to mix and match network configurations to meet the specific needs of campus networks (Table 3).

Table 3.   Cisco Catalyst 4500 Series Port Densities

Cisco Catalyst 4500 Series Switching Modules	Number of Interfaces Supported per Line Card	Cisco Catalyst 4503-E	Cisco Catalyst 4506-E	Cisco Catalyst 4507R+E	Cisco Catalyst 4510R+E
Switched 10/100 Fast Ethernet (RJ-45)	48	96	240	240	384
Switched 10/100 Fast Ethernet (RJ+45) with IEEE 802.3af at Power over Ethernet (PoE/PoE+)	48	96	240	240	384
Switched 100 FX Fast Ethernet (MT-RJ)	48	96	240	240	384
Switched 1000BASE-X (fiber)	6, 18, or 48	100	244	244	388
Switched 10/100/1000BASE-T Gigabit Ethernet	48	96	240	240	384
Switched 10/100/1000BASE-T Gigabit Ethernet with IEEE 802.3af at PoE/PoE+	48	96	240	240	384
Switched 10/100/1000BASE-T Gigabit Ethernet with UPOE	48	96	240	240	384
Switched 10 Gigabit Ethernet	6 or 12	32	68	68	104

Configuration Flexibility and Modular Superiority

You can mix and match Cisco Catalyst 4500 Series Line Cards to suit numerous LAN access, server connectivity, small and medium-sized business (SMB), or branch-office deployments. The Cisco Catalyst 4500 Series supports the line cards listed in Table 4 by part number.

Table 4.   Cisco Catalyst 4500 Series Line Cards

Product Number	Description
Cisco Catalyst 4500E Series Line Cards	
WS-X4748-12X48U+E	Cisco Catalyst 4500E 48-Port UPOE w/ 12-Port MultiGigabit and 36-Port 10/100/1000
WS-X4748-UPOE+E	Cisco Catalyst 4500E Series 48-Port UPOE 10/100/1000 (RJ-45)
WS-X4748-RJ45V+E	Cisco Catalyst 4500E Series 48-Port 802.3at PoEP 10/100/1000 (RJ-45)
WS-X4748-RJ45-E	Cisco Catalyst 4500E Series 48-Port 10/100/1000 (RJ-45)
WS-X4712-SFP+E	Cisco Catalyst 4500E Series 12-port 10 Gigabit Ethernet (SFP+)
WS-X4748-SFP-E	Cisco Catalyst 4500E Series 48-Port GE (SFP)
WS-X4724-SFP-E	Cisco Catalyst 4500E Series 24-Port GE (SFP)
WS-X4712-SFP-E	Cisco Catalyst 4500E Series 12-Port GE (SFP)
WS-X4624-SFP-E	Cisco Catalyst 4500E Series 24-port GE (SFP)
WS-X4612-SFP-E	Cisco Catalyst 4500E Series 12-port GE (SFP)
WS-X4648-RJ45V-E	Cisco Catalyst 4500E Series 48-Port PoE 10/100/1000(RJ45)
WS-X4648-RJ45V+E	Cisco Catalyst 4500E Series 48-Port Premium PoE 10/100/1000(RJ45)
WS-X4606-X2-E	Cisco Catalyst 4500E Series 6-Port 10GE (X2)
WS-X4648-RJ45-E	Cisco Catalyst 4500E Series 48-Port Data 10/100/1000(RJ45)
Cisco Catalyst 4500 Classic 10/100 Line Cards	
WS-X4148-RJ	Cisco Catalyst 4500 10/100 Auto Module, 48-Port (RJ-45)
WS-X4248-RJ45V	Cisco Catalyst 4500 PoE 802.3af 10/100, 48-Port (RJ-45)
Cisco Catalyst 4500 Classic 10/100/1000 Line Cards	
WS-X4548-GB-RJ45	Cisco Catalyst 4500 Enhanced 48-Port 10/100/1000 Module (RJ-45)
WS-X4548-RJ45V+	Cisco Catalyst 4500 48-Port 802.3af PoE and 802.3at PoEP 10/100/1000 (RJ-45)
WS-X4548-GB-RJ45V	Cisco Catalyst 4500 PoE IEEE 802.3af 10/100/1000, 48 Ports (RJ-45)
Cisco Catalyst 4500 Classic 100 BASE-X FE Line Cards	
WS-X4148-FX-MT	Cisco Catalyst 4500 Series 48-Port 100BASE-FX Fast Ethernet Line Card (MT-RJ) for multimode fiber
WS-X4248-FE-SFP	Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-Port 100BASE-X (SFP)
Cisco Catalyst 4500 Classic 1000 BASE-X GE Line Cards	
WS-X4506-GB-T	Cisco Catalyst 4500 6-Port 10/100/1000 RJ-45 PoE IEEE 802.3af and 1000BASE-X (SFP)
WS-X4418-GB	Cisco Catalyst 4500 Gigabit Ethernet Module, Server Switching 18 Ports (GBIC)
WS-X4448-GB-SFP	Cisco Catalyst 4500 Gigabit Ethernet Module, 48 Ports 1000X (SFP)

Table 5 lists the minimum software requirements for the Cisco Catalyst 4500 supervisor engines.

Table 5.   Cisco Catalyst Supervisor Engine Software Minimum Requirements

Chassis	Supervisor Engine	Minimum Software Requirement
Cisco WS-C4503-E and WS-C4506-E	Supervisor Engine 6-E	Cisco IOS® Software Release 12.2(40)SG
	Supervisor Engine 6L-E	Cisco IOS Software Release 12.2(52)SG
	Supervisor Engine 7-E	Cisco IOS XE Software Release 3.0(1)SG
	Supervisor Engine 7L-E	Cisco IOS XE Software Release 3.2.0XO
	Supervisor Engine 8-E	Cisco IOS XE Software Release 3.3.0XO
	Supervisor Engine 8L-E	Cisco IOS XE Software Release 3.8.1E

Chassis	Supervisor Engine	Minimum Software Requirement
Cisco WS-C4507R+E	Supervisor Engine 6-E	Cisco IOS Software Release 12.2(54)SG
	Supervisor Engine 6L-E	Cisco IOS Software Release 12.2(54)SG
	Supervisor Engine 7-E	Cisco IOS XE Software Release 3.0(1)SG
	Supervisor Engine 7L-E	Cisco IOS XE Software Release 3.2.0XO
	Supervisor Engine 8-E	Cisco IOS XE Software Release 3.3.0XO
	Supervisor Engine 8L-E	Cisco IOS XE Software Release 3.8.1E
Cisco WS-C4510R+E	Supervisor Engine 6-E	Cisco IOS Software Release 12.2(54)SG
	Supervisor Engine 7-E	Cisco IOS XE Software Release 3.0(1)SG
	Supervisor Engine 8-E	Cisco IOS XE Software Release 3.3.0XO

Managing the Cisco Catalyst 4500E Series Switch

Network management applications are instrumental in lowering operating expenditures (OpEx) while improving network availability by simplifying and automating many of the day-to-day tasks associated with managing an end-to-end network. The Cisco Catalyst 4500 Series Switches offer both a superior CLI for detailed configuration and Cisco Prime™ infrastructure for unified wired plus wireless management. Prime infrastructure provides day 0 and ongoing provisioning, ongoing monitoring and maintenance, configuration templates, and device and user 360-degree views and serves as the FNF collector for user traffic views using the Prime Assurance Manager module.

For detailed information about Cisco Prime infrastructure, go to
http://www.cisco.com/en/US/products/ps12239/index.html.

Unified Access One Management

Cisco Prime Infrastructure combines the wireless functionality of Cisco Prime Network Control System (NCS) and the wired functionality of Cisco Prime LAN Management Solution (LMS) with rich application performance monitoring and troubleshooting capabilities of Cisco Prime Assurance Manager.

This single solution can enable IT organizations to consolidate tools and converge workflows, reducing operational overhead and increasing productivity. It provides a new operational model based on lifecycle processes aligned with the way network operators do their jobs.

Cisco Prime Infrastructure provides:

- Converged wired and wireless management of access, branch, and wide area networks
- Comprehensive network lifecycle management, including user access visibility, inventory, configuration management, plug and play, radio frequency planning, and best practices reporting
- End-to-end application and service assurance visibility to quickly isolate and troubleshoot performance issues, using technologies such as flexible NetFlow, Network-Based Application Recognition (NBAR), and Medianet Performance Agent
- Prime 360 Experience providing a relational, multidimensional view of users, applications, and network to simplify the diagnostics and remediation of network and service affecting issues

Cisco Prime Infrastructure is built with scalability and extensibility in mind. It has the ability to manage global enterprise networks with thousands of network devices and hundreds of thousands of access devices, or smaller commercial networks with the same level of control and resiliency. It also provides powerful REST-based APIs enabling IT and service organizations to gather and distribute network information for operations, capacity planning, automation, and business intelligence.

Physical Specifications

Table 6 lists physical specifications.

Table 6. Physical Specifications of Cisco Catalyst 4500 Series Chassis

Specification	WS-C4503-E	WS-C4506-E	WS-C4507R+E	WS-C4510R+E
Dimensions (H x W x D)	12.25 x 17.31 x 12.50 in. (31.12 x 43.97 x 31.70 cm)	17.38 x 17.31 x 12.50 in. (44.13 x 43.97 x 31.70 cm)	19.19 x 17.31 x 12.50 in. (48.74 x 43.97 x 31.70 cm)	24.35 x 17.31 x 12.50 in. (61.84 x 43.97 x 31.70 cm)
Rack units (RU)	7RU	10RU	11RU	14RU
Chassis weight (with fan tray)	32.25 lb (14.63 kg)	40.50 lb (18.37 kg)	44.50 lb (20.19 kg)	54.50 lb (24.73 kg)
Mounting	19- and 23-in. rack compatible (19-in. rack and cable guide hardware included)	19- and 23-in. rack compatible (19-in. rack and cable guide hardware included)	19- and 23-in. rack compatible (19-in. rack and cable guide hardware included)	19- and 23-in. rack compatible (19-in. rack and cable guide hardware included)

Power Supply Indicators and Interfaces

- Output Fail LED (per unit): RED
- Input OK LED(per input): Green
- Fan OK LED(per input): Green

Tables 7 and 8 describe power supply specification.

Table 7. Cisco Catalyst 4500E Series Power Supply Specifications (Data Only)

Power Supply	1000W AC	1400W AC	1400W DC Triple Input
Integrated PoE	No (data only)	No (data only)	No (data only)
Input current (rated)	12A at 100 VAC, 5A at 240 VAC	16A at 100 VAC, 7A at 240 VAC	Two -48 VDC at 15A; One -48 VDC at 12.5A
Output current (data)	• 12V at 83.4A • 3.3V at 12.2A	• 12V at 113.4A • 3.3V at 12.2A	• 12V at 1360W • 3.3V at 40W
Output power redundant mode (data)	1000W + 40W	1360W + 40W	1400W + 40W
Output power combined mode (data)	1667W	2473W	-
Heat dissipation	943 BTU per hour	1048 BTU per hour	1048 BTU per hour
Holdup time	20 ms	20 ms	8 ms
Hot-swappable	Yes	Yes	Yes

Table 8. Cisco Catalyst 4500E Series Power Supply Specifications (Data and PoE)

Power Supply	1300W AC	2800W AC	4200W AC	6000 AC	9000 AC	1400W DC with Power Entry Module (PEM)
Integrated PoE	Yes (up to 800W)	Yes (up to 1400W)	Yes (up to 3855W)	Yes (up to 4800W)	Yes (up to 7500W)	Up to 7500W (minus the power consumed for data) when connected directly to a DC power plant or 2 external AC power shelves

Power Supply	1300W AC	2800W AC	4200W AC	6000 AC	9000 AC	1400W DC with Power Entry Module (PEM)
Input current (rated)	• 16A at 100 VAC • 7A at 240 VAC	• 16A at 200 VAC	• Two 12A at 100 VAC Or • Two 12A at 200 VAC	• Two 12A at 100 VAC Or • Two 16A at 200 VAC	• Three 12A at 100 VAC Or • Three 16A at 200 VAC	• 31A at -60 VDC (data only) • 180A at -48 VDC (PoE)
Output current (data)	• 12V at 84.7A • 3.3V at 12.5A	• 12V at 113.3A • 3.3V at 12.5A	• 12V at 115.3A • 3.3V at 12.5A	• 12V at 186.9A • 3.3V at 12.5A	• 12V at 163.3A • 3.3V at 12.5A	• 12V at 120A • 3.3V at 12.5A
Output current (PoE)	-50V at 16.7A	-50V at 28A	-50V at 77.1A (200V) -50V at 38A (100V)	-50V at 100.0A (200V) -50V at 38.5A (120V)	-50V at 150.0A (200V) -50V at 50.0A (120V)	140A at -48/-60 VDC
Output power redundant mode (data)	1000W + 40W	1360W + 40W	1383W + 40W	2200W + 40W	1960W + 40W	1360W + 40W
Output power redundant mode (PoE)	800W maximum per power supply	1400W maximum per power supply	• 3700W (220V) • 1850W (110V)	• 4800W (220V) • 1850W (110V)	• 7500W (220V) • 2500W (110V)	Up to 7500W (minus the power consumed for data)
Output power combined mode (data)	1667W	2473W	2766W	4400W	3920W	-
Output power combined mode (PoE)	1333W	2333W	6700W (220V) 3360W (110V)	8700W (220V) 3360W (110V)	14,400W (220V) 4150W (110V)	3800W (100V)
Heat dissipation	1568 BTU/hr	2387 BTU/hr	3580 BTU/hr	2720 BTU/hr	3010 BTU/hr	Data only: 1591 BTUs per hour Data and voice: 2905 BTUs per hour
Holdup time	20 ms	20 ms	20 ms	20 ms	20 ms	4 ms
Hot swappable	Yes	Yes	Yes	Yes	Yes	Yes

Additional notes for Tables 7 and 8:

- Output power is per power supply unless otherwise stated.

- Heat-dissipation numbers represent the power-conversion losses of the power supply in operation.

- The number of power devices supported depends on customer configuration.

Fan Trays

Each Cisco Catalyst 4500E Series uses a single fan tray for cooling. All fan trays are composed of independent fans. If one fan fails, the system will continue to operate without a significant degradation in cooling. The system will detect and notify the user (through LED, CLI, and Simple Network Management Protocol [SNMP]) that a fan has failed and the tray needs to be replaced.

Environmental Conditions

The Cisco Catalyst 4500 and 4500E Series require the following conditions:

- Operating temperature: 32 to 104ºF (0 to 40ºC)

- Storage temperature: -40 to 167ºF (-40 to 75ºC)

- Relative humidity: 10 to 90 percent, noncondensing

- Operating altitude: -60 to 3000 meters (m)

Regulatory Standards Compliance

Table 9 lists the regulatory standards compliance of the Cisco Catalyst 4500 and 4500E Series.

Table 9.   Regulatory Standards Compliance

Specification	Standard
Regulatory compliance	CE Marking
Safety	• UL 60950 • CAN/CSA-C22.2 No. 60950 • EN 60950 • IEC 60950 • TS 001 • AS/NZS 3260
EMC	• FCC Part 15 (CFR 47) Class A • ICES-003 Class A • EN55022 Class A • CISPR22 Class A • AS/NZS 3548 Class A • VCCI Class A • EN 50121-4 • EN 55022 • EN 55024 • EN 61000-6-1 • EN 50082-1 • EN 61000-3-2 • EN 61000-3-3 • ETS 300 386
Industry EMC, safety, and environmental standards	• NEBS Level 3 • ETS 300 019 Storage Class 1.1 • ETS 300 019 Transportation Class 2.3 • ETS 300 019 Stationary Use Class 3.1 • ETS 300 386
Telecom (E1)	• CTR 12/13 • CTR 4 • ACA TS016
Telecom (T1)	• FCC Part 68 • Canada CS-03 • JATE Green Book
ROHS compliance	ROHS5

Power and MTBF Information

Table 10 gives power and mean-time-between-failures (MTBF) information for different chassis.

Table 10.   Power and MTBF Information

Part Number	Maximum Rated Power (W)	Rated MTBF (Hours)
WS-C4503-E	60	1,064,279
WS-C4506-E	120	710,119
WS-C4507R+E	135	248,630
WS-C4510R+E	200	179,714

Note: All power numbers shown in Table 10 are maximum values recommended for facility power and cooling capacity planning. These figures are not indicative of the actual power draw during operation. Typical power draw is about 20 percent lower than the maximum value shown.

Ordering Information

Table 11 lists the ordering information for chassis, power supplies, supervisor engines, and memory that are commonly used with the Cisco Catalyst 4500 Series.

Table 11. Ordering Information

Product Number	Description
WS-C4503-E	Cisco Catalyst E-Series 4503 switch (3-slot chassis), fan, no power supply
WS-C4506-E	Cisco Catalyst E-Series 4506 switch (6-slot chassis), fan, no power supply
WS-C4507R+E	Cisco Catalyst E-Series 4507R+E switch (7-slot chassis), fan, no power supply, redundant supervisor capable
WS-C4510R+E	Cisco Catalyst E-Series 4510R+E switch (10-slot chassis), fan, no power supply; redundant supervisor capable
PWR-C45-1000AC	Cisco Catalyst 4500 Series 1000W AC power supply (data only)
PWR-C45-1400AC	Cisco Catalyst 4500 Series 1400W AC power supply (data only)
PWR-C45-1300ACV	Cisco Catalyst 4500 Series 1300W AC power supply (with integrated PoE)
PWR-C45-2800ACV	Cisco Catalyst 4500 Series 2800W AC power supply (with integrated PoE)
PWR-C45-4200ACV	Cisco Catalyst 4500 Series 4200W AC power supply (with integrated PoE)
PWR-C45-6000ACV	Cisco Catalyst 4500 Series 6000W AC power supply (with integrated PoE)
PWR-C45-9000ACV	Cisco Catalyst 4500 Series 9000W AC power supply (with integrated PoE)
PWR-C45-1400DC-P	Cisco Catalyst 4500 Series 1400W DC power supply with integrated power entry module (PEM)
PWR-C45-1400DC	Cisco Catalyst 4500 Series triple input 1400W DC power supply (data only)
WS-X4516-10GE	Cisco Catalyst 4500 Series Supervisor Engine V-10GE
WS-X45-Sup6-E	Cisco Catalyst 4500 Series Supervisor Engine 6-E
WS-X45-Sup6L-E	Cisco Catalyst 4500 Series Supervisor Engine 6L-E
WS-X45-Sup7-E	Cisco Catalyst 4500 Series Supervisor Engine 7-E
WS-X45-Sup7L-E	Cisco Catalyst 4500 Series Supervisor Engine 7L-E
WS-X45-Sup8-E	Cisco Catalyst 4500 Series Supervisor Engine 8-E
WS-X45-Sup8L-E	Cisco Catalyst 4500 Series Supervisor Engine 8L-E
MEM-C4K-FLD64M	Compact Flash memory, 64-MB option
MEM-C4K-FLD128M	Compact Flash memory, 128-MB option

Licensing for Cisco Catalyst 4500E Series

The three feature sets available with Cisco Catalyst 4500E Series Switches are:

- Cisco IOS XE Software LAN Base: This feature set on the bundles provides Layer 2 features for access.
- Cisco IOS XE Software IP Base: This feature set is upgradable with a software activation license (SAL). It includes all Layer 2 features and some basic Layer 3 features. ISSU and SSO are supported in this package.
- Cisco IOS XE Software Enterprise Services: This feature set is upgradable with a SAL; it supports full Layer 3 protocols and advanced features such as complete routing scalability, Border Gateway Protocol (BGP), Virtual Route Forwarding (VRF), Policy-Based Routing (PBR), and so on.

These features can be enabled using the software-licensing mechanism. For details about software licensing, refer to http://www.cisco.com/go/sa.

Cisco ONE Software

Cisco ONE Software for Access Switching is available for the Cisco Catalyst 4500E Series Switches.

Cisco ONE Software is a new way for customers to purchase and use our infrastructure software. It offers a simplified consumption model, centered on common customer scenarios in the data center, WANs, and LANs.

Cisco ONE Software and services provide customers with four primary benefits:

- Software suites that address typical customer use scenarios at an attractive price
- Investment protection of their software purchase through software services-enabled license portability
- Access to ongoing innovation and new technology with Cisco Software Support Service (SWSS)
- Flexible licensing models to smoothly distribute customer's software spend over time

For ordering information for Cisco ONE Software for the Cisco Catalyst 4500E Series Switches, go to http://www.cisco.com/c/en/us/products/software/one-access/switching-part-numbers.html.

Cisco Limited Lifetime Hardware Warranty

The Cisco Limited Lifetime Hardware Warranty (LLW) includes 10-day advance hardware replacement for as long as the original end user owns the product. Table 12 describes the warranty.

Your formal warranty statement, including the warranty applicable to Cisco software, appears in the Cisco information packet that accompanies your Cisco product. We encourage you to review carefully the warranty statement shipped with your specific product before use.

For additional information about warranty terms, visit http://www.cisco.com/go/warranty.

Table 12.   Limited Lifetime Hardware Warranty

	Cisco Limited Lifetime Hardware Warranty[1]
Warranty duration	As long as the original end user continues to own or use the product.
End-of-life policy	In the event of discontinuance of product manufacture, Cisco warranty support is limited to 5 years from the announcement of discontinuance.
Hardware replacement	Cisco or its service center will use commercially reasonable efforts to ship a replacement part within 10 business days after receipt of the return materials authorization (RMA) request and confirmation that a replacement part is appropriate response. Actual delivery times may vary depending on customer location.
Effective date	Hardware warranty commences from the date of shipment to the customer (and in case of resale by a Cisco reseller, not more than 90 days after original shipment by Cisco).
Cisco Technical Assistance Center (TAC) support	None
Cisco.com access	Warranty allows guest access only to Cisco.com.

[1] Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

Cisco and Partner Services for Expanding the Borderless Network

Encourage Borderless Networks innovation, optimize operational efficiencies, establish business flexibility, and gain competitive advantage using intelligent, personalized services from Cisco and our partners. Through a discovery process that begins with understanding your business objectives, we help you integrate the next-generation Cisco Catalyst 4500-E Series Switches into your architecture and incorporate network services onto that platform. Sharing knowledge and leading practices, we support your success every step of the way as you deploy, absorb, manage, and scale new technology.

For additional information about Cisco services, visit http://www.cisco.com/go/services.

Adding a Cisco technical services contract to your device coverage provides benefits not available with warranty, including access to the Cisco TAC, a variety of hardware replacement options to meet critical business needs, updates for licensed Cisco IOS Software, and registered access to the extensive Cisco.com knowledge base and support tools. Choose from a flexible suite of support services designed to meet your business needs and help you maintain high-quality network performance while controlling operating costs. Table 13 shows the Cisco technical services available for Cisco Catalyst 4500-E Series Switches.

For information about Cisco Technical Services, visit http://www.cisco.com/go/ts.

Table 13.   Cisco Technical Services for Cisco Catalyst 4500-E Series Switches

Technical Services
Cisco Smart Net Total Care™ Service • Twenty-four-hour global access to the Cisco TAC • Unrestricted access to the extensive Cisco.com resources, communities, and tools • Next-business-day, 8 x 5 x 4, 24 x 7 x 4, and 24 x 7 x 2 advance hardware replacement[2] and onsite parts replacement and installation available • Ongoing operating system software updates within the licensed feature set[1] • Proactive diagnostics and real-time alerts on Smart Call Home-enabled devices
Cisco Smart Foundation Service • Next-business-day (NBD) advance hardware replacement as available • Business hours access to SMB TAC (access levels vary by region) • Access to Cisco.com SMB knowledge base • Online technical resources through Smart Foundation Portal • Operating system software bug fixes and patches
Cisco Focused Technical Support Services Three levels of premium, high-touch services are available: • Cisco High-Touch Operations Management Service • Cisco High-Touch Technical Support Service • Cisco High-Touch Engineering Service Valid Cisco Smart Net Total Care or SP Base contracts on all network equipment are required.

Notes:

[1] Cisco operating system updates include the following: maintenance releases, minor updates, and major updates within the licensed feature set.

[2] Advance hardware replacement is available in various service-level combinations. For example, 8 x 5 x NBD indicates that shipment will be initiated during the standard 8-hour business day, 5 days a week (the generally accepted business days within the relevant region), with next-business-day (NBD) delivery. Where NBD is not available, same-day shipping is provided. Restrictions apply; review the appropriate service descriptions for details.

Cisco Capital

Financing to Help You Achieve Your Objectives

Cisco Capital can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.

Cisco ASA with FirePOWER Services

Meet the industry's first adaptive, threat-focused next-generation firewall (NGFW) designed for a new era of threat and advanced malware protection. Cisco® ASA with FirePOWER Services delivers integrated threat defense for the entire attack continuum - before, during, and after an attack. How? By combining the proven security capabilities of the Cisco ASA firewall with the industry-leading Sourcefire® threat and Advanced Malware Protection (AMP) features together in a single device. The solution uniquely extends the capabilities of the Cisco ASA 5500-X Series Next-Generation Firewalls beyond what today's NGFW solutions are capable of. Whether you need protection for a small or midsized business, a distributed enterprise, or a single data center, Cisco ASA with FirePOWER Services provides the needed scale and context in a NGFW solution.

Superior Multilayered Protection

Cisco ASA with FirePOWER Services brings distinctive threat-focused next-generation security services to the Cisco ASA 5500-X Series Next-Generation Firewalls. It provides comprehensive protection from known and advanced threats, including protection against targeted and persistent malware attacks (Figure 1). Cisco ASA is the world's most widely deployed, enterprise-class stateful firewall. Cisco ASA with FirePOWER Services features these comprehensive capabilities:

- Site-to-site and remote access VPN and advanced clustering provide highly secure, high-performance access and high availability to help ensure business continuity.

- Granular Application Visibility and Control (AVC) supports more than 4,000 application-layer and risk-based controls that can launch tailored intrusion prevention system (IPS) threat detection policies to optimize security effectiveness.

- The industry-leading Cisco ASA with FirePOWER next-generation IPS (NGIPS) provides highly effective threat prevention and full contextual awareness of users, infrastructure, applications, and content to detect multivector threats and automate defense response.

- Reputation- and category-based URL filtering offer comprehensive alerting and control over suspicious web traffic and enforce policies on hundreds of millions of URLs in more than 80 categories.

- AMP provides industry-leading breach detection effectiveness, sandboxing, a low total cost of ownership, and superior protection value that helps you discover, understand, and stop malware and emerging threats missed by other security layers.

Figure 1.   Cisco ASA with FirePOWER Services: Key Security Features

Unprecedented Network Visibility

Cisco ASA with FirePOWER Services is centrally managed by the Cisco Firepower Management Center (formerly known as Cisco FireSIGHT Management Center), which provides security teams with comprehensive visibility into and control over activity within the network. Such visibility includes users, devices, communication between virtual machines, vulnerabilities, threats, client-side applications, files, and web sites. Holistic, actionable indications of compromise (IoCs) correlate detailed network and endpoint event information and provide further visibility into malware infections. Cisco's enterprise-class management tools help administrators reduce complexity with unmatched visibility and control across NGFW deployments. Cisco Firepower Management Center also provides content awareness with malware file trajectory that aids infection scoping and root cause determination to speed time to remediation.

Cisco Security Manager provides scalable and centralized network operations workflow management. It integrates a powerful suite of capabilities; including policy and object management, event management, reporting, and troubleshooting for Cisco ASA firewall functions when utilizing Cisco Firepower Management Center.

For local, on-device management including deployments for small and midsized businesses, Cisco Adaptive Security Device Manager (ASDM) 7.3.x provides, access control and advanced threat defense management. ASDM V 7.3.x provides an enhanced user interface that provides quick views on trends and the ability to drill down for further analysis.

Figure 2.   Cisco Firepower Management Center: Intuitive High-Level and Detailed Drill-Down Dashboards

Reduced Costs and Complexity

Cisco ASA with FirePOWER Services incorporates an integrated approach to threat defense, reducing capital and operating costs and administrative complexity. It smoothly integrates with the existing IT environment, work stream, and network fabric. The appliance family is highly scalable, performs at up to multigigabit speeds, and provides consistent and robust security across branch, Internet edge, and data centers in both physical and virtual environments.

