UNIVERSIDAD NACIONAL TECNOLÓGICA DE LIMA SUR

FACULTAD DE INGENIERÍA MECÁNICA, ELECTRÓNICA Y AMBIENTAL

INGENIERIA ELECTRONICA Y TELECOMUNICACIONES

“PROPUESTA DE DISEÑO DE RED DE DATOS PARA LA EMPRESA BATA EN EL DISTRITO DE MIRAFLORES”.

TEMA DE INVESTIGACIÓN PARA OPTAR EL TÍTULO DE

INGENIERO ELECTRÓNICO Y TELECOMUNICACIONES

PRESENTADO POR EL BACHILLER

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DEDICATORIA

A Dios, mi familia y a las personas que me
Brindaron apoyo incondicional durante esta etapa de mi vida.

AGRADECIMIENTO

A los Docentes y Maestros que a lo largo de

Mi carrera Profesional me apoyaron

Y brindaron todos los conocimientos para hacer esto

Posible, ya que sin su guía no lo hubiera logrado.

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INTRODUCCIÓN

El presente trabajo de Investigación lleva por título “PROPUESTA DE DISEÑO DE RED DE DATOS PARA LA EMPRESA BATA EN EL DISTRITO DE MIRAFLORES” para optar el título de Ingeniero Electrónico y telecomunicaciones, presentado por el bachiller Kenny Levy Laveriano Porroa.

El proyecto tiene como objetivo diseñar un “Modelo de Red de Datos” como apoyo a las dependencias administrativas de la Empresa BATA, y la necesidad de aplicar políticas de seguridad y administración a todos los usuarios de la red LAN, lo cual resulta una tarea compleja en la tecnología actual pero se puede resolver aplicando diversas tecnologías y equipos de red ideales para el diseño que se quiere lograr, el presente modelo de red se propone para cumplir con los requerimientos de la Empresa en cuanto a Costo y Fidelidad.

En la actualidad la necesidad de las empresas de contar con un diseño de Red confiable, seguro y eficiente para la transmisión de datos es un tema de mucha importancia debido a que las empresas requieren la interconectividad de todos sus dispositivos de red dentro de un determinado lugar y también al exterior a través de Internet, teniendo más facilidades y beneficios para la empresa.

La estructura que hemos seguido en este proyecto se compone de 3 capítulos. El Primer Capítulo comprende el Planteamiento del Problema, el Segundo Capítulo el Desarrollo del marco teórico y el tercer capítulo corresponde al desarrollo del Proyecto.

El Autor.

CAPÍTULO I

PLANTEAMIENTO DEL PROBLEMA

1.1 DESCRIPCIÓN DE LA REALIDAD PROBLEMÁTICA

Las nuevas oficinas de la Empresa de calzado BATA, ubicado en el piso 11 y 12 del edificio Platino en el distrito de Miraflores, requieren del diseño e implementación de una Red de Datos que permitan la interconexión entre ambos pisos del edificio, para ello requieren de una infraestructura de red de cableado estructurado en ambos pisos, además de equipos de Red que permitan la conmutación eficaz de las diferentes áreas de trabajo.

1.2 JUSTIFICACIÓN DEL PROBLEMA

Debido al crecimiento de la demanda en el Perú hacia la empresa de calzado, ésta se ve en la necesidad de contar con muchas oficinas administrativas y de atención al cliente dentro del país y que éstas se puedan comunicar de manera inmediata y eficiente, se hace necesario contar con toda una infraestructura de comunicación de Datos para así lograr el correcto rendimiento y fiabilidad en la Red, brindándoles una tecnología de red capaz de cumplir con todos los requerimientos de la Empresa.

1.3 DELIMITACIÓN DE LA INVESTIGACIÓN

1.3.1 Espacial: Se realizará en las oficinas de la Empresa BATA ubicada en los pisos 11 y 12 del edificio Platino ubicado en el Distrito de Miraflores, Lima, Perú.

1.3.2 Temporal: Comprende el periodo de abril 2014 a junio 2014.

1.4 FORMULACIÓN DEL PROBLEMA

¿Qué métodos, topología o modelo de Diseño de Red de Datos, se debe aplicar en ésta empresa, puesto que la empresa cuenta con diferentes áreas como: Administración, Finanzas, Gerencia, etc.; que permita independizar el tráfico entre las mismas y a la vez no genere Saturación, congestión de datos o inseguridad de envío de datos en la Red?

1.5 OBJETIVOS

1.5.1 Objetivo General

Diseñar un modelo de Red de Datos jerárquico, bajo tecnología VLAN para las oficinas de la Empresa BATA, garantizando la eficiencia en la red, seguridad, fluidez en la conmutación de datos y escalabilidad de la Red.

1.5.2 Objetivos Específicos

- Proponer un modelo de arquitectura de Red de Datos.
- Establecer el diseño de red propuesto en función de su topología, tecnología y protocolos de comunicación que se utilizarán en dicha Red.
- Identificar los riesgos de la red a implementar para dar solución a posibles problemas futuros en la red.

CAPITULO II

MARCO TEÓRICO

2.1 ANTECEDENTES

A lo largo de la investigación se han encontrado Tesis que sirvieron de consulta y ayuda para finalizar el presente Trabajo, entre algunas están:

2.1.1 "MODELO DE UNA RED DE DATOS, VOZ Y VIDEO BAJO TECNOLOGÍA VLAN COMO APOYO A LAS DEPENDENCIAS ADMINISTRATIVAS DE LA UNIVERSIDAD BOLIVARIANA DE VENEZUELA SEDE MONAGAS".

Autor: MARIANNI JOSÉ IDROGO GUZMÁN (2009), Trabajo de investigación que tenía como objetivo Diseñar un Modelo de Red de Datos, Voz y Video bajo Tecnología VLAN que surgió de la necesidad de aplicar políticas administrativas a los usuarios de dicha red, se realizó un estudio para identificar la arquitectura de Red que disponía la institución y así dar solución en cuanto a topologías, Tecnologías y Protocolos de comunicación proporcionando así mayor seguridad en la transmisión.

2.1.2 "RED LAN PARA EL CENTRO LOCAL AMAZONAS", UNIVERSIDAD NACIONAL ABIERTA." Autor: JUAN PABLO ORJUELA (2010).

El trabajo de investigación tuvo como objetivo proponer el diseño e implementación de la Red LAN del centro Local UNA-Amazonas a través de la arquitectura de cableado y gestión de la red.

2.1.3 “PROPUESTA DE DISEÑO DE UNA RED DE COMUNICACIÓN DE DATOS PARA LA INSTITUCION EDUCATIVA PRIVADA EMILIO SOYER CABERO” TRABAJO DE INVESTIGACIÓN PARA OPTAR EL TÍTULO DE INGENIERO ELECTRÓNICO Y TELECOMUNICACIONES.

Autor: Jhaset Raul Ortega Cubas(2013). En este trabajo de investigación se propone diseñar una Red de Comunicación de Datos para dicho institución, que presenta un modelo de red LAN con muchas ventajas por el tipo de Red jerárquica que se emplea, además se basa en la tecnología VLAN para resolver problemas de congestión de Datos por tráfico Broadcast y una red escalable.

2.1.4 “OPTIMIZACIÓN E IMPLEMENTACIÓN DE LA RED LAN DEL INSTITUTO DE ELECTRICIDAD Y ELECTRÓNICA”, TRABAJO DE TIITULACIÓN PARA OPTAR AL TÍTULO DE INGENIERO ELECTRÓNICO, UNIVERSIDAD AUSTRAL DE CHILE.

Autor: Esteban Andrés Asenjo Castruccio Valdivia. Este trabajo analiza acuciosamente la Red del Instituto de Electricidad y Electrónica para descubrir las debilidades y fortalezas de la Red, y se elabora un nuevo modelo de red que sirve como base para tener un red de Transporte ATM, esto permitirá tener una red alternativa.

2.2 BASES TEÓRICAS

2.2.1 RED DE COMUNICACIONES

Es un conjunto de equipos o computadoras conectadas entre sí que permiten compartir recursos e información. La información por compartir suele consistir en archivo y datos. Los recursos son los dispositivos o las áreas de almacenamiento de datos de una computadora, compartida por otra computadora mediante la red.

Las redes de datos se diseñan y construyen en arquitecturas que pretenden servir a sus objetivos de uso. Las redes de datos, generalmente, están basadas en la conmutación de paquetes y se clasifican de acuerdo a su tamaño, la distancia que cubre y su arquitectura física.

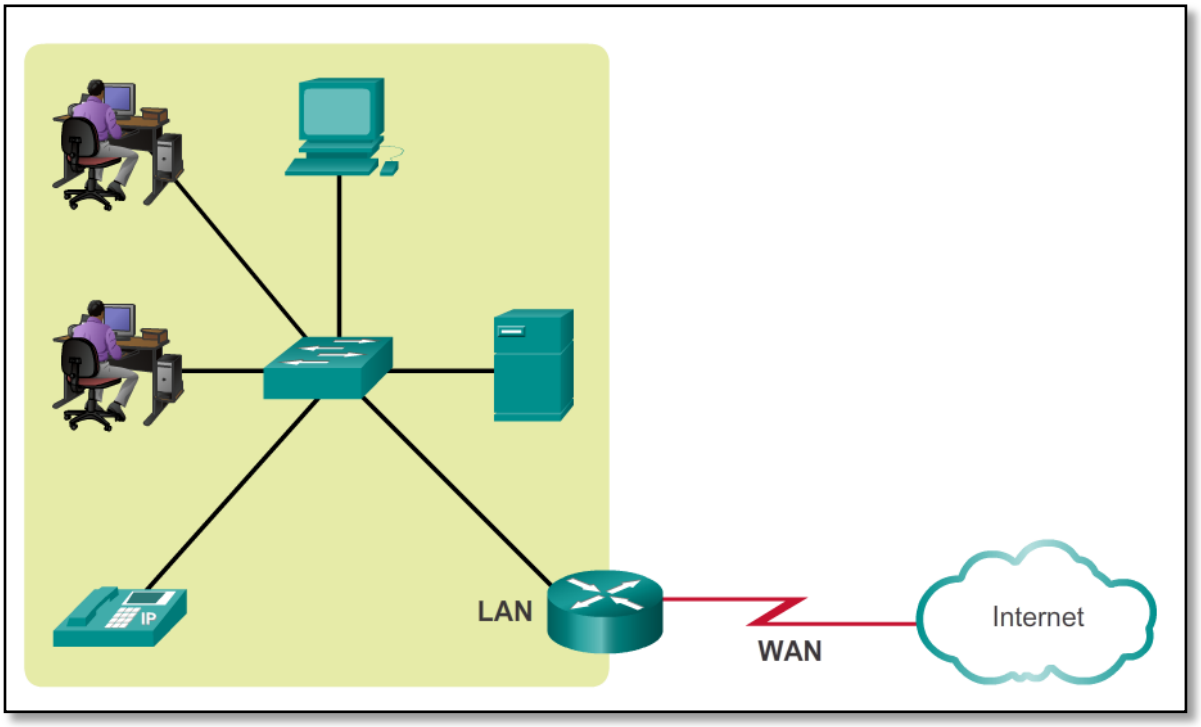


Figura 1: “TOPOLOGÍA DE RED DE COMUNICACIÓN TÍPICA” Fuente: Cisco

2.2.2 TIPOS DE REDES.

Los dos tipos más comunes de infraestructura de Red son los siguientes:

2.2.2.1 Red de área local (LAN)

Una red que se limita a un área especial relativamente pequeña tal como un cuarto, un solo edificio, una oficina o campus y la mayoría son de propiedad privada. Una LAN grande se divide generalmente en segmentos lógicos más pequeños llamados Workgroups. Un Workgroups es un conjunto de computadoras que comparten un sistema común de recursos dentro de un LAN.

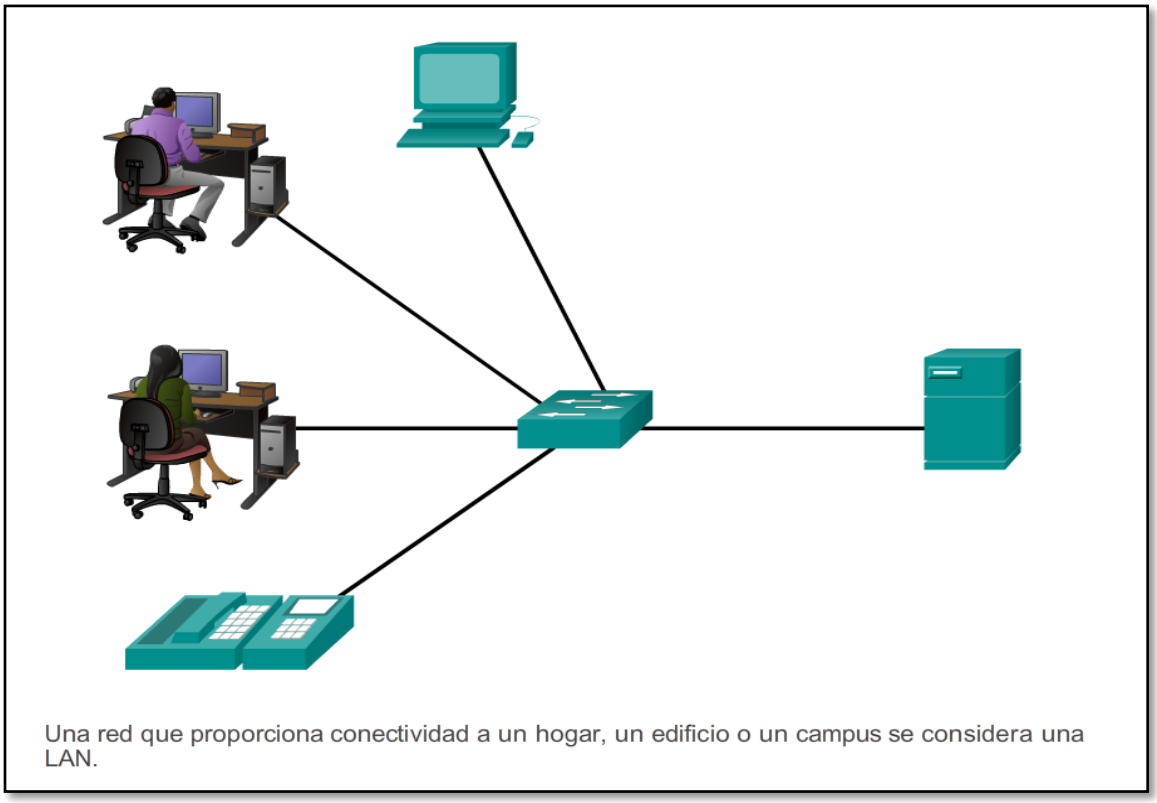


Figura 2: Red LAN. Fuente:Cisco

2.2.2.2 Redes de área amplia (WAN)

Las Redes de área extensa son aquellas que proporcionen un medio de transmisión a lo largo de grandes extensiones geográficas (regional, nacional e incluso internacional). Una red WAN generalmente utiliza redes de servicio público y redes privadas que pueden extenderse alrededor del mundo.

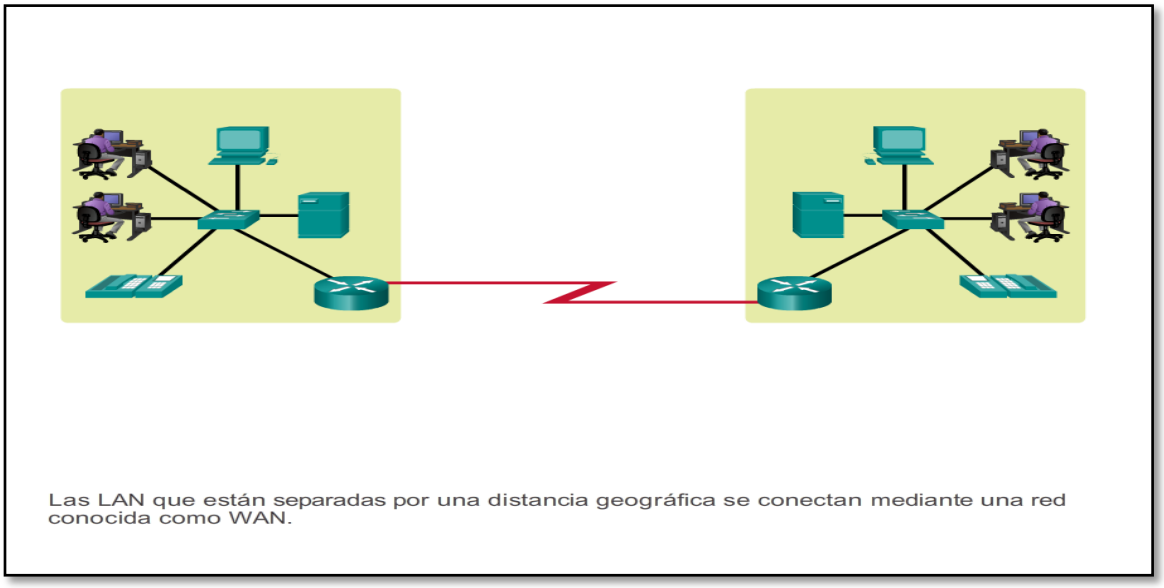


Figura 3: Red WAN Fuente: Cisco

2.2.3 REDES INALÁMBRICAS (WLAN)

Una WLAN es una red de área local, pero inalámbrica; consiste en un sistema de comunicación de datos que los transmite y recibe a través del aire utilizando tecnología de radio. Las WLAN se utilizan en entornos tanto empresariales como privados, bien como extensiones de las redes existentes o en entornos de pequeñas empresas, o como una alternativa a las redes de cable. Las WLAN proporcionan todas las ventajas y características de las tecnologías de las redes de área local (LAN), sin las limitaciones que imponen los cables.

Las WLAN redefinen la forma de ver las LAN. La conectividad ya no implica una conexión física. Los usuarios pueden seguir conectados a la red mientras se desplazan por las diferentes áreas de una compañía. Con las WLAN, la infraestructura de red se puede desplazar y modificar a la misma velocidad que crece la empresa. Veamos algunos ejemplos clásicos de aplicación de la tecnología:

-En empresas pequeñas, las WLAN pueden ser una alternativa a las LAN con cable. Las WLAN son fáciles de instalar y ofrecen un alto grado de flexibilidad, lo que facilita el crecimiento de las empresas.

-En empresas medianas, las WLAN se pueden utilizar para ofrecer acceso en las salas de reuniones y en las áreas comunes. También proporcionan a los usuarios acceso en las zonas que se utilizan menos.

-En empresas grandes, las WLAN pueden proporcionar una red superpuesta que favorece la movilidad, con el fin de que los usuarios tengan acceso a la información que necesiten desde cualquier lugar del edificio.

2.2.4 VIRTUAL LAN (VLAN)

Una VLAN (acrónimo de virtual LAN, «red de área local virtual») es un método para crear redes lógicas independientes dentro de una misma red física. Varias VLAN pueden coexistir en un único conmutador físico o en una única red física. Son útiles para reducir el tamaño del dominio de difusión y ayudan en la administración de la red, separando segmentos lógicos de una red de área local (los departamentos de una empresa, por ejemplo) que no deberían intercambiar datos usando la red local (aunque podrían hacerlo a través de un enrutador o un conmutador de capa 3 y 4).

Una VLAN consiste en redes de ordenadores que se comportan como si estuviesen conectados al mismo PCI, aunque se encuentren físicamente conectados a diferentes segmentos de una red de área local. Los administradores de red configuran las VLAN mediante software en lugar de software, lo que las hace extremadamente duros. Una de las mayores ventajas de las VLAN surge cuando se traslada físicamente algún ordenador a otra ubicación y este puede permanecer en la misma VLAN sin necesidad de cambiar la configuración de la máscara de subred vertical.

Durante todo el proceso de configuración y funcionamiento de una VLAN es necesaria la participación de una serie de protocolos entre los que destacan el IEEE 802.1Q, STP y VTP (cuyo equivalente IEEE es GVRP). El protocolo IEEE 802.1Q se encarga del etiquetado de las tramas que es asociada inmediatamente con la información de la VLAN. El cometido principal de Spanning Tree Protocol (STP) es evitar la aparición de bucles lógicos para que haya un sólo camino entre dos nodos. VTP (VLAN Trunking Protocol) es un protocolo propietario de Cisco que permite una gestión centralizada de todas las VLAN.

Para evitar el bloqueo de los switches debido a las tormentas broadcast, una red con topología redundante tiene que tener habilitado el protocolo STP. Los switches utilizan STP para intercambiar mensajes entre sí (BPDUs, Bridge Protocol Data Units) para lograr que en cada VLAN sólo haya activo un camino para ir de un nodo a otro.

En los dispositivos Cisco, VTP (VLAN trunking protocol) se encarga de mantener la coherencia de la configuración VLAN por toda la red. VTP utiliza tramas de nivel 2 para gestionar la creación, borrado y renombrado de VLAN en una red sincronizando todos los dispositivos entre sí y evitar tener que configurarlos uno a uno. Para eso hay que establecer primero un dominio de administración VTP. Un dominio VTP para una red es un conjunto contiguo de switch unidos con enlaces trunk que tienen el mismo nombre de dominio VTP.

Los Switch pueden estar en uno de los siguientes modos: servidor, cliente o transparente. El servidor es el modo por defecto, anuncia su configuración al resto de equipos y se sincroniza con otros servidores VTP. Un Switch cliente no puede modificar la configuración VLAN, simplemente sincroniza la configuración en base a la información que le envían los servidores. Por último, un Switch está en modo transparente cuando sólo se puede configurar localmente pues ignora el contenido de los mensajes VTP.

VTP también permite «podar» (función VTP prunning), lo que significa dirigir tráfico VLAN específico sólo a los conmutadores que tienen puertos en la VLAN destino. Con lo que se ahorra ancho de banda en los posiblemente saturados enlaces trunk.

2.2.5 ARQUITECTURA DE RED

Las redes deben admitir una amplia variedad de aplicaciones y servicios, como así también funcionar con diferentes tipos de infraestructuras físicas. El término arquitectura de red, en este contexto, se refiere a las tecnologías que admiten la infraestructura y a los servicios y protocolos programados que pueden trasladar los mensajes en toda esa infraestructura. Debido a que Internet evoluciona, al igual que las redes en general, descubrimos que existen cuatro características básicas que la arquitectura subyacente necesita para cumplir con las expectativas de los usuarios: tolerancia a fallas, escalabilidad, calidad del servicio y seguridad.

2.2.5.1Tolerancia a fallas

La expectativa de que Internet está siempre disponible para millones de usuarios que confían en ella requiere de una arquitectura de red diseñada y creada con tolerancia a fallas. Una red tolerante a fallas es la que limita el impacto de una falla del software o hardware y puede recuperarse rápidamente cuando se produce dicha falla. Estas redes dependen de enlaces o rutas redundantes entre el origen y el destino del mensaje. Si un enlace o ruta falla, los procesos garantizan que los mensajes pueden enrutarse en forma instantánea en un enlace diferente transparente para los usuarios en cada extremo. Tanto las infraestructuras físicas

como los procesos lógicos que direccionan los mensajes a través de la red están diseñados para adaptarse a esta redundancia. Ésta es la premisa básica de la arquitectura de redes actuales.

2.2.5.2 Escalabilidad

Una red escalable puede expandirse rápidamente para admitir nuevos usuarios y aplicaciones sin afectar el rendimiento del servicio enviado a los usuarios actuales. Miles de nuevos usuarios y proveedores de servicio se conectan a Internet cada semana. La capacidad de la red de admitir estas nuevas interconexiones depende de un diseño jerárquico en capas para la infraestructura física subyacente y la arquitectura lógica. El funcionamiento de cada capa permite a los usuarios y proveedores de servicios insertarse sin causar disrupción en toda la red. Los desarrollos tecnológicos aumentan constantemente las capacidades de transmitir el mensaje y el rendimiento de los componentes de la estructura física en cada capa. Estos desarrollos, junto con los nuevos métodos para identificar y localizar usuarios individuales dentro de una internetwork, estan permitiendo a Internet mantenerse al ritmo de la demanda de los usuarios.

2.2.5.3 Calidad de servicio (QoS)

Internet actualmente proporciona un nivel aceptable de tolerancia a fallas y escalabilidad para sus usuarios. Pero las nuevas aplicaciones disponibles para los usuarios en internetworks crean expectativas mayores para la calidad de los servicios enviados. Las transmisiones de voz y video en vivo requieren un nivel de calidad consistente y un envío ininterrumpido que no era necesario para las aplicaciones informáticas tradicionales. La calidad de estos servicios se mide con la calidad de experimentar la misma presentación de audio y video en persona.

Las redes de voz y video tradicionales están diseñadas para admitir un único tipo de transmisión y, por lo tanto, pueden producir un nivel aceptable de calidad. Los nuevos requerimientos para admitir esta calidad de servicio en una red convergente cambian la manera en que se diseñan e implementan las arquitecturas de red.

2.2.5.4 Seguridad

Internet evolucionó de una internetwork de organizaciones gubernamentales y educativas estrechamente controlada a un medio ampliamente accesible para la transmisión de comunicaciones personales y empresariales. Como resultado, cambiaron los requerimientos de seguridad de la red. Las expectativas de privacidad y seguridad que se originan del uso de internetworks para intercambiar información empresarial crítica y confidencial exceden lo que puede enviar la arquitectura actual. La rápida expansión de las áreas de comunicación que no eran atendidas por las redes de datos tradicionales aumenta la necesidad de incorporar seguridad en la arquitectura de red. Como resultado, se está dedicando un gran esfuerzo a esta área de investigación y desarrollo. Mientras tanto, se están implementando muchas herramientas y procedimientos para combatir los defectos de seguridad inherentes en la arquitectura de red.

2.2.6 DISPOSITIVOS DE RED

2.2.6.1Switch (Conmutador)

Es el dispositivo digital lógico de interconexión de equipos que opera en la capa de enlace de datos del modelo OSI. Su función es interconectar dos o más segmentos de red, de manera similar a los puentes de red, pasando datos de un segmento a otro de acuerdo con la dirección MAC de destino de las tramas en la red.

2.2.6.1.1 Conmutadores de capa 2.

Son los conmutadores tradicionales, que funcionan como puentes multi-puertos. Su principal finalidad es dividir una LAN en múltiples dominios de colisión, o en los casos de las redes en anillo, segmentar la LAN en diversos anillos. Basan su decisión de envío en la dirección MAC destino que contiene cada trama.

Los conmutadores de la capa 2 posibilitan múltiples transmisiones simultáneas sin interferir en otras sub-redes. Los switches de capa 2 no consiguen, sin embargo, filtrar difusiones o broadcasts, multicasts (en el caso en que más de una sub-red contenga las estaciones pertenecientes al grupo multicast de destino), ni tramas cuyo destino aún no haya sido incluido en la tabla de direccionamiento.

2.2.6.1.2 Conmutadores de capa 3.

Son los conmutadores que, además de las funciones tradicionales de la capa 2, incorporan algunas funciones de enrutamiento o routing, como por ejemplo la determinación del camino basado en informaciones de capa de red (capa 3 del modelo OSI), validación de la integridad del cableado de la capa 3 por checksum y soporte a los protocolos de routing tradicionales (RIP, OSPF, etc)

Los conmutadores de capa 3 soportan también la definición de redes virtuales (VLAN), y según modelos posibilitan la comunicación entre las diversas VLAN sin la necesidad de utilizar un router externo.

2.2.6.2 Router

Es un dispositivo de red que proporciona conectividad a nivel de red o nivel tres en el modelo OSI. Su función principal consiste en enviar o encaminar paquetes de datos de una red a otra, es decir, interconectar subredes.

Es un dispositivo de interconexión de redes informáticas que permite asegurar el enrutamiento de paquetes entre redes o determinar la ruta que debe tomar el paquete de datos.

La estación de trabajo envía la solicitud al router más cercano, es decir, a la pasarela predeterminada de la red en la que se encuentra. Este router determinará así el siguiente equipo al que se le enviarán los datos para poder escoger la mejor ruta posible. Para hacerlo, el router cuenta con tablas de enrutamiento actualizadas, que son verdaderos mapas de los itinerarios que pueden seguirse para llegar a la dirección de destino. Existen numerosos protocolos dedicados a esta tarea.

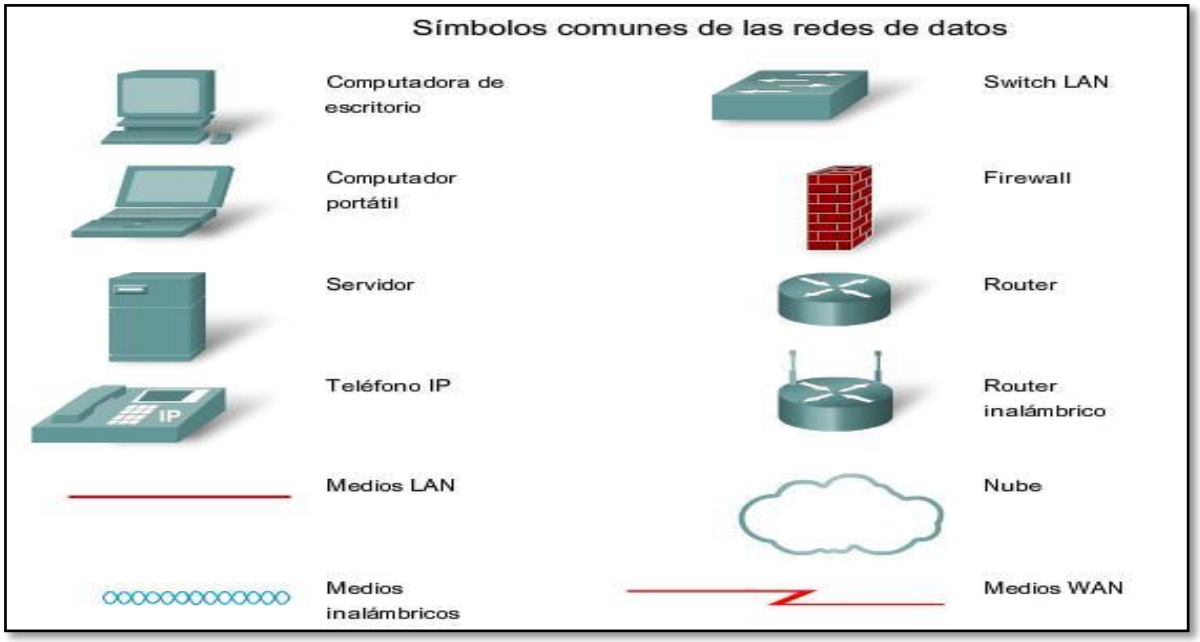
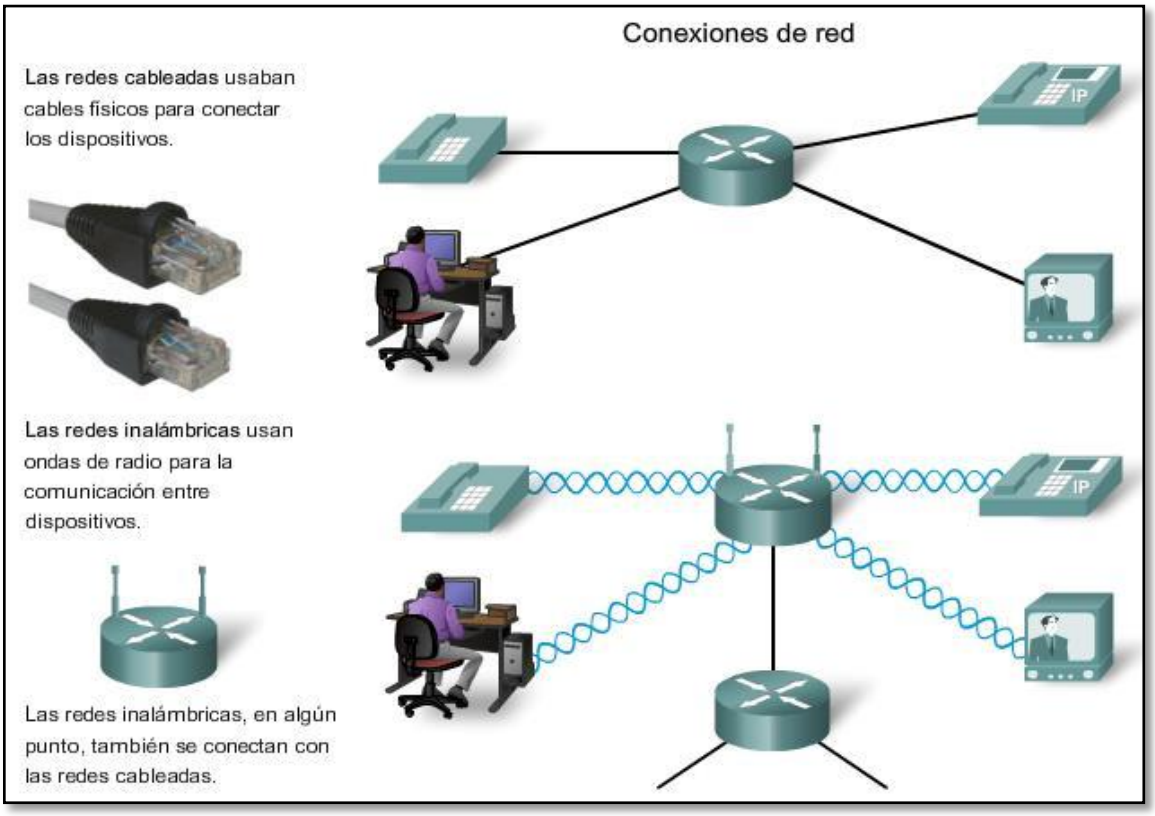


Figura N°4: Símbolos comunes en Redes de Datos.

