![Cisco]

Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 24.4.1

Network Convergence System 5500 Series Routers

What's New in Cisco IOS XR Release 24.4.1

Cisco IOS XR Release 24.4.1 is a new feature release for Cisco NCS 5500 Series routers.

For more details on the Cisco IOS XR release model and associated support, see Software Lifecycle Support Statement - IOS XR.

Software Features Enhanced and Introduced

To learn about features introduced in other Cisco IOS XR releases, select the release from the Documentation Landing Page.

Feature	Description
System Setup and Software Installation	
Immutable bootstrap configuration	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native]
	This feature ensures that the boot configuration of the router remains static and tamper-proof. Immutable bootstrap maintains the integrity and security of the router from the initial boot stage and throughout its entire operation, preventing unauthorized misconfigurations that could disrupt the router's functionality. As a result, it enhances the overall security and reliability of network devices, ensuring they always boot into a known good state.
	In earlier releases, the boot configuration of the router was not immutable
Programmability	
Data logging with gNSI AcctzStream service	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	This feature replaces the existing bi-directional data streaming service, **Acctz**, with the new server-streaming service, **AcctzStream** and ensures effective network optimization and resource utilization.
	With this feature, you can configure the maximum memory allocated for cached accounting history records using the **grpc aaa accounting history-memomy** command.
	The feature introduces these changes:
	CLI:
	• **grpc aaa accounting history-memomy**
	For the specification on the gNSI Accounting (AcctzStream) RPCs and messages, see the Github repository.

Feature	Description
gNOI Healthz	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	With gNOI Healthz, you can monitor and troubleshoot device health by collecting logs and conducting root-cause analysis (RCA) on detected issues. This proactive approach allows for the early identification and resolution of system health problems, thereby reducing downtime and enhancing reliability.
	For the specification on gNOI.healthz, see the GitHub repository.
gRPC server TLS version 1.3 support	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	You can now enhance your network security by enabling TLS 1.3 support for gRPC services. This update provides stronger protection against vulnerabilities, improves performance with faster connection times and reduced latency, and removes outdated ciphers. Additionally, it complies with internal security mandates, offering a more robust and future-proof solution for your network management needs.
	Previously, gRPC server supported TLS version 1.2.
	The feature introduces these changes:
	CLI:
	• **tls-min-version**
	• **tls-max-version**
Routing	
IS-IS Protocol Shutdown Mode	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	You can now gracefully shut down IS-IS on an interface or router without abruptly interrupting network operations. This feature simplifies operations by consolidating multiple steps into a single command, ensuring network stability during maintenance or configuration changes.
	This feature introduces these changes:
	CLI:
	• **protocol shutdown**
	YANG Data Model:
	• Cisco-IOS-XR-um-router-isis-cfg
	(see GitHub, YANG Data Models Navigator)
MPLS	

Feature	Description

MPLS traffic flow control for TTL and QoS propagation on MPLS push, pop, and penultimate nodes	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native]).
	
	With this feature, the extended granular control capability for the incoming and outgoing MPLS traffic changes the behavior of the IP TTL and IP QoS DSCP propagation on the MPLS push, pop, and penultimate nodes. This ensures a reduced network latency, enhanced QoS management, and simplified network operations.
	
	This feature introduces these changes:
	
	CLI:
	
	   • **hw-module fib mpls ip-ttl-propagate-disable exclude mpls-push ttl**
	
	   • **hw-module fib mpls ip-ttl-propagate-disable exclude mpls-pop ttl-and-cos**
	
	   • **hw-module fib mpls ip-ttl-propagate-disable exclude mpls-pop-penultimate-hop ttl-and-cos**
	
	YANG Data Model: New XPaths for Cisco-IOS-XR-um-hw-module-profile-cfg (see Github, YANG Data Models Navigator).

MPLS traffic flow control for TTL and QoS propagation on penultimate node on NC57 line cards	Introduced in this release on: NCS 5700 fixed port routers;NCS 5700 line cards [Mode: Native].
	
	You can now control the incoming and outgoing MPLS and IP traffic granularly to change the behavior of IP Time-to- live (TTL) and IP QoS Differentiated Services Code Point (DSCP) propagation separately on the MPLS penultimate hop popping (PHP) node using the **hw-module fib mpls ip-ttl-propagate-disable exclude mpls-pop-penultimate-hop ttl** and **hw-module fib mpls ip-ttl-propagate-disable exclude mpls-pop-penultimate-hop cos** configurations within the MPLS core network. This feature ensures reduced network latency, enhanced QoS management, and simplified network operations on the MPLS penultimate nodes.
	
	This feature introduces these changes:
	
	CLI:
	
	   • **hw-module fib mpls ip-ttl-propagate-disable exclude mpls-pop-penultimate-hop ttl**
	
	   • **hw-module fib mpls ip-ttl-propagate-disable exclude mpls-pop-penultimate-hop cos**
	
	YANG Data Model: New XPaths for Cisco-IOS-XR-um-hw-module-profile-cfg (see Github, YANG Data Models Navigator).

Segment Routing	

Feature	Description
Delay and synthetic loss measurement for GRE tunnel interfaces	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Native])
	You can now measure the latency or delay experienced by data packets when they traverse a network, and also proactively monitor and address potential network issues before they impact users by measuring key parameters such as packet loss, and jitter for GRE tunnel interfaces.
	This feature enables you to report synthetic Two-Way Active Measurement Protocol (TWAMP) test packets that are deployed in delay-profile or delay measurement sessions, and enables delay measurement for GRE tunnel interfaces.
	The feature introduces these changes:
	CLI:
	The **performance-measurement interface** command supports the **tunnel-ip** keyword.
Fallback delay advertisement for interfaces	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Native])
	You can now advertise fallback delay value, retaining delay information in performance metrics even when delay metrics for interfaces are temporarily unavailable due to hardware, synchronization, or network connectivity issues. The feature ensures optimal routing decisions, by maintaining network stability and continuous performance, even when real-time metrics are temporarily inaccessible.
	Previously, the performance metrics did not include delay metrics when they were temporarily inaccessible, resulting in visibility gaps in the network and less effective routing.
	The feature introduces these changes:
	CLI:
	The **performance-measurement interface** command is modified with a new **advertise-delay fallback** keyword.
	YANG Data Models:
	• `Cisco-IOS-XR-um-performance-measurement-cfg.yang`
	See (GitHub, Yang Data Models Navigator)
Far-end delay metrics in one-way measurement mode	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Native])
	SR PM now enables network operators to compute both far-end (T4 – T3) and near-end (T2 – T1) delay metrics, providing a complete view of end-to-end delay across the entire data path. Measuring the far-end delay from the responder to the querier node improves visibility, and allows operators to accurately monitor and evaluate network performance.
	Previously, you could measure the near-end delay metrics for a given data path.

Feature	Description
Flexible algorithm with bandwidth optimization	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	The enhanced IGP flexible algorithm path computation optimizes paths by automatically adjusting to changes in link bandwidth, which is particularly advantageous for handling parallel L3 links and dynamic changes in link bandwidth, such as in L2 link bundles. This ensures optimal capacity paths by considering cumulative bandwidth in parallel links, preferring paths with the best available bandwidth and benefiting high-bandwidth traffic flows. In addition to traditional metrics like link delay or monetary cost, the algorithm also optimizes paths based on the maximum available bandwidth of links. The bandwidth metric can be locally configured or computed from advertised link bandwidth.
	The feature introduces these changes:
	CLI: • **bandwidth-metric flex-algo** • **metric-type bandwidth** • **reference-bandwidth** • **group-mode**
	YANG Data Models: • New Xpaths are introduced for `Cisco-IOS-XR-um-router-isis-cfg.yang` (see GitHub, YANG Data Models Navigator)
Performance Measurement with Class-C mode on NC57-36H6D-S Line Cards	Introduced in this release on: NCS 5700 fixed port routers (NCS 5700 line cards [Mode: Native])
	The NC57-36H6D-S line card now supports Performance Measurement with Class-C mode of PTP, providing enhanced accuracy and a higher level of frequency precision. It also ensures that TWAMP functionality works seamlessly with Class-C mode.
	Note that from Release 7.6.1, the Cisco NCS 5700 routers support Performance Measurement in the default Class-B mode.
SR-TE policy with enhanced flexible algorithm metric types	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	We have enhanced the SR-TE policy at headend with flexible algorithm that supports additional metric types, user-defined and bandwidth, ensuring consistent path computation across flexible algorithm metric types and constraints, on both intra-IGP and inter-IGP domains. The feature also supports headend computed inter-domain SR policies with Flex Algo constraints and IGP redistribution or leaking.
	The feature introduces these changes:
	CLI: • The **flex-algo-metric-type** keyword is introduced in the **effective-metric admin-distance** command.
	YANG Data Models: • New Xpaths are introduced for `Cisco-IOS-XR-infra-statsd-oper.yang` (see GitHub, YANG Data Models Navigator)

Feature	Description
SRv6 double recursion for multilayer BGP underlay	Introduced in this release on; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	The feature introduces support to SRv6 double recursion where network service such as BGP VPN (Layer 2/Layer 3) requires multiple layers of resolution, specifically where one routing layer resolves over another before reaching its final destination. You can achieve double recursion by collapsing the underlay, which typically involves protocols like IGP or BGP in the packet forwarding chain, allowing three-level load balancing and even distribution of traffic across multiple layers of the network stack.
	The feature is supported on the ingress Provider Edge (PE) router.
	Previously, SRv6 supported only two levels of load balancing, which works for traditional service provider setups.
	The feature introduces these changes:
	CLI:
	• **tag-map tag** *<value>* **map forwarding-hierarchy level-2-used-as-nexthop**
	• The **show cef ipv6** *ipv6-prefixes* and **show cef ipv4** *ipv4-prefixes* commands now include the Layer 2 prefix information, which resolve as nexthop Layer 3 prefixes.
	YANG Data Models:
	• `Cisco-IOS-XR-um-router-rib-cfg:router` (see GitHub, Yang Data Models Navigator) data model.
Segment routing Tree-SID interoperability and SR-P2MP enhancements	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	The feature introduces enhancements to the SR Tree-SID functionality and SR-P2MP Policy, enabling full alignment with the Path Computation Element Protocol (PCEP) standard as per IETF specifications. These improvements enable interoperability between Path Computation Client (PCC) devices from different vendors connected to the PCE, while still supporting the previous Cisco-proprietary implementation.
	The feature introduces these changes:
	CLI:
	• The **show pce ipv4** and **show segment-routing traffic-eng pcc ipv4** commands are enhanced to display the SR-P2MP capability and the number of SR-P2MP instances.
VRF-to-VRF route leaking in SRv6 core	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	VRF-to-VRF route leaking enables sharing of routes between VRFs while maintaining their isolation. This feature allows the source VRF to send leaked routes to remote PEs or Route Reflectors (RRs) across an SRv6 core network, similar to an MPLS core network, enabling communication between different service tenants or administrative domains without compromising VRF isolation.

