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Cisco Nexus 3550-F Fusion

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A flexible low latency networking platform

The Cisco Nexus® 3550-F Fusion is a compact, yet powerful networking platform designed specifically for low latency applications. The device features up to 48 ports of 10G Ethernet connectivity in a single rack unit form factor. It can be configured as:

- Layer 1 matrix switch for low latency data fan-out, electronic patch panel, and transparent monitoring applications. Layer 1 switching offers port-to-port latencies under 5ns
- Layer 2 multiplexer/demultiplexer for many-to-one aggregation use case. Applications include low latency link aggregation for financial trading order entry networks, and low latency telecommunications networks. This mode offers latencies as low as 39ns
- Fully managed Layer 2 MAC learning switch, with VLAN tagging/trunking and IGMP snooping. This is intended for applications where simple multiplexers are insufficient. As a layer 2 switch, the device offers latencies down to 95ns.

Scalable modular architecture

The Cisco Nexus 3550-F Fusion is built around a unique modular architecture that scales with your network. Three-line card bays provide the flexibility to grow and change connectivity options over time, while two internal module bays allow the device to be upgraded with expanded functionality, adding new capabilities and extending the useful life of the product. The 3550-F architecture is shown in the figure below (Figure 2). At the heart of the architecture is a high-density layer 1 matrix switch. This matrix switch provides low latency programmable 10GbE connectivity between all modules.

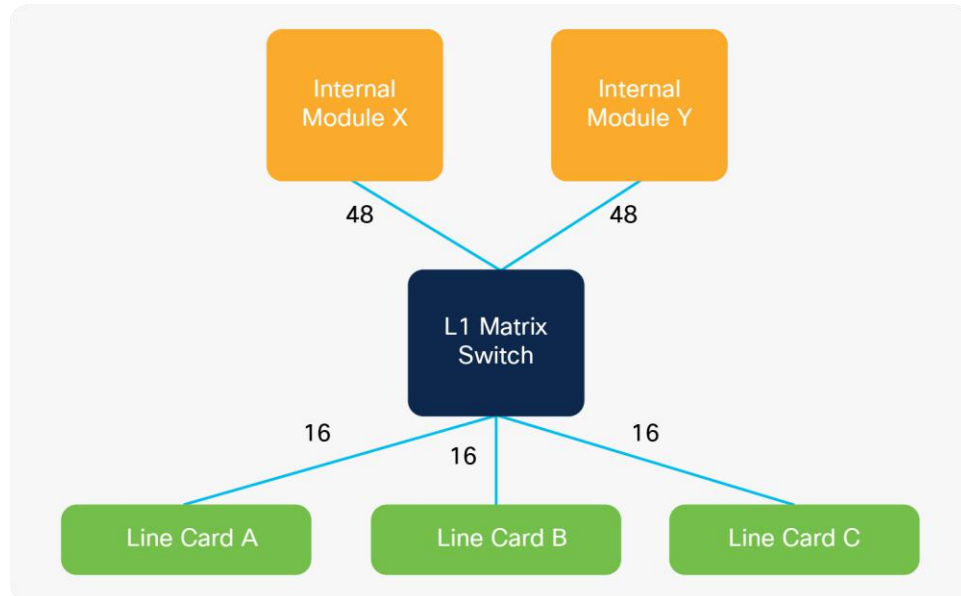


Figure 1.
Cisco Nexus 3550-F Fusion Modular Architecture

The external module bays (A, B, & C) can be populated with a 16-port SFP+ line card (N35-F-16P) and/or a 4-port QSFP+ line card (N35-F-4Q). Standard SFP+ and QSFP+ optics or cable connectivity options are available.

The internal modules bays are unpopulated for Layer 1 only use. A high-density FPGA (N35-F-KU115) module is included for Layer 2 Mux and Layer 2 Switch applications. For custom applications, multiple FPGAs and/or multiple X86 CPU modules (N35-F-SKL) may be fitted.

Ease of use and manageability

The Cisco Nexus 3550-F Fusion runs a custom operating system and Command Line Interface (CLI), designed specifically to address the needs of layer 1 switching and low latency FPGA configuration. Users rate our CLI as one of the best they've operated on.

Every command available on the CLI is also available via a remote JSON RPC API. This makes the device easy to operate and to manage at scale.

All Cisco Nexus 3550-F Fusion products include standard enterprise manageability and deployment ability features including automatic configuration (via DHCP), SNMP, TACACS+ authentication, on-board python programmability, BASH shell access and time series logging.