Para que funcione una red, los dispositivos deben estar interconectados. Las conexiones de red pueden ser con cables o inalámbricas. En las conexiones con cables, el medio puede ser cobre, que transmite señales eléctricas, o fibra óptica, que transmite señales de luz. En las conexiones inalámbricas, el medio es la atmósfera de la tierra o espacio y las señales son microondas. Los medios de cobre incluyen cables, como el par trenzado del cable de teléfono, el cable coaxial, cable de par trenzado no blindado (UTP).

Las fibras ópticas, son hebras finas de vidrio o plástico que transmiten señales de luz, son otra forma de medios de networking. Los medios inalámbricos incluyen conexiones inalámbricas domésticas entre un router inalámbrico y una computadora con una tarjeta de red inalámbrica, conexión inalámbrica terrestre entre dos estaciones de tierra o comunicación entre dispositivos en tierra y satélites. En un viaje típico a través de Internet, un mensaje puede viajar en una variedad de medios.

Figura 5. Conexiones de Red Fuente CISCO.



2.2.7 PROTOCOLOS

2.2.7.1 REGLAS QUE RIGEN LAS COMUNICACIONES

Toda comunicación, ya sea cara a cara o por una red, está regida por reglas predeterminadas denominadas protocolos. Estos protocolos son específicos de las características de la conversación. En nuestras comunicaciones personales cotidianas, las reglas que utilizamos para comunicarnos a través de un medio, como

el teléfono, no necesariamente son las mismas que los protocolos que se usan en otro medio, como escribir una carta.

Piense cuántas reglas o protocolos diferentes rigen los distintos métodos de comunicación que existen actualmente en el mundo.

La comunicación exitosa entre los hosts de una red requiere la interacción de gran cantidad de protocolos diferentes. Un grupo de protocolos interrelacionados que son necesarios para realizar una función de comunicación se denomina suite de protocolos. Estos protocolos se implementan en el software y hardware que está cargado en cada host y dispositivo de red.

Una de las mejores maneras de visualizar de qué manera todos los protocolos interactúan en un host en particular es verlo como un stack. Una stack de protocolos muestra cómo los protocolos individuales de una suite se implementan en el host. Los protocolos se muestran como una jerarquía en capas, donde cada servicio de nivel superior depende de la funcionalidad definida por los protocolos que se muestran en los niveles inferiores. Las capas inferiores del stack competen a los movimientos de datos por la red y a la provisión de servicios a las capas superiores, concentrados en el contenido del mensaje que se está enviando y en la interfaz del usuario.

2.2.7.2 Modelos de protocolo y referencia

Existen dos tipos básicos de modelos de networking: modelos de protocolo y modelos de referencia.

Un modelo de protocolo proporciona un modelo que coincide fielmente con la estructura de una suite de protocolo en particular. El conjunto jerárquico de protocolos relacionados en una suite representa típicamente toda la funcionalidad requerida para interconectar la red humana con la red de datos. El modelo TCP/IP es un modelo de protocolo porque describe las funciones que se producen en cada capa de los protocolos dentro del conjunto TCP/IP.

Un modelo de referencia proporciona una referencia común para mantener consistencia en todos los tipos de protocolos y servicios de red. Un modelo de referencia no está pensado para ser una especificación de implementación ni para proporcionar un nivel de detalle suficiente para definir de forma precisa los servicios de la arquitectura de red. El propósito principal de un modelo de referencia es asistir en la comprensión más clara de las funciones y los procesos involucrados.

El modelo de interconexión de sistema abierto (OSI) es el modelo de referencia de internetwork más ampliamente conocido. Se utiliza para el diseño de redes de datos, especificaciones de funcionamiento y resolución de problemas.

Aunque los modelos TCP/IP y OSI son los modelos principales que se utilizan cuando se analiza la funcionalidad de red, los diseñadores de protocolos de red, servicios o dispositivos pueden crear sus propios modelos para representar sus productos. Por último, se solicita a los diseñadores que se comuniquen con la industria asociando sus productos o servicios con el modelo OSI, el modelo TCP/IP o ambos.

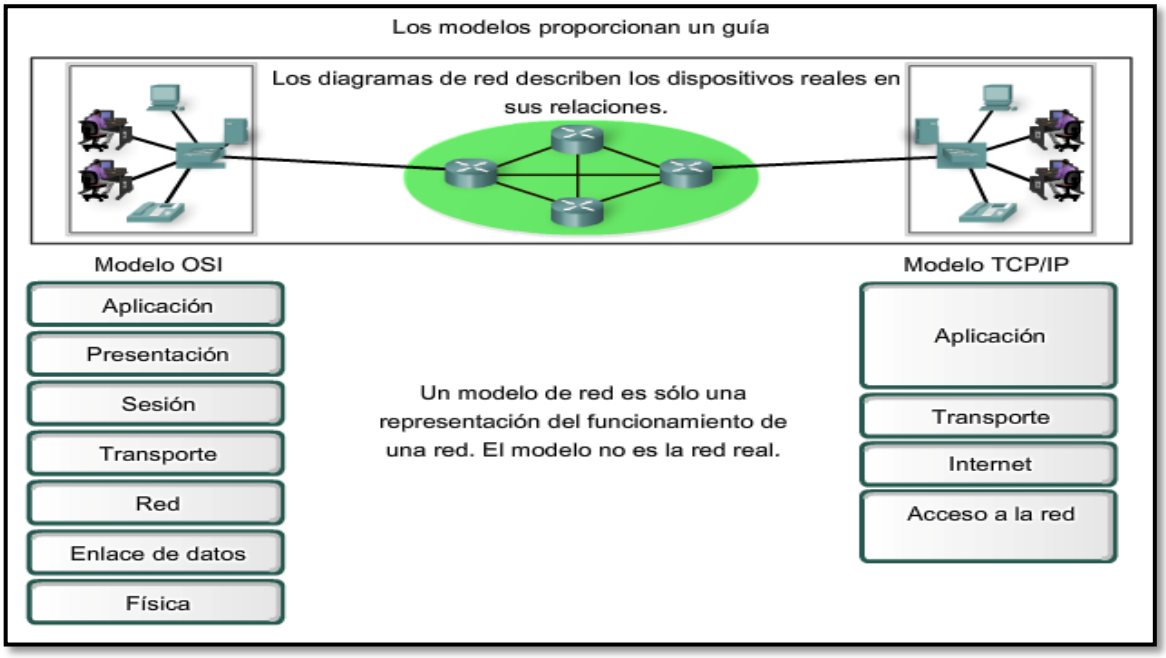


Figura 6. Modelo de Protocolos de red y capas.

2.2.7.3 Modelo TCP/IP

El primer modelo de protocolo en capas para comunicaciones de internetwork se creó a principios de la década de los setenta y se conoce con el nombre de modelo de Internet. Define cuatro categorías de funciones que deben tener lugar para que las comunicaciones sean exitosas. La arquitectura de la suite de protocolos TCP/IP sigue la estructura de este modelo. Por esto, es común que al modelo de Internet se lo conozca como modelo TCP/IP.

La mayoría de los modelos de protocolos describen un stack de protocolos específicos del proveedor. Sin embargo, puesto que el modelo TCP/IP es un estándar abierto, una compañía no controla la definición del modelo. Las definiciones del estándar y los protocolos TCP/IP se explican en un foro público y se definen en un conjunto de

Documentos disponibles al público. Estos documentos se denominan Solicitudes de comentarios (RFCS). Contienen las especificaciones formales de los protocolos de comunicación de datos y los recursos que describen el uso de los protocolos.

Las RFC (Solicitudes de comentarios) también contienen documentos técnicos y organizacionales sobre Internet, incluyendo las especificaciones técnicas y los documentos de las políticas producidos por el Grupo de trabajo de ingeniería de Internet (IETF).

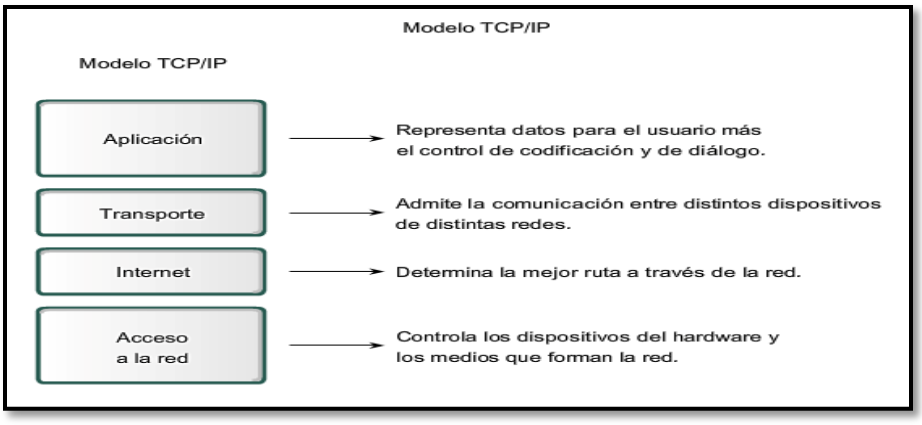


Figura N°7: Modelo TCP/IP

2.2.7.4 Modelo OSI

Inicialmente, el modelo OSI fue diseñado por la Organización Internacional para la Estandarización (ISO, International Organization for Standardization) para proporcionar un marco sobre el cual crear una suite de protocolos de sistemas abiertos. La visión era que este conjunto de protocolos se utilizara para desarrollar una red internacional que no dependiera de sistemas propietarios.

Lamentablemente, la velocidad a la que fue adoptada la Internet basada en TCP/IP y la proporción en la que se expandió ocasionó que el desarrollo y la aceptación de la suite de protocolos OSI quedaran atrás. Aunque pocos de los protocolos desarrollados mediante las especificaciones OSI son de uso masivo en la actualidad, el modelo OSI de siete capas ha realizado aportes importantes para el desarrollo de otros protocolos y productos para todos los tipos de nuevas redes.

Como modelo de referencia, el modelo OSI proporciona una amplia lista de funciones y servicios que pueden producirse en cada capa. También describe la interacción de cada capa con las capas directamente por encima y por debajo de él. Aunque el contenido de este curso se estructurará en torno al modelo OSI, el eje del análisis serán los protocolos identificados en el stack de protocolos TCP/IP.

2.2.7.5 Comparación entre el modelo OSI y el modelo TCP/IP

Los protocolos que forman la suite de protocolos TCP/IP pueden describirse en términos del modelo de referencia OSI.

En el modelo OSI, la capa Acceso a la red y la capa Aplicación del modelo TCP/IP están subdivididas para describir funciones discretas que deben producirse en estas capas.

En la capa Acceso a la red, la suite de protocolos TCP/IP no especifica cuáles protocolos utilizar cuando se transmite por un medio físico; sólo describe la transferencia desde la capa de Internet a los protocolos de red física. Las Capas OSI 1 y 2 analizan los procedimientos necesarios para tener acceso a los medios y los medios físicos para enviar datos por una red.

Los paralelos clave entre dos modelos de red se producen en las Capas 3 y 4 del modelo OSI. La Capa 3 del modelo OSI, la capa Red, se utiliza casi universalmente para analizar y documentar el rango de los procesos que se producen en todas las redes de datos para direccionar y enrutar mensajes a través de una internetwork. El Protocolo de Internet (IP) es el protocolo de la suite TCP/IP que incluye la funcionalidad descrita en la Capa 3.

La Capa 4, la capa Transporte del modelo OSI, con frecuencia se utiliza para describir servicios o funciones generales que administran conversaciones individuales entre los hosts de origen y de destino. Estas funciones incluyen acuse de recibo, recuperación de errores y secuenciamiento. En esta capa, los protocolos TCP/IP, Protocolo de control de transmisión (TCP) y Protocolo de datagramas de usuario (UDP) proporcionan la funcionalidad necesaria.

La capa de aplicación TCP/IP incluye una cantidad de protocolos que proporcionan funcionalidad específica para una variedad de aplicaciones de usuario final. Las Capas 5, 6 y 7 del modelo OSI se utilizan como referencias para proveedores y programadores de software de aplicación para fabricar productos que necesitan acceder a las redes para establecer comunicaciones.

FIGURA 8 “Comparación del Modelo OSI con el Modelo TCP/IP”. Fuente: CISCO

2.3 MARCO CONCEPTUAL

2.3.1 RED DE COMUNICACIONES

Se denomina red de comunicación de datos a aquella infraestructura que se ha diseñado específicamente a la transmisión de información mediante el intercambio de datos. Las redes de comunicación de datos se diseñan y construyen en arquitecturas que pretenden servir a sus objetivos de uso. Las redes de comunicación de datos, generalmente, están basadas en la conmutación de paquetes y se clasifican de acuerdo a su tamaño, la distancia que cubre y su arquitectura física.

2.3.2 PROTOCOLO

En informática y telecomunicaciones, un protocolo de comunicaciones es un conjunto de reglas y normas que permiten que dos o más entidades de un sistema de comunicación se comuniquen entre ellos para transmitir información por medio de cualquier tipo de variación de una magnitud física. Se trata de las reglas o el estándar que define la sintaxis, semántica y sincronización de la comunicación, así como posibles métodos de recuperación de errores. Los protocolos pueden ser implementados por hardware, software, o una combinación de ambos.

2.3.3 DIRECCION IP

Es un numero de 32 bits definida por el Protocolo Internet en STD 5, RFC 791. Se representa usualmente mediante notación decimal separada por puntos en 4 octetos en notación binaria. Un ejemplo de dirección IP es 193.127.88.345.

2.3.4 Wi-Fi

Es un mecanismo de conexión de dispositivos electrónicos de forma inalámbrica. Los dispositivos habilitados con Wi-Fi, tales como: un ordenador personal, una consola de videojuegos, un smartphone o un reproductor de audio digital, pueden conectarse a la red a través de un punto de acceso de red inalámbrica. Los estándares que certifica la Wi-fi Alliance son el IEEE 802.11b, IEEE 802.11g y IEEE 802.11n en la banda de 2.4GHz con una velocidad de hasta 11 Mbit/s, 54 Mbit/s y 300 Mbit/s, respectivamente y el estándar IEEE 802.11ac que opera en la banda de 5 GHz

2.3.5 Vlan Trunking Protocol (VTP)

Un protocolo de mensajes de nivel 2 usado para configurar y administrar VLANs en equipos Cisco. Permite centralizar y simplificar la administración en un domino de VLANs, pudiendo crear, borrar y renombrar las mismas, reduciendo así la necesidad de configurar la misma VLAN en todos los nodos. El protocolo VTP nace como una herramienta de administración para redes de cierto tamaño, donde la gestión manual se vuelve inabordable.

2.3.6 Spanning Tree Protocol (STP)

En comunicaciones, STP es un protocolo de red de nivel 2 del modelo OSI (capa de enlace de datos). Su función es la de gestionar la presencia de bucles en topologías de red debido a la existencia de enlaces redundantes (necesarios en muchos casos para garantizar la disponibilidad de las conexiones). El protocolo permite a los dispositivos de interconexión activar o desactivar automáticamente los enlaces de conexión, de forma que se garantice la eliminación de bucles. STP es transparente a las estaciones de usuario.

2.3.7 Hot Standby Router Protocol (HSRP)

El Hot Standby Router Protocol es un protocolo propietario de CISCO que permite el despliegue de routers redundantes tolerantes a fallos en una red. Este protocolo evita la existencia de puntos de fallo únicos en la red mediante técnicas de redundancia y comprobación del estado de los routers.

Su funcionamiento consiste en crear un grupo de routers en el que uno de ellos actúa como maestro, enrutando el tráfico, y los demás actúan como respaldo a la espera de que se produzca un fallo en el maestro. HSRP es un protocolo que actúa en la capa 3 del modelo OSI administrando las direcciones virtuales que identifican al router que actúa como maestro en un momento dado.

2.3.10 DISEÑO DE RED JERÁRQUICO

El Diseño de red Jerárquico consiste en la división de la Red en Capas de manera independiente.

Cada capa cumple una Función diferente dentro del modelo de Red, y para ello se utilizaran diferentes dispositivos de Red en cada Capa de acuerdo a Capacidad de Transmisión de Datos y facilitando la escabilidad y redimiento en la Red.

2.3.11 CAPAS DE DISEÑO DE RED JERÁRQUICO

El modelo de red basado en un diseño jerárquico, consta de 3 capas fundamentales:

a) Capa de Núcleo

Es el backbone de alta velocidad de la red. La Capa de Núcleo es esencial para la interconectividad entre los dispositivos de la capa de distribución, por lo tanto, es importante que el núcleo sea sumamente disponible y redundante. El área del núcleo también puede conectarse a los recursos de Internet. El núcleo agrega el tráfico de todos los dispositivos de la capa de distribución, por lo tanto debe poder reenviar grandes cantidades de datos rápidamente.

b) Capa de Distribución

Es la encargada de agregar los datos recibidos de los switches de la capa de acceso antes de que se transmitan a la capa núcleo para el enrutamiento hacia su destino final. La capa de distribución controla el flujo de tráfico de la red con el uso de políticas y traza los dominios de broadcast al realizar el enrutamiento de las funciones entre las LAN virtuales (VLAN) definidas en la capa de acceso. Las VLAN permiten al usuario segmentar el tráfico sobre un switch en subredes separadas.

También a veces se llama workgroup layer, y es el medio de comunicación entre la capa de acceso y el Core. Las funciones de esta capa son proveer ruteo, filtrado, acceso a la red WAN y determinar que paquetes deben llegar al Core. Además, determina cuál es la manera más rápida de responder a los requerimientos de red, por ejemplo, cómo traer un archivo desde un servidor.

Aquí además se implementan las políticas de red, por ejemplo: ruteo, access-list, filtrado de paquetes, cola de espera (queuing), se implementa la seguridad y políticas de red (traducciones NAT y firewalls), la redistribución entre protocolos de ruteo (incluyendo rutas estáticas), ruteo entre VLANs y otras funciones de grupo de trabajo, se definen dominios de broadcast y multicast. Debemos evitar que se hagan funciones en esta capa que son exclusivas de otras capas.

c) Capa de Acceso.

Controla a los usuarios y el acceso de grupos de trabajo (workgroup access) o los recursos de internetwork, y a veces se le llama desktop layer. Los recursos más utilizados por los usuarios deben ser ubicados localmente, pero el tráfico de servicios remotos es manejado aquí, y entre sus funciones están la continuación de control de acceso y políticas, creación de dominios de colisión separados (segmentación), conectividad de grupos de trabajo en la capa de distribución (workgroup connectivity). En esta capa se lleva a cabo la conmutación Ethernet (Ethernet switching), DDR y ruteo estático (el dinámico es parte de la capa de distribución). Es importante considerar que no tienen que ser routers separados los que efectúan estas funciones de diferentes capas, podrían ser incluso varios dispositivos por capa o un dispositivo haciendo funciones de varias capas.

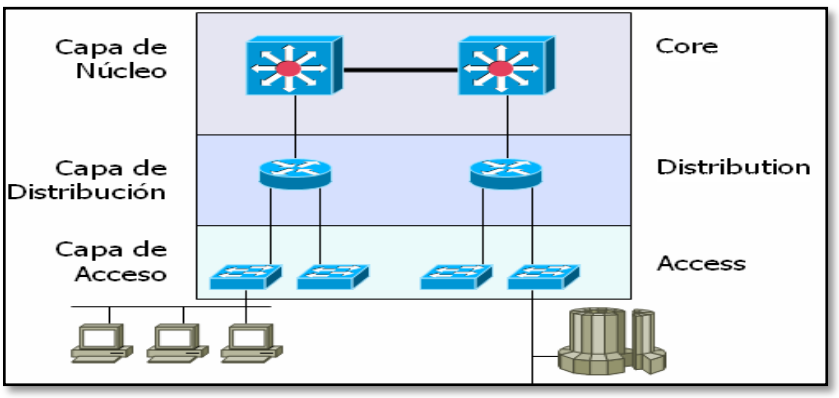


FIGURA N° 9: Modelo Jerárquico de CISCO.

CAPITULO III

DESARROLLO DE LA METODOLOGÍA

3.1 Descripción del Proyecto

El proyecto consiste en la elaboración de un Diseño de Red que presente factores de escalabilidad, fiabilidad y seguridad en la Red así mismo tiempo de asegurar que el flujo de información no presente congestión, se realizará el Direccionamiento IP de acuerdo al análisis del diseño previo y se elegirá los equipos de red adecuados para el Diseño, según sus características, especificaciones y protocolos de Capa 2 y Capa3.

Se analizará también el tipo de Cableado Estructurado a usar y el UPS para no perder la conexión por un tiempo determinado ante algún corte de energía en el edificio.

Se explicará paso a paso la utilización de los Equipos de Red con sus diversos protocolos y tipo de interconexión y la segmentación lógica de la Red en Subredes.

3.2 ANALISIS DEL DISEÑO DE RED

3.2.1 Análisis y Diagnóstico de la Infraestructura Actual

A continuación se muestra la distribución de los puntos de Red en el Piso 11 y piso 12, y las diversas áreas que comprende la Empresa, se detallará que tipo de infraestructura de Red se utilizará para transportar el cableado UTP desde el Data Center ubicado en el piso 11.

3.2.1.1 Detalles de la Infraestructura

Los dos niveles cuentan con una serie de Oficinas distribuidas cada una con una cantidad de Ordenadores, Impresoras y Dispositivos Inalámbricos, de la siguiente manera:

PISO 11: Área de: Contabilidad, Finanzas, Administración, Sistemas, Legal, Recepción, Compartimiento de Especialidades, Gerencia.

PISO 12: Área de compras, ventas, Operaciones, Non retail, Arquitectura y gerencia.

N°	AREA	CANTIDAD DE HOSTS
1	CONTABILIDAD	23
2	FINANZAS	12
3	ADMINISTRACIÓN	10
4	SISTEMAS	24
5	LEGAL	12
6	RECEPCIÓN	8
7	COMPARTIMIENTO DE ESPECIALIDADES	5
8	GERENCIA	7
9	ACCESS POINT	4

TABLA N° 1: Detalles de cantidad de Host por área en el Piso 11.

N°	AREA	CANTIDAD DE HOSTS
1	COMPRAS	22
2	VENTAS	9
3	OPERACIONES	13
4	NON RETAIL	10
5	ARQUI Y VISUAL	12
6	GERENCIA	10
7	ACCESS POINT	4

TABLA N° 2: Detalles de cantidad de Host por área en el Piso 12.

3.2.2 TOPOLOGÍA DE RED

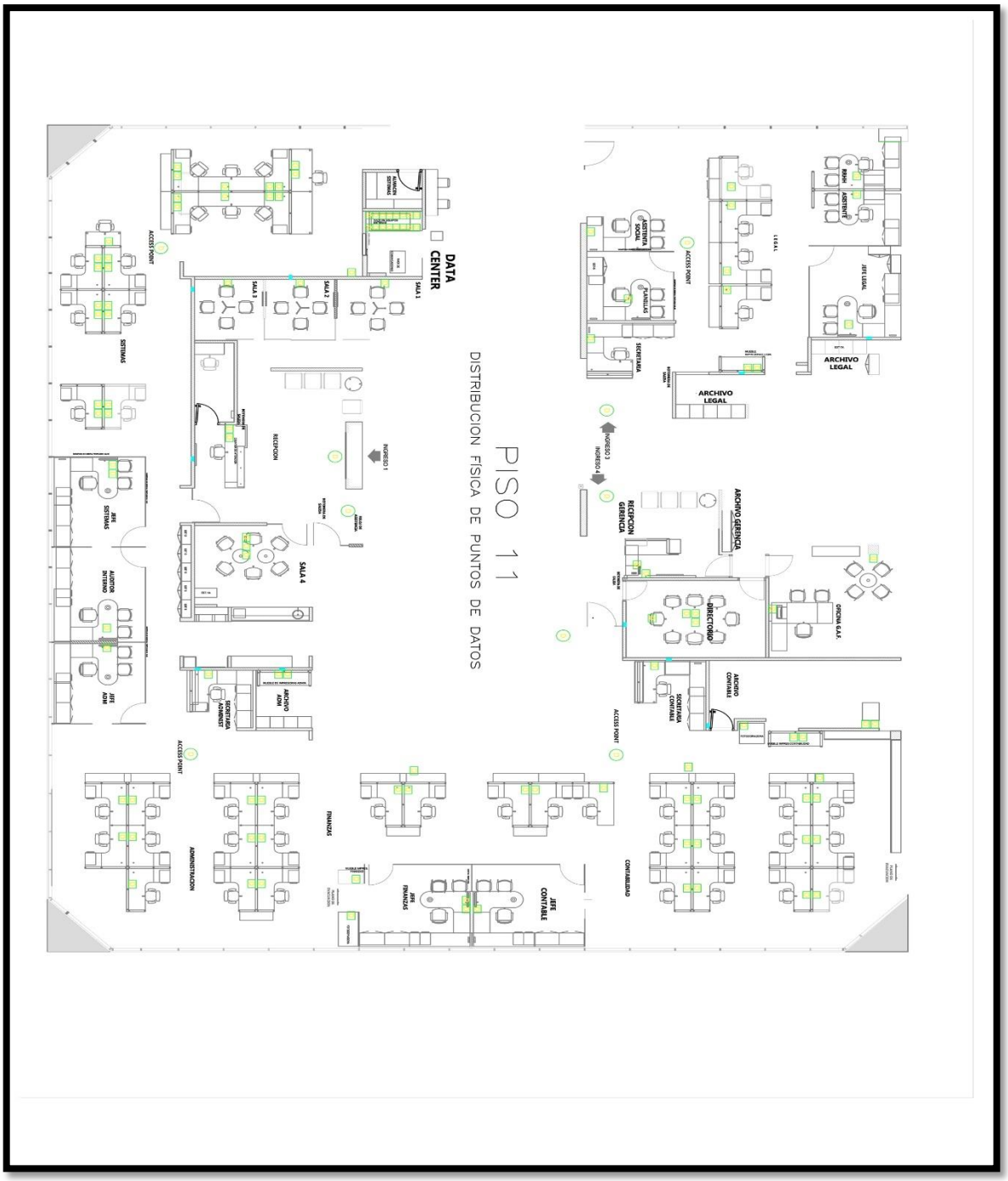
Analizando la Información la cuál comprende la Estructura Organizacional y Física de la Empresa se optará por establecer el diseño de red adecuado.

Hay muchas opciones para realizar el Diseño de la Red, de acuerdo a la distribución Física de las Oficinas se optó por elegir una Topología Lógica de Broadcast, esto quiere decir que cada Host envía Oficinas de la Empresa BATA se ha establecido de acuerdo a los parámetros proponer el siguiente Diseño de Red de Datos que consiste en:

- Proponer una Topología de Red Jerárquica, haciendo que la Red sea Escalable y de Rendimiento Eficiente.
- Segmentar la Red Original en Sub-redes con criterio de tal manera de evitar saturación en la Transmisión de Datos.
- Ubicar los puntos de Red para todos los Host y Access Point para el acceso a la Red de Forma Inalámbrica.
- Garantizar la Seguridad de la Red para todos los usuarios.

- Datos a todos los demás host dentro de la Red, y se optará por realizar una topología Física de Árbol. (Modelo de red Jerárquico).

FIGURA N°10: DISTRIBUCIÓN FÍSICA DEL PISO 11



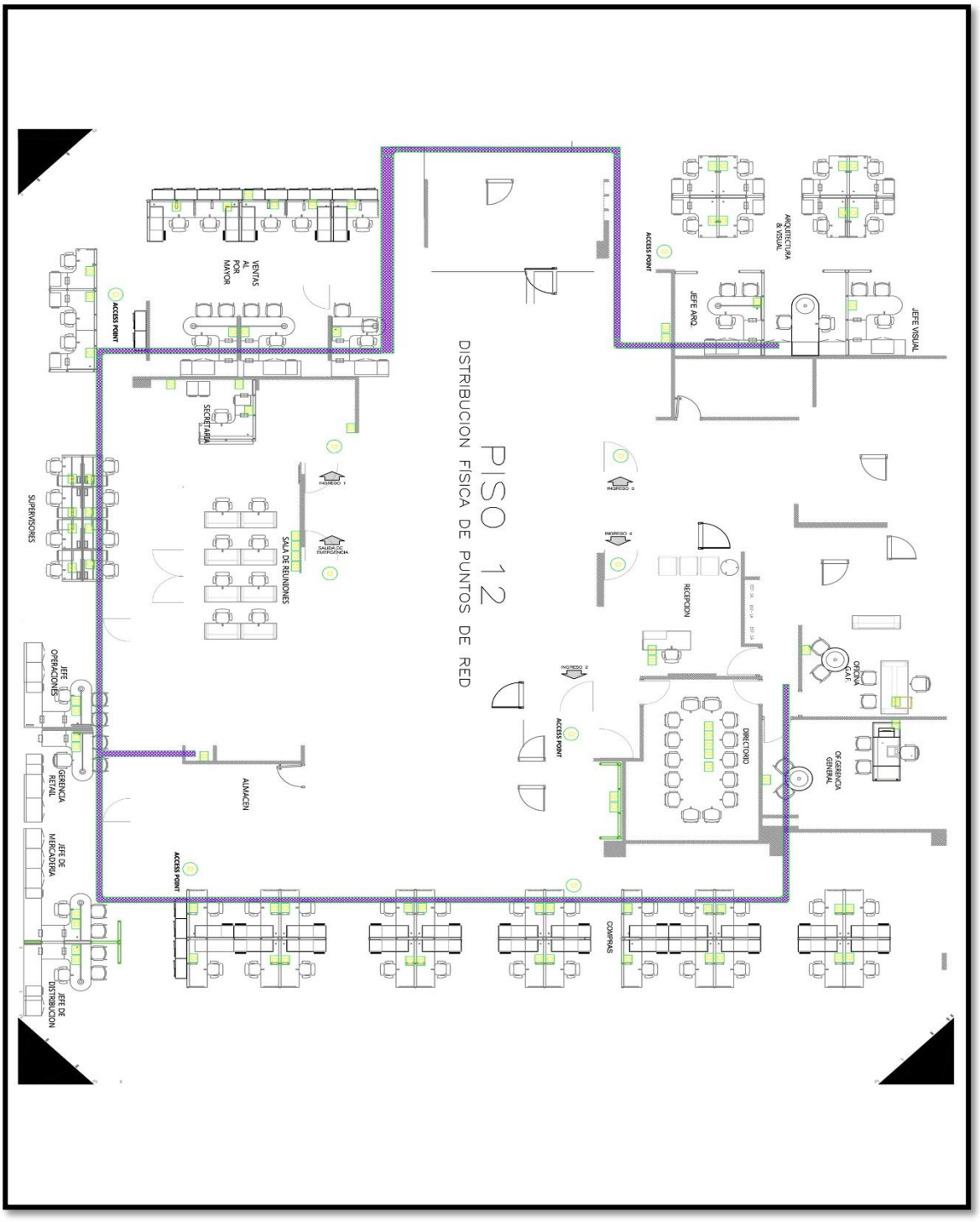


FIGURA N°11: DISTRIBUCIÓN FÍSICA DEL PISO 12

3.3 CONSTRUCCIÓN DEL DISEÑO

3.3.1 SEGMENTACIÓN DE LA RED

El primer paso para llevar a cabo el diseño de la infraestructura lógica es saber la distribución de los abonados y las áreas que conforman. Es por eso que la red se segmenta en varios grupos de trabajo a los cuales llamaremos subredes.

La distribución de las áreas está organizada de acuerdo a los requerimientos de ubicación según el Plano arquitectónico del Edificio, pero las diversas áreas no están físicamente cercanas entre sí, sino distribuidas entre el piso 11 y 12, y dichas áreas necesitan compartir información explícitamente entre sí.

Por ejemplo:

El área de Gerencia de piso 11 con el área de Gerencia del piso 12 y requiere máxima seguridad.

El área de Contabilidad del piso 11 con el área de Compras y ventas del piso 12 y requiere un nivel de seguridad.

