

x540L Series

10 Gigabit Stackable Switches




Overview

Allied Telesis x540L Series switches provide high performance with up to 10G connectivity on every port. At the distribution layer, the power of Virtual Chassis Stacking (VCStack™) enables a resilient solution where up to 4 units, whether copper or fiber models, can be managed as a single virtual device for simplicity.

The x540L-28XTm and 28XHm have Multi-Gigabit (1/2.5/5/10G) copper ports for flexible deployment, while the x540L-28XS has 1/10G SFP fiber ports for secure long distance connectivity.

Power over Ethernet (PoE++) models connect and power wireless access points, IP video surveillance cameras, and more with up to 60W per port.

Device and network management

The Device GUI provides graphical monitoring of key switch features to support easy management, and the integrated Autonomous Wave Control (AWC) wireless controller provides visibility and management of wireless APs.

AWC automatically optimizes wireless performance, and floor and heat maps show coverage. AWC Channel Blanket hybrid operation provides maximum performance and seamless roaming, while AWC Smart Connect enables plug-and-play deployment using wireless uplink connectivity.

Resiliency

Converging network services means increasing demand for highly available networks with minimal downtime. VCStack, in conjunction with link aggregation, provides a network with no single point of failure, and provides access application resiliency.

Ethernet Protection Switched Ring (EPSRing™), and the standards-based G.8032 Ethernet Ring Protection, ensure distributed networks have high-speed access to online resources and applications.

Advanced Layer 3 performance

The x540L Series support both static routes and RIP, OSPF and BGP routing protocols. Easily manage Layer 3 environments, and increase routing capability when required with licensing.

Secure

The x540L Series offers powerful control over network traffic types, secure management options, loop guard to protect against cabling mistakes, and tri-authentication for comprehensive access control.

Network protection

Advanced storm protection features include bandwidth limiting, policy-based storm protection and packet storm protection. Network storms are often caused by cabling errors that result in a loop. The x540L Series detects loops as soon as they are created, with loop detection and thrash limiting taking immediate action to prevent storms.

Future-proof

x540L Series switches are Software Defined Networking (SDN) ready and support OpenFlow v1.3.

Powerful network management

Autonomous Management Framework™ Plus (AMF Plus) automates everyday management tasks, as the complete network can be managed as a single virtual device. Growing the network is plug-and-play simple, and device recovery fully zero-touch.

Key Features

- AlliedWare Plus fully featured OS
- Autonomous Management Framework Plus (AMF Plus)
- AMF-Security compatible
- 1/2.5/5/10G (Multi-Gigabit) copper ports
- 1/10 G (SFP and SFP+) fiber ports
- Up to 60W PoE++ per port (x540L-28XHm)
- VCStack 4 units at any speed
- EPSR and G.8032 high-speed resilient rings
- Media Redundancy Protocol (MRP)
- Active Fiber Monitoring
- Link Monitoring
- VLAN ACLs
- Precision Time Protocol (PTP) transparent mode
- Data Center Bridging Capabilities Exchange Protocol (DCBX)
- Enhanced Transmission Selection (ETS)
- Priority-based Flow Control (PFC)
- OpenFlow v1.3 for SDN
- Static and dynamic routing for L3 environments
- NETCONF/RESTCONF with YANG data modelling
- The wireless controller enables:
 - Wired and wireless network visibility
 - AWC wireless network management
 - AWC-Channel Blanket hybrid wireless
 - AWC-Smart Connect wireless uplinks

Cybersecurity

The x540L Series acting as AMF Plus members are compatible with our AMF-Security solution, which enables a self-defending network. The AMF-Sec controller responds immediately to any internal malware threats by instructing the x540L Series to isolate the affected part of the network, and quarantine the suspect device. Vista Manager EX alerts networks administrators of threats that have been dealt with.

KEY FEATURES

Autonomous Management Framework Plus (AMF Plus)

AMF Plus is a sophisticated suite of management tools that provide a simplified approach to network administration.

The x540L Series can operate as the AMF Plus master, storing firmware and configuration backups for other network nodes. The AMF Plus master enables auto-backup and auto-recovery for zero-touch device replacement, while auto-provisioning and auto-upgrade provide appropriate files to new network members. New network devices can be pre-provisioned, making installation plug-and-play easy because no onsite configuration is required.

An AMF Plus license provides all standard AMF network management and automation features, and also enables the AMF Plus intent-based networking features in Vista Manager EX (from version 3.10.1 onwards).

AWC Wireless Management

Optimize wireless network performance with the Autonomous Wave Control (AWC) Wireless Controller built-in to the Device GUI. AWC analyzes wireless traffic patterns and automatically reconfigures access points to meet demand.

Wireless network operation in multi-channel, single-channel (Channel Blanket), and hybrid (multi-channel and Channel Blanket) modes, supports maximum data throughput and seamless roaming for the most flexible wireless solution available.

AWC-Smart Connect (AWC-SC) enables plug-and-play wireless network growth, as new APs only need a power connection, and will then automatically create resilient wireless uplink connections to other APs.

High Speed

The x540L Series supports Multi-Gigabit (1/2.5/5/10G) speeds on copper and SFP and SFP+ (1/10G) speeds on fiber, for flexible high-density high-speed distribution or edge connectivity in next-generation networks.

Virtual Chassis Stacking (VCStack™)

Create a VCStack of up to four units with 40Gbps stacking bandwidth to each unit, which has dual links for increased resiliency. VCStack provides a highly available system where network resources are spread out across stacked units, reducing the impact if one of the units fails. Aggregating switch ports on different units across the stack provides excellent network resiliency.

Ethernet Protection Switched Ring (EPSRing™)

EPSRing allows several x540L switches to join a protected ring capable of recovery within as little as 50ms. This feature is perfect for high availability in enterprise networks.

G.8032 Ethernet Ring Protection

G.8032 provides standards-based high-speed ring protection, that can be deployed stand-alone, or interoperate with Allied Telesis EPSR.

Ethernet Connectivity Fault Monitoring (CFM) proactively monitors links and VLANs, and provides alerts when a fault is detected.

Advanced Layer 3 routing

The x540L Series support both static routes and RIP, OSPF and BGP. Increased routing capacity can be added with the premium software license.

Access Control Lists (ACLs)

ACLs filter network traffic to control whether routed packets are forwarded or blocked, and can be applied to a specific port or a VLAN. This provides a powerful network security mechanism to select the types of traffic to be analyzed, forwarded, or influenced in some way

Quality of Service

Data Center Bridging Capabilities Exchange Protocol (DCBX) lets network devices in the data center automatically discover and negotiate settings for DCB features, ensuring optimized performance.