Layer 1 switching

Unlike traditional network switches that operate only at the data-link layer (layer 2), the Cisco Nexus 3550-F Fusion can operate at the physical network layer (layer 1). Layer 1 switching brings the benefits of circuit switching to Ethernet devices. Connections through the device are programmed into a matrix switch (see Figure 2) ahead of time and remain configured indefinitely. Unlike dynamic packet-based switching this has the advantage of providing very low and deterministic latency. Packets can cross a layer 1 matrix switch in under 5ns (port to port).

The layer 1 matrix switch has several useful purposes. It allows the device to tap into connections (for near transparent network monitoring), to patch connections between ports (for electronic network reconfiguration) and to fan-out connections from one port to many (for low latency data replication applications).

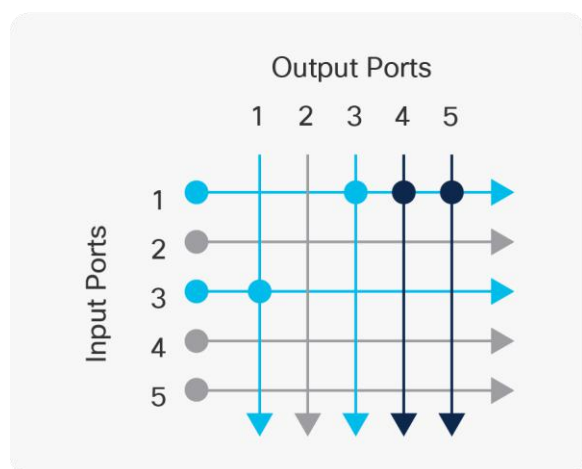


Figure 2. Cisco Nexus 3550-F Fusion matrix switch configuration

Figure 2 above shows an example configuration of a layer 1 matrix switch:

- A “patch” is configured between ports 1 and 3: all traffic from port 1 is directed to port 3, all traffic from port 3 is directed to port 1. This patch can be
- Two “taps” are configured from port 1 to ports 4 and 5: traffic from port 1 is replicated to ports 4 and 5 at latencies as low as 2.8ns. Typically, such low latencies would be viewed as transparent to other network devices.

Transparent tapping

Network monitoring is vital for logging, debugging and compliance. While optical taps can be used for low latency network inspection, they consume valuable rack space and cannot be remotely managed. The Cisco Nexus 3550-F Fusion replaces 16 optical taps (48 ports) in a single 1RU device. Taps through the Cisco Nexus 3550-F Fusion employ active signal regeneration so that the signal quality remains high while port-to-port latencies are as low.

An electronic patch panel

Network reconfiguration is a fact of life, yet colocation access is often expensive and sometimes impossible (e.g. during business hours). The Cisco Nexus 3550-F Fusion offers a fast and convenient tool for managing and reconfiguring a physical network, remotely and at any time of the day, yet adds nearly no overhead. The remote JSON RPC API allows for such changes to be simply automated and controlled by a logically central controller.

Packet aware statistics and monitoring

Although the Cisco Nexus 3550-F Fusion operates at the physical layer, it is fully packet aware. Every port on the device is monitored for vital packet statistics including the number of packets/bytes transmitted/received and transmit/receive errors. The device also provides deep diagnostics including light levels, operating temperatures, transceiver capabilities, and more. All these statistics are available at no latency cost on the critical path.

Layer 2 multiplexing

Most Ethernet network switches typically perform all-to-all switching. Any port can send a packet to any other port. To do so, devices must inspect every packet and make a dynamic switching decision. However, many low-latency applications such as electronic trading order entry networks, and low latency telecommunication networks require only n-to-1 link aggregation (or multiplexing) and 1-to-n link disaggregation (or demultiplexing). Performing all-to-all switching is slow and expensive if only n-to-1 multiplexing / 1-to-n demultiplexing is required.

The Cisco Nexus 3550-F Fusion offers specialized multiplexing/demultiplexing features designed for low latency applications. In the absence of queueing, packets can cross the device in as little as 39ns. This makes the Cisco Nexus 3550-F Fusion one of the fastest multiplexers available on the market.

Different multiplexers for different requirements

Multiplexing may seem simple in principle, but there are many tradeoffs depending on the use case: what line speeds are required? How many ports are needed? How deep should buffers be for contention? What sort of demultiplexing is supported? The Cisco Nexus 3550-F Fusion supports multiple multiplexing modes, each with different feature and latency tradeoffs, summarized in Table 1 below.