Feature	Description
mLDP LSP protection with optimal TI-LFA backup paths	With this release, the Topology Independent Loop-Free Alternate (TI-LFA) calculates an optimal, loop-free post-convergence path and enforces it by encoding the path as a list of segments. You can now enhance the protection and convergence for Multicast Label Distribution Protocol Label Switched Paths (mLDP LSP) using TI-LFA backup paths. TI-LFA supports zero-segment and single-segment backup paths, enabling native Point-to-Multipoint (P2MP) over SR code with a Tree Segment Identifier (Tree-SID) profile.
BGP	
Per-VRF Label Allocation for VPN Routes	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native]) This feature modifies the default label allocation from per-prefix to per-VRF by allowing you to enforce per-VRF label allocation for imported VPN routes using the **advertise vpn-imported label-mode per-vrf** command. This feature introduces these changes: **CLI:** • **advertise vpn-imported label-mode per-vrf** **YANG Data Model:** • `Cisco-IOS-XR-um-router-bgp-cfg.yang` (see GitHub, YANG Data Models Navigator)
Source-based Remote Traffic Black Holing (S-RTBH)	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards [Mode: Compatibility; Native]) Source-based RTBH (S-RTBH) is a network security technique used to drop traffic originating from specific malicious source IP addresses. It leverages BGP updates and Unicast Reverse Path Forwarding (uRPF) to ensure that unwanted traffic is discarded at the network edge.
Interface and Hardware Component	
1x100GbE Auto-Breakout	Introduced in this release on: NCS 5700 fixed port routers You can seamlessly switch between interface speeds with the 1x100GbE auto-breakout feature. When QDD-400G-ZRP-S optics are inserted into specified ports, 1x100GbE breakout interfaces are automatically created without manual configuration. This feature provides you the flexibility to switch between different interface speeds without manual reconfiguration. 1x100GbE auto-breakout feature is supported on the following Cisco router variant: • NCS-57B1-6D24H-S • NCS-57B1-5D24-SE

Feature	Description
GRE over HSRP and VRRP	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers(NCS 5500 line cards)
	You can enhance network resilience, flexibility, and efficiency using GRE encapsulation with HSRP and VRRP. This capability provides network redundancy and high availability by allowing GRE tunnels to operate seamlessly over redundant paths, ensuring uninterrupted service during failovers. The protocol independence of GRE facilitates the integration of different network segments without compatibility issues, while its scalability supports the easy expansion of network connectivity across multiple remote sites. Additionally, leveraging existing infrastructure with GRE minimizes the need for new investments, making it cost-effective. GRE also supports network segmentation and better traffic management, enhancing Quality of Service (QoS).
Multiple SPAN ACL sessions for MPLS	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards).
	This feature allows to configure multiple SPAN ACL sessions for MPLS on Layer 3 interfaces configured on the Label-Switched Paths (LSPs) to monitor the MPLS traffic based on the labels and the EXP bit. This feature verifies the overall network performance simultaneously from various network locations and ensures a better network visibility, network resource efficiency, and flexibility.
	This MPLS SPAN ACL configuration is supported only in the ingress direction.
	This feature introduces these changes:
	CLI:
	• **acl mpls**
	• **mpls access-list**
	YANG Data Model: Cisco-IOS-XR-um-mpls-acl-cfg.yang (see Github, YANG Data Models Navigator).
QDD Optical Line System	This feature is now supported on the following line cards or fixed chassis PIDs of the NCS 5700 Series Routers:
	• NC57-18DD-SE
	• NC57-24DD
	• NC57-36H6D-S
	• NC57-MOD-S
	• NC57-MOD-S via MPA-2D4H
	• NC57-48Q2D-S
	• NC57-48Q2D-SE-S
	• NCS-57C1
	• NCS-57D2
	• NC57-MOD via MPA-1FH1D
	• NCS-57C3-MOD-S via MPA-1FH1D
	• NCS-57C3-MOD-SE-S via MPA-1FH1D

Feature	Description
IP Addresses and Services	
BFD for HSRP	Introduced in this release on: NCS 5700 fixed port routers; NCS 5500 modular routers(NCS 5700 line cards [Mode: Compatibility; Native])
	You can now create a robust and highly reliable network solution that minimizes downtime and ensures continuous service by using Hot Standby Router Protocol (HSRP) with Bidirectional Forwarding Detection (BFD). HSRP uses BFD to detect link failures, facilitating fast failover times without excessive control packet overhead. The routers support up to 255 sessions each for both IPv4 and IPv6, allowing for a total of up to 510 sessions. You can also configure BFD timers that ensure HSRP can quickly switch to a standby router when needed.
	Previously, HSRP with BFD was supported only in NCS 5500 Fixed Port and NCS 5500 line cards.
Hot Standby Router Protocol	Introduced in this release on: NCS 5700 fixed port routers; NCS 5500 modular routers(NCS 5700 line cards [Mode: Compatibility; Native])
	You can now ensures network reliability by providing automatic router failover in case of device failure, enhancing network uptime and minimizing disruption. HSRP achieves this by allowing multiple routers to function as a single virtual router, with one router actively forwarding packets while others stand by. If the active router fails, a standby router quickly takes over, maintaining seamless connectivity. This protocol supports load balancing and provides redundancy, ensuring that critical network paths remain operational, thereby improving overall network resilience and stability.
	Previously, HSRP was supported only in NCS 5500 Fixed Port and NCS 5500 line cards.
L2VPN and Ethernet Services	

Feature	Description
EVPN-IRB ARP and ND proxy suppression	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards) You can now manage and minimize Address Resolution Protocol (ARP) for IPv4 traffic or Neighbor Discovery (ND) for IPv6 traffic on a network segment by configuring full or partial suppression mode. If the target host entry is not found in the ARP and ND tables, • the full suppression mode prevents ARP and ND request flooding and reduces the consumption of processing resources on network devices. • the partial suppression mode broadcasts the packet to all devices within the EVPN Bridge Domain (BD) as it would perform without suppression, ensuring connectivity even if the information isn't immediately available in the EVPN control plane. The feature introduces these changes: **CLI:** • **arp evpn-proxy mode** • **ipv6 nd evpn-proxy mode** **YANG Data Model:** • `Cisco-IOS-XR-um-ipv6-nd-cfg.yang` • `Cisco-IOS-XR-um-if-arp-cfg.yang` (see GitHub, YANG Data Models Navigator)
Fat label-based load balancing on L2VPN decapsulation node	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards) This feature enables traffic load balancing at the decapsulation node based on the MPLS labels, which include both the Flow-Aware Transport (FAT) label and the Virtual Circuit (VC) label. The MPLS labels are used for hashing, this results in effective traffic load balancing based on the flow direction. By default, fat based load balancing is disabled. The *fat-based-hash* keyword is introduced in the **hw-module profile load-balance algorithm** command for L2VPN traffic.
System Management	

Feature	Description
Monitor PTP virtual port using PTP timeReceiver ports	You can now configure a threshold value for the Time of Day (ToD) difference or offset between the PTP virtual port Global Navigation Satellite System (GNSS) and the time received by the timeReceiver ports. The timeReceiver ports receive the timing signal from remote timeTransmitters.
	As part of the monitoring process, the servo mechanism in the router routinely calculates the ToD offset between the GNSS receiver and the best PTP timeTransmitter. When the offset value exceeds the configured threshold, the router raises a syslog message. Based on the generated syslog message, you can determine if you should switch from the virtual port GNSS to selecting the PTP timeTransmitter as a fallback source.
	Command introduced: **gm-threshold-breach** *threshold_value*
	YANG data models:
	• Cisco-IOS-XR-ptp-cfg, version 3.2.0
	• Cisco-IOS-XR-um-ptp-cfg, version 2.0.0
	• Cisco-IOS-XR-ptp-oper, version 2.3.0
	See (GitHub, Yang Data Models Navigator)
SyncE Preference for PTP Receiver Interface	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	You can now mitigate synchronization issues when SyncE and PTP sources come from different, non-traceable origins. This feature ensures that SyncE selection among sources with equal Quality Levels (QL) and user priority prefers the interface on which the PTP receiver is selected. If the PTP source fails or its quality degrades, causing the system to switch to another PTP source, SyncE switches to the new PTP source, provided the new interface has the same SyncE QL and priority as the previously selected interface.
	This feature introduces **synchronous-ethernet prefer-interface ptp-receiver** command.
System Security	
Lawful Intercept on MPLS Layer 3	Introduced in this release on: NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5700 line cards [Mode: Native])
	You can now enable Lawful Intercept (LI) within an MPLS Layer 3 network that supports both IPv4 and IPv6 traffic. This capability provides access to MPLS-labeled traffic at a disposition node.To enable LI, use SNMPv3, noting that it is restricted to per-VRF label mode and does not support MPLS disposition traffic allocated per-prefix or per-CE.This centralized management streamlines compliance with Law Enforcement Agency (LEA) requests and reduces administrative effort.
TLS version 1.3 support	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	We have enhanced the security and performance of the routers by upgrading to TLS version 1.3. This version minimizes vulnerabilities by eliminating outdated algorithms and ensuring forward secrecy. Additionally, TLS 1.3 improves router performance by providing faster connection times and reducing latency. The routers will now use TLS version 1.3 as the default for all TLS session establishment requests. If the peer device does not support TLS version 1.3, the router will automatically revert to TLS version 1.2.

Feature	Description
RADIUS with TLS protection	Remote Authentication Dial-In User Service (RADIUS) over Transport Layer Security (TLS) or RADSEC is now supported on Cisco IOS XR NCS 540 routers. You can configure the RADIUS protocol on the Cisco router (RADIUS client) to redirect RADIUS packets to a remote RADIUS server connected over TLS for Authentication, Authorization, and Accounting (AAA) services.
	Without TLS, RADIUS packets may be subject to potential security vulnerabilities, including data exposure, replay attacks, weak authentication, and encryption vulnerabilities, especially when transmitted across untrusted networks.
	The feature introduces these changes:
	CLI:
	• The keyword **radsec-server** is introduced in the **radius-server host** command.
	YANG Data Models:
	• New Xpath for
	`Cisco-IOS-XR-um-aaa-cfg.yang`
	• New Xpath for
	`Cisco-IOS-XR-aaa-lib-cfg.yang`
	(see GitHub, YANG Data Models Navigator)
System Monitoring	
Syslog Message Sent to Syslog Servers using Rsyslog Daemon	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	To handle a high rate of system logging, you can use the rsyslog daemon to forward syslog messages to remote syslog servers.
Monitor interface	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native])
	The **filter physical** keyword was introduced, along with new columns `InDrops` and `OutDrops` in the output, to provide enhanced monitoring capabilities for physical interfaces.
	The feature introduces these changes:
	CLI:
	• The **filter physical** keyword is added to the **monitor interface** command.

YANG Data Models Introduced and Enhanced

This release introduces or enhances the following data models. For detailed information about the supported and unsupported sensor paths of all the data models, see the Github repository. To get a comprehensive list of the data models supported in a release, navigate to the Available-Content.md file for the release in the Github repository. The unsupported sensor paths are documented as deviations. For example, openconfig-acl.yang provides details about the supported sensor paths, whereas cisco-xr-openconfig-acl-deviations.yang provides the unsupported sensor paths for openconfig-acl.yang on Cisco IOS XR routers.

You can also view the data model definitions using the YANG Data Models Navigator tool. This GUI-based and easy-to-use tool helps you explore the nuances of the data model and view the dependencies between various containers in the model. You can view the list of models supported across Cisco IOS XR releases and platforms, locate a specific model, view the containers and their respective lists, leaves, and leaf lists presentedvisually in a tree structure.

Feature	Description
Programmability	
openconfig-aft-summary.yang	The OpenConfig data model is revised from version 2.4.0 to 4.3.0.
	The new aft-summaries container provides the count of routes per origin protocol for both IPv4 and IPv6 protocols.
	The feature introduces the following change:
	CLI:
	• The detail keyword is introduced in the **show cef tables**command.
	You can stream Model-driven telemetry (MDT) and Event-driven telemetry (EDT) data for this OpenConfig data model.
Openconfig-platform-transceiver Version 0.13.0	The OpenConfig data model provides various metrics and thresholds for transceiver monitoring on gNMI subscribe. It includes minimum, maximum, average, instant, interval, minimum-time, and maximum-time values for containers such as supply-voltage, laser-temperature, tec-current, and target-frequency-deviation. The model also defines upper thresholds for transceiver with leaves like laser-temperature-upper, output-power-upper, input-power-upper, laser-bias-current-upper, supply-voltage-upper, and module-temperature-upper, as well as lower thresholds leaves such as laser-temperature-lower, output-power-lower, input-power-lower, laser-bias-current-lower, supply-voltage-lower, and module-temperature-lower. Additionally, it supports transceiver leaves such as state, enabled and module-functional-type, and transceiver physical-channels leaves including associated-optical-channel, tx-laser, target-output-power, and laser-age.
	This OC model supports event-driven and model-driven telemetry.
Cisco-IOS-XR-um-performance-measurement-cfg	This unified data model is enhanced with a new container fallback to advertise a fallback delay value, retaining delay information in performance metrics even when the delay metrics for interfaces is temporarily unavailable due to hardware, synchronization, or network connectivity issues.