With Cisco Firepower Management Center, administrators can streamline operations to correlate threats, assess their impact, automatically tune security policy, and easily attribute user identities to security events. Cisco Firepower Management Center continually monitors how the network is changing over time. New threats are automatically assessed to determine which ones can affect your business. Responses are then focused on remediation and network defenses are adapted to changing threat conditions. Critical security activities such as policy tuning are automated, saving time and effort, while protections and countermeasures are maintained in an optimal state.

Cisco Firepower Management Center integrates easily with third-party security solutions through the eStreamer API to streamline operation workflows and fit existing network fabrics.

Table 1 highlights the best-in-class features and benefits of Cisco ASA with FirePOWER Services.

Table 1. Features and Benefits of Cisco ASA with FirePOWER Services

Feature	Benefits
Next-generation firewall	Industry's first threat-focused NGFW; provides ASA firewall functionality, advanced threat protection, and advanced breach detection and remediation combined in a single device
Proven ASA firewall	Rich routing, stateful firewall, Network Address Translation, and dynamic clustering for high-performance, highly secure, and reliable access with Cisco AnyConnect® VPN
Market-leading NGIPS	Superior threat prevention and mitigation for both known and unknown threats
Advanced malware protection	Detection, blocking, tracking, analysis, and remediation to protect the enterprise against targeted and persistent malware attacks
Full contextual awareness	Policy enforcement based on complete visibility of users, mobile devices, client-side applications, communication between virtual machines, vulnerabilities, threats, and URLs
Application control and URL filtering	Application-layer control (over applications, geolocations, users, websites) and ability to enforce usage and tailor detection policies based on custom applications and URLs
Enterprise-class management	Dashboards and drill-down reports of discovered hosts, applications, threats, and indications of compromise for comprehensive visibility
Streamlined operations automation	Lower operating cost and administrative complexity with threat correlation, impact assessment, automated security policy tuning, and user identification
Purpose-built, scalable	Highly scalable security appliance architecture that performs at up to multigigabit speeds; consistent and robust security across small office, branch offices, Internet edge, and data centers in either physical and virtual environments
On-device management	Simplifies advanced threat defense management for small and medium sized business with small scale deployments
Remote Access VPN	Extends secure corporate network access beyond corporate laptops to personal mobile devices, regardless of physical location; support for Cisco AnyConnect Secure Mobility Solution, with granular, application-level VPN capability, as well as native Apple iOS and Android VPN clients
Site-to-site VPN	Protect traffic, including VoIP and client-server application data, across the distributed enterprise and branch offices
Integrated wireless access	Integrated Wi-Fi is available in the desktop form factor (ASA 5506W-X) for compact and simplified small office deployments
Ruggedized form factor	A ruggedized model (ASA 5506H-X), designed specifically for extreme environmental conditions, is available for critical infrastructure and control network applications
Third-party technology ecosystem	Open API that enables the third-party technology ecosystem to integrate with existing customer work streams
Integration with Snort and OpenAppID	Open source security integration with Snort and OpenAppID for access to community resources and ability to easily customize security to address new and specific threats and applications quickly
Collective Security intelligence (CSI)	Unmatched security and web reputation intelligence provides real-time threat intelligence and security protection

Product Performance and Specifications

Table 2 details the NGFW capabilities and capacities of the Cisco ASA with FirePOWER Services for Cisco ASA 5500-X Series.

Table 2.   Cisco ASA 5500-X with FirePOWER Services Capabilities and Capacities

Feature	Cisco ASA 5506-X w/ FirePOWER Services	Cisco ASA 5506W-X w/ FirePOWER Services	Cisco ASA 5506H-X w/ FirePOWER Services	Cisco ASA 5508-X w/ FirePOWER Services	Cisco ASA 5516-X w/ FirePOWER Services	Cisco ASA 5512-X w/ FirePOWER Services	Cisco ASA 5515-X w/ FirePOWER Services	Cisco ASA 5525-X w/ FirePOWER Services	Cisco ASA 5545-X w/ FirePOWER Services	Cisco ASA 5555-X w/ FirePOWER Services
Throughput: Application Control (AVC)	250 Mbps	250 Mbps	250 Mbps	450 Mbps	850 Mbps	300 Mbps	500 Mbps	1,100 Mbps	1,500 Mbps	1,750 Mbps
Throughput: Application Control (AVC) and IPS	125 Mbps	125 Mbps	125 Mbps	250 Mbps	450 Mbps	150 Mbps	250 Mbps	650 Mbps	1,000 Mbps	1,250 Mbps
Maximum concurrent sessions	20,000; 50000[1]	20,000; 50000[1]	50000	100,000	250,000	100,000	250,000	500,000	750,000	1,000,000
Maximum New Connections per second	5,000	5,000	5,000	10,000	20,000	10,000	15,000	20,000	30,000	50,000
Supported applications	More than 3,000									
URL categories	80+									
Number of URLs categorized	More than 280 million									
Centralized configuration, logging, monitoring, and reporting	Multi-device Cisco Security Manager (CSM) and Cisco Firepower Management Center									
On-Device Management	ASDM (version 7.3 or higher required)					ASDM				

[1] Higher specifications are associated with the Security Plus license.

Table 3 compares the features and capacities of the different ASA 5500-X Series Next-Generation Firewalls for small offices, branch locations, and Internet edge deployments.

Table 3.   Cisco ASA 5500-X Series Next-Generation Firewalls

Feature	Cisco ASA 5506-X w/ FirePOWER Services	Cisco ASA 5506W-X w/ FirePOWER Services	Cisco ASA 5506H-X w/ FirePOWER Services	Cisco ASA 5508-X w/ FirePOWER Services	Cisco ASA 5516-X w/ FirePOWER Services	Cisco ASA 5512-X w/ FirePOWER Services	Cisco ASA 5515-X w/ FirePOWER Services	Cisco ASA 5525-X w/ FirePOWER Services	Cisco ASA 5545-X w/ FirePOWER Services	Cisco ASA 5555-X w/ FirePOWER Services
Stateful inspection throughput (maximum[1])	750 Mbps	750 Mbps	750 Mbps	1 Gbps	1.8 Gbps	1 Gbps	1.2 Gbps	2 Gbps	3 Gbps	4 Gbps
Stateful inspection throughput (multiprotocol[2])	300 Mbps	300 Mbps	300 Mbps	500 Mbps	900 Mbps	500 Mbps	600 Mbps	1 Gbps	1.5 Gbps	2 Gbps
Triple Data Encryption Standard/Advanced Encryption Standard (3DES/AES) VPN throughput[3]	100 Mbps	100 Mbps	100 Mbps	175 Mbps	250 Mbps	200 Mbps	250 Mbps	300 Mbps	400 Mbps	700 Mbps
Users/nodes	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
IPsec site-to-site VPN peers	10; 50[4]	10; 50[4]	50	100	300	250	250	750	2500	5000
Cisco Cloud Web Security users	For detailed sizing guidance see the [CWS Connector Sizing for ASA 5500 and ASA 5500-X](#)									
Cisco AnyConnect Plus/Apex VPN maximum simultaneous connections[5]	50[5]	50[5]	50[5]	100[5]	300[5]	250[5]	250[5]	750[5]	2500[5]	5000[5]
Virtual interfaces (VLANs)	5; 30[4]	5; 30[4]	30	50	100	50; 100	100	200	300	500
Security contexts[5] (included; maximum)	N/A	N/A	N/A	2; 5	2; 5	0,0; 2,5	2;5	2; 20	2; 50	2; 100
High availability[4]	Requires Security Plus License; Active/Standby	Requires Security Plus License; Active/Standby	Active/Standby	Active/Active and Active/Standby	Active/Active and Active/Standby	Requires Security Plus License; Active/Active and Active/Standby	Active/Active and Active/Standby	Active/Active and Active/Standby	Active/Active and Active/Standby	Active/Active and Active/Standby
Integrated Wireless Access Point (See Cisco AP 702 datasheet for WiFi technical details)	N/A	Wireless Bands a/b/g/n; Max n wifi throughput 54 Mbps; internal antenna only; local management or centralized via Cisco WLC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Feature	Cisco ASA 5506-X w/ FirePOWER Services	Cisco ASA 5506W-X w/ FirePOWER Services	Cisco ASA 5506H-X w/ FirePOWER Services	Cisco ASA 5508-X w/ FirePOWER Services	Cisco ASA 5516-X w/ FirePOWER Services	Cisco ASA 5512-X w/ FirePOWER Services	Cisco ASA 5515-X w/ FirePOWER Services	Cisco ASA 5525-X w/ FirePOWER Services	Cisco ASA 5545-X w/ FirePOWER Services	Cisco ASA 5555-X w/ FirePOWER Services
Expansion slot	N/A	N/A	N/A	N/A	N/A	1 interface card	1 interface card	1 interface card	1 interface card	1 interface card
User-accessible Flash slot	No	No	No	No	No	No	No	0	-	0
USB 2.0 ports	USB port type 'A', High Speed 2.0	USB port type 'A', High Speed 2.0	USB port type 'A', High Speed 2.0	USB port type 'A', High Speed 2.0	USB port type 'A', High Speed 2.0	2	2	2	2	2
Integrated I/O	8 x 1 Gigabit Ethernet (GE)	8 x 1GE	4 x 1GE	8 x 1GE	8 x 1GE	6 GE copper	6 GE copper	8 GE copper	8 GE copper	8 GE copper
Expansion I/O	N/A	N/A	N/A	N/A	N/A	6 GE copper or 6 GE Small Form-Factor Pluggable (SFP)	6 GE copper or 6 GE SFP	6 GE copper or 6 GE SFP	6 GE copper or 6 GE SFP	6 GE copper or 6 GE SFP
Dedicated management port	Yes (To be shared with FirePOWER Services), 10/100/1000	Yes (To be shared with FirePOWER Services), 10/100/1000	Yes (To be shared with FirePOWER Services), 10/100/1000	Yes (To be shared with FirePOWER Services), 10/100/1000	Yes (To be shared with FirePOWER Services), 10/100/1000	Yes (1 GE)	Yes (1 GE)	Yes (1 GE)	Yes (1 GE)	Yes (1 GE)
Serial ports	1 RJ-45 and Mini USB console	1 RJ-45 and Mini USB console	1 RJ-45 and Mini USB console	1 RJ-45 and Mini USB console	1 RJ-45 and Mini USB console	1 RJ-45 console	1 RJ-45 console	1 RJ-45 console	1 RJ-45 console	1 RJ-45 console
Solid-state drive	50 GB mSata[6]	50 GB mSata[6]	50 GB mSata tested for heat	80 GB mSata[6]	100 GB mSata[6]	1 slot, 120 GB multiline configuration or self-encrypting drive (MLC SED)	1 slot, 120 GB MLC SED	1 slot, 120 GB MLC SED	2 slots, RAID 1 120 GB MLC SED	2 slots, RAID 1 120 GB MLC SED
Memory	4 GB	4 GB	4 GB	8 GB	8 GB	4 GB	8 GB	8 GB	12 GB	16 GB
System flash	8 GB	8 GB	8 GB	8 GB	8 GB	4 GB	8 GB	8 GB	8 GB	8 GB
System bus	Multibus architecture	Multibus architecture	Multibus architecture	Multibus architecture	Multibus architecture	Multibus architecture	Multibus architecture	Multibus architecture	Multibus architecture	Multibus architecture
Operating Parameters										
Temperature	32 to 104°F (0 to 40 °C)	32 to 104°F (0 to 40 °C)	-4 to 140°F (-20 to 60 °C)	32 to 104°F (0 to 40 °C)	32 to 104°F (0 to 40 °C)	23 to 104°F (-5 to 40°C)	23 to 104°F (-5 to 40°C)	23 to 104°F (-5 to 40°C)	23 to 104°F (-5 to 40°C)	23 to 104°F (-5 to 40°C)
Relative humidity	90 percent noncondensing	90 percent noncondensing	95 percent noncondensing	10 to 90 percent noncondensing	10 to 90 percent noncondensing	10 to 90 percent noncondensing	10 to 90 percent noncondensing	90 percent	90 percent	90 percent
Altitude	Designed and tested for 0 to 10,000 ft (3048 m)	Designed and tested for 0 to 10,000 ft (3048 m)	Designed and tested for 0 to 10,000 ft (3050 m)	Designed and tested for 0 to 10,000 ft (3048 m)	Designed and tested for 0 to 10,000 ft (3048 m)	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 10,000 ft (3050 m)	Designed and tested for 0 to 10,000 ft (3050 m)	Designed and tested for 0 to 10,000 ft (3050 m)

Feature	Cisco ASA 5506-X w/ FirePOWER Services	Cisco ASA 5506W-X w/ FirePOWER Services	Cisco ASA 5506H-X w/ FirePOWER Services	Cisco ASA 5508-X w/ FirePOWER Services	Cisco ASA 5516-X w/ FirePOWER Services	Cisco ASA 5512-X w/ FirePOWER Services	Cisco ASA 5515-X w/ FirePOWER Services	Cisco ASA 5525-X w/ FirePOWER Services	Cisco ASA 5545-X w/ FirePOWER Services	Cisco ASA 5555-X w/ FirePOWER Services
Acousticnoise	Fanless 0 dBA	Fanless 0 dBA	Fanless 0 dBA	41.6 A-weighted decibels (dBA) type / 67.2 dBA max	41.6 dBA type / 67.2 dBA max	64.2 dBA max	64.2 dBA max	64.2 dBA max	67.9 dBA max	67.9 dBA max
Non-operating Parameters										
Temperature[7]	-13 to 158ºF (-25 to 70ºC)	-13 to 158ºF (-25 to 70ºC)	-40 to 185ºF (-40 to 85ºC)	-13 to 158ºF (-25 to 70ºC)	-13 to 158ºF (-25 to 70ºC)	-13 to 158ºF (-25 to 70ºC)	-13 to 158ºF (-25 to 70ºC)	-13 to 158ºF (-25 to 70ºC)	-13 to 158ºF (-25 to 70ºC)	-13 to 158ºF (-25 to 70ºC)
Relative humidity	10 to 90 percent noncondensing	10 to 90 percent noncondensing	10 to 95 percent noncondensing	10 to 90 percent noncondensing	10 to 90 percent noncondensing	10 to 90 percent noncondensing	10 to 90 percent noncondensing	10 to 90 percent	10 to 90 percent	10 to 90 percent
Altitude	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 15,000 ft (4570 m)	Designed and tested for 0 to 15,000 ft (4570 m)	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 15,000 ft (4572 m)	Designed and tested for 0 to 15,000 ft (4572 m)
Power Input (per power supply)										
AC range line voltage	External, 90 to 240 volts alternating current (VAC)	External, 90 to 240 volts alternating current (VAC)	External, 90 to 240 volts alternating current (VAC)	External, 90 to 240 volts alternating current (VAC)	External, 90 to 240 volts alternating current (VAC)	100 to 240 VAC	100 to 240 VAC	100 to 240 VAC	100 to 240 VAC	100 to 240 VAC
AC normal line voltage	90 to 240 VAC	90 to 240 VAC	90 to 240 VAC	91 to 240 VAC	92 to 240 VAC	100 to 240 VAC	100 to 240 VAC	100 to 240 VAC	100 to 240 VAC	100 to 240 VAC
AC current	N/A	N/A	N/A	0.25AC amps	0.25AC amps	4.85A	4.85A	4.85A	5A, 100 to 120V / 2.5A, 200 to 240V	5A, 100 to 120V / 2.5A, 200 to 240V
AC frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Dual-power supplies	None	None	None	None	None	None	None	None	Yes	Yes
DC domestic line voltage	N/A	N/A	N/A	N/A	N/A	-40.5 to 56 volts direct current (VDC) (-48 VDC nominal)	-40.5 to 56 VDC (-48 VDC nominal)	-40.5 to 56 VDC (-48 VDC nominal)	-40.5 to 56 VDC (-48 VDC nominal)	-40.5 to 56 VDC (-48 VDC nominal)
DC international line voltage	N/A	N/A	N/A	N/A	N/A	-55 to -72 VDC (-60 VDC nominal)	-55 to -72 VDC (-60 VDC nominal)	-55 to -72 VDC (-60 VDC nominal)	-55 to -72 VDC (-60 VDC nominal)	-55 to -72 VDC (-60 VDC nominal)
DC current	N/A	N/A	N/A	N/A	N/A	15A (maximum input)	15A (maximum input)	15A (maximum input)	15A (maximum input)	15A (maximum input)
Output										
Steady state	12V @2.5A	12V @2.5A	5V @3.6A	12V @ 3.0A	12V @ 3.0A	51W	65W	75W	86W	90W
Maximum peak	12V @ 5A	12V @ 5A	5V @4.4A	12V @ 5.0A	12V @ 5.0A	56W	70W	108W	125W	134W
Maximum heat dissipation	205 British thermal units (Btu)/hr	205 Btu/hr	75 Btu/hr	205 Btu/hr	205 Btu/hr	192 Btu/hr	239 Btu/hr	369 Btu/hr	427 Btu/hr	458 Btu/hr

Feature	Cisco ASA 5506-X w/ FirePOWER Services	Cisco ASA 5506W-X w/ FirePOWER Services	Cisco ASA 5506H-X w/ FirePOWER Services	Cisco ASA 5508-X w/ FirePOWER Services	Cisco ASA 5516-X w/ FirePOWER Services	Cisco ASA 5512-X w/ FirePOWER Services	Cisco ASA 5515-X w/ FirePOWER Services	Cisco ASA 5525-X w/ FirePOWER Services	Cisco ASA 5545-X w/ FirePOWER Services	Cisco ASA 5555-X w/ FirePOWER Services
Form factor	Desktop, rack mountable	Desktop, rack mountable	Desktop, rack mountable, wall mountable, DIN-Rail	1 rack unit (RU), 19-in. rack-mountable	1 rack unit (RU), 19-in. rack-mountable	1 rack unit (RU), 19-in. rack-mountable	1RU, 19-in. rack-mountable	1RU, 19-in. rack-mountable	1RU, 19-in. rack-mountable	1RU, 19-in. rack-mountable
Dimensions	1.72 x 7.871 x 9.23 in.	1.72 x 7.871 x 9.23 in.	2.72 x 9.05 x 9.05 in.	1.72 x 17.2 x 11.288 in.	1.72 x 17.2 x 11.288 in.	1.67 x 16.7 x 15.6 in.	1.67 x 16.7 x 15.6 in.	1.75 x 17.5 x 14.25 in.	1.67 x 16.7 x 19.1 in.	1.67 x 16.7 x 19.1 in.
(H x W x D)	(4.369 x 19.992 x 23.444 cm)	(4.369 x 19.992 x 23.444 cm)	(6.9 x 23.0 x 23.0 cm)	(4.369 x 43.688 x 28.672 cm)	(4.369 x 43.688 x 28.672 cm)	(4.24 x 42.9 x 39.5 cm)	(4.24 x 42.9 x 39.5 cm)	(4.45 x 20.04 x 36.20 cm)	(4.24 x 42.9 x 48.4 cm)	(4.24 x 42.9 x 48.4 cm)
Weight (with AC power supply)	4 lb (1.82 kg)	4 lb (1.82 kg)	7 lb (3.18 kg)	8 lb (3 kg)	8 lb (3 kg)	13.39 lb (6.07 kg)	13.39 lb (6.07 kg)	22.0 lb (10 kg)	16.82 lb (7.63 kg) with single power supply	16.82 lb (7.63 kg) with single power supply
									18.86 lb (8.61 kg) with dual power supply	18.86 lb (8.61 kg) with dual power supply

[1] Maximum throughput measured with UDP traffic under ideal conditions.
[2] Multiprotocol = Traffic profile consisting primarily of TCP-based protocols/applications like HTTP, SMTP, FTP, IMAPv4, BitTorrent, and DNS.
[3] VPN throughput and sessions count depend on the ASA device configuration and VPN traffic patterns. These elements should be taken into consideration as part of your capacity planning.
[4] Higher specifications are associated with the Security Plus license.
[5] Separately licensed feature. For AnyConnect, licenses are purchased based on feature tier (Plus/Apex), term and authorized user license. See ordering guide below for detailed ordering instructions.
[6] Usable space dependent upon system software.
[7] Derate the maximum operating temperature 1.5°C per 1000 ft above sea level.

Hardware Product Compliance

Current information on ASA with FirePOWER product compliance information can be found on the Cisco Product Approval Status (PAS) link:

http://tools.cisco.com/cse/prdapp.

If you are not registered with Cisco.com, please refer to the registration link located at: http://tools.cisco.com/RPF/register/register.do.

To access information please follow the below steps:

1. Select the **Product Certifications by Country** radio button select **GO**

2. Under option 2 enter **product ID** or part of it in the product name box (one at a time only) for example **FPR-C9300**

3. Under additional filter select or highlight your country of interest or keep all countries selected for full results

4. Select submit

5. Your results will be displayed. Under status select the hyperlink **Details**

6. Find your corresponding documents

Hardware Product Performance and Specifications

Platform Support/Compatibility

Cisco ASA with FirePOWER Services include Cisco ASA firewalling, AVC, URL filtering, NGIPS, and AMP. This unique set of capabilities is available on the Cisco ASA 5500-X Series NGFW platforms: Cisco ASA 5506-X, 5506W-X, 5506H-X, 5508-X, 5516-X, 5512-X, 5515-X, 5525-X, 5545-X, 5555-X.

Cisco ASA with FirePOWER Services software is supported on the Cisco ASA 5500-X Series of next-generation midrange security appliances running Cisco ASA Software Release 9.2.2 and later. Cisco Firepower Management Center and Cisco Security Manager are required to manage Cisco ASA with FirePOWER Services ASA 5512-X, 5515-X, 5525-X, 5545-X, 5555-X. ASDM V 7.3.x is available on-device to manage single instance deployments of Cisco ASA 5506-X, 5506W-X, 5506H-X, 5508-X, and 5516-X with FirePOWER Services.

Cisco ASA 5500-X Series 6-Port GE Interface Cards

Cisco ASA 5500-X Series 6-port Gigabit Ethernet Interface Cards extend the I/O profile of the Cisco ASA 5500-X Series appliances[*] by providing additional GE ports. The cards provide the following benefits:

- Better segmentation of network traffic into separate security zones
- Fiber-optic cable connectivity for long-distance communication
- Load sharing of traffic as well as protection against link failure through the use of EtherChannel
- Support for jumbo Ethernet frames of up to 9000 bytes
- Protection against cable failure for the most demanding active/active failover and full-mesh firewall deployments

Note: [*]Not available on ASA 5508-X or ASA 5516-X

Table 4 lists the characteristics of the Cisco ASA 5500-X Series 6-port GE interface cards.

Table 4. Characteristics of Cisco ASA 5500-X Series 6-Port GE Interface Cards

Feature	Cisco ASA 5500-X Series 6-Port 10/100/1000	Cisco ASA 5500-X Series 6-Port GE SFP SX, LH, and LX
Technical Specifications		
Integrated ports	Six 10/100/1000BASE-T	Six GE optical SFP 1000BASE-SX, 1000BASE-LX, or 1000BASE-LH transceiver supported
Environmental Operating Ranges		
Operating		
Temperature	32 to 113ºF (0 to 45ºC)	32 to 113ºF (0 to 45ºC)
Relative humidity	5 to 95 percent noncondensing	5 to 95 percent noncondensing
Nonoperating		
Temperature	-40 to 149ºF (-40 to 65ºC)	-40 to 149ºF (-40 to 65ºC)
Power consumption	25W maximum	25W maximum
Physical Specifications		
Dimensions (H x W x D)	1.57 x 5.31 x 9.09 in. (3.99 x 13.49 x 23.09 cm)	1.57 x 5.31 x 9.09 in. (3.99 x 13.49 x 23.09 cm)

Feature	Cisco ASA 5500-X Series 6-Port 10/100/1000	Cisco ASA 5500-X Series 6-Port GE SFP SX, LH, and LX
Weight	1.00 lb (0.45 kg)	1.00 lb (0.45 kg)
Regulatory and Standards Compliance		
Safety	UL 60950, CSA C22.2 No. 60950, EN 60950 IEC 60950, AS/NZS60950	UL 60950, CSA C22.2 No. 60950, EN 60950 IEC 60950, AS/NZS60950
Electromagnetic compatibility (EMC)	CE marking, FCC Part 15 Class A, AS/NZS CISPR22 Class A, VCCI Class A, EN55022 Class A, CISPR22 Class A, EN61000-3-2, EN61000-3-3	CE marking, FCC Part 15 Class A, AS/NZS CISPR22 Class A, VCCI Class A, EN55022 Class A, CISPR22 Class A, EN61000-3-2, EN61000-3-3

Ordering Information

To place an order, visit the [Cisco ordering homepage](). Table 5 provides ordering information for Cisco ASA with FirePOWER Services.

Table 5.   Cisco ASA with Fire POWER Services Ordering Information

The following table includes Cisco ASA FirePOWER Services bundle SKUs (including hardware and subscription) that offer a convenient mechanism for ordering both the appliances and software subscriptions in a single SKU configuration. It is the recommended mode of configuration for ordering. Standalone AMP license and subscriptions are also available to **upgrade** an existing TA or TAC subscription license. Please see the ASA with FirePOWER Services Ordering Guide for details.