Enhanced Transmission Selection (ETS) provides quality of service by allocating bandwidth to important traffic classes, with the flexibility to share remaining bandwidth to maximize traffic throughput and performance.

Priority-based Flow Control (PFC) enables lossless data forwarding by managing high priority traffic queues to support their class-of-service.

NETCONF/RESTCONF

NETCONF/RESTCONF with YANG data modeling provides a standardized way to represent data and securely configure devices.

Storm protection

Protect the network from broadcast storms:

Bandwidth limiting minimizes the effects of the storm by reducing the amount of flooding traffic.

Policy-based storm protection is more powerful than bandwidth limiting. It restricts storm damage to within the storming VLAN, with a defined traffic rate. The action the device should take when it detects a storm can be configured, such as disabling or shutting down the port..

Loop protection

Thrash limiting, also known as Rapid MAC movement, detects and resolves network loops. It is highly user-configurable – from the rate of looping traffic to the type of action the switch should take when it detects a loop.

sFlow

sFlow is an industry-standard technology for monitoring high-speed switched networks. It provides complete visibility into network use, enabling performance optimization, usage accounting/billing, and defense against security threats. Sampled packets sent to a collector (up to 5 collectors can be configured) ensure a real-time view of network traffic.

Tri-authentication

Authentication options include 802.1x port authentication, web authentication for guest access, and MAC authentication for end points without an 802.1x supplicant. All three can be used simultaneously.

Upstream Forwarding Only (UFO)

UFO lets you manage which ports in a VLAN can communicate with each other, and which only have upstream access to services, for secure multi-user deployment.

TACACS+ Command Authorization

TACACS+ Command Authorization offers centralized control over which commands may be issued by each

specific AlliedWare Plus device user. It complements authentication and accounting services for an AAA solution.

UniDirectional Link Detection

UniDirectional Link Detection (UDLD) is useful for monitoring fiber-optic links between two switches that use two single-direction fibers to transmit and receive packets. UDLD prevents traffic from being sent across a bad link by blocking the ports at both ends of the link in the event that either the individual transmitter or receiver for that connection fails.

Optical DDM

Most SFP/SFP+/XFPs support Digital Diagnostics Monitoring (DDM) functions, which enables real time monitoring of transceiver parameters, such as optical output power, temperature, laser bias current and supply voltage. This simplifies diagnosing problems with optical modules and fiber connections.

Active Fiber Monitoring

Active Fiber Monitoring prevents eavesdropping on fiber communications by monitoring received optical power. If an intrusion is detected, the link can be automatically shut down, or an operator alert can be sent.

VLAN Mirroring (RSPAN)

VLAN mirroring allows traffic from a port on a remote switch to be analyzed locally. Traffic being transmitted or received on the port is duplicated and sent across the network on a special VLAN.

Find Me

In busy server rooms it can be quite a job finding the correct switch quickly. "Find Me" is a simple visual way to identify the switch by causing its LEDs to flash in a specified pattern.

Precision Time Protocol (PTP)

PTP (IEEE 1588v2) synchronizes clocks throughout the network with micro-second accuracy, supporting industrial automation and control systems.

Link Monitoring (Linkmon)

Linkmon enables network health monitoring by regularly sending probes over key links to gather metrics comprising latency, jitter, and probe loss. This supports pro-active network management, and can also be used with triggers to automate a change to device or network configuration in response to the declining health of a monitored link.

Virtual Routing and Forwarding (VRF-Lite)

VRF-Lite provides Layer 3 network virtualization by dividing a single switch into multiple independent virtual routing domains. With independent routing domains, IP addresses can overlap without causing conflict, allowing multiple customers to have their own secure virtual network within the same physical infrastructure. VRF-Lite supports IPv4 and IPv6 unicast and multicast traffic.

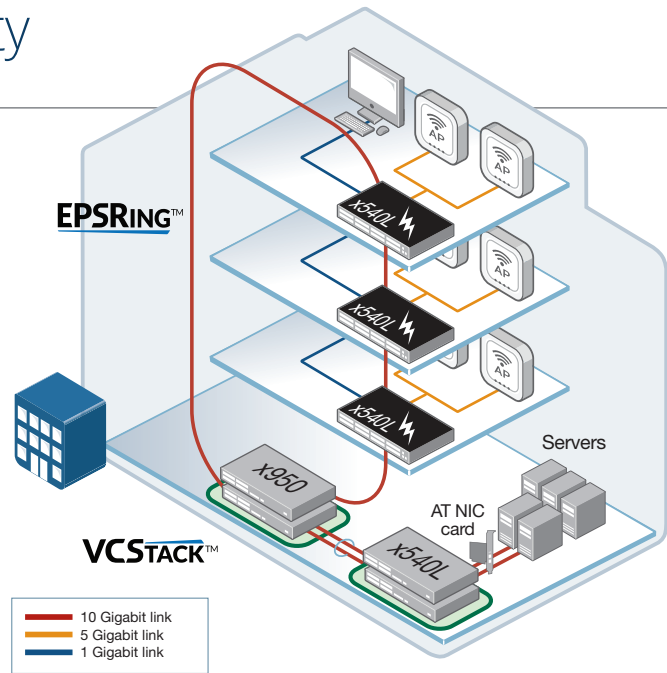
The built-in DHCP Server on the x540L Series is VRF aware, enabling the supply of IP addresses to clients across multiple isolated networks.

KEY SOLUTIONS

Flexible edge connectivity

Modern networks require superior performance to support the latest high-bandwidth applications, as well as the increasing number of wireless devices accessing online business resources. A high-speed resilient EPSR ring ensures always-on connectivity.

As shown in the diagram, the x540L Series supports multi-gigabit speeds of 2.5 and 5G, with PoE++ of up to 60W per port, making them ideal for high-speed wireless. 10G supports high performance server connectivity.