Feature	Description
Cisco-IOS-XR-um-router-isis-cfg.yang	The latest update to the Cisco-IOS-XR-um-router-isis-cfg.yang unified data model includes the following additions: • The **metric-type**leaf is enhanced to include **bandwidth** and **generic** as metric types. • The **auto-cost** container - This is a new container in the **flex-algo** container to configure the auto-cost for bandwidth metric. The newly added **reference-bandwidth-number, granularity,** and **group-mode** leaves enable you to configure the different parameters required for bandwidth metric auto-cost calculation.
Cisco-IOS-XR-um-hw-module-profile-cfg	This YANG data model is enhanced to have a new container, **ip-ttl-propagate-disable**, which is used to exclude the propagation of the IP Time-To-Live (TTL) and QoS capability to and from the MPLS header using the MPLS Push, Pop, and Penultimate Hop Pop (PHP) operations with these three sub-containers: • **mpls-push** - This container in turn uses its sub-container, **ttl**, to change the IP TTL propagation on the MPLS Push (imposition) node to uniform mode. • **mpls-pop** - Changes the IP TTL and QoS DSCP propagation to uniform mode on the MPLS Pop (disposition) node using the sub-container, **ttl-and-cos**. • **mpls-pop-penultimate-hop** - Uses the additional three sub-containers, **ttl**, **cos**, and **ttl-and-cos** to change the IP TTL and QoS DSCP propagation to uniform mode on the MPLS PHP node. If **cos** is used, the TTL propagation remains in pipe mode. If **ttl**is used, the QoS propagation remains in pipe mode.

Hardware Introduced

Hardware	Description

Optics	**Note**: Optics support varies across devices (routers, line cards, RPs, and so on). To know if an optics is compatible with a specific Cisco device, refer to the Transceiver Module Group (TMG) Compatibility Matrix.
	
	This release introduces the following optics:
	
	Cisco 400G QSFP-DD Cable and Transceiver Modules
	
	    • QDD-400G-SR4.2-BD
	
	Cisco 100GBASE QSFP-100G Module
	
	    • QSFP-100G-B40D-I/U-I

Features Supported on Cisco NC5700 Line Cards and NCS 5700 Fixed Port Routers

The following table lists the features supported on Cisco NC5700 line cards in compatibility mode (NC5700 line cards with previous generation NCS 5500 line cards in the same NCS 5500 modular routers) and native mode (NCS 5500 modular routers with only NCS 5700 line cards and NCS 5700 fixed port routers).

To enable the native mode on Cisco NCS 5500 series modular routers having Cisco NCS 5700 line cards, use the **hw-module profile npu native-mode-enable** command in the configuration mode. Ensure that you reload the router after configuring the native mode.

Features supported in the native mode are also available on Cisco NCS 5700 fixed port routers.

Table 1: Features Supported on Cisco NC5700 Line Cards

Feature	Compatible Mode	Native Mode
Immutable bootstrap configuration	✓	✓
Data logging with gNSI AcctzStream service	✓	✓
gNOI Healthz	✓	✓
gRPC server TLS version 1.3 support	✓	✓
IS-IS Protocol Shutdown Mode	✓	✓
MPLS traffic flow control for TTL and QoS propagation on MPLS push, pop, and penultimate nodes	✓	✓
MPLS traffic flow control for TTL and QoS propagation on penultimate node on NC57 line cards	✗	✓
Delay and synthetic loss measurement for GRE tunnel interfaces	✗	✓
Fallback delay advertisement for interfaces	✗	✓

Feature	Compatible Mode	Native Mode
Far-end delay metrics in one-way measurement mode	✕	✓
Flexible algorithm with bandwidth optimization	✓	✓
Performance Measurement with Class-C mode on NC57-36H6D-S Line Cards	✕	✓
SR-TE policy with enhanced flexible algorithm metric types	✓	✓
SRv6 double recursion for multilayer BGP underlay	✓	✓
Segment routing Tree-SID interoperability and SR-P2MP enhancements	✓	✓
VRF-to-VRF route leaking in SRv6 core	✓	✓
mLDP LSP protection with optimal TI-LFA backup paths	✓	✓
Per-VRF Label Allocation for VPN Routes	✓	✓
Source-based Remote Traffic Black Holing (S-RTBH)	✓	✓
BFD for HSRP	✓	✓
Hot Standby Router Protocol	✓	✓
Monitor PTP virtual port using PTP timeReceiver ports	✓	✓
SyncE Preference for PTP Receiver Interface	✓	✓
Lawful Intercept on MPLS Layer 3	✕	✓
TLS version 1.3 support	✓	✓
RADIUS with TLS protection	✓	✓
Syslog Message Sent to Syslog Servers using Rsyslog Daemon	✓	✓
Monitor interface	✓	✓

For the complete list of features supported on Cisco NC57 line cards until Cisco IOS XR Release 24.1.1. see:

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 24.2.11](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 24.2.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 24.1.2](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 24.1.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.11.21](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.11.2](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.11.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.10.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.9.2](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.9.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.8.2](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.8.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.7.2](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.7.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.6.2](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.6.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.5.3](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.5.2](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.5.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.4.2](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.4.1](#)

- [Release Notes for Cisco NCS 5500 Series Routers, IOS XR Release 7.3.1](#)

Caveats

Table 2: Cisco NCS 5500 Series Router Specific Bugs

Bug ID	Headline
[CSCwm40676](#)	VPLS BUM traffic loss on AC with Calvados VM reload of active followed by FC reload.
[CSCwm68533](#)	'TAP read exceeded time' was observed on NC57-18DD-SE LC when the admin VM was reloaded.

Behavior Changes

- Starting from Cisco IOS XR Release 24.4.1, the **username** command is modified to deprecate the following options:
  - The *type secret value 5* that specifies a Type 5 password that uses MD5 hashing algorithm.
  - The **password-policy***name* option to specify a password-policy with password for a username.
  - The option to specify Type 7 encrypted password in *type password* by entering *7* under **password** keyword.

- The directory disk0/disk2 maps to the /misc/scratch partition for IOS-XR, which may be erased during upgrades. Due to the new disk encryption feature requiring re-partitioning, it's advised to move user scripts to a subdirectory under the /harddisk partition to preserve the content.

Release Package

This table lists the Cisco IOS XR Software feature set matrix (packages) with associated filenames.

Visit the Cisco Software Download page to download the Cisco IOS XR software images.

Table 3: Release 24.4.1 Packages for Cisco NCS 5500 Series Router

Composite Package		
Feature Set	**Filename**	**Description**
Cisco IOS XR IP Unicast Routing Core Bundle	ncs5500-mini-x.iso	Contains base image contents that includes: • Host operating system • System Admin boot image • IOS XR boot image • BGP packages
Individually-Installable Optional Packages		
Feature Set	**Filename**	**Description**
Cisco IOS XR Manageability Package	ncs5500-mgbl-3.0.0.0-r2441.x86_64.rpm	Extensible Markup Language (XML) Parser, Telemetry, Netconf, gRPC and HTTP server packages.
Cisco IOS XR MPLS Package	ncs5500-mpls-2.1.0.0-r2441.x86_64.rpm ncs5500-mpls-te-rsvp-2.2.0.0-r2441.x86_64.rpm	MPLS and MPLS Traffic Engineering (MPLS-TE) RPM.
Cisco IOS XR Security Package	ncs5500-k9sec-3.1.0.0-r2441.x86_64.rpm	Support for Encryption, Decryption, Secure Shell (SSH), Secure Socket Layer (SSL), and Public-key infrastructure (PKI)
Cisco IOS XR ISIS package	ncs5500-isis-1.2.0.0-r2441.x86_64.rpm	Support ISIS

Cisco IOS XR OSPF package	ncs5500-ospf-2.0.0.0-r2441.x86_64.rpm	Support OSPF
Lawful Intercept (LI) Package	ncs5500-li-1.0.0.0-r2441.x86_64.rpm	Includes LI software images
Multicast Package	ncs5500-mcast-1.0.0.0-r2441.x86_64rpm	Support Multicast
EIGRP	ncs5500-eigrp-1.0.0.0-r2441.x86_64.rpm	Supports Enhanced Interior Gateway Routing Protocol
Lawful Intercept Control	ncs5500-lictrl-1.0.0.0-r2441x86_64.rpm	Supports Lawful Intercept Control
Healthcheck	ncs5500-healthcheck-1.0.0.0-r2441.x86_64.rpm	Supports System Health Check

Table 4: Release 24.4.1 TAR files for Cisco NCS 5500 Series Router

Feature Set	Filename
NCS 5500 IOS XR Software 3DES	NCS5500-iosxr-k9-24.4.1.tar
NCS 5500 IOS XR Software	NCS5500-iosxr-24.4.1.tar
NCS 5500 IOS XR Software	NCS5500-docs-24.4.1.tar

Table 5: Release 24.4.1 Packages for Cisco NCS 5700 Series Router

Feature Set	Filename
NCS 5700 IOS XR Software	ncs5700-x64-24.4.1.iso
NCS 5700 IOS XR Software (only k9 RPMs)	ncs5700-k9sec-rpms.24.4.1.tar
NCS 5700 IOS XR Software Optional Package	NCS5700-optional-rpms.24.4.1.tar This TAR file contains the following RPMS: • optional-rpms/cdp/* • optional-rpms/eigrp/* • optional-rpms/telnet/*

Determine Software Version

To verify the software version running on the router, use **show version** command in the EXEC mode.

```
Router# show version
Cisco IOS XR Software, Version 24.4.1
Copyright (c) 2013-2024 by Cisco Systems, Inc.

Build Information:
 Built By      : swtools
 Built On      : Sun Dec 15 21:16:43 PST 2024
 Built Host    : iox-lnx-118
 Workspace     : /auto/srcarchive10/prod/24.4.1/ncs5500/ws
 Version       : 24.4.1
```

```
Location     : /opt/cisco/XR/packages/
Label        : 24.4.1

cisco NCS-5500 () processor
System uptime is 2 hours 26 minutes
```

Determine Firmware Support

Use the **show hw-module fpd** command in EXEC and Admin mode to view the hardware components with their current FPD version and status. The status of the hardware must be CURRENT; Running and Programed version must be the same.

You can also use the **show fpd package** command in Admin mode to check the fpd versions.