Cisco ASA with FirePOWER Services 5500-X Series Bundles (Hardware and Subscription)	
ASA 5506-X with FirePOWER Svcs. Chassis and Subs. Bundle	ASA5506-FPWR-BUN
ASA 5506W-X with FirePOWER Svcs. WiFi Chassis and Subs. Bundle	ASA5506W-FPWR-BUN
ASA 5508-X with FirePOWER Svcs. Chassis and Subs. Bundle	ASA5508-FPWR-BUN
ASA 5516-X with FirePOWER Svcs. Chassis and Subs. Bundle	ASA5516-FPWR-BUN
ASA 5512-X with FirePOWER Svcs. Chassis and Subs. Bundle	ASA5512-FPWR-BUN
ASA 5515-X with FirePOWER Svcs. Chassis and Subs. Bundle	ASA5515-FPWR-BUN
ASA 5525-X with FirePOWER Svcs. Chassis and Subs. Bundle	ASA5525-FPWR-BUN
ASA 5545-X with FirePOWER Svcs. Chassis and Subs. Bundle	ASA5545-FPWR-BUN
ASA 5555-X with FirePOWER Svcs. Chassis and Subs. Bundle	ASA5555-FPWR-BUN

Product Description	Part Number
Cisco ASA 5506-X Series Low-End Appliances (Hardware)	
ASA 5506-X with FirePOWER services, 8GE Data, 1GE Mgmt, AC, DES	ASA5506-K8
ASA 5506-X with FirePOWER services, 8GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5506-K9
ASA 5506W-A-X with FirePOWER services, WiFi for North America (NOT US), 8GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5506W-A-K9
ASA 5506W-B-X with FirePOWER services, WiFi for US ONLY, 8GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5506W-B-K9
ASA 5506W-E-X with FirePOWER services, WiFi for Europe, 8GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5506W-E-K9
ASA 5506W-Q-X with FirePOWER services, WiFi for Japan, 8GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5506W-Q-K9
ASA 5506W-Z-X with FirePOWER services, WiFi for Australia/New Zealand, 8GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5506W-Z-K9
ASA 5506H-X with FirePOWER services, ruggedized, security plus, 4GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5506H-SP-BUN-K9
ASA 5506H-X with FirePOWER services, ruggedized, security plus, 4GE Data, 1GE Mgmt, AC, DES	ASA5506H-SP-BUN-K8
ASA 5508-X with FirePOWER services, 8GE Data, 1GE Mgmt, AC, DES	ASA5508-K8
ASA 5508-X with FirePOWER services, 8GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5508-K9
ASA 5516-X with FirePOWER services, 8GE Data, 1GE Mgmt, AC, DES	ASA5516-FPWR-K8
ASA 5516-X with FirePOWER services, 8GE Data, 1GE Mgmt, AC, 3DES/AES	ASA5516-FPWR-K9
Cisco ASA 5500-X Series Midrange Appliances (Hardware)	
ASA 5512-X with FirePOWER Services, 6GE data, AC, 3DES/AES, SSD	ASA5512-FPWR-K9
ASA 5515-X with FirePOWER Services, 6GE data, AC, 3DES/AES, SSD	ASA5515-FPWR-K9
ASA 5525-X with FirePOWER Services, 8GE data, AC, 3DES/AES, SSD	ASA5525-FPWR-K9
ASA 5545-X with FirePOWER Services, 8GE data, AC, 3DES/AES, 2 SSD	ASA5545-FPWR-K9
ASA 5555-X with FirePOWER Services, 8GE data, AC, 3DES/AES, 2 SSD	ASA5555-FPWR-K9
Cisco ASA 5500-X Series Interface Cards	
Cisco ASA Interface Card with 6 copper GE data ports for ASA 5512-X and ASA 5515-X	ASA-IC-6GE-CU-A
Cisco ASA Interface Card with 6 copper GE data ports for ASA 5525-X	ASA-IC-6GE-CU-B
Cisco ASA Interface Card with 6 copper GE data ports for ASA 5545-X and ASA 5555-X	ASA-IC-6GE-CU-C
Cisco ASA Interface Card with 6 SFP GE data ports (SX, LH, and LX) for ASA 5512-X and ASA 5515-X	ASA-IC-6GE-SFP-A
Cisco ASA Interface Card with 6 SFP GE data ports (SX, LH, and LX) for ASA 5525-X	ASA-IC-6GE-SFP-B
Cisco ASA Interface Card with 6 SFP GE data ports (SX, LH, and LX) for ASA 5545-X and ASA 5555-X	ASA-IC-6GE-SFP-C
Cisco ASA Interface Card with 6 copper GE data ports for ASA 5512-X and ASA 5515-X (spare)	ASA-IC-6GE-CU-A=
Cisco ASA Interface Card with 6 copper GE data ports for ASA 5525-X (spare)	ASA-IC-6GE-CU-B=
Cisco ASA Interface Card with 6 copper GE data ports for ASA 5545-X and ASA 5555-X (spare)	ASA-IC-6GE-CU-C=
Cisco ASA Interface Card with 6 SFP GE data ports (SX, LH, and LX) for ASA 5512-X and ASA 5515-X (spare)	ASA-IC-6GE-SFP-A=
Cisco ASA 5500-X Series Accessories	

Product Description	Part Number	
Cisco GE optical SFP connector, 1000BASE-SX short-wavelength transceiver (spare)	GLC-SX-MM=	
Cisco GE optical SFP connector, 1000BASE-LX/LH long-wavelength/long-haul transceiver (spare)	GLC-LH-SM=	
Cisco GE optical SFP connector, 1000BASE-SX short-wavelength transceiver, digital optical monitoring (DOM) (spare)	GLC-SX-MMD=	
Cisco GE optical SFP connector, 1000BASE-LX/LH long-wavelength/long-haul transceiver, DOM (spare)	GLC-LH-SMD=	
Cisco ASA 5512-X and 5515-X interface card (blank) (spare)	ASA-IC-A-BLANK=	
Cisco ASA 5525-X interface card slot (blank) (spare)	ASA-IC-B-BLANK=	
Cisco ASA 5545-Xand 5555-X interface card slot (blank) (spare)	ASA-IC-C-BLANK=	
ASA with FirePOWER Services Software Subscriptions: 3-Year Term (1-Year Service Software Bundle Subscriptions Can be Purchased as well as Individual Cisco IPS, AMP, and URL Filtering Service Software Subscriptions with 1-Year and 3-Year Terms)		
Cisco ASA5506 FirePOWER IPS and Apps 3YR Subscription	L-ASA5506-TA=	L-ASA5506-TA-3Y
Cisco ASA5506 FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5506-TAC=	L-ASA5506-TAC-3Y
Cisco ASA5506 FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5506-TAM=	L-ASA5506-TAM-3Y
Cisco ASA5506 FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5506-TAMC=	L-ASA5506-TAMC-3Y
Cisco ASA5506 FirePOWER URL Filtering 3YR Subscription	L-ASA5506-URL=	L-ASA5506-URL-3Y
Cisco ASA5506W FirePOWER IPS and Apps 3YR Subscription	L-ASA5506W-TA=	L-ASA5506-TA-3Y
Cisco ASA5506W FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5506W-TAC=	L-ASA5506-TAC-3Y
Cisco ASA5506W FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5506W-TAM=	L-ASA5506-TAM-3Y
Cisco ASA5506W FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5506W-TAMC=	L-ASA5506-TAMC-3Y
Cisco ASA5506W FirePOWER URL Filtering 3YR Subscription	L-ASA5506W-URL=	L-ASA5506-URL-3Y
Cisco ASA5506H FirePOWER IPS and Apps 3YR Subscription	L-ASA5506H-TA=	L-ASA5506H-TA-3Y
Cisco ASA5506H FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5506H-TAC=	L-ASA5506H-TAC-3Y
Cisco ASA5506H FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5506H-TAM=	L-ASA5506H-TAM-3Y
Cisco ASA5506H FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5506H-TAMC=	L-ASA5506H-TAMC-3Y
Cisco ASA5508 FirePOWER IPS and Apps 3YR Subscription	L-ASA5508-TA=	L-ASA5508-TA-3Y
Cisco ASA5508 FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5508-TAC=	L-ASA5508-TAC-3Y
Cisco ASA5508 FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5508-TAM=	L-ASA5508-TAM-3Y
Cisco ASA5508 FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5508-TAMC=	L-ASA5508-TAMC-3Y
Cisco ASA5508 FirePOWER URL Filtering 3YR Subscription	L-ASA5508-URL=	L-ASA5508-URL-3Y
Cisco ASA5516 FirePOWER IPS and Apps 3YR Subscription	L-ASA5516-TA=	L-ASA5516-TA-3Y
Cisco ASA5516 FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5516-TAC=	L-ASA5516-TAC-3Y
Cisco ASA5516 FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5516-TAM=	L-ASA5516-TAM-3Y
Cisco ASA5516 FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5516-TAMC=	L-ASA5516-TAMC-3Y
Cisco ASA5516 FirePOWER URL Filtering 3YR Subscription	L-ASA5516-URL=	L-ASA5516-URL-3Y
Cisco ASA5512 FirePOWER IPS and Apps 3YR Subscription	L-ASA5512-TA=	L-ASA5512-TA-3Y
Cisco ASA5512 FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5512-TAC=	L-ASA5512-TAC-3Y
Cisco ASA5512 FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5512-TAM=	L-ASA5512-TAM-3Y
Cisco ASA5512 FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5512-TAMC=	L-ASA5512-TAMC-3Y
Cisco ASA5512 FirePOWER URL Filtering 3YR Subscription	L-ASA5512-URL=	L-ASA5512-URL-3Y
Cisco ASA5515 FirePOWER IPS and Apps 3YR Subscription	L-ASA5515-TA=	L-ASA5515-TA-3Y
Cisco ASA5515 FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5515-TAC=	L-ASA5515-TAC-3Y
Cisco ASA5515 FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5515-TAM=	L-ASA5515-TAM-3Y

Product Description	Part Number	
Cisco ASA5515 FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5515-TAMC=	L-ASA5515-TAMC-3Y
Cisco ASA5515 FirePOWER URL Filtering 3YR Subscription	L-ASA5515-URL=	L-ASA5515-URL-3Y
Cisco ASA5525 FirePOWER IPS and Apps 3YR Subscription	L-ASA5525-TA=	L-ASA5525-TA-3Y
Cisco ASA5525 FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5525-TAC=	L-ASA5525-TAC-3Y
Cisco ASA5525 FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5525-TAM=	L-ASA5525-TAM-3Y
Cisco ASA5525 FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5525-TAMC=	L-ASA5525-TAMC-3Y
Cisco ASA5525 FirePOWER URL Filtering 3YR Subscription	L-ASA5525-URL=	L-ASA5525-URL-3Y
Cisco ASA5545 FirePOWER IPS and Apps 3YR Subscription	L-ASA5545-TA=	L-ASA5545-TA-3Y
Cisco ASA5545 FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5545-TAC=	L-ASA5545-TAC-3Y
Cisco ASA5545 FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5545-TAM=	L-ASA5545-TAM-3Y
Cisco ASA5545 FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5545-TAMC=	L-ASA5545-TAMC-3Y
Cisco ASA5545 FirePOWER URL Filtering 3YR Subscription	L-ASA5545-URL=	L-ASA5545-URL-3Y
Cisco ASA5555 FirePOWER IPS and Apps 3YR Subscription	L-ASA5555-TA=	L-ASA5555-TA-3Y
Cisco ASA5555 FirePOWER IPS, Apps and URL 3YR Subscription	L-ASA5555-TAC=	L-ASA5555-TAC-3Y
Cisco ASA5555 FirePOWER IPS, Apps and AMP 3YR Subscription	L-ASA5555-TAM=	L-ASA5555-TAM-3Y
Cisco ASA5555 FirePOWER IPS, Apps, AMP and URL 3YR Subscription	L-ASA5555-TAMC=	L-ASA5555-TAMC-3Y
Cisco ASA5555 FirePOWER URL Filtering 3YR Subscription	L-ASA5555-URL=	L-ASA5555-URL-3Y

To Download the Software

Visit the Cisco Software Center to download Cisco ASA with FirePOWER Services Software.

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For More Information

For more information, please visit the following links:

- Cisco ASA 5500-X Series Next-Generation Firewalls:
  http://www.cisco.com/go/asa.
- Cisco Security Manager:
  http://www.cisco.com/c/en/us/products/security/security-manager/index.html.
- Cisco Adaptive Security Device Manager:
  http://www.cisco.com/c/en/us/products/security/adaptive-security-device-manager/index.html.
- Cisco Security Services: http://www.cisco.com/en/US/products/svcs/ps2961/ps2952/serv_group_home.html.
- Cisco AnyConnect Secure Mobility Client
  http://www.cisco.com/go/anyconnect.
- Cisco AnyConnect Ordering Guide
  http://www.cisco.com/c/dam/en/us/products/security/anyconnect-og.pdf.

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Cisco SFP Modules for Gigabit Ethernet Applications

Cost-effective Small Form-factor Pluggable (SFP) transceivers for Gigabit Ethernet applications

Product Overview

The industry-standard Cisco® Small Form-Factor Pluggable (SFP) Gigabit Interface Converter (Figure 1) links your switches and routers to the network. The hot-swappable input/output device plugs into a Gigabit Ethernet port or slot. Optical and copper models can be used on a wide variety of Cisco products and intermixed in combinations of 1000BASE-T, 1000BASE-SX, 1000BASE-LX/LH, 1000BASE-EX, 1000BASE-ZX, or 1000BASE-BX10-D/U on a port-by-port basis.

Figure 1.   Cisco Optical Gigabit Ethernet SFP
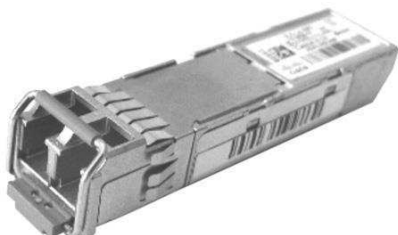
Figure 2.   Cisco 1000BASE-T Copper SFP
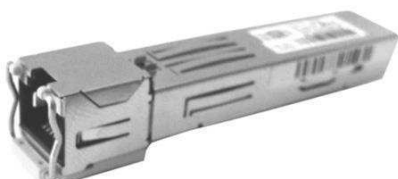
Figure 3.   Cisco 2-Channel 1000BASE-BX Optical SFP

Features and Benefits

- Hot swappable to maximize uptime and simplify serviceability
- Flexibility of media and interface choice on a port-by-port basis, so you can "pay as you populate"
- Robust design for enhanced reliability
- Supports digital optical monitoring (DOM) capability

1000BASE-T SFP for Copper Networks

The 1000BASE-T SFP operates on standard Category 5 unshielded twisted-pair copper cabling of link lengths up to 100 m (328 ft). Cisco 1000BASE-T SFP modules support 10/100/1000 auto negotiation and Auto MDI/MDIX.

1000BASE-SX SFP for Multimode Fiber Only

The 1000BASE-SX SFP, compatible with the IEEE 802.3z 1000BASE-SX standard, operates on legacy 50 μm multimode fiber links up to 550 m and on 62.5 μm Fiber Distributed Data Interface (FDDI)-grade multimode fibers up to 220 m. It can support up to 1km over laser-optimized 50 μm multimode fiber cable.

1000BASE-LX/LH SFP for Both Multimode and Single-Mode Fibers

The 1000BASE-LX/LH SFP, compatible with the IEEE 802.3z 1000BASE-LX standard, operates on standard single-mode fiber-optic link spans of up to 10 km and up to 550 m on any multimode fibers. When used over legacy multimode fiber type, the transmitter should be coupled through a mode conditioning patch cable. For details on this implementation, refer to http://www.cisco.com/en/US/prod/collateral/modules/ps5455/product_bulletin_c25-530836.html.

1000BASE-EX SFP for Long-Reach Single-Mode Fibers

The 1000BASE-EX SFP operates on standard single-mode fiber-optic link spans of up to 40 km in length. A 5-dB inline optical attenuator should be inserted between the fiber-optic cable and the receiving port on the SFP at each end of the link for back-to-back connectivity.

1000BASE-ZX SFP for Long-Reach Single-Mode Fibers

The 1000BASE-ZX SFP operates on standard single-mode fiber-optic link spans of up to approximately 70 km in length. The SFP provides an optical link budget of 21 dB, but the precise link span length depends on multiple factors such as fiber quality, number of splices, and connectors.

When shorter distances of single-mode fiber (SMF) are used, it might be necessary to insert an inline optical attenuator in the link to avoid overloading the receiver. A 10-dB inline optical attenuator should be inserted between the fiber-optic cable plant and the receiving port on the SFP at each end of the link whenever the fiber-optic cable span loss is less than 8 dB.

1000BASE-BX10-D and 1000BASE-BX10-U SFP for Single-Fiber Bidirectional Applications

The 1000BASE-BX-D and 1000BASE-BX-U SFPs, compatible with the IEEE 802.3ah 1000BASE-BX10-D and 1000BASE-BX10-U standards, operate on a single strand of standard SMF.

A 1000BASE-BX10-D device is always connected to a 1000BASE-BX10-U device with a single strand of standard SMF with an operating transmission range up to 10 km.

The communication over a single strand of fiber is achieved by separating the transmission wavelength of the two devices as depicted in Figure 2: 1000BASE-BX10-D transmits a 1490-nm channel and receives a 1310-nm signal, whereas 1000BASE-BX10-U transmits at a 1310-nm wavelength and receives a 1490-nm signal. As shown, the presence of a wavelength-division multiplexing (WDM) splitter integrated into the SFP to split the 1310-nm and 1490-nm light paths.

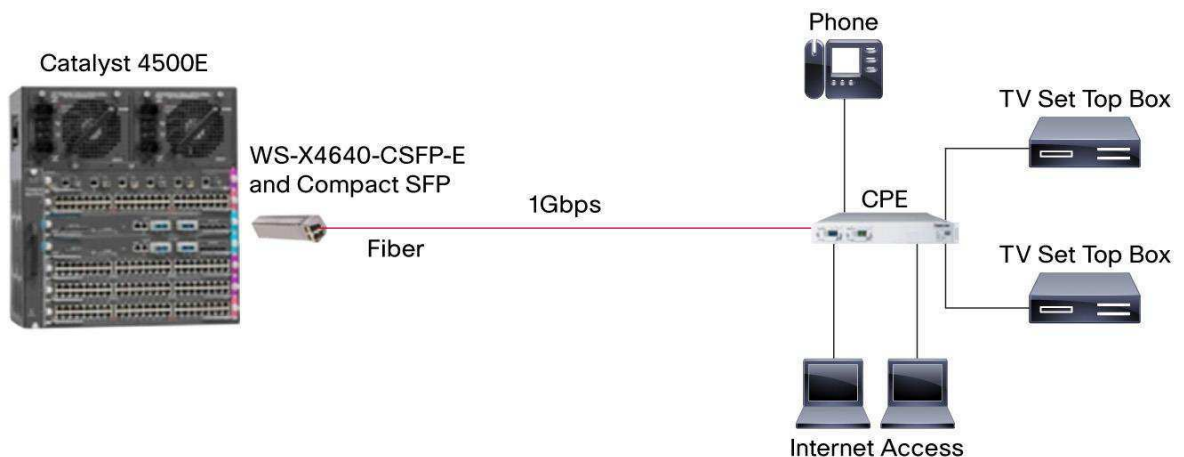**Figure 4.** Bidirectional Transmission of a Single Strand of SMF
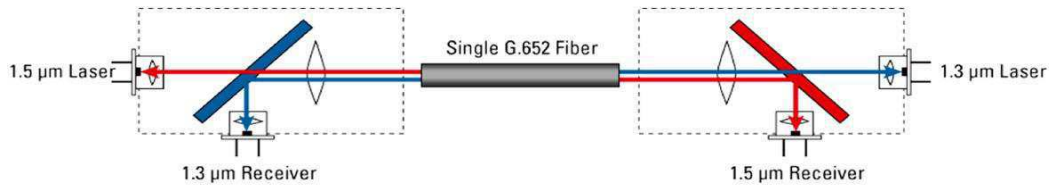
The GLC-BX-D and GLC-BX-U SFPs also support digital optical monitoring (DOM) functions according to the industry-standard SFF-8472 multisource agreement (MSA). This feature gives the end user the ability to monitor real-time parameters of the SFP, such as optical output power, optical input power, temperature, laser bias current, and transceiver supply voltage.

2-Channel 1000BASE-BX10-D for Single-Fiber Bidirectional Applications

The 2-channel 1000BASE-BX-D SFP module, also known as Compact SFP, integrates two IEEE 802.3ah 1000BASE-BX10-D interfaces in one SFP module. The GLC-2BX-D or GLC-2BX-D-I is always connected to two 1000BASE-BX10-U interfaces over two single strands of standard SMF with an operating transmission range up to 10km.

GLC-2BX-D or GLC-2BX-D-I is designed to connect to any standard-based Customer Premises Equipment (CPE) in FTTx links (Figure 3).

Figure 5. Compact SFP Deployment with Cisco Catalyst 4500

1000BASE-BX40-D and 1000BASE-BX40-U for Single-Fiber Bidirectional Applications

The Cisco GLC-BX40-D-I, GLC-BX40-DA-I, and GLC-BX40-U-I SFPs operate on a single strand of standard SMF.

A GLC-BX40-D-I or GLC-BX40-DA-I device connects to a GLC-BX40-U-I device with a single strand of standard SMF with an operating transmission range up to 40 km.

The communication over a single strand of fiber is achieved by separating the transmission wavelength of the two devices. The GLC-BX40-D-I, GLC-BX40-DA-I, and GLC-BX40-U-I SFPs also support digital optical monitoring (DOM) functions according to the industry-standard SFF-8472 multisource agreement (MSA). This feature gives the end user the ability to monitor real-time parameters of the SFP, such as optical output power, optical input power, temperature, laser bias current, and transceiver supply voltage.

1000BASE-BX80-D and 1000BASE-BX80-U for Single-Fiber Bidirectional Applications

The Cisco GLC-BX80-D-I and GLC-BX80-U-I SFPs operate on a single strand of standard SMF.

A GLC-BX80-D-I device is always connected to a GLC-BX80-U-I device with a single strand of standard SMF with an operating transmission range up to 80 km.

The communication over a single strand of fiber is achieved by separating the transmission wavelength of the two devices. The GLC-BX80-D-I and GLC-BX80-U-I SFPs also support digital optical monitoring (DOM) functions according to the industry-standard SFF-8472 multisource agreement (MSA). This feature gives the end user the ability to monitor real-time parameters of the SFP, such as optical output power, optical input power, temperature, laser bias current, and transceiver supply voltage.

100/1000BASE-LX SFP for Long-Reach Single-Mode Fibers

The dual-rate 100M/1G 10Km SFP is interoperable with the IEEE 100BASE-LX and 1000BASE-LX/LH standards.

The GLC-GE-DR-LX SFP also supports digital optical monitoring (DOM) functions according to the industry-standard SFF-8472 multisource agreement (MSA). This feature gives the end user the ability to monitor real-time parameters of the SFP, such as optical output power, optical input power, temperature, laser bias current, and transceiver supply voltage.

SFP Operation at 100M

The GLC-GE-DR-LX SFP can interoperate with other 100M SFPs/interfaces as long as those are based on 100BASE-LX10 standard. A 5dB attenuator is needed on the path of dual-rate SFP Tx and 100BASE-LX10 interface Rx. No attenuator is needed on the other fiber strand.

SFP Operation at 1G

The GLC-GE-DR-LX SFP can interoperate with other 1G SFPs/interfaces as long as those are based on 1000BASE-LX/LH standard. No attenuator is needed in any fiber strand.

Platform Support

The Cisco 1-Gbps SFPs are supported across a variety of Cisco networking equipment[*]. For more details, refer to the document SFP Compatibility Matrix at

http://www.cisco.com/en/US/docs/interfaces_modules/transceiver_modules/compatibility/matrix/OL_6981.pdf.

• ASA5500 Series Appliances	• Cisco uBR7200 Series
• ASR 901 and 903 Series Routers	• Cisco 7200, 7300, 7500, and 7600 Series Routers
• ASR 1000, 9000, and 9000v Series Routers	• Cisco 10000 and uBR 10000 Series Routers
• Catalyst Express 500 and Express 520	• Cisco 10700 Series Internet Router
• Catalyst 2350 and 2360 Series	• Cisco 12000 Series Router
• Catalyst 2900, 2940, 2950, 2960, 2960-Plus, 2960-C, 2960-S, 2960-SF, 2960-X Series	• Cisco 2000 Connected Grid Router Series
• Catalyst 2970 and 2975 Series	• Cisco 2500 Connected Grid Switch Series
• Catalyst 3000 and 3100 Blade Switches	• Cisco IE2000 and IE2000U Series
• Catalyst 3500XL Series	• Cisco IE3010 Series
• Catalyst 3550, 3560, 3560-C, 3560-E, 3560-X Series	• Cisco MDS 9000
• Catalyst 3750-E Series, 3750 Metro, 3750-X Series	• Cisco ME 2400
• Catalyst 3850 Series	• Cisco ME 2600X
• Catalyst 4500 and 4500-X Series	• Cisco ME 3400
• Catalyst 4900 Series	• Cisco ME 3600X and ME 3800X
• Catalyst 6000 Series	• Cisco ME 4600 and ME 4900 Series
• Catalyst 6800 Series	• Cisco ME 6500 Series
	• Cisco MWR 2941 Mobile Wireless Router

- Cisco 1941 Series Router
- Cisco 2600, 2800, 2900 Series Router
- Cisco 3200, 3600, 3700 Series Router
- Cisco 4400 Series Router
- Cisco 5700 Series Wireless LAN Controller
- Cisco 6400 Universal Access Router

- CRS Router Series
- CSS 11500 Series
- Cisco RF Gateway Series
- NAM 2200 Series Appliances
- Nexus 2000, 3000, 4000, 5000, 7000, 9000, 9300, 9500 (modular) Series

[*] Additional platforms may continually be added; please check the compatibility matrix for the latest information and for the Cisco compatible operating system for each platform.

Product Specifications

Cabling and Connectors

Connectors include the following:

- Dual LC/PC connector (1000BASE-SX, 1000BASE-LX/LH, 1000BASE-EX and 1000BASE-ZX)
- Single LC/PC connector (1000BASE-BX-D and 1000BASE-BX-U)
- RJ-45 connector (1000BASE-T)

Note: Only connections with patch cords with PC or UPC connectors are supported. Patch cords with APC connectors are not supported. All cables and cable assemblies used must be compliant with the standards specified in the standards section.

Table 1 provides cabling specifications for the SFPs that you install in the Gigabit Ethernet port. Note that all SFP ports have LC-type connectors, and the minimum cable distance for all SFPs listed (multimode and single-mode fiber) is 6.5 feet (2 m).

Table 1. SFP Port Cabling Specifications

Product	Wavelength (nm)	Fiber Type	Core Size (µm)	Modal Bandwidth (MHz[*] Km)[***]	Operating Distance (m)
1000BASE-SX	850	MMF	62.5	160 (FDDI-grade)	220 (722 ft)
			62.5	200 (OM1)	275 (902 ft)
			50	400 (400/400)	500 (1,640 ft)
			50	500 (OM2)	550 (1,804 ft)
			50	2000 (OM3)	1000 (3281 ft)
1000BASE-LX/LH	1310	MMF*	62.5	500	550 (1,804 ft)
			50	400	550 (1,804 ft)
			50	500	550 (1,804 ft)
		SMF	-**	-	10,000 (32,821 ft)
1000BASE-EX	1310	SMF	-**	-	40,000 (131,234 ft)
1000BASE-ZX	1550	SMF	-	-	Approximately 70 km depending on link loss
1000BASE-BX-U	1310	SMF	-**	-	10,000 (32,821 ft)
1000BASE-BX-D	1490	SMF	-**	-	10,000 (32,821 ft)
GLC-BX40-D-I	1550	SMF	-**	-	40,000 (131,234 ft)
GLC-BX40-DA-I	1490	SMF	-**	-	40,000 (131,234 ft)
GLC-BX40-U-I	1310	SMF	-**	-	40,000 (131,234 ft)
GLC-BX80-D-I	1570	SMF	-**	-	80,000 (262,467 ft)
GLC-BX80-U-I	1490	SMF	-**	-	80,000 (262,467 ft)
GLC-GE-DR-LX	1310	SMF	-**	-	10,000 (32,821 ft)

Optical Specifications

Table 2 specifies the optical parameters for the SFPs. Both receiver power and channel insertion loss specifications must be met for guaranteed operation.

Table 2.   Main Optical Parameters

Product	Transmit Power Range (dBm)	Receive Power Range (dBm)	Maximum Channel insertion loss in dB (by fiber type)*	Transmit and Receive Wavelength Range (nm)
1000BASE-SX	-3 to -9.5	0 to -17	2.4 (FDDI-grade) 2.6 (OM1) 3.4 (400/400) 3.6 (OM2) 5 (OM3)	770 to 860
1000BASE-LX/LH	-3 to -9.5	-3 to -20	2.4 (any MMF) 6 (G.652 SMF)	1270 to 1355
1000BASE-EX	+3 to -1	+1 to -22	18 (G.652 SMF)	1290 to 1335
1000BASE-ZX	+5 to 0	-3 to -23	21 (any SMF)	1500 to 1580
1000BASE-BX10-D	-3 to -9	-3 to -19.5	5.5 (G.652 SMF)	1480 to 1500 (Transmit) 1260 to 1360 (Receive)
1000BASE-BX10-U	-3 to -9	-3 to -19.5	6 (G.652 SMF)	1260 to 1360 (Transmit) 1480 to 1500 (Receive)
GLC-BX40-D-I	-5 to +3	-25 to +3	19 (G.652 SMF)	1540 to 1560 (Transmit) 1260 to 1360 (Receive)
GLC-BX40-DA-I	-5 to +3	-25 to +3	19 (G.652 SMF)	1480 to 1500 (Transmit) 1260 to 1360 (Receive)
GLC-BX40-U-I	-5 to +3	-25 to +3	19 (G.652 SMF)	1260 to 1360 (Transmit) 1480 to 1600 (Receive)
GLC-BX80-D-I	-2 to +3	-27 to +3	23 (G.652 SMF)	1560 to 1580 (Transmit) 1470 to 1510 (Receive)
GLC-BX80-U-I	-2 to +3	-27 to +3	23 (G.652 SMF)	1480 to 1500 (Transmit) 1550 to 1620 (Receive)
GLC-GE-DR-LX	-9.5 to -3	-25 to -3	6 (G.652 SMF)	1260 to 1360

* Maximum channel insertion loss is defined for maximum distance guaranteed as specified in Table 1 and by fiber type. When links are deployed over shorter distances, additional channel insertion loss may be allowed.