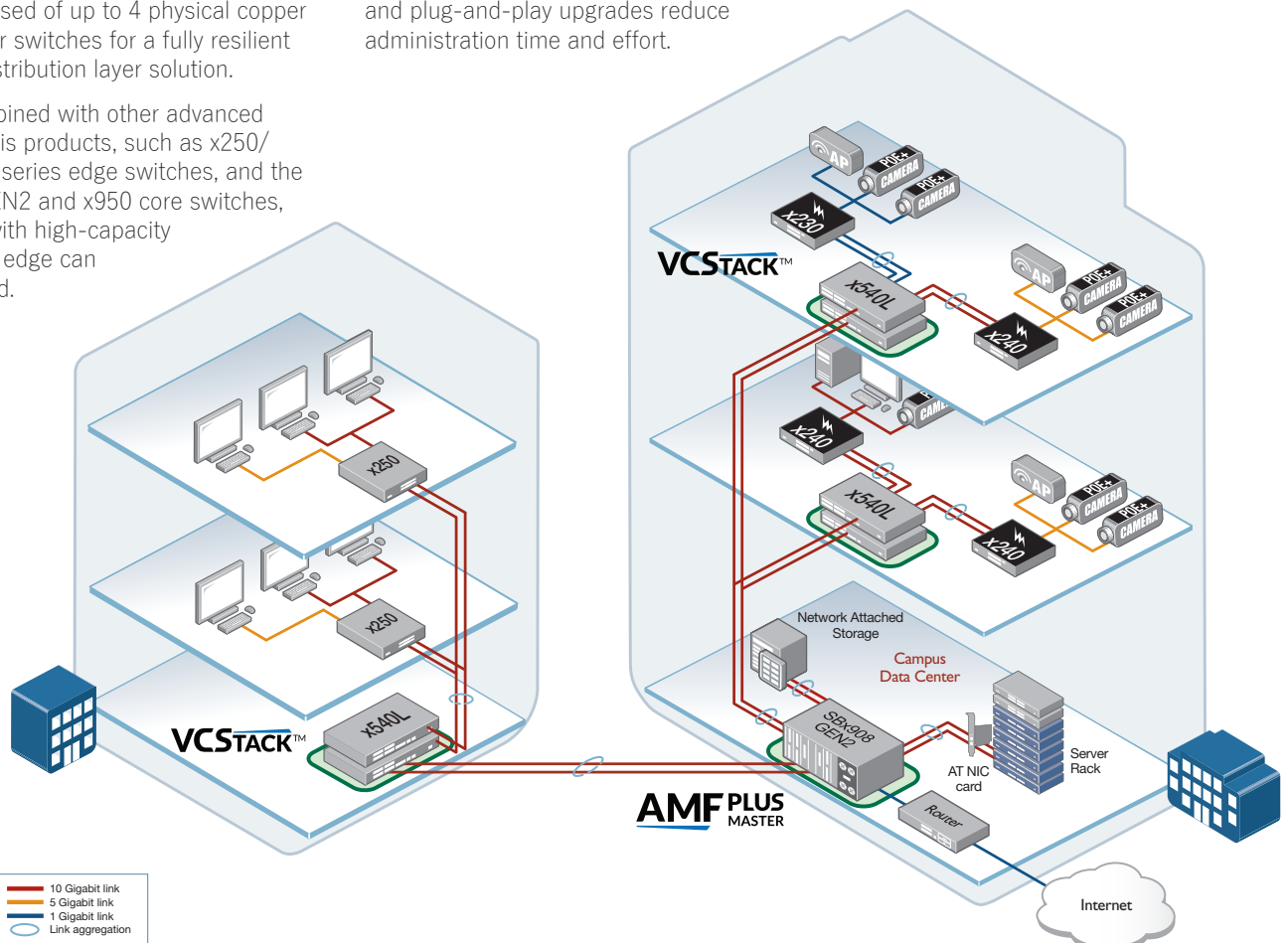


High performing network distribution

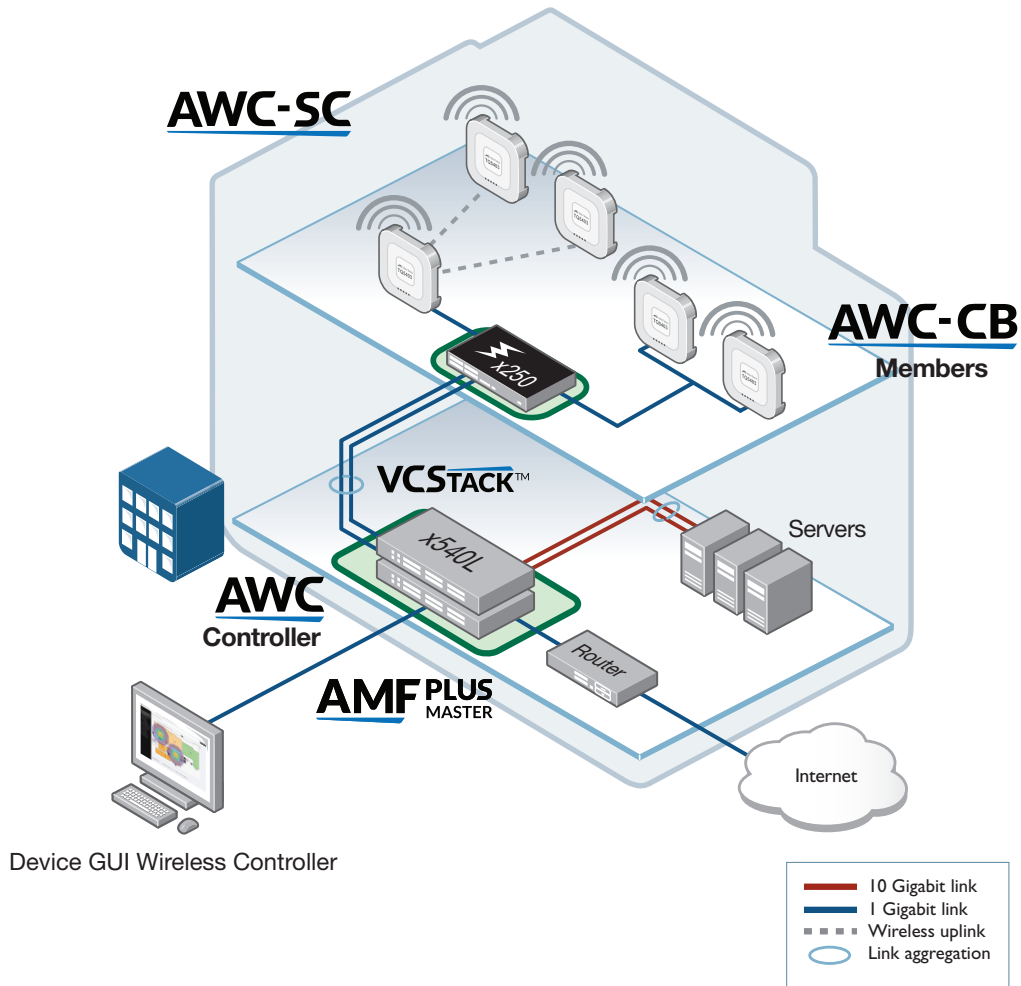
As shown in the diagram, the x540L Series provides up to 10G connectivity on every port for high performance. VCStack enables deploying a single virtual unit comprised of up to 4 physical copper and/or fiber switches for a fully resilient network distribution layer solution.

When combined with other advanced Allied Telesis products, such as x250/x240/x230 series edge switches, and the SBx908 GEN2 and x950 core switches, networks with high-capacity right to the edge can be deployed.