NCS 5500 Fixed Port Routers

```
Router# show fpd package
Mon Dec 16 17:12:30.345 IST

============================== =================================================
                               Field Programmable Device Package
                               =================================================
                               Req    SW      Min Req  Min Req
Card Type          FPD Description          Reload Ver     SW Ver   Board Ver
================= ========================= ====== ======= ======== =========
-------------------------------------------------------------------------------
NC55-12X100G-SE-PR Bootloader(A)            YES    1.20    1.20      0.0
                   IOFPGA(A)                YES    0.12    0.12      0.0
                   MIFPGA                   YES    0.03    0.03      0.0
                   SATA-INTEL_240G(A)       NO     1132.00 1132.00   0.0
                   SATA-INTEL_480G(A)       NO     1132.00 1132.00   0.0
                   SATA-M500IT-MC(A)        NO     3.00    3.00      0.0
                   SATA-M500IT-MU-A(A)      NO     5.00    5.00      0.0
                   SATA-M500IT-MU-B(A)      NO     4.00    4.00      0.0
                   SATA-M5100(A)            NO     75.00   75.00     0.0
                   SATA-M600-MCT(A)         NO     5.00    5.00      0.0
                   SATA-M600-MU(A)          NO     6.00    6.00      0.0
                   SATA-Micron(A)           NO     1.00    1.00      0.0
                   SATA-SMART-128G(A)       NO     1535.00 1535.00   0.0
-------------------------------------------------------------------------------
NC55-12X100GE-PROT Bootloader(A)            YES    1.22    1.22      0.0
                   IOFPGA(A)                YES    0.15    0.15      0.0
                   MIFPGA                   YES    0.09    0.09      0.0
                   SATA-INTEL_240G(A)       NO     1132.00 1132.00   0.0
                   SATA-INTEL_480G(A)       NO     1132.00 1132.00   0.0
                   SATA-M500IT-MC(A)        NO     3.00    3.00      0.0
                   SATA-M500IT-MU-A(A)      NO     5.00    5.00      0.0
                   SATA-M500IT-MU-B(A)      NO     4.00    4.00      0.0
                   SATA-M5100(A)            NO     75.00   75.00     0.0
                   SATA-M600-MCT(A)         NO     5.00    5.00      0.0
                   SATA-M600-MU(A)          NO     6.00    6.00      0.0
                   SATA-Micron(A)           NO     1.00    1.00      0.0
                   SATA-SMART-128G(A)       NO     1535.00 1535.00   0.0
-------------------------------------------------------------------------------
NC55-18H18F        Bootloader(A)            YES    1.20    1.20      0.0
                   IOFPGA(A)                YES    0.22    0.22      0.0
                   MIFPGA                   YES    0.03    0.03      0.0
                   SATA-INTEL_240G(A)       NO     1132.00 1132.00   0.0
                   SATA-INTEL_480G(A)       NO     1132.00 1132.00   0.0
                   SATA-M500IT-MC(A)        NO     3.00    3.00      0.0
                   SATA-M500IT-MU-A(A)      NO     5.00    5.00      0.0
                   SATA-M500IT-MU-B(A)      NO     4.00    4.00      0.0
                   SATA-M5100(A)            NO     75.00   75.00     0.0
```

```
                      SATA-M600-MCT(A)            NO       5.00      5.00      0.0
                      SATA-M600-MU(A)             NO       6.00      6.00      0.0
                      SATA-Micron(A)              NO       1.00      1.00      0.0
                      SATA-SMART-128G(A)          NO    1535.00   1535.00      0.0
--------------------------------------------------------------------------------
NC55-24H12F-SE        Bootloader(A)               YES      1.20      1.20      0.0
                      IOFPGA(A)                   YES      0.09      0.09      0.0
                      MIFPGA                      YES      0.03      0.03      0.0
                      SATA-INTEL_240G(A)          NO    1132.00   1132.00      0.0
                      SATA-INTEL_480G(A)          NO    1132.00   1132.00      0.0
                      SATA-M500IT-MC(A)           NO       3.00      3.00      0.0
                      SATA-M500IT-MU-A(A)         NO       5.00      5.00      0.0
                      SATA-M500IT-MU-B(A)         NO       4.00      4.00      0.0
                      SATA-M5100(A)               NO      75.00     75.00      0.0
                      SATA-M600-MCT(A)            NO       5.00      5.00      0.0
                      SATA-M600-MU(A)             NO       6.00      6.00      0.0
                      SATA-Micron(A)              NO       1.00      1.00      0.0
                      SATA-SMART-128G(A)          NO    1535.00   1535.00      0.0
--------------------------------------------------------------------------------
NC55-24X100G-SE       Bootloader(A)               YES      1.20      1.20      0.0
                      IOFPGA(A)                   YES      0.13      0.13      0.0
                      MIFPGA                      YES      0.03      0.03      0.0
                      SATA-INTEL_240G(A)          NO    1132.00   1132.00      0.0
                      SATA-INTEL_480G(A)          NO    1132.00   1132.00      0.0
                      SATA-M500IT-MC(A)           NO       3.00      3.00      0.0
                      SATA-M500IT-MU-A(A)         NO       5.00      5.00      0.0
                      SATA-M500IT-MU-B(A)         NO       4.00      4.00      0.0
                      SATA-M5100(A)               NO      75.00     75.00      0.0
                      SATA-M600-MCT(A)            NO       5.00      5.00      0.0
                      SATA-M600-MU(A)             NO       6.00      6.00      0.0
                      SATA-Micron(A)              NO       1.00      1.00      0.0
                      SATA-SMART-128G(A)          NO    1535.00   1535.00      0.0
--------------------------------------------------------------------------------
NC55-32T16Q4H-A       Bootloader(A)               YES      0.05      0.05      0.0
                      DBFPGA(A)                   YES      0.14      0.14      0.0
                      IOFPGA(A)                   YES      0.95      0.95      0.0
                      MIFPGA                      YES      0.60      0.60      0.0
                      SATA-INTEL_240G(A)          NO    1132.00   1132.00      0.0
                      SATA-INTEL_480G(A)          NO    1132.00   1132.00      0.0
                      SATA-M500IT-MC(A)           NO       3.00      3.00      0.0
                      SATA-M500IT-MU-A(A)         NO       5.00      5.00      0.0
                      SATA-M500IT-MU-B(A)         NO       4.00      4.00      0.0
                      SATA-M5100(A)               NO      75.00     75.00      0.0
                      SATA-M600-MCT(A)            NO       5.00      5.00      0.0
                      SATA-M600-MU(A)             NO       6.00      6.00      0.0
                      SATA-Micron(A)              NO       1.00      1.00      0.0
                      SATA-SMART-128G(A)          NO    1535.00   1535.00      0.0
                      TimingIC-A                  YES      7.216     7.216     0.0
                      TimingIC-B                  YES      7.216     7.216     0.0
--------------------------------------------------------------------------------
NC55-32T16Q4H-AT      Bootloader(A)               YES      0.05      0.05      0.0
                      DBFPGA(A)                   YES      0.14      0.14      0.0
                      IOFPGA(A)                   YES      0.95      0.95      0.0
                      MIFPGA                      YES      0.60      0.60      0.0
                      SATA-INTEL_240G(A)          NO    1132.00   1132.00      0.0
                      SATA-INTEL_480G(A)          NO    1132.00   1132.00      0.0
                      SATA-M500IT-MC(A)           NO       3.00      3.00      0.0
                      SATA-M500IT-MU-A(A)         NO       5.00      5.00      0.0
                      SATA-M500IT-MU-B(A)         NO       4.00      4.00      0.0
                      SATA-M5100(A)               NO      75.00     75.00      0.0
                      SATA-M600-MCT(A)            NO       5.00      5.00      0.0
                      SATA-M600-MU(A)             NO       6.00      6.00      0.0
                      SATA-Micron(A)              NO       1.00      1.00      0.0
                      SATA-SMART-128G(A)          NO    1535.00   1535.00      0.0
```

```
                    TimingIC-A              YES     7.216    7.216     0.0
                    TimingIC-B              YES     7.216    7.216     0.0
--------------------------------------------------------------------------------
NC55-36X100G        Bootloader(A)           YES     1.22     1.22      0.0
                    IOFPGA(A)               YES     0.15     0.15      0.0
                    MIFPGA                  YES     0.09     0.09      0.0
                    SATA-INTEL_240G(A)      NO      1132.00  1132.00   0.0
                    SATA-INTEL_480G(A)      NO      1132.00  1132.00   0.0
                    SATA-M500IT-MC(A)       NO      3.00     3.00      0.0
                    SATA-M500IT-MU-A(A)     NO      5.00     5.00      0.0
                    SATA-M500IT-MU-B(A)     NO      4.00     4.00      0.0
                    SATA-M5100(A)           NO      75.00    75.00     0.0
                    SATA-M600-MCT(A)        NO      5.00     5.00      0.0
                    SATA-M600-MU(A)         NO      6.00     6.00      0.0
                    SATA-Micron(A)          NO      1.00     1.00      0.0
                    SATA-SMART-128G(A)      NO      1535.00  1535.00   0.0
--------------------------------------------------------------------------------
NC55-36X100G-A-SE   Bootloader(A)           YES     0.15     0.15      0.0
                    DBFPGA(A)               YES     0.14     0.14      0.0
                    IOFPGA(A)               YES     0.26     0.26      0.0
                    MIFPGA                  YES     0.03     0.03      0.0
                    SATA-INTEL_240G(A)      NO      1132.00  1132.00   0.0
                    SATA-INTEL_480G(A)      NO      1132.00  1132.00   0.0
                    SATA-M500IT-MC(A)       NO      3.00     3.00      0.0
                    SATA-M500IT-MU-A(A)     NO      5.00     5.00      0.0
                    SATA-M500IT-MU-B(A)     NO      4.00     4.00      0.0
                    SATA-M5100(A)           NO      75.00    75.00     0.0
                    SATA-M600-MCT(A)        NO      5.00     5.00      0.0
                    SATA-M600-MU(A)         NO      6.00     6.00      0.0
                    SATA-Micron(A)          NO      1.00     1.00      0.0
                    SATA-SMART-128G(A)      NO      1535.00  1535.00   0.0
--------------------------------------------------------------------------------
NC55-36X100G-S      Bootloader(A)           YES     1.20     1.20      0.0
                    IOFPGA(A)               YES     0.12     0.12      0.0
                    MIFPGA                  YES     0.07     0.07      0.0
                    SATA-INTEL_240G(A)      NO      1132.00  1132.00   0.0
                    SATA-INTEL_480G(A)      NO      1132.00  1132.00   0.0
                    SATA-M500IT-MC(A)       NO      3.00     3.00      0.0
                    SATA-M500IT-MU-A(A)     NO      5.00     5.00      0.0
                    SATA-M500IT-MU-B(A)     NO      4.00     4.00      0.0
                    SATA-M5100(A)           NO      75.00    75.00     0.0
                    SATA-M600-MCT(A)        NO      5.00     5.00      0.0
                    SATA-M600-MU(A)         NO      6.00     6.00      0.0
                    SATA-Micron(A)          NO      1.00     1.00      0.0
                    SATA-SMART-128G(A)      NO      1535.00  1535.00   0.0
--------------------------------------------------------------------------------
NC55-5504-FC        Bootloader(A)           YES     1.75     1.75      0.0
                    IOFPGA(A)               YES     0.10     0.10      0.0
--------------------------------------------------------------------------------
NC55-5504-FC2       Bootloader(A)           YES     1.13     1.13      0.0
                    IOFPGA(A)               YES     0.47     0.47      0.0
                    SATA-INTEL_240G(A)      NO      1132.00  1132.00   0.0
                    SATA-INTEL_480G(A)      NO      1132.00  1132.00   0.0
                    SATA-M500IT-MC(A)       NO      3.00     3.00      0.0
                    SATA-M500IT-MU-A(A)     NO      5.00     5.00      0.0
                    SATA-M500IT-MU-B(A)     NO      4.00     4.00      0.0
                    SATA-M5100(A)           NO      75.00    75.00     0.0
                    SATA-M600-MCT(A)        NO      5.00     5.00      0.0
                    SATA-M600-MU(A)         NO      6.00     6.00      0.0
                    SATA-Micron(A)          NO      1.00     1.00      0.0
                    SATA-SMART-128G(A)      NO      1535.00  1535.00   0.0
--------------------------------------------------------------------------------
NC55-5508-FC        Bootloader(A)           YES     1.74     1.74      0.0
                    IOFPGA(A)               YES     0.17     0.17      0.0
```

```
-------------------------------------------------------------------------------
NC55-5508-FC2      Bootloader(A)           YES      1.80     1.80      0.0
                   IOFPGA(A)               YES      0.20     0.20      0.0
                   SATA-INTEL_240G(A)      NO    1132.00  1132.00      0.0
                   SATA-INTEL_480G(A)      NO    1132.00  1132.00      0.0
                   SATA-M500IT-MC(A)       NO       3.00     3.00      0.0
                   SATA-M500IT-MU-A(A)     NO       5.00     5.00      0.0
                   SATA-M500IT-MU-B(A)     NO       4.00     4.00      0.0
                   SATA-M5100(A)           NO      75.00    75.00      0.0
                   SATA-M600-MCT(A)        NO       5.00     5.00      0.0
                   SATA-M600-MU(A)         NO       6.00     6.00      0.0
                   SATA-Micron(A)          NO       1.00     1.00      0.0
                   SATA-SMART-128G(A)      NO    1535.00  1535.00      0.0
-------------------------------------------------------------------------------
NC55-5516-FC       Bootloader(A)           YES      1.75     1.75      0.0
                   IOFPGA(A)               YES      0.27     0.27      0.0
-------------------------------------------------------------------------------
NC55-5516-FC2      Bootloader(A)           YES      1.80     1.80      0.0
                   IOFPGA(A)               YES      0.24     0.24      0.0
                   SATA-INTEL_240G(A)      NO    1132.00  1132.00      0.0
                   SATA-INTEL_480G(A)      NO    1132.00  1132.00      0.0
                   SATA-M500IT-MC(A)       NO       3.00     3.00      0.0
                   SATA-M500IT-MU-A(A)     NO       5.00     5.00      0.0
                   SATA-M500IT-MU-B(A)     NO       4.00     4.00      0.0
                   SATA-M5100(A)           NO      75.00    75.00      0.0
                   SATA-M600-MCT(A)        NO       5.00     5.00      0.0
                   SATA-M600-MU(A)         NO       6.00     6.00      0.0
                   SATA-Micron(A)          NO       1.00     1.00      0.0
                   SATA-SMART-128G(A)      NO    1535.00  1535.00      0.0
-------------------------------------------------------------------------------
NC55-6X100GE-PROT  Bootloader(A)           YES      1.22     1.22      0.0
                   IOFPGA(A)               YES      0.15     0.15      0.0
                   MIFPGA                  YES      0.09     0.09      0.0
                   SATA-INTEL_240G(A)      NO    1132.00  1132.00      0.0
                   SATA-INTEL_480G(A)      NO    1132.00  1132.00      0.0
                   SATA-M500IT-MC(A)       NO       3.00     3.00      0.0
                   SATA-M500IT-MU-A(A)     NO       5.00     5.00      0.0
                   SATA-M500IT-MU-B(A)     NO       4.00     4.00      0.0
                   SATA-M5100(A)           NO      75.00    75.00      0.0
                   SATA-M600-MCT(A)        NO       5.00     5.00      0.0
                   SATA-M600-MU(A)         NO       6.00     6.00      0.0
                   SATA-Micron(A)          NO       1.00     1.00      0.0
                   SATA-SMART-128G(A)      NO    1535.00  1535.00      0.0
-------------------------------------------------------------------------------
NC55-6X200-DWDM-S  Bootloader(A)           YES      1.20     1.20      0.0
                   CFP2_PORT_0             NO       5.56     5.56      2.1
                   CFP2_PORT_1             NO       5.56     5.56      2.1
                   CFP2_PORT_2             NO       5.56     5.56      2.1
                   CFP2_PORT_3             NO       5.56     5.56      2.1
                   CFP2_PORT_4             NO       5.56     5.56      2.1
                   CFP2_PORT_5             NO       5.56     5.56      2.1
                   DENALI0                 NO      13.48    13.48      0.0
                   DENALI1                 NO      13.48    13.48      0.0
                   DENALI2                 NO      13.48    13.48      0.0
                   IOFPGA(A)               YES      0.14     0.14      0.0
                   MORGOTH                 YES      5.26     5.26      0.0
                   MSFPGA0                 YES      2.22     2.22      0.0
                   MSFPGA1                 YES      2.22     2.22      0.0