Dimensions

Dimensions (H x W x D): 8.5 x 13.4 x 56.5 mm. Cisco SFPs typically weigh 75 grams or less.

Environmental Conditions and Power Requirements

Operating temperature range:

- Commercial temperature range (COM): 0 to 70°C (32 to 158°F)

- Extended temperature range (EXT): -5°C to 85°C (23 to 185°F)

- Industrial temperature range (IND): -40 to 85°C (-40 to 185°F)

- Storage temperature range: -40 to 85°C (-40 to 185°F)

Cisco SFP modules typically consume up to 1W per SFP port, with the exception of the Compact SFP (GLC-2BX-D) consuming up to 1.5W.

Table 3 lists temperature range and DOM support information for the SFPs.

Table 3. Temperature Range and DOM Support

Product Number	Temperature Range	DOM
GLC-ZX-SM	COM	Yes
GLC-BX-U	COM	Yes
GLC-BX-D	COM	Yes
GLC-2BX-D	COM	Yes
GLC-2BX-D-I	IND	Yes
GLC-T	COM	n/a
GLC-TE	EXT	n/a
SFP-GE-T	EXT	n/a
SFP-GE-Z	EXT	Yes
GLC-SX-MMD	EXT	Yes
GLC-LH-SMD	EXT	Yes
GLC-EX-SMD	EXT	Yes
GLC-ZX-SMD	EXT	Yes
GLC-SX-MM-RGD	IND	Yes
GLC-LX-SM-RGD	IND	Yes
GLC-ZX-SM-RGD	IND	Yes
GLC-BX40-D-I	IND	Yes
GLC-BX40-DA-I	IND	Yes
GLC-BX40-U-I	IND	Yes
GLC-BX80-D-I	IND	Yes
GLC-BX80-U-I	IND	Yes
GLC-GE-DR-LX	EXT	Yes

Ordering Information

To place an order, refer to Table 4 and visit the Cisco Ordering Home Page

Table 4. Ordering Information

Product Description	Product Number
1000BASE-T standard	GLC-T
1000BASE-T standard	GLC-TE
1000BASE-ZX extended distance	GLC-ZX-SM
1000BASE-BX10-D downstream bidirectional single fiber; with DOM	GLC-BX-D
2-channel 1000BASE-BX10-D downstream bidirectional single fiber; with DOM	GLC-2BX-D
2-channel 1000BASE-BX10-D downstream bidirectional single fiber; with DOM	GLC-2BX-D-I
1000BASE-BX10-U upstream bidirectional single fiber; with DOM	GLC-BX-U
1000BASE-T NEBS 3 ESD	SFP-GE-T
1000BASE-SX short wavelength; with DOM	GLC-SX-MMD
1000BASE-LX/LH long-wavelength; with DOM	GLC-LH-SMD

Product Description	Product Number
1000BASE-EX long-wavelength; with DOM	GLC-EX-SMD
1000BASE-ZX extended distance; with DOM	SFP-GE-Z GLC-ZX-SMD
1000BASE-SX short wavelength; rugged	GLC-SX-MM-RGD
1000BASE-LX/LH long wavelength; rugged	GLC-LX-SM-RGD
1000BASE-ZX extended distance; rugged	GLC-ZX-SM-RGD
1000BASE-BX40-D for 40km Single-Fiber Bidirectional Applications; with DOM	GLC-BX40-D-I
1000BASE-BX40-D (Alternative) for 40km Single-Fiber Bidirectional Applications; with DOM	GLC-BX40-DA-I
1000BASE-BX40-U for 40km Single-Fiber Bidirectional Applications; with DOM	GLC-BX40-U-I
1000BASE-BX80-D for 80km Single-Fiber Bidirectional Applications; with DOM	GLC-BX80-D-I
1000BASE-BX80-U for 80km Single-Fiber Bidirectional Applications; with DOM	GLC-BX80-U-I
100/1000BASE-LX long-wavelength; with DOM	GLC-GE-DR-LX

Warranty

- Standard warranty: 1 year
- Extended warranty (option): Available under a Cisco SMARTnet® Service support contract for the Cisco switch or router chassis

Regulatory and Standards Compliance

Safety:

- Laser Class I 21CFR1040 LN#50 7/2001
- Laser Class I IEC 60825-1

Standards:

- IEEE 802.3z
- IEEE 802.3ah
- GR-20-CORE: Generic Requirements for Optical Fiber and Optical Fiber Cable
- GR-326-CORE: Generic Requirements for Single-Mode Optical Connectors and Jumper Assemblies
- GR-1435-CORE: Generic Requirements for Multifiber Optical Connectors

Next Steps

Learn more about the Cisco SFP Ethernet Converter Modules by contacting your sales representative or visiting http://www.cisco.com/c/en/us/products/interfaces-modules/transceiver-modules/index.html.

Cisco Capital

Financing to Help You Achieve Your Objectives

Cisco Capital can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.

FortiGate 100E

Podnikové firewallové řešení společnosti Fortinet poskytuje komplexní zabezpečení sítě na jedné platformě, s jedním bezpečnostním operačním systémem a jednotnou správou pravidel z jednoho uživatelského rozhraní. Nabízí bezkonkurenčně nejvyšší míru ochrany proti nejpokročilejším bezpečnostním hrozbám a cíleným útokům.

Integrace pomocí architektury Security Fabric

Zařízení FortiGate, propojená pomocí architektury Fortinet Security Fabric, tvoří páteř uceleného podnikového řešení společnosti Fortinet.

Založené na proprietárním bezpečnostním procesoru SoC3

- Spojuje procesor architektury RISC a specializované obsahové a síťové bezpečnostní procesory společnosti Fortinet, což zaručuje bezkonkurenční výkon
- Zjednodušuje konstrukci zařízení a umožňuje špičkový výkon u sítí menšího rozsahu
- Podporuje firewallovou akceleraci u paketů všech velikostí a maximalizuje tím propustnost
- Poskytuje zrychlené zpracování obsahu v rámci jednotného řízení hrozeb (UTM), což zvyšuje výkon a zkvalitňuje ochranu
- Zvyšuje výkon VPN pro bezpečný vysokorychlostní vzdálený přístup

Záložní napájecí zdroj

Redundance napájení je nezbytná pro provoz kriticky důležitých sítí. Zařízení FortiGate řady 100E nabízí možnost připojit externí záložní napájecí zdroj FortiRPS 100, jehož účelem je zvýšit dostupnost a omezit případné výpadky.

FortiOS

Veškeré bezpečnostní a síťové funkce platformy FortiGate lze řídit a spravovat pomocí jediného intuitivního operačního systému. Snižte si provozní náklady a ušetřete čas díky skutečně konsolidované bezpečnostní platformě příští generace.

- Skutečně konsolidovaná platforma s jedním operačním systémem pro veškeré bezpečnostní a síťové služby všech řešení FortiGate.
- Špičková ochrana: ověřená kvalita zabezpečení a výkon v testech NSS Labs, VB100, AV Comparatives a ICSA.

- Řízení tisíců aplikací, blokace zneužití nejnovějších zranitelností a filtrování internetového provozu za základě milionů hodnocení URL v reálném čase.
- Automaticky detekuje, blokuje a neutralizuje útoky v řádu minut pomocí integrovaného systému ochrany proti pokročilým hrozbám.
- Řeší veškeré síťové potřeby díky širokému spektru funkcí včetně směrování, přepínání, WiFi, LAN a WAN.
- Nejrychlejší firewallová platforma na trhu založená na proprietárních bezpečnostních procesorech.

Bezpečnostní služby FortiGuard™

FortiGuard Labs poskytuje informace o vývoji hrozeb v reálném čase a komplexní bezpečnostní aktualizace pro všechna řešení společnosti Fortinet. Tým sestává z bezpečnostních výzkumníků, techniků a forenzních specialistů a spolupracuje s předními světovými organizacemi, které sledují vývoj hrozeb, s dalšími dodavateli síťových a bezpečnostních řešení i národními bezpečnostními složkami:

- Aktualizace v reálném čase — nepřetržitý výzkum celosvětově poskytuje bezpečnostní zpravodajství pro všechny platformy Fortinet v režimu 24x7x365 prostřednictvím sítě Fortinet Distributed Network.
- Bezpečnostní výzkum — Laboratoře FortiGuard dosud odhalily přes 170 unikátních zranitelnosti nultého dne a měsíčně poskytují miliony automatizovaných aktualizací signatur.
- Ověřená efektivita bezpečnostního zpravodajství — účinnost síťové bezpečnostní platformy využívající FortiGuard ověřily přední mezinárodní nezávislé laboratoře i spotřebitelé na celém světě.

Podpůrné služby FortiCare™

Náš tým zákaznické podpory FortiCare poskytuje globální technickou podporu pro veškeré produkty Fortinet. Centra podpory jsou umístěná v Severní a Jižní Americe, Evropě, Asii a na Blízkém východě. FortiCare nabízí služby, které vyhoví potřebám podniků všech velikostí:

- Rozšířená podpora — pro zákazníky, kteří potřebují podporu pouze během běžné pracovní doby.
- Komplexní podpora — pro zákazníky, kteří potřebují nepřetržitou podporu kvůli zajištění kriticky důležitého provozu včetně rozšířených možností výměny hardwaru.
- Pokročilé služby — pro globální nebo regionální zákazníky, kteří potřebují mít přiděleného vlastního manažera technické podpory, vyšší zaručené parametry úrovně služeb, rozšířenou podporu softwaru, prioritní řešení problémů, návštěvy na místě a další služby.
- Profesionální služby — pro zákazníky s rozsáhlejšími a složitějšími bezpečnostními implementacemi, kteří vyžadují architektonické služby, návrh, implementaci a zprovoznění řešení, provozní služby apod.

HPE FlexNetwork 5120 SI Switch Series

Key features

- Full wire-speed, multi-layer switching

- High reliability with redundancy

- Comprehensive security control policies

- Diversified quality of service (QoS) policies

- Excellent manageability

Product overview

The HPE 5120 SI Switch Series comprises intelligent, fully managed Gigabit Ethernet switches that provide high performance, high port density, and simplified installation to improve the value of your network infrastructure investment. The 5120 SI Switch Series is enhanced for the access layer in enterprise networks that require Gigabit Ethernet to the desktop or at the distribution layer in metropolitan area networks (MANs). Wire-speed forwarding delivers more effective throughput and the bandwidth necessary for mission-critical data and high-speed communications. As part of their comprehensive security control, 5120 SI switches employ IEEE 802.1X authentication to identify users who attempt to access the network. These switches are highly reliable, providing redundancy while eliminating loops in the network. They also offer a range of management protocols to simplify network administration.

Features and benefits

Quality of Service (QoS)

• Broadcast control

  allows limitation of broadcast traffic rate to cut down on unwanted network broadcast traffic

• Powerful QoS feature

  supports the following congestion actions: strict priority (SP) queuing, SDWRR, and SP+SDWRR

• Advanced classifier-based QoS

  classifies traffic using multiple match criteria based on Layer 2, 3, and 4 information; applies QoS policies such as setting priority level and rate limit to selected traffic on a per-port basis

Management

• Friendly port names

  allows assignment of descriptive names to ports

• Remote configuration and management

  enables configuration and management through a secure Web browser or a CLI located on a remote device

• Manager and operator privilege levels

  provides read-only (operator) and read/write (manager) access on CLI and Web browser management interfaces

• Command authorization

  leverages RADIUS to link a custom list of CLI commands to an individual network administrator's login; an audit trail documents activity

• Secure Web GUI

  provides a secure, easy-to-use graphical interface for configuring the module via HTTPS

• Dual flash images

  provides independent primary and secondary operating system files for backup while upgrading

• Multiple configuration files

  stores easily to the flash image

• Complete session logging

  provides detailed information for problem identification and resolution

• SNMPv1, v2c, and v3

  facilitate centralized discovery, monitoring, and secure management of networking devices

• Remote monitoring (RMON)

  uses standard SNMP to monitor essential network functions; supports events, alarm, history, and statistics group plus a private alarm extension group

• IEEE 802.1AB Link Layer Discovery Protocol (LLDP)

advertises and receives management information from adjacent devices on a network, facilitating easy mapping by network management applications

• Management VLAN

segments traffic to and from management interfaces, including CLI/telnet, a Web browser interface, and SNMP

• Device Link Detection Protocol (DLDP)

monitors a cable between two switches and shuts down the ports on both ends if the cable is broken, this prevents network problems such as loops

• Intelligent Resilient Framework (IRF) Lite

allows configuration and management of a system of up to four devices by accessing a single switch connected with Gigabit Ethernet links

Connectivity
• Auto-MDIX

automatically adjusts for straight-through or crossover cables on all 10/100/1000 ports

• Flow control

provides back pressure using standard IEEE 802.3x, reducing congestion in heavy traffic situations

• Jumbo packet support

supports up to 10k byte frame size to improve performance of large data transfers

• High-density port connectivity

provides up to 48 fixed 10/100/1000BASE-T ports in an entry-level static Layer 3 switch

• Ethernet operations, administration and maintenance (OAM)

detects data link layer problems that occurred in the "last mile" using the IEEE 802.3ah OAM standard; monitors the status of the link between two devices

• Power over Ethernet Plus (PoE+) support

provides 30 W power for connected devices, simplifies deployment, and dramatically reduces installation costs by helping to eliminate the time and cost involved in supplying local power at each access point location

• IPv6

– IPv6 host

enables switches to be managed and deployed at the IPv6 network's edge

– Dual stack (IPv4 and IPv6 using BIS)

allows IPv4 hosts to communicate with IPv6 hosts

– IPv6 ACL

for filtering IPv6 network traffic

Performance
- Nonblocking architecture

  up to 104 Gb/s nonblocking switching fabric provides wirespeed switching with up to 77.4 million pps throughput

- Hardware-based wirespeed access control lists (ACLs)

  help provide high levels of security and ease of administration without impacting network performance with a feature-rich TCAM-based ACL implementation

Resiliency and high availability
- Separate data and control paths

  increases security and performance

- Spanning Tree/MSTP, RSTP

  provide redundant links while preventing network loops

- IEEE 802.3ad Link Aggregation Control Protocol (LACP)

  supports up to 26 trunks, each with 8 links per trunk; supports static or dynamic groups

- Smart link

  allows 50 ms failover between links

Layer 2 switching
- 8K MAC address table

  provides access to many Layer 2 devices

- VLAN support and tagging

  supports IEEE 802.1Q with 4,094 simultaneous VLAN IDs

- IP multicast snooping

  automatically prevents flooding of IP multicast traffic

- Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) protocol snooping

  controls and manages the flooding of multicast packets in a Layer 2 network

Layer 3 services
- Address Resolution Protocol (ARP)

  determines the MAC address of another IP host in the same subnet; supports static ARPs; gratuitous ARP allows detection of duplicate IP addresses

- Dynamic Host Configuration Protocol (DHCP)

  simplifies the management of large IP networks; supports client; DHCP Relay enables DHCP operation across subnets

- Loopback interface address

  defines an address in Routing Information Protocol (RIP) and Open Standard Path First (OSPF), improving diagnostic capability

Layer 3 routing
- Static IP routing

  provides manually configured routing for both IPv4 and IPv6 networks

Security
- Access control lists (ACLs)

  provides IP Layer 2 to Layer 4 traffic filtering; supports global ACL, VLAN ACL, port ACL, and IPv6 ACL

- Identity-driven security and access control

  – Per-user ACLs

    permits or denies user access to specific network resources based on user identity and time of day, allowing multiple types of users on the same network to access specific network services without risking network security or allowing unauthorized access to sensitive data

  – Automatic VLAN assignment

    automatically assigns users to the appropriate VLAN based on their identities

- Secure management access

  delivers secure encryption of all access methods (CLI, GUI, or MIB) through SSHv2, SSL, and/ or SNMPv3

- Secure FTP

  allows secure file transfer to and from the switch; protects against unwanted file downloads or unauthorized copying of a switch configuration file

- Guest VLAN

  provides a browser-based environment to authenticated clients that is similar to IEEE 802.1X

- Port isolation

  secures and adds privacy, and prevents malicious attackers from obtaining user information

- STP BPDU port protection

  blocks Bridge Protocol Data Units (BPDUs) on ports that do not require BPDUs, preventing forged BPDU attacks

- STP root guard

  protects the root bridge from malicious attacks or configuration mistakes

- DHCP protection

  blocks DHCP packets from unauthorized DHCP servers, preventing denial-of-service attacks

- Dynamic ARP protection

  blocks ARP broadcasts from unauthorized hosts, preventing eavesdropping or theft of network data

- IP source guard

  helps prevent IP spoofing attacks

- Endpoint Admission Defense (EAD)

  provides security policies to users accessing a network

- RADIUS/HWTACACS

  eases switch management security administration by using a password authentication server

- Port security

  allows access only to specified MAC addresses, which can be learned or specified by the administrator

- MAC-based authentication

  allows or denies access to the switch based on a client MAC address

Convergence
- IEEE 802.1AB Link Layer Discovery Protocol (LLDP)

  facilitates easy mapping using network management applications with LLDP automated device discovery protocol

- LLDP-MED

  is a standard extension that automatically configures network devices, including LLDP-capable IP phones

- LLDP-CDP compatibility

  receives and recognizes CDP packets from Cisco's IP phones for seamless interoperation

- Voice VLAN

  automatically assigns VLAN and priority for IP phones, simplifying network configuration and maintenance

- IP multicast snooping (data-driven IGMP)

  prevents flooding of IP multicast traffic

- Multicast VLAN

  reduces network bandwidth demand by eliminating multiple streams to each VLAN

Additional information
- Green IT and power

  improves energy efficiency through the use of the latest advances in silicon development; shuts off unused ports and utilizes variable-speed fans, reducing energy costs

- Green initiative support

  provides support for RoHS and WEEE regulations

Warranty and support
- Limited Lifetime Warranty

  See **hpe.com/networking/warrantysummary** for warranty and support information included with your product purchase.

- Software releases

  To find software for your product, refer to **hpe.com/networking/support**; for details on the software releases available with your product purchase, refer to **hpe.com/networking/warrantysummary**

HPE 5120 SI Switch Series

Specifications

	HPE 5120 48G SI Switch (JE072B)	HPE 5120 24G SI Switch (JE074B)	HPE 5120 16G SI Switch (JE073B)
I/O ports and slots	48 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASET/100BASE-TX: half or full; 1000BASE-T: full only 4 fixed Gigabit Ethernet SFP ports	24 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASET/100BASE-TX: half or full; 1000BASE-T: full only 4 fixed Gigabit Ethernet SFP ports	16 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASET/100BASE-TX: half or full; 1000BASE-T: full only 4 fixed Gigabit Ethernet SFP ports
Additional ports and slots	1 RJ-45 serial console port	1 RJ-45 serial console port	1 RJ-45 serial console port
Physical characteristics Dimensions Weight	17.3(w) x 10.24(d) x 1.72(h) in (43.94 x 26.01 x 4.37 cm) (1U height) 11.02 lb (5 kg)	17.3(w) x 6.3(d) x 1.72(h) in (43.94 x 16 x 4.37 cm) (1U height) 6.61 lb (3 kg)	17.3(w) x 6.3(d) x 1.72(h) in (43.94 x 16 x 4.37 cm) (1U height) 6.61 lb (3 kg)
Memory and processor	128 MB flash, 128 MB SDRAM; packet buffer size: 1 MB	128 MB flash, 128 MB SDRAM; packet buffer size: 0.5 MB	128 MB flash, 128 MB SDRAM; packet buffer size: 0.5 MB
Mounting and enclosure	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)
Performance 1000 Mb Latency Throughput Routing/Switching capacity Routing table size	< 3 μs up to 77.4 Mpps 104 Gbps 32 entries (IPv4)	< 3 μs up to 41.7 Mpps 56 Gbps 32 entries (IPv4)	< 3 μs up to 29.8 Mpps 40 Gbps 32 entries (IPv4)
Environment Operating temperature Operating relative humidity Nonoperating/Storage temperature Nonoperating/Storage relative humidity	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing
Acoustics	Pressure: 42.2 dB, Low-speed fan: 42.2 dB, High-speed fan: 50 dB; ISO 7779	Pressure: 43.8 dB; ISO 7779	Pressure: 44.4 dB; ISO 7779

	HPE 5120 48G SI Switch (JE072B)	HPE 5120 24G SI Switch (JE074B)	HPE 5120 16G SI Switch (JE073B)
Electrical characteristics Frequency Maximum heat dissipation AC voltage Maximum power rating	50/60 Hz 204 BTU/hr (215.22 kJ/hr) 100–240 VAC 59.8 W	50/60 Hz 107 BTU/hr (112.89 kJ/hr) 100–240 VAC 31.5 W	50/60 Hz 85 BTU/hr (89.68 kJ/hr) 100–240 VAC 25.1 W
	Notes Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.	Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.	Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; ROHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; ROHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; ROHS Compliance
Emissions	FCC part 15 Class A; VCCI Class A; EN 55022 Class A; CISPR 22 Class A; ICES-003 Class A; ANSI C63.4 2003; ETSI EN 300 386 V1.3.3; AS/NZS CISPR 22 Class A; EN 61000-3-2; EN 61000-3-3; EN 61000-4-2; EN 61000-4-3; EN 61000-4-4; EN 61000-4-5; EN 61000-4-6; EN 61000-4-11; EN 61000-3-2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A	FCC part 15 Class A; VCCI Class A; EN 55022 Class A; CISPR 22 Class A; ICES-003 Class A; ANSI C63.4 2003; ETSI EN 300 386 V1.3.3; AS/NZS CISPR 22 Class A; EN 61000-3-2; EN 61000-3-3; EN 61000-4-2; EN 61000-4-3; EN 61000-4-4; EN 61000-4-5; EN 61000-4-6; EN 61000-4-11; EN 61000-3-2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A	FCC part 15 Class A; VCCI Class A; EN 55022 Class A; CISPR 22 Class A; ICES-003 Class A; ANSI C63.4 2003; ETSI EN 300 386 V1.3.3; AS/NZS CISPR 22 Class A; EN 61000-3-2; EN 61000-3-3; EN 61000-4-2; EN 61000-4-3; EN 61000-4-4; EN 61000-4-5; EN 61000-4-6; EN 61000-4-11; EN 61000-3-2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A
Management	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager
Services	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services, and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services, and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services, and response times in your area, please contact your local Hewlett Packard Enterprise sales office.

HPE 5120 SI Switch Series

Specifications (continued)

HPE 5120 24G PoE+ SI Switch (JG091B)

I/O ports and slots	24 RJ-45 autosensing 10/100/1000 PoE+ ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T, IEEE 802.3at PoE+); Duplex: 10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only 4 fixed Gigabit Ethernet SFP ports
Additional ports and slots	1 RJ-45 serial console port
Physical characteristics Dimensions Weight	 17.32(w) x 14.17(d) x 1.72(h) in (44.0 x 36 x 4.36 cm) (1U height) 15.43 lb (7 kg)
Memory and processor	128 MB flash, 128 MB SDRAM; packet buffer size: 0.5 MB
Mounting and enclosure	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)
Performance 1000 Mb Latency Throughput Routing/Switching capacity Routing table size	 < 3 µs up to 41.7 Mpps 56 Gbps 32 entries (IPv4)
Environment Operating temperature Operating relative humidity Nonoperating/Storage temperature Nonoperating/Storage relative humidity	 32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing
Electrical characteristics Frequency Maximum heat dissipation AC voltage Maximum power rating PoE power	 50/60 Hz 539 BTU/hr (568.65 kJ/hr) 100 - 240 VAC 832 W 720 W PoE+
	Notes Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. PoE power is the power supplied by the internal power supply and the optional redundant power unit. With AC input, the maximum power consumption is 523 W (370 W for PoE).
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; ROHS Compliance
Emissions	FCC part 15 Class A; VCCI Class A; EN 55022 Class A; CISPR 22 Class A; ICES-003 Class A; ANSI C63.4 2003; ETSI EN 300 386 V1.3.3; AS/NZS CISPR 22 Class A; EN 61000-3-2; EN 61000-3-3; EN 61000-4-2; EN 61000-4-3; EN 61000-4-4; EN 61000-4-5; EN 61000-4-6; EN 61000-4-11; EN 61000-3-2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A
Management	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager
Services	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services, and response times in your area, please contact your local Hewlett Packard Enterprise sales office.