Por esta razón se segmentará la Red en cantidad de subredes necesarias para dividir las diferentes áreas y agrupándolas según el envío de información en diferentes sub-redes y grupos de VLAN.

3.3.2CRITERIOS A CONSIDERAR EN EL USO DE VLAN

3.3.2.1 SEGURIDAD EN EL ENVÍO DE LA INFORMACIÓN

A los grupos que tienen datos sensibles se les separa del resto de la red, disminuyendo las posibilidades de que ocurran violaciones de información confidencial.

3.3.2.2 MAYOR RENDIMIENTO

La división de las redes planas de Capa 2 en múltiples grupos lógicos de trabajo (dominios de broadcast) reduce el tráfico innecesario en la red y potencia el rendimiento.

3.3.2.3 MITIGACIÓN DE LA TORMENTA DE BROADCAST.

La división de una red en las VLAN reduce el número de dispositivos que pueden participar en una tormenta de broadcast.

De acuerdo a la arquitectura del edificio y separación entre las diversas áreas que conformar grupos de sub-redes se optó por dividir las áreas en diferentes VLAN.

3.3.3 ANÁLISIS DE LA DIVISIÓN DE LOS GRUPOS DE TRABAJO EN DIFERENTES VLAN (VIRTUAL LAN)

	N°	AREA	CANTIDAD DE HOSTS	CANTIDAD DE HOST AMPLIADA
PISO 11	1	CONTABILIDAD	23	25
	2	FINANZAS	12	14
	3	ADMINISTRACIÓN	10	12
	4	SISTEMAS	24	26
	5	LEGAL	12	14
	6	RECEPCIÓN	8	10
	7	COMPARTIMIENTO DE ESPECIALIDADES	5	7
	8	GERENCIA	7	9
	9	ACCESS POINT	60	75
	10	SERVIDORES	2	4
		total	163	192

TABLA N° 3: Detalles de Asignación de Host ampliada a cada Grupo de trabajo.

	N°	AREA	CANTIDAD DE HOSTS	CANTIDAD DE HOST AMPLIADA
PISO 12	1	COMPRAS	22	24
	2	VENTAS	9	11
	3	OPERACIONES	13	15
	4	NON RETAIL	10	12
	5	ARQUI Y VISUAL	12	14
	6	GERENCIA	10	12
	7	ACCESS POINT	60	75
		TOTAL	136	163

TABLA N° 4: Detalles de Asignación de Host ampliada a cada Grupo de trabajo.

	N°	AREA	N° DE VLAN
PISO 11	1	CONTABILIDAD	VLAN 4
	2	FINANZAS	VLAN 3
	3	ADMINISTRACIÓN	VLAN 3
	4	SISTEMAS	VLAN 3
	5	LEGAL	VLAN 3
	6	RECEPCIÓN	VLAN 3
	7	COMPARTIMIENTO DE ESPECIALIDADES	VLAN 3
	8	GERENCIA	VLAN 5
	9	ACCESS POINT	VLAN 2
	10	SERVIDORES	VLAN 6

TABLA N° 5: Asignación de VLAN por grupos de Trabajo – Piso 11.

	N°	AREA	CANTIDAD DE HOSTS
PISO 12	1	COMPRAS	VLAN 4
	2	VENTAS	VLAN 4
	3	OPERACIONES	VLAN 3
	4	NON RETAIL	VLAN 3
	5	ARQUI Y VISUAL	VLAN 3
	6	GERENCIA	VLAN 5
	7	ACCESS POINT	VLAN 2

TABLA N° 6: Asignación de VLAN por grupos de Trabajo – Piso 12.

3.3.3.1 AGRUPACIÓN DE LAS ÁREAS EN DIFERENTES VLAN

- VLAN 2: Está conformado por los Host conectados inalámbricamente a la Red a través de los 8 Access Point que irán distribuidos en el Piso 11 y 12.

A esta VLAN le llamaremos “Wifi”.

-VLAN 3: Está conformado por todas las áreas de operación de la Empresa distribuidas entre el Piso 11 y 12 del Edificio sin incluir el área de Contabilidad y Gerencia.

A esta VLAN le llamaremos “Operaciones”.

-VLAN 4: Conformada por el área de Contabilidad ubicada en el Piso 11 y las Áreas de Compra y Venta ubicadas en el Piso 12.

A esta VLAN le llamaremos “Contabilidad”

-VLAN 5: Está conformada por el Sector de Gerencia de la Empresa, ésta VLAN requiere nivel estricto de Seguridad en el envío de Información y un nivel moderado en el envío de tráfico.

-VLAN 6: Está conformada por la granja de Servidores.

N° DE VLAN	NOMBRE DE VLAN	CANTIDAD DE HOTS
VLAN 2	WiFi	150
VLAN 3	Operaciones	124
VLAN 4	Contabilidad	60
VLAN 5	Gerencia	22
VLAN 6	Server	4

TABLA N° 7: Cantidad de Host por VLAN.

3.3.4 ASIGNACIÓN DE SUBREDES A LAS VLAN

3.3.4.1 SUBREDES (Subneteo)

En el punto anterior se Segmentó la Red en diferentes VLAN de acuerdo a los Grupos de Trabajo, ahora debemos aplicar la técnica de subneteo para establecer el Rango de IP por cada Subred.

Cada VLAN cuenta con diferentes números de hosts, por tal motivo usaremos la Técnica de Máscaras de Subred de tamaño variable (VLSM)

De acuerdo a la Tabla N° 7 ya se ha aumentado una cantidad de host a cada VLAN como IP de reserva para futuros hosts con el fin de hacer escalable la Red.

3.3.4.2 PASOS PARA LA APLICACIÓN DEL SUBNETEO

- RED ORIGINAL

Se utilizará una red de clase B porque la cantidad de hosts supera los 255, utilizaremos la Red: 172.16.0.0 / 16 que es una dirección utilizada generalmente para redes medianas empresariales.

RED	172.16.0.0 / 16
RANGO HOSTS	172.16.0.1 - 172.16.255.254
BROADCAST	172.16.255.255
TIPO	IP PRIVADA - CLASE B

Tabla N° 8 Red de Clase B

-El proceso de Subneteo se realiza tomando la Red Original, y dividiendo en Sub-Resdes a partir de la VLAN con mayor cantidad de Host hasta la VLAN con menor cantidad de Hosts.

-**PASO 1.**

Aplicando Subneteo para las IP de la VLAN 2;

RED	RANGO IP´S	BROADCAST
172.16.10.0/24	172.16.10.1 -172.16.10.254	172.16.10.255
172.16.11.0/24	**172.16.11.1 -172.16.11.254**	**172.16.11.255**

Utilizaremos la Sub Red 172.16.11.0/24 para la VLAN 2.

Seguiremos el Proceso de Subneteo con la Sub Red: 172.16.10.0/24

-PASO 2.

Para las IP de la VLAN 3: 124 hosts

RED	RANGO IP´S	BROADCAST
172.16.10.0/25	**172.16.10.1 -172.16.10.126**	**172.16.10.127**
172.16.10.128/25	172.16.10.129 - 172.16.10.254	172.16.10.255

Utilizaremos la Sub Red 172.16.10.0/25 para la VLAN 3.

Seguiremos el Proceso de Subneteo con la Sub Red: 172.16.10.128/25

-PASO 3

Para las IP de la VLAN 4: 60 HOSTS

RED	RANGO IP´S	BROADCAST
172.16.10.128/26	**172.16.10.129 -- 172.16.10.190**	**172.16.10.191**
172.16.10.192/26	172.16.10.193 -- 172.16.10.254	172.16.10.255

Utilizaremos la Sub Red 172.16.10.128/26 para la VLAN 4.

Seguiremos el Proceso de Subneteo con la Sub Red: 172.16.10.192/26

-PASO 4

Para las IP de la VLAN 5: 22 hosts

RED	RANGO IP´S	BROADCAST
172.16.10.192/27	**172.16.10.193 -- 172.16.10.222**	**172.16.10.223**
172.16.10.224/27	172.16.10.225 -- 172.16.10.254	172.16.10.255

Utilizaremos la Sub Red 172.16.10.192/27 para la VLAN 5

Seguiremos el Proceso de Subneteo con la Sub Red: 172.16.10.224/27

-PASO 5

Para las IP de la VLAN 6 se utilizarán las siguientes subredes (Servidores)

RED	RANGO IP´S	BROADCAST
172.16.10.224/28	**172.16.10.225 -- 172.16.10.238**	**172.16.10.239**
172.16.10.240/28	172.16.10.241 -- 172.16.10.254	172.16.10.255

Utilizaremos la Sub Red 172.16.10.224/28 para la VLAN 6

-**PASO 6**

Se eligirá una Red distinta a la de las VLAN para la configuración de los puertos que harán el enrutamiento dinámico.

Se eligirán las redes de tipo 172.16.1.x/30, la máscara se debe a que sólo se utilizarán dos direcciones IP por red.

Obtenemos las siguientes Sub-redes.

RED	RANGO IP´S	BROADCAST
172.16.1.0/30	**172.16.1.1– 172.16.1.2**	**172.16.1.3**
172.16.1.4/30	**172.16.1.5– 172.16.1.6**	**172.16.1.7**
172.16.1.8/30	**172.16.1.9– 172.16.1.10**	**172.16.1.11**
172.16.1.12/30	**172.16.1.13– 172.16.1.14**	**10.1.1.15**

N° DE VLAN	NOMBRE DE VLAN	N° DE HOTS	SUBRED	Rango de hosts	Broadcast
VLAN 2	WiFi	150	172.16.11.0/24	172.16.11.1 - 172.16.11.254	172.16.11.255
VLAN 3	Operaciones	124	172.16.10.0/25	172.16.10.1 - 172.16.10.126	172.16.10.127
VLAN 4	Contabilidad	60	172.16.10.128/26	172.16.10.129 - 172.16.10.190	172.16.10.191
VLAN 5	Gerencia	22	172.16.10.192/27	172.16.10.193 - 172.16.10.222	172.16.10.223
VLAN 6	Server	4	172.16.10.224/28	172.16.10.225 - 172.16.10.238	172.16.10.231

TABLA N° 9: Rango de IP por VLAN.

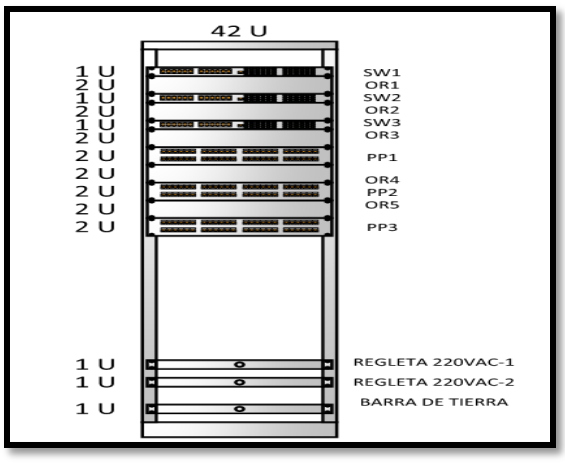
3.3.5 EQUIPOS E INFRAESTRUCTURA DE RED DE ACUERDO AL DISEÑO.

Para efectuar el Diseño de la Infraestructura Física de la Red se debe tomar en cuenta los siguientes aspectos.

- La ubicación Física de los dispositivos.
- Tipo de cableado a utilizar para el despliegue a lo largo de los dos pisos.
- Tipos de dispositivos de Red a utilizar.
- Cantidad de host para cada área de trabajo.

3.3.5.1 Cableado Horizontal. Está conformado por el Cableado estructurado de los switch de capa de acceso en Data center del piso 11 hacia los usuarios finales o hosts. Este cableado se realizará utilizando Cable UTP cat. 5e.

3.3.5.2 Cableado Vertical. Es el cableado de backbone y su función es proporcionaar interconexión entre el Data center ubicado en el Piso 11 y el armario de Comunicaciones del piso 12 donde se ubican los 2 switch de capa de acceso que brindan conexión a los usuarios de dicho piso.



.FIGURA N° 12: Distribución de Switch en rack

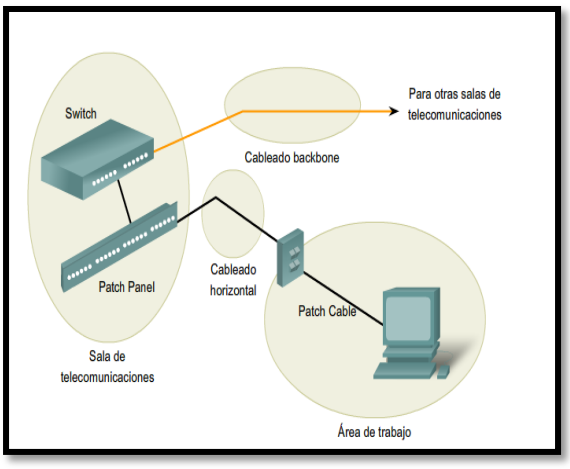


FIGURA N° 13: Cableado Horizontal de la Red

3.3.6 Equipos de Red

Teniendo en cuenta el tipo de Cableado que se usará en el Diseño de Red, la Cantidad de Host y la cantidad de usuarios máximos permisibles que se conectarán de manera inalámbrica, podemos elegir los tipos de dispositivos de Red y las características de acuerdo a las especificaciones de la Red.

3.3.6.1 Router de Borde

Será encargado del Enrutamiento de los paquetes hacia el ISP (Proveedor de Servicio) es el dispositivo encargado del enrutamiento de los diferentes host a sus destinatarios.

Principales Características del Router a utilizar:

- IP Routing and Multicast.

- 2 Puertos LAN Gigabit Ethernet para conectar a los Switch de Capa 3 de la etapa de Núcleo.

-2 ranuras WAN de alta velocidad (EHWIC).

- Power Over Ethernet (PoE)

- Encriptación VPN.

- Calidad de Servicio QoS

- Multiprotocol Label Switching (MPLS)

- Encapsulación 802.1q VLAN.

El router con las Características antes mencionadas es el CISCO 1921 Series.

FIGURA N° 14: Router Cisco 1921/K9

Características Principales:

- 2 Puertos RJ-45 LAN 10/100/1000
- Slot WAN de alta velocidad EHWIC
- Maximum power capacity with AC power supply 60W.

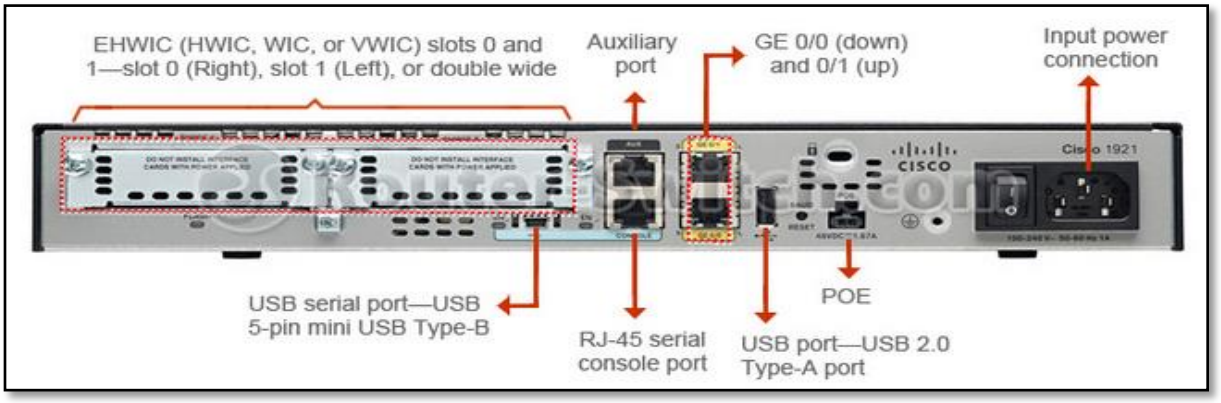


FIGURA N° 15: Parte trasera del Router Cisco 1921/K9

3.3.6.2Switch de Capa 3

Es el encargado de hacer el enrutamiento entre VLANs, es decir funciona como un dispositivo de Capa 2 y de capa 3 y debe tener puertos de Alta velocidad 1GigabitEthernet para realizar la Conmutación y el Trunking entre VLANs, Es el encargado de distribuir las Tramas entre Switch de capa 3 y a los Switches de capa de Acceso y de establecer conexiones redundantes hacia los Router de Borde.

Especificaciones Mínimas del Switch de Capa 3:

- 24 Puertos GigabitEthernet
- Power Over Ethernet en los 24 Puertos.
- QoS (Calidad de servicio)
- Vlan Trunking Protocol (VTP)
- Protocolos de Routing (OSPF, EIGRP)
- Hot Standby Router Protoco (HSRP)

El Switch con las características antes mencionadas que se eligirá para el diseño es el CISCO WS-C3560G-24TS-E

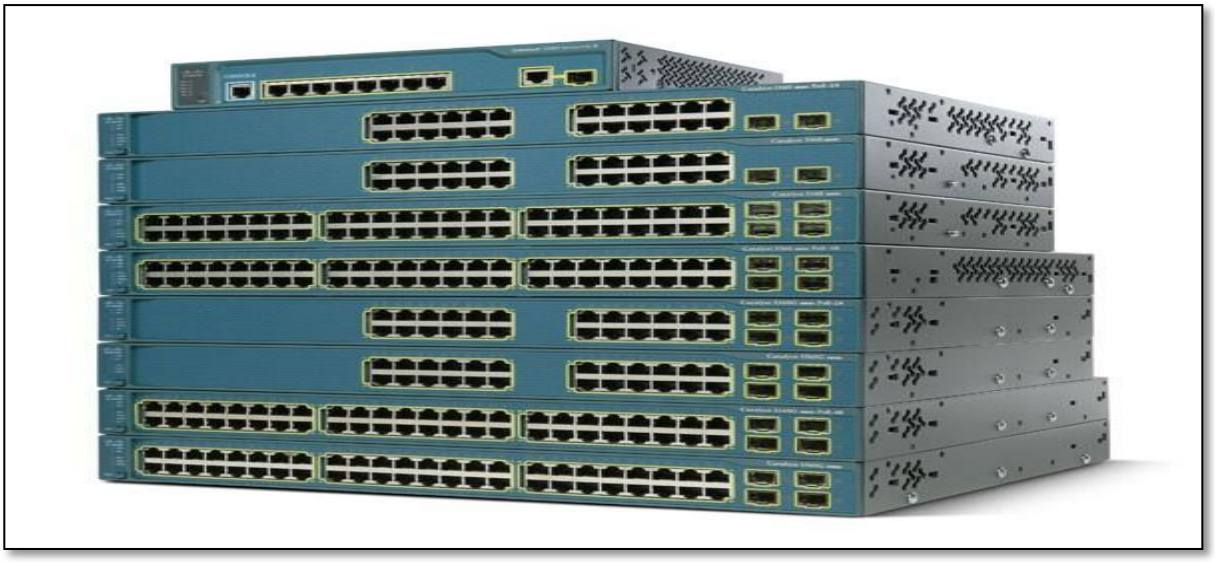


FIGURA N° 16: Switch CISCO WS-C3560G-24TS-E

3.3.6.3Switch de Capa 2 (ACCESO)

Es el dispositivo encargado de enviar los datos a los host finales a una velocidad de 100Mbps, este Switch debe soportar la Encapsulación DOIT.Q

VLAN y QoS además de dos puertos Gigabit Ethernet que irán conectados al Switch de Capa 3.

Especificaciones Mínimas del Switch de Capa 2:

- 48 puertos Fast Ethernet y 2 Puertos Gigabit Ethernet
- Layer 2 Switching.
- Creación de VLAN y seguridad a nivel de puerto.
- Calidad de Servicio. (QoS)
- PoE.(Power Over Ethernet)
- Spanning tree protocol IEEE802.1d
- VLAN Access control lists
- Etherchannel (Soporte para el protocolo PAgP)

El Switch a utilizar será el CISCO2960-48PST-L que se muestra a continuación:

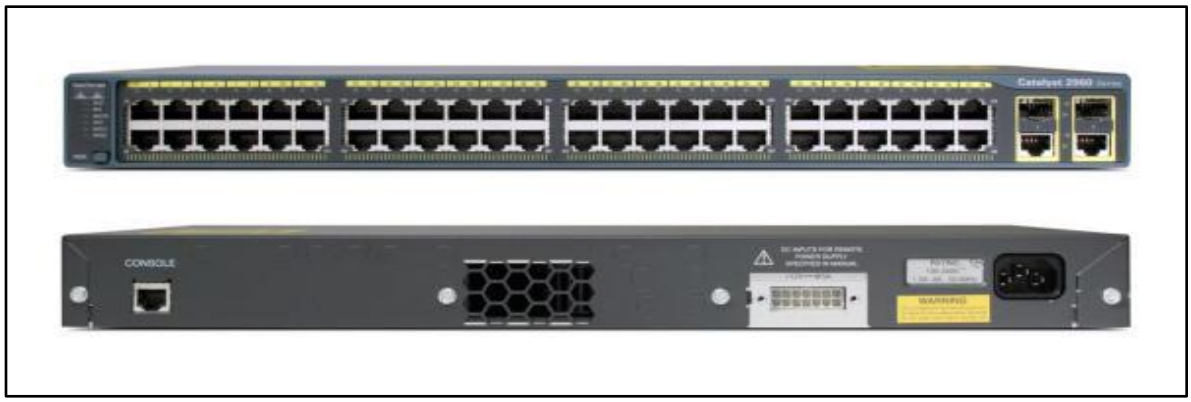


FIGURA N° 17: SW CISCO Catalyst 2960-48PST-L

3.3.6.4 Access Point

Éste dispositivo permitirá a los usuarios conectarse a la red de forma inalámbrica.

Según el diseño se optará por colocar 4 Puntos de Acceso en cada Piso, cada Access Point debe operar en distintos canales para evitar interferencias entre los mismos.

Los Access Point irán conectados directamente a los Switches de acceso y el direccionamiento IP estará en el rango asignado a la VLAN 2.

FIGURA N° 18: Access Point: Cisco Aironet 2700 Series

Especificaciones Mínimas del Access Point:

- Compatible con tecnología PoE.
- Debe soportar el estándar 802.11ac
- Encriptación WPA2-Protocolo 802.1x (Autentificación Enterprise)

Un Access Point para lugares cerrados es el AIRONET 2700 SERIES y será ubicado en lugares estratégicos del Edificio, 4 por cada piso.

Características:

Dual band 2.4GHz and 5GHz.

Velocidad de Conexión teórica de hasta 1.3Gbps.

3.3.7 ELECCIÓN DE UPS

Ya que tenemos equipos de Red que consumen determinada Potencia y ante cualquier corte de energía eléctrica necesitan estar protegidos y respaldados por un UPS (Sistema de alimentación ininterrumpida)

Un Sistema de Alimentación ininterrumpida SAI y más conocido como UPS (del inglés Uninterruptible Power Supply), es un dispositivo que gracias a sus baterías u otros elementos almacenadores de energía, puede proporcionar energía eléctrica por un tiempo limitado ante un corte de energía.

Se conectará al UPS los equipos dentro del Rack de comunicaciones ubicado en el piso 11 que tienen las siguientes especificaciones:

DISPOSITIVO	POTENCIA MÁXIMA REQUERIDA EN WATTS
2 ROUTER 1921	160W
2 SWITCH CATALIST WS-C3560G-24TS	1000W
3 Switch Catalyst 2960-48PST	1380W

TABLA N° 10: Potencia máxima de trabajo de cada Dispositivo

Sumando la Potencia Máxima requerida por todos los dispositivos, puesto que es muy poco probable que todos los dispositivos de red funcionen en su máxima capacidad al mismo tiempo, se restaura un 33% de capacidad y finalmente se multiplicará por el factor de 1.3 al resultado debido a un crecimiento en el futuro y se obtendrá finalmente la capacidad con el cual debe contar nuestro UPS.

Total de Potencia máxima requerida: 160+1000+1380=2540

Restándole el 33%= 0.67*2540=1701.8

Aumentando el 30% debido al posible incremento de equipos en el futuro.

1.3*1701.8=2212.34

Con este resultado debemos tener en cuenta un UPS que tenga la capacidad de dotar energía para una carga de 2142W, se escogerá el UPS APC Smart-UPS 3000VA USB & Serial RM 2U 230V. (2700W)

FIGURA N°19 UPS APC 2700W

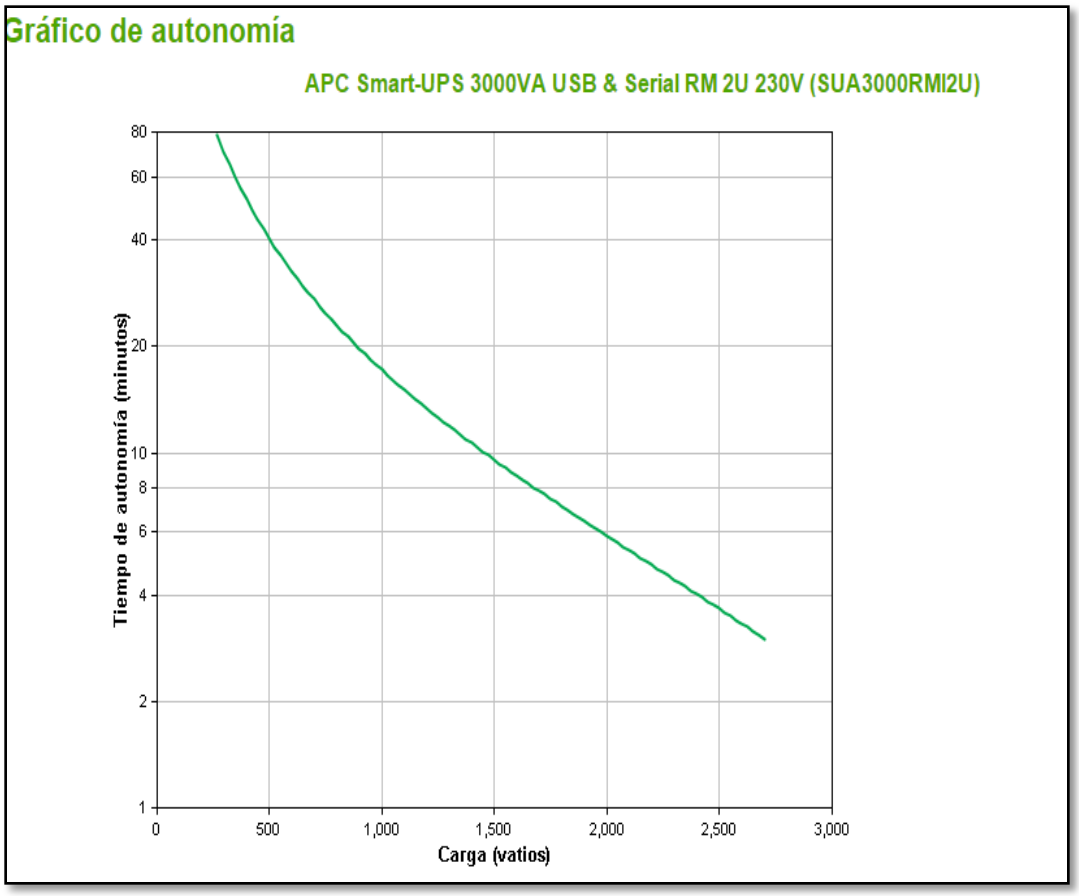


FIGURA N° 20: Gráfico de autonomía UPS 2700W

3.3.8TOPOLOGÍA FÍSICA DEL DISEÑO DE RED.

El Modelo de Red Diseñado se basa en un Modelo Jerárquico de Núcleo Colapsado, este diseño garantiza la flexibilidad, Escalabilidad, redundancia y mayor facilidad de administración y mantenimiento de la Red.

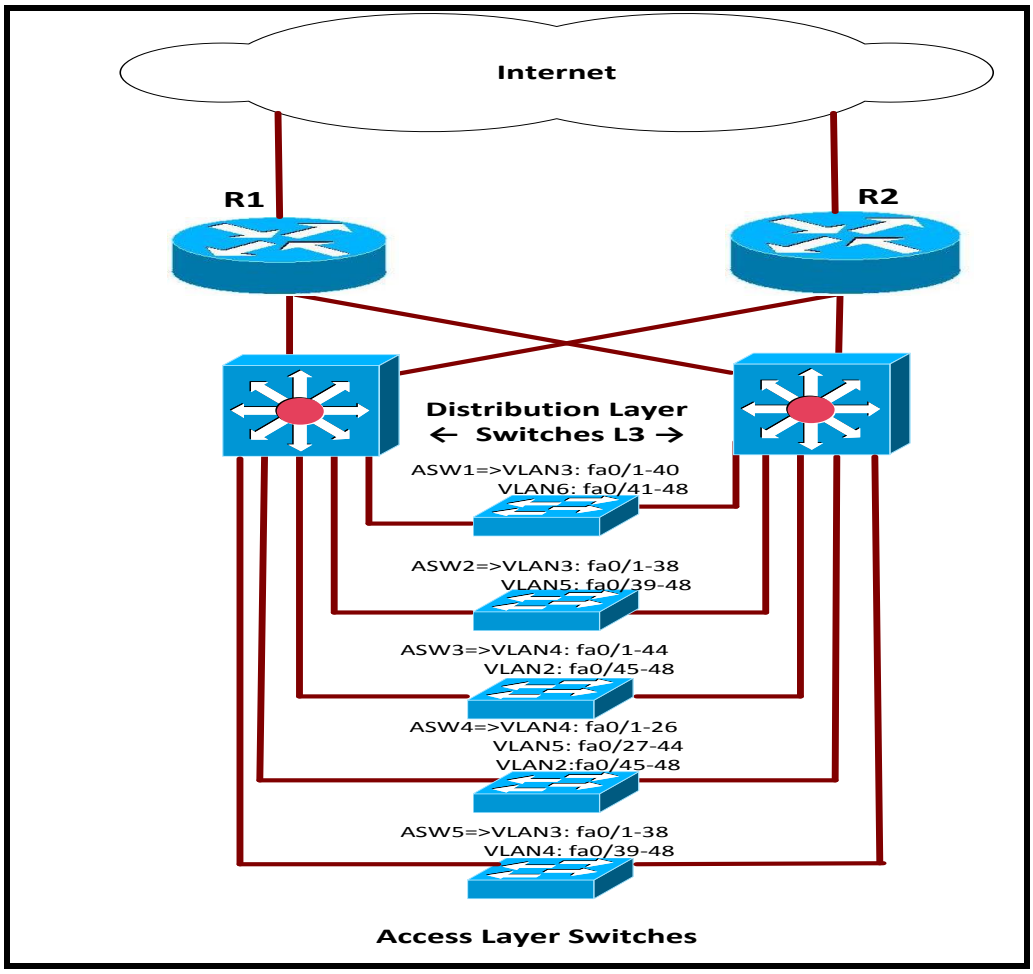


FIGURA N° 21: TOPOLOGÍA FÍSICA DEL DISEÑO DE RED

3.3.9 FUNCIONAMIENTO DE LA RED

3.3.9.1 CAPA DE ACCESO

Está conformado por 5 Switch que brindan acceso a los usuarios y a los Servidores de acuerdo a la asignación de VLAN configurada en cada puerto FastEthernet del Switch. Los switch de capa de acceso se encuentran directamente conectados a los 2

Switch de capa de distribución como enlaces Troncales de VLAN generando así enlaces redundantes.

Los enlaces redundantes en capa 2 podrían ocasionar bucles en la red que pueden perjudicar seriamente el rendimiento de la misma, por lo que se debe implementar el Protocolo Spanning Tree STP de una manera adecuada en los switch de capa de Acceso y distribución.

Las principales configuraciones que se aplicarán en los switch de capa de acceso son:

Habilitar los puertos que irán conectados a los host y servidores en modo acceso a las VLAN correspondientes.

Habilitar los puertos conectados a los switch de la siguiente capa en modo Troncal.

Seguridad de Puerto.

3.3.9.2 CAPA DE DISTRIBUCIÓN/NÚCLEO

El diseño de red a implementar se basa en un Diseño de Red Jerárquico de Núcleo Colapsado, esto significa que se unirán el núcleo y la capa de distribución en una sola capa, pero con la posibilidad de expandir o separar las dos capas debido a la flexibilidad del diseño.

Los equipos a usarse en esta etapa son Switch que operan en la capa 2 y 3 del modelo OSI, esto significa que se pueden implementar protocolos de Enrutamiento y direcciones IP en sus puertos.

3.3.9.3 Funciones Principales de los Switch de Capa 3.

a) Spanning tree Protocol: El Protocolo Spanning tree será configurado de la siguiente manera:

Las VLAN 2,3 y 4 se configurarán con un número de menor prioridad para el DSW1, es decir sólo trasladará tramas de las VLAN 2,3 y 4; las tramas de otras vlan serán filtradas.