                   MSFPGA2                 YES      2.22     2.22      0.0
                   SATA-INTEL_240G(A)      NO    1132.00  1132.00      0.0
                   SATA-INTEL_480G(A)      NO    1132.00  1132.00      0.0
                   SATA-M500IT-MC(A)       NO       3.00     3.00      0.0
                   SATA-M500IT-MU-A(A)     NO       5.00     5.00      0.0
                   SATA-M500IT-MU-B(A)     NO       4.00     4.00      0.0
```

```
                      SATA-M5100(A)              NO      75.00     75.00      0.0
                      SATA-M600-MCT(A)           NO       5.00      5.00      0.0
                      SATA-M600-MU(A)            NO       6.00      6.00      0.0
                      SATA-Micron(A)             NO       1.00      1.00      0.0
                      SATA-SMART-128G(A)         NO    1535.00   1535.00      0.0
--------------------------------------------------------------------------------
NC55-MOD-A-S          Bootloader(A)              YES      1.03      1.03      0.0
                      DBFPGA(A)                  YES      0.14      0.14      0.0
                      IOFPGA(A)                  YES      0.14      0.14      0.0
                      MIFPGA                     YES      0.16      0.16      0.0
                      SATA-INTEL_240G(A)         NO    1132.00   1132.00      0.0
                      SATA-INTEL_480G(A)         NO    1132.00   1132.00      0.0
                      SATA-M500IT-MC(A)          NO       3.00      3.00      0.0
                      SATA-M500IT-MU-A(A)        NO       5.00      5.00      0.0
                      SATA-M500IT-MU-B(A)        NO       4.00      4.00      0.0
                      SATA-M5100(A)              NO      75.00     75.00      0.0
                      SATA-M600-MCT(A)           NO       5.00      5.00      0.0
                      SATA-M600-MU(A)            NO       6.00      6.00      0.0
                      SATA-Micron(A)             NO       1.00      1.00      0.0
                      SATA-SMART-128G(A)         NO    1535.00   1535.00      0.0
--------------------------------------------------------------------------------
NC55-MOD-A-SE-S       Bootloader(A)              YES      1.03      1.03      0.0
                      DBFPGA(A)                  YES      0.14      0.14      0.0
                      IOFPGA(A)                  YES      0.14      0.14      0.0
                      MIFPGA                     YES      0.16      0.16      0.0
                      SATA-INTEL_240G(A)         NO    1132.00   1132.00      0.0
                      SATA-INTEL_480G(A)         NO    1132.00   1132.00      0.0
                      SATA-M500IT-MC(A)          NO       3.00      3.00      0.0
                      SATA-M500IT-MU-A(A)        NO       5.00      5.00      0.0
                      SATA-M500IT-MU-B(A)        NO       4.00      4.00      0.0
                      SATA-M5100(A)              NO      75.00     75.00      0.0
                      SATA-M600-MCT(A)           NO       5.00      5.00      0.0
                      SATA-M600-MU(A)            NO       6.00      6.00      0.0
                      SATA-Micron(A)             NO       1.00      1.00      0.0
                      SATA-SMART-128G(A)         NO    1535.00   1535.00      0.0
--------------------------------------------------------------------------------
NC55-MPA-12T-S        MPAFPGA                    YES      0.28      0.28      0.0
--------------------------------------------------------------------------------
NC55-MPA-1TH2H-S      CFP2-D-DCO_2               NO    38.27397  38.27397     0.1
                      CFP2-D10-DCO_2             NO    67.30726  67.30726     0.1
                      CFP2-D15-DCO_2             NO    67.30726  67.30726     0.1
                      CFP2-DE-DCO_2              NO    38.27397  38.27397     0.1
                      CFP2-DETS-DCO_2            NO    38.27397  38.27397     0.1
                      CFP2-DS-DCO_2              NO    38.27397  38.27397     0.1
                      CFP2-DS100-DCO_2           NO    38.27397  38.27397     0.1
                      MPAFPGA                    YES      0.54      0.54      0.0
--------------------------------------------------------------------------------
NC55-MPA-2TH-HX-S     CFP2-D-DCO_0               NO    38.27397  38.27397     0.1
                      CFP2-D-DCO_1               NO    38.27397  38.27397     0.1
                      CFP2-D10-DCO_0             NO    67.30726  67.30726     0.1
                      CFP2-D10-DCO_1             NO    67.30726  67.30726     0.1
                      CFP2-D15-DCO_0             NO    67.30726  67.30726     0.1
                      CFP2-D15-DCO_1             NO    67.30726  67.30726     0.1
                      CFP2-DE-DCO_0              NO    38.27397  38.27397     0.1
                      CFP2-DE-DCO_1              NO    38.27397  38.27397     0.1
                      CFP2-DETS-DCO_0            NO    38.27397  38.27397     0.1
                      CFP2-DETS-DCO_1            NO    38.27397  38.27397     0.1
                      CFP2-DS-DCO_0              NO    38.27397  38.27397     0.1
                      CFP2-DS-DCO_1              NO    38.27397  38.27397     0.1
                      CFP2-DS100-DCO_0           NO    38.27397  38.27397     0.1
                      CFP2-DS100-DCO_1           NO    38.27397  38.27397     0.1
                      MPAFPGA                    YES      0.54      0.54      0.0
--------------------------------------------------------------------------------
NC55-MPA-2TH-S        CFP2-D-DCO_0               NO    38.27397  38.27397     0.1
```

```
                        CFP2-D-DCO_1              NO      38.27397   38.27397    0.1
                        CFP2-D10-DCO_0            NO      67.30726   67.30726    0.1
                        CFP2-D10-DCO_1            NO      67.30726   67.30726    0.1
                        CFP2-D15-DCO_0            NO      67.30726   67.30726    0.1
                        CFP2-D15-DCO_1            NO      67.30726   67.30726    0.1
                        CFP2-DE-DCO_0            NO      38.27397   38.27397    0.1
                        CFP2-DE-DCO_1            NO      38.27397   38.27397    0.1
                        CFP2-DETS-DCO_0          NO      38.27397   38.27397    0.1
                        CFP2-DETS-DCO_1          NO      38.27397   38.27397    0.1
                        CFP2-DS-DCO_0            NO      38.27397   38.27397    0.1
                        CFP2-DS-DCO_1            NO      38.27397   38.27397    0.1
                        CFP2-DS100-DCO_0         NO      38.27397   38.27397    0.1
                        CFP2-DS100-DCO_1         NO      38.27397   38.27397    0.1
                        MPAFPGA                  YES      0.54       0.54       0.0
-----------------------------------------------------------------------------------
NC55-MPA-4H-HD-S        MPAFPGA                  YES      0.55       0.55       0.0
-----------------------------------------------------------------------------------
NC55-MPA-4H-HX-S        MPAFPGA                  YES      0.54       0.54       0.0
-----------------------------------------------------------------------------------
NC55-MPA-4H-S           MPAFPGA                  YES      0.54       0.54       0.0
-----------------------------------------------------------------------------------
NC55-OIP-2              CPLD-MPAFPGA             YES      2.00       2.00       0.0
                        MPAFPGA                  YES      4.11       4.11       0.0
-----------------------------------------------------------------------------------
NC55-OIP-4              MPAFPGA                  YES      0.10       0.10       0.0
-----------------------------------------------------------------------------------
NC55-PWR-3KW-2HV        DT-LogicMCU(A)           NO       3.01       3.01       0.2
                        DT-PriMCU(A)             NO       3.00       3.00       0.2
                        DT-SecMCU(A)             NO       3.01       3.01       0.2
-----------------------------------------------------------------------------------
NC55-PWR-3KW-DC         DT-SecMCU(A)             NO       4.12       4.12       0.1
-----------------------------------------------------------------------------------
NC55-PWR-4.4KW-DC       QCS-LogicMCU(A)          NO       3.00       3.00       0.1
                        QCS-PriMCU(A)            NO       3.00       3.00       0.1
                        QCS-SecMCU(A)            NO       3.00       3.00       0.1
-----------------------------------------------------------------------------------
NC55-RP                 Bootloader(A)            YES      9.31       9.31       0.0
                        IOFPGA(A)                YES      0.09       0.09       0.0
                        SATA-INTEL_240G(A)       NO    1132.00    1132.00       0.0
                        SATA-INTEL_480G(A)       NO    1132.00    1132.00       0.0
                        SATA-M500IT-MC(A)        NO       3.00       3.00       0.0
                        SATA-M500IT-MU-A(A)      NO       5.00       5.00       0.0
                        SATA-M500IT-MU-B(A)      NO       4.00       4.00       0.0
                        SATA-M5100(A)            NO      75.00      75.00       0.0
                        SATA-M600-MCT(A)         NO       5.00       5.00       0.0
                        SATA-M600-MU(A)          NO       6.00       6.00       0.0
                        SATA-Micron(A)           NO       1.00       1.00       0.0
                        SATA-SMART-128G(A)       NO    1535.00    1535.00       0.0
-----------------------------------------------------------------------------------
NC55-RP-E               Bootloader(A)            YES      1.24       1.24       0.0
                        IOFPGA(A)                YES      0.23       0.23       0.0
                        OMGFPGA(A)               YES      0.61       0.61       0.0
                        SATA-INTEL_240G(A)       NO    1132.00    1132.00       0.0
                        SATA-INTEL_480G(A)       NO    1132.00    1132.00       0.0
                        SATA-M500IT-MC(A)        NO       3.00       3.00       0.0
                        SATA-M500IT-MU-A(A)      NO       5.00       5.00       0.0
                        SATA-M500IT-MU-B(A)      NO       4.00       4.00       0.0
                        SATA-M5100(A)            NO      75.00      75.00       0.0
                        SATA-M600-MCT(A)         NO       5.00       5.00       0.0
                        SATA-M600-MU(A)          NO       6.00       6.00       0.0
                        SATA-Micron(A)           NO       1.00       1.00       0.0
                        SATA-SMART-128G(A)       NO    1535.00    1535.00       0.0
-----------------------------------------------------------------------------------
NC55-RP-PROTO           Bootloader(A)            YES      9.31       9.31       0.0
```

```
                    IOFPGA(A)                YES      0.06      0.06      0.0
                    SATA-INTEL_240G(A)       NO    1132.00   1132.00      0.0
                    SATA-INTEL_480G(A)       NO    1132.00   1132.00      0.0
                    SATA-M500IT-MC(A)        NO       3.00      3.00      0.0
                    SATA-M500IT-MU-A(A)      NO       5.00      5.00      0.0
                    SATA-M500IT-MU-B(A)      NO       4.00      4.00      0.0
                    SATA-M5100(A)            NO      75.00     75.00      0.0
                    SATA-M600-MCT(A)         NO       5.00      5.00      0.0
                    SATA-M600-MU(A)          NO       6.00      6.00      0.0
                    SATA-Micron(A)           NO       1.00      1.00      0.0
                    SATA-SMART-128G(A)       NO    1535.00   1535.00      0.0
--------------------------------------------------------------------------------
NC55-RP2-E          Bootloader(A)            YES      0.09      0.09      0.0
                    IOFPGA(A)                YES      0.50      0.50      0.0
                    OMGFPGA(A)               YES      0.52      0.52      0.0
                    SATA-INTEL_240G(A)       NO    1132.00   1132.00      0.0
                    SATA-INTEL_480G(A)       NO    1132.00   1132.00      0.0
                    SATA-M500IT-MC(A)        NO       3.00      3.00      0.0
                    SATA-M500IT-MU-A(A)      NO       5.00      5.00      0.0
                    SATA-M500IT-MU-B(A)      NO       4.00      4.00      0.0
                    SATA-M5100(A)            NO      75.00     75.00      0.0
                    SATA-M600-MCT(A)         NO       5.00      5.00      0.0
                    SATA-M600-MU(A)          NO       6.00      6.00      0.0
                    SATA-Micron(A)           NO       1.00      1.00      0.0
                    SATA-SMART-128G(A)       NO    1535.00   1535.00      0.0
                    TimingIC-A               YES      7.216     7.216     0.0
                    TimingIC-B-0             YES      7.216     7.216     0.0
                    TimingIC-B-1             YES      7.216     7.216     0.0
--------------------------------------------------------------------------------
NC55-SC             Bootloader(A)            YES      1.74      1.74      0.0
                    IOFPGA(A)                YES      0.11      0.11      0.0
--------------------------------------------------------------------------------
NC57-1600W-ACFW     PriMCU-ACFW(A)           NO       1.02      1.02      0.0
                    SecMCU-ACFW(A)           NO       1.07      1.07      0.0
--------------------------------------------------------------------------------
NC57-1600W-DCFW     PriMCU-DCFW(A)           NO       1.07      1.00      0.0
--------------------------------------------------------------------------------
NC57-18DD-SE        Bootloader(A)            YES      1.03      1.03      0.0
                    DBFPGA(A)                YES      0.14      0.14      0.0
                    IOFPGA(A)                YES      0.22      0.22      0.0
                    MIFPGA                   YES      0.11      0.11      0.0
                    QDD_BRT_FW_C0_P00        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P01        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P02        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P03        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P04        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P05        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P06        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P07        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P08        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P09        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P10        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P11        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P12        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P13        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P14        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P15        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P16        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P17        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P18        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P19        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P20        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P21        YES     70.130    70.130     0.0
                    QDD_BRT_FW_C0_P22        YES     70.130    70.130     0.0
```

```
                        QDD_BRT_FW_C0_P23          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P24          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P25          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P26          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P27          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P28          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P29          YES    70.130     70.130    0.0
                        QDD_FW_C0_P00              YES    61.23      61.23     0.0
                        QDD_FW_C0_P01              YES    61.23      61.23     0.0
                        QDD_FW_C0_P02              YES    61.23      61.23     0.0
                        QDD_FW_C0_P03              YES    61.23      61.23     0.0
                        QDD_FW_C0_P04              YES    61.23      61.23     0.0
                        QDD_FW_C0_P05              YES    61.23      61.23     0.0
                        QDD_FW_C0_P06              YES    61.23      61.23     0.0
                        QDD_FW_C0_P07              YES    61.23      61.23     0.0
                        QDD_FW_C0_P08              YES    61.23      61.23     0.0
                        QDD_FW_C0_P09              YES    61.23      61.23     0.0
                        QDD_FW_C0_P10              YES    61.23      61.23     0.0
                        QDD_FW_C0_P11              YES    61.23      61.23     0.0
                        QDD_FW_C0_P12              YES    61.23      61.23     0.0
                        QDD_FW_C0_P13              YES    61.23      61.23     0.0
                        QDD_FW_C0_P14              YES    61.23      61.23     0.0
                        QDD_FW_C0_P15              YES    61.23      61.23     0.0
                        QDD_FW_C0_P16              YES    61.23      61.23     0.0
                        QDD_FW_C0_P17              YES    61.23      61.23     0.0
                        QDD_FW_C0_P18              YES    61.23      61.23     0.0
                        QDD_FW_C0_P19              YES    61.23      61.23     0.0