HPE FlexNetwork 5120 SI Switch Series

Specifications

	HPE FlexNetwork 5120 8G PoE+ (180W) SI Switch (JG309B)	HPE FlexNetwork 5120 8G PoE+ (65W) SI Switch (JG310B)
I/O ports and slots	8 RJ-45 autosensing 10/100/1000 PoE+ ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T, IEEE 802.3at PoE+); Duplex: 10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only 1 SFP fixed Gigabit Ethernet SFP port	8 RJ-45 autosensing 10/100/1000 PoE+ ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T, IEEE 802.3at PoE+); Duplex: 10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only 1 SFP fixed Gigabit Ethernet SFP port
Additional ports and slots	1 RJ-45 serial console port	1 RJ-45 serial console port
Physical characteristics Dimensions Weight	11.81(w) x 6.3(d) x 1.72(h) in (30.0 x 26 x 4.36 cm) (1U height) 6.61 lb (3 kg)	11.81(w) x 6.3(d) x 1.72(h) in (30.0 x 26.0 x 4.36 cm) (1U height) 6.61 lb (3 kg)
Memory and processor	128 MB flash, 128 MB SDRAM; Packet buffer size: 0.5 MB	128 MB flash, 128 MB SDRAM; Packet buffer size: 0.5 MB
Mounting and enclosure	Requires angle mounting set if rack mounted (not included)	Requires angle mounting set if rack mounted (not included)
Performance 1000 Mb Latency Throughput Routing/Switching capacity Routing table size MAC address table size	< 3 µs up to 13.4 Mpps 18 Gbps 32 entries (IPv4) 8192 entries	< 3 µs up to 13.4 Mpps 18 Gbps 32 entries (IPv4) 8192 entries
Environment Operating temperature Operating relative humidity Nonoperating/Storage temperature Nonoperating/Storage relative humidity Acoustic	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Pressure: 39.4 dB, Low-speed fan: 39.4 dB, High-speed fan: 48.6 dB; ISO 7779	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing N/A (fanless)
Electrical characteristics Frequency Maximum heat dissipation Voltage Maximum power rating Idle power PoE power	50/60 Hz 163 BTU/hr (171.97 kJ/hr) 100–240 VAC, rated 230 W 19 W 180 W PoE+	50/60 Hz 95 BTU/hr (100.23 kJ/hr) 100–240 VAC, rated 93 W 10 W 65 W PoE+
	Notes Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. PoE Power is the power supplied by the internal power supply, it is dependent on the type and quantity of power supplies and may be supplemented with the use of a External Power Supply (EPS).	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. PoE Power is the power supplied by the internal power supply, it is dependent on the type and quantity of power supplies and may be supplemented with the use of a External Power Supply (EPS).
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; ROHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; ROHS Compliance

	HPE FlexNetwork 5120 8G PoE+ (180W) SI Switch (JG309B)	HPE FlexNetwork 5120 8G PoE+ (65W) SI Switch (JG310B)
Emissions	FCC part 15 Class A; VCCI Class A; EN 55022 Class A; CISPR 22 Class A; ICES-003 Class A; ANSI C63.4 2003; ETSI EN 300 386 V1.3.3; AS/NZS CISPR 22 Class A; EN 61000-3-2; EN 61000-3-3; EN 61000-4-2; EN 61000-4-3; EN 61000-4-4; EN 61000-4-5; EN 61000-4-6; EN 61000-4-11; EN 61000-3-2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A	FCC part 15 Class A; VCCI Class A; EN 55022 Class A; CISPR 22 Class A; ICES-003 Class A; ANSI C63.4 2003; ETSI EN 300 386 V1.3.3; AS/NZS CISPR 22 Class A; EN 61000-3-2; EN 61000-3-3; EN 61000-4-2; EN 61000-4-3; EN 61000-4-4; EN 61000-4-5; EN 61000-4-6; EN 61000-4-11; EN 61000-3-2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A
Management	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP manager	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP manager
Services	Refer to the Hewlett Packard Enterprise website at **hpe. com/networking/services** for details on the service-level descriptions and product numbers. For details about services, and response times in your area, please contact your local Hewlett Packard Enterprise sales office	Refer to the Hewlett Packard Enterprise website at **hpe. com/networking/services** for details on the service-level descriptions and product numbers. For details about services, and response times in your area, please contact your local Hewlett Packard Enterprise sales office

Standards and Protocols
(applies to all products in series)

General protocols	IEEE 802.1D MAC Bridges IEEE 802.1p Priority IEEE 802.1Q VLANs IEEE 802.1s Multiple Spanning Trees IEEE 802.1w Rapid Reconfiguration of Spanning Tree IEEE 802.1X PAE IEEE 802.3ad Link Aggregation Control Protocol (LACP)	IEEE 802.3x Flow Control IEEE 802.3z 1000BASE-X Gigabit Ethernet over fiber RFC 768 UDP RFC 792 ICMP RFC 793 TCP RFC 826 ARP RFC 854 TELNET	RFC 951 BOOTP RFC 1350 TFTP Protocol (revision 2) RFC 2131 DHCP RFC 2865 Remote Authentication Dial In User Service (RADIUS) RFC 2866 RADIUS Accounting
IPv6	RFC 1350 TFTP RFC 1886 DNS Extension for IPv6 RFC 1887 IPv6 Unicast Address Allocation Architecture RFC 1981 IPv6 Path MTU Discovery RFC 2292 Advanced Sockets API for IPv6 RFC 2373 IPv6 Addressing Architecture RFC 2460 IPv6 Specification RFC 2461 IPv6 Neighbor Discovery RFC 2462 IPv6 Stateless Address Auto-configuration RFC 2463 ICMPv6 RFC 2464 Transmission of IPv6 over Ethernet Networks RFC 2475 IPv6 DiffServ Architecture RFC 2553 Basic Socket Interface Extensions for IPv6 RFC 2711 IPv6 Router Alert Option RFC 2893 Transition Mechanisms for IPv6 Hosts and Routers	RFC 2925 Definitions of Managed Objects for Remote Ping, Traceroute, and Lookup Operations (Ping only) RFC 2925 Remote Operations MIB (Ping only) RFC 3056 Connection of IPv6 Domains via IPv4 Clouds RFC 3162 RADIUS and IPv6 RFC 3363 DNS support RFC 3484 Default Address Selection for IPv6 RFC 3493 Basic Socket Interface Extensions for IPv6 RFC 3513 IPv6 Addressing Architecture RFC 3542 Advanced Sockets API for IPv6 RFC 3587 IPv6 Global Unicast Address Format RFC 3596 DNS Extension for IPv6 RFC 3736 Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6	RFC 4007 IPv6 Scoped Address Architecture RFC 4022 MIB for TCP RFC 4113 MIB for UDP RFC 4251 SSHv6 Architecture RFC 4252 SSHv6 Authentication RFC 4253 SSHv6 Transport Layer RFC 4254 SSHv6 Connection RFC 4291 IP Version 6 Addressing Architecture RFC 4293 MIB for IP RFC 4419 Key Exchange for SSH RFC 4443 ICMPv6 RFC 4541 IGMP & MLD Snooping Switch RFC 4861 IPv6 Neighbor Discovery RFC 4862 IPv6 Stateless Address Auto-configuration RFC 5095 Deprecation of Type 0 Routing Headers in IPv6 RFC 5722 Handling of Overlapping IPv6 Fragments
MIBs	IEEE8021-PAE-MIB IEEE8023-LAG-MIB RFC 1213 MIB II RFC 1493 Bridge MIB RFC 2011 SNMPv2 MIB for IP RFC 2013 SNMPv2 MIB for UDP RFC 2233 Interface MIB RFC 2571 SNMP Framework MIB	RFC 2572 SNMP-MPD MIB RFC 2573 SNMP-Target MIB RFC 2618 RADIUS Authentication Client MIB RFC 2620 RADIUS Accounting Client MIB RFC 2665 Ethernet-Like-MIB RFC 2668 802.3 MAU MIB RFC 2674 802.1p and IEEE 802.1Q Bridge MIB RFC 2819 RMON MIB	RFC 2925 Ping MIB RFC 3414 SNMP-User based-SM MIB RFC 3415 SNMP-View based-ACM MIB RFC 3418 MIB for SNMPv3 RFC 4133 Entity MIB (Version 3) LLDP-EXT-DOT1-MIB LLDP-EXT-DOT3-MIB LLDP-MIB
Network management	IEEE 802.1AB Link Layer Discovery Protocol (LLDP)	ANSI/TIA-1057 LLDP Media Endpoint Discovery (LLDP-MED)	SNMPv1/v2c/v3

HPE 5120 SI Switch Series accessories

Transceivers	HPE X120 1G SFP LC SX Transceiver (JD118B) HPE X120 1G SFP LC LX Transceiver (JD119B) HPE X125 1G SFP LC LH40 1310nm Transceiver (JD061A) HPE X120 1G SFP LC LH40 1550nm Transceiver (JD062A) HPE X125 1G SFP LC LH70 Transceiver (JD063B) HPE X120 1G SFP LC BX 10-U Transceiver (JD098B) HPE X120 1G SFP LC BX 10-D Transceiver (JD099B) HPE X120 1G SFP RJ45 T Transceiver (JD089B)
Cables	HPE 0.5 m Multimode OM3 LC/LC Optical Cable (AJ833A) HPE 1 m Multimode OM3 LC/LC Optical Cable (AJ834A) HPE 2 m Multimode OM3 LC/LC Optical Cable (AJ835A) HPE 5 m Multimode OM3 LC/LC Optical Cable (AJ836A) HPE 15 m Multimode OM3 LC/LC Optical Cable (AJ837A) HPE 30 m Multimode OM3 LC/LC Optical Cable (AJ838A) HPE 50 m Multimode OM3 LC/LC Optical Cable (AJ839A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 1m Cable (QK732A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 2m Cable (QK733A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 5m Cable (QK734A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 15m Cable (QK735A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 30m Cable (QK736A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 50m Cable (QK737A) HPE 3600 Switch SFP Stacking Kit (JD324B)

HPE FlexNetwork 5120 24G PoE+ (370W) SI Switch (JG091B)

Power Supply	HPE RPS1600 Redundant Power System (JG136A) HPE RPS1600 1600W AC Power Supply (JG137A)
Power Cords and Adapters	HPE X290 1000 A JD5 2m RPS Cable (JD187A)

HPE FlexNetwork 5120 8G PoE+ (180W) SI Switch (JG309B)

Mounting Kit	HPE 3100/4210-16/-8 PoE Rack Mount Kit (JD323A)

HPE FlexNetwork 5120 8G PoE+ (65W) SI Switch (JG310B)

Mounting Kit	HPE 3100/4210-16/-8 PoE Rack Mount Kit (JD323A)

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Enterprise

HPE FlexNetwork 5130 EI Switch Series

Key features

- Fixed 10GbE ports for high-speed stacking or uplinks

- Support for multiple services

- Comprehensive security control policies

- Diversified quality of service (QoS) policies

- Excellent manageability

Product overview

The HPE FlexNetwork 5130 EI Switch Series comprises Gigabit Ethernet switches that support static and RIP Layer 3 routing, diversified services, and IPv6 forwarding, as well as provides four 10-Gigabit Ethernet (10GbE) interfaces. Unique Intelligent Resilient Fabric (IRF) technology creates a virtual fabric by managing several switches as one logical device, which increases network resilience, performance, and availability, while reducing operational complexity. These switches provide Gigabit Ethernet access and can be used at the edge of a network or to connect server clusters in small data centers. High availability, simplified management, and comprehensive security control policies are among the key features that distinguish this series.

Features and benefits

Software-defined networking
- OpenFlow

  Supports OpenFlow 1.3 specification to enable SDN by allowing separation of the data (packet forwarding) and control (routing decision) paths

Quality of service (QoS)
- Broadcast control

  Allows limitation of broadcast traffic rate to cut down on unwanted network broadcast traffic

- Advanced classifier-based QoS

  Classifies traffic using multiple match criteria based on Layer 2, 3, and 4 information; applies QoS policies such as setting priority level and rate limit to selected traffic on a port, VLAN, or whole switch

- Powerful QoS feature

  Supports the following congestion actions: strict priority (SP) queuing, weighted round robin (WRR), and SP+WRR

- Traffic policing

  Supports Committed Access Rate (CAR) and line rate

Management
- Remote configuration and management

  Enables configuration and management through a secure Web browser or a CLI located on a remote device

- Manager and operator privilege levels

  Provides read-only (operator) and read or write (manager) access on CLI and Web browser management interfaces

- Command authorization

  Leverages HWTACACS to link a custom list of CLI commands to an individual network administrator's login; also provides an audit trail

- Secure Web GUI

  Provides a secure, easy-to-use graphical interface for configuring the module via HTTPS

- Multiple configuration files

  Stores easily to the flash image

- Complete session logging

  Provides detailed information for problem identification and resolution

- Remote monitoring (RMON)

  Uses standard SNMP to monitor essential network functions; supports events, alarm, history, and statistics group plus a private alarm extension group

- IEEE 802.1AB Link Layer Discovery Protocol (LLDP)

  Advertises and receives management information from adjacent devices on a network, facilitating easy mapping by network management applications

- sFlow® (RFC 3176)

  Provides scalable ASIC-based wire-speed network monitoring and accounting with no impact on network performance; this allows network operators to gather a variety of sophisticated network statistics and information for capacity planning and real-time network monitoring purposes

- Management VLAN

  Segments traffic to and from management interfaces, including CLI/Telnet, a Web browser interface, and SNMP

- Remote intelligent mirroring

  Mirrors ingress/egress ACL-selected traffic from a switch port or VLAN to a local or remote switch port anywhere on the network

- Device Link Detection Protocol (DLDP)

  Monitors a cable between two compatible switches and shuts down the ports on both ends if the cable is broken, which prevents network problems such as loops

- IPv6 management

  Provides future-proof networking because the switch is capable of being managed whether the attached network is running IPv4 or IPv6; supports pingv6, tracertv6, Telnetv6, TFTPv6, DNSv6, syslogv6, FTPv6, SNMPv6, DHCPv6, and RADIUS for IPv6

• Troubleshooting

Ingress and egress port monitoring enables network problem-solving; virtual cable tests provide visibility into cable problems

• HPE Intelligent Management Center (IMC)

Integrates fault management, element configuration, and network monitoring from a central vantage point; built-in support for third-party devices enables network administrators to centrally manage all network elements with a variety of automated tasks, including discovery, categorization, baseline configurations, and software images; the software also provides configuration comparison tools, version tracking, change alerts, and more

• Network management

Offers SNMP v1/v2c/v3, with MIB-II Traps, and RADIUS Authentication Client MIB (RFC 2618); embedded HTML management tool with secure access

Connectivity
• Auto-MDIX

Adjusts automatically for straight-through or crossover cables on all 10/100/1000 ports

• Flow control

Provides back pressure using standard IEEE 802.3x, reducing congestion in heavy traffic situations

• High-density connectivity

Provides up to 48 fixed 10/100/1000BASE-T ports in a Layer 2/Layer 3 switch

• IEEE 802.3at Power over Ethernet (PoE+) support

Simplifies deployment and dramatically reduces installation costs by helping to eliminate the time and cost involved in supplying local power at each access point location

• Ethernet operations, administration, and maintenance (OAM)

Detects data link layer problems that occurred in the "last mile" using the IEEE 802.3ah OAM standard; monitors the status of the link between two devices

Performance
• Non-blocking architecture

Up to 176 Gbps non-blocking switching fabric provides wire-speed switching with up to 130.9 million pps throughput

• Hardware-based wire-speed access control lists (ACLs)

Helps provide high levels of security and ease of administration without impacting network performance with a feature-rich TCAM-based ACL implementation

Resiliency and high availability
• Separate data and control paths

Separates control from services and keeps service processing isolated; increases security and performance

• External redundant power supply

Provides high reliability

• Smart Link

Allows under 100 ms failover between links

• Spanning Tree/PVST+, MSTP, RSTP

Provides redundant links while preventing network loops, supports up to 64 instances of MSTP

• Intelligent Resilient Fabric (IRF)

Creates virtual resilient switching fabrics, where two to nine switches perform as a single L2 switch and L3 router; switches do not have to be co-located and can be part of a disaster-recovery system; servers or switches can be attached using standard LACP for automatic load balancing and high availability; can reduce need for complex protocols like Spanning Tree Protocol, Equal-Cost Multipath (ECMP), or VRRP, thereby simplifying network operation

Layer 2 switching

• 16K MAC address table

Provides access to many Layer 2 devices

• VLAN support and tagging

Supports IEEE 802.1Q with 4,094 simultaneous VLAN IDs

• IEEE 802.1ad QinQ and selective QinQ

Increases the scalability of an Ethernet network by providing a hierarchical structure; connects multiple LANs on a high-speed campus or metro network

• 10GbE port aggregation

Allows grouping of ports to increase overall data throughput to a remote device

• Device Link Detection Protocol (DLDP)

Monitors link connectivity and shuts down ports at both ends if unidirectional traffic is detected, preventing loops in STP-based networks

• Jumbo frame support

Improves the performance of large data transfers; supports frame size of up to 9K-bytes

Layer 3 services

• Address Resolution Protocol (ARP)

Determines the MAC address of another IP host in the same subnet; supports static ARPs; gratuitous ARP allows detection of duplicate IP addresses; proxy ARP allows normal ARP operation between subnets or when subnets are separated by a Layer 2 network

• Dynamic Host Configuration Protocol (DHCP)

Simplifies the management of large IP networks; supports client; DHCP Relay enables DHCP operation across subnets

• Loopback interface address

Defines an address that can always be reachable, improving diagnostic capability

• User Datagram Protocol (UDP) helper function

Allows UDP broadcasts to be directed across router interfaces to specific IP unicast or subnet broadcast addresses and prevents server spoofing for UDP services such as DHCP

• Route maps

Provides more control during route redistribution; allows filtering and altering of route metrics

• DHCP server

Centralizes and reduces the cost of IPv4 address management

Layer 3 routing

• Static IP routing

Provides manually configured routing for both IPv4 and IPv6 networks

• Routing Information Protocol (RIP)

Uses a distance vector algorithm with UDP packets for route determination; supports RIPv1 and RIPv2 routing; includes loop protection

Security
- Access control lists (ACLs)

  Provides IP Layer 2 to Layer 4 traffic filtering; supports global ACL, VLAN ACL, port ACL, and IPv6 ACL

- IEEE 802.1X

  Industry-standard method of user authentication using an IEEE 802.1X supplicant on the client in conjunction with a RADIUS server

- MAC-based authentication

  Client is authenticated with the RADIUS server based on the client's MAC address

- Identity-driven security and access control

  – Per-user ACLs

    Permits or denies user access to specific network resources based on user identity and time of day, allowing multiple types of users on the same network to access specific network services without risking network security or providing unauthorized access to sensitive data

  – Automatic VLAN assignment

    Automatically assigns users to the appropriate VLAN based on their identities

- Secure management access

  Delivers secure encryption of all access methods (CLI, GUI, or MIB) through SSHv2, SSL, HTTPS, and/or SNMPv3

- Secure FTP/SCP

  Allows secure file transfer to and from the switch; protects against unwanted file downloads or unauthorized copying of a switch configuration file

- Guest VLAN

  Provides a browser-based environment to authenticated clients that is similar to IEEE 802.1X

- Port security

  Allows access only to specified MAC addresses, which can be learned or specified by the administrator

- Port isolation

  Secures and adds privacy, and prevents malicious attackers from obtaining user information

- STP BPDU port protection

  Blocks Bridge Protocol Data Units (BPDUs) on ports that do not require BPDUs, preventing forged BPDU attacks

- STP root guard

  Protects the root bridge from malicious attacks or configuration mistakes

- DHCP protection

  Blocks DHCP packets from unauthorized DHCP servers, preventing denial-of-service attacks

- IP source guard

  Helps prevent IP spoofing attacks

- Dynamic ARP protection

  Blocks ARP broadcasts from unauthorized hosts, preventing eavesdropping or theft of network data

- RADIUS/HWTACACS

  Eases switch management security administration by using a password authentication server

Convergence
- IEEE 802.1AB Link Layer Discovery Protocol (LLDP)

  Facilitates easy mapping using network management applications with LLDP automated device discovery protocol

- LLDP-MED

  Is a standard extension that automatically configures network devices, including LLDP-capable IP phones

- LLDP-CDP compatibility

  Receives and recognizes CDP packets from Cisco's IP phones for seamless interoperation

- IEEE 802.3at Power over Ethernet (PoE+)

  Provides up to 30 W per port that allows support of the latest PoE+-capable devices such as IP phones, wireless access points, and security cameras, as well as any IEEE 802.3af-compliant end device; eliminates the cost of additional electrical cabling and circuits that would otherwise be necessary in IP phone and WLAN deployments

- PoE allocations

  Supports multiple methods (automatic, IEEE 802.3af class, LLDP-MED, or user-specified) to allocate PoE power for more efficient energy savings

- Voice VLAN

  Automatically assigns VLAN and priority for IP phones, simplifying network configuration and maintenance

- IP multicast snooping (data-driven IGMP)

  Prevents flooding of IP multicast traffic

Device support
- Pre-standard PoE Support

  Detects and provides power to pre-standard PoE devices such as wireless LAN access points and IP phones

Additional information
- Green IT and power

  Improves energy efficiency through the use of the latest advances in silicon development; shuts off unused ports and utilizes variable-speed fans, reducing energy costs

- Green initiative support

  Provides support for RoHS and WEEE regulations

- Unified HPE Comware operating system with modular architecture

  Provides an easy-to-enhance-and-extend feature set, which doesn't require whole-scale changes; all switching, routing, and security platforms leverage the Comware OS, a common unified modular operating system

- Energy Efficient Ethernet (EEE) Support

  Reduces power consumption in accordance with IEEE 802.3az

Warranty and support
- Limited Lifetime Warranty

  See **hpe.com/networking/warrantysummary** for warranty and support information included with your product purchase.

- Software releases

  To find software for your product, refer to **hpe.com/networking/support**; for details on the software releases available with your product purchase, refer to **hpe.com/networking/warrantysummary**

HPE FlexNetwork 5130 EI Switch Series

Specifications	HPE FlexNetwork 5130-24G-4SFP+ EI Switch (JG932A)	HPE FlexNetwork 5130-24G-SFP-4SFP+ EI Switch (JG933A)	HPE FlexNetwork 5130-48G-4SFP+ EI Switch (JG934A)
I/O ports and slots	24 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASE-T/ 100BASE-TX: half or full; 1000BASE-T: full only 4 SFP+ fixed 1000/10000 SFP+ ports	16 SFP 100/1000 Mbps ports 8 SFP dual-personality ports—10/100/1000BASE-T RJ-45 or 100/1000BASE-X Combo Ports 4 SFP+ fixed 1000/10000 SFP+ ports	48 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASE-T/ 100BASE-TX: half or full; 1000BASE-T: full only 4 SFP+ fixed 1000/10000 SFP+ ports
Additional ports and slots	1 RJ-45 serial console port	1 RJ-45 serial console port	1 RJ-45 serial console port
Power supplies		2 power supply slots 1 minimum power supply required (ordered separately)	
Physical characteristics Dimensions Weight	17.32(w) x 6.3(d) x 1.72(h) in. (44 x 16 x 4.36 cm) (1U height) 11.02 lb (5 kg)	17.32(w) x 14.17(d) x 1.72(h) in. (44 x 36 x 4.36 cm) (1U height) 17.64 lb (8 kg)	17.32(w) x 10.24(d) x 1.72(h) in. (44 x 26 x 4.36 cm) (1U height) 11.02 lb (5 kg)
Memory and processor	1 GB SDRAM, 512 MB flash; packet buffer size: 1.5 MB	1 GB SDRAM, 512 MB flash; packet buffer size: 1.5 MB	1 GB SDRAM, 512 MB flash; packet buffer size: 3 MB
Mounting and enclosure	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)
Performance 1000 Mb Latency 10 Gbps Latency Throughput Routing/Switching capacity Routing table size MAC address table size	< 5 µs < 3 µs 96 Mpps 128 Gbps 512 entries (IPv4), 256 entries (IPv6) 16384 entries IPv6 Ready Certified	< 5 µs < 3 µs 96 Mpps 128 Gbps 512 entries (IPv4), 256 entries (IPv6) 16384 entries IPv6 Ready Certified	< 5 µs < 3 µs 130.9 Mpps 176 Gbps 512 entries (IPv4), 256 entries (IPv6) 16384 entries IPv6 Ready Certified
Environment Operating temperature Operating relative humidity Non-operating/Storage temperature Non-operating/Storage relative humidity Acoustic	23°F to 113°F (-5°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing High-speed fan: 39.7 dB; ISO 7779	23°F to 113°F (-5°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 47.1 dB, High-speed fan: 50.7 dB; ISO 7779	23°F to 113°F (-5°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 38.4 dB, High-speed fan: 47.0 dB; ISO 7779

Specifications (continued)	HPE FlexNetwork 5130-24G-4SFP+ EI Switch (JG932A)	HPE FlexNetwork 5130-24G-SFP-4SFP+ EI Switch (JG933A)	HPE FlexNetwork 5130-48G-4SFP+ EI Switch (JG934A)
Electrical characteristics			
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Maximum heat dissipation	64/88 BTU/hr (67.52/92.84 kJ/hr)	102/204 BTU/hr (107.61/215.22 kJ/hr), for AC powered units. For DC powered units heat dissipation is 130 BTU/hr minimum, 232 BTU/hr maximum.	130/153 BTU/hr (137.15/161.42 kJ/hr), for AC powered units. For DC powered units heat dissipation is 130 BTU/hr minimum, 171 BTU/hr maximum.
AC voltage	100–240 VAC	100–240 VAC	100–240 VAC
DC voltage		-48 to -60 VDC	-48 to -60 VDC
Current	2 A	5 A	10 A
Maximum power rating	26 W	60 W	45 W
Idle power	19 W	30 W	38 W
Notes	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. Power ratings for AC power supply indicated above. For DC input power, idle power is 38 W and maximum is 68 W. DC maximum input current is 8 A. Units are supplied without a power supply. Customer must buy 1 or 2 JD362B (AC) or JD366B (DC) power supply.	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. Power ratings for AC power indicated above. Current used is 5 A maximum when DC power used. For DC input power, idle power is 38 W, maximum DC power used is 50 W. When supplemented with the use of an HPE RPS1600 or RPS 800 Redundant Power System, up to 54 W of DC power can be supplied. DC input voltage range is -48 to -60 VDC. Total DC input power is 36 W typical and 54 W maximum. DC input voltage range is -48 VDC to -60 VDC. DC input source is the HPE RPS1600 or RPS 800.
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance
Emissions	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29:2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29:2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29:2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A
Immunity			
Generic	EN 55024	EN 55024	EN 55024
ESD	EN 300 386	EN 300 386	EN 300 386
Management	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager
Services	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.

HPE 5130 EI Switch Series

Specifications (continued)	HPE FlexNetwork 5130-24G-PoE+-4SFP+ (370W) EI Switch (JG936A)	HPE FlexNetwork 5130-48G-PoE+-4SFP+ (370W) EI Switch (JG937A)	HPE FlexNetwork 5130-24G-2SFP+-2XGT EI Switch (JG938A)
I/O ports and slots	24 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type1000BASE-T);Duplex:10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only 4 SFP+ fixed 1000/10000 SFP+ ports	48 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only 4 SFP+ fixed 1000/10000 SFP+ ports	24 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only 2 SFP+ fixed 1000/10000 SFP+ ports 2 RJ-45 1/10GBASE-T ports
Additional ports and slots	1 RJ-45 Serial Console Port	1 RJ-45 Serial Console Port	1 RJ-45 Serial Console Port
Physical characteristics Dimensions Weight	17.32(w) x 11.81(d) x 1.72(h) in. (44 x 30 x 4.37 cm) (1U height) 17.64 lb (8 kg)	17.32(w) x 14.17(d) x 1.72(h) in. (44 x 36 x 4.36 cm) (1U height) 17.64 lb (8 kg)	17.32(w) x 6.3(d) x 1.72(h) in. (44 x 16 x 4.37 cm) (1U height) 6.61 lb (3 kg)
Memory and processor	1 GB SDRAM, 512 MB flash; packet buffer size: 1.5 MB	1 GB SDRAM, 512 MB flash; packet buffer size: 3 MB	1 GB SDRAM; Packet buffer size: 1.5 MB, 512 MB flash
Mounting and enclosure	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)
Performance 1000 Mb Latency 10 Gbps Latency Throughput Routing/Switching capacity Routing table size MAC address table size	< 5 µs < 3 µs 96 Mpps 128 Gbps 512 entries (IPv4), 256 entries (IPv6) 16384 entries IPv6 Ready Certified	< 5 µs < 3 µs 130.9 Mpps 176 Gbps 512 entries (IPv4), 256 entries (IPv6) 16384 entries IPv6 Ready Certified	< 5 µs < 3 µs up to 96 Mpps 128 Gbps 512 entries (IPv4), 256 entries (IPv6) 16384 entries IPv6 Ready Certified
Environment Operating temperature Operating relative humidity Non-operating/Storage temperature Non-operating/Storage relative humidity Acoustic	23°F to 113°F (-5°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 49.8 dB, High-speed fan: 52.9 dB; ISO 7779	23°F to 113°F (-5°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 50.6 dB, High-speed fan: 54.6 dB; ISO 7779	23°F to 113°F (-5°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 19 dB, High-speed fan: 44.5 dB; ISO 7779

Specifications (continued)	HPE FlexNetwork 5130-24G-PoE+-4SFP+ (370W) EI Switch (JG936A)	HPE FlexNetwork 5130-48G-PoE+-4SFP+ (370W) EI Switch (JG937A)	HPE FlexNetwork 5130-24G-2SFP+-2XGT EI Switch (JG938A)
Electrical characteristics			
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Maximum heat dissipation	102/1569 BTU/hr (107.61/1655.29 kJ/hr), for AC power. For DC power minimum heat dissipation is 85 BTU/hr and maximum heat dissipation is 2695 BTU/hr.	160/1671 BTU/hr (168.8/1762.91 kJ/hr), for AC power. For DC power minimum heat dissipation is 147 BTU/hr and 3037 BTU/hr maximum.	68/116 BTU/hr (71.74/122.38 kJ/hr), for AC power.
AC voltage	100–240 VAC	100–240 VAC	100–240 VAC
DC voltage	-54 to -57 VDC	-54 to -57 VDC	
Current	10 A	10 A	2 A
Maximum power rating	460 W	490 W	34 W
Idle power	30 W	47 W	20 W
PoE power	370 W PoE+	370 W PoE+	
Notes	Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. PoE power is the power supplied by the internal power supply. When supplemented with the use of an HPE RPS1600 Redundant Power System, up to 740 W of PoE+ can be supplied. Maximum current rating for DC power is 25 A. AC input power is 30 W typical, and 460 W maximum (including 370 W PoE+ consumption). DC input voltage range is -54 to -57 VDC. Total DC input power is 25 W typical and 790 W with 740 W PoE+ power consumption. DC input voltage range is -54 VDC to -57 VDC. DC input source is the HPE RPS1600.	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. PoE power is the power supplied by the internal power supply. When supplemented with the use of an HPE RPS1600 Redundant Power System, up to 740 W of PoE+ can be supplied. Maximum current rating for DC power is 25 A. AC input power is 47 W typical, and 490 W maximum (including 370 W PoE+ consumption). DC input voltage range is -54 to -57 VDC. Total DC input power is 43 W typical and 890 W with 800 W PoE+ power consumption. DC input voltage range is -54 VDC to -57 VDC. DC input source is the HPE RPS1600.	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance
Emissions	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29:2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29:2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A

Specifications (continued)	HPE FlexNetwork 5130-24G-PoE+-4SFP+ (370W) EI Switch (JG936A)	HPE FlexNetwork 5130-48G-PoE+-4SFP+ (370W) EI Switch (JG937A)	HPE FlexNetwork 5130-24G-2SFP+-2XGT EI Switch (JG938A)
Immunity			
Generic	EN 55024	EN 55024	EN 55024
ESD	EN 300 386	EN 300 386	EN 300 386
Management	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager	IMC—Intelligent Management Center; command-line interface; Web browser; SNMP Manager	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP Manager
Services	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.