Las VLAN 5,6 y 99(VLAN de administración) con un número de menor prioridad para el DSW2, es decir sólo trasladará tramas de las VLAN 4,5 y 6; las tramas de otras vlan serán filtradas.

Este procedimiento se realiza con el fin de que ambos switch trabajen para distintas VLAN y establecer el balanceo de carga en la etapa de distribución.

Comandos para la configuración de STP:

```
DSW1(config)# spanning-tree vlan 2 priority 4096
DSW1(config)# spanning-tree vlan 3 priority 4096
DSW1(config)# spanning-tree vlan 4 priority 4096
DSW1(config)# spanning-tree vlan 5 priority 8192
DSW1(config)# spanning-tree vlan 6 priority 8192
DSW1(config)# spanning-tree vlan 7 priority 8192
```

```
DSW2(config)# spanning-tree vlan 2 priority 8192
DSW2(config)# spanning-tree vlan 3 priority 8192
DSW2(config)# spanning-tree vlan 4 priority 8192
DSW2(config)# spanning-tree vlan 5 priority 4096
DSW2(config)# spanning-tree vlan 6 priority 4096
DSW2(config)# spanning-tree vlan 7 priority 4096
```

b) Inter-VLAN Routing: Permite la conectividad entre host de diferentes VLAN, se configura asignando una dirección IP a la interface VLAN de salida.

c) HSRP: Es un protocolo de primer salto que permite la implementación de un router virtual, con el fin de establecer la convergencia en la red en el caso que algún puerto de un router o el mismo equipo deje de funcionar, para este proceso se configuraran ambos switch capa 3, La dirección IP del router virtual se configura como la puerta de enlace predeterminada para las estaciones de trabajo de un segmento específico de IP.

DSW1: Se debe crear una IP para la puerta de enlace virtual a cada VLAN, para la VLAN 2,3 y 4 la prioridad es mayor, es decir DSW2 queda en Standby hasta que se interrumpa el enlace hacia DSW1.

DSW2: Para este equipo la prioridad es mayor para la VLAN 5,6 y 99 es decir DSW1 queda en Standby hasta que se interrumpa el enlace hacia DSW2.

Comandos para la configuración de Inter-VLAN y HSRP:

```
DSW1(config)# interface vlan 2
DSW1(config-if)# ip add 172.16.11.1 255.255.255.0
DSW1(config-if)#standby 2 ip 172.16.11.254
DSW1(config-if)#standby 2 priority 150
DSW1(config-if)#standby 2 preempt
DSW1(config-if)#exit

DSW2(config)# interface vlan 2
DSW2(config-if)#ip add 172.16.11.2 255.255.255.0
DSW2(config-if)#standby 2 ip 172.16.11.254
DSW2(config-if)#standby 2 priority 100
DSW2(config-if)#exit
```

NOTA: Se debe realizar el mismo criterio de configuración para cada VLAN.

d) Protocolo de Enrutamiento: El Protocolo de enrutamiento a utilizar será el EIGRP (Protocolo de routing de Gateway interior mejorado, su routing se mide por vetor distancia y su algoritmo es de actualización difusa (DUAL) garantizando así rutas de respaldp y sin bucles en todo el dominio routing.

3.3.9.4 ROUTER DE BORDE

Es el encargado de enviar los paquetes hacia la WAN, en el diseño se han considerado dos router debido que la Empresa requiere tener dos enlaces hacia el Internet y así garantizar la redundancia y la alta disponibilidad de la Red ante algún fallo o corte en la WAN. En estos equipos también se configurará el protocolo EIGRP para las redes que se conectan a los switch de capa 3 de la etapa Núcleo/Distrubución.

3.4 REVISIÓN Y CONSOLIDACIÓN DE RESULTADOS

En esta parte del Proyecto se probará el Diseño de Red propuesto para la Empresa Bata en un Software de simulación donde se implementarán los aspectos importantes y necesarios para garantizar el funcionamiento de la Red y poder visualizar como trabajará la Red completa.

Cabe resaltar que también estaremos limitados por algunas características del mismo software de simulación como el uso de los puertos de conexión a los equipos, aunque esto no influirá de una manera determinante a la generalización de los resultados debido que la Simulación de la Red a escala del Simulador mantendrá la misma esencia que la red real.

3.4.1 TOPOLOGÍA DE RED A ESCALA DEL SOFTWARE DE SIMULACIÓN

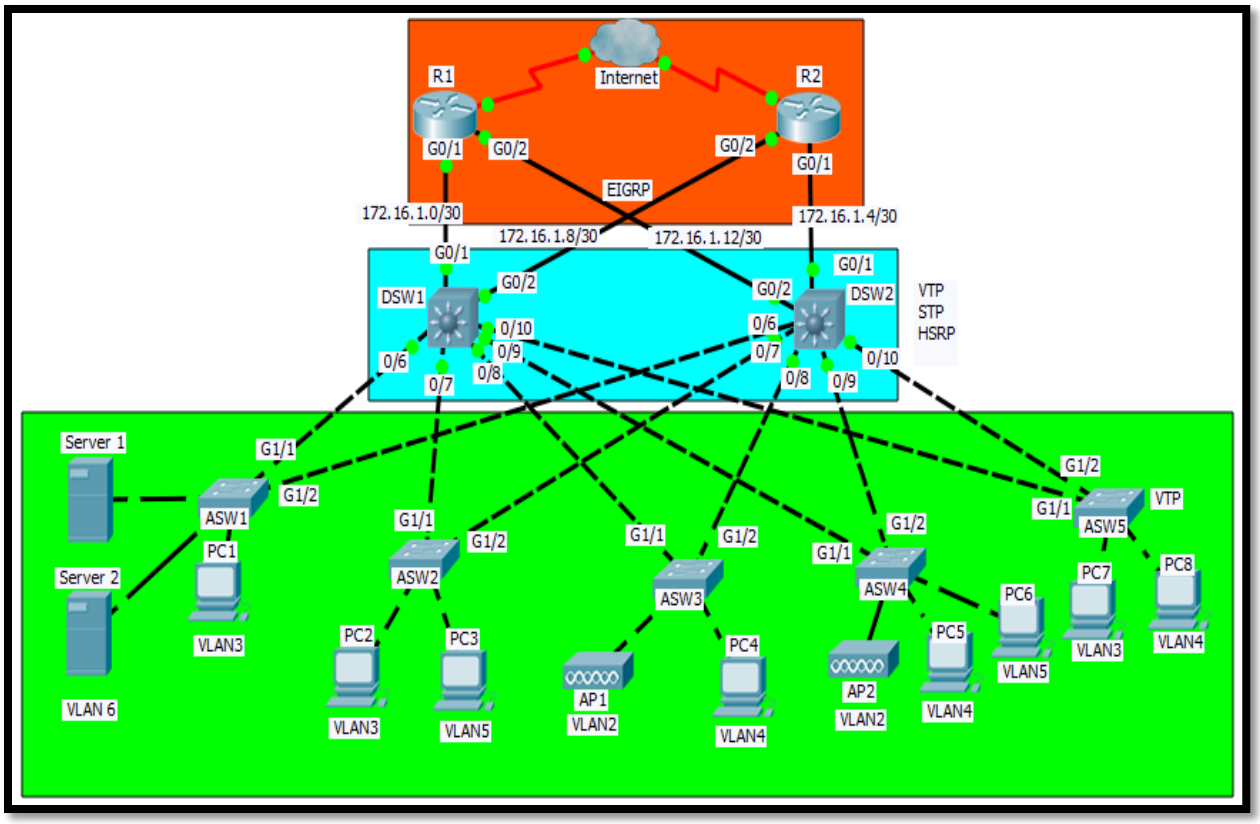


FIGURA N° 22: Diseño de Red Sobre el Software de Simulación

En la Figura N° 22 podemos visualizar el diseño a escala del Software Packet Tracer 6.2, (Software de simulación para redes de Cisco Systems), herramienta fundamental para la comprobar el correcto funcionamiento de la Red, podemos visualizar los equipos de red a usar según el modelo de red diseñado.

TABLA N° 11: ASIGNACIÓN DE DIRECCIONES IP

Dispositivo	Interfaz	Dirección IP	Máscara de subred	Gateway predeterminado
R1	G0/1	172.16.1.1	255.255.255.252	N/A
	G0/2	172.16.1.13	255.255.255.252	N/A
R2	G0/1	172.16.1.5	255.255.255.252	N/A
	G0/2	172.16.1.10	255.255.255.252	N/A
DSW1	G0/1	172.16.1.2	255.255.255.252	N/A
	G0/2	172.16.1.9	255.255.255.252	N/A
	VLAN 2	172.16.11.1	255.255.255.0	172.16.11.254
	VLAN 3	172.16.10.1	255.255.255.128	172.16.10.126
	VLAN 4	172.16.10.129	255.255.255.192	172.16.10.196
	VLAN 5	172.16.10.193	255.255.255.224	172.16.10.222
	VLAN 6	172.16.10.225	255.255.255.240	172.16.10.238
	VLAN 99	172.16.99.1	255.255.255.0	172.16.99.254
DSW2	G0/1	172.16.1.6	255.255.255.252	N/A
	G0/2	172.16.1.14	255.255.255.252	N/A
	VLAN 2	172.16.11.2	255.255.255.0	172.16.11.254
	VLAN 3	172.16.10.2	255.255.255.128	172.16.10.126
	VLAN 4	172.16.10.130	255.255.255.192	172.16.10.196
	VLAN 5	172.16.10.194	255.255.255.224	172.16.10.222
	VLAN 6	172.16.10.226	255.255.255.240	172.16.10.238
	VLAN 99	172.16.99.2	255.255.255.0	172.16.99.254
PC1	NIC	172.16.10.5	255.255.255.128	172.16.10.126
PC2	NIC	172.16.10.7	255.255.255.128	172.16.10.126
PC3	NIC	172.16.10.198	255.255.255.224	172.16.10.222
PC4	NIC	172.16.10.138	255.255.255.192	172.16.10.196
PC5	NIC	172.16.10.140	255.255.255.192	172.16.10.196
PC6	NIC	172.16.10.199	255.255.255.224	172.16.10.222
PC7	NIC	172.16.10.9	255.255.255.128	172.16.10.126
PC8	NIC	172.16.10.141	255.255.255.192	172.16.10.196
SERVER1	NIC	172.16.10.230	255.255.255.240	172.16.10.238
SERVER2	NIC	172.16.10.232	255.255.255.240	172.16.10.238

CONCLUSIONES

- Se logró diseñar un modelo de Red de Datos jerárquico bajo tecnología VLAN garantizando la eficiencia en la red, seguridad, fluidez en la conmutación de datos y escalabilidad de la Red.

- El Diseño e implementación de la Red de Datos Jerárquica permitió la interconexión entre ambos pisos del edificio usando la infraestructura de red de cableado estructurado adecuada en ambos pisos y además los equipos de Red que permitieron la interconexión de las diferentes áreas de trabajo.

- Se creó un Modelo de Red Jerárquico con buen rendimiento y fiabilidad, brindando una tecnología de red capaz de cumplir con todos los requerimientos de la Empresa como es la Escalabilidad, rendimiento y alta disponibilidad.

- Se estableció el diseño de red propuesto en función de su topología, tecnología y se utilizaron protocolos de comunicación necesarios para el diseño lógico de la Red.

- En el proceso de diseño se identificaron los riesgos en la red implementada y se dieron soluciones a problemas futuros usando correctamente los dispositivos de Red, el cableado adecuado para la interconexión y los protocolos necesarios para garantizar la fiabilidad de la Red.

- La creación de VLAN permitió establecer funciones de Seguridad, y capacidad en el envio del tráfico; además ayuda a tener un mejor control de la Red y evitar mitigaciones de Tráfico Broadcast innecesarios.

RECOMENDACIONES

- Para establecer y llevar a cabo el Diseño de Red por capas se debe considerar la ubicación geográfica de cada dispositivo o host, tamaño y ubicación de las oficinas de las distintas áreas para el despliegue del cableado y los equipos de Red a usar.

- Al momento hacer el diseño de red se deben usar equipos de red como Router y Switch del mismo fabricante para conservar las características técnicas del fabricante y compatibilidad además de asegurar el correcto despliegue de protocolos propietarios del Fabricante en la Red diseñada sin afectar la eficiencia e incompatibilidad de la Red.

- Se debe seguir las normas y Estándares para el despliegue del cableado Estructurado para garantizar la fiabilidad y eficacia de la Red.

- Se debe hacer uso de software de simulación de Red para observar el correcto funcionamiento de la Red antes de la implementación.

- El proceso del Direccionamiento IP y segmentación de la Red es un punto muy importante a considerar en la Red ya que depende de la cantidad de usuarios y la creación de nuevas VLAN cuando se implementen otras áreas.

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ANEXOS

DATASHEETS DE DISPOSITIVOS DE RED

FUENTE:

- CISCO

- APC

Cisco 1921 Series Integrated Services Routers

Product Names: CISCO 1921/K9, CISCO 1921-SEC/K9, and CISCO 1921DC/K9

Cisco® 1900 Series Integrated Services Routers (ISRs) build on 25 years of Cisco innovation and product leadership. The new platforms are architected to enable the next phase of branch-office evolution, providing rich-media collaboration to the branch office while maximizing operational cost savings. The Cisco Integrated Services Routers Generation 2 (ISR G2) platforms are future-enabled with multicore CPUs, Gigabit Ethernet switching with enhanced Power over Ethernet (PoE), and new energy monitoring and control capabilities that enhance overall system performance. Additionally, a new Cisco IOS® Software Universal image enables you to decouple the deployment of hardware and software, providing a stable technology foundation that can quickly adapt to evolving network requirements. Overall, the Cisco 1900 Series offers exceptional total cost of ownership (TCO) savings and network agility through the intelligent integration of market-leading security, unified communications, wireless, and application services.

Product Overview

The Cisco 1921 builds on the best-in-class offering of the Cisco 1841 Integrated Services Routers. All Cisco 1900 Series Integrated Services Routers offer embedded hardware encryption acceleration, optional firewall, intrusion prevention, and advanced security services. In addition, the platforms support the industry's widest range of wired and wireless connectivity options such as Serial, T1/E1, xDSL, Gigabit Ethernet, and third-generation (3G) wireless (Figure 1).

Figure 1. Cisco 1921 Integrated Services Router

Key Business Benefits

Cisco ISR G2 routers provide superior services integration and agility. Designed for scalability, the modular architecture of these platforms enables you to grow and adapt with your business needs. Table 1 lists the business benefits of the Cisco 1900.

Table 1. Key Features and Benefits of the Cisco 1921 Integrated Services Router

Service integration	• The Cisco 1921 offers increased levels of services integration with data, security, wireless, and mobility services, enabling greater efficiencies and cost savings.
Services on demand	• A single Cisco IOS Software Universal image is installed on each ISR G2. The Universal image contains all of the Cisco IOS Software technology sets that can be activated with a software license, allowing your business to quickly deploy advanced features without downloading a new Cisco IOS Software image. Additionally, larger default memory is included to support the new capabilities.
High performance with integrated services	• The Cisco 1900 Series enables deployment in high-speed WAN environments with concurrent services enabled up to 15 Mbps.

Benefits	Description
Network agility	• Designed to address customer business requirements, the Cisco 1921 with the modular architecture offers a performance range of modular interfaces and services as your network needs grow. • Modular interfaces offer increased bandwidth, a diversity of connection options, and network resiliency.
Energy efficiency	• The Cisco 1921 architecture provides energy-savings features that include the following: ◦ The Cisco 1900 Series offers intelligent power management and allows you to control power to the modules based on the time of day. Cisco EnergyWise technology will be supported in the future. ◦ Services integration and modularity on a single platform performing multiple functions optimizes raw-materials consumption and energy usage. ◦ Platform flexibility and ongoing development of both hardware and software capabilities lead to a longer product lifecycle, lowering all aspects of the TCO, including materials and energy use. ◦ High-efficiency power supplies are provided with each platform. ◦ DC Power option available (CISCO1921DC/K9).
Investment protection	• The Cisco 1921 maximizes investment protection: ◦ Reuse of a broad array of existing modules supported on the original ISRs provides a lower TCO. ◦ A rich set of Cisco IOS Software features is carried forward from the original ISRs and delivered in the Universal image. ◦ This router gives you the flexibility to grow as your business needs evolve.

Architecture and Modularity

The Cisco 1921 is architected to meet the application demands of today's branch offices with design flexibility for future applications. The modular architecture is designed to support expanding customer requirements, increased bandwidth, and fully integrated power distribution to modules supporting 802.3af PoE and Cisco Enhanced PoE (ePoE). Table 2 lists the architectural features and benefits of the Cisco 1921.

Table 2. Architectural Features and Benefits

Architectural Feature	Benefits
Modular platform	• The Cisco 1921 ISRs are highly modular platforms with multiple module slots to provide connectivity and services for varied branch-office network requirements. • The ISRs offer an industry-leading breadth of LAN and WAN connectivity options through modules to accommodate field upgrades to future technologies without requiring replacement of the platform.
Processors	• The Cisco 1921 is powered by high-performance multicore processors that support growing demands of branch-office networks by supporting high-throughput WAN requirements.
Embedded IP Security/Secure Sockets Layer (IPsec/SSL) VPN hardware acceleration	• Embedded hardware encryption acceleration is enhanced to provide higher scalability, which, combined with an optional Cisco IOS Security license, enables WAN link security and VPN services (both IPsec and SSL acceleration). • The onboard encryption hardware outperforms the advanced integration modules (AIMs) of previous generations.
Integrated Gigabit Ethernet ports	• All onboard LAN and WAN ports are 10/100/1000 Gigabit Ethernet routed ports.
Innovative universal-serial-bus (USB)-based console access	• A new, innovative, mini-Type B USB console port supports management connectivity when traditional serial ports are not available. • The traditional console and auxiliary ports are also available. You can use either the USB-based console or the RJ-45-based console port to configure the router.
Optional external power supply for distribution of PoE	• An optional upgrade to the power supply provides inline power (802.3af-compliant PoE) and Cisco Standard Inline Power to optional integrated switch modules.

Modularity Features and Benefits

The Cisco 1921 provides significantly enhanced modular capabilities (refer to Table 3) that offer you investment protection. Most of the modules available on previous generations of Cisco routers, such as the Cisco 1841 ISR, are supported on the Cisco 1921. Additionally, you can easily interchange modules used on the Cisco 1921 with other Cisco routers to provide maximum investment protection. Taking advantage of common interface cards across a network greatly reduces the complexity of managing inventory requirements, implementing large network

A complete list of supported modules is available at http://www.cisco.com/go/1921.

Table 3. Modularity Features and Benefits

Feature	Benefits
Cisco Enhanced High-Speed WAN Interface Card (EHWIC) 	• The EHWIC slot replaces the high-speed WAN interface card (HWIC) slot and can natively support HWICs, WAN interface cards (WICs), and voice/WAN interface cards (VWICs). • Two integrated EHWIC slots are available on the Cisco 1921 for flexible configurations for support of two modules: One doublewide HWIC-D or two singlewide EHWIC/HWIC modules are supported. • Each EHWIC slot offers high-data-throughput capability.
USB 2.0 ports	• One high-speed USB 2.0 port is supported. The USB port enables another mechanism for secure-token capabilities and storage.

Cisco IOS Software

The Cisco 1921 Integrated Services Routers deliver innovative technologies running on industry-leading Cisco IOS Software. Developed for wide deployment in the world's most demanding enterprise, access, and service provider networks, Cisco IOS Software Releases 15M and T support a comprehensive portfolio of Cisco technologies, including new functions and features delivered in Releases 12.4 and 12.4T, and new innovations that span multiple technology areas, including security, high availability, IP Routing and Multicast, quality of service (QoS), IP Mobility, Multiprotocol Label Switching (MPLS), VPNs, and embedded management.

Cisco IOS Software Licensing and Packaging

A single Cisco IOS Universal image encompassing all functions is delivered with the platforms. You can enable advanced features by activating a software license on the Universal image. In previous generations of access routers, these feature sets required you to download a new software image. Technology packages and feature licenses, enabled through the Cisco software licensing infrastructure, simplify software delivery and decrease the operational costs of deploying new features.

Four major technology licenses are available on the Cisco 1921 Integrated Services Routers; you can activate the licenses through the Cisco software activation process identified at http://www.cisco.com/go/sa.

- IP Base: This technology package is available as default
- Data
- Security (SEC) or Security with No Payload Encryption (SEC-NPE)

For additional information and details about Cisco IOS Software licensing and packaging on Cisco 1921 Integrated Services Routers, please visit http://www.cisco.com/go/1921.

Key Branch-Office Services

The industry-leading Cisco Integrated Services Routers offer unprecedented levels of services integration. Designed to meet the requirements of the branch office, these platforms provide a complete solution with security, mobility, and data services. Businesses enjoy the benefit by deploying a single device that meets all their needs and saves on capital and operational expenses.

Integrated Network Security for Data and Mobility

Security is essential to protect a business' intellectual property while also ensuring business continuity and providing the ability to extend the corporate workplace to employees who need anytime, anywhere access to company resources. As part of the architectural framework of the SAFE Blueprint from Cisco that allows organizations to identify, prevent, and adapt to network security threats, the Cisco 1900 Series ISRs facilitate secure business transactions and collaboration.

The Cisco IOS Software Security technology package license for the Cisco 1900 Series offers a wide array of common security features such as advanced application inspection and control, threat protection, and encryption architectures for enabling more scalable and manageable VPN networks in one solution set. The Cisco 1921 offers native hardware-based encryption acceleration to provide greater IPsec throughput with less overhead for the router processor when compared with software-based encryption solutions. Cisco ISRs offer a comprehensive and adaptable security solution for branch-office routers that include features such as:

- Secure connectivity: Achieve secure collaborative communications with Group Encrypted Transport VPN, Dynamic Multipoint VPN (DMVPN), or Enhanced Easy VPN.
- Integrated threat control: Respond to sophisticated network attacks and threats using Cisco IOS Firewall, Cisco IOS Zone-Based Firewall, Cisco IOS IPS, and Cisco ScanSafe Web Security and Flexible Packet Matching (FPM).
- Identity management: Intelligently protect endpoints using technologies such as authentication, authorization, and accounting (AAA) and public key infrastructure (PKI).

Detailed information about the security features and solutions supported on the Cisco 1900 Series routers is available at http://www.cisco.com/go/routersecurity.

Mobility Services

Wireless WAN

Cisco 3G wireless WAN (WWAN) modules combine traditional enterprise router functions such as remote management, advanced IP services such as voice over IP (VoIP), and security, with mobility capabilities of 3G WAN access. Using high-speed 3G wireless networks, routers can replace or complement existing landline infrastructure such as dialup, Frame Relay, and ISDN. Cisco 3G solutions support 3G standards High-Speed Packet Access (HSPA+) and Evolution Data Only/Evolution Data Optimized (EVDO), offering you a true multipath WAN backup and the ability to rapidly deploy primary WAN connectivity. For more information about 3G solutions on Cisco ISRs, please visit http://www.cisco.com/go/3g.

Integrated LAN Switching

The Cisco 1921 Integrated Services Router will support the EHWIC LAN modules when they become available in the future. The Cisco 1921 supports the existing singlewide Cisco EtherSwitch® HWIC and the doublewide HWIC-D modules, which greatly expand the capabilities of the router by integrating industry-leading Layer 2 switching.

Managing Your Integrated Services Routers

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. "Day-one device support" provides immediate manageability support for the ISR, enabling quick and easy deployment, monitoring, and troubleshooting from Cisco and third-party applications.

Organizations rely on Cisco, third-party, and in-house developed network management applications to achieve their operating expense (OpEx) and productivity goals. Underpinning those applications are the embedded management features available in every ISR. The new ISRs continue a tradition of broad and deep manageability features within the devices. Features such as Cisco IOS IP Service-Level Agreements (IP SLAs), Cisco IOS Embedded Event Manager (EEM), and NetFlow allow you to know what is going on in your network at all times. These features along with Simple Network Management Protocol (SNMP) and syslog support enable your organization's management applications.

Tables 4 through 6 give details about Cisco IOS software feature and protocol support, Cisco IOS software management capabilities, and Cisco Network Management applications for Cisco 1921 Integrated Services Routers.

Table 4. Cisco 1921 with Cisco IOS Software Feature and Protocol High-Level Support

Feature	Description
Protocols	IPv4, IPv6, static routes, Open Shortest Path First (OSPF), Enhanced IGRP (EIGRP), Border Gateway Protocol (BGP), BGP Router Reflector, Intermediate System-to-Intermediate System (IS-IS), Multicast Internet Group Management Protocol (IGMPv3) Protocol Independent Multicast sparse mode (PIM SM), PIM Source-Specific Multicast (SSM), Distance Vector Multicast Routing Protocol (DVMRP), IPsec, generic routing encapsulation (GRE), Bidirectional Forwarding Detection (BVD), IPv4-to-IPv6 Multicast, MPLS, Layer 2 Tunneling Protocol Version 3 (L2TPv3), 802.1ag, 802.3ah, and Layer 2 and Layer 3 VPN.
Encapsulations	Ethernet, 802.1q VLAN, Point-to-Point Protocol (PPP), Multilink Point-to-Point Protocol (MLPPP), Frame Relay, Multilink Frame Relay (MLFR) (FR.15 and FR.16), High-Level Data Link Control (HDLC), Serial (RS-232, RS-449, X.21, V.35, and EIA-530), Point-to-Point Protocol over Ethernet (PPPoE), and ATM.
Traffic management	QoS, Class-Based Weighted Fair Queuing (CBWFQ), Weighted Random Early Detection (WRED), Hierarchical QoS, Policy-Based Routing (PBR), Performance Routing (PfR), and Network-Based Application Recognition (NBAR).

For a more comprehensive list of features supported in Cisco IOS Software, refer to the Feature Navigator tool at: http://www.cisco.com/go/fn.

Table 5 highlights several ISR management capabilities that are available within Cisco IOS Software.

Table 5. Cisco IOS Software Management Capabilities

Feature	Description of Feature Supported by Cisco Integrated Services Routers
WSMA	The Web Services Management Agent (WSMA) defines a mechanism through which you can manage a network device, retrieve configuration data information, and upload and manipulate new configuration data. WSMA uses XML-based data encoding that is transported by the Simple Object Access Protocol (SOAP) for the configuration data and protocol messages.
EEM	Cisco IOS EEM is a distributed and customized approach to event detection and recovery offered directly in a Cisco IOS Software device. It offers the ability to monitor events and take informational, corrective, or any desired EEM action when the monitored events occur or when a threshold is reached.
IPSLA	Cisco IOS IP SLAs enable you to assure new business-critical IP applications, as well as IP services that use data, voice, and video, in an IP network.
SNMP, RMON, syslog, NetFlow, and TR-069	Cisco 1900 Series ISRs support SNMP, Remote Monitoring (RMON), syslog, NetFlow, and TR-069 in addition to the embedded management features previously mentioned.

Cisco Network Management Applications

The applications listed in Table 6 are standalone products that you can purchase or download to manage your Cisco network devices. The applications are built for the different operational phases; you can select the ones that best fit your needs.

Table 6. Network Management Solutions

Operational Phase	Application	Description
Device staging and configuration	Cisco Configuration Professional	• Cisco Configuration Professional is a GUI device-management tool for Cisco IOS Software-based access routers. This tool simplifies routing, firewall, IPS, VPN, unified communications, and WAN and LAN configuration through GUI-based easy-to-use wizards.
Networkwide deployment, configuration, monitoring, and troubleshooting	CiscoWorks LMS	• CiscoWorks LAN Management Solution (LMS) is a suite of integrated applications for simplifying day-to-day management of a Cisco end-to-end network, lowering OpEx while increasing network availability. CiscoWorks LMS offers network managers an easy-to-use web-based interface for configuring, administering, and troubleshooting the Cisco ISRs, using new instrumentation such as Cisco IOS EEM. • In addition to supporting basic platform services of the ISR, CiscoWorks also provides added-value support for the Cisco Services-Ready Engine (SRE) by enabling the management and distribution of software images to the SRE, thereby reducing the time and complexities associated with image management.
Networkwide staging, configuration, and compliance	CiscoWorks NCM	• CiscoWorks Network Compliance Manager (NCM) tracks and regulates configuration and software changes throughout a multivendor network infrastructure. It provides superior visibility into network changes and can track compliance with a broad variety of regulatory, IT, corporate governance, and technology requirements.
Security staging, configuration, and monitoring	Cisco Security Manager	• Cisco Security Manager is a leading enterprise-class application for managing security. It delivers provisioning of firewall, VPN, and intrusion-prevention-system (IPS) services across Cisco routers, security appliances, and switch service modules. The suite also includes the Cisco Security Monitoring, Analysis and Response System (Cisco Security MARS) for monitoring and mitigation.
Configuration and provisioning	Cisco Unified Provisioning Manager	• Cisco Unified Provisioning Manager provides a reliable and scalable web-based solution for managing a company's crucial next-generation communications services. It manages unified communications services in an integrated IP telephony, voicemail, and messaging environment.
Staging, deployment, and changes of licenses	Cisco License Manager	• Easily manage Cisco IOS Software activation and license management for a wide range of Cisco platforms running Cisco IOS Software as well as other operating systems with the secure client-server application Cisco License Manager.
Staging, deployment, and changes to configuration and image files	Cisco Configuration Engine	• Cisco Configuration Engine is a secure network management product that provides zero-touch image and configuration distribution through centralized, template-based management.

Summary and Conclusion

As businesses strive to lower the TCO in running their networks and increase their overall employee productivity with more centralized and collaborative network applications, more intelligent branch-office solutions are required. The Cisco 1921 offers these solutions by providing enhanced performance and increased modular density to support multiple services. The Cisco 1921 is designed to consolidate the functions of separate devices into a single, compact system that can be remotely managed. Table 7 gives specifications of the Cisco 1921.

Product Specifications

Table 7. Product Specifications of Cisco 1921 Integrated Services Router

	Cisco 1921 Integrated Services Router
Services and Slot Density	
Embedded hardware-based cryptography acceleration (IPsec + SSL)	Yes
RJ-45 onboard LAN/WAN 10/100/1000 ports	2
EHWIC slots	2
Doublewide EHWIC slots (use of a doublewide EHWIC slot will consume 2 EHWIC slots)	1
Cisco Integrated Services Module (ISM) slots	0
Memory (DDR2 DRAM): Default/maximum	512 MB/512 MB
USB flash memory (internal): Default/maximum	256 MB/256 MB
External USB flash-memory slots (Type A)	1
USB console port (mini-Type B) (up to 115.2 kbps)	1
Serial console port (up to 115.2 kbps)	1
Serial auxiliary port (up to 115.2 kbps	1
Integrated power supply	AC and DC power-supply models
Power-supply options	POE (external) - on AC models only
Redundant-power-supply support	No
Power Specifications	
AC input voltage	100-240V ~
AC input frequency	47-63 Hz
AC input current range AC power supply (maximum) (amps)	1.5-0.6
AC input surge current	<50A
Typical power (no modules)	25W
Maximum power capacity with AC power supply	60W
Maximum power capacity with PoE power supply (platform only)	70W
Maximum PoE device power capacity with PoE power supply	80W
DC power input	32-60 VDC, 4A, positive or negative, single source
DC input wire size	AWG 14 (2.0 mm2)
Safety ground-wire size	AWG 14 (2.0 mm2), minimum
Wire terminal (lug)	Amp/Tyco No.32957
Overcurrent protection	20A maximum
Physical Specifications	
Dimensions (H x W x D)	1.75 x 13.5 x 11.5 in. (4.45 x 34.29 x 29.21 cm)
Rack height	1 rack unit (1RU)
Rack-mount 19 in. (48.3 cm) EIA	Optional
Wall-mount (refer to installation guide for approved orientation)	Yes
Weight: With AC power supply (no modules)	6.75 lb
Weight: With PoE power supply (no modules)	7.5 lb
Airflow	Back to sides

	Cisco 1921 Integrated Services Router
Environmental Specifications	
Operating Conditions	
Temperature: 5906 ft (1800m) maximum altitude	32-104˚F (0-40˚C)
Temperature: 9843 ft (3000m) maximum altitude	32-77˚F (0-25˚C)
Altitude	10,000 ft (3,000m)
Humidity	10 to 85% relative humidity (RH)
Acoustic: Sound pressure (typical/maximum)	32.99/58.33 dBA
Acoustic: Sound power (typical/maximum)	41.99/67.22 dBA
Transportation and Storage Conditions	
Temperature	-40 to 158˚F (-40 to 70˚C)
Humidity	5 to 95% RH
Altitude	15,000 ft (4,570m)
Regulatory Compliance	
Safety	UL 60950-1 CAN/CSA C22.2 No. 60950-1 EN 60950-1 AS/NZS 60950-1 IEC 60950-1
EMC	47 CFR, Part 15 ICES-003 Class A EN55022 Class A CISPR22 Class A AS/NZS 3548 Class A VCCI V-3 EN 300-386 EN 61000 (Immunity) EN 55024, CISPR 24 EN50082-1
Telecom	TIA/EIA/IS-968 CS-03 ANSI T1.101 IEEE 802.3 RTTE Directive

Supported Modules

Cisco 1921 Integrated Services Routers support a wide range of modules that span industry-leading breadths of services at the branch office. Please refer to the following link for the list of modules supported on the Cisco 1900: http://www.cisco.com/en/US/products/ps10538/products_relevant_interfaces_and_modules.html.