                        QDD_FW_C0_P20              YES    61.23      61.23     0.0
                        QDD_FW_C0_P21              YES    61.23      61.23     0.0
                        QDD_FW_C0_P22              YES    61.23      61.23     0.0
                        QDD_FW_C0_P23              YES    61.23      61.23     0.0
                        QDD_FW_C0_P24              YES    61.23      61.23     0.0
                        QDD_FW_C0_P25              YES    61.23      61.23     0.0
                        QDD_FW_C0_P26              YES    61.23      61.23     0.0
                        QDD_FW_C0_P27              YES    61.23      61.23     0.0
                        QDD_FW_C0_P28              YES    61.23      61.23     0.0
                        QDD_FW_C0_P29              YES    61.23      61.23     0.0
                        SATA-INTEL_240G(A)         NO   1132.00    1132.00    0.0
                        SATA-INTEL_480G(A)         NO   1132.00    1132.00    0.0
                        SATA-M500IT-MC(A)          NO      3.00       3.00    0.0
                        SATA-M500IT-MU-A(A)        NO      5.00       5.00    0.0
                        SATA-M500IT-MU-B(A)        NO      4.00       4.00    0.0
                        SATA-M5100(A)              NO     75.00      75.00    0.0
                        SATA-M600-MCT(A)           NO      5.00       5.00    0.0
                        SATA-M600-MU(A)            NO      6.00       6.00    0.0
                        SATA-Micron(A)             NO      1.00       1.00    0.0
                        SATA-SMART-128G(A)         NO   1535.00    1535.00    0.0
--------------------------------------------------------------------------------
NC57-24DD               Bootloader(A)              YES     1.03       1.03    0.0
                        DBFPGA(A)                  YES     0.14       0.14    0.0
                        IOFPGA(A)                  YES     0.23       0.23    0.0
                        MIFPGA                     YES     0.11       0.11    0.0
                        QDD_BRT_FW_C0_P00          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P01          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P02          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P03          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P04          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P05          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P06          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P07          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P08          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P09          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P10          YES    70.130     70.130    0.0
                        QDD_BRT_FW_C0_P11          YES    70.130     70.130    0.0
```

```
                         QDD_BRT_FW_C0_P12              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P13              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P14              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P15              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P16              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P17              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P18              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P19              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P20              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P21              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P22              YES     70.130    70.130    0.0
                         QDD_BRT_FW_C0_P23              YES     70.130    70.130    0.0
                         QDD_FW_C0_P00                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P01                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P02                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P03                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P04                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P05                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P06                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P07                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P08                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P09                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P10                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P11                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P12                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P13                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P14                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P15                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P16                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P17                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P18                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P19                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P20                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P21                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P22                  YES     61.23     61.23     0.0
                         QDD_FW_C0_P23                  YES     61.23     61.23     0.0
                         SATA-INTEL_240G(A)            NO     1132.00   1132.00    0.0
                         SATA-INTEL_480G(A)            NO     1132.00   1132.00    0.0
                         SATA-M500IT-MC(A)             NO      3.00      3.00     0.0
                         SATA-M500IT-MU-A(A)           NO      5.00      5.00     0.0
                         SATA-M500IT-MU-B(A)           NO      4.00      4.00     0.0
                         SATA-M5100(A)                 NO     75.00     75.00     0.0
                         SATA-M600-MCT(A)              NO      5.00      5.00     0.0
                         SATA-M600-MU(A)               NO      6.00      6.00     0.0
                         SATA-Micron(A)                NO      1.00      1.00     0.0
                         SATA-SMART-128G(A)            NO     1535.00   1535.00    0.0
--------------------------------------------------------------------------------
NC57-36H-SE             Bootloader(A)                 YES     1.03      1.03     0.0
                         DBFPGA(A)                     YES     0.14      0.14     0.0
                         IOFPGA(A)                     YES     0.07      0.07     0.0
                         MIFPGA                        YES     0.03      0.03     0.0
                         SATA-INTEL_240G(A)            NO     1132.00   1132.00    0.0
                         SATA-INTEL_480G(A)            NO     1132.00   1132.00    0.0
                         SATA-M500IT-MC(A)             NO      3.00      3.00     0.0
                         SATA-M500IT-MU-A(A)           NO      5.00      5.00     0.0
                         SATA-M500IT-MU-B(A)           NO      4.00      4.00     0.0
                         SATA-M5100(A)                 NO     75.00     75.00     0.0
                         SATA-M600-MCT(A)              NO      5.00      5.00     0.0
                         SATA-M600-MU(A)               NO      6.00      6.00     0.0
                         SATA-Micron(A)                NO      1.00      1.00     0.0
                         SATA-SMART-128G(A)            NO     1535.00   1535.00    0.0
--------------------------------------------------------------------------------
NC57-36H6D-S            Bootloader(A)                 YES     0.02      0.02     0.0
                         DBFPGA(A)                     YES     0.14      0.14     0.0
```

```
                        IOFPGA(A)              YES     0.52      0.52     0.0
                        MIFPGA                 YES     0.40      0.40     0.0
                        QDD_BRT_FW_C0_P24      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P25      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P26      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P27      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P28      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P29      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P30      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P31      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P32      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P33      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P34      YES    70.130    70.130    0.0
                        QDD_BRT_FW_C0_P35      YES    70.130    70.130    0.0
                        QDD_FW_C0_P24          YES    61.23     61.23     0.0
                        QDD_FW_C0_P25          YES    61.23     61.23     0.0
                        QDD_FW_C0_P26          YES    61.23     61.23     0.0
                        QDD_FW_C0_P27          YES    61.23     61.23     0.0
                        QDD_FW_C0_P28          YES    61.23     61.23     0.0
                        QDD_FW_C0_P29          YES    61.23     61.23     0.0
                        QDD_FW_C0_P30          YES    61.23     61.23     0.0
                        QDD_FW_C0_P31          YES    61.23     61.23     0.0
                        QDD_FW_C0_P32          YES    61.23     61.23     0.0
                        QDD_FW_C0_P33          YES    61.23     61.23     0.0
                        QDD_FW_C0_P34          YES    61.23     61.23     0.0
                        QDD_FW_C0_P35          YES    61.23     61.23     0.0
                        SATA-INTEL_240G(A)     NO   1132.00   1132.00    0.0
                        SATA-INTEL_480G(A)     NO   1132.00   1132.00    0.0
                        SATA-M500IT-MC(A)      NO      3.00      3.00    0.0
                        SATA-M500IT-MU-A(A)    NO      5.00      5.00    0.0
                        SATA-M500IT-MU-B(A)    NO      4.00      4.00    0.0
                        SATA-M5100(A)          NO     75.00     75.00    0.0
                        SATA-M600-MCT(A)       NO      5.00      5.00    0.0
                        SATA-M600-MU(A)        NO      6.00      6.00    0.0
                        SATA-Micron(A)         NO      1.00      1.00    0.0
                        SATA-SMART-128G(A)     NO   1535.00   1535.00    0.0
                        TimingIC-A             YES     7.216     7.216    0.0
                        TimingIC-B             YES     7.216     7.216    0.0
-------------------------------------------------------------------------------
NC57-48Q2D-S            ALDRINFPGA(A)          YES     1.06      1.06     0.0
                        Bootloader(A)          YES     1.00      1.00     0.0
                        DBFPGA(A)              YES     0.14      0.14     0.0
                        IOFPGA(A)              YES     0.105     0.105    0.0
                        MIFPGA                 YES     0.21      0.21     0.0
                        SATA-INTEL_240G(A)     NO   1132.00   1132.00    0.0
                        SATA-INTEL_480G(A)     NO   1132.00   1132.00    0.0
                        SATA-M500IT-MC(A)      NO      3.00      3.00    0.0
                        SATA-M500IT-MU-A(A)    NO      5.00      5.00    0.0
                        SATA-M500IT-MU-B(A)    NO      4.00      4.00    0.0
                        SATA-M5100(A)          NO     75.00     75.00    0.0
                        SATA-M600-MCT(A)       NO      5.00      5.00    0.0
                        SATA-M600-MU(A)        NO      6.00      6.00    0.0
                        SATA-Micron(A)         NO      1.00      1.00    0.0
                        SATA-SMART-128G(A)     NO   1535.00   1535.00    0.0
                        TimingIC-A             YES     7.216     7.216    0.0
                        TimingIC-B             YES     7.216     7.216    0.0
-------------------------------------------------------------------------------
NC57-48Q2D-SE-S         ALDRINFPGA(A)          YES     1.06      1.06     0.0
                        Bootloader(A)          YES     1.00      1.00     0.0
                        DBFPGA(A)              YES     0.14      0.14     0.0
                        IOFPGA(A)              YES     0.105     0.105    0.0
                        MIFPGA                 YES     0.21      0.21     0.0
                        SATA-INTEL_240G(A)     NO   1132.00   1132.00    0.0
                        SATA-INTEL_480G(A)     NO   1132.00   1132.00    0.0
```

```
                        SATA-M500IT-MC(A)          NO      3.00      3.00      0.0
                        SATA-M500IT-MU-A(A)        NO      5.00      5.00      0.0
                        SATA-M500IT-MU-B(A)        NO      4.00      4.00      0.0
                        SATA-M5100(A)              NO     75.00     75.00      0.0
                        SATA-M600-MCT(A)           NO      5.00      5.00      0.0
                        SATA-M600-MU(A)            NO      6.00      6.00      0.0
                        SATA-Micron(A)             NO      1.00      1.00      0.0
                        SATA-SMART-128G(A)         NO   1535.00   1535.00      0.0
                        TimingIC-A                 YES     7.216     7.216     0.0
                        TimingIC-B                 YES     7.216     7.216     0.0
--------------------------------------------------------------------------------
NC57-MOD-RP2-E          Bootloader(A)              YES     0.14      0.14      0.0
                        IOFPGA                     YES     0.51      0.51      0.0
                        SATA-INTEL_240G(A)         NO   1132.00   1132.00      0.0
                        SATA-INTEL_480G(A)         NO   1132.00   1132.00      0.0
                        SATA-M500IT-MC(A)          NO      3.00      3.00      0.0
                        SATA-M500IT-MU-A(A)        NO      5.00      5.00      0.0
                        SATA-M500IT-MU-B(A)        NO      4.00      4.00      0.0
                        SATA-M5100(A)              NO     75.00     75.00      0.0
                        SATA-M600-MCT(A)           NO      5.00      5.00      0.0
                        SATA-M600-MU(A)            NO      6.00      6.00      0.0
                        SATA-Micron(A)             NO      1.00      1.00      0.0
                        SATA-SMART-128G(A)         NO   1535.00   1535.00      0.0
--------------------------------------------------------------------------------
NC57-MOD-S              Bootloader(A)              YES     2.03      2.03      0.0
                        DBFPGA(A)                  YES     0.14      0.14      0.0
                        IOFPGA(A)                  YES     0.42      0.42      0.0
                        MIFPGA                     YES     0.18      0.18      0.0
                        QDD_BRT_FW_C0_P08          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C0_P09          YES    70.130    70.130     0.0
                        QDD_FW_C0_P08              YES    61.23     61.23      0.0
                        QDD_FW_C0_P09              YES    61.23     61.23      0.0
                        SATA-INTEL_240G(A)         NO   1132.00   1132.00      0.0
                        SATA-INTEL_480G(A)         NO   1132.00   1132.00      0.0
                        SATA-M500IT-MC(A)          NO      3.00      3.00      0.0
                        SATA-M500IT-MU-A(A)        NO      5.00      5.00      0.0
                        SATA-M500IT-MU-B(A)        NO      4.00      4.00      0.0
                        SATA-M5100(A)              NO     75.00     75.00      0.0
                        SATA-M600-MCT(A)           NO      5.00      5.00      0.0
                        SATA-M600-MU(A)            NO      6.00      6.00      0.0
                        SATA-Micron(A)             NO      1.00      1.00      0.0
                        SATA-SMART-128G(A)         NO   1535.00   1535.00      0.0
                        TimingIC-A                 YES     7.216     7.216     0.0
                        TimingIC-B                 YES     7.216     7.216     0.0
--------------------------------------------------------------------------------
NC57-MPA-12L-S          MPAFPGA                    YES     0.28      0.28      0.0
--------------------------------------------------------------------------------
NC57-MPA-1FH1D-S        CFP2-M25-DCO_1             NO    67.30726  67.30726    0.1
                        MPAFPGA                    YES     0.80      0.80      0.0
                        QDD_BRT_FW_C1_P00          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C2_P00          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C3_P00          YES    70.130    70.130     0.0
                        QDD_FW_C1_P00              YES    61.23     61.23      0.0
                        QDD_FW_C2_P00              YES    61.23     61.23      0.0
                        QDD_FW_C3_P00              YES    61.23     61.23      0.0
--------------------------------------------------------------------------------
NC57-MPA-2D4H-S         MPAFPGA                    YES     0.07      0.07      0.0
                        QDD_BRT_FW_C1_P00          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C1_P01          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C1_P02          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C1_P03          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C2_P00          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C2_P01          YES    70.130    70.130     0.0