HPE 5130 EI Switch Series

Specifications (continued)	HPE FlexNetwork 5130-48G-2SFP+-2XGT EI Switch (JG939A)	HPE FlexNetwork 5130-24G-PoE+-2SFP+-2XGT (370W) EI Switch (JG940A)	HPE FlexNetwork 5130-48G-PoE+-2SFP+-2XGT (370W) EI Switch (JG941A)
I/O ports and slots	48 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASE-T/ 100BASE-TX: half or full; 1000BASE-T: full only	24 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASE-T/ 100BASE-TX: half or full; 1000BASE-T: full only	48 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASE-T/ 100BASE-TX: half or full; 1000BASE-T: full only
	2 SFP+ fixed 1000/10000 SFP+ ports	2 SFP+ fixed 1000/10000 SFP+ ports	2 SFP+ fixed 1000/10000 SFP+ ports
	2 RJ-45 1/10GBASE-T ports	2 RJ-45 1/10GBASE-T ports	2 RJ-45 1/10GBASE-T ports
Additional ports and slots	1 RJ-45 serial console port	1 RJ-45 serial console port	1 RJ-45 serial console port
Physical characteristics			
Dimensions	17.32(w) x 10.63(d) x 1.72(h) in. (44 x 27 x 4.37 cm) (1U height)	17.32(w) x 14.17(d) x 1.72(h) in. (44 x 36 x 4.37 cm) (1U height)	17.32(w) x 16.54(d) x 1.72(h) in. (44 x 42 x 4.37 cm) (1U height)
Weight	11.02 lb (5 kg)	13.23 lb (6 kg)	15.43 lb (7 kg)
Mounting and enclosure	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)
Performance			
1000 Mb Latency	< 5 µs	< 5 µs	< 5 µs
10 Gbps Latency	< 3 µs	< 3 µs	< 3 µs
Throughput	up to 130.9 Mpps	up to 96 Mpps	up to 130.9 Mpps
Routing/Switching capacity	176 Gbps	128 Gbps	176 Gbps
Routing table size	512 entries (IPv4), 256 entries (IPv6)	512 entries (IPv4), 256 entries (IPv6)	512 entries (IPv4), 256 entries (IPv6)
MAC address table size	16384 entries	16384 entries	16384 entries
	IPv6 Ready Certified	IPv6 Ready Certified	IPv6 Ready Certified
Environment			
Operating temperature	23°F to 113°F (-5°C to 45°C)	23°F to 113°F (-5°C to 45°C)	23°F to 113°F (-5°C to 45°C)
Operating relative humidity	10% to 90%, noncondensing	10% to 90%, noncondensing	10% to 90%, noncondensing
Non-operating/Storage temperature	-40°F to 158°F (-40°C to 70°C)	-40°F to 158°F (-40°C to 70°C)	-40°F to 158°F (-40°C to 70°C)
Non-operating/Storage relative humidity	5% to 95%, noncondensing	5% to 95%, noncondensing	5% to 95%, noncondensing
Acoustic	Low-speed fan: 43.1 dB, High-speed fan: 53.4 dB; ISO 7779	Low-speed fan: 37.3 dB, High-speed fan: 47.1 dB; ISO 7779	Low-speed fan: 47.3 dB, High-speed fan: 50 dB; ISO 7779

Specifications (continued)	HPE FlexNetwork 5130-48G-2SFP+-2XGT EI Switch (JG939A)	HPE FlexNetwork 5130-24G-PoE+-2SFP+-2XGT (370W) EI Switch (JG940A)	HPE FlexNetwork 5130-48G-PoE+-2SFP+-2XGT (370W) EI Switch (JG941A)
Electrical characteristics			
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Maximum heat dissipation	122/184 BTU/hr (128.71/194.12 kJ/hr), for AC power. For DC power min heat dissipation is 122 BTU/hr and 184 BTU/hr max.	105/1450 BTU/hr (159.3/1529.75 kJ/hr), for AC power. For DC Power 68 BTU/hr and max heat dissipation is 2627.3 BTU/hr	147/1603 BTU/hr (155.08/1691.17 kJ/hr), for AC power. For DC power min heat dissipation is 102 BTU/hr and max heat dissipation is 3105 BTU/hr
AC Voltage	100–240 VAC	100–240 VAC,	100–240 VAC
DC Voltage	-48 to -60 VDC	-54 to -57 VDC	-54 to -57 VDC
Current	2 A	10 A	10 A
Maximum power rating	54 W	425 W	470 W
Idle Power	36 W	31 W	43 W
PoE Power		370 W PoE+	370 W PoE+
Notes	Power ratings for AC power indicated above. Current used is 5 A Max when DC Power used. When supplemented with the use of an HPE RPS1600 or RPS800 Redundant Power System, up to 54 W of DC power can be supplied. DC input voltage range is -48 to -60 VDC. Total DC input power is 36 W typical and 54 W maximum. DC input voltage range is -48 VDC to -60 VDC. DC input source is the HPE RPS1600 or RPS800.	PoE Power is the power supplied by the internal power supply. When supplemented with the use of an HPE RPS1600 Redundant Power System, up to 740 W of PoE+ can be supplied. Max current rating for DC power is 25 A. AC Input power is 31 W typical, and 425 W max (including 370 W PoE+ consumption). DC Input voltage range is -54 to -57 VDC. Total DC input power is 20 W Typical and 770 W with 740 W PoE+ Power consumption. DC Input Source is the HPE RPS1600.	PoE Power is the power supplied by the internal power supply. When supplemented with the use of an HPE RPS1600 Redundant Power System, up to 740 W of PoE+ can be supplied. Max current rating for DC power is 25 A. AC Input power is 43 W typical, and 470 W max (including 370 W PoE+ consumption). DC Input voltage range is -54 to -57 VDC. Total DC input power is 30 W typical and 910 W with 800 W PoE+ Power consumption. DC Input Source is the HPE RPS1600.
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance
Emissions	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-4/2012.04; EN 6100-3-2:2006+A1:2009+A2:2009; EN 61000-3-2:2006+A1:2009+A2:2009; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; AS/NZS CISPR 22:2009 Class A; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A
Immunity			
Generic	EN 55024	EN 55024	EN 55024
ESD	EN 300 386	EN 300 386	EN 300 386
Management	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP Manager	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP Manager	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP Manager
Services	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.

Standards and protocols
(applies to all products in series)

IP Multicast	RFC 1112 IGMPv1 RFC 3376 IGMPv3		
Device management	RFC 1157 SNMPv1/v2c RFC 1305 NTPv3 RFC 2573 (SNMPv3 Applications)	RFC 2819 (RMON groups Alarm, Event, History, and Statistics only) RFC 3416 (SNMP Protocol Operations v2) HTML and Telnet management	Multiple Configuration Files SNMPv3 and RMON RFC support SSHv1/SSHv2 Secure Shell TACACS/TACACS+ Web UI
General protocols	IEEE 802.1ad Q-in-Q IEEE 802.1ak Multiple Registration Protocol (MRP) and Multiple VLAN Registration Protocol (MVRP) IEEE 802.1AX—2008 Link Aggregation IEEE 802.1D MAC Bridges IEEE 802.1p Priority IEEE 802.1Q VLANs IEEE 802.1s Multiple Spanning Trees IEEE 802.1w Rapid Reconfiguration of Spanning Tree IEEE 802.1X PAE IEEE 802.3 Type 10BASE-T IEEE 802.3ab 1000BASE-T IEEE 802.3ac VLAN Tagging Extension IEEE 802.3ad Link Aggregation Control Protocol (LACP) IEEE 802.3ae 10-Gigabit Ethernet IEEE 802.3af Power over Ethernet IEEE 802.3at Power over Ethernet Plus IEEE 802.3az Energy Efficient Ethernet IEEE 802.3i 10BASE-T IEEE 802.3u 100BASE-X IEEE 802.3x Flow Control IEEE 802.3z 1000BASE-X RFC 768 UDP RFC 783 TFTP Protocol (revision 2) RFC 791 IP RFC 792 ICMP RFC 793 TCP RFC 826 ARP RFC 854 TELNET RFC 855 Telnet Option Specification RFC 894 IP over Ethernet RFC 950 Internet Standard Subnetting Procedure	RFC 951 BOOTP RFC 959 File Transfer Protocol (FTP) RFC 1027 Proxy ARP RFC 1042 IP Datagrams RFC 1071 Computing the Internet Checksum RFC 1123 Requirements for Internet Hosts RFC 1166 IP Addresses RFC 1213 Management Information Base for Network Management of TCP/IP-based Internet RFC 1256 ICMP Router Discovery Protocol (IRDP) RFC 1305 NTPv3 RFC 1350 TFTP Protocol (revision 2) RFC 1519 CIDR RFC 1533 DHCP Options and BOOTP Vendor Extensions RFC 1591 DNS (client only) RFC 1643 Definitions of Managed Objects for the Ethernet-like Interface Types RFC 1812 IPv4 Routing RFC 1866 Hypertext Markup Language—2.0 RFC 1901 Introduction to Community-based SNMPv2 RFC 1902-1907 SNMPv2 RFC 2131 DHCP RFC 2236 IGMP Snooping RFC 2462 IPv6 Stateless Address Auto-configuration RFC 2474 Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers RFC 2475 Architecture for Differentiated Services RFC 2597 Assured Forwarding PHB Group RFC 2616 HTTP Compatibility v1.1 RFC 2665 Definitions of Managed Objects for the Ethernet-like Interface Types RFC 2668 Definitions of Managed Objects for IEEE 802.3 Medium Attachment Units (MAUs)	RFC 2865 Remote Authentication Dial In User Service (RADIUS) RFC 2866 RADIUS Accounting RFC 3046 DHCP Relay Agent Information Option RFC 3246 Expedited Forwarding PHB RFC 3414 User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3) RFC 3415 View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP) RFC 3416 Protocol Operations for SNMP RFC 3418 Management Information Base (MIB) for the Simple Network Management Protocol (SNMP) RFC 3576 Ext to RADIUS (CoA only) RFC 3580 IEEE 802.1X Remote Authentication Dial In User Service (RADIUS) Usage Guidelines RFC 3587 IPv6 Global Unicast Address Format RFC 3810 Multicast Listener Discovery Version 2 (MLDv2) for IPv6 RFC 4213 Basic IPv6 Transition Mechanisms RFC 4291 IP Version 6 Addressing Architecture RFC 4541 Considerations for Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping Switches RFC 4575 A Session Initiation Protocol (SIP) Event Package for Conference State RFC 4675 RADIUS VLAN & Priority RFC 5095 Deprecation of Type 0 Routing Headers in IPv6 802.1r—GARP Proprietary Attribute Registration Protocol (GPRP)
IPv6	RFC 1981 IPv6 Path MTU Discovery RFC 2460 IPv6 Specification RFC 2461 IPv6 Neighbor Discovery RFC 2463 ICMPv6 RFC 2464 Transmission of IPv6 over Ethernet Networks RFC 3162 RADIUS and IPv6	RFC 3306 Unicast-Prefix-based IPv6 Multicast Addresses RFC 3315 DHCPv6 (client and relay) RFC 3484 Default Address Selection for IPv6 RFC 3736 Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6	RFC 4291 IP version 6 Addressing Architecture RFC 4293 MIB for IP RFC 4443 ICMPv6 RFC 4861 IPv6 Neighbor Discovery RFC 4862 IPv6 Stateless Address Auto-configuration RFC 6724 Default Address Selection for Internet Protocol Version 6 (IPv6)
MIBs	RFC 1212 Concise MIB Definitions RFC 1213 MIB-II RFC 1493 Bridge MIB RFC 1757 Remote Network Monitoring MIB RFC 2096 IP Forwarding Table MIB RFC 2233 Interface MIB RFC 2571 SNMP Framework MIB RFC 2572 SNMP-MPD MIB	RFC 2573 SNMP-Notification MIB RFC 2573 SNMP-Target MIB RFC 2574 SNMP USM MIB RFC 2618 RADIUS Authentication Client MIB RFC 2620 RADIUS Accounting Client MIB RFC 2665 Ethernet-like-MIB RFC 2668 802.3 MAU MIB RFC 2674 802.1p and IEEE 802.1Q Bridge MIB	RFC 2737 Entity MIB (version 2) RFC 2819 RMON MIB RFC 2863 The Interfaces Group MIB RFC 2925 Ping MIB RFC 3414 SNMP-user-based-SM MIB RFC 3415 SNMP-view-based-ACM MIB RFC 3418 MIB for SNMPv3 RFC 3621 Power Ethernet MIB

Network management	IEEE 802.1AB Link Layer Discovery Protocol (LLDP) RFC 2579 Textual Conventions for SMIv2 RFC 2580 Conformance Statements for SMIv2	RFC 2819 four groups of RMON: 1 (statistics), 2 (history), 3 (alarm), and 9 (events)	ANSI/TIA-1057 LLDP Media Endpoint Discovery (LLDP-MED) SNMPv1/v2c/v3
Security	IEEE 802.1X Port-based Network Access Control RFC 1492 TACACS+ RFC 2138 RADIUS Authentication	RFC 2139 RADIUS Accounting RFC 2865 RADIUS (client only) RFC 2866 RADIUS Accounting RFC 3260 New Terminology and Clarifications for DiffServ	Secure Sockets Layer (SSL) SSHv2 Secure Shell

HPE FlexNetwork 5130 EI Switch Series accessories

Transceivers	HPE X115 100M SFP LC FX Transceiver (JD102B)[1] HPE X110 100M SFP LC LX Transceiver (JD120B)[1] HPE X115 100M SFP LC BX 10-U Transceiver (JD100A)[1] HPE X115 100M SFP LC BX 10-D Transceiver (JD101A)[1] HPE X125 1G SFP LC LH40 1310nm Transceiver (JD061A) HPE X120 1G SFP LC LH40 1550nm Transceiver (JD062A) HPE X125 1G SFP LC LH70 Transceiver (JD063B) HPE X120 1G SFP LC LH100 Transceiver (JD103A) HPE X120 1G SFP LC SX Transceiver (JD118B) HPE X120 1G SFP LC LX Transceiver (JD119B) HPE X120 1G SFP LC BX 10-U Transceiver (JD098B) HPE X120 1G SFP LC BX 10-D Transceiver (JD099B) HPE X120 1G SFP RJ45 1000BASE-T Transceiver (JD089B) HPE X130 10G SFP+ LC SR Transceiver (JD092B) HPE X130 10G SFP+ LC LR Transceiver (JD094B) HPE X240 10G SFP+ SFP+ 0.65m DAC Campus-Cable (JH693A) HPE X240 10G SFP+ SFP+ 1.2m DAC Campus-Cable (JH694A) HPE X240 10G SFP+ SFP+ 3m DAC Campus-Cable (JH695A) HPE FlexNetwork X240 10G SFP+ to SFP+ 5m Direct Attach Copper Cable (JG081C)
Cables	HPE LC to LC Multi-mode OM3 2-Fiber 0.5m 1-Pack Fiber Optic Cable (AJ833A) HPE LC to LC Multi-mode OM3 2-Fiber 1.0m 1-Pack Fiber Optic Cable (AJ834A) HPE LC to LC Multi-mode OM3 2-Fiber 2.0m 1-Pack Fiber Optic Cable (AJ835A) HPE LC to LC Multi-mode OM3 2-Fiber 5.0m 1-Pack Fiber Optic Cable (AJ836A) HPE LC to LC Multi-mode OM3 2-Fiber 15.0m 1-Pack Fiber Optic Cable (AJ837A) HPE LC to LC Multi-mode OM3 2-Fiber 30.0m 1-Pack Fiber Optic Cable (AJ838A) HPE LC to LC Multi-mode OM3 2-Fiber 50.0m 1-Pack Fiber Optic Cable (AJ839A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 1m Cable (QK732A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 2m Cable (QK733A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 5m Cable (QK734A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 15m Cable (QK735A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 30m Cable (QK736A) HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 50m Cable (QK737A)
HPE FlexNetwork 5130 24G SFP 4SFP+ EI Switch (JG933A)	HPE X361 150W 100-240VAC to 12VDC Power Supply (JD362B)[2] HPE X361 150W 48-60VDC to 12VDC Power Supply (JD366B)[2] HPE RPS800 Redundant Power Supply (JD183A)[3] HPE X290 500 V 1m RPS Cable (JD186A)[3]
HPE FlexNetwork 5130-48G-4SFP+ EI Switch (JG934A)	HPE RPS800 Redundant Power Supply (JD183A)[2] HPE RPS1600 Redundant Power System (JG136A)[2] HPE RPS1600 1600W AC Power Supply (JG137A)[2] HPE X290 500 V 1m RPS Cable (JD186A) HPE X290 1000 A JD5 Non-PoE 2m RPS Cable (JD188A)
HPE FlexNetwork 5130-24G-PoE+-4SFP+ (370W) EI Switch (JG936A)	HPE RPS1600 Redundant Power System (JG136A)[2] HPE RPS1600 1600W AC Power Supply (JG137A)[2] HPE X290 1000 A JD5 2m RPS Cable (JD187A)

HPE FlexNetwork 5130 EI Switch Series accessories (continued)

HPE FlexNetwork 5130-48G-PoE+-4SFP+ (370W) EI Switch (JG937A)	HPE RPS1600 Redundant Power System (JG136A)[2] HPE RPS1600 1600W AC Power Supply (JG137A)[2] HPE X290 1000 A JD5 2m RPS Cable (JD187A)
HPE FlexNetwork 5130-48G-2SFP+-2XGT EI Switch (JG939A)	HPE RPS 800 Redundant Power Supply (JD183A)[2] HPE RPS1600 Redundant Power System (JG136A)[2] HPE RPS1600 1600W AC Power Supply (JG137A)[2] HPE X290 500 V 1m RPS Cable (JD186A) HPE X290 1000 A JD5 Non-PoE 2m RPS Cable (JD188A)
HPE FlexNetwork 5130-24G-PoE+-2SFP+-2XGT (370W) EI Switch (JG940A)	HPE RPS1600 Redundant Power System (JG136A)[2] HPE RPS1600 1600W AC Power Supply (JG137A)[2] HPE X290 1000 A JD5 2m RPS Cable (JD187A)
HPE FlexNetwork 5130-48G-PoE+-2SFP+-2XGT (370W) EI Switch (JG941A)	HPE RPS1600 Redundant Power System (JG136A)[2] HPE RPS1600 1600W AC Power Supply (JG137A)[2] HPE X290 1000 A JD5 2m RPS Cable (JD187A)

[1] Supported only on the HPE 5130-24G-SFP-4SFP+ EI Switch (JG933A), and only when used in the 1G downlink configuration

[2] Products covered by one year warrant; see details at **hpe.com/networking/warrantyquickref**

[3] Supported on JG933A only when connected to HPE 5500 150WDC Power Supply (JD366A) or HPE X361 150W 48-60VDC to 12VDC Power Supply (JD366B) with HPE X290 500 V 1m RPS Cable (JD186A)

Learn more at
hpe.com/networking

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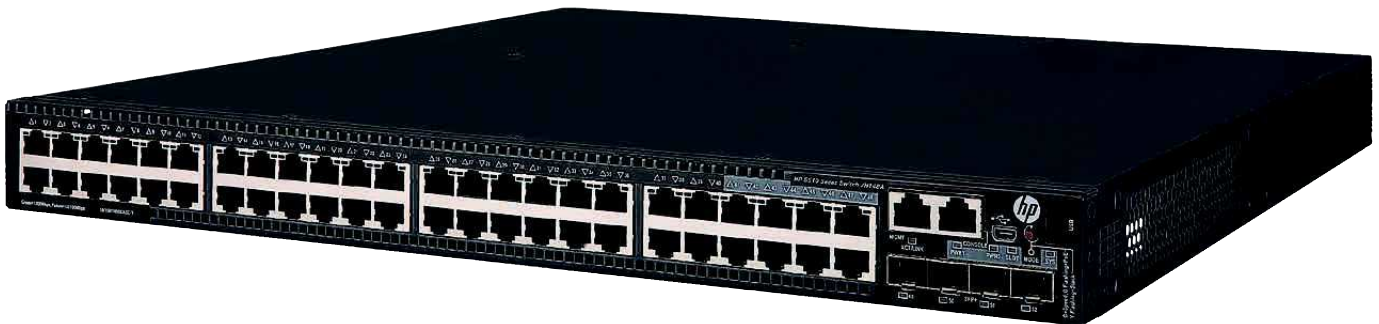
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Hewlett Packard Enterprise

HPE FlexNetwork 5510 HI Switch Series

Key features

- Scalable with 10 Gigabit uplinks and 9-chassis IRF with up to 160 Gbps stacking bandwidth

- 40G QSFP+ ports for uplink or stacking

- Four convenient built-in SFP+ 10GbE uplinks provide performance for bandwidth hungry applications

- PoE+ for up to 30 W of PoE power per port on all ports simultaneously

- MACsec support

Product overview

The HPE FlexNetwork 5510 HI Switch Series comprises Gigabit Ethernet switches that deliver outstanding resiliency, security, and multiservice support capabilities at the edge layer of data center, large campus, and metro Ethernet networks. The switches can also be used in the core layer of SMB networks.

With Intelligent Resilient Fabric (IRF) support and available dual power supplies, the HPE FlexNetwork 5510 HI Series Switch can deliver the highest levels of resiliency and manageability. In addition, the PoE+ models provide up to 1440 W of PoE+ power with the dual power supply configuration.

Designed with four fixed 10GbE ports and supports additional modular uplinks, these switches can provide up to six 10GbE uplink ports. With complete IPv4/IPv6, OpenFlow, and MPLS/VPLS features, the series provides investment protection with an easy transition from IPv4 to IPv6 networks.

Features and benefits

Software-defined networking

• OpenFlow

Supports OpenFlow 1.3 specification to enable SDN by allowing separation of the data (packet forwarding) and control (routing decision) paths

Quality of Service (QoS)

• Advanced classifier-based QoS

Classifies traffic using multiple match criteria based on Layer 2, 3, and 4 information; applies QoS policies such as setting priority level and rate limit to selected traffic on a per-port or per-VLAN basis

• Traffic policing

Supports Committed Access Rate (CAR) and line rate

• Powerful QoS feature

Creates traffic classes based on access control lists (ACLs), IEEE 802.1p precedence, IP, and DSCP or Type of Service (ToS) precedence; supports filter, redirect, mirror, or remark; supports the following congestion actions: strict priority (SP) queuing, weighted round robin (WRR), weighted fair queuing (WFQ), weighted random early discard (WRED), weighted deficit round robin (WDRR), SP+WDRR, and SP+WFQ

• Storm restraint

Allows limitation of broadcast, multicast, and unknown unicast traffic rate to reduce unwanted broadcast traffic on the network

• Broadcast control

Allows limitations of broadcast traffic rate to cut down on unwanted network broadcast traffic

Management

• Friendly port names

Allows assignment of descriptive names to ports

• sFlow (RFC 3176)

Provides scalable ASIC-based wire-speed network monitoring and accounting with no impact on network performance; this allows network operators to gather a variety of sophisticated network statistics and information for capacity planning and real-time network monitoring purposes

• Complete session logging

Provides detailed information for problem identification and resolution

• Remote configuration and management

Enables configuration and management through a secure Web browser or a CLI located on a remote device

• Manager and operator privilege levels

Provides read-only (operator) and read/write (manager) access on CLI and Web browser management interfaces

• Management VLAN

Segments traffic to and from management interfaces, including CLI/Telnet, a Web browser interface, and SNMP

• Command authorization

Leverages RADIUS/HWTACACS to link a custom list of CLI commands to an individual network administrator's login; also provides an audit trail

• Secure Web GUI

Provides a secure, easy-to-use graphical interface for configuring the module via HTTPS

• Remote monitoring (RMON)

Uses standard SNMP to monitor essential network functions; supports events, alarm, history, and statistics group plus a private alarm extension group

• Multiple configuration

Files store easily to the flash image

• Remote intelligent mirroring

Mirrors ingress/egress ACL-selected traffic from a switch port or VLAN to a local or remote switch port anywhere on the network

• In-service software upgrade (ISSU)

Enables operators to perform upgrades in the shortest possible amount of time with reduced risk to network operations or traffic disruptions

• Network Management

SNMPv1/v2c/v3, MIB-II with Traps, and RADIUS Authentication Client MIB (RFC 2618); embedded HTML management tool with secure access

• IPv6 management

Provides future-proof networking because the switch is capable of being managed whether the attached network is running IPv4 or IPv6; supports pingv6, tracertv6, Telnetv6, TFTPv6, DNSv6, syslogv6, FTPv6, SNMPv6, DHCPv6, and RADIUS for IPv6

• Troubleshooting

Ingress and egress port monitoring enables network problem solving; virtual cable tests provide visibility into cable problems

• HPE Intelligent Management Center (IMC)

Integrates fault management, element configuration, and network monitoring from a central vantage point; built-in support for third-party devices enables network administrators to centrally manage all network elements with a variety of automated tasks, including discovery, categorization, baseline configurations, and software images; the software also provides configuration comparison tools, version tracking, change alerts, and more

Connectivity

• Auto-MDIX

Automatically adjusts for straight-through or crossover cables on all 10/100/1000 port

• Packet storm protection

Protects against broadcast, multicast, or unicast storms with user-defined thresholds

• Ethernet operations, administration, and maintenance (OAM)

Detects data link layer problems that occurred in the "last mile" using the IEEE 802.3ah OAM standard; monitors the status of the link between two devices

• Flow Control

Provides back pressure using standard IEEE 802.3x, reducing congestion in heavy traffic situations

- Fixed 10GbE ports

  Provides four fixed SFP+ ports for a 20GbE connection to the network without the need for additional extension interface modules

- Optional 10GbE or 40GbE ports

  Deliver, through the use of optional modules, additional 10GbE or 40GbE connections, which are available for uplinks or high-bandwidth server connections; flexibly support copper, SFP+, or 40GbE QSFP+ connections

- Jumbo packet support

  Supports up to 10000-byte frame size to improve the performance of large data transfers

- IEEE 802.3at Power over Ethernet (PoE+)

  Provides up to 30 W per port that allows support of the latest PoE+-capable devices such as IP phones, wireless access points, and security cameras, as well as any IEEE 802.3af-compliant end device; eliminates the cost of additional electrical cabling and circuits that would otherwise be necessary in IP phone and WLAN deployments

Performance

- Hardware-based wire-speed access control lists (ACLs)

  Help provide high levels of security and ease of administration without impacting network performance with a feature-rich TCAM-based ACL implementation

- Non-blocking architecture

  Delivers up to 336 Gbps of wire-speed switching with a non-blocking switching fabric and up to 250 million pps throughput

Resiliency and high availability

- Separate data and control paths

  Separates control from services and keeps service processing isolated; increases security and performance

- Device Link Detection Protocol (DLDP)

  Monitors link connectivity and shuts down ports at both ends if unidirectional traffic is detected, preventing loops in STP-based networks

- Intelligent Resilient Fabric (IRF)

  Creates virtual resilient switching fabrics, where two to nine switches perform as a single L2 switch and L3 router; switches do not have to be co-located and can be part of a disaster-recovery system; servers or switches can be attached using standard LACP for automatic load balancing and high availability; can eliminate need for complex protocols like Spanning Tree Protocol, Equal-Cost Multipath (ECMP), or VRRP, thereby simplifying network operations