AMF Plus network management and automation provides an easy yet powerful solution. Simplified management of multiple devices, zero-touch replacement, and plug-and-play upgrades reduce administration time and effort.



Integrated wireless LAN management



Allied Telesis Autonomous Wave Controller (AWC) offers solutions for two of the most common problems with Wireless LANs: initial setup complexity and on-going performance degradation. Initial WLAN set-up usually requires a site survey to achieve the best coverage; and performance of WLANs can often change over time as external sources of radio interference reduce coverage and bandwidth. These issues can be time-consuming to identify and resolve.

AWC features an intelligent process that automatically re-calibrates the signal

strength and radio channel of each Access Point (AP) for optimal WLAN performance.

AWC Smart Connect (AWC-SC) uses wireless uplink connections between APs, so deployment is as easy as plugging in and powering on the new APs, which automatically extend the Wi-Fi network, creating a resilient solution.

The AWC wireless controller integrated into the Device GUI of the x540L Series provides an ideal solution for modern networks, enabling management of wireless APs. Up to 5 wireless APs can be

managed for free, and up to 100¹ APs with feature licenses

On some AP models, hybrid channel blanket enables multi-channel and single-channel WiFi operation simultaneously. This supports seamless roaming and maximum throughput. Channel Blanket licenses are available for up to 100¹ APs, which enable both Channel Blanket (AWC-CB) and Smart Connect (AWC-SC).

¹ Please note that the 100 limit also includes AMF nodes, and is flexible. For example, a user could buy licenses for 20 AMF nodes and 80 APs.

SPECIFICATIONS

Product Specifications

	100/1000T/2.5/5/10G (RJ-45) copper ports	1/10 gigabit SFP+ Ports	Total Ports	PoE enable Ports	Switching Fabric	Forwarding Rate
x540L-28XTm	24	4	28		560Gbps	416.7Mpps
x540L-28XHm	24	4	28	24	560Gbps	416.7Mpps
x540L-28XS	-	28	28		560Gbps	416.7Mpps

Power Characteristics

	No PoE Load			Full PoE+ Load			Max PoE Power	PoE sourcing ports					
	Max Power Consumption	Max Heat Dissipation	Noise	Max Power Consumption	Max Heat Dissipation	Noise		PoE (7.5W)	PoE (15.4W)	PoE+ (30W)	PoE++ (60W)	PoE++ (90W)	
x540L-28XTm	160W	540 BTU/h	46-63 db	-	-	-	-	-	-	-	-	-	-
x540L-28XHm	170W	580 BTU/h	39-52 db	890W	3033 BTU/h	51-67 db	600W	24	24	20	10	6	
x540L-28XS	86W	293 BTU/h	39-52 db	-	-	-	-	-	-	-	-	-	-

Noise: tested to ISO7779; front bystander position

Physical Specifications

	Width	Depth	Height	Weight
x540L-28XTm	440 mm (17.32 in)	290 mm (11.41 in)	44 mm (1.73 in)	4.0 kg (8.8 lb)
x540L-28XHm	441 mm (17.36 in)	421 mm (16.57 in)	44 mm (1.73 in)	6.1 kg (13.4 lb)
x540L-28XS	440 mm (17.32 in)	290 mm (11.41 in)	44 mm (1.73 in)	3.8 kg (8.3 lb)

Latency (microseconds)

	Port Speed			
	1Gbps	2.5Gbps	5Gbps	10Gbps
x540L-28XTm	4.48µs	8.43µs	5.72µs	2.73µs
x540L-28XHm	5.12µs	8.35µs	5.73µs	4.75µs
x540L-28XS	3.59µs	-	-	1.60µs

Performance

- Up to 32K MAC addresses
- Up to 1,000 static routes
- Up to 256 dynamic routes
- 2GB DDR SDRAM
- 4094 configurable VLANs
- 256MB flash memory
- Packet Buffer memory: 8MB
- Supports 9KB L2 jumbo frames
- Wirespeed forwarding

Reliability

- Modular AlliedWare Plus operating system
- Full environmental monitoring of PSU internal temperature and internal voltages. SNMP traps alert network managers in case of any failure

Flexibility and compatibility

- 10G SFP+ ports will support any combination of Allied Telesis 1000Mbps SFP and 10GbE SFP+ modules and direct attach cables listed in this document under Ordering Information
- Flexi-stacking - use any port-speed to stack

Diagnostic Tools

- Active Fiber Monitoring detects tampering on optical links
- Cable fault locator (TDR)
- Find-me device locator
- Connectivity Fault Management (CFM) for use with G.8032 ERPS
- Link Monitoring
- Automatic link flap detection and port shutdown
- Optical Digital Diagnostic Monitoring (DDM)
- Ping polling for IPv4 and IPv6
- Port mirroring
- No limit on mirrored ports
- Up to 7 mirror (analyzer) ports
- VLAN mirroring (RSPAN)
- TraceRoute for IPv4 and IPv6
- Uni-Directional Link Detection (UDLD)

IPv4 Features

- Black hole routing
- DHCP client, relay and server for IPv4 and IPv6

- Directed broadcast forwarding
- DNS relay
- Equal Cost Multi Path (ECMP) routing
- Policy-based routing
- Route maps
- Route redistribution (OSPF, BGP, RIP)
- Static IPv4 multicast routing
- Static unicast routing for IPv4
- UDP broadcast helper (IP helper)
- Virtual Routing and Forwarding Lite (VRF-Lite) up to 64 domains

IPv6 Features

- DHCPv6 client and relay
- DNSv6 client, DNSv6 relay
- IPv4 and IPv6 dual stack
- IPv6 aware storm protection and QoS
- IPv6 hardware ACLs
- Device management over IPv6 networks with SNMPv6, Telnetv6 and SSHv6
- IPv6 QoS support
- NTP client and server
- Static and dynamic IPv6 multicast routing
- Static and dynamic unicast routing for IPv6
- Log to IPv6 hosts with Syslog v6
- VRF-Lite

Management

- Autonomous Management Framework Plus (AMF plus) enables powerful centralized management and zero-touch device installation and recovery
- Try AMF Plus for free with the built-in Starter license (includes network management and automation features, but not Vista Manager AMF Plus features)
- NETCONF/RESTCONF northbound interface with YANG data modelling
- Console management port on the front panel for ease of access
- Eco-friendly mode allows ports and LEDs to be disabled to save power
- Industry-standard CLI with context-sensitive help
- Powerful CLI scripting engine

- Comprehensive SNMP MIB support for standards-based device management
- Built-in text editor
- Event-based triggers allow user-defined scripts to be executed upon selected system events
- USB interface allows software release files, configurations and other files to be stored for backup and distribution to other devices
- Wireless controller for managing APs
- Web-based Graphical User Interface (GUI)