Ordering Information

For more information about the Cisco 1900 Series, visit http://www.cisco.com/go/1921.

Table 8 gives ordering information for the Cisco 1921 Router; also refer to the Cisco Ordering Home Page. For information about how to order the Cisco 1900 Series, please visit the Cisco 1900 Series Ordering Guide. For additional product numbers, including the Cisco 1900 Series bundle offerings, please check the Cisco 1900 Series Integrated Services Router Price List or contact your local Cisco account representative.

Table 8. Cisco 1921 Basic Ordering Information

Product Number	Product Description
Cisco1921/K9	Cisco 1921 with 2 onboard GE, 2 EHW IC slots, 256MB USB Flash (internal) 512MB DRAM, IP Base Lic
Cisco1921-SEC/K9	Cisco 1921 with 2 onboard GE, 2 EHW IC slots, 256MB USB Flash (internal) 512MB DRAM, SEC Feature Lic
Cisco1921DC/K9	Cisco 1921 Modular Router DC Power,2GE,2EHWICslots,512MB, IP Base
C1921-AX/K9	Cisco 1921 Router, 256MB CF, 512MB DRAM, IP Base, SEC, AX
C1921-4G-V-SEC/K9	C1921 4G LTE 700MHz (B13) For Verizon Networks with security
Cisco1921-T1SEC/K9	Cisco 1921 SEC T1 bundle with HW IC-1DSU-T1, 256F/512D, IOS SEC Lic
C1921-VA/K9	Cisco 1921 ISR with EHW IC-VA-DSL-A bundle
C1921VAM/K9	Cisco 1921 ISR with Multimode EHW IC for VDSL/ADSL2+ Annex M
C1921-4SHDSL-EA/K9	Cisco 1921 4pair Double W ide EHW IC-4SHDSL-EA bundle, IP Base
PWR-1900-POE	POE Power Adapter for Cisco1921

To download the Cisco 1921 with Cisco IOS Software, go to Download Software, click "Router Software", and go to "Cisco ISR 1921 Integrated Services Router".

ISR Migration Options

Cisco 1900 Series Routers are included in the standard Cisco Technology Migration Program (TMP). Refer to http://www.cisco.com/go/TMP and contact your local Cisco account representative for program details.

Warranty Information

The Cisco 1900 Series Integrated Services Routers have a 1-year limited liability warranty.

Cisco and Partner Services for the Branch Office

Services from Cisco and our certified partners can help you reduce the cost and complexity of branch-office deployments. We have the depth and breadth of experience across technologies to architect a blueprint for a branch-office solution to meet your company's needs. Planning and design services align technology with business goals and can increase the accuracy, speed, and efficiency of deployment. Technical services help maintain operational health, strengthen software application functions, solve performance problems, and lower expenses. Optimization services are designed to continually improve performance and help your team succeed with new technologies. For more information, please visit http://www.cisco.com/go/services.

Cisco SMARTnet® technical support for the Cisco 1900 Series is available on a one-time or annual contract basis. Support options range from help-desk assistance to proactive, onsite consultation. All support contracts include:

- Major Cisco IOS Software updates in protocol, security, bandwidth, and feature improvements
- Full access rights to Cisco.com technical libraries for technical assistance, electronic commerce, and product information
- Access to the industry's largest dedicated technical support staff 24 hours a day

Cisco Catalyst 3560 Series Switches

Product Overview

The Cisco® Catalyst® 3560 Series is a line of fixed-configuration, enterprise-class switches that include IEEE 802.3af and Cisco prestandard Power over Ethernet (PoE) functionality in Fast Ethernet and Gigabit Ethernet configurations. The Cisco Catalyst 3560 is an ideal access layer switch for small enterprise LAN access or branch-office environments, combining both 10/100/1000 and PoE configurations for maximum productivity and investment protection while enabling the deployment of new applications such as IP telephony, wireless access, video surveillance, building management systems, and remote video kiosks. Customers can deploy networkwide intelligent services-such as advanced quality of service (QoS), rate limiting, access control lists (ACLs), multicast management, and high-performance IP routing-while maintaining the simplicity of traditional LAN switching. Available for the Cisco Catalyst 3560 Series at no charge, the Cisco Network Assistant is a centralized management application that simplifies the administration tasks for Cisco switches, routers, and wireless access points. Cisco Network Assistant provides configuration wizards that greatly simplify the implementation of converged networks and intelligent network services.

The Cisco Catalyst 3560 is part of a larger and more scalable family of Cisco Catalyst switches that includes the Cisco Catalyst 3560-E Series switches, the Cisco Catalyst 3750 and 3750-E Series switches with Cisco StackWise™ technology, and the Cisco Catalyst 4500 and Catalyst 6500 modular switches. United by Cisco IOS® Software, the entire family offers industry-leading availability, integrated security, optimized delivery, and manageability.

Configurations

The Cisco Catalyst 3560 Series comprises the following switches (refer to Figure 1):

Figure 1. Cisco Catalyst 3560 Switches

- Cisco Catalyst 3560-8PC: 8 Ethernet 10/100 ports with PoE and 1 dual-purpose 10/100/1000 and SFP port; compact form factor with no fan
- Cisco Catalyst 3560-12PC: 12 Ethernet 10/100 ports with PoE and 1 dual-purpose 10/100/1000 and SFP port; compact form factor with no fan
- Cisco Catalyst 3560-24TS: 24 Ethernet 10/100 ports and 2 Small Form-Factor Pluggable (SFP)-based Gigabit Ethernet ports; 1 rack unit (RU)

- Cisco Catalyst 3560-48TS: 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560-24PS: 24 Ethernet 10/100 ports with PoE and 2 SFP-based Gigabit Ethernet ports; 1 RU
- Cisco Catalyst 3560-48PS: 48 Ethernet 10/100 ports with PoE and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560G-24TS: 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560G-48TS: 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560G-24PS: 24 Ethernet 10/100/1000 ports with PoE and 4 SFP-based Gigabit Ethernet ports; 1RU
- Cisco Catalyst 3560G-48PS: 48 Ethernet 10/100/1000 ports with PoE and 4 SFP-based Gigabit Ethernet ports; 1RU

The Cisco Catalyst 3560 Series can be purchased with the IP Base or IP Services licenses pre-installed. The IP Base license offers advanced QoS, rate limiting, ACLs, and basic static and Routing Information Protocol (RIP) routing functions. The IP Services license provides a richer set of enterprise-class features, including advanced hardware-based IPv6 unicast and IPv6 Multicast routing as well as policy-based routing (PBR). The IP Services license upgrades Cisco Catalyst 3560 Series switches to include IPv6 routing support. Upgrade licenses are available to upgrade a switch from the IP Base license to the IP Services license.

The SFP-based GE ports accommodate a range of SFP transceivers, including the Cisco 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, and CWDM SFP transceivers. These ports also support the Cisco Catalyst 3560 SFP Interconnect Cable for establishing a low-cost Gigabit Ethernet point-to-point connection.

Power over Ethernet

The Cisco Catalyst 3560 Series can provide a lower total cost of ownership (TCO) for deployments that incorporate Cisco IP phones, Cisco Aironet® wireless LAN (WLAN) access points, or any IEEE 802.3af-compliant end device. PoE removes the need for wall power to each PoE-enabled device and eliminates the cost for additional electrical cabling that would otherwise be necessary in IP phone and WLAN deployments. The Cisco Catalyst 3560 8-port PoE and 24-port PoE configurations can support 8 and 24 simultaneous full-powered PoE ports at 15.4W for maximum powered-device support. The Cisco Catalyst 3560 12-port PoE can support 8 ports at 15.4W or 12 ports at 10W or any combination in between. Taking advantage of Cisco Catalyst Intelligent Power Management, the 48-port PoE configurations can deliver the necessary power to support 24 ports at 15.4W, 48 ports at 7.7W, or any combination in between. Maximum power availability for a converged voice and data network is attainable when a Cisco Catalyst 3560 switch is combined with the Cisco RPS 2300 Redundant Power System for transparent protection against internal power supply failures and an uninterruptible power supply (UPS) system to safeguard against power outages.

Gigabit Ethernet

At speeds of 1000 Mbps, Gigabit Ethernet provides the bandwidth to meet new and evolving network demands, alleviate bottlenecks, and boost performance while increasing the return on existing infrastructure investments. Today's workers are placing higher demands on networks,

running multiple, concurrent applications. For example, a worker joins a team conference call through an IP videoconference, sends a 10-MB spreadsheet to meeting participants, broadcasts the latest marketing video for the team to evaluate, and queries the customer-relationship-management database for the latest real-time feedback. Meanwhile, a multigigabyte system backup starts in the background and the latest virus updates are delivered to the client. The Cisco Catalyst 3560 provides a means to intelligently scale the network beyond 100 Mbps over existing Category 5 copper cabling and simultaneously support PoE for maximum productivity and investment protection.

Intelligence in the Network

Networks of today are evolving to address four new developments at the network edge:

- Increase in desktop computing power
- Introduction of bandwidth-intensive applications
- Expansion of highly sensitive data on the network
- Presence of multiple device types, such as IP phones, WLAN access points, and IP video cameras

These new demands are contending for resources with many existing mission-critical applications. As a result, IT professionals must view the edge of the network as critical to effectively manage the delivery of information and applications.

As companies increasingly rely on networks as the strategic business infrastructure, it is more important than ever to help ensure their high availability, security, scalability, and control. By adding Cisco intelligent functions for LAN access, customers can now deploy networkwide intelligent services that consistently address these requirements from the desktop to the core and through the WAN.

With Cisco Catalyst Intelligent Ethernet switches, Cisco Systems® helps enable companies to realize the full benefits of adding intelligent services into their networks. Deployment of capabilities that make the network infrastructure highly available to accommodate time-critical needs, scalable to accommodate growth, secure enough to protect confidential information, and capable of differentiating and controlling traffic flows is critical to further optimizing network operations.

Cisco EnergyWise Technology

Cisco EnergyWise is an innovative architecture, added to the Cisco Catalyst 3560 switches, promoting companywide sustainability by reducing energy consumption across an entire corporate infrastructure and affecting more than 50 percent of global greenhouse gas emissions created by worldwide building infrastructure, a much greater effect than the 2 percent generated by the IT industry. Cisco EnergyWise enables companies to measure the power consumption of network infrastructure and network-attached devices and manage power consumption with specific policies, reducing power consumption to realize increased cost savings, potentially affecting any powered device.

EnergyWise encompasses a highly intelligent network based approach to communicate messages that measure and control energy between network devices and endpoints. The network discovers Cisco EnergyWise manageable devices, monitors their power consumption, and takes action based on business rules to reduce power consumption. EnergyWise uses a unique domain-naming system to query and summarize information from large sets of devices, making it simpler than traditional network management capabilities. Cisco EnergyWise's management interfaces allow

facilities and network management applications to communicate with endpoints and each other using the network as a unifying fabric. The management interface uses standard SNMP or SSL to integrate Cisco and third-party management systems.

Cisco EnergyWise extends the network as a platform for power control plane for gathering, managing, and reducing power consumption of all devices, resulting in companywide optimized power delivery and reduced energy costs.

Enhanced Security

With the wide range of security features that the Cisco Catalyst 3560 Series offers, businesses can protect important information, keep unauthorized people off the network, guard privacy, and maintain uninterrupted operation.

Cisco Identity Based Networking Services (IBNS) provides authentication, access control, and security policy administration to secure network connectivity and resources. Cisco IBNS in the Cisco Catalyst 3560 Series prevents unauthorized access and helps ensure that users get only their designated privileges. It provides the ability to dynamically administer granular levels of network access. Using the 802.1x standard and the Cisco Access Control Server (ACS), users can be assigned a VLAN or an ACL upon authentication, regardless of where they connect to the network. This setup allows IT departments to enable strong security policies without compromising user mobility-and with minimal administrative overhead.

To guard against denial-of-service and other attacks, ACLs can be used to restrict access to sensitive portions of the network by denying packets based on source and destination MAC addresses, IP addresses, or TCP/UDP ports. ACL lookups are done in hardware, so forwarding performance is not compromised when implementing ACL-based security.

Port security can be used to limit access on an Ethernet port based on the MAC address of the device to which it is connected. It also can be used to limit the total number of devices plugged into a switch port, thereby protecting the switch from a MAC flooding attack as well as reducing the risks of rogue wireless access points or hubs.

With Dynamic Host Configuration Protocol (DHCP) snooping, DHCP spoofing can be thwarted by allowing only DHCP requests (but not responses) from untrusted user-facing ports. Additionally, the DHCP Interface Tracker (Option 82) helps enable granular control over IP address assignment by augmenting a host IP address request with the switch port ID. Building further on the DHCP snooping capabilities, IP address spoofing can be thwarted using Dynamic ARP Inspection and IP Source Guard.

The MAC Address Notification feature can be used to monitor the network and track users by sending an alert to a management station so that network administrators know when and where users entered the network. The Private VLAN feature isolates ports on a switch, helping ensure that traffic travels directly from the entry point to the aggregation device through a virtual path and cannot be directed to another port.

Secure Shell (SSH) Protocol Version 2, Kerberos, and Simple Network Management Protocol Version 3 (SNMPv3) encrypt administrative and network-management information, protecting the network from tampering or eavesdropping. TACACS+ or RADIUS authentication enables centralized access control of switches and restricts unauthorized users from altering the configurations. Alternatively, a local username and password database can be configured on the switch itself. Fifteen levels of authorization on the switch console and two levels on the Web-based

management interface provide the ability to give different levels of configuration capabilities to different administrators.

Availability and Scalability

The Cisco Catalyst 3560 Series is equipped with a robust set of features that allow for network scalability and higher availability through IP routing as well as a complete suite of Spanning Tree Protocol enhancements aimed to maximize availability in a Layer 2 network.

The Cisco Catalyst 3560 switches deliver high-performance, hardware-based IP routing. The Cisco Express Forwarding-based routing architecture allows for increased scalability and performance. This architecture allows for very high-speed lookups while also helping ensure the stability and scalability necessary to meet the needs of future requirements. In addition to dynamic IP unicast routing, the Cisco Catalyst 3560 Series is perfectly equipped for networks requiring multicast support. Protocol Independent Multicast (PIM) and Internet Group Management Protocol (IGMP) snooping in hardware make the Cisco Catalyst 3560 Series switches ideal for intensive multicast environments.

Implementing routed uplinks to the core improves network availability by enabling faster failover protection and simplifying the Spanning Tree Protocol algorithm by terminating all Spanning Tree Protocol instances at the aggregator switch. If one of the uplinks fails, quicker failover to the redundant uplink can be achieved with a scalable routing protocol such as Open Shortest Path First (OSPF) or Enhanced Interior Gateway Routing Protocol (EIGRP) rather than relying on standard Spanning Tree Protocol convergence. Redirection of a packet after a link failure using a routing protocol results in faster failover than a solution that uses Layer 2 spanning-tree enhancements. Additionally, routed uplinks allow better bandwidth use by implementing equal cost routing (ECR) on the uplinks to perform load balancing. Routed uplinks optimize the utility of uplinks out of the LAN Access by eliminating unnecessary broadcast data flows into the network backbone.

The Cisco Catalyst 3560 also offers dramatic bandwidth savings as a wiring-closet switch in a multicast environment. Using routed uplinks to the network core eliminates the requirement to transmit multiple streams of the same multicast from the upstream content servers to LAN access switches. For example, if three users are assigned to three separate VLANs and they all want to view multicast ABC, then three streams of multicast ABC must be transmitted from the upstream router to the wiring-closet switch-assuming the wiring-closet switch is not capable of routed uplinks. Deploying IP routing to the core with Cisco Catalyst 3560 switches allows users to create a scalable, multicast-rich network. The Cisco IP Services license offers IPv6 routing , including support for simultaneous IPv4 and IPv6 forwarding. IPv6 protocol support includes OSPFv3, and EIGRPv6. IPv6 management and MLD Snooping are supported on all Cisco Catalyst 3560 software images.

Enhancements to the standard Spanning Tree Protocol, such as Per-VLAN Spanning Tree Plus (PVST+), Uplink Fast, and PortFast, maximize network uptime. PVST+ allows for Layer 2 load sharing on redundant links to efficiently use the extra capacity inherent in a redundant design. Uplink Fast, PortFast, and BackboneFast all greatly reduce the standard 30- to 60-second Spanning Tree Protocol convergence time. Loop guard and bridge-protocol-data-unit (BPDU) guard provide Spanning Tree Protocol loop avoidance.

Advanced QoS

The Cisco Catalyst 3560 offers superior multilayer, granular QoS features to help ensure that network traffic is classified and prioritized, and that congestion is avoided in the best possible manner. Configuration of QoS is greatly simplified through automatic QoS (Auto QoS), a feature that detects Cisco IP phones and automatically configures the switch for the appropriate classification and egress queuing. This optimizes traffic prioritization and network availability without the challenge of a complex configuration.

The Cisco Catalyst 3560 can classify, reclassify, police, mark, queue, and schedule incoming packets, and can queue and schedule packets at egress. Packet classification allows the network elements to discriminate between various traffic flows and enforce policies based on Layer 2 and Layer 3 QoS fields.

To implement QoS, the Cisco Catalyst 3560 Series Switch first identifies traffic flows or packet groups, and classifies or reclassifies these groups using the Differentiated Services Code Point (DSCP) field or the 802.1p Class of Service (CoS) field. Classification and reclassification can be based on criteria as specific as the source or destination IP address, source or destination MAC address, or the Layer 4 TCP or UDP port. At the ingress, the Cisco Catalyst 3560 also polices to determine whether a packet is in or out of profile, marks to change the classification label, passes through or drops out of profile packets, and queues packets based on classification. Control- and data-plane ACLs are supported on all ports to help ensure proper treatment on a per-packet basis.

The Cisco Catalyst 3560 supports four egress queues per port, allowing the network administrator to be more discriminating and specific in assigning priorities for the various applications on the LAN. At egress, the switch performs scheduling and congestion control. Scheduling is an algorithm or process that determines the order in which the queues are processed. The Cisco Catalyst 3560 Series Switch supports shaped round robin (SRR) and strict priority queuing. The SRR algorithm helps ensure differential prioritization.

These QoS features allow network administrators to prioritize mission-critical and bandwidth-intensive traffic, such as enterprise resource planning (ERP) (Oracle, etc.), voice (IP telephony traffic), and computer-aided design (CAD) or computer-aided manufacturing (CAM) over less-time-sensitive applications such as FTP or e-mail. For example, it would be highly undesirable to have a large file download destined to one port on a wiring-closet switch and have quality implications such as increased latency in voice traffic destined to another port on this switch. This condition is avoided by making sure that voice traffic is properly classified and prioritized throughout the network. Other applications, such as Web browsing, can be treated as low priority and handled on a best-effort basis.

The Cisco Catalyst 3560 Series can perform rate limiting through its support of the Cisco Committed Information Rate (CIR) function. Through CIR, bandwidth can be guaranteed in increments as low as 8 kbps. Bandwidth can be allocated based on several criteria, including MAC source address, MAC destination address, IP source address, IP destination address, and TCP or UDP port number. Bandwidth allocation is essential when network environments require service-level agreements or when it is necessary for the network manager to control the bandwidth given to certain users.

Management

The new Cisco Express Setup feature simplifies the initial configuration of a switch. Users now have the option to set up the switch through a Web browser, eliminating the need for more complex terminal-emulation programs and knowledge of the command-line interface (CLI). Cisco Express Setup reduces the cost of deployment by helping less-skilled personnel quickly and simply set up switches.

Cisco Network Assistant is a PC-based network-management application optimized for LANs of small and medium-sized businesses with up to 250 users. Cisco Network Assistant offers centralized management of Cisco switches, routers, and WLAN access points. It supports a wide range of Cisco Catalyst intelligent switches from Cisco Catalyst 2950 through Cisco Catalyst 4506. Through a user-friendly GUI, users can configure and manage a wide array of switch functions and start the device manager of Cisco routers and Cisco wireless access points. A few mouse clicks enable the Cisco recommended security, availability, and QoS features without the need to consult a detailed design guide. The Security wizard automatically restricts unauthorized access to servers with sensitive data. Smartports and wizards save hours of time for network administrators, eliminate human errors, and help ensure that the configuration of the switch is optimized for these applications. Available at no cost, Cisco Network Assistant can be downloaded from Cisco.com.

In addition to the Cisco Network Assistant, the Cisco Catalyst 3560 Series switches provide for extensive management using SNMP network-management platforms such as CiscoWorks LAN Management Solution (LMS). LMS is a suite of powerful management tools that simplify the configuration, administration, monitoring, and troubleshooting of Cisco networks. It integrates these capabilities into a world-class solution for improving the accuracy and efficiency of your operations staff, while increasing the overall availability of your network. LMS supports over 400 different device types providing:

- Network discovery, topology views, end-station tracking, and VLAN management
- Real-time network fault analysis with easy-to-deploy device specific best-practice templates
- Hardware and software inventory management, centralized configuration tools, and syslog monitoring
- Network response time and availability monitoring and tracking
- Real-time device, link, and port traffic management, analysis, and reporting

Cisco Catalyst 3560 SFP Interconnect Cable

The Cisco Catalyst 3560 SFP Interconnect Cable (see Figure 2) provides for a low-cost point-to-point Gigabit Ethernet connection between Cisco Catalyst 3560 switches. The 50cm cable is an alternative to using SFP transceivers when interconnecting Cisco Catalyst 3560 switches through their SFP ports over a short distance.

Figure 2. Cisco Catalyst 3560 SFP Interconnect Cable

Table 1 gives the features and benefits of the Cisco Catalyst 3560 Series. Table 2 gives the hardware specifications, and Table 3 gives the power specifications. Table 4 lists the management and standards support, and Table 5 provides the safety and compliance information.

Table 1. Features and Benefits of Cisco Catalyst 3560 Series

Feature	Benefit
Ease of Use and Deployment	• Cisco Express Setup simplifies initial configuration with a Web browser, eliminating the need for more complex terminal emulation programs and CLI knowledge. • IEEE 802.3af and Cisco prestandard PoE support comes with automatic discovery to detect a Cisco prestandard or IEEE 802.3af endpoint and provide the necessary power without any user configuration. • DHCP autoconfiguration of multiple switches through a boot server eases switch deployment. • Automatic QoS (Auto QoS) simplifies QoS configuration in voice-over-IP (VoIP) networks by issuing interface and global switch commands to detect Cisco IP phones, classify traffic, and enable egress queue configuration. • Autosensing on each 10/100 port detects the speed of the attached device and automatically configures the port for 10- or 100-Mbps operation, easing switch deployment in mixed 10- and 100-Mbps environments. • Autonegotiating on all ports automatically selects half- or full-duplex transmission mode to optimize bandwidth. • Dynamic Trunking Protocol (DTP) helps enable 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. • DHCP Server enables a convenient deployment option for the assignment of IP addresses in networks that do not have a dedicated DHCP server. • DHCP Relay allows a DHCP relay agent to broadcast DHCP requests to the network DHCP server. • IEEE 802.3z-compliant 1000BASE-SX, 1000BASE-LX/LH, 1000BASE-ZX, 1000BASE-T, and coarse wavelength-division multiplexing (CWDM) physical interface support through a field-replaceable SFP module provides unprecedented flexibility in switch deployment. • Support for the Cisco Catalyst 3560 SFP Interconnect Cable facilitates a low-cost, point-to-point gigabit connection between Cisco Catalyst 3560 Series switches. • The default configuration stored in Flash memory helps ensure that the switch can be quickly connected to the network and can pass traffic with minimal user intervention. • Automatic medium-dependent interface crossover (Auto-MDIX) automatically adjusts transmit and receive pairs if an incorrect cable type (crossover or straight-through) is installed on a 10/100 port. • Time Domain Reflectometry (TDR) to diagnose and resolve cabling problems on copper Ethernet 10/100/1000 ports.
Cisco EnergyWise	• Cisco EnergyWise for greenhouse gas emissions and operational cost optimization by measuring, reporting, and reducing energy consumption across the entire corporate infrastructure, well beyond the scope of IT.

Availability and Scalability	
Superior Redundancy for Fault Backup	• Cisco Uplink Fast and BackboneFast technologies help ensure quick failover recovery, enhancing overall network stability and reliability. • IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) provides rapid spanning-tree convergence independent of spanning-tree timers and the benefit of distributed processing. • Per-VLAN Rapid Spanning Tree Plus (PVRST+) allows rapid spanning-tree reconvergence on a per-VLAN spanning-tree basis, without requiring the implementation of spanning-tree instances. • Cisco Hot Standby Router Protocol (HSRP) is supported to create redundant, fail-safe routing topologies. • Command-switch redundancy enabled in Cisco Network Assistant software allows designation of a backup command switch that takes over cluster-management functions if the primary command switch fails. • Unidirectional Link Detection Protocol (UDLD) and Aggressive UDLD allow unidirectional links to be detected and disabled to avoid problems such as spanning-tree loops. • Switch port autorecovery (errdisable) automatically attempts to reenable a link that is disabled because of a network error. • Cisco RPS 2300 support provides superior internal power-source redundancy, resulting in improved fault tolerance and network uptime. • Equal cost routing (ECR) provides load balancing and redundancy. • Bandwidth aggregation up to 8 Gbps through Cisco Gigabit EtherChannel technology and up to 800 Mbps through Cisco Fast EtherChannel technology enhances fault tolerance and offers higher-speed aggregated bandwidth between switches and to routers and individual servers.
High-Performance IP Routing	• Cisco Express Forwarding hardware routing architecture delivers extremely high-performance IP routing. • Basic IP unicast routing protocols (static, RIPv1, RIPv2 and RIPng) are supported for small-network routing applications. • Advanced IP unicast routing protocols (OSPF, Interior Gateway Routing Protocol [IGRP], EIGRP, Border Gateway Protocol Version 4 [BGPv4] and IS-ISv4) are supported for load balancing and constructing scalable LANs. The IP Services license is required. • IPv6 routing capability (OSPFv3, EIGRPv6) is support. IP Services license is required. • Policy-Based Routing (PBR) allows superior control by enabling flow redirection regardless of the routing protocol configured. • Inter-VLAN IP routing provides for full Layer 3 routing between two or more VLANs. • Protocol Independent Multicast (PIM) for IP Multicast routing is supported, including PIM sparse mode (PIM-SM), PIM dense mode (PIM-DM), and PIM sparse-dense mode. The IP Services license is required. • Fallback bridging forwards non-IP traffic between two or more VLANs.
Integrated Cisco IOS Software Features for Bandwidth Optimization	• Per-port broadcast, multicast, and unicast storm control prevents faulty end stations from degrading overall systems performance. • IEEE 802.1d Spanning Tree Protocol support for redundant backbone connections and loop-free networks simplifies network configuration and improves fault tolerance. • PVST+ allows for Layer 2 load sharing on redundant links to efficiently use the extra capacity inherent in a redundant design. • IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) allows a spanning-tree instance per VLAN, enabling Layer 2 load sharing on redundant links. • ECR provides load balancing and redundancy. • VPN routing/forwarding (VRF)-Lite enables a service provider to support two or more VPNs, with overlapping IP addresses. • Local Proxy Address Resolution Protocol (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 link. • VLAN Trunking Protocol (VTP) pruning limits bandwidth consumption on VTP trunks by flooding broadcast traffic only on trunk links required to reach the destination devices. • Internet Group Management Protocol v3 (IGMP) Snooping for IPv4 and IPv6 MLD v1 and v2 Snooping provide fast client joins and leaves of multicast streams and limits bandwidth-intensive video traffic to only the requestors. • IGMP filtering provides multicast authentication by filtering out nonsubscribers and limits the number of concurrent multicast streams available per port. • Multicast VLAN registration (MVR) continuously sends multicast streams in a multicast VLAN while isolating the streams from subscriber VLANs for bandwidth and security reasons.

QoS and Control	
Advanced QoS	• Standard 802.1p CoS and DSCP field classification are provided, using marking and reclassification on a per-packet basis by source and destination IP address, source and destination MAC address, or Layer 4 TCP or UDP port number. • Cisco control- and data-plane QoS ACLs on all ports help ensure proper marking on a per-packet basis. • Four egress queues per port enable differentiated management of up to four traffic types. • SRR scheduling helps ensure differential prioritization of packet flows by intelligently servicing the ingress and egress queues. • Weighted tail drop (WTD) provides congestion avoidance at the ingress and egress queues before a disruption occurs. • Strict priority queuing guarantees that the highest-priority packets are serviced ahead of all other traffic. • There is no performance penalty for highly granular QoS functions.
Granular Rate Limiting	• The Cisco Committed Information Rate (CIR) function guarantees 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 and UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps. • Asynchronous data flows upstream and downstream from the end station or on the uplink are easily managed using ingress policing and egress shaping. • Up to 64 aggregate or individual policers are available per Fast Ethernet or Gigabit Ethernet port.
Security	
Networkwide Security Features	• IEEE 802.1x allows dynamic, port-based security, providing user authentication. • IEEE 802.1x with VLAN assignment allows a dynamic VLAN assignment for a specific user regardless of where the user is connected. • IEEE 802.1x with voice VLAN permits an IP phone to access the voice VLAN irrespective of the authorized or unauthorized state of the port. • IEEE 802.1x and port security are provided to authenticate the port and manage network access for all MAC addresses, including those of the client. • IEEE 802.1x with an ACL assignment allows for specific identity-based security policies regardless of where the user is connected. • IEEE 802.1x with Guest VLAN allows guests without 802.1x clients to have limited network access on the guest VLAN. • Web authentication for non-802.1x clients allows non-802.1x clients to use an SSL-based browser for authentication. • Multi-Domain 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 Auth Bypass (MAB) for voice allows third-party IP phones without an 802.1x supplicant to get authenticated using their MAC address. • Cisco security VLAN ACLs (VACLs) on all VLANs prevent unauthorized data flows from being bridged within VLANs. • Cisco standard and extended IP security router ACLs (RACLs) define security policies on routed interfaces for control- and data-plane traffic. • Port-based ACLs (PACLs) for Layer 2 interfaces allow application of security policies on individual switch ports. • Unicast MAC filtering prevents the forwarding of any type of packet with a matching MAC address. • Unknown unicast and multicast port blocking allows tight control by filtering packets that the switch has not already learned how to forward. • SSHv2, Kerberos, and SNMPv3 provide network security by encrypting administrator traffic during Telnet and SNMP sessions. SSHv2, Kerberos, and the cryptographic version of SNMPv3 require a special cryptographic software image because of U.S. export restrictions. • Private VLAN Edge provides security and isolation between switch ports, helping ensure that users cannot snoop on other users' traffic. • Private VLANs restrict traffic between hosts in a common segment by segregating traffic at Layer 2, turning a broadcast segment into a nonbroadcast multi-access-like segment. • Bidirectional data support on the Switched Port Analyzer (SPAN) port allows the Cisco Secure Intrusion Detection System (IDS) to take action when an intruder is detected. • TACACS+ and RADIUS authentication enable centralized control of the switch and restrict unauthorized users from altering the configuration. • MAC address notification allows administrators to be notified of users added to or removed from the network. • Dynamic ARP Inspection (DAI) helps ensure user integrity by preventing malicious users from exploiting the insecure nature of the ARP protocol.