Table 1. Cisco Nexus 3550-F Fusion multiplexing mode

Mode	Latency (min)	Link Rate(s)	Total Muxes	Max ports	Buffer per port	Demuxing
FastMux	39ns	10GbE	4	15,11,11,1	4kB	L1 only
Mux	92ns	1/10GbE	4	48	20kB	L1/L2/VLAN
Switch	86ns	10GbE	48	48	32kB	L1/L2/VLAN

The FastMux mode, is the fastest multiplexer available. It offers only 10G Ethernet connectivity and limited buffer depth. Demultiplexing is performed by layer 1 broadcast only. The FastMux is designed for situations where contention is low and pure speed is the only objective, such as electronic trading order entry networks.

The Mux mode offers 1G and 10G Ethernet options, with the ability to rate convert between these rates. It also offers Layer 2 and VLAN based demultiplexing. These features are useful on low latency long range wireless telecommunication networks where many customers require access to the same low-speed radio link.

Like the Mux mode, the Switch mode offers more compressive demultiplexing options. Additionally, it offers an unlimited number of muxes, allowing users more flexibility in their network configurations.

Layer 2 learning switch

Not all use cases can make do with Layer 1 switching (see XXX) or Layer 2 Multiplexing (see YYY). Sometimes a Layer 2 learning switch is needed, yet low latency is still required. The Cisco Nexus 3550 also offers a fully managed Layer 2 learning switch. With latencies as low as 95ns, the device is less than half the latency of previous generation L2 switches. In addition to MAC learning, it also offers:

- VLAN tagging, trunking, stripping and rewriting
- IGMP Snooping
- Tap/agg timestamping with 2.8ns timestamp resolution
- BGP Client (peering only)



Figure 3.
Cisco Nexus 3550-F Fusion Switch

Cisco Nexus 3550-F Fusion feature comparison

The modularity of the Cisco Nexus 3550-F Fusion can be purchased in multiple configurations. Table 2 lists the feature matrix for each configuration.

Table 2. Cisco Nexus 3550-F Fusion feature comparison

Device	Layer 1 Switching	Layer 2 Muxing	Layer 2 Switching	Ordering ID
Cisco Nexus 3550-F Fusion L1	Yes			N35-F-48X
Cisco Nexus 3550-F Fusion Mux	Yes	Yes		N35-FM-48X
Cisco Nexus 3550-F Fusion Switch	Yes	Yes	Yes	N35-FS-48X

Cisco Nexus 3550-F Fusion platform features

Latency

- L1 Tap/Patch: 3ns minimum - 5ns maximum
- FastMux: 39ns minimum - 48ns maximum
- Mux: 92ns minimum - 107ns maximum
- Mux (switch): 86ns minimum - 102ns maximum
- Switch: 95ns minimum - 126ns maximum

Statistics

- Packet counters (RX, TX, dropped etc)
- Per port status LEDs
- Live packet dump
- SFP diagnostics (light levels, temps, etc)
- SNMP, local and remote syslog
- Time series logging to InfluxDB

Connectivity

- 3x 16 SFP+ line cards, up to 48 ports
- 3x 4QSFP line cards, up to 12 ports (48x10G)
- SFP+ Fiber (10GBASE-SR, 10GBASE-LR, 10GBASE-LRM, 1000BASE-SX, 1000BASE-LX)
- SFP+ Copper Direct Attach
- SMA for PPS in/out
- SMA for GPS in
- RJ45 management port
- RJ45 Industry standard serial port
- USB (for firmware upgrades)

Management

- CLI via serial, SSH and telnet
- JSON RPC API for all CLI commands
- Automatic configuration via DHCP
- TACACS+ and multi user support
- ACL's on management interface
- FW updates via SFTP, TFTP, HTTP and USB
- Onboard BASH and Python scripts
- Onboard Cron jobs
- Time sync via PPS, GPS, PTP and NTP

General

- 19" 1RU, rack mount
- Weight 11kg (24lbs)
- Dual, hot-swappable supplies
- Standard: AC 90-264V, 47-64 Hz, included IEC C13-C14 cables
- Optional: DC 40-72V
- Maximum consumption: 150W
- Dual hot-swappable fan modules
- Optional airflow direction

Cisco environmental sustainability

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Reference links to information about key environmental sustainability topics (mentioned in the “Environment Sustainability” section of the CSR Report) are provided in the following table:

Sustainability topic	Reference
Information on product material content laws and regulations	Materials
Information on electronic waste laws and regulations, including products, batteries, and packaging	WEEE compliance

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