Quality of Service (QoS)

- 8 priority queues with a hierarchy of high priority queues for real time traffic, and mixed scheduling, for each switch port
- Limit bandwidth per port or per traffic class down to 64kbps
- Wirespeed traffic classification with low latency essential for VoIP and real-time streaming media applications
- Policy-based QoS based on VLAN, port, MAC and general packet classifiers
- Policy-based storm protection
- Extensive remarking capabilities
- Taildrop for queue congestion control
- Queue scheduling options for strict priority, weighted round robin or mixed scheduling
- IP precedence and DiffServ marking based on layer 2, 3 and 4 headers
- Data Center Bridging Capabilities Exchange Protocol (DCBX)
- Enhanced Transmission Selection (ETS)
- Priority-based Flow Control (PFC)

Resiliency Features

- Continuous PoE
- Control Plane Prioritization (CPP) ensures the CPU always has sufficient bandwidth to process network control traffic
- Dynamic link failover (host attach)
- EPSR (Ethernet Protection Switched Rings)
- EPSRing SuperLoop Protection (SLP)
- Ethernet Ring Protection Switching (ITU-T G.8032 ERPS)
- Media Redundancy Protocol (MRP)
- Link aggregation (LACP) on LAN ports
- Loop protection: loop detection and thrash limiting
- PVST+ compatibility mode
- Spanning Tree Protocols (STP, RSTP, MSTP)
- STP root guard
- VCStack fast failover minimizes network disruption
- Flexi-stacking - use any port-speed to stack
- Long-distance stacking with 10G SFP+ modules (LD-VCStack)
- Virtual Router Redundancy Protocol (VRRP)

Security Features

- Access Control Lists (ACLs) based on layer 3 and 4 headers
- Auth fail and guest VLANs
- RADIUS and TACACS+ Authentication, Authorisation and Accounting (AAA)
- Bootloader can be password protected for device security
- BPDU protection
- DHCP snooping, IP source guard and Dynamic ARP Inspection (DAI)
- DoS attack blocking and virus throttling
- Dynamic VLAN assignment

- Local RADIUS server for user and device authentication
- MAC-based authentication
- MAC address filtering and MAC address lock-down
- Network Access and Control (NAC) features manage endpoint security
- Port-based learn limits (intrusion detection)
- RADIUS group selection per VLAN or port
- RADIUS proxy
- Secure Copy (SCP)
- Secure File Transfer Protocol (SFTP) client
- Simple Certificate Enrollment Protocol (SCEP) supports secure management
- Strong password security and encryption
- Tri-authentication: MAC-based, web-based and IEEE 802.1x

VLAN Support

- Private VLANs provide security and port isolation for multiple customers using the same VLAN
- Upstream Forwarding Only (UFO)
- VLAN ID translation
- Voice VLAN

Environmental Specifications

- Operating temperature range: 0°C to 50°C (32°F to 122°F)
Derated by 1°C per 305 meters (1,000 ft)
- Storage temperature range: -25°C to 70°C (-13°F to 158°F)
- Operating relative humidity range: 5% to 90% non-condensing
- Storage relative humidity range: 5% to 95% non-condensing
- Operating altitude: 3,000 meters maximum (9,843 ft)

Electrical approvals and compliances

- EMC: ETSI EN300-386, EN300-132-2,
- FCC class A, VCCI class A
- Immunity: EN55024, EN61000-3-levels 2 (Harmonics), and 3 (Flicker) – AC models only

Safety

- Standards: UL62368-1, CAN/CSA-C22.2 No. 60950-1-03, EN60950-1, EN60825-1, AS/NZS 60950.1
- Certifications: UL, cUL, UL-EU

Restrictions on Hazardous Substances (RoHS) Compliance

- EU RoHS compliant
- China RoHS compliant-1

STANDARDS & PROTOCOLS

AlliedWare Plus Operating System

Version 5.5.6

Authentication

- RFC 1321 MD5 Message-Digest algorithm
- RFC 1828 IP authentication using keyed MD5

Border Gateway Protocol (BGP)

- BGP dynamic capability
- BGP outbound route filtering
- RFC 1772 Application of the Border Gateway Protocol (BGP) in the Internet
- RFC 1997 BGP communities attribute
- RFC 2385 Protection of BGP sessions via the TCP MD5 signature option

- RFC 2439 BGP route flap damping
- RFC 2545 Use of BGP-4 multiprotocol extensions for IPv6 inter-domain routing
- RFC 2858 Multiprotocol extensions for BGP-4
- RFC 2918 Route refresh capability for BGP-4
- RFC 3392 Capabilities advertisement with BGP-4
- RFC 3882 Configuring BGP to block Denial-of-Service (DoS) attacks
- RFC 4271 Border Gateway Protocol 4 (BGP-4)
- RFC 4360 BGP extended communities
- RFC 4456 BGP route reflection - an alternative to full mesh iBGP
- RFC 4724 BGP graceful restart
- RFC 4893 BGP support for four-octet AS number space
- RFC 5065 Autonomous system confederations for BGP
- RFC 5492 Capabilities advertisement with BGP-4
- RFC 5925 The TCP authentication option
- RFC 6793 BGP support for four-octet AS number space
- RFC 7606 Revised error handling for BGP UPDATE messages

Cryptographic Algorithms

FIPS Approved Algorithms

Encryption (Block Ciphers):

- AES (ECB, CBC, CFB and OFB Modes)
- 3DES (ECB, CBC, CFB and OFB Modes)

Block Cipher Modes:

- CCM
- CMAC
- GCM
- XTS

Digital Signatures & Asymmetric Key Generation:

- DSA
- ECDSA
- RSA

Secure Hashing:

- SHA-1
- SHA-2 (SHA-224, SHA-256, SHA-384, SHA-512)
- Message Authentication: HMAC (SHA-1, SHA-2(224, 256, 384, 512)
- Random Number Generation: DRBG (Hash, HMAC and Counter)

Non FIPS Approved Algorithms

- RNG (AES128/192/256)
- DES
- MD5

Ethernet Standards

- IEEE 802.2 Logical Link Control (LLC)
- IEEE 802.3 Ethernet
- IEEE 802.3ab1000BASE-T
- IEEE 802.3ae10 Gigabit Ethernet
- IEEE 802.3an10GBASE-T
- IEEE 802.3azEnergy Efficient Ethernet (EEE)
- IEEE 802.3af Power over Ethernet (PoE)
- IEEE 802.3at Power over Ethernet up to 30W (PoE+)
- IEEE 802.3bt Power over Ethernet up to 90W (PoE++)
- IEEE 802.3bz2.5GBASE-T and 5GBASE-T ("multi-gigabit")
- IEEE 802.3x Flow control - full-duplex operation
- IEEE 802.3z 1000BASE-X