                        QDD_BRT_FW_C2_P02          YES    70.130    70.130     0.0
```

```
                    QDD_BRT_FW_C2_P03        YES    70.130    70.130    0.0
                    QDD_BRT_FW_C3_P00        YES    70.130    70.130    0.0
                    QDD_BRT_FW_C3_P01        YES    70.130    70.130    0.0
                    QDD_BRT_FW_C3_P02        YES    70.130    70.130    0.0
                    QDD_BRT_FW_C3_P03        YES    70.130    70.130    0.0
                    QDD_FW_C1_P00            YES    61.23     61.23     0.0
                    QDD_FW_C1_P01            YES    61.23     61.23     0.0
                    QDD_FW_C1_P02            YES    61.23     61.23     0.0
                    QDD_FW_C1_P03            YES    61.23     61.23     0.0
                    QDD_FW_C2_P00            YES    61.23     61.23     0.0
                    QDD_FW_C2_P01            YES    61.23     61.23     0.0
                    QDD_FW_C2_P02            YES    61.23     61.23     0.0
                    QDD_FW_C2_P03            YES    61.23     61.23     0.0
                    QDD_FW_C3_P00            YES    61.23     61.23     0.0
                    QDD_FW_C3_P01            YES    61.23     61.23     0.0
                    QDD_FW_C3_P02            YES    61.23     61.23     0.0
                    QDD_FW_C3_P03            YES    61.23     61.23     0.0
                    QDD_OLS_A_C1_P00         NO     2.07      2.07      0.0
                    QDD_OLS_A_C1_P01         NO     2.07      2.07      0.0
                    QDD_OLS_A_C1_P02         NO     2.07      2.07      0.0
                    QDD_OLS_A_C1_P03         NO     2.07      2.07      0.0
                    QDD_OLS_A_C2_P00         NO     2.07      2.07      0.0
                    QDD_OLS_A_C2_P01         NO     2.07      2.07      0.0
                    QDD_OLS_A_C2_P02         NO     2.07      2.07      0.0
                    QDD_OLS_A_C2_P03         NO     2.07      2.07      0.0
                    QDD_OLS_A_C3_P00         NO     2.07      2.07      0.0
                    QDD_OLS_A_C3_P01         NO     2.07      2.07      0.0
                    QDD_OLS_A_C3_P02         NO     2.07      2.07      0.0
                    QDD_OLS_A_C3_P03         NO     2.07      2.07      0.0
                    QDD_OLS_C_C1_P00         NO     1.00      1.00      0.0
                    QDD_OLS_C_C1_P01         NO     1.00      1.00      0.0
                    QDD_OLS_C_C1_P02         NO     1.00      1.00      0.0
                    QDD_OLS_C_C1_P03         NO     1.00      1.00      0.0
                    QDD_OLS_C_C2_P00         NO     1.00      1.00      0.0
                    QDD_OLS_C_C2_P01         NO     1.00      1.00      0.0
                    QDD_OLS_C_C2_P02         NO     1.00      1.00      0.0
                    QDD_OLS_C_C2_P03         NO     1.00      1.00      0.0
                    QDD_OLS_C_C3_P00         NO     1.00      1.00      0.0
                    QDD_OLS_C_C3_P01         NO     1.00      1.00      0.0
                    QDD_OLS_C_C3_P02         NO     1.00      1.00      0.0
                    QDD_OLS_C_C3_P03         NO     1.00      1.00      0.0
-------------------------------------------------------------------------------
NCS-57C3-MOD-SYS    ALDRINFPGA(A)            YES    1.04      1.04      0.0
                    Bootloader(A)            YES    0.16      0.16      0.0
                    DBFPGA(A)                YES    0.56      0.56      0.0
                    IOFPGA                   YES    0.101     0.101     0.0
                    MIFPGA                   YES    0.19      0.19      0.0
                    SATA-INTEL_240G(A)       NO     1132.00   1132.00   0.0
                    SATA-INTEL_480G(A)       NO     1132.00   1132.00   0.0
                    SATA-M500IT-MC(A)        NO     3.00      3.00      0.0
                    SATA-M500IT-MU-A(A)      NO     5.00      5.00      0.0
                    SATA-M500IT-MU-B(A)      NO     4.00      4.00      0.0
                    SATA-M5100(A)            NO     75.00     75.00     0.0
                    SATA-M600-MCT(A)         NO     5.00      5.00      0.0
                    SATA-M600-MU(A)          NO     6.00      6.00      0.0
                    SATA-Micron(A)           NO     1.00      1.00      0.0
                    SATA-SMART-128G(A)       NO     1535.00   1535.00   0.0
                    SSFP_E1F_0               NO     13.01     13.01     0.0
                    SSFP_E1F_1               NO     13.01     13.01     0.0
                    SSFP_E1F_10              NO     13.01     13.01     0.0
                    SSFP_E1F_11              NO     13.01     13.01     0.0
                    SSFP_E1F_12              NO     13.01     13.01     0.0
                    SSFP_E1F_13              NO     13.01     13.01     0.0
                    SSFP_E1F_14              NO     13.01     13.01     0.0
```

```
SSFP_E1F_15                NO    13.01    13.01      0.0
SSFP_E1F_16                NO    13.01    13.01      0.0
SSFP_E1F_17                NO    13.01    13.01      0.0
SSFP_E1F_18                NO    13.01    13.01      0.0
SSFP_E1F_19                NO    13.01    13.01      0.0
SSFP_E1F_2                 NO    13.01    13.01      0.0
SSFP_E1F_20                NO    13.01    13.01      0.0
SSFP_E1F_21                NO    13.01    13.01      0.0
SSFP_E1F_22                NO    13.01    13.01      0.0
SSFP_E1F_23                NO    13.01    13.01      0.0
SSFP_E1F_24                NO    13.01    13.01      0.0
SSFP_E1F_25                NO    13.01    13.01      0.0
SSFP_E1F_26                NO    13.01    13.01      0.0
SSFP_E1F_27                NO    13.01    13.01      0.0
SSFP_E1F_28                NO    13.01    13.01      0.0
SSFP_E1F_29                NO    13.01    13.01      0.0
SSFP_E1F_3                 NO    13.01    13.01      0.0
SSFP_E1F_30                NO    13.01    13.01      0.0
SSFP_E1F_31                NO    13.01    13.01      0.0
SSFP_E1F_32                NO    13.01    13.01      0.0
SSFP_E1F_33                NO    13.01    13.01      0.0
SSFP_E1F_34                NO    13.01    13.01      0.0
SSFP_E1F_35                NO    13.01    13.01      0.0
SSFP_E1F_36                NO    13.01    13.01      0.0
SSFP_E1F_37                NO    13.01    13.01      0.0
SSFP_E1F_38                NO    13.01    13.01      0.0
SSFP_E1F_39                NO    13.01    13.01      0.0
SSFP_E1F_4                 NO    13.01    13.01      0.0
SSFP_E1F_40                NO    13.01    13.01      0.0
SSFP_E1F_41                NO    13.01    13.01      0.0
SSFP_E1F_42                NO    13.01    13.01      0.0
SSFP_E1F_43                NO    13.01    13.01      0.0
SSFP_E1F_44                NO    13.01    13.01      0.0
SSFP_E1F_45                NO    13.01    13.01      0.0
SSFP_E1F_46                NO    13.01    13.01      0.0
SSFP_E1F_47                NO    13.01    13.01      0.0
SSFP_E1F_5                 NO    13.01    13.01      0.0
SSFP_E1F_6                 NO    13.01    13.01      0.0
SSFP_E1F_7                 NO    13.01    13.01      0.0
SSFP_E1F_8                 NO    13.01    13.01      0.0
SSFP_E1F_9                 NO    13.01    13.01      0.0
SSFP_OC3_STM1_0            NO    12.01    12.01      0.0
SSFP_OC3_STM1_1            NO    12.01    12.01      0.0
SSFP_OC3_STM1_10           NO    12.01    12.01      0.0
SSFP_OC3_STM1_11           NO    12.01    12.01      0.0
SSFP_OC3_STM1_12           NO    12.01    12.01      0.0
SSFP_OC3_STM1_13           NO    12.01    12.01      0.0
SSFP_OC3_STM1_14           NO    12.01    12.01      0.0
SSFP_OC3_STM1_15           NO    12.01    12.01      0.0
SSFP_OC3_STM1_16           NO    12.01    12.01      0.0
SSFP_OC3_STM1_17           NO    12.01    12.01      0.0
SSFP_OC3_STM1_18           NO    12.01    12.01      0.0
SSFP_OC3_STM1_19           NO    12.01    12.01      0.0
SSFP_OC3_STM1_2            NO    12.01    12.01      0.0
SSFP_OC3_STM1_20           NO    12.01    12.01      0.0
SSFP_OC3_STM1_21           NO    12.01    12.01      0.0
SSFP_OC3_STM1_22           NO    12.01    12.01      0.0
SSFP_OC3_STM1_23           NO    12.01    12.01      0.0
SSFP_OC3_STM1_24           NO    12.01    12.01      0.0
SSFP_OC3_STM1_25           NO    12.01    12.01      0.0
SSFP_OC3_STM1_26           NO    12.01    12.01      0.0
SSFP_OC3_STM1_27           NO    12.01    12.01      0.0
SSFP_OC3_STM1_28           NO    12.01    12.01      0.0
SSFP_OC3_STM1_29           NO    12.01    12.01      0.0
```

```
                         SSFP_OC3_STM1_3              NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_30             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_31             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_32             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_33             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_34             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_35             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_36             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_37             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_38             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_39             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_4              NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_40             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_41             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_42             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_43             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_44             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_45             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_46             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_47             NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_5              NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_6              NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_7              NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_8              NO    12.01      12.01     0.0
                         SSFP_OC3_STM1_9              NO    12.01      12.01     0.0
                         TimingIC-A                   YES   23.112     23.112    0.0
                         TimingIC-B                   YES    7.216      7.216    0.0
--------------------------------------------------------------------------------
NCS-57C3-MODS-SYS        ALDRINFPGA(A)                YES    1.04       1.04     0.0
                         Bootloader(A)                YES    0.16       0.16     0.0
                         DBFPGA(A)                    YES    0.56       0.56     0.0
                         IOFPGA                       YES    0.101      0.101    0.0
                         MIFPGA                       YES    0.19       0.19     0.0
                         SATA-INTEL_240G(A)           NO  1132.00    1132.00     0.0
                         SATA-INTEL_480G(A)           NO  1132.00    1132.00     0.0
                         SATA-M500IT-MC(A)            NO     3.00       3.00     0.0
                         SATA-M500IT-MU-A(A)          NO     5.00       5.00     0.0
                         SATA-M500IT-MU-B(A)          NO     4.00       4.00     0.0
                         SATA-M5100(A)                NO    75.00      75.00     0.0
                         SATA-M600-MCT(A)             NO     5.00       5.00     0.0
                         SATA-M600-MU(A)              NO     6.00       6.00     0.0
                         SATA-Micron(A)               NO     1.00       1.00     0.0
                         SATA-SMART-128G(A)           NO  1535.00    1535.00     0.0
                         SSFP_E1F_0                   NO    13.01      13.01     0.0
                         SSFP_E1F_1                   NO    13.01      13.01     0.0
                         SSFP_E1F_10                  NO    13.01      13.01     0.0
                         SSFP_E1F_11                  NO    13.01      13.01     0.0
                         SSFP_E1F_12                  NO    13.01      13.01     0.0
                         SSFP_E1F_13                  NO    13.01      13.01     0.0
                         SSFP_E1F_14                  NO    13.01      13.01     0.0
                         SSFP_E1F_15                  NO    13.01      13.01     0.0
                         SSFP_E1F_16                  NO    13.01      13.01     0.0
                         SSFP_E1F_17                  NO    13.01      13.01     0.0
                         SSFP_E1F_18                  NO    13.01      13.01     0.0
                         SSFP_E1F_19                  NO    13.01      13.01     0.0
                         SSFP_E1F_2                   NO    13.01      13.01     0.0
                         SSFP_E1F_20                  NO    13.01      13.01     0.0
                         SSFP_E1F_21                  NO    13.01      13.01     0.0
                         SSFP_E1F_22                  NO    13.01      13.01     0.0
                         SSFP_E1F_23                  NO    13.01      13.01     0.0
                         SSFP_E1F_24                  NO    13.01      13.01     0.0
                         SSFP_E1F_25                  NO    13.01      13.01     0.0
                         SSFP_E1F_26                  NO    13.01      13.01     0.0
                         SSFP_E1F_27                  NO    13.01      13.01     0.0
```

```
SSFP_E1F_28            NO    13.01    13.01    0.0
SSFP_E1F_29            NO    13.01    13.01    0.0
SSFP_E1F_3             NO    13.01    13.01    0.0
SSFP_E1F_30            NO    13.01    13.01    0.0
SSFP_E1F_31            NO    13.01    13.01    0.0
SSFP_E1F_32            NO    13.01    13.01    0.0
SSFP_E1F_33            NO    13.01    13.01    0.0
SSFP_E1F_34            NO    13.01    13.01    0.0
SSFP_E1F_35            NO    13.01    13.01    0.0
SSFP_E1F_36            NO    13.01    13.01    0.0
SSFP_E1F_37            NO    13.01    13.01    0.0
SSFP_E1F_38            NO    13.01    13.01    0.0
SSFP_E1F_39            NO    13.01    13.01    0.0
SSFP_E1F_4             NO    13.01    13.01    0.0
SSFP_E1F_40            NO    13.01    13.01    0.0
SSFP_E1F_41            NO    13.01    13.01    0.0
SSFP_E1F_42            NO    13.01    13.01    0.0
SSFP_E1F_43            NO    13.01    13.01    0.0
SSFP_E1F_44            NO    13.01    13.01    0.0
SSFP_E1F_45            NO    13.01    13.01    0.0
SSFP_E1F_46            NO    13.01    13.01    0.0
SSFP_E1F_47            NO    13.01    13.01    0.0
SSFP_E1F_5             NO    13.01    13.01    0.0
SSFP_E1F_6             NO    13.01    13.01    0.0
SSFP_E1F_7             NO    13.01    13.01    0.0
SSFP_E1F_8             NO    13.01    13.01    0.0
SSFP_E1F_9             NO    13.01    13.01    0.0
SSFP_OC3_STM1_0        NO    12.01    12.01    0.0
SSFP_OC3_STM1_1        NO    12.01    12.01    0.0
SSFP_OC3_STM1_10       NO    12.01    12.01    0.0
SSFP_OC3_STM1_11       NO    12.01    12.01    0.0
SSFP_OC3_STM1_12       NO    12.01    12.01    0.0
SSFP_OC3_STM1_13       NO    12.01    12.01    0.0
SSFP_OC3_STM1_14       NO    12.01    12.01    0.0
SSFP_OC3_STM1_15       NO    12.01    12.01    0.0
SSFP_OC3_STM1_16       NO    12.01    12.01    0.0
SSFP_OC3_STM1_17       NO    12.01    12.01    0.0
SSFP_OC3_STM1_18       NO    12.01    12.01    0.0
SSFP_OC3_STM1_19       NO    12.01    12.01    0.0
SSFP_OC3_STM1_2        NO    12.01    12.01    0.0
SSFP_OC3_STM1_20       NO    12.01    12.01    0.0
SSFP_OC3_STM1_21       NO    12.01    12.01    0.0
SSFP_OC3_STM1_22       NO    12.01    12.01    0.0
SSFP_OC3_STM1_23       NO    12.01    12.01    0.0
SSFP_OC3_STM1_24       NO    12.01    12.01    0.0
SSFP_OC3_STM1_25       NO    12.01    12.01    0.0
SSFP_OC3_STM1_26       NO    12.01    12.01    0.0
SSFP_OC3_STM1_27       NO    12.01    12.01    0.0
SSFP_OC3_STM1_28       NO    12.01    12.01    0.0
SSFP_OC3_STM1_29       NO    12.01    12.01    0.0
SSFP_OC3_STM1_3        NO    12.01    12.01    0.0
SSFP_OC3_STM1_30       NO    12.01    12.01    0.0
SSFP_OC3_STM1_31       NO    12.01    12.01    0.0
SSFP_OC3_STM1_32       NO    12.01    12.01    0.0
SSFP_OC3_STM1_33       NO    12.01    12.01    0.0
SSFP_OC3_STM1_34       NO    12.01    12.01    0.0
SSFP_OC3_STM1_35       NO    12.01    12.01    0.0
SSFP_OC3_STM1_36       NO    12.01    12.01    0.0
SSFP_OC3_STM1_37       NO    12.01    12.01    0.0
SSFP_OC3_STM1_38       NO    12.01    12.01    0.0
SSFP_OC3_STM1_39       NO    12.01    12.01    0.0
SSFP_OC3_STM1_4        NO    12.01    12.01    0.0
SSFP_OC3_STM1_40       NO    12.01    12.01    0.0
SSFP_OC3_STM1_41       NO    12.01    12.01    0.0
```

```
SSFP_OC3_STM1_42                       NO    12.01     12.01       0.0
SSFP_OC3_STM1_43                       NO    12.01     12.01       0.0
SSFP_OC3_STM1_44                       NO    12.01     12.01       0.0
SSFP_OC3_STM1_45                       NO    12.01     12.01       0.0
SSFP_OC3_STM1_46                       NO    12.01     12.01       0.0
SSFP_OC3_STM1_47                       NO    12.01     12.01       0.0
SSFP_OC3_STM1_5                        NO    12.01     12.01       0.0
SSFP_OC3_STM1_6                        NO    12.01     12.01       0.0
SSFP_OC3_STM1_7                        NO    12.01     12.01       0.0
SSFP_OC3_STM1_8                        NO    12.01     12.01       0.0
SSFP_OC3_STM1_9                        NO    12.01     12.01       0.0
TimingIC-A                             YES   23.112    23.112      0.0
TimingIC-B                             YES    7.216     7.216      0.0
```