	• DHCP snooping allows administrators to help ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port. • 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. • DHCP Interface Tracker (Option 82) augments a host IP address request with the switch port ID. • Port security secures the access to an access or trunk port based on MAC address. • After a specific timeframe, the aging feature removes the MAC address from the switch to allow another device to connect to the same port. • Trusted Boundary provides the ability to trust the QoS priority settings if an IP phone is present and to disable the trust setting if the IP phone is removed, thereby preventing a malicious user from overriding prioritization policies in the network. • Multilevel security on console access prevents unauthorized users from altering the switch configuration. • The user-selectable address-learning mode simplifies configuration and enhances security. • BPDU Guard shuts down Spanning Tree Protocol 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. • IGMP filtering provides multicast authentication by filtering out nonsubscribers and limits the number of concurrent multicast streams available per port. • Dynamic VLAN assignment is supported through implementation of VLAN Membership Policy Server (VMPS) client functions to provide flexibility in assigning ports to VLANs. Dynamic VLAN helps enable the fast assignment of IP addresses. • Cisco Network Assistant software security wizards ease the deployment of security features for restricting user access to a server as well as to a portion of or the entire network. • Two thousand access control entries (ACEs) are supported.
Manageability	
Superior Manageability	• Cisco IOS CLI support provides a common user interface and command set with all Cisco routers and Cisco Catalyst desktop switches. • Cisco Discovery Protocol version 2 (CDPv2) allows the Cisco Catalyst 3560 Series Switch 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. • The PoE MIB provides proactive visibility into power usage and allows customers to set different power level thresholds. • Switching Database Manager templates for access, routing, and VLAN deployment scenarios allow the administrator to easily maximize memory allocation to the desired features based on deployment-specific requirements. • Generic On-Line Diagnostic (GOLD) checks the health of hardware components and verifies proper operation of the system data and control plane at run time and boot time. • VLAN trunks can be created from any port, using either standards-based 802.1Q tagging or the Cisco Inter-Switch Link (ISL) VLAN architecture. • Up to 1024 VLANs and up to 128 spanning-tree instances per switch are supported. • Four thousand VLAN IDs are supported. • Voice VLAN simplifies telephony installations by keeping voice traffic on a separate VLAN for easier administration and troubleshooting. • Cisco VTP supports dynamic VLANs and dynamic trunk configuration across all switches. • IGMPv3 snooping provides fast client joins and leaves of multicast streams and limits bandwidth-intensive video traffic to only the requestors. • Remote SPAN (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. • All nine RMON groups are supported through a SPAN port, which permits traffic monitoring of a single port, a group of ports from a single network analyzer or RMON probe. • Domain Name System (DNS) provides IP address resolution with user-defined device names. • 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.

	• Multifunction LEDs per port for port status; half-duplex and full-duplex mode; and 10BASE-T, 100BASE-TX, and 1000BASE-T indication as well as switch-level status LEDs for system, redundant power supply, and bandwidth use provide a comprehensive and convenient visual management system.
Cisco Network Assistant Software	• Cisco Network Assistant is a free, Windows-based application that simplifies the administration of networks of up to 250 users. It supports a wide range of Cisco Catalyst intelligent switches from Cisco Catalyst 2950 through Cisco Catalyst 4506. With Cisco Network Assistant, users can manage Cisco Catalyst switches plus launch the device managers of Cisco integrated services routers (ISRs) and Cisco Aironet WLAN access points. • The easy-to-use graphical interface provides both a topology map and front-panel view of the switch. • Cisco AVVID (Architecture for Voice, Video and Integrated Data) wizards need just a few user inputs to automatically configure the switch to optimally handle different types of traffic: voice, video, multicast, and high-priority data. • A security wizard is provided to restrict unauthorized access to applications, servers, and networks. • Upgrading the Cisco IOS Software on Cisco Catalyst switches is a simple matter of pointing and clicking, with one-click upgrades. • Cisco Network Assistant supports multilayer feature configurations such as routing protocols, ACLs, and QoS parameters. • Multidevice and multiport configuration capabilities allow administrators to save time by configuring features across multiple switches and ports simultaneously. • The user-personalized interface allows modification of polling intervals, table views, and other settings. • Alarm notification provides automated e-mail notification of network errors and alarm thresholds.
Cisco Express Setup	• Cisco Express Setup simplifies initial configuration of a switch through a Web browser, eliminating the need for more complex terminal emulation programs and CLI knowledge. • The Web interface helps less-skilled personnel quickly and simply set up switches, thereby reducing the cost of deployment.
CiscoWorks Support	• CiscoWorks network-management software provides management capabilities on a per-port and per-switch basis, providing a common management interface for Cisco routers, switches, and hubs. • SNMP v1, v2c, and v3 and Telnet interface support delivers comprehensive in-band management, and a CLI-based management console provides detailed out-of-band management. • Cisco Discovery Protocol Versions 1 and 2 help enable a CiscoWorks network-management station for automatic switch discovery. • The CiscoWorks LAN Management Solution supports the Cisco Catalyst 3560 Series.

Table 2. Cisco Catalyst 3560 Series Switch Hardware

Description	Specification
Performance	• 32 Gbps forwarding bandwidth • Forwarding rate based on 64-byte packets: • 38.7 Mpps (Cisco Catalyst 3560G-48TS, Catalyst 3560G-48PS, Catalyst 3560G-24TS, and Catalyst 3560G-24PS); • 13.1 Mpps (Cisco Catalyst 3560-48TS and Catalyst 3560-48PS); • 6.5 Mpps (Cisco Catalyst 3560-24TS and Catalyst 3560-24PS); • 3.2 Mpps (Cisco Catalyst 3560-12PC) • 2.7 Mpps (Cisco Catalyst 3560-8PC) • 128 MB DRAM • 32 MB Flash memory (Cisco Catalyst 3560G-24TS, Catalyst 3560G-24PS, Catalyst 3560G-48TS, Catalyst 3560G-48PS, Catalyst 3560-24TS, Catalyst 3560-48TS, and Catalyst 3560-8PC); • 16-MB Flash memory (Cisco Catalyst 3560-48PS and Catalyst 3560-24PS) • Configurable up to 12,000 MAC addresses • Configurable up to 11,000 unicast routes • Configurable up to 1000 IGMP groups and multicast routes • Configurable maximum transmission unit (MTU) of up to 9000 bytes, with a maximum Ethernet frame size of 9018 bytes (Jumbo frames), for bridging on Gigabit Ethernet ports, and up to 1546 bytes for bridging of Multiprotocol Label Switching (MPLS) tagged frames on 10/100 ports
Connectors and Cabling	• 10BASE-T ports: RJ-45 connectors, two-pair Category 3, 4, or 5 unshielded twisted-pair (UTP) cabling • 10BASE-T PoE ports: RJ-45 connectors, two-pair Category 3, 4, or 5 UTP cabling power pins 1,2 (negative) and 3,6 (positive)

	• 100BASE-TX ports: RJ-45 connectors, two-pair Category 5 UTP cabling • 100BASE-TX PoE ports: RJ-45 connectors, two-pair Category 5 UTP cabling, power on pins 1,2 (negative) and 3,6 (positive) • 1000BASE-T ports: RJ-45 connectors, four-pair Category 5 UTP cabling • 1000BASE-T SFP-based ports: RJ-45 connectors, four-pair Category 5 UTP cabling • 1000BASE-SX, -LX/LH, -ZX, and CWDM SFP-based ports: LC fiber connectors (single/multimode fiber) • Cisco Catalyst 3560 SFP Interconnect Cable: two-pair shielded cabling, 50 cm • Management console port: RJ-45-to-DB-9 cable for PC connections; for terminal connections, use RJ-45-to-DB-25 female data-terminal-equipment (DTE) adaptor (can be ordered separately from Cisco; part number ACS-DSBUASYN=)
Power Connectors	• Customers can provide power to a switch by using either the internal power supply or the Cisco RPS 2300. The connectors are located at the back of the switch. Note: The Cisco Catalyst 3560-8PC and Catalyst 3560-12PC do not have an RPS port. • Internal-Power-Supply Connector • The internal power supply is an autoranging unit. • The internal power supply supports input voltages between 100 and 240 VAC. • Use the supplied AC power cord to connect the AC power connector to an AC power outlet. • Cisco RPS Connector • The connector offers connection for an optional Cisco RPS 2300 that uses AC input and supplies DC output to the switch. • The connector supports up to six external network devices and provides power to two failed devices at a time. • The connector automatically senses when the internal power supply of a connected device fails and provides power to the failed device, preventing loss of network traffic. • Only the Cisco RPS 2300 (model PWR-RPS2300) should be attached to the redundant-power-supply receptacle.
Indicators	• Per-port status LEDs: Link integrity, disabled, activity, speed, full-duplex indications, PoE applied, PoE error, and PoE disabled indications • System-status LEDs: System, RPS, link status, link duplex, link speed, and PoE indications
Dimensions (H x W x D)	• Cisco Catalyst 3560-8PC: 1.73 x 10.6 x 9.1 in. (4.4 x 27 x 23 cm) • Cisco Catalyst 3560-12PC: 1.73 x 10.6 x 9.1 in. (4.4 x 27 x 23 cm) • Cisco Catalyst 3560-24TS: 1.73 x 17.5 x 11.8 in. (4.4 x 44.5 x 30 cm) • Cisco Catalyst 3560-48TS: 1.73 x 17.5 x 11.8 in. (4.4 x 44.5 x 30 cm) • Cisco Catalyst 3560-24PS: 1.73 x 17.5 x 11.8 in. (4.4 x 44.5 x 30 cm) • Cisco Catalyst 3560-48PS: 1.73 x 17.5 x 14.9 in. (4.4 x 44.5 x 37.8 cm) • Cisco Catalyst 3560G-24TS: 1.73 x 17.5 x 14.9 in. (4.4 x 44.5 x 37.8 cm) • Cisco Catalyst 3560G-48TS: 1.73 x 17.5 x 16.1 in. (4.4 x 44.5 x 40.9 cm) • Cisco Catalyst 3560G-24PS: 1.73 x 17.5 x 14.9 in. (4.4 x 44.5 x 37.8 cm) • Cisco Catalyst 3560G-48PS: 1.73 x 17.5 x 16.1 in. (4.4 x 44.5 x 40.9 cm)
Weight	• Cisco Catalyst 3560-8PC: 5 lb (2.3 kg) • Cisco Catalyst 3560-12PC: 5 lb (2.3 kg) • Cisco Catalyst 3560-24TS: 8.5 lb (3.9 kg) • Cisco Catalyst 3560-48TS: 9.1 lb (4.1 kg) • Cisco Catalyst 3560-24PS: 11.3 lb (5.1 kg) • Cisco Catalyst 3560-48PS: 13.2 lb (6.0 kg) • Cisco Catalyst 3560G-24TS: 12 lb (5.4 kg) • Cisco Catalyst 3560G-24PS: 13.5 lb (6.1 kg) • Cisco Catalyst 3560G-48TS: 14.0 lb (6.4 kg) • Cisco Catalyst 3560G-48PS: 15.5 lb (7.0 kg)
Environmental Ranges	• Operating temperature: 32 to 113ºF (0 to 45ºC) • Storage temperature: -13 to 158ºF (-25 to 70ºC) • Operating relative humidity: 10 to 85% (noncondensing) • Operating altitude: Up to 10,000 ft (3049m) • Storage altitude: Up to 15,000 ft (4573m)
Acoustic Noise	• ISO 7779: Bystander position operating to an ambient temperature of 25°C • Cisco Catalyst 3560-8PC: 0 dBa (no fan) • Cisco Catalyst 3560-12PC: 0 dBa (no fan) • Cisco Catalyst 3560-24TS: 42 dBa • Cisco Catalyst 3560-48TS: 42 dBa • Cisco Catalyst 3560-24PS: 42 dBa

	• Cisco Catalyst 3560-48PS: 42 dBa • Cisco Catalyst 3560G-24TS: 42 dBa • Cisco Catalyst 3560G-48TS: 48 dBa • Cisco Catalyst 3560G-24PS: 38-44 dBa • Cisco Catalyst 3560G-48PS: 52-58 dBa
Mean Time Between Failure (MTBF)	• Cisco Catalyst 3560-8PC: 367,586 hours • Cisco Catalyst 3560-12PC: 406,470 hours • Cisco Catalyst 3560-24TS: 326,100 hours • Cisco Catalyst 3560-48TS: 280,900 hours • Cisco Catalyst 3560-24PS: 224,100 hours • Cisco Catalyst 3560-48PS: 173,500 hours • Cisco Catalyst 3560G-24TS: 230,700 hours • Cisco Catalyst 3560G-24PS: 186,300 hours • Cisco Catalyst 3560G-48TS: 173,400 hours • Cisco Catalyst 3560G-48PS: 147,000 hours

Table 3. Power Specifications for Cisco Catalyst 3560 Series Switch

Description	Specification		
Power Supply Rated Maximum	• 204W (Cisco Catalyst 3560-8PC, Catalyst 3560-12PC) • Dissipated power: 80W, 273 BTUs per hour • PoE: 124W • 45W (Cisco Catalyst 3560-24TS) • 485W (Cisco Catalyst 3560-24PS) • Dissipated power: 115W, 393 BTUs per hour • PoE: 370W • 65W (Cisco Catalyst 3560-48TS) • 530W (Cisco Catalyst 3560-48PS) • Dissipated power: 160W, 546 BTUs per hour • PoE: 370W • 100W (Cisco Catalyst 3560G-24TS) • 540W (Cisco Catalyst 3560G-24PS) • Dissipated power: 170W, 534 BTUs per hour • PoE: 370W • 160W (Cisco Catalyst 3560G-48TS) • 590W (Cisco Catalyst 3560G-48PS) • Dissipated power: 220W, 690 BTUs per hour • PoE: 370W		
Measured 100% Throughput Power Consumption	**Cisco Catalyst 3560 Series**	**Switch Power**	**Total Output BTU**
	3560-8PC	19W	64 BTU/hour
	3560-12PC	22W	73 BTU/hour
	3560-24TS	27W	89 BTU/hour
	3560-48TS	45W	153 BTU/hour
	3560-24PS	43W	144 BTU/hour
	3560-48PS	86W	293 BTU/hour
	3560G-24TS	74W	249 BTU/hour
	3560G-24PS	96W	325 BTU/hour
	3560G-48TS	124W	422 BTU/hour
	3560G-48PS	130W	443 BTU/hour
Measured 5% Throughput Power Consumption	**Cisco Catalyst 3560 Series**	**Switch Power**	**Total Output BTU**
	3560-8PC	18W	60 BTU/hour
	3560-12PC	20W	68 BTU/hour
	3560-24TS	24W	82 BTU/hour
	3560-48TS	41W	138 BTU/hour
	3560-24PS	40W	134 BTU/hour

	3560-48PS	72W		245 BTU/hour
	3560G-24TS	66W		225 BTU/hour
	3560G-24PS	86W		293 BTU/hour
	3560G-48TS	113W		386 BTU/hour
	3560G-48PS	123W		418 BTU/hour
Measured 100% Throughput Power Consumption (with maximum possible PoE loads)	**Cisco Catalyst 3560 Series**	**Switch Power**	**PoE Power**	**Total Output BTU**
	3560-8PC	145W	124W	70 BTU/hour
	3560-12PC	145W	124W	72 BTU/hour
	3560-24PS	449W	370W	267 BTU/hour
	3560-48PS	483W	370W	383 BTU/hour
	3560G-24PS	496W	370W	429 BTU/ hour
	3560G-48PS	534W	370W	559 BTU/hour
Measured 5% Throughput Power Consumption (with 50% PoE loads)	**Cisco Catalyst 3560 Series**	**Switch Power**	**PoE Power**	**Total Output BTU**
	3560-8PC	82W	62W	69 BTU/hour
	3560-12PC	86W	63W	76 BTU/hour
	3560-24PS	247W	188W	197 BTU/hour
	3560-48PS	275W	184W	311 BTU/hour
	3560G-24PS	287W	186W	345 BTU/ hour
	3560G-48PS	328W	189	474 BTU/hour
AC Input Voltage and Current	• 100-240 VAC (autoranging), 2.5-1.3A, 50-60 Hz (Cisco Catalyst 3560-8PC) • 100-240 VAC (autoranging), 2.5-1.3A, 50-60 Hz (Cisco Catalyst 3560-12PC) • 100-240 VAC (autoranging), 450-190mA, 50-60 Hz (Cisco Catalyst 3560-24TS) • 100-240 VAC (autoranging), 650-270mA, 50-60 Hz (Cisco Catalyst 3560-48TS) • 100-240 VAC (autoranging), 5.5-2.8A, 50-60 Hz (Cisco Catalyst 3560-24PS and Catalyst 3560-48PS) • 100-240 VAC (autoranging), 3.0-1.5A, 50-60Hz (Cisco Catalyst 3560G-24TS and Catalyst 3560G-48TS) • 100-240 VAC (autoranging), 8.0-4.0A, 50-60Hz (Cisco Catalyst 3560G-24PS and Catalyst 3560G-48PS)			
Power Rating	• Cisco Catalyst 3560-8PC: 0.2 kVA • Cisco Catalyst 3560-12PC: 0.2 kVA • Cisco Catalyst 3560-24TS: 0.075 kVA • Cisco Catalyst 3560-48TS: 0.110 kVA • Cisco Catalyst 3560-24PS: 0.485 kVA • Cisco Catalyst 3560-48PS: 0.530 kVA • Cisco Catalyst 3560G-24TS: 0.10 kVA • Cisco Catalyst 3560G-48TS: 0.16 kVA • Cisco Catalyst 3560G-24PS: 0.52 kVA • Cisco Catalyst 3560G-48PS: 0.56 kVA			
DC Input Voltages (RPS Input)	• +12V at 5A (Cisco Catalyst 3560-24TS and Catalyst 3560-48TS); 7.5A (Cisco Catalyst 3560-24PS and Catalyst 3560-48PS); 10.5A (Cisco Catalyst 3560G-24TS); 17.5A (Cisco Catalyst 3560G-48TS); 14A (Cisco Catalyst 3560G-24PS and Catalyst 3560G-48PS) • -48V at 7.8A (PoE switches)			
PoE	• Maximum power supplied per port: 15.4W • Total power dedicated to PoE: 370W • Total power dedicated to PoE: 124W (Cisco Catalyst 3560-8PC, Catalyst 3560-12PC)			

Note:

Disclaimer: All power consumption numbers were measured under controlled laboratory conditions and are provided as an estimate.

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 the actual power consumption as a significant portion of PoE loads are dissipated in the endpoints.

Non-PoE Power Consumption

100 Percent Throughput Switch Power Consumption

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. Typically such power draws are only seen when encountering a 100 percent traffic load made up entirely of 64-byte packets on the switch and the uplinks.

5 Percent Throughput Switch Power Consumption

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load on the switch and its uplinks.

PoE Power Consumption

100 Percent Throughput Switch Power Consumption (no PoE loads)

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. Typically such power draws are only seen when encountering a 100 percent traffic load made up entirely of 64-byte packets with no PoE loads on the switch and uplinks.

Measured 5 Percent Throughput Switch Power Consumption (no PoE loads)

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load on the switch and its uplinks

100 Percent Throughput Switch Power Consumption (with maximum PoE loads)

The numbers indicate the power consumed by a typical system (the switch and the corresponding PoE loads) under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. Typically this power draw is realized when a switch is running 100 percent traffic load of 64 byte sized packets on all its ports and uplinks and also drawing 100 percent PoE load .

5 Percent Throughput Switch Power Consumption (with 50 percent PoE loads).

The numbers indicate the power consumed by a typical system (the switch and the corresponding PoE loads) under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load and 50 percent PoE load on the switch and its uplinks.

Table 4. Management and Standards Support for Cisco Catalyst 3560 Series Switch

Description	Specification	
Management	• BRIDGE-MIB • CISCO-CDP-MIB • CISCO-CLUSTER-MIB • CISCO-CONFIG-MAN-MIB • CISCO-ENTITY-FRU-CONTROL-MIB • CISCO-ENVMON-MIB • CISCO-FLASH-MIB • CISCO-FTP-CLIENT-MIB • CISCO-HSRP-MIB • CISCO-HSRP-EXT-MIB • CISCO-IGMP-FILTER-MIB • CISCO-IMAGE-MIB • CISCO-IP-STAT-MIB • CISCO-L2L3-INTERFACE-CONFIG-MIB • CISCO-MAC-NOTIFICATION-MIB • CISCO-MEMORY-POOL-MIB • CISCO-PAGP-MIB • CISCO-PING-MIB • CISCO-PROCESS-MIB • CISCO-RTTMON-MIB • CISCO-STP-EXTENSIONS-MIB • CISCO-SYSLOG-MIB • CISCO-TCP-MIB • CISCO-VLAN-IFTABLE-RELATIONSHIP-MIB • CISCO-VLAN-MEMBERSHIP-MIB	• CISCO-VTP-MIB • ENTITY-MIB • ETHERLIKE-MIB • IF-MIB • IGMP-MIB • IPMROUTE-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 • OSPF-MIB (RFC 1253) • PIM-MIB • RFC1213-MIB • RFC1253-MIB • RMON-MIB • RMON2-MIB • SNMP-FRAMEWORK-MIB • SNMP-MPD-MIB • SNMP-NOTIFICATION-MIB • SNMP-TARGET-MIB • SNMPv2-MIB • TCP-MIB • UDP-MIB
Standards	• IEEE 802.1s • IEEE 802.1w • IEEE 802.1x • IEEE 802.3ad • IEEE 802.3af • 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	• 1000BASE-X (SFP) • 1000BASE-SX • 1000BASE-LX/LH • 1000BASE-ZX • 1000BASE-CWDM SFP 1470 nm • 1000BASE-CWDM SFP 1490 nm • 1000BASE-CWDM SFP 1510 nm • 1000BASE-CWDM SFP 1530 nm • 1000BASE-CWDM SFP 1550 nm • 1000BASE-CWDM SFP 1570 nm • 1000BASE-CWDM SFP 1590 nm • 1000BASE-CWDM SFP 1610 nm • RMON I and II standards • SNMPv1, SNMPv2c, and SNMPv3

Table 5. Safety and Compliance

Description	Specification
Safety Certifications	• UL 60950-1, First Edition • CUL to CAN/CSA 22.2 No. 60950-1, First Edition • TUV/GS to EN 60950-1, First Edition • CB to IEC 60950-1 with all country deviations • AS/NZS 60950-1, First Edition • NOM (through partners and distributors) • CE Marking
Electromagnetic Emissions Certifications	• FCC Part 15 Class A • EN 55022 Class A (CISPR22) • EN 55024 (CISPR24) • AS/NZS CISPR22 Class A • CE • CNS 13438 Class A

	• MIC • GOST • China EMC Certifications
Telco	Common Language Equipment Identifier (CLEI) code
Warranty	Limited lifetime warranty

Cisco Services for Access Switching

Cisco and our partners can help you create a robust, dependable Cisco Access Switching solution. The Cisco lifecycle approach to services defines the requisite activities at each phase of the solution lifecycle. Assessments help align your solution to business goals and gauge readiness to support new technology. Effective planning and design expedite solution adoption. Award-winning technical support increases operational efficiency, and optimization improves performance, resiliency, stability, and predictability and prepares your network and teams for change. For more information, visit http://www.cisco.com/go/services.

Table 6. Cisco Services and Support Programs

Service and Support	Features	Benefits
Advanced Services		
• Cisco Total Implementation Solutions (TIS), available direct from Cisco • Cisco Packaged TIS, available through resellers • Cisco SMARTnet® and SMARTnet Onsite support, available direct from Cisco • Cisco Packaged SMARTnet support program, available through resellers	• Project management • Site survey, configuration, and deployment • Installation, text, and cutover • Training • Major moves, adds, and changes • Design review and product staging • Access to software updates 24 hours • Web access to technical repositories • Telephone support through the Cisco Technical Assistance Center (TAC) • Advance Replacement of hardware parts	• Supplements existing staff • Helps ensure that functions meet needs • Mitigates risk • Helps enable proactive or expedited issue resolution • Lowers TCO by taking advantage of Cisco expertise and knowledge • Minimizes network downtime

Ordering Information

Table 7 gives ordering information for the Cisco Catalyst 3560 Series switches.

Table 7. Ordering Information for Cisco Catalyst 3560 Series Switches

Part Numbers	Description
WS-C3560-8PC-S	• 8 Ethernet 10/100 ports and 1 dual-purpose 10/100/1000 and SFP port • Compact form-factor with no fan • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560-12PC-S	• 12 Ethernet 10/100 ports and 1 dual-purpose 10/100/1000 and SFP port • Compact form-factor with no fan • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560-24TS-S	• 24 Ethernet 10/100 ports and 2 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Base software feature set (IPB)
WS-C3560-24TS-E	• 24 Ethernet 10/100 ports and 2 SFP-based Gigabit Ethernet ports • RU fixed-configuration, multilayer switch

	• Enterprise-class intelligent services delivered to the network edge • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560-48TS-S	• 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Base software feature set (IPB)
WS-C3560-48TS-E	• 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560-24PS-S	• 24 Ethernet 10/100 ports and 2 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560-24PS-E	• 24 Ethernet 10/100 ports and 2 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560-48PS-S	• 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560-48PS-E	• 48 Ethernet 10/100 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560G-24TS-S	• 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Base software feature set (IPB)
WS-C3560G-24TS-E	• 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560G-48TS-S	• 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Base software feature set (IPB)
WS-C3560G-48TS-E	• 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560G-24PS-S	• 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard • IP Base software feature set (IPB)

WS-C3560G-24PS-E	• 24 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
WS-C3560G-48PS-S	• 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Base software feature set (IPB)
WS-C3560G-48PS-E	• 48 Ethernet 10/100/1000 ports and 4 SFP-based Gigabit Ethernet ports • 1RU fixed-configuration, multilayer switch • Enterprise-class intelligent services delivered to the network edge • IEEE 802.3af and Cisco prestandard Power over Ethernet • IP Services software feature set (IPS) • Provides full IPv6 dynamic routing
CD-3560G-EMI=	• IP Services License (formerly EMI) upgrade kit for IP Base versions of the Cisco Catalyst 3560G-24TS, Catalyst 3560G-24PS, Catalyst 3560G-48TS and Catalyst 3560G-48PS • Advanced IPv6 routing
CD-3560-EMI=	• IP Services License (formerly EMI) upgrade kit for IP Base versions of the Cisco Catalyst 3560-24PS, Catalyst 3560-48PS, Catalyst 3560-24TS, Catalyst 3560-48TS, and Catalyst 3560-8PC • Advanced IPv6 routing
PWR-RPS2300	Cisco RPS 2300 with one connector cable
RCKMNT-1RU=	Spare rack-mount kit for the Cisco Catalyst 3560
RCKMNT-REC-1RU=	1RU recessed rack-mount kit for the Cisco Catalyst 3560
RCKMNT-19-CMPCT=	Rack-mount kit for the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
CBLGRD-C3560-8PC=	Cable guard for the Cisco Catalyst 3560-8PC compact switch
CBLGRD-C3560-12PC=	Cable guard for the Cisco Catalyst 3560-12PC compact switch
GLC-LH-SM=	1000BASE-LX/LH SFP transceiver module for MMF and SMF, 1300-nm wavelength
GLC-SX-MM=	1000BASE-SX SFP transceiver module for MMF, 850-nm wavelength
GLC-ZX-SM=	1000BASE-ZX SFP transceiver module for SMF, 1550-nm wavelength
GLC-T=	1000BASE-T SFP transceiver module for Category 5 copper wire Not supported on the Cisco Catalyst 3560-8PC compact switch
GLC-BX-D=	1000BASE-BX10 SFP transceiver module for single strand SMF, 1490-nm TX / 1310-nm RX wavelength
GLC-BX-U=	1000BASE-BX10 SFP transceiver module for single strand SMF, 1310-nm TX / 1490-nm RX wavelength
GLC-GE-100FX=	• 100BASE-FX SFP transceiver module for Gigabit Ethernet ports, 1310 nm wavelength, 2 km over MMF • Not supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
GLC-FE-100FX=	• 100BASE-FX SFP transceiver module for 100-Mb ports, 1310 nm wavelength, 2 km over MMF • Only supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
GLC-FE-100LX=	• 100BASE-FX SFP transceiver module for 100-Mb ports, 1310 nm wavelength, 10 km over SMF • Only supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
GLC-FE-100BX-D=	• 100BASE-BX10-D SFP transceiver module for 100-Mb ports, 1550 nm TX /1310 nm RX wavelength, 10 km over single-strand SMF • Only supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches

GLC-FE-100BX-U=	• 100BASE-BX10-U SFP transceiver module for 100-Mb ports, 1310 nm TX/1550 nm RX wavelength, 10 km over single-strand SMF • Only supported on the Cisco Catalyst 3560-8PC and Catalyst 3560-12PC compact switches
CWDM-SFP-1470=	Cisco CWDM SFP 1470 nm; Gigabit Ethernet and 1G/2G FC (gray)
CWDM-SFP-1490=	Cisco CWDM SFP, 1490 nm; Gigabit Ethernet and 1G/2G FC (violet)
CWDM-SFP-1510=	Cisco CWDM SFP, 1510 nm; Gigabit Ethernet and 1G/2G FC (blue)
CWDM-SFP-1530=	Cisco CWDM SFP, 1530 nm; Gigabit Ethernet and 1G/2G FC (green)
CWDM-SFP-1550=	Cisco CWDM SFP, 1550 nm; Gigabit Ethernet and 1G/2G FC (yellow)
CWDM-SFP-1570=	Cisco CWDM SFP, 1570 nm; Gigabit Ethernet and 1G/2G FC (orange)
CWDM-SFP-1590=	Cisco CWDM SFP, 1590 nm; Gigabit Ethernet and 1G/2G FC (red)
DWDM-SFP-3033=	DWDM SFP 1530.33 nm SFP (100 GHz ITU grid)
DWDM-SFP-3112=	DWDM SFP 1531.12 nm SFP (100 GHz ITU grid)
DWDM-SFP-3190=	DWDM SFP 1531.90 nm SFP (100 GHz ITU grid)
DWDM-SFP-3268=	DWDM SFP 1532.68 nm SFP (100 GHz ITU grid)
DWDM-SFP-3425=	DWDM SFP 1534.25 nm SFP (100 GHz ITU grid)
DWDM-SFP-3504=	DWDM SFP 1535.04 nm SFP (100 GHz ITU grid)
DWDM-SFP-3582=	DWDM SFP 1535.82 nm SFP (100 GHz ITU grid)
DWDM-SFP-3661=	DWDM SFP 1536.61 nm SFP (100 GHz ITU grid)
DWDM-SFP-3819=	DWDM SFP 1538.19 nm SFP (100 GHz ITU grid)
DWDM-SFP-3898=	DWDM SFP 1538.98 nm SFP (100 GHz ITU grid)
DWDM-SFP-3977=	DWDM SFP 1539.77 nm SFP (100 GHz ITU grid)
DWDM-SFP-4056=	DWDM SFP 1540.56 nm SFP (100 GHz ITU grid)
DWDM-SFP-4214=	DWDM SFP 1542.14 nm SFP (100 GHz ITU grid)
DWDM-SFP-4294=	DWDM SFP 1542.94 nm SFP (100 GHz ITU grid)
DWDM-SFP-4373=	DWDM SFP 1543.73 nm SFP (100 GHz ITU grid)
DWDM-SFP-4453=	DWDM SFP 1544.53 nm SFP (100 GHz ITU grid)
CWDM-SFP-1610=	Cisco CWDM SFP, 1610 nm; Gigabit Ethernet and 1G/2G FC (brown)
CAB-SFP-50CM=	Cisco Catalyst 3560 SFP Interconnect Cable (50 dcm)
CAB-SM-LCSC-1M	1m-fiber single-mode LC-to-SC connectors
CAB-SM-LCSC-5M	5m-fiber single-mode LC-to-SC connectors

For more information about Cisco products, contact:

- United States and Canada: (toll free) 800 553-NETS (6387)
- Europe: 32 2 778 4242
- Australia: 612 9935 4107
- Other: 408 526-7209

World Wide Web URL: http://www.cisco.com

Cisco Catalyst 2960-S and 2960 Series Switches with LAN Base Software

Product Overview

The Cisco® Catalyst® 2960-S and 2960 Series Switches are the leading Layer 2 edge, providing improved ease of use, highly secure business operations, improved sustainability, and a borderless network experience. The Catalyst 2960-S Series Switches include new FlexStack switch stacking capability with 1 and 10 Gigabit connectivity, and Power over Ethernet Plus (PoE+) with the Cisco Catalyst 2960 Series Switches offering Fast Ethernet access connectivity and PoE capabilities. The Cisco Catalyst 2960-S and 2960 Series are fixed-configuration access switches designed for enterprise, midmarket, and branch office networks to provide lower total cost of ownership. The Cisco Catalyst 2960-S is shown in Figure 1, and the Cisco Catalyst 2960 Series Switches are shown in Figure 2.

What's new for the Cisco Catalyst 2960-S Series Switches with LAN Base Software:

- 10 and 1 Gigabit Ethernet uplink flexibility with Small Form-Factor Pluggable Plus (SFP+), providing business continuity and fast transition to 10 Gigabit Ethernet
- 24 or 48 ports of Gigabit Ethernet desktop connectivity
- Cisco FlexStack stacking module with 20 Gbps of throughput, allowing ease of operation with single configuration and simplified switch upgrade
- PoE+ with up to 30W per port that allows you to support the latest PoE+ capable devices
- Power supply options, with 740W or 370W fixed power supplies for PoE+ switches are available
- USB storage for file backup, distribution, and simplified operations
- A wide range of software features to provide ease of operation, highly secure business operations, sustainability, and a borderless network experience
- Limited lifetime hardware warranty, including next-business-day replacement with 90-day service and support

The Cisco Catalyst 2960 Series Switches with LAN Base Software offer the following:

- Dual-purpose uplinks for Gigabit Ethernet uplink flexibility, allowing use of either a copper or fiber uplink; each dual-purpose uplink port has one 10/100/1000 Ethernet port and one SFP-based Gigabit Ethernet port, with one port active at a time
- 24 or 48 ports of Fast Ethernet desktop connectivity
- PoE configurations with up to 15.4W per port
- A wide range of software features to provide ease of operation, highly secure business operations, sustainability, and a borderless networking experience
- Limited lifetime hardware warranty

Figure 1. Cisco Catalyst 2960-S Series Switches

Figure 2. Cisco Catalyst 2960 Series Switches

Switch Configurations

Table 1 shows the configuration information for the Catalyst 2960-S Series Switches with LAN Base Software, and Table 2 shows the configuration information for the Catalyst 2960 Series Switches with LAN Base Software.