IPv4 Features

- RFC 768 User Datagram Protocol (UDP)
- RFC 791 Internet Protocol (IP)
- RFC 792 Internet Control Message Protocol (ICMP)
- RFC 793 Transmission Control Protocol (TCP)
- RFC 826 Address Resolution Protocol (ARP)
- RFC 894 Standard for the transmission of IP datagrams over Ethernet networks
- RFC 919 Broadcasting Internet datagrams
- RFC 922 Broadcasting Internet datagrams in the presence of subnets
- RFC 932 Subnetwork addressing scheme
- RFC 950 Internet standard subnetting procedure
- RFC 951 Bootstrap Protocol (BootP)
- RFC 1027 Proxy ARP
- RFC 1035 DNS client
- RFC 1042 Standard for the transmission of IP datagrams over IEEE 802 networks
- RFC 1071 Computing the Internet checksum
- RFC 1122 Internet host requirements
- RFC 1191 Path MTU discovery
- RFC 1256 ICMP router discovery messages

RFC 1518	An architecture for IP address allocation with CIDR
RFC 1519	Classless Inter-Domain Routing (CIDR)
RFC 1542	Clarifications and extensions for BootP
RFC 1591	Domain Name System (DNS)
RFC 1812	Requirements for IPv4 routers
RFC 1918	IP addressing
RFC 2581	TCP congestion control
RFC 3021	Using 31-Bit Prefixes on IPv4 Point-to-Point Links

IPv6 Features

RFC 1981	Path MTU discovery for IPv6
RFC 2460	IPv6 specification
RFC 2464	Transmission of IPv6 packets over Ethernet networks
RFC 3484	Default address selection for IPv6
RFC 3587	IPv6 global unicast address format
RFC 3596	DNS extensions to support IPv6
RFC 4007	IPv6 scoped address architecture
RFC 4193	Unique local IPv6 unicast addresses
RFC 4213	Transition mechanisms for IPv6 hosts and routers
RFC 4291	IPv6 addressing architecture
RFC 4443	Internet Control Message Protocol (ICMPv6)
RFC 4861	Neighbor discovery for IPv6
RFC 4862	IPv6 Stateless Address Auto-Configuration (SLAAC)
RFC 5014	IPv6 socket API for source address selection
RFC 5095	Deprecation of type 0 routing headers in IPv6
RFC 5175	IPv6 Router Advertisement (RA) flags option
RFC 6105	IPv6 Router Advertisement (RA) guard

Management

AT Enterprise MIB including AMF Plus MIB and SNMP traps	
Optical DDM MIB	
SNMPv1, v2c and v3	
Power over Ethernet (PoE) MIB	
ANSI/TIA-1057 LLDP-Media Endpoint Detection	
IEEE 802.1AB Link Layer Discovery Protocol (LLDP)	
RFC 1155	Structure and identification of management information for TCP/IP-based Internets
RFC 1157	Simple Network Management Protocol (SNMP)
RFC 1212	Concise MIB definitions
RFC 1213	MIB for network management of TCP/IP-based Internets: MIB-II
RFC 1215	Convention for defining traps for use with the SNMP
RFC 1227	SNMP MUX protocol and MIB
RFC 1239	Standard MIB
RFC 1724	RIPv2 MIB extension
RFC 2578	Structure of Management Information v2 (SMIv2)
RFC 2579	Textual conventions for SMIv2
RFC 2580	Conformance statements for SMIv2
RFC 2674	Definitions of managed objects for bridges with traffic classes, multicast filtering and VLAN
RFC 2741	Agent extensibility (AgentX) protocol
RFC 2787	Definitions of managed objects for VRRP
RFC 2819	RMON MIB (groups 1,2,3 and 9)
RFC 2863	Interfaces group MIB
RFC 3176	sFlow: a method for monitoring traffic in switched and routed networks
RFC 3411	An architecture for describing SNMP management frameworks
RFC 3412	Message processing and dispatching for the SNMP
RFC 3413	SNMP applications
RFC 3414	User-based Security Model (USM) for SNMPv3
RFC 3415	View-based Access Control Model (VACM) for SNMP
RFC 3416	Version 2 of the protocol operations for the SNMP
RFC 3417	Transport mappings for the SNMP
RFC 3418	MIB for SNMP
RFC 3635	Definitions of managed objects for the Ethernet-like interface types
RFC 3636	IEEE 802.3 MAU MIB
RFC 4022	MIB for the Transmission Control Protocol (TCP)
RFC 4113	MIB for the User Datagram Protocol (UDP)

RFC 4188	Definitions of managed objects for bridges
RFC 4292	IP forwarding table MIB
RFC 4293	MIB for the Internet Protocol (IP)
RFC 4318	Definitions of managed objects for bridges with RSTP
RFC 4560	Definitions of managed objects for remote ping, traceroute and lookup operations
RFC 5424	The Syslog protocol
RFC 6527	Definitions of managed objects for VRRPv3

Multicast Support

Bootstrap Router (BSR) mechanism for PIM-SM	
IGMP query solicitation	
IGMP snooping (IGMPv1, v2 and v3)	
IGMP snooping fast-leave	
IGMP/MLD multicast forwarding (IGMP/MLD proxy)	
MLD snooping (MLDv1 and v2)	
PIM and PIM SSM for IPv6	
RFC 1112	Host extensions for IP multicasting (IGMPv1)
RFC 2236	Internet Group Management Protocol v2 (IGMPv2)
RFC 2710	Multicast Listener Discovery (MLD) for IPv6
RFC 2715	Interoperability rules for multicast routing protocols
RFC 3306	Unicast-prefix-based IPv6 multicast addresses
RFC 3376	IGMPv3
RFC 3590	Source address selection for the Multicast Listener Discovery (MLD) protocol
RFC 3618	Multicast Source Discovery Protocol (MSDP)
RFC 3810	Multicast Listener Discovery v2 (MLDv2) for IPv6
RFC 3956	Embedding the Rendezvous Point (RP) address in an IPv6 multicast address
RFC 3973	PIM Dense Mode (DM)
RFC 4541	IGMP and MLD snooping switches
RFC 4604	Using IGMPv3 and MLDv2 for source-specific multicast
RFC 4607	Source-specific multicast for IP
RFC 7761	Protocol Independent Multicast - Sparse Mode (PIM-SM)

Open Shortest Path First (OSPF)