- Rapid Ring Protection Protocol (RRPP)

  Connects multiple switches in a high-performance ring using standard Ethernet technology; traffic can be rerouted around the ring in less than 50 ms, reducing the impact on traffic and applications

- Smart Link

  Allows under 100 ms failover between links

- Virtual Router Redundancy Protocol (VRRP)

  Allows groups of two routers to dynamically back each other up to create highly available routed environments

- IRF capability

  Provides single IP address management for a resilient virtual switching fabric of up to nine switches using up to 160 Gbps bidirectional using QSFP+ links

- Spanning Tree/PVST+, MSTP, RSTP

  Provides redundant links while preventing network loops

- Internal Dual-Redundant Power Supply

  Provides high reliability by keeping network up while delivering up to 1440 W of PoE+

Manageability

- Dual-flash images

  Provides independent primary and secondary operating system files for backup while upgrading

- Multiple configuration files

  Allow multiple configuration files to be stored to a flash image

- Troubleshooting

  Allows ingress and egress port monitoring, enabling network problem solving; virtual cable tests provide visibility into cable problems

- IPv6 management

  Future-proofs networking, as the switch is capable of being managed whether the attached network is running IPv4 or IPv6; supports pingv6, tracertv6, Telnetv6, TFTPv6, DNSv6, and ARPv6

Layer 2 switching

- GARP VLAN Registration Protocol

  Allows automatic learning and dynamic assignment of VLANs

- IP multicast snooping and data-driven IGMP

  Automatically prevents flooding of IP multicast traffic

- Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) protocol snooping

  Controls and manages the flooding of multicast packets in a Layer 2 network

- 32K MAC addresses

  Provide access to many Layer 2 devices

- IEEE 802.1ad QinQ and selective QinQ

  Increase the scalability of an Ethernet network by providing a hierarchical structure; connect multiple LANs on a high-speed campus or metro network

- 10GbE port aggregation

  Allows grouping of ports to increase overall data throughput to a remote device

- Spanning Tree/MSTP, RSTP, and STP root guard

  Prevent network loops

- 64 MSTP instances

  Allow multiple configurations of STP per VLAN group

- Isolation at data link layer with private VLANs

  Provides, through a two-tier VLAN structure, an additional layer of protection, simplifying network configuration while saving VLAN resources

- VLAN support and tagging

  Supports the IEEE 802.1Q (4094 VLAN IDs)

Layer 3 services

- Address Resolution Protocol (ARP)

  Determines the MAC address of another IP host in the same subnet; supports static ARPs; gratuitous ARP allows detection of duplicate IP addresses; proxy ARP allows normal ARP operation between subnets or when subnets are separated by a Layer 2 network

- Dynamic Host Configuration Protocol (DHCP)

  Simplifies the management of large IP networks; supports client; DHCP Relay enables DHCP operation across subnets

- Loopback interface address

  Defines an address that can always be reachable, improving diagnostic capability

- User Datagram Protocol (UDP) helper function

  Allows UDP broadcasts to be directed across router interfaces to specific IP unicast or subnet broadcast addresses and prevents server spoofing for UDP services such as DHCP

- Route maps

  Provide more control during route redistribution; allow filtering and altering of route metrics

- DHCP server

  Centralizes and reduces the cost of the IPv4 address management

Layer 3 routing

- IPv4 routing protocols

  Support static routes, RIP, OSPF, ISIS, and BGP

- IPv6 routing protocols

  Provide routing of IPv6 at wire speed; support static routes, RIPng, OSPFv3, IS-ISv6, and BGP4+ for IPv6

- PIM-SSM, PIM-DM, and PIM-SM (for IPv4 and IPv6)

  Support IP Multicast address management and inhibition of DoS attacks

- MPLS support

  Provides extended support of MPLS, including MPLS VPNs and MPLS Traffic Engineering (MPLS TE)

- Virtual Private LAN Service (VPLS)

  Establishes point-to-multipoint Layer 2 VPNs across a provider network

- Bidirectional Forwarding Detection (BFD)

  Enables link connectivity monitoring and reduces network convergence time for RIP, OSPF, BGP, IS-IS, VRRP, MPLS, and IRF

- Policy-based routing

  Makes routing decisions based on policies set by the network administrator

- Equal-Cost Multipath (ECMP)

  Enables multiple equal-cost links in a routing environment to increase link redundancy and scale bandwidth

- IPv6 tunneling

  Allows a smooth transition from IPv4 to IPv6 by encapsulating IPv6 traffic over an existing IPv4 infrastructure

Security

- Access control lists (ACLs)

  Provide IP Layer 2 to Layer 4 traffic filtering; support global ACL, VLAN ACL, port ACL, and IPv6 ACL; up to 6144 ingress ACLs and 1024 egress ACLs are supported

- IEEE 802.1X

  Defines an industry-standard method of user authentication using an IEEE 802.1X supplicant on the client in conjunction with a RADIUS server

- MAC-based authentication

  Client is authenticated with the RADIUS server based on the client's MAC address

- Identity-driven security and access control

  – Per-user ACLs

    Permits or denies user access to specific network resources based on user identity and time of day, allowing multiple types of users on the same network to access specific network services without risking network security or providing unauthorized access to sensitive data

  – Automatic VLAN assignment

    Automatically assigns users to the appropriate VLAN based on their identities

- Port security

  Allows access only to specified MAC addresses, which can be learned or specified by the administrator

- Secure FTP/ SCP

  Allows secure file transfer to and from the switch; protects against unwanted file downloads or unauthorized copying of a switch configuration file

- STP BPDU port protection

  Blocks Bridge Protocol Data Units (BPDUs) on ports that do not require BPDUs, preventing forged BPDU attacks

- DHCP protection

  Blocks DHCP packets from unauthorized DHCP servers, preventing denial-of-service attacks

- DHCP snooping

  Helps ensure that DHCP clients receive IP addresses from authorized DHCP servers and maintain a list of DHCP entries for trusted ports; prevents reception of fake IP addresses and reduces ARP attacks, improving security

- DHCPv6 snooping

  Ensures that DHCPv6 clients obtain IPv6 addresses from authorized DHCPv6 servers and record IP-to-MAC mappings of DHCPv6 clients

- Dynamic ARP

  Protection blocks ARP broadcasts from unauthorized hosts, preventing eavesdropping or theft of network data

- STP root guard

  Protects the root bridge from malicious attacks or configuration mistakes

- Guest VLAN

  Provides a browser-based environment to authenticated clients that is similar to IEEE 802.1X

- Port isolation

  Secures and adds privacy, and prevents malicious attackers from obtaining user information

- Endpoint Admission Defense (EAD)

  Provides security policies to users accessing a network

- RADIUS/HWTACACS

  Eases switch management security administration by using a password authentication server

- Secure management access

  Delivers secure encryption of all access methods (CLI, GUI, or MIB) through SSHv2, SSL, HTTPS, and/or SNMPv3

- Unicast Reverse Path Forwarding (URPF)

  Allows normal packets to be forwarded correctly, but discards the attaching packet due to lack of reverse path route or incorrect inbound interface; prevents source spoofing and distributed attacks; supports distributed URPF

- IP source guard

  Helps prevent IP spoofing attacks

- IPv6 source guard

  Helps prevent IPv6 spoofing attacks using ND Snooping as well as DHCPv6 Snooping

- ND Snooping

  Allows only packets with a legally obtained IPv6 address to pass

Virtual private network (VPN)
- Generic Routing Encapsulation (GRE)

  Transports Layer-2 connectivity over a Layer-3 path in a secured way; enables the segregation of traffic from site to site

Convergence
- LLDP-MED (Media Endpoint Discovery)

  Defines a standard extension of LLDP that stores values for parameters such as QoS and VLAN to automatically configure network devices such as IP phones

- Internet Group Management Protocol (IGMP)

  Utilizes Any-Source Multicast (ASM) or Source-Specific Multicast (SSM) to manage IPv4 multicast networks; supports IGMPv1, v2, and v3

- IEEE 802.1AB Link Layer Discovery Protocol (LLDP)

  Facilitates easy mapping using network management applications with LLDP automated device discovery protocol

- Multicast Source Discovery Protocol (MSDP)

  Allows multiple PIM-SM domains to interoperate; is used for inter-domain multicast applications

- Multicast VLAN

  Allows multiple VLANs to receive the same IPv4 or IPv6 multicast traffic, lessening network bandwidth demand by reducing or eliminating multiple streams to each VLAN

- LLDP-CDP compatibility

  Receives and recognizes CDP packets from Cisco's IP phones for seamless interoperation

- IEEE 802.3at Power over Ethernet (PoE+)

  Provides up to 30 W per port that allows support of the latest PoE+-capable devices such as IP phones, wireless access points, and security cameras, as well as any IEEE 802.3af-compliant end device; eliminates the cost of additional electrical cabling and circuits that would otherwise be necessary in IP phone and WLAN deployments

- PoE allocations

  Supports multiple methods (automatic, IEEE 802.3af-class, LLDP-MED, or user-specified) to allocate PoE power for more efficient energy savings

- Voice VLAN

  Automatically assigns VLAN and priority for IP phones, simplifying network configuration and maintenance

- IP multicast snooping (data-driven IGMP)

  Prevents flooding of IP multicast traffic

Additional information

- Green initiative support

  Provides support for RoHS and WEEE regulations

- Green IT and power

  Improves energy efficiency through the use of the latest advances in silicon development; shuts off unused ports and utilizes variable-speed fans, reducing energy costs

- Unified HPE Comware operating system with modular architecture

  Provides an easy-to-enhance-and-extend feature set, which doesn't require whole-scale changes; all switching, routing, and security platforms leverage the Comware OS, a common unified modular operating system

- Energy Efficient Ethernet (EEE) support

  Reduces power consumption in accordance with IEEE 802.3az

Warranty and support

- Limited Lifetime Warranty

  See **hpe.com/networking/warrantysummary** for warranty and support information included with your product purchase.

- Software releases

  To find software for your product, refer to **hpe.com/networking/support**; for details on the software releases available with your product purchase, refer to **hpe.com/networking/warrantysummary**

HPE FlexNetwork 5510 HI Switch Series

Specifications

	HPE 5510 24G 4SFP+ HI 1-SLOT SWITCH (JH145A)	HPE 5510 48G 4SFP+ HI 1-SLOT SWITCH (JH146A)	HPE 5510 24G POE+ 4SFP+ HI 1-SLOT SWITCH (JH147A)
I/O ports and slots	24 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Media Type: Auto-MDIX; Duplex: 10BASE-T /100BASE-TX: half or full; 1000BASE-T: full only; Ports 1 - 8 support MACSec 4 SFP+ 10GbE ports 1 port expansion module slot Supports a maximum of 6 SFP+ ports or 2 1/10GBASE-T ports or 2 40GbE ports, with optional module	48 RJ-45 autosensing 10/100/1000 ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T); Media Type: Auto-MDIX; Duplex: 10BASE-T /100BASE-TX: half or full; 1000BASE-T: full only; Ports 1 - 8 support MACSec 4 SFP+ 10GbE ports 1 port expansion module slot Supports a maximum of 6 SFP+ ports or 2 1/10GBASE-T ports or 2 40GbE ports, with optional module	24 RJ-45 autosensing 10/100/1000 PoE+ ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T, IEEE 802.3at PoE+); Media Type: Auto-MDIX; Duplex: 10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only; Ports 1 - 8 support MACSec 4 SFP+ 10GbE ports 1 port expansion module slot Supports a maximum of 6 SFP+ ports or 2 1/10GBASE-T ports or 2 40GbE ports, with optional module
Additional ports and slots	1 dual-personality (RJ-45 or USB micro-B) serial console port 1 RJ-45 out-of-band management port 1 USB 2.0	1 dual-personality (RJ-45 or USB micro-B) serial console port 1 RJ-45 out-of-band management port 1 USB 2.0	1 dual-personality (RJ-45 or USB micro-B) serial console port 1 RJ-45 out-of-band management port 1 USB 2.0
Power supplies	2 power supply slots 1 minimum power supply required (ordered separately)	2 power supply slots 1 minimum power supply required (ordered separately)	2 power supply slots 1 minimum power supply required (ordered separately)
Fan tray	Airflow direction is Front (port side) to Back (power cord side)	Airflow direction is Front (port side) to Back (power cord side)	Airflow direction is Front (port side) to Back (power cord side)
Physical characteristics Dimensions Weight	17.32(w) x 14.17(d) x 1.72(h) in (44.00 x 36.00 x 4.37cm) (1U height) 16.53 lb (7.5 kg) shipping weight	17.32(w) x 14.17(d) x 1.72(h) in (44.0 x 36.0 x 4.37 cm) (1U height) 16.53 lb (7.5 kg)	17.32(w) x 18.11(d) x 1.72(h) in (43.99 x 46 x 4.37 cm) (1U height) 27.56 lb (12.5 kg) shipping weight
Memory and processor	2 GB SDRAM; Packet buffer size: 4 MB, 512 MB flash	2 GB SDRAM; Packet buffer size: 4 MB, 512 MB flash	2 GB SDRAM; Packet buffer size: 4 MB, 512 MB flash
Mounting and enclosure	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)
Performance 1000 Mb Latency 10 Gbps Latency Throughput Routing/Switching capacity Routing table size MAC address table size	< 5 µs < 3 µs up to 214 Mpps 288 Gbps 32768 entries (IPv4), 16384 entries (IPv6) 32768 entries	< 5 µs < 3 µs up to 250 Mpps 336 Gbps 32768 entries (IPv4), 16384 entries (IPv6) 32768 entries	< 5 µs < 3 µs up to 214 Mpps 288 Gbps 32768 entries (IPv4), 16384 entries (IPv6) 32768 entries
Environment Operating temperature Operating relative humidity Nonoperating/Storage temperature Nonoperating/Storage relative humidity Acoustic	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 52.8 dB, High-speed fan: 66.7 dB; ISO 7779	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 49.9 dB, High-speed fan: 64.8 dB; ISO 7779	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 57.6 dB, High-speed fan: 66.9 dB; ISO 7779

HPE FlexNetwork 5510 HI Switch Series

Specifications (continued)

	HPE 5510 24G 4SFP+ HI 1-SLOT SWITCH (JH145A)	HPE 5510 48G 4SFP+ HI 1-SLOT SWITCH (JH146A)	HPE 5510 24G POE+ 4SFP+ HI 1-SLOT SWITCH (JH147A)
Electrical characteristics			
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Maximum heat dissipation	365 BTU/hr (385.08 kJ/hr), Ranges from 167 BTU/hr to 392 BTU/hr, depending on power supply configuration	238 BTU/hr (686.81 kJ/hr), Ranges from 201 BTU/hr to 443 BTU/hr, depending on power supply configuration	2217 BTU/hr (3599.66 kJ/hr), Ranges from 228 BTU/hr to 3412 BTU/hr, depending on power supply configuration
Voltage	100 - 240 VAC, rated (90 - 264 VAC, max) -48 to -60 VDC, rated (-36 to -72 VDC, max) (depending on power supply chosen)	100 - 240 VAC, rated (90 - 264 VAC, max) -48 to -60 VDC, rated (-36 to -72 VDC, max) (depending on power supply chosen)	100 - 240 VAC, rated (90 - 264 VAC, max) (depending on power supply chosen)
Maximum power rating	107 W	150 W	650 W
Idle power	55 W	70 W	67 W
PoE power			740 W PoE+
Notes	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. PoE+ power range is from 450W to 740W. PoE+ power is the power supplied by the internal power supply(ies). It is dependent on the type and quantity of power supplies. Device supports 1 or 2 internal modular power supplies.
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; EN 60950-1; CAN/CSA-C22.2 No. 60950-1; FDA 21 CFR Subchapter J; ROHS Compliance; AS/NZS 60950-1; GB 4943; EAC (EurAsian Conformity Certification)	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; EN 60950-1; CAN/CSA-C22.2 No. 60950-1; FDA 21 CFR Subchapter J; ROHS Compliance; AS/NZS 60950-1; GB 4943; EAC (EurAsian Conformity Certification)	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; EN 60950-1; CAN/CSA-C22.2 No. 60950-1; FDA 21 CFR Subchapter J; ROHS Compliance; AS/NZS 60950-1; GB 4943; EAC (EurAsian Conformity Certification)
Emissions	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-3/2012.04; EN 61000-3-2:2006+A1:2009+A2:2009 ; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-3/2012.04; EN 61000-3-2:2006+A1:2009+A2:2009 ; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-3/2012.04; EN 61000-3-2:2006+A1:2009+A2:2009 ; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A
Immunity			
Generic	EN 55024	EN 55024	EN 55024
ESD	EN300 386	EN300 386	EN300 386
Management	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP manager	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP manager	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP manager
Services	Refer to the HPE website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HPE sales office.	Refer to the HPE website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HPE sales office.	Refer to the HPE website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HPE sales office.

HPE FlexNetwork 5510 HI Switch Series

Specifications (continued)

	HPE 5510 48G PoE+ 4SFP+ HI 1-slot Switch (JH148A)	HPE 5510 24G SFP 4SFP+ HI 1-slot Switch (JH149A)
I/O ports and slots	48 RJ-45 autosensing 10/100/1000 PoE+ ports (IEEE 802.3 Type 10BASE-T, IEEE 802.3u Type 100BASE-TX, IEEE 802.3ab Type 1000BASE-T, IEEE 802.3at PoE+); Duplex: 10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only; Ports 1 - 8 support MACSec 4 SFP+ 10GbE ports 1 port expansion module slot Supports a maximum of 6 SFP+ ports or 2 1/10GBASE-T ports or 2 40GbE ports, with optional module	16 fixed Gigabit Ethernet SFP ports; Ports 1 - 8 support MACSec 8 Combo GbE (SFP and RJ45) dual-personality 1000 Mbps port, IEEE 802.3ab Type 1000BASE-T); Duplex: 10BASE-T/100BASE-TX: half or full; 1000BASE-T: full only 4 SFP+ 10GbE ports 1 port expansion module slot Supports a maximum of 6 SFP+ ports or 2 1/10GBASE-T ports or 2 40GbE ports, with optional module
Additional ports and slots	1 dual-personality (RJ-45 or USB micro-B) serial console port 1 RJ-45 out-of-band management port 1 USB 2.0	1 dual-personality (RJ-45 or USB micro-B) serial console port 1 RJ-45 out-of-band management port 1 USB 2.0
Power supplies	2 power supply slots 1 minimum power supply required (ordered separately)	2 power supply slots 1 minimum power supply required (ordered separately)
Fan tray	Airflow direction is Front (port side) to Back (power cord side)	Airflow direction is Front (port side) to Back (power cord side)
Physical characteristics Dimensions Weight	17.32(w) x 18.11(d) x 1.72(h) in (43.99 x 46 x 4.37 cm) (1U height) 27.56 lb (12.5 kg) shipping weight	17.32(w) x 14.17(d) x 1.72(h) in (43.99 x 35.99 x 4.37 cm) (1U height) 16.53 lb (7.5 kg) shipping weight
Memory and processor	2 GB SDRAM; Packet buffer size: 4 MB, 512 MB flash	2 GB SDRAM; Packet buffer size: 4 MB, 512 MB flash
Mounting and enclosure	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)	Mounts in an EIA standard 19-inch telco rack or equipment cabinet (hardware included)
Performance 1000 Mb Latency 10 Gbps Latency Throughput Routing/Switching capacity Routing table size MAC address table size	< 5 µs < 3 µs up to 250 Mpps 336 Gbps 32768 entries (IPv4), 16384 entries (IPv6) 32768 entries	< 5 µs < 3 µs up to 214 Mpps 288 Gbps 32768 entries (IPv4), 16384 entries (IPv6) 32768 entries
Environment Operating temperature Operating relative humidity Nonoperating/Storage temperature Nonoperating/Storage relative humidity Acoustic	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 57.6 dB, High-speed fan: 66.9 dB; ISO 7779	32°F to 113°F (0°C to 45°C) 10% to 90%, noncondensing -40°F to 158°F (-40°C to 70°C) 5% to 95%, noncondensing Low-speed fan: 50.5 dB, High-speed fan: 66.9 dB; ISO 7779

HPE FlexNetwork 5510 HI Switch Series

Specifications (continued)

	HPE 5510 24G 4SFP+ HI 1-SLOT SWITCH (JH145A)	HPE 5510 48G 4SFP+ HI 1-SLOT SWITCH (JH146A)
Electrical characteristics		
Frequency	50/60 Hz	50/60 Hz
Maximum heat dissipation	2286 BTU/hr (2411.73 kJ/hr), Heat dissipation ranges from 256 BTU/hr to 6142 BTU/hr, depending on power supply configuration	409 BTU/hr (431.49 kJ/hr), Heat dissipation ranges from 163 BTU/hr to 498 BTU/hr, depending on power supply configuration
Voltage	100 - 240 VAC, rated (90 - 264 VAC, max) (depending on power supply chosen)	100 - 240 VAC, rated (90 - 264 VAC, max) -48 to -60 VDC, rated (-36 to -72 VDC, max) (depending on power supply chosen)
Maximum power rating	670 W	120 W
Idle power	75 W	48 W
PoE power	1440 W PoE+	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.
Notes	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated. PoE+ power range is from 450W to 1440W. PoE+ power is the power supplied by the internal power supply(ies). It is dependent on the type and quantity of power supplies. Device supports 1 or 2 internal modular power supplies.	
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; EN 60950-1; CAN/CSA-C22.2 No. 60950-1; FDA 21 CFR Subchapter J; ROHS Compliance; AS/NZS 60950-1; GB 4943; EAC (EurAsian Conformity Certification)	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; EN 60950-1; CAN/CSA-C22.2 No. 60950-1; FDA 21 CFR Subchapter J; ROHS Compliance; AS/NZS 60950-1; GB 4943; EAC (EurAsian Conformity Certification)
Emissions	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-3/2012.04; EN 61000-3-2:2006+A1:2009+A2:2009 ; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A	EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; EN 61000-4-11:2004; ANSI C63.4-2009; EN 61000-3-3:2008; VCCI V-3/2012.04; EN 61000-3-2:2006+A1:2009+A2:2009 ; EN 61000-4-3:2006; EN 61000-4-4:2012; EN 61000-4-5:2006; EN 61000-4-6:2009; CISPR 22:2008 Class A; EN 55022:2010 Class A; EN 61000-4-29: 2000; CISPR 24:2010; EN 300 386 V1.6.1; VCCI V-3/2013.04 Class A
Immunity		
Generic	EN 55024	EN 55024
ESD	EN300 386	EN300 386
Management	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP manager	IMC—Intelligent Management Center; Command-line interface; Web browser; SNMP manager
Services	Refer to the HPE website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HPE sales office.	Refer to the HPE website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HPE sales office.

STANDARDS AND PROTOCOLS
(APPLIES TO ALL PRODUCTS IN SERIES)

BGP	RFC 1657 Definitions of Managed Objects for BGPv4	RFC 1771 BGPv4	RFC 2385 BGP Session Protection via TCP MD5 RFC 2858 BGP-4 Multi-Protocol Extensions
Device management	RFC 1157 SNMPv1/v2c RFC 1305 NTPv3 RFC 2573 (SNMPv3 Applications)	RFC 2819 (RMON groups Alarm, Event, History and Statistics only) RFC 3416 (SNMP Protocol Operations v2) HTML and telnet management	Multiple Configuration Files SNMP v3 and RMON RFC support SSHv1/SSHv2 Secure Shell TACACS/TACACS+ Web UI
General protocols	IEEE 802.1ad Q-in-Q IEEE 802.1ak Multiple Registration Protocol (MRP) and Multiple VLAN Registration Protocol (MVRP) IEEE 802.1D MAC Bridges IEEE 802.1p Priority IEEE 802.1Q (GVRP) IEEE 802.1Q VLANs IEEE 802.1s Multiple Spanning Trees IEEE 802.1v VLAN classification by Protocol and Port IEEE 802.1w Rapid Reconfiguration of Spanning Tree IEEE 802.1X PAE IEEE 802.3 Type 10BASE-T IEEE 802.3ab 1000BASE-T IEEE 802.3ac (VLAN Tagging Extension) IEEE 802.3ad Link Aggregation (LAG) IEEE 802.3ad Link Aggregation Control Protocol (LACP) IEEE 802.3ae 10-Gigabit Ethernet IEEE 802.3af Power over Ethernet IEEE 802.3at Power over Ethernet Plus IEEE 802.3az Energy Efficient Ethernet IEEE 802.3i 10BASE-T IEEE 802.3u 100BASE-X IEEE 802.3x Flow Control IEEE 802.3z 1000BASE-X RFC 768 UDP RFC 783 TFTP Protocol (revision 2) RFC 791 IP RFC 792 ICMP RFC 793 TCP RFC 826 ARP RFC 854 TELNET RFC 855 Telnet Option Specification RFC 894 IP over Ethernet RFC 925 Multi-LAN Address Resolution RFC 950 Internet Standard Subnetting Procedure RFC 951 BOOTP RFC 1027 Proxy ARP RFC 1042 IP Datagrams RFC 1058 RIPv1 RFC 1071 Computing the Internet Checksum RFC 1122 Requirements for Internet Hosts—Communication Layers RFC 1123 Requirements for Internet Hosts RFC 1141 Incremental updating of the Internet checksum RFC 1191 Path MTU discovery RFC 1213 Management Information Base for Network Management of TCP/IP-based internets RFC 1305 NTPv3	RFC 1350 TFTP Protocol (revision 2) RFC 1519 CIDR RFC 1533 DHCP Options and BOOTP Vendor Extensions RFC 1542 BOOTP Extensions RFC 1591 DNS (client only) RFC 1723 RIP v2 RFC 1812 IPv4 Routing RFC 1866 Hypertext Markup Language - 2.0 RFC 1887 An Architecture for IPv6 Unicast Address Allocation RFC 2131 DHCP RFC 2236 IGMP Snooping RFC 2338 VRRP RFC 2375 IPv6 Multicast Address Assignments RFC 2462 IPv6 Stateless Address Autoconfiguration RFC 2474 Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers RFC 2597 Assured Forwarding PHB Group RFC 2616 Hypertext Transfer Protocol -- HTTP/1.1 RFC 2644 Directed Broadcast Control RFC 2665 Definitions of Managed Objects for the Ethernet-like Interface Types RFC 2668 Definitions of Managed Objects for IEEE 802.3 Medium Attachment Units (MAUs) RFC 2711 IPv6 Router Alert Option RFC 2784 Generic Routing Encapsulation (GRE) RFC 2865 Remote Authentication Dial In User Service (RADIUS) RFC 2866 RADIUS Accounting RFC 3209 RSVP-TE Extensions to RSVP for LSP Tunnels RFC 3246 Expedited Forwarding PHB RFC 3410 Applicability Statements for SNMP RFC 3414 User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3) RFC 3415 View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP) RFC 3416 Protocol Operations for SNMP RFC 3417 Transport Mappings for the Simple Network Management Protocol (SNMP) RFC 3418 Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)	RFC 3484 Default Address Selection for Internet Protocol version 6 (IPv6) RFC 3493 Basic Socket Interface Extensions for IPv6 RFC 3542 Advanced Sockets Application Program Interface (API) for IPv6 RFC 3576 Ext to RADIUS (CoA only) RFC 3587 IPv6 Global Unicast Address Format RFC 3596 DNS Extensions to Support IP Version 6 RFC 3623 Graceful OSPF Restart RFC 3704 Unicast Reverse Path Forwarding (URPF) RFC 3768 Virtual Router Redundancy Protocol (VRRP) RFC 3810 Multicast Listener Discovery Version 2 (MLDv2) for IPv6 RFC 4090 Fast Reroute Extensions to RSVP-TE for LSP Tunnels RFC 4113 Management Information Base for the User Datagram Protocol (UDP) RFC 4213 Basic IPv6 Transition Mechanisms RFC 4250 The Secure Shell (SSH) Protocol Assigned Numbers RFC 4251 The Secure Shell (SSH) Protocol Architecture RFC 4252 The Secure Shell (SSH) Authentication Protocol RFC 4253 The Secure Shell (SSH) Transport Layer Protocol RFC 4254 The Secure Shell (SSH) Connection Protocol RFC 4291 IP Version 6 Addressing Architecture RFC 4443 Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification RFC 4541 Considerations for Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping Switches RFC 4575 A Session Initiation Protocol (SIP) Event Package for Conference State RFC 4594 Configuration Guidelines for DiffServ Service Classes RFC 4762 Virtual Private LAN Service (VPLS) Using Label Distribution Protocol (LDP) Signaling RFC 5095 Deprecation of Type 0 Routing Headers in IPv6 802.1r - GARP Proprietary Attribute Registration Protocol (GPRP)
IP multicast	RFC 1112 IGMPv1 RFC 2236 IGMPv2 RFC 2710 Multicast Listener Discovery (MLD) for IPv6	RFC 2858 Multiprotocol Extensions for BGP-4 RFC 3376 IGMPv3 RFC 3569 An Overview of Source-Specific Multicast (SSM)	RFC 3618 Multicast Source Discovery Protocol (MSDP) RFC 3973 PIM Dense Mode RFC 4601 PIM Sparse Mode