Table 1. Configurations of Cisco Catalyst 2960-S Series Switches with LAN Base Software

Cisco Catalyst 2960-S Switch Model	Description	Uplinks	Available PoE Power
10 Gigabit Uplinks with 10/100/1000 Ethernet Connectivity			
Cisco Catalyst 2960S-48FPD-L	48 Ethernet 10/100/1000 PoE+ ports	2 Ten Gigabit Ethernet SFP+ or 2 One Gigabit Ethernet SFP ports	740W
Cisco Catalyst 2960S-48LPD-L	48 Ethernet 10/100/1000 PoE+ ports	2 Ten Gigabit Ethernet SFP+ or 2 One Gigabit Ethernet SFP ports	370W
Cisco Catalyst 2960S-24PD-L	24 Ethernet 10/100/1000 PoE+ ports	2 Ten Gigabit Ethernet SFP+ or 2 One Gigabit Ethernet SFP ports	370W
Cisco Catalyst 2960S-48TD-L	48 Ethernet 10/100/1000 ports	2 Ten Gigabit Ethernet SFP+ or 2 One Gigabit Ethernet SFP ports	-
Cisco Catalyst 2960S-24TD-L	24 Ethernet 10/100/1000 ports	2 Ten Gigabit Ethernet SFP+ or 2 One Gigabit Ethernet SFP ports	-
1 Gigabit Uplinks with 10/100/100 Ethernet Connectivity			
Cisco Catalyst 2960S-48FPS-L	48 Ethernet 10/100/1000 PoE+ ports	4 One Gigabit Ethernet SFP ports	740W
Cisco Catalyst 2960S-48LPS-L	48 Ethernet 10/100/1000 PoE+ ports	4 One Gigabit Ethernet SFP ports	370W
Cisco Catalyst 2960S-24PS-L	24 Ethernet 10/100/1000 PoE+ ports	4 One Gigabit Ethernet SFP ports	370W
Cisco Catalyst 2960S-48TS-L	48 Ethernet 10/100/1000 ports	4 One Gigabit Ethernet SFP ports	-
Cisco Catalyst 2960S-24TS-L	24 Ethernet 10/100/1000 ports	4 One Gigabit Ethernet SFP ports	-
Cisco Catalyst 2960S-STACK	Hot-swappable FlexStack stacking module	-	-
All models available with optional Cisco FlexStack stacking module. No DC power supplies are available.			

Table 2. Configurations of Cisco Catalyst 2960 Series Switches with LAN Base Software

Cisco Catalyst 2960 Switch Model	Description	Uplinks	Available PoE Power
1 Gigabit Uplinks with 10/100 Ethernet Connectivity			
Cisco Catalyst 2960-48PST-L	48 Ethernet 10/100 PoE ports	2 One Gigabit Ethernet SFP ports and 2 fixed Ethernet 10/100/1000 ports	370W
Cisco Catalyst 2960-24PC-L	24 Ethernet 10/100 PoE ports	2 dual-purpose ports (10/100/1000 or SFP)	370W
Cisco Catalyst 2960-24LT-L	24 Ethernet 10/100 ports	2 Ethernet 10/100/1000 ports	123W
Cisco Catalyst 2960-24TC-L	24 Ethernet 10/100 ports	2 dual-purpose ports	-
Cisco Catalyst 2960-48TC-L	48 Ethernet 10/100 ports	2 dual-purpose ports (10/100/1000 or SFP)	-
Cisco Catalyst 2960-24TT-L	24 Ethernet 10/100 ports	2 Ethernet 10/100/1000 ports	-
Cisco Catalyst 2960-48TT-L	48 Ethernet 10/100 ports	2 Ethernet 10/100/1000 ports	-
1 Gigabit Uplinks with 10/100/1000 Ethernet Connectivity			
Cisco Catalyst 2960G-24TC-L	24 Ethernet 10/100/1000 ports, 4 of which are dual-purpose (10/100/1000 or SFP)	4 dual-purpose ports (10/100/1000 or SFP)	
Cisco Catalyst 2960G-48TC-L	48 Ethernet 10/100/1000 ports, 4 of which are dual-purpose (10/100/1000 or SFP)	4 dual-purpose ports (10/100/1000 or SFP)	
Compact Switches			
Cisco Catalyst 2960-8TC-L	8 Ethernet 10/100 ports; compact size with no fan	1 dual-purpose port (10/100/1000 or SFP)	
Cisco Catalyst 2960PD-8TT-L	8 Ethernet 10/100 ports; compact size with no fan	1 10/100/1000 PoE input port	
Cisco Catalyst 2960G-8TC-L	7 Ethernet 10/100/1000 ports; compact size with no fan	1 dual-purpose port (10/100/1000 or SFP)	

Cisco FlexStack Stacking

Cisco FlexStack stacking with a hot-swappable module and IOS software provides true stacking, all switches in a stack act as a single switch unit. The Cisco FlexStack provides a unified data plane, unified configuration, and single IP address management for a group of switches. The advantages of true stacking are lower total cost of ownership through simplified management and higher availability. Cisco FlexStack supports cross-stack features including Etherchannel, SPAN and FlexLink technology. A stack module can be added to any Catalyst 2960-S switch with LAN Base software to quickly upgrade the switch to make it stack capable, and the switch added to the stack will upgrade to the correct Cisco IOS® Software version and transparently become a stack member. Figure 3 shows the FlexStack stacking module for the Catalyst 2960-S.

Figure 3. Cisco FlexStack Module and Switches

Power over Ethernet Plus PoE+

In addition to PoE 802.3af, the Cisco Catalyst 2960-S Series Switches support PoE+ (IEEE 802.3at standard), which provides up to 30W of power per port. The Cisco Catalyst 2960-S and 2960 Series Switches can provide a lower total cost of ownership for deployments that incorporate Cisco IP phones, Cisco Aironet® wireless LAN (WLAN) access points, or any IEEE 802.3af-compliant end device. 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. Table 3 shows the power supply combinations required for different PoE needs.

Table 3. Switch PoE and PoE+ Power Capacity

Switch Model	Maximum Number of PoE+ (IEEE 802.3at) Ports*	Maximum Number of PoE (IEEE 802.3af) Ports*	Available PoE Power
10 Gigabit Uplinks with 10/100/1000 Ethernet Connectivity			
Cisco Catalyst 2960S-48FPD-L	24 ports up to 30W	48 ports up to 15.4W	740W
Cisco Catalyst 2960S-48LPD-L	12 ports up to 30W	24 ports up to 15.4W 48 ports up to 7.7W	370W
Cisco Catalyst 2960S-24PD-L	12 ports up to 30W	24 ports up to 15.4W	370W
1 Gigabit Uplinks with 10/100/1000 Ethernet Connectivity			
Cisco Catalyst 2960S-48FPS-L	24 ports up to 30W	48 ports up to 15.4W	740W
Cisco Catalyst 2960S-48LPS-L	12 ports up to 30W	24 ports up to 15.4W 48 ports up to 7.7W	370W
Cisco Catalyst 2960S-24PS-L	12 ports up to 30W	24 ports up to 15.4W	370W
Cisco Catalyst 2960-48PST-L	N/A	24 ports up to 15.4W	370W
Cisco Catalyst 2960-24PC-L	N/A	24 ports up to 15.4W	370W
Cisco Catalyst 2960-24LT-L	N/A	8 ports up to 15.4W	123W

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

Cisco Catalyst 2960-S and 2960 Series Switches Enable Cisco Borderless Network

Borderless Networks, a Cisco architecture, deliver the new workspace experience, connecting anyone, anywhere, using any device, to any resource securely, reliably, and transparently. Cisco's Borderless Networks architecture addresses primary IT and business challenges to help create a truly borderless experience by bringing interactions closer to the employee and customer.

Borderless experience is only possible with intelligent network elements designed and architected to meet the needs of a global workspace. Cisco Network Access is a primary component of this architecture, enabling various borderless network services such as mobility, security, sustainability, EnergyWise and ease of operations for increased productivity and operational efficiency. When network access is intelligent, it knows the identity of the user, as well as where the user is on the network. It knows what is connecting to the network, to automatically provision the network for QoS and delivery. It becomes services-aware to optimize user experience. Only with intelligent access network, your enterprise can go borderless securely and transparently. Your business can save energy, simplify operations with better business efficiency, and have an optimized total cost of ownership.

Cisco Network Access for Borderless solution focuses on the following primary areas:

- Sustainability
- EnergyWise
- Ease of operations
- Borderless security
- Borderless experience

Sustainability

Cisco Catalyst switching solutions enable greener practices through measurable power efficiency, integrated services, and continuous innovations such as Cisco EnergyWise, an enterprise wide solution that monitors and conserves energy with customized policies. Together, Cisco EnergyWise technology and Cisco Catalyst switches reduce greenhouse gas (GhG) emissions and increase energy cost savings and sustainable business behavior. Sustainability features in the Cisco Catalyst 2960-S and 2960 Series Switches include the following features sets:

- Cisco EnergyWise technology
- Efficient switch operation
- Intelligent power management

Cisco EnergyWise Technology

Cisco EnergyWise is an innovative architecture, added to fixed configuration switches, promoting companywide sustainability by reducing energy consumption across an entire corporate infrastructure and affecting more than 50 percent of global greenhouse gas emissions created by worldwide building infrastructure, a much greater effect than the 2 percent generated by the IT industry. Cisco EnergyWise enables companies to measure the power consumption of network infrastructure and network-attached devices and manage power consumption with specific policies, reducing power consumption to realize increased cost savings, potentially affecting any powered device.

EnergyWise encompasses a highly intelligent network-based approach to communicate messages that measure and control energy between network devices and endpoints. The network discovers Cisco EnergyWise-manageable devices, monitors their power consumption, and takes action based on business rules to reduce power consumption. EnergyWise uses a unique domain-naming system to query and summarize information from large sets of devices, making it simpler than traditional network management capabilities. Cisco EnergyWise's management interfaces allow facilities and network management applications to communicate with endpoints and each other using the network as a unifying fabric. The management interface uses standard SNMP or TCP to integrate Cisco and third-party management systems.

Efficient Switch Operation

Cisco Catalyst 2960-S and 2960 Series Switches, designed and engineered by Cisco, provide optimum power savings, low power operations for industry best-in-class power management, and power consumption capabilities. The Catalyst 2960-S ports are capable of reduced power modes so that ports not in use can move into a lower power utilization state.

Intelligent Power over Ethernet Management

The Cisco Catalyst 2960-S PoE models support the latest PoE+ devices including Cisco IP phones and Cisco Aironet WLAN access points providing up to 30W of power per port, as well as any IEEE 802.3af-compliant end device.

- **Per port power consumption** command allows customers to specify maximum power setting on an individual port
- **Per port PoE power sensing** measures actual power being drawn, enabling more intelligent control of powered devices
- **Cisco Discovery Protocol Version 2** allows 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
- **The PoE MIB** provides proactive visibility into power usage and allows customers to set different power-level thresholds

Ease of Operations

The Cisco Catalyst 2960-S and 2960 Series Switches help reduce the operating costs through:

- Cisco Catalyst Smart Operations
- Easy to use deployment and control features
- Advanced, intelligent network management tools

Cisco Catalyst Smart Operations

Cisco Catalyst Smart Operations is a comprehensive set of capabilities that simplify LAN deployment, configuration, and troubleshooting. Cisco Catalyst Smart Operations enable zero touch installation and replacement of switches, fast upgrade, as well as ease of troubleshooting with reduced operational cost.

Cisco Catalyst Smart Operations is 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 Configuration** provides a single point of management for a group of switches and in addition adds the ability archive and backup configuration files to a file server or switch allowing seamless zero touch switch replacement.
- **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).

Easy to Use Deployment and Control Features

- **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.
- **Stacking Master configuration management** and Cisco FlexStack stacking 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.
- **Dynamic Host Configuration Protocol (DHCP)** autoconfiguration of multiple switches through a boot server eases switch deployment.
- **Auto-negotiation** 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.
- **Switching Database Manager (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 Address Resolution Protocol (ARP)** works in conjunction with Private VLAN Edge to minimize broadcasts and maximize available bandwidth.
- **Internet Group Management Protocol (IGMP)** Snooping for IPv4 and IPv6 MLD v1 and v2 Snooping provide fast client joins and leaves of multicast streams and limit bandwidth-intensive video traffic to only the requestors.
- **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 systems 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 traceroute** 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 Timing Protocol (NTP)** provides an accurate and consistent timestamp to all intranet switches.

Advanced, Intelligent Network Management Tools

The Cisco Catalyst 2960-S and 2960 Series Switches offer both a superior CLI for detailed configuration and Cisco Network Assistant software, a PC-based tool for quick configuration based on preset templates. In addition, CiscoWorks LAN Management Solution (LMS) supports the Cisco Catalyst 2960-S and 2960 Series Switches for networkwide management.

Cisco Network Assistant

A PC-based network management application designed for small and medium-sized business (SMB) networks with up to 250 users, Cisco Network Assistant offers centralized network management and configuration capabilities. Cisco Network Assistant uses Cisco Smartports technology to simplify both initial deployment and ongoing maintenance. This application also features an intuitive GUI where users can easily apply common services across Cisco switches, routers, and access points, such as:

- Configuration management
- Troubleshooting advice
- Inventory reports
- Event notification
- Network security settings
- Password synchronization
- Drag-and-drop Cisco IOS Software upgrades
- Secure wireless

For detailed information about Cisco Network Assistant, visit http://www.cisco.com/go/cna.

CiscoWorks LAN Management Solution

CiscoWorks LAN Management Solution (LMS) is a comprehensive network lifecycle management solution. It provides an extensive library of easy-to-use features to automate the initial and day-to-day management of your Cisco network infrastructure. CiscoWorks LMS uniquely uses Cisco hardware and software platform knowledge and operational experience into a powerful set of workflow-driven configuration, monitoring, troubleshooting, reporting, and administrative tools. Including:

- Support for new Cisco hardware platforms the day they ship
- Support for new technologies and services from initial deployment to day-to-day administration and management, such as EnergyWise, Identity, Cisco Auto Smartports, Cisco Smart Install, and much more
- Configuration management tools built from Cisco experience and Cisco Validated Design recommendations
- Monitoring and troubleshooting capabilities that incorporates Cisco hardware best practices and diagnostics features
- Automation in managing hardware inventories, security vulnerabilities (PSIRTS) and platform end-of-life.

For detailed information about CiscoWorks LMS, go to http://www.cisco.com/en/US/products/sw/cscowork/ps2425/index.html.

Borderless Security

The Cisco Catalyst 2960-S and 2960 Series Switches provide superior Layer 2 threat defense capabilities for mitigating man-in-the-middle attacks (such as MAC, IP, and ARP spoofing). TrustSec, a primary element of Borderless Security Architecture, helps enterprise customers secure their networks, data and resources with policy-based access control, identity and role-aware networking, pervasive integrity, and confidentiality. The borderless security is enabled by the following feature sets in the Cisco Catalyst 2960-S and 2960 Series Switches:

- Threat defense
- Cisco TrustSec
- Other advanced security features

Threat Defense

Cisco Integrated Security Features is an industry-leading solution available on Cisco Catalyst Switches that proactively protects your critical network infrastructure. Delivering powerful, easy-to-use tools to effectively prevent the most common and potentially damaging Layer 2 security threats, Cisco Integrated Security Features provides robust security throughout the network. Cisco Integrated Security Features include Port Security, DHCP Snooping, Dynamic ARP Inspection, and IP Source guard.

- **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 the ARP protocol.
- **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.

Cisco TrustSec

TrustSec secures access to the network, enforces security policies, and delivers standard based security solutions such as 802.1X enabling secure collaboration and policy compliance. TrustSec capabilities reflect Cisco thought leadership, innovations, and commitment to customer success. These new capabilities include:

- **Flexible authentication** that supports multiple authentication mechanisms including 802.1X, MAC Authentication Bypass and web authentication using a single, consistent configuration.
- **Open mode** that creates a user friendly environment for 802.1X operations.
- **Integration of device profiling technology and guest access** handling with Cisco switching to significantly improve security while reducing deployment and operational challenges.
- **RADIUS Change of Authorization and downloadable calls** for comprehensive policy management capabilities.

- **802.1X Supplicant with Network Edge Access Transport (NEAT)** enables extended secure access where compact switches in the conference rooms have the same level of security as switches inside the locked wiring closet.

Other Advanced Security Features

Other Advanced Security features include but are not limited to:

- **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.
- **Port-based ACLs** for Layer 2 interfaces allow security policies to be applied on individual switch ports.
- **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.
- Bidirectional data support on the **Switched Port Analyzer (SPAN)** port allows Cisco Intrusion Detection System (IDS) to take action when an intruder is detected.
- **TACACS+ and RADIUS authentication** facilitates centralized control of the switch and restricts unauthorized users from altering the configuration.
- **MAC Address Notification** allows administrators to be notified of users added to or removed from the network.
- **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.
- **IGMP filtering** provides multicast authentication by filtering out nonsubscribers and limits the number of concurrent multicast streams available per port.
- **Dynamic VLAN assignment** is supported 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.

Borderless Experience

Borderless network enables enterprise mobility and business-grade video services. Industry's first unified network (wired and wireless) location services enable tracking of mobile assets and the users of those assets for both wired and wireless devices. The true borderless experience is enabled by the following feature sets in the Cisco Catalyst 2960-S and 2960 Series Switches:

- High availability and layer 2 networking
- QoS
- Location awareness and mobility

High Availability and Layer 2 Networking

The Cisco Catalyst 2960-S Series Switches provides Cisco FlexStack stacking and both the Cisco 2960-S and 2960 Series switches provide layer 2 networking to enable resiliency and availability.

Other high-availability features include but are not limited to:

- **Cross-Stack EtherChannel** provides the ability to configure Cisco EtherChannel technology across different members of the Cisco FlexStack for high resiliency.
- **Flexlink** provides link redundancy with convergence time less than 100 ms.
- **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 (Errdisable)** automatically attempts to reactivate a link that is disabled because of a network error.

Enhanced Quality of Service

The Cisco 2960-S and 2960 Series Switches offers intelligent services that keep everything flowing smoothly. Industry-leading mechanisms for marking, classification, and scheduling deliver superior performance for data, voice, and video traffic, all at wire speed.

Following are some of the QoS features supported in the Cisco 2960-S and 2960 Series Switches:

- **Cross-stack QoS** allows QoS to be configured across the entire Cisco 2960-S Flexstack.
- **802.1p class of service (CoS)** and differentiated services code point (DSCP) field classification are provided, using marking and reclassification on a per-packet basis by source and destination IP address, MAC address, or Layer 4 TCP/UDP port number.
- **Cisco control-plane and data-plane QoS ACLs** on all ports help ensure proper marking on a per-packet basis.
- **Four egress queues per port** help enable differentiated management of different traffic types across the stack.
- **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.
- **Trusted Boundary** provides the ability to trust the QoS priority settings if an IP phone is present and to disable the trust setting if the IP phone is removed, thereby preventing a malicious user.
- **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.
- **Up to 64 aggregate or individual policers** are available per Fast Ethernet or GbE port.

Location Awareness and Mobility

In order to provide delivery of a best-in-class network experience to end users, it's critical for network access to be location aware. A wide variety of devices can appear on the network, both wired (switches, routers, IP phones, PCs, access points, controllers, video digital media players, and so on) and wireless (mobile devices, wireless tags, rogues, and so on). In many industries, locating assets is primarily a manual process and is time consuming and error prone. The inability to locate assets in real time and to help ensure their availability when and where they are needed limits reaction time and efficiency.

Location services answer business-critical questions about both mobile assets and the users of those assets regardless of whether those assets are connecting using wired or wireless, and hence directly improve their organization's profitability. Network Location Services also improve security and accelerate client troubleshooting by locating an asset, user, or device on the network.

- **Network visibility and control** provide centralized visibility into wired and wireless devices on the network and their location.
- **Location-assisted client troubleshooting** enables tracking of wired or wireless clients for quick problem resolution.
- **Asset tracking and improved security** provide centralized inventory of wired and wireless devices and asset management for improved business processes.
- **Location based policy** allows greater control and visibility. With EnergyWise, power policies can be set up (to reduce the power or shut down the power from a port) based on the location.
- **Cisco Emergency Responder (CER)** enhances emergency calling from Cisco Unified CallManager. It helps assure that Cisco Unified CallManager sends emergency calls to the appropriate Public Safety Answering Point (PSAP) for the caller's location.

Tables 4, 6, 7, and 8 provide hardware features, power specifications, management and standards support, and safety and compliance information for the Cisco Catalyst 2960-S and 2960 Series Switches with LAN Base Software.

Table 4. Cisco Catalyst 2960-S and 2960 Series Switches with LAN Base Software switch performance and scalability information

Performance and Scalability Numbers for All Switch Models		
	Catalyst 2960-S	**Catalyst 2960**
Forwarding bandwidth	88 Gbps	16 Gbps 32 Gbps (2960G)
Switching bandwidth*	176 Gbps	32Gbps 32 Gbps (2960G)
Flash memory	64 MB	32 MB
Memory DRAM	128 MB	64 MB
Max VLANs	255	255
VLAN IDs	4000	4000
Maximum transmission unit (MTU)	9198 bytes	Up to 9000 bytes
Jumbo frames	9216 bytes	9018 bytes (2960G only)

Performance and Scalability Numbers for All Switch Models			
Forwarding Rate: 64-Byte Packet Cisco Catalyst 2960-S			
Cisco Catalyst 2960S-48FPD-L	101.2 mpps		
Cisco Catalyst 2960S-48LPD-L	101.2 mpps		
Cisco Catalyst 2960S-24PD-L	65.5 mpps		
Cisco Catalyst 2960S-48TD-L	101.2 mpps		
Cisco Catalyst 2960S-24TD-L	65.5 mpps		
Cisco Catalyst 2960S-48FPS-L	77.4 mpps		
Cisco Catalyst 2960S-48LPS-L	77.4 mpps		
Cisco Catalyst 2960S-24PS-L	41.7 mpps		
Cisco Catalyst 2960S-48TS-L	77.4 mpps		
Cisco Catalyst 2960S-24TS-L	41.7 mpps		
Forwarding Rate: 64-Byte Packet Cisco Catalyst 2960			
Cisco Catalyst 2960PD-8TT-L	2.7 mpps		
Cisco Catalyst 2960-8TC-L	2.7 mpps		
Cisco Catalyst 2960-24TT-L	6.5 mpps		
Cisco Catalyst 2960-24TC-L	6.5 mpps		
Cisco Catalyst 2960-24LT-L	6.5 mpps		
Cisco Catalyst 2960-24PC-L	6.5 mpps		
Cisco Catalyst 2960-48TT-L	10.1 mpps		
Cisco Catalyst 2960-48TC-L	10.1 mpps		
Cisco Catalyst 2960-48PST-L	13.3 mpps		
Cisco Catalyst 2960G-8TC-L	11.9 mpps		
Cisco Catalyst 2960G-24TC-L	35.7 mpps		
Cisco Catalyst 2960G-48TC-L	39.0 mpps		
Resource: Cisco Catalyst 2960-S and 2960	**Default**	**QoS**	**Dual**
Unicast MAC addresses	8000	8000	8000
IPv4 IGMP groups	255	255	255
IPv4 MAC QoS access control entries (ACEs)	128	384	0
IPv4 MAC security ACEs	384	128	256

* Switching bandwidth is full-duplex capacity.

Table 5. Dimensions, weight, acoustic, MTBF and environmental range

Dimensions (H x W x D)		
Cisco Catalyst 2960-S	**Inches**	**Centimeters**
Cisco Catalyst 2960S-48FPD-L	1.75 x 17.5 x 15.2	4.5 x 44.5 x 38.6
Cisco Catalyst 2960S-48LPD-L		
Cisco Catalyst 2960S-24PD-L		
Cisco Catalyst 2960S-48TD-L	1.75 x 17.5 x 11.8	4.5 x 44.5 x 30
Cisco Catalyst 2960S-24TD-L		
Cisco Catalyst 2960S-48FPS-L	1.75 x 17.5 x 15.2	4.5 x 44.5 x 38.6
Cisco Catalyst 2960S-48LPS-L		
Cisco Catalyst 2960S-24PS-L		

Cisco Catalyst 2960S-48TS-L **Cisco Catalyst 2960S-24TS-L**	1.75 x 17.5 x 11.8	4.5 x 44.5 x 30
Cisco Catalyst 2960	**Inches**	**Centimeters**
Cisco Catalyst 2960PD-8TT-L	1.73 x 10.6 x 6.2	4.4 x 27 x 15.7
Cisco Catalyst 2960-8TC-L	1.73 x 10.6 x 6.4	4.4 x 27 x 16.3
Cisco Catalyst 2960-24TT-L **Cisco Catalyst 2960-24TC-L** **Cisco Catalyst 2960-24LT-L**	1.73 x 17.7 x 9.52	4.4 x 45 x 23.6
Cisco Catalyst 2960-24PC-L **Cisco Catalyst 2960-48TT-L** **Cisco Catalyst 2960-48TC-L**	1.73 x 17.7 x 13	4.4 x 45 x 33.2
Cisco Catalyst 2960-48PST-L	1.73 x 17.7 x 13.07	4.4 x 45 x 23.6
Cisco Catalyst 2960G-8TC-L	1.73 x 10.6 x 8.1	4.4 x 27 x 20.5
Cisco Catalyst 2960G-24TC-L **Cisco Catalyst 2960G-48TC-L**	1.73 x 17.7 x 12.9	4.4 x 45 x 32.8

Weight

Cisco Catalyst 2960-S	**Pounds**	**Kilograms**
Cisco Catalyst 2960S-48FPD-L	13	5.9
Cisco Catalyst 2960S-48LPD-L	12.5	5.7
Cisco Catalyst 2960S-24PD-L	12.5	5.7
Cisco Catalyst 2960S-48TD-L	9.5	4.3
Cisco Catalyst 2960S-24TD-L	9.5	4.3
Cisco Catalyst 2960S-48FPS-L	13	5.9
Cisco Catalyst 2960S-48LPS-L	12.5	5.7
Cisco Catalyst 2960S-24PS-L	12.5	5.7
Cisco Catalyst 2960S-48TS-L	10.5	4.8
Cisco Catalyst 2960S-24TS-L	10	4.5
Cisco Catalyst 2960	**Pounds**	**Kilograms**
Cisco Catalyst 2960PD-8TT-L	3	1.4
Cisco Catalyst 2960-8TC-L	3	1.4
Cisco Catalyst 2960-24TT-L	8	3.6
Cisco Catalyst 2960-24TC-L	8	3.6
Cisco Catalyst 2960-24LT-L	10	4.5
Cisco Catalyst 2960-24PC-L	12	5.4
Cisco Catalyst 2960-48TT-L	8	3.6
Cisco Catalyst 2960-48TC-L	8	3.6
Cisco Catalyst 2960-48PST-L	12	5.4
Cisco Catalyst 2960G-8TC-L	3	1.4
Cisco Catalyst 2960G-24TC-L	10	4.5
Cisco Catalyst 2960G-48TC-L	12	5.4

Environmental Ranges

	Cisco Catalyst 2960-S		**Cisco Catalyst 2960**	
	Fahrenheit	**Centigrade**	**Fahrenheit**	**Centigrade**
Operating temperature up to 5000 ft (1500 m)	0º to 113ºF	-5º to 45ºC	23º to 113ºF	-5º to 45ºC
Operating temperature up to 10,000 ft (3000 m)	23º to 104ºF	-5º to 40ºC	23º to 104ºF	-5º to 40ºC

Short-term exception at sea level*	23º to 31ºF	-5º to 55ºC	23º to 31ºF	-5º to 55ºC
Short-term exception up to 5000 feet (1500 m)*	23º to 122ºF	-5º to 50ºC	23º to 122ºF	-5º to 50ºC
Short-term exception up to 10,000 feet (3000 m)*	23º to 113ºF	-5º to 45ºC	23º to 113ºF	-5º to 45ºC
Short-term exception up to 13,000 feet (4000 m)*	23º to 104ºF	-5º to +40ºC	23º to 104ºF	-5º to 40ºC
Storage temperature up to 15,000 feet (4573 m)	-13º to 158ºF	-25º to 70ºC	-13º to 158ºF	-25º to 70ºC
	Feet	**Meters**		
Operating altitude	Up to 10,000	Up to 3000	Up to 10,000	Up to 3000
Storage altitude	Up to 13,000	Up to 4000	Up to 13,000	Up to 4000
Operating relative humidity	10% to 95% noncondensing		10% to 95% noncondensing	
Storage relative humidity	10% to 95% noncondensing		10% to 95% noncondensing	

Acoustic Noise

Measured per ISO 7779 and declared per ISO 9296.

Bystander positions operating mode at 25°C ambient.

	Sound Pressure		**Sound Power**	
Model	**LpA (Typical)**	**LpAD (Maximum)**	**LwA (Typical)**	**LwAD (Maximum)**
Cisco Catalyst 2960S-48FPD-L **Cisco Catalyst 2960S-48LPD-L** **Cisco Catalyst 2960S-24PD-L**	42 dB	45 dB	5.2 B	5.5 B
Cisco Catalyst 2960S-48TD-L **Cisco Catalyst 2960S-24TD-L**	44 dB	47 dB	5.4 B	5.7 B
Cisco Catalyst 2960S-48FPS-L **Cisco Catalyst 2960S-48LPS-L** **Cisco Catalyst 2960S-24PS-L**	42 dB	45 dB	5.2 B	5.5 B
Cisco Catalyst 2960S-48TS-L **Cisco Catalyst 2960S-24TS-L**	44 dB	47 dB	5.4 B	5.7 B

Mean time between failures (MTBF)

Cisco Catalyst 2960-S		**Cisco Catalyst 2960**	
Model	**MTBF in hours**	**Model**	**MTBF in hours**
Cisco Catalyst 2960S-48FPD-L	183,498	**Cisco Catalyst 2960PD-8TT-L**	737,065
Cisco Catalyst 2960S-48LPD-L	198,300	**Cisco Catalyst 2960-8TC-L**	615,549
Cisco Catalyst 2960S-24PD-L	237,016	**Cisco Catalyst 2960-24TT-L**	407,707
Cisco Catalyst 2960S-48TD-L	311,291	**Cisco Catalyst 2960-24TC-L**	339,743
Cisco Catalyst 2960S-24TD-L	332,958	**Cisco Catalyst 2960-24LT-L**	402,926
Cisco Catalyst 2960S-48FPS-L	189,242	**Cisco Catalyst 2960-24PC-L**	311,781
Cisco Catalyst 2960S-48LPS-L	205,052	**Cisco Catalyst 2960-48TT-L**	243,277
Cisco Catalyst 2960S-24PS-L	245,604	**Cisco Catalyst 2960-48TC-L**	336,409
Cisco Catalyst 2960S-48TS-L	328,058	**Cisco Catalyst 2960-48PST-L**	180,427
Cisco Catalyst 2960S-24TS-L	349,824	**Cisco Catalyst 2960G-8TC-L**	485,576
Cisco Catalyst 2960S-STACK	25,743,890	**Cisco Catalyst 2960G-24TC-L**	313,828
		Cisco Catalyst 2960G-48TC-L	221,432

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

Note: For Catalyst 2960G-8TC-L, reduce the high range temperature by 5°C.