OSPF link-local signaling	
OSPF MD5 authentication	
Out-of-band LSDB resync	
RFC 1245	OSPF protocol analysis
RFC 1246	Experience with the OSPF protocol
RFC 1370	Applicability statement for OSPF
RFC 1765	OSPF database overflow
RFC 2328	OSPFv2
RFC 2370	OSPF opaque LSA option
RFC 2740	OSPFv3 for IPv6
RFC 3101	OSPF Not-So-Stubby Area (NSSA) option
RFC 3509	Alternative implementations of OSPF area border routers
RFC 3623	Graceful OSPF restart
RFC 3630	Traffic engineering extensions to OSPF
RFC 4552	Authentication/confidentiality for OSPFv3
RFC 5329	Traffic engineering extensions to OSPFv3
RFC 5340	OSPFv3 for IPv6 (partial support)

Quality of Service (QoS)

IEEE 802.1p	Priority tagging
IEEE 802.1Qaz	Data Center Bridging Capabilities Exchange Protocol (DCBX)
IEEE 802.1Qaz	Enhanced Transmission Selection (ETS)
IEEE 802.1Qbb	Priority-based Flow Control (PFC)
RFC 2211	Specification of the controlled-load network element service
RFC 2474	DiffServ precedence for eight queues/port
RFC 2475	DiffServ architecture
RFC 2597	DiffServ Assured Forwarding (AF)
RFC 2697	A single-rate three-color marker
RFC 2698	A two-rate three-color marker
RFC 3246	DiffServ Expedited Forwarding (EF)

Resiliency Features

IEC61439-2	Media Redundancy Protocol (MRP)
ITU-T G.8032 / Y.1344	Ethernet Ring Protection Switching (ERPS)
IEEE 802.1ag	Connectivity Fault Management (CFM), Continuity Check Protocol (CCP)
IEEE 802.1AX	Link aggregation (static and LACP)

IEEE 802.1D	MAC bridges
IEEE 802.1s	Multiple Spanning Tree Protocol (MSTP)
IEEE 802.1w	Rapid Spanning Tree Protocol (RSTP)
IEEE 802.3ad	Static and dynamic link aggregation
RFC 5798	Virtual Router Redundancy Protocol version 3 (VRRPv3) for IPv4 and IPv6

Routing Information Protocol (RIP)

RFC 1058	Routing Information Protocol (RIP)
RFC 2080	RIPng for IPv6
RFC 2081	RIPng protocol applicability statement
RFC 2082	RIP-2 MD5 authentication
RFC 2453	RIPv2

Security Features

SSH remote login	
SSLv2 and SSLv3	
IEEE 802.1X	authentication protocols (TLS, TTLS, PEAP and MD5)
IEEE 802.1X	multi-suplicant authentication
IEEE 802.1X	port-based network access control
RFC 2560	X.509 Online Certificate Status Protocol (OCSP)
RFC 2818	HTTP over TLS ("HTTPS")
RFC 2865	RADIUS authentication
RFC 2866	RADIUS accounting
RFC 2868	RADIUS attributes for tunnel protocol support
RFC 2986	PKCS #10: certification request syntax specification v1.7
RFC 3546	Transport Layer Security (TLS) extensions
RFC 3579	RADIUS support for Extensible Authentication Protocol (EAP)
RFC 3580	IEEE 802.1x RADIUS usage guidelines
RFC 3748	PPP Extensible Authentication Protocol (EAP)
RFC 4251	Secure Shell (SSHv2) protocol architecture
RFC 4252	Secure Shell (SSHv2) authentication protocol
RFC 4253	Secure Shell (SSHv2) transport layer protocol
RFC 4254	Secure Shell (SSHv2) connection protocol
RFC 5176	RADIUS Change of Authorization (CoA)
RFC 5280	X.509 certificate and Certificate Revocation List (CRL) profile
RFC 5425	Transport Layer Security (TLS) transport mapping for Syslog
RFC 5656	Elliptic curve algorithm integration for SSH
RFC 6125	Domain-based application service identity within PKI using X.509 certificates with TLS
RFC 6614	Transport Layer Security (TLS) encryption for RADIUS
RFC 6668	SHA-2 data integrity verification for SSH
RFC 8446	Transport Layer Security (TLS) v1.3
RFC 8894	Simple Certificate Enrollment Protocol (SCEP)

Services

RFC 854	Telnet protocol specification
RFC 855	Telnet option specifications
RFC 857	Telnet echo option
RFC 858	Telnet suppress go ahead option
RFC 1091	Telnet terminal-type option
RFC 1350	Trivial File Transfer Protocol (TFTP)
RFC 1985	SMTP service extension
RFC 2049	MIME
RFC 2131	DHCPv4 (server, relay and client)
RFC 2132	DHCP options and BootP vendor extensions
RFC 2616	Hypertext Transfer Protocol - HTTP/1.1
RFC 2821	Simple Mail Transfer Protocol (SMTP)
RFC 2822	Internet message format
RFC 3046	DHCP relay agent information option (DHCP option 82)
RFC 3315	DHCPv6 (server, relay and client)
RFC 3396	Encoding long options in DHCPv4
RFC 3633	IPv6 prefix options for DHCPv6
RFC 3646	DNS configuration options for DHCPv6
RFC 3993	Subscriber-ID suboption for DHCP relay agent option
RFC 4330	Simple Network Time Protocol (SNTP) version 4
RFC 4954	SMTP service extension for authentication
RFC 5905	Network Time Protocol (NTP) version 4

VLAN Support

IEEE 802.1ad	Provider bridges (VLAN stacking, Q-in-Q)
IEEE 802.1Q	Virtual LAN (VLAN) bridges
IEEE 802.1v	VLAN classification by protocol and port
IEEE 802.3ac	VLAN tagging