STANDARDS AND PROTOCOLS (CONTINUED)
(APPLIES TO ALL PRODUCTS IN SERIES)

IPv6	RFC 1981 IPv6 Path MTU Discovery RFC 2460 IPv6 Specification RFC 2461 IPv6 Neighbor Discovery RFC 2463 ICMPv6 RFC 2464 Transmission of IPv6 over Ethernet Networks RFC 3162 RADIUS and IPv6	RFC 3306 Unicast-Prefix-based IPv6 Multicast Addresses RFC 3307 IPv6 Multicast Address Allocation RFC 3315 DHCPv6 (client and relay) RFC 3484 Default Address Selection for IPv6 RFC 3736 Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6	RFC 4291 IP Version 6 Addressing Architecture RFC 4293 MIB for IP RFC 4443 ICMPv6 RFC 4861 IPv6 Neighbor Discovery RFC 4862 IPv6 Stateless Address Auto-configuration
MIBs	RFC 1212 Concise MIB Definitions RFC 1213 MIB II RFC 1493 Bridge MIB RFC 1757 Remote Network Monitoring MIB RFC 2096 IP Forwarding Table MIB RFC 2233 Interface MIB RFC 2571 SNMP Framework MIB RFC 2572 SNMP-MPD MIB RFC 2573 SNMP-Notification MIB	RFC 2573 SNMP-Target MIB RFC 2574 SNMP USM MIB RFC 2618 RADIUS Authentication Client MIB RFC 2620 RADIUS Accounting Client MIB RFC 2665 Ethernet-Like-MIB RFC 2668 802.3 MAU MIB RFC 2674 Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering, and Virtual Extensions	RFC 2737 Entity MIB (Version 2) RFC 2819 RMON MIB RFC 2863 The Interfaces Group MIB RFC 2925 Ping MIB RFC 3414 SNMP-User based-SM MIB RFC 3415 SNMP-View based-ACM MIB RFC 3418 MIB for SNMPv3 RFC 3621 Power Ethernet MIB
MPLS	RFC 2961 RSVP Refresh Overhead Reduction Extensions RFC 3031 Multiprotocol Label Switching Architecture	RFC 3032 MPLS Label Stack Encoding RFC 3036 LDP Specification	RFC 4762 Virtual Private LAN Service (VPLS) Using Label Distribution Protocol (LDP) Signaling
Network management	IEEE 802.1AB Link Layer Discovery Protocol (LLDP) RFC 2579 Textual Conventions for SMIv2 RFC 2580 Conformance Statements for SMIv2	RFC 2819 Four groups of RMON: 1 (statistics), 2 (history), 3 (alarm) and 9 (events)	ANSI/TIA-1057 LLDP Media Endpoint Discovery (LLDP-MED) SNMPv1/v2c/v3
OSPF	RFC 1587 OSPF NSSA	RFC 1850 OSPFv2 Management Information Base (MIB), traps	RFC 2328 OSPFv2 RFC 2370 OSPF Opaque LSA Option
QoS/CoS	RFC 2474 DS Field in the IPv4 and IPv6 Headers	RFC 3260 New Terminology and Clarifications for DiffServ	
Security	IEEE 802.1X Port Based Network Access Control RFC 1492 TACACS+ RFC 2138 RADIUS Authentication	RFC 2139 RADIUS Accounting RFC 2865 RADIUS Authentication RFC 2866 RADIUS Accounting	Secure Sockets Layer (SSL) SSHv2 Secure Shell

HPE FlexNetwork 5510 HI Switch Series accessories

Modules	**NEW** HPE 5510 QSFP+ 2-port Module (JH155A) **NEW** HPE 5130/5510 10GBASE-T 2-port Module (JH156A) **NEW** HPE 5130/5510 10GbE SFP+ 2-port Module (JH157A)
Transceivers	HPE X140 40G QSFP+ MPO SR4 Transceiver (JG325B) HPE X240 40G QSFP+ to QSFP+ 1m Direct Attach Copper Cable (JG326A) HPE X240 40G QSFP+ to QSFP+ 3m Direct Attach Copper Cable (JG327A) HPE X240 40G QSFP+ to QSFP+ 5m Direct Attach Copper Cable (JG328A) HPE X240 40G QSFP+ to 4x10G SFP+ 1m Direct Attach Copper Splitter Cable (JG329A) HPE X240 40G QSFP+ to 4x10G SFP+ 3m Direct Attach Copper Splitter Cable (JG330A) HPE X240 40G QSFP+ to 4x10G SFP+ 5m Direct Attach Copper Splitter Cable (JG331A) HPE X140 40G QSFP+ LC LR4 SM 10km 1310nm Transceiver (JG661A) HPE X140 40G QSFP+ MPO MM 850nm CSR4 300m Transceiver (JG709A) HPE X125 1G SFP LC LH40 1310nm Transceiver (JD061A) HPE X120 1G SFP LC LH40 1550nm Transceiver (JD062A) HPE X125 1G SFP LC LH70 Transceiver (JD063B) HPE X120 1G SFP RJ45 T Transceiver (JD089B) HPE X110 100M SFP LC LH40 Transceiver (JD090A) HPE X110 100M SFP LC LH80 Transceiver (JD091A) HPE X130 10G SFP+ LC SR Transceiver (JD092B) HPE X130 10G SFP+ LC LR Transceiver (JD094B)

Transceivers	HPE X240 10G SFP+ to SFP+ 0.65m Direct Attach Copper Cable (JD095C)
	HPE X240 10G SFP+ to SFP+ 1.2m Direct Attach Copper Cable (JD096C)
	HPE X240 10G SFP+ to SFP+ 3m Direct Attach Copper Cable (JD097C)
	HPE X120 1G SFP LC BX 10-U Transceiver (JD098B)
	HPE X120 1G SFP LC BX 10-D Transceiver (JD099B)
	HPE X115 100M SFP LC BX 10-U Transceiver (JD100A)
	HPE X115 100M SFP LC BX 10-D Transceiver (JD101A)
	HPE X110 100M SFP LC FX Transceiver (JD102B)
	HPE X120 1G SFP LC LH100 Transceiver (JD103A)
	HPE X120 1G SFP LC SX Transceiver (JD118B)
	HPE X120 1G SFP LC LX Transceiver (JD119B)
	HPE X110 100M SFP LC LX Transceiver (JD120B)
	HPE X240 10G SFP+ to SFP+ 5m Direct Attach Copper Cable (JG081C)
	HPE X130 10G SFP+ LC ER 40km Transceiver (JG234A) - Note: Can only be used on optional module JH157A
	HPE X130 10G SFP+ LC LH 80km Transceiver (JG915A) - Note: Can only be used on optional module JH157A
	HPE X130 10G SFP+ LC LRM Transceiver (JD093B) - Note: Can only be used on optional module JH157A
Cables	HPE 0.5 m Multimode OM3 LC/LC Optical Cable (AJ833A)
	HPE 1 m Multimode OM3 LC/LC Optical Cable (AJ834A)
	HPE 2 m Multimode OM3 LC/LC Optical Cable (AJ835A)
	HPE 5 m Multimode OM3 LC/LC Optical Cable (AJ836A)
	HPE 15 m Multimode OM3 LC/LC Optical Cable (AJ837A)
	HPE 30 m Multimode OM3 LC/LC Optical Cable (AJ838A)
	HPE 50 m Multimode OM3 LC/LC Optical Cable (AJ839A)
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 1m Cable (QK732A)
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 2m Cable (QK733A)
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 5m Cable (QK734A)
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 15m Cable (QK735A)
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 30m Cable (QK736A)
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 50m Cable (QK737A)
HPE 5510 24G 4SFP+ HI 1-slot Switch (JH145A)	HPE 5500 150WAC Power Supply (JD362A)
	HPE 5500 150WDC Power Supply (JD366A)
HPE 5510 48G 4SFP+ HI 1-slot Switch (JH146A)	HPE 5500 150WAC Power Supply (JD362A)
	HPE 5500 150WDC Power Supply (JD366A)
HPE 5510 24G PoE+ 4SFP+ HI 1-slot Switch (JH147A)	HPE X362 720W 100-240VAC to 56VDC PoE Power Supply (JG544A)
	HPE X362 1110W 115-240VAC to 56VDC PoE Power Supply (JG545A)
HPE 5510 48G PoE+ 4SFP+ HI 1-slot Switch (JH148A)	HPE X362 720W 100-240VAC to 56VDC PoE Power Supply (JG544A)
	HPE X362 1110W 115-240VAC to 56VDC PoE Power Supply (JG545A)
HPE 5510 24G SFP 4SFP+ HI 1-slot Switch (JH149A)	HPE 5500 150WAC Power Supply (JD362A)
	HPE 5500 150WDC Power Supply (JD366A)

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QuickSpecs

Overview

Models

HP X120 1G SFP LC LH100 Transceiver	JD103A
HP X120 1G SFP LC SX Transceiver	JD118B
HP X120 1G SFP LC LX Transceiver	JD119B

Warranty and support

- 1-year warranty: with advance replacement and 30-calendar-day delivery (available in most countries)
- Electronic and telephone support: limited electronic and telephone support is available from HP; refer to www.hp.com/networking/warranty for details on the support provided and the period during which support is available
- Software releases: refer to www.hp.com/networking/warranty for details on the software releases provided and the period during which software releases are available for your product(s)

QuickSpecs

HP X12x 1G SFP LC Transceivers (LH100, LX, and SX)

Technical Specifications

HP X120 1G SFP LC LH100 Transceiver (JD103A)

A small form factor pluggable (SFP) Gigabit LH100 transceiver that provides a full-duplex Gigabit solution up to 100km on a single mode fiber.

Ports	1 LC 1000BASE-LH port (no IEEE standard exists for 1550 nm optics)		
Connectivity	**Connector type**	LC	
	Wavelength	1550 nm	
Electrical characteristics	**Power consumption typical**	0.8 W	
	Power consumption maximum	1.0 W	
Cabling	Cable type: Single-mode fiber optic, complying with ITU-T G.652;		
	Maximum distance: • Up to 100km		
	Fiber type	Single Mode	
Services	Refer to the HP website at www.hp.com/networking/services for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HP sales office.		

HP X120 1G SFP LC SX Transceiver (JD118B)

A small form-factor pluggable (SFP) Gigabit SX transceiver that provides a full-duplex Gigabit solution up to 550m on a Multimode fiber.

Ports	1 LC 1000BASE-SX		
Connectivity	**Connector type**	LC	
	Wavelength	850 nm	
Physical characteristics	**Dimensions**	2.17(d) x 0.6(w) x 0.46(h) in. (5.51 x 1.52 x 1.17 cm)	
	Full configuration weight	0.04 lb. (0.02 kg)	
Electrical characteristics	**Power consumption typical**	0.8 W	
	Power consumption maximum	1.0 W	
Cabling	Maximum distance: • FDDI Grade distance = 220m • OM1 = 275m • OM2 = 500m • OM3 = Not Specified by standard		
	Cable length	up to 550m	
	Fiber type	Multi Mode	
Services	Refer to the HP website at www.hp.com/networking/services for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HP sales office.		

QuickSpecs

Technical Specifications

HP X120 1G SFP LC LX Transceiver (JD119B)

A small form-factor pluggable (SFP) LX transceiver that provides a full duplex Gigabit solution up to 550m on MMF or 10Km on SMF

Ports	1 SFP 1000BASE-LX port (IEEE 802.3z Type 1000BASE-LX)		
Connectivity	**Connector type**	LC	
	Wavelength	1300 nm	
Physical characteristics	**Dimensions**	2.17(d) x 0.6(w) x 0.46(h) in. (5.51 x 1.52 x 1.17 cm)	
	Full configuration weight	0.04 lb. (0.02 kg)	
Electrical characteristics	**Power consumption typical**	0.8 W	
	Power consumption maximum	1.0 W	
Cabling	Cable type: Either single mode or multimode;		
	Maximum distance: • 550m for Multimode • 10km for Singlemode		
	Fiber type	Both	
Services	Refer to the HP website at www.hp.com/networking/services for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HP sales office.		

To learn more, visit www.hp.com/networking

QuickSpecs

Overview

Models

HP X132 10G SFP+ LC SR Transceiver	J9150A
HP X132 10G SFP+ LC LR Transceiver	J9151A
HP X132 10G SFP+ LC LRM Transceiver	J9152A
HP X132 10G SFP+ LC ER Transceiver	J9153A

QuickSpecs

Technical Specifications

HP X132 10G SFP+ LC SR Transceiver (J9150A)

A 10-Gigabit transceiver in SFP+ form-factor that supports the 10-Gigabit SR standard, providing 10-Gigabit connectivity up to 300 m on multimode fiber.

Ports	1 LC 10-GbE port (IEEE 802.3ae Type 10Gbase-SR); Duplex: full only		
Connectivity	**Connector type**	LC	
	Wavelength	850 nm	
Physical characteristics	**Dimensions**	2.19(d) x 0.54(w) x 0.47(h) in. (5.57 x 1.38 x 1.19 cm)	
	Weight	0.04 lb. (0.02 kg)	
	Transceiver form factor	SFP+	
Environment	**Operating temperature**	32°F to 158°F (0°C to 70°C)	
	Operating relative humidity	0% to 85%, noncondensing	
	Nonoperating/Storage temperature	-40°F to 185°F (-40°C to 85°C)	
	Altitude	up to 10,000 ft. (3 km)	
Electrical characteristics	**Power consumption typical**	0.6 W	
	Power consumption maximum	0.8 W	

Cabling

Cable type:
62.5/125 µm or 50/125 µm (core/cladding) diameter, graded-index, low metal content, multimode fiber optic, complying with ITU-T G.651 and ISO/IEC 793-2 Type A1b or A1a, respectively;
Maximum distance:

- 2-26m with 62.5 µm multimode cable @ 160 MHz*km
- 2-33m with 62.5 µm multimode cable @ 200 MHz*km
- 2-66m with 50 µm multimode cable @ 400 MHz*km
- 2-82m with 50 µm multimode cable @ 500 MHz*km
- 2-300m with 50 µm multimode cable @ 2000 MHz*km

Cable length	2-300m
Fiber type	Multi Mode

Notes For fiber patch cords, use Ultra Physical Contact (UPC) surface termination/polish. Angled Physical Contact (APC) is not recommended.

Services Refer to the HP website at: www.hp.com/networking/services for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HP sales office.

QuickSpecs

Technical Specifications

HP X132 10G SFP+ LC LR Transceiver (J9151A)

A 10-Gigabit transceiver in SFP+ form-factor that supports the 10-Gigabit LR standard, providing 10-Gigabit connectivity up to 10 km on single-mode fiber.

Ports	1 LC 10-GbE port (IEEE 802.3ae Type 10Gbase-LR); Duplex: full only		
Connectivity	**Connector type**	LC	
	Wavelength	1310 nm	
Physical characteristics	**Dimensions**	2.19(d) x 0.54(w) x 0.47(h) in. (5.57 x 1.38 x 1.19 cm)	
	Weight	0.04 lb. (.02 kg)	
	Transceiver form factor	SFP+	
Environment	**Operating temperature**	32°F to 158°F (0°C to 70°C)	
	Operating relative humidity	0% to 85%, noncondensing	
	Nonoperating/Storage temperature	-40°F to 185°F (-40°C to 85°C)	
	Altitude	up to 10,000 ft. (3 km)	
Electrical characteristics	**Power consumption typical**	0.9 W	
	Power consumption maximum	1 W	
Cabling	Cable type: Low metal content, single-mode fiber-optic, complying with ITU-T G.652 and ISO/IEC 793-2 Type B1; Maximum distance:		
	● 2m-10km with 9/125 µm single-mode cable		
	Cable length	2m to 10km	
	Fiber type	Single Mode	
Notes	Conditioning patch cord cables are not supported. For fiber patch cords, use Ultra Physical Contact (UPC) surface termination/polish. Angled Physical Contact (APC) is not recommended.		
Services	Refer to the HP website at: www.hp.com/networking/services for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HP sales office.		

QuickSpecs

Technical Specifications

HP X132 10G SFP+ LC LRM Transceiver (J9152A)

A 10-Gigabit transceiver in SFP+ form-factor that supports the 10-Gigabit LRM standard, for 10-Gigabit connectivity up to 220 m on legacy multimode fiber.

Ports		1 LC 10-GbE port (IEEE 802.3aq Type 10Gbase-LRM); Duplex: full only	
Connectivity	**Connector type**	LC	
	Wavelength	1310 nm	
Physical characteristics	**Dimensions**	2.19(d) x 0.54(w) x 0.47(h) in. (5.57 x 1.38 x 1.19 cm)	
	Weight	0.04 lb. (.02 kg)	
	Transceiver form factor	SFP+	
Environment	**Operating temperature**	32°F to 158°F (0°C to 70°C)	
	Operating relative humidity	0% to 85%, noncondensing	
	Nonoperating/Storage temperature	-40°F to 185°F (-40°C to 85°C)	
	Altitude	up to 10,000 ft. (3 km)	
Electrical characteristics	**Power consumption typical**	0.7 W	
	Power consumption maximum	1 W	

Cabling

Cable type:
62.5/125 μm or 50/125 μm (core/cladding) diameter, graded-index, low metal content, multimode fiber optic, complying with ITU-T G.651 and ISO/IEC 793-2 Type A1b or A1a, respectively (a mode conditioning patch cord may be needed in some multimode fiber installations);
Maximum distance:

- 0.5-220m with 62.5 μm multimode cable @ 160/500 MHz*km
- 0.5-220m with 62.5 μm multimode cable @ 200/500 MHz*km
- 0.5-100m with 50 μm multimode cable @ 400/400 MHz*km
- 0.5-220m with 50 μm multimode cable @ 500/500 MHz*km
- 0.5-220m with 50 μm multimode cable @ 1500/500 MHz*km

Cable length	0.5m to 220m
Fiber type	Multi Mode

Notes — For OM3 cable (50 μm multimode @ 1500/500 MHz*km), a mode-conditioning patch cord is not required. Other multimode cables may require mode-conditioning patch cords to achieve the maximum distances listed above. For fiber patch cords, use Ultra Physical Contact (UPC) surface termination/polish. Angled Physical Contact (APC) is not recommended.

Services — Refer to the HP website at: www.hp.com/networking/services for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HP sales office.

QuickSpecs

Technical Specifications

HP X132 10G SFP+ LC ER Transceiver (J9153A)

The SFP+ ER Transceiver will transmit 10Gbps over up to 40km using standard OM3 fiber cable. This product expands the HP Networking transceiver portfolio for connections from 0m to 40km. Use only genuine HP transceivers with your HP Networking equipment to ensure reliability and support.

Ports		1 LC 10-GbE port (IEEE 802.3ae Type 10Gbase-ER); Duplex: full only	
Connectivity	**Connector type**	LC	
	Wavelength	1550 nm	
Physical characteristics	**Dimensions**	2.22(d) x 0.55(w) x 0.47(h) in. (5.65 x 1.39 x 1.19 cm)	
	Weight	.04 lb., Fully loaded	
	Transceiver form factor	SFP+	
Environment	**Operating temperature**	32°F to 158°F (0°C to 70°C)	
	Operating relative humidity	5% to 95%, noncondensing	
	Nonoperating/Storage temperature	-40°F to 185°F (-40°C to 85°C)	
	Nonoperating/Storage relative humidity	5% to 95%, noncondensing	
	Altitude	up to 10,000 ft. (3 km)	
Electrical characteristics	**Power consumption typical**	1.3 W	
	Power consumption maximum	1.5 W	
Cabling		Cable type: Single-mode fiber optic, complying with ITU-T G.652; Maximum distance:	
		• 40km	
	Fiber type	Single Mode	
Notes		Check switch release notes for minimum version of software required to support this transceiver. Some switches have limits as to how many of this particular transceiver can be installed. See the release notes of the switch software/firmware being used for more details.	
Services		Refer to the HP website at: www.hp.com/networking/services for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local HP sales office.	

To learn more, visit: www.hp.com/networking

QuickSpecs

Overview

HPE X242 SFP+ SFP+ Direct Attach Cables

Models

HPE X242 10G SFP+ to SFP+ 1m Direct Attach Copper Cable	J9281B
HPE X242 10G SFP+ to SFP+ 3m Direct Attach Copper Cable	J9283B
HPE X242 10G SFP+ to SFP+ 7m Direct Attach Copper Cable	J9285B

Product overview

Low-price 10-Gigabit connectivity options consisting of 1, 3, 7, 10 or 15 m cables with SFP+ connectors permanently attached to each end.

Key Features

- SFF-8431 compliant
- Supports 10-GbE data rate operation
- Serial data transmission

Hewlett Packard Enterprise

Technical Specifications

HPE X242 10G SFP+ to SFP+ 1m Direct Attach Copper Cable (J9281B)	**Connectivity**	Length	3.28 ft. (1 m)
	Physical characteristics	Weight	0. 24 lb (0.11 kg)
	Environment	Operating temperature	32ºF to 158ºF (0ºC to 70ºC)
		Operating relative humidity	5% to 95%, noncondensing
		Nonoperating/Storage temperature	14ºF to 185ºF (-10ºC to 85ºC)
		Nonoperating/Storage relative humidity	5% to 95%, noncondensing
		Altitude	up to 10,000 ft (3 km)
	Electrical characteristics	Notes	0.04 watts maximum per transceiver end
	Notes	Electrical Properties • Cable Characteristic Impedance: 100 ohms • Crosstalk between pairs: 2% max • Time delay: 1.31 nsec/ft Physical Properties • Cable Diameter: 0.180" • Minimum Cable Bend Radius: 1.0"	
	Services	Refer to the Hewlett Packard Enterprise website at **http://www.hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	

HPE X242 10G SFP+ to SFP+ 3m Direct Attach Copper Cable (J9283B)	**Connectivity**	Length	10 ft. (3 m)
	Physical characteristics	Weight	0.49 lb (0.22 kg) shipping weight
	Environment	Operating temperature	32ºF to 158ºF (0ºC to 70ºC)
		Operating relative humidity	5% to 95%, noncondensing
		Nonoperating/Storage temperature	14ºF to 185ºF (-10ºC to 85ºC)
		Nonoperating/Storage relative humidity	5% to 95%, noncondensing
		Altitude	up to 10,000 ft (3 km)
	Electrical characteristics	Notes	0.04 watts maximum per transceiver end
	Notes	Electrical Properties • Cable Characteristic Impedance: 100 ohms • Crosstalk between pairs: 2% max • Time delay: 1.31 nsec/ft Physical Properties	

Technical Specifications

		• Cable Diameter: 0.180"	
		• Minimum Cable Bend Radius: 1.0"	
	Services	Refer to the Hewlett Packard Enterprise website at **http://www.hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	

HPE X242 10G SFP+ to SFP+ 7m Direct Attach Copper Cable (J9285B)	**Connectivity**	Length	22.97 ft. (7 m)
	Physical characteristics	Weight	1.02 lb shipping weight
	Environment	Operating temperature	32ºF to 158ºF (0ºC to 70ºC)
		Operating relative humidity	5% to 95%, noncondensing
		Nonoperating/Storage temperature	14ºF to 185ºF (-10ºC to 85ºC)
		Nonoperating/Storage relative humidity	5% to 95%, noncondensing
		Altitude	up to 10,000 ft (3 km)
	Electrical characteristics	Notes	0.04 watts maximum per transceiver end
	Notes	Electrical Properties	

• Cable Characteristic Impedance: 100 ohms
• Crosstalk between pairs: 2% max
• Time delay: 1.31 nsec/ft

Physical Properties
• Cable Diameter: 0.180"
• Minimum Cable Bend Radius: 1.0"

Services   Refer to the Hewlett Packard Enterprise website at **http://www.hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.

Summary of Changes

Date	Version History	Action	Description of Change
27-May-2016	From Version 6 to 7	Changed	Product description updated. Technical Specifications updated.
20-Mar-2015	From Version 5 to 6	Removed	Removed obsolete SKUs: J9286B, J9287B
10-Aug-2012	From Version 4 to 5	Changed	Updated the Introduction so that the 10 and 15 meter cables are included.
01-Sep-2011	From Version 3 to 4	Changed	Added two new cables to the QuickSpecs.
14-Mar-2011	From Version 2 to 3	Changed	The product names were updated throughout the document.
20-Aug-2009	From Version 1 to 2	Changed	Updated the model part numbers (all now end in "B").

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Hewlett Packard Enterprise

KERNUN UTM – Technický list

HW appliance	Počet ethernet portů	Max. počet ethernet portů	IPMI	Rack mount	Hot swab disky / redundantní zdroje	HDD / SSD	802.1Q (vlany)	LACP (agregace portů)	Dynamický / source routing	Jumbo frame packets	Multi-houming	Statistiky a performace grafy	Trace logging	IP inspekce	IP inspekce: počet paralelních spojení	IP inspekce: počet nových spojení za 1s	L7 inspekce: počet nových spojení za 1s	Počet paralelních VPN tunelů
KERNUN UTM 10	4x1Gbps	8x	ANO	1U	NE/NE	500GB /NE	ANO	ANO	ANO /ANO	ANO	ANO	On box	On box	< 1Gb per 1Gbps port	TCP > 2M	3 000	1000	Neomezeno
KERNUN UTM 200	6x1Gbps	10x	ANO	1U	NE/NE	500GB /NE	ANO	ANO	ANO /ANO	ANO	ANO	On box	On box	< 1Gb per 1Gbps port	TCP > 5M	15 000	5 000	Neomezeno
KERNUN UTM 200R	6x1Gbps	10x	ANO	1U	ANO/ANO	500GB /NE	ANO	ANO	ANO /ANO	ANO	ANO	On box	On box	< 1Gb per 1Gbps port	TCP > 5M	15 000	5 000	Neomezeno
KERNUN UTM 440	2x1Gbps	22x	ANO	2U	ANO/ANO	500GB /NE	ANO	ANO	ANO /ANO	ANO	ANO	On box	On box	< 1Gb per 1Gbps port	TCP > 10M	25 000	9 000	Neomezeno

Požadované parametry pro virtuální appliance
KERNUN UTM 102 / 2 x vyhrazená CPU / Výkon procesoru dle www.cpubenchmark.net alespoň 2 200 bodů / 4 GB RAM / platforma: VMWare ESX, HyperV, VirtualBox
KERNUN UTM 104 / 4 x vyhrazená CPU / Výkon procesoru dle www.cpubenchmark.net alespoň 4 500 bodů / 8 GB RAM / platforma: VMWare ESX, HyperV, VirtualBox
KERNUN UTM 106 / 6 x vyhrazená CPU / Výkon procesoru dle www.cpubenchmark.net alespoň 15 000 bodů / 16 GB RAM / platforma: VMWare ESX, HyperV, VirtualBox
KERNUN Business Intelligence 8800 / 4 x vyhrazená CPU / Výkon procesoru dle http://www.cpubenchmark.net alespoň 10 000 bodů / 32 GB RAM / SSD disky 500GB / platforma: VMWare ESX, HyperV, VirtualBox