Table 6. Connectors, LED indicators and Dimensions

Connectors and LED Indicators
Cisco Catalyst 2960-S with SFP+ based ports: • 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 • 1000BASE-SX, -LX/LH, -ZX, -BX, -T,* -FX,* and coarse wavelength-division multiplexing (CWDM) SFP-based ports: LC fiber connectors (single/multimode fiber) • 10GBASE-LR, SR, LRM, CX1 SFP+ based ports * *The Cisco Catalyst 2960-S with SFP+ does not support the GLC-FE-100BX, GLC-FE-100FX, or GLC-FE-100LX.*
Cisco Catalyst 2960-S and 2960 with SFP-based ports: • 10BASE-T ports: RJ-45 connectors, 2-pair Category 3, 4, or 5 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 • 1000BASE-SX -LX/LH, -ZX, -BX, -T,* -FX,* and CWDM SFP-based ports: LC fiber connectors (single/multimode fiber) • 100BASE-LX, -BX, -FX SFP-based ports: LC fiber connectors (single/multimode fiber) * *GLC-T and GLC-GE-100FX are not supported on the Catalyst 2960-8TC-S, 2960-8TC-L, or 2960G-8TC-L switches.*
Cisco Catalyst 2960-S FlexStack stacking cables: • CAB-STK-E-0.5M FlexStack stacking cable with a 0.5 m length • CAB-STK-E-1M FlexStack stacking cable with a 1.0 m length • CAB-STK-E-3M FlexStack stacking cable with a 3.0 m length **Cisco Catalyst 2960-S 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
• Customers can provide power to a switch by using the internal power supply. The connector is located at the back of the switch. These switches do not have a redundant-power-supply port • The internal power supply is an auto-ranging unit • The internal power supply supports input voltages between 100 and 240 VAC • Use the supplied AC power cord to connect the AC power connector to an AC power outlet • Cisco RPS connector: ◦ The Cisco RPS connector offers connection for an optional Cisco RPS 2300 that uses AC input and supplies DC output to the switch. ◦ The connector offers a 2300W redundant power system that supports up to 6 external network devices and provides power to 2 failed devices at a time ◦ The connector automatically senses when the internal power supply of a connected device fails and provides power to the failed device, preventing loss of network traffic ◦ Only the Cisco RPS 2300 (model PWR-RPS2300) should be attached to the redundant-power-system receptacle Note: The Cisco Catalyst 2960-8TC-L and 2960G-8TC-L do not have RPS ports.
• Per-port status: Link integrity, disabled, activity, speed, and full duplex • System status: System, RPS, link status, link duplex, PoE, and link speed

** 1000Base-T not supported on Cisco Catalyst 2960-S switches.

Table 7. Management and Standards Support for Cisco Catalyst 2960-S and 2960 Series Switches with LAN Base Software

Description	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-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

Description	Specification	
	• 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	• 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-S)
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 802.3ad • IEEE 802.3af • IEEE 802.3ah (100BASE-X single/multimode fiber only) • IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports • IEEE 802.3 10BASE-T specification • IEEE 802.3u 100BASE-TX specification • IEEE 802.3ab 1000BASE-T specification • IEEE 802.3z 1000BASE-X specification	• 100BASE-BX (SFP) • 100BASE-FX (SFP) • 100BASE-LX (SFP) • 1000BASE-BX (SFP) • 1000BASE-SX (SFP) • 1000BASE-LX/LH (SFP) • 1000BASE-ZX (SFP) • 1000BASE-CWDM SFP 1470 nm • 1000BASE-CWDM SFP 1490 nm • 1000BASE-CWDM SFP 1510 nm • 1000BASE-CWDM SFP 1530 nm • 1000BASE-CWDM SFP 1550 nm • 1000BASE-CWDM SFP 1570 nm • 1000BASE-CWDM SFP 1590 nm • 1000BASE-CWDM SFP 1610 nm • 10GBASE-LR (SFP+) • 10GBASE-SR (SFP+) • 10GBASE-LRM (SFP+) • 10GBASE-CX1 (SFP+) • RMON I and II standards • SNMP v1, v2c, and v3
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)	• 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

Description	Specification	
	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 2474 - Differentiated Services (DiffServ) Precedence • RFC 2597 - Assured Forwarding • RFC 2598 - Expedited Forwarding • RFC 2571 - SNMP Management • RFC 3046 - DHCP Relay Agent Information Option • RFC 3376 - IGMP v3 • RFC 3580 - 802.1X RADIUS

Table 8. Voltage and power information

AC/DC input voltage and current			
Cisco Catalyst 2960-S	**Voltage (Autoranging)**	**Current**	**Frequency**
Cisco Catalyst 2960S-48FPD-L	100 to 240 VAC	9 to 4 A	50 to 60Hz
Cisco Catalyst 2960S-48LPD-L		5 to 2 A	
Cisco Catalyst 2960S-24PD-L		5 to 2 A	
Cisco Catalyst 2960S-48TD-L		1 to 0.5 A	
Cisco Catalyst 2960S-24TD-L		1 to 0.5 A	
Cisco Catalyst 2960S-48FPS-L		9 to 4 A	
Cisco Catalyst 2960S-48LPS-L		5 to 2 A	
Cisco Catalyst 2960S-24PS-L		5 to 2 A	
Cisco Catalyst 2960S-48TS-L		1 to 0.5 A	
Cisco Catalyst 2960S-24TS-L		1 to 0.5 A	
Cisco Catalyst 2960	**Voltage (Autoranging)**	**Current**	**Frequency**
Cisco Catalyst 2960-8TC-L	100 to 240 VAC	0.5 to 0.25 A	50 to 60Hz
Cisco Catalyst 2960G-8TC-L		0.8 to 0.4 A	
Cisco Catalyst 2960-24LT-L		3.0 to 1.5 A	
Cisco Catalyst 2960-24PC-L		8.0 to 4.0 A	
Cisco Catalyst 2960-48PST-L		5.0 to 2.0 A	
Cisco Catalyst 2960-24TT-L and Catalyst 2960-24TC-L and Catalyst 2960-48TT-L and Catalyst 2960-48TC-L		1.3 to 0.8 A	
Cisco Catalyst 2960G-24TC-L and Catalyst 2960G-48TC-L		3.0 to 1.5 A	
Cisco Catalyst 2960PD-8TT-L	DC input 48 VDC (for AC use PWR-A= sold separately)	0.3 A	

Power Rating			
Cisco Catalyst 2960-S		**Cisco Catalyst 2960**	
Model	**Power Rating**	**Model**	**Power Rating**
Cisco Catalyst 2960S-48FPD-L	0.89 kVA	**Cisco Catalyst 2960PD-8TT-L**	11W
Cisco Catalyst 2960S-48LPD-L	0.48 kVA	**Cisco Catalyst 2960-8TC-L**	0.035 kVA
Cisco Catalyst 2960S-24PD-L	0.46 kVA	**Cisco Catalyst 2960-24TT-L**	0.05 kVA
Cisco Catalyst 2960S-48TD-L	0.09 kVA	**Cisco Catalyst 2960-48TT-L**	0.075 kVA
Cisco Catalyst 2960S-24TD-L	0.09 kVA	**Cisco Catalyst 2960-24TC-L**	0.05 kVA
Cisco Catalyst 2960S-48FPS-L	0.89 kVA	**Cisco Catalyst 2960-24LT-L**	0.175 kVA
Cisco Catalyst 2960S-48LPS-L	0.48 kVA	**Cisco Catalyst 2960-24PC-L**	0.470 kVA
Cisco Catalyst 2960S-24PS-L	0.46 kVA	**Cisco Catalyst 2960-48PST-L**	0.5 kVA
Cisco Catalyst 2960S-48TS-L	0.13 kVA	**Cisco Catalyst 2960-48TC-L**	0.075 kVA

Cisco Catalyst 2960S-24TS-L	0.09 kVA	**Cisco Catalyst 2960G-8TC-L**	0.05 kVA
		Cisco Catalyst 2960G-24TC-L	0.075 kVA
		Cisco Catalyst 2960G-48TC-L	0.140 kVA
DC input voltages (RPS input)			
Cisco Catalyst 2960-S			
Cisco Catalyst 2960S-48FPD-L	12V at 4 A	-52 V at 15 A	
Cisco Catalyst 2960S-48LPD-L	12V at 4 A	-52 V at 8 A	
Cisco Catalyst 2960S-24PD-L	12V at 3 A	-52 V at 8 A	
Cisco Catalyst 2960S-48TD-L	12V at 4 A	N/A	
Cisco Catalyst 2960S-24TD-L	12V at 3 A	N/A	
Cisco Catalyst 2960S-48FPS-L	12V at 4 A	-52 V at 15A	
Cisco Catalyst 2960S-48LPS-L	12V at 4 A	-52 V at 8 A	
Cisco Catalyst 2960S-24PS-L	12V at 3 A	-52 V at 8 A	
Cisco Catalyst 2960S-48TS-L	12V at 4 A	N/A	
Cisco Catalyst 2960S-24TS-L	12V at 4 A	N/A	
Cisco Catalyst 2960			
Cisco Catalyst 2960-24TT-L **Cisco Catalyst 2960-48TT-L** **Cisco Catalyst 2960-24TC-L**	12V at 5 A	5 A	
Cisco Catalyst 2960-24LT-L	12 V at 8.3 A	-48 V at 2.7 A	
Cisco Catalyst 2960-24PC-L	12 V at 11.25 A	-48 V at 7.8 A	
Cisco Catalyst 2960-48PST-L	12 V at 4 A	-48 V at 7.8 A	
Cisco Catalyst 2960-48TC-L	12 V at 5 A		
Cisco Catalyst 2960G-24TC-L	12 V at 10.5 A		
Cisco Catalyst 2960G-48TC-L			
No RPS input for Cisco Catalyst 2960PD-8TT-L, Catalyst 2960-8TC-L, or Catalyst 2960G-8TC-L.			
PoE and PoE+			
• Maximum power supplied per port for PoE+ is 30W. • Maximum power supplied per port for PoE is 15.4W. • Total power dedicated to PoE or PoE+ is 370W or 740W.			

Table 9. Power Specifications for Cisco Catalyst 2960-S and 2960 Series Switches with LAN Base Software

Description	**C2960-S Specifications**				
Models	**C2960S-48FPD-L**	**C2960S-48LPD-L**	**C2960S-24PD-L**	**C2960S-48TD-L**	**C2960S-24TD-L**
100 Percent Throughput					
Measured Power Consumption	81W	71W	55W	55W	39W
5 Percent Throughput					
Measured Power Consumption	80W	70W	54W	53W	38W
5 Percent Throughput (with 50 Percent PoE Loads)					
Measured Power Consumption	Switch Power: 464W PoE Power: 386W	Switch Power: 266W PoE Power: 195W	Switch Power: 249W PoE Power: 195W	-	-
100 Percent Throughput (with Maximum Possible PoE Loads)					
Measured Power Consumption	Switch Power: 870W PoE Power: 744W	Switch Power: 466W PoE Power: 375W	Switch Power: 451W PoE Power: 375W	-	-

Description	C2960-S Specifications				
Models	**C2960S-48FPS-L**	**C2960S-48LPS-L**	**C2960S-24PS-L**	**C2960S-48TS-L**	**C2960S-24TS-L**
100 Percent Throughput					
Measured Power Consumption	79W	71W	55W	52W	40W
5 Percent Throughput					
Measured Power Consumption	78W	70W	54W	50W	39W
5 Percent Throughput (with 50 Percent PoE Loads)					
Measured Power Consumption	Switch Power: 464W PoE Power: 386W	Switch Power: 266W PoE Power: 195W	Switch Power: 249W PoE Power: 195W	-	-
100 Percent Throughput (with Maximum Possible PoE Loads)					
Measured Power Consumption	Switch Power: 870W PoE Power: 744W	Switch Power: 466W PoE Power: 375W	Switch Power: 449W PoE Power: 375W	-	-

Description	C2960 Specifications				
Models	**C2960-48PST-L**	**C2960-24PC-L**	**C2960-24LT-L**	**C2960-48TC-L**	**C2960-24TC-L**
100 Percent Throughput					
Measured Power Consumption	67W	45W	36W	39W	27W
5 Percent Throughput					
Measured Power Consumption	63W	43W	34W	36W	24W
5 Percent Throughput (with 50 Percent PoE Loads)					
Measured Power Consumption	Switch Power: 262W PoE Power: 187W	Switch Power: 237W PoE Power: 185W	Switch Power: 98W PoE Power: 62W	-	-
100 Percent Throughput (with Maximum Possible PoE Loads)					
Measured Power Consumption	Switch Power: 460W PoE Power: 339W	Switch Power: 433W PoE Power: 357W	Switch Power: 162W PoE Power: 119W	-	-

Description	C2960 Specifications				
Models	**C2960-48TT-L**	**C2960-24TT-L**	**C2960G-48TC-L**	**C2960G-24TC-L**	**C2960-24T-L**
100 Percent Throughput					
Measured Power Consumption	42W	28W	123W	72W	22W
5 Percent Throughput					
Measured Power Consumption	38W	26W	114W	65W	21W
5 Percent Throughput (with 50 Percent PoE Loads)					
Measured Power Consumption	-	-	-	-	-
100 Percent Throughput (with Maximum Possible PoE Loads)					
Measured Power Consumption	-	-	-	-	-

Description	Compact Switch Specifications		
Models	**C2960-8TC-L**	**C2960PD-8TT-L**	**C2960G-8TC-L**
100 Percent Throughput			
Measured Power Consumption	12W	11W	22W
5 Percent Throughput			
Measured Power Consumption	11W	N/A	20W
5 Percent Throughput (with 50 Percent PoE Loads)			
Measured Power Consumption	-	-	-
100 Percent Throughput (with Maximum Possible PoE Loads)			
Measured Power Consumption	-	-	-

Note: Disclaimer: All power consumption numbers were measured under controlled laboratory conditions and are provided as an estimate.

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 the actual power consumption as a significant portion of PoE loads are dissipated in the endpoints.

Non-PoE Power Consumption

100 Percent Throughput Switch Power Consumption

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. Typically such power draws are only seen when encountering a 100 percent traffic load made up entirely of 64-byte packets on the switch and the uplinks.

5 Percent Throughput Switch Power Consumption

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load on the switch and its uplinks.

PoE Power Consumption

100 Percent Throughput Switch Power Consumption (No PoE Loads)

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar, and relative humidity from 30 to 75 percent. Typically such power draws are only seen when encountering a 100 percent traffic load made up entirely of 64-byte packets with no PoE loads on the switch and uplinks.

Measured 5 Percent Throughput Switch Power Consumption (No PoE Loads)

The numbers indicate the power consumed by a typical switch under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load on the switch and its uplinks.

100 Percent Throughput Switch Power Consumption (with Maximum PoE Loads)

The numbers indicate the power consumed by a typical system (the switch and the corresponding PoE loads) under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. Typically this power draw is realized when a switch is running 100 percent traffic load of 64 byte sized packets on all its ports and uplinks and also drawing 100 percent PoE load.

5 Percent Throughput Switch Power Consumption (with 50 Percent PoE Loads)

The numbers indicate the power consumed by a typical system (the switch and the corresponding PoE loads) under normal conditions. Normal conditions signify a temperature of 25 degrees Celsius, atmospheric pressure in the range of 860 to 1060 mbar and relative humidity from 30 to 75 percent. The numbers below indicate a 5 percent traffic load and 50 percent PoE load on the switch and its uplinks.

Table 10. Safety and Compliance

Description	Specification
Safety certifications	• UL 60950-1, Second Edition • CAN/CSA 22.2 No. 60950-1, Second Edition • TUV/GS to EN 60950-1, Second Edition • CB to IEC 60950-1 Second Edition with all country deviations • CE Marking • NOM (through partners and distributors)
Electromagnetic emissions certifications	• FCC Part 15 Class A • EN 55022 Class A (CISPR22) • EN 55024 (CISPR24) • AS/NZS CISPR22 Class A • CE • CNS13438 Class A • MIC • GOST • China EMC Certifications
Environmental	Reduction of Hazardous Substances (ROHS) 5
Telco	Common Language Equipment Identifier (CLEI) code
Warranty	Limited lifetime warranty

Cisco Limited Lifetime Hardware Warranty

Cisco Catalyst 2960-S and 2960 Series Switches come with a limited lifetime warranty (Table 11). The warranty for the Catalyst 2960-S has the same terms as our standard limited lifetime warranty plus the addition of 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 on warranty terms, visit http://www.cisco.com/go/warranty.

Table 11. Limited Lifetime Warranty Terms

	Cisco Limited Lifetime Hardware Warranty	Cisco Enhanced Limited Lifetime Hardware Warranty
Device covered	Applies to Cisco Catalyst 2960 Series Switches sold on or after May 1, 2009.	Applies to Cisco Catalyst 2960-S Series Switches.
Warranty duration	As long as the original customer owns the product.	As long as the original end user continues to own or use the product, provided that: fan and power supply warranty is limited to five (5) years.
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.	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 replacement part within ten (10) working days after receipt of the RMA request. Actual delivery times may vary depending on customer location.	Cisco or its service center will use commercially reasonable efforts to ship a Catalyst 2960-S 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).	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	Not included.	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-S 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	Warranty allows guest access only to Cisco.com

Software Update Policy for Cisco Catalyst 2960-S and 2960 Series Switches with LAN Base Software

Customers with Cisco Catalyst LAN Base software licenses 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 premium software images, Enterprise Services or IP Services, require a service support contract such as Cisco SMARTnet® 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 the Catalyst 2960

Minimize operating costs and reduce power consumption with the Cisco Catalyst 2960 Switch 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 Cisco Catalyst into your architecture and incorporate network services onto it. 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 10 lists the technical services available for the Cisco Catalyst 2960-S and 2960 Series Switches.

Table 12. Technical Services Available for Cisco Catalyst 2960-S and 2960 Series Switches

Technical Services
Cisco SMARTnet 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 SMARTnet or SP Base contracts are required on all network equipment.

Ordering Information

Tables 13, 14, and 15 give ordering information for the Cisco Catalyst 2960-S and 2960 Series Switches with LAN Base Software.

Table 13. Ordering Information for Cisco Catalyst 2960-S Series Switches with LAN Base Software

Part Numbers	Description
10 Gigabit Uplinks with 10/100/1000 Ethernet Connectivity	
WS-C2960S-48FPD-L	• 48 Ethernet 10/100/1000 PoE+ ports • 740W PoE capacity • 2 10 Gigabit Ethernet or 2 1 Gigabit Ethernet SFP+ uplink ports • Optional Cisco FlexStack stacking support • LAN Base image

[1] ~~Advance hardware replacement is avail~~able 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.

Part Numbers	Description
WS-C2960S-48LPD-L	• 48 Ethernet 10/100/1000 PoE+ ports • 370W PoE capacity • 2 10 Gigabit Ethernet or 2 1 Gigabit Ethernet SFP+ uplink ports • Optional Cisco FlexStack stacking support • LAN Base image
WS-C2960S-24PD-L	• 24 Ethernet 10/100/1000 PoE+ ports • 370W PoE capacity • 2 10 Gigabit Ethernet or 2 1 Gigabit Ethernet SFP+ uplink ports • Optional Cisco FlexStack stacking support • LAN Base image
WS-C2960S-48TD-L	• 48 Ethernet 10/100/1000 ports • 2 10 Gigabit Ethernet or 2 1 Gigabit Ethernet SFP+ uplink ports • Optional Cisco FlexStack stacking support • LAN Base image
WS-C2960S-24TD-L	• 24 Ethernet 10/100/1000 ports • 2 10 Gigabit Ethernet or 2 1 Gigabit Ethernet SFP+ uplink ports • Optional Cisco FlexStack stacking support • LAN Base image
1 Gigabit Uplinks with 10/100/1000 Ethernet Connectivity	
WS-C2960S-48FPS-L	• 48 Ethernet 10/100/1000 PoE+ ports • 740W PoE capacity • 2 1 Gigabit Ethernet SFP uplink ports • Optional Cisco FlexStack stacking support • LAN Base image
WS-C2960S-48LPS-L	• 48 Ethernet 10/100/1000 PoE+ ports • 370W PoE capacity • 2 1 Gigabit Ethernet SFP uplink ports • Optional Cisco FlexStack stacking support • LAN Base image
WS-C2960S-24PS-L	• 24 Ethernet 10/100/1000 PoE+ ports • 370W PoE capacity • 2 1 Gigabit Ethernet SFP uplink ports • Optional Cisco FlexStack stacking support • LAN Base image
WS-C2960S-48TS-L	• 48 Ethernet 10/100/1000 ports • 2 1 Gigabit Ethernet SFP uplink ports • Optional Cisco FlexStack stacking support • LAN Base image
WS-C2960S-STACK	FlexStack hot-swappable stacking module

Table 14. Ordering Information for Cisco Catalyst 2960 Series Switches with LAN Base Software

Part Numbers	Description
WS-C2960PD-8TT-L	• 8 Ethernet 10/100 ports and 1 10/100/1000 PoE input port • Power adaptor (PWR-A=) and power cord sold separately • Compact size with no fan; magnet included • LAN Base image
WS-C2960-8TC-L	• 8 Ethernet 10/100 ports • 1 dual-purpose uplink (dual-purpose uplink port has 1 10/100/1000 Ethernet port,1 SFP-based Gigabit Ethernet port, 1 port active) • Compact size with no fan; magnet included • LAN Base image

Part Numbers	Description
WS-C2960-24TT-L	• 24 Ethernet 10/100 ports and 2 10/100/1000 TX uplinks • 1 RU fixed-configuration • LAN Base image
WS-C2960-48TT-L	• 48 Ethernet 10/100 ports and 2 10/100/1000 TX uplinks • 1 RU fixed-configuration • LAN Base image
WS-C2960-24LT-L	• 24 Ethernet 10/100 ports with 8 PoE ports and 2 10/100/1000 TX uplinks • 1 RU fixed-configuration • LAN Base image
WS-C2960-24PC-L	• 24 Ethernet 10/100 PoE ports and 2 dual-purpose uplinks • 1 RU fixed-configuration • LAN Base image
WS-C2960-48PST-L	• 48 Ethernet 10/100 PoE ports and 2 10/100/1000 uplinks and 2 SFP uplinks • 1 RU fixed-configuration • LAN Base image
WS-C2960-48TC-L	• 48 Ethernet 10/100 ports and 2 dual-purpose uplinks (each dual-purpose uplink port has 1 10/100/1000 Ethernet port and 1 SFP-based Gigabit Ethernet port, 1 port active) • 1 RU fixed-configuration • LAN Base image
WS-C2960G-8TC-L	• 7 Ethernet 10/100/1000 ports and 1 dual-purpose uplink (dual-purpose uplink port has 1 10/100/1000 Ethernet port and 1 SFP-based Gigabit Ethernet port, 1 port active) • Compact size with no fan; magnet included • LAN Base image
WS-C2960G-24TC-L	• 20 Ethernet 10/100/1000 ports and 4 dual-purpose uplinks (each dual-purpose uplink port has 1 10/100/1000 Ethernet port and 1 SFP-based Gigabit Ethernet port, 1 port active) • 1 RU fixed-configuration • LAN Base image
WS-C2960G-48TC-L	• 44 Ethernet 10/100/1000 ports and 4 dual-purpose uplinks (each dual-purpose uplink port has 1 10/100/1000 Ethernet port and 1 SFP-based Gigabit Ethernet port, 1 port active) • 1 RU fixed-configuration • LAN Base image

Table 15. Ordering Information for Cisco Catalyst 2960-S and 2960 Series Switches with LAN Base Software Accessories

Part Numbers	Description
CAB-STK-E-0.5M	FlexStack stacking cable with a 0.5 m length
CAB-STK-E-1M	FlexStack stacking cable with a 1.0 m length
CAB-STK-E-3M	FlexStack stacking cable with a 3.0 m length
CAB-CONSOLE-RJ45	Console cable 6 ft with RJ45
CAB-CONSOLE-USB	Console cable 6 ft with USB Type A and mini-B connectors
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

Part Numbers	Description
CAB-ACC	Power cord (China) 10A, IEC 320, C13 (APN=CS-PWR-CH)
CAB-3P-JPN	CABASY,POWER CORD, JAPAN 3P, PSE, 12A @125VAC
CAB-L620P-C13-JPN	Power cord (Japan) 250VAC, 15A, NEMA L6-20 to C13, JAPAN
CAB-IND-10A	Power cord (India)
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 and Catalyst 2960-S switches
CAB-RPS2300-E=	Spare RPS2300 cable for Cisco Catalyst 2960-48PST-L, 2960-24PC-L and 2960-24LT-L switches and Catalyst 2960-S switches
CAB-RPS2300=	Spare RPS2300 cable for Cisco Catalyst 2960 except as noted with CAB-RPS2300-E above
BLWR-RPS2300=	Spare 45 CFM blower for Cisco Redundant Power System 2300
C3K-PWR-750WAC=	Catalyst 2960 and Catalyst 2960-S RPS 2300 750W AC power supply spare
PWR-A=	Power adapter for Cisco Catalyst 2960PD-8TT-L compact switch
CBLGRD-C2960-8TC=	Cable guard for Cisco Catalyst 2960-8TC compact switch
CBLGRD-C2960G-8TC=	Cable guard for Cisco Catalyst 2960G-8TC compact switch
RCKMNT-19-CMPCT=	Rack mount for Cisco Catalyst 2960-8TC and Catalyst 2960G-8TC compact switches
RCKMNT-1RU=	Spare rack-mount kit for Cisco Catalyst 2960 and 2960-S Series for 19- and 24-inch racks
RCKMNT-REC-1RU=	1 RU recessed rack-mount kit for Cisco Catalyst 2960 and 2960-S Series
GLC-LH-SM=	1000BASE-LX/LH SFP transceiver module for MMF and SMF, 1300-nm wavelength
GLC-SX-MM=	1000BASE-SX SFP transceiver module for MMF, 850-nm wavelength
GLC-ZX-SM=	1000BASE-ZX SFP transceiver module for SMF, 1550-nm wavelength
GLC-T=	1000BASE-T SFP transceiver module for Category 5 copper wire Not supported on the Cisco Catalyst 2960-8TC and Catalyst 2960G-8TC compact switches
GLC-BX-D=	1000BASE-BX10 SFP transceiver module for single strand SMF, 1490-nm TX/1310-nm RX wavelength
GLC-BX-U=	1000BASE-BX10 SFP transceiver module for single strand SMF, 1310-nm TX/1490-nm RX wavelength
GLC-GE-100FX=	100BASE-FX SFP module for Gigabit Ethernet ports, 1310-nm wavelength, 2 km over MMF Not supported on the Cisco Catalyst 2960-8TC and Catalyst 2960G-8TC compact switches
GLC-FE-100FX=	100BASE-FX SFP module for 100-Mb ports, 1310-nm wavelength, 2 km over MMF
GLC-FE-100LX=	100BASE-LX10 SFP module for 100-Mb ports, 1310-nm wavelength, 10 km over SMF
GLC-FE-100BX-D=	100BASE-BX10-D SFP module for 100-Mb ports, 1550-nm TX/1310-nm RX wavelength, 10 km over single-strand SMF
GLC-FE-100BX-U=	100BASE-BX10-U SFP module for 100-Mb ports, 1310-nm TX/1550-nm RX wavelength, 10 km over single-strand SMF
CWDM-SFP-1470=	Cisco CWDM SFP 1470 nm; Gigabit Ethernet and 1G/2G Fibre Channel (FC) (gray)
CWDM-SFP-1490=	Cisco CWDM SFP, 1490 nm; Gigabit Ethernet and 1G/2G FC (violet)
CWDM-SFP-1510=	Cisco CWDM SFP, 1510 nm; Gigabit Ethernet and 1G/2G FC (blue)
CWDM-SFP-1530=	Cisco CWDM SFP, 1530 nm; Gigabit Ethernet and 1G/2G FC (green)
CWDM-SFP-1550=	Cisco CWDM SFP, 1550 nm; Gigabit Ethernet and 1G/2G FC (yellow)
CWDM-SFP-1570=	Cisco CWDM SFP, 1570 nm; Gigabit Ethernet and 1G/2G FC (orange)
CWDM-SFP-1590=	Cisco CWDM SFP, 1590 nm; Gigabit Ethernet and 1G/2G FC (red)
CWDM-SFP-1610=	Cisco CWDM SFP, 1610 nm; Gigabit Ethernet and 1G/2G FC (brown)
CAB-SM-LCSC-1M	1m fiber single-mode LC-to-SC connectors
CAB-SM-LCSC-5M	5m fiber single-mode LC-to-SC connectors

Part Numbers	Description
SFP-10G-LR=	10GBASE-LR SFP+ module
SFP-10G-SR=	10GBASE-SR SFP+ module
SFP-10G-LRM=	10GBASE-LRM SFP module
SFP-10G-CX1=	10GBASE-CX1 SFP module
SFP-H10GB-CU1M=	10GBASE-CU SFP+ Cable 1 Meter
SFP-H10GB-CU3M=	10GBASE-CU SFP+ Cable 3 Meter
SFP-H10GB-CU5M=	10GBASE-CU SFP+ Cable 5 Meter

For the latest SFP compatibility information with C2960 model switches, please consult the tables available here: http://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

For more information about Cisco products, contact:

- United States and Canada: (toll free) 800 553-NETS (6387)
- Europe: 32 2 778 4242
- Australia: 612 9935 4107
- Other: 408 526-7209
- World Wide Web URL: http://www.cisco.com

APC Smart-UPS 3000VA USB & Serial RM 2U 230V
Part Number: SUA3000RMI2U

Salida	
Capacidad de Potencia de Salida	2700 Vatios / 3000 VA
Máxima potencia configurable	2700 Vatios / 3000 VA
Tensión de salida nominal	230V
Nota de tensión de salida	Configurable para tensión de salida nominal para 220 : 230 o 240
Distorsión de tensión de salida	Menos del 5% con carga completa
Frecuencia de salida (sincronizada a red eléctrica principal)	47 - 53 Hz para 50 Hz nominal, 57 - 63 Hz para 60 Hz nominal
Topología	Línea interactiva
Tipo de forma de onda	Onda senoidal
Conexiones de salida	(8) IEC 320 C13 (1) IEC 320 C19 (2) IEC Jumpers

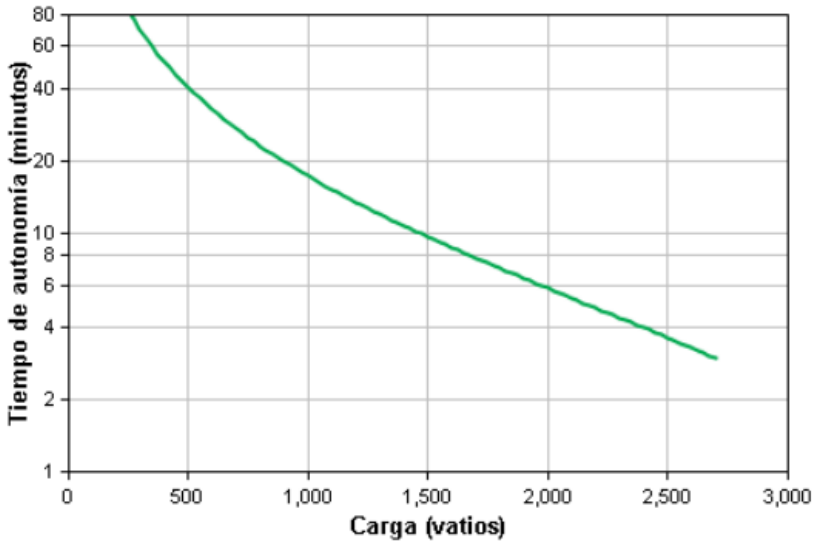
Entrada	
Entrada de voltaje	230V
Frecuencia de entrada	50/60 Hz +/- 3 Hz (autosensible)
Tipo de enchufe	IEC-320 C20 Schuko CEE 7 / EU1-16P British BS1363A

Variación de tensión de entrada para operaciones principales	160 - 286V
Variación de tensión de entrada adaptable para operaciones principales	151 - 302V

Baterías y autonomía

Tipo de batería	Batería sellada de plomo sin necesidad de mantención con electrolito suspendido: a prueba de filtración
Tiempo típico de recarga	3 hora(s)
Cartucho de repuesto de batería	RBC43
Cantidad de cartuchos de batería de recambio	1

Gráfico de autonomía



Comunicaciones y manejo

Puerto de interfaz	DB-9 RS-232, SmartSlot, USB
Cantidad de interfaces SmartSlot™	1
Panel de control	Visualizador de estatus LED con gráfico de barras de carga y batería y en línea: En línea: Batería en actividad: Batería de reemplazo: e indicadores de sobrecarga
Alarma audible	Alarma de batería encendida: alarma distintiva de carga de batería baja: retrasos configurables
Interruptor de emergencia (EPO)	Sí

Proteção contra surtos e filtragem

Clasificación de energía de	480 Joules

Físico	
Dimensiones de altura máxima	89.00 mm
Dimensiones de anchura máxima	483.00 mm
Dimensiones de profundidad máxima	660.00 mm
Altura del rack	2U
Peso neto	43.64 KG
Peso de embarque	54.00 KG
Altura de envío	250.00 mm
Anchura de envío	600.00 mm
Profundidad de envío	980.00 mm
Unidades de la caja master	1.00
Color	Negro
Unidades por tarima	8.00

Ambiental	
Ambiente operativo	0 - 40 °C
Humedad relativa de operación	0 - 95%
Elevación de operación	0-3000 metros
Temperatura de almacenamiento	-15 - 45 °C
Humedad relativa de almacenamiento	0 - 95%