Feature Licenses

	Description	Includes	Stack Licensing
AT-FL-x540L-01	x540L Premium license	<ul style="list-style-type: none"> ■ OSPFv2 (256 routes)² ■ BGP4 (256 routes)² ■ PIMv4-SM, DM and SSM v4 ■ RIPng (256 routes) ■ OSPFv3 (256 routes) ■ MLDv1/v2 ■ PIM-SMv6/SSMv6 ■ VLAN double tagging (Q-in-Q) ■ VLAN Translation ■ PTP Transparent Mode ■ RADIUS Full ■ VRF-Lite (64 domains) 	<ul style="list-style-type: none"> ■ One license per stack member
AT-SW-APM10-1YR^{3,4}	Cumulative AMF Plus Master license	<ul style="list-style-type: none"> ■ AMF Plus Master license for up to 10 nodes for 1 year 	<ul style="list-style-type: none"> ■ One license per stack
AT-SW-APM10-5YR^{3,4}	Cumulative AMF Plus Master license	<ul style="list-style-type: none"> ■ AMF Plus Master license for up to 10 nodes for 5 years 	<ul style="list-style-type: none"> ■ One license per stack
AT-SW-AWC10-1YR⁵	Cumulative AWC license	<ul style="list-style-type: none"> ■ Autonomous Wave Control (AWC) license for up to 10 access points for 1 year 	<ul style="list-style-type: none"> ■ One license per stack
AT-SW-AWC10-5YR⁵	Cumulative AWC license	<ul style="list-style-type: none"> ■ Autonomous Wave Control (AWC) license for up to 10 access points for 5 years 	<ul style="list-style-type: none"> ■ One license per stack
AT-SW-CB10-1YR-2022⁶	Cumulative AWC-CB and AWC-SC license	<ul style="list-style-type: none"> ■ AWC Channel Blanket and AWC Smart Connect license for up to 10 access points for 1 year 	<ul style="list-style-type: none"> ■ One license per stack
AT-SW-CB10-5YR-2022⁶	Cumulative AWC-CB and AWC-SC license	<ul style="list-style-type: none"> ■ AWC Channel Blanket and AWC Smart Connect license for up to 10 access points for 5 years 	<ul style="list-style-type: none"> ■ One license per stack
AT-FL-x540L-OF13-1YR	OpenFlow license	<ul style="list-style-type: none"> ■ OpenFlow v1.3 for 1 year 	<ul style="list-style-type: none"> ■ Not supported on a stack
AT-FL-x540L-OF13-5YR	OpenFlow license	<ul style="list-style-type: none"> ■ OpenFlow v1.3 for 5 years 	<ul style="list-style-type: none"> ■ Not supported on a stack

² 64 OSPF and BGP routes included in base license

³ From AW+ version 5.5.2-2 onwards, AMF Plus licenses provide all standard AMF network management and automation features. They also enable the AMF Plus intent-based networking features in Vista Manager EX (from version 3.10.1 onwards)

⁴ Purchase one license per 10 AMF nodes (up to 100 nodes maximum). Note that the 100 limit also includes APs and is flexible. For example a user could buy licenses for 20 AMF nodes, and 80 APs

⁵ 5 APs can be managed for free. Purchase one license per 10 additional APs (up to 100 APs maximum). Note that the 100 limit also includes AMF nodes and is flexible. For example a user could buy licenses for 30 AMF nodes and 70 APs.

⁶ Channel Blanket and Smart Connect are not available as free services. Both an AWC-CB license and an AWC license are required for Channel Blanket and/or Smart Connect to operate. Purchase one AWC-CB license per 10 APs (up to 100 APs maximum).

ORDERING INFORMATION

AT-x540L-28XTm	24-port 100M/1/2.5/5/10G stackable copper switch with 4 x SFP/SFP+ports, and a single fixed PSU
AT-x540L-28XHm	24-port 100M/1/2.5/5/10G PoE++ stackable copper switch with 4 x SFP/SFP+ports, and a single fixed PSU
AT-x540L-28XS	28-port SFP/SFP+ stackable fiber switch, with a single fixed PSU

Accessories

10GbE SFP+ Modules	
Any 10G SFP+ module or cable can be used for stacking with the front panel 10G ports	
AT-SP10SR	10GSR 850 nm short-haul, 300 m with MMF
AT-SP10SR/I	10GSR 850 nm short-haul, 300 m with MMF industrial temperature
AT-SP10LRa/I	10GLR 1310 nm medium-haul, 10 km with SMF industrial temperature Trade Act Agreement compliant

AT-SP10ER40a/I	10GER 1310 nm long-haul, 40 km with SMF industrial temperature
AT-SP10ZR80/I	10GER 1550 nm long-haul, 80 km with SMF industrial temperature
AT-SP10TM/I	1G/2.5G/5G/10G, 100 m copper, industrial temperature, TAA ⁵

10GbE SFP+ Modules	
AT-SP10BD10/I-12	10 GbE Bi-Di (1270 nm Tx, 1330 nm Rx) fiber up to 10 km industrial temperature, TAA ⁷
AT-SP10BD10/I-13	10 GbE Bi-Di (1330 nm Tx, 1270 nm Rx) fiber up to 10 km industrial temperature, TAA ⁷
AT-SP10BD20-12	10 GbE Bi-Di (1270 nm Tx, 1330 nm Rx) fiber up to 20 km, TAA ⁷
AT-SP10BD20-13	10 GbE Bi-Di (1330 nm Tx, 1270 nm Rx) fiber up to 20 km, TAA ⁷
AT-SP10BD40/I-12	10 GbE Bi-Di (1270 nm Tx, 1330 nm Rx) fiber up to 40 km industrial temperature, TAA ⁷
AT-SP10BD40/I-13	10 GbE Bi-Di (1330 nm Tx, 1270 nm Rx) fiber up to 40 km industrial temperature, TAA ⁷
AT-SP10BD80/I-14	10 GbE Bi-Di (1490 nm Tx, 1550 nm Rx) fiber up to 80 km industrial temperature, TAA ⁷
AT-SP10BD80/I-15	10 GbE Bi-Di (1550nm Tx, 1490 nm Rx) fiber up to 80 km industrial temperature, TAA ⁷
10GbE SFP+ Cables	
AT-SP10TW1	1 meter SFP+ direct attach cable
AT-SP10TW3	3 meter SFP+ direct attach cable

⁷ Trade Act Agreement compliant

1000Mbps SFP Modules	
AT-SPSX	1000SX GbE multi-mode 850 nm fiber up to 550 m
AT-SPLX10a	1000LX GbE single-mode 1310 nm fiber up to 10 km
AT-SPLX10a/I	1000LX GbE single-mode 1310 nm fiber up to 10 km industrial temperature
AT-SPBD10-13	1000LX GbE Bi-Di (1310 nm Tx, 1490 nm Rx) fiber up to 10 km
AT-SPBD10-14	1000LX GbE Bi-Di (1490 nm Tx, 1310 nm Rx) fiber up to 10 km
AT-SPBD20-13/I	1000BX GbE Bi-Di (1310 nm Tx, 1490 nm Rx) fiber up to 20 km industrial temperature
AT-SPBD20-14/I	1000BX GbE Bi-Di (1490 nm Tx, 1310 nm Rx) fiber up to 20 km industrial temperature
AT-SPBD40-13/I	1000LX GbE single-mode Bi-Di (1310 nm Tx, 1490 nm Rx) fiber up to 40 km, industrial temperature
AT-SPBD40-14/I	1000LX GbE single-mode Bi-Di (1490 nm Tx, 1310 nm Rx) fiber up to 40 km, industrial temperature
AT-SPLX40	1000LX GbE single-mode 1310 nm fiber up to 40 km
AT-SPZX80	1000ZX GbE single-mode 1550 nm fiber up to 80 km
AT-SPZX120/I	1000ZX GbE single-mode 1550 nm fiber up to 120 km industrial temperature
AT-SPTXc	10/100/1000 TX (RJ45), up to 100 m