NCS 5700 Fixed Port Routers

```
Router# show fpd package
Mon Dec 16 16:59:05.551 IST


=============================== =================================================
                                           Field Programmable Device Package
                                =================================================
                                Req    SW      Min Req   Min Req
Card Type          FPD Description      Reload Ver     SW Ver  Board Ver
================== ========================= ====== ======= ======== =========
-----------------------------------------------------------------------------
NCS-57B1-5DSE-SYS  ADM1_Config            NO     0.50    0.50        0.0
                   ADM2_Config            NO     0.50    0.50        0.0
                   ADM3_Config            NO     0.50    0.50        0.0
                   IoFpga                 YES    0.09    0.09        0.0
                   IoFpgaGolden           YES    0.09    0.08        0.0
                   Primary-BIOS           YES    1.11    1.11        0.0
                   SsdIntelS4510          YES   11.20   11.20        0.0
                   ssdIntelS4520          YES    1.11    1.11        0.0
                   SsdMicron5300          YES    0.01    0.01        0.0
                   StdbyFpga              YES    0.24    0.24        0.0
                   StdbyFpgaGolden        YES    0.24    0.24        0.0
                   TamFw                  YES    6.05    6.05        0.0
                   TamFwGolden            YES    6.05    6.05        0.0
-----------------------------------------------------------------------------
NCS-57B1-6D24-SYS  ADM1_Config            NO     0.94    0.94        0.0
                   ADM2_Config            NO     0.94    0.94        0.0
                   ADM3_Config            NO     0.94    0.94        0.0
                   IoFpga                 YES    0.09    0.09        0.0
                   IoFpgaGolden           YES    0.09    0.08        0.0
                   Primary-BIOS           YES    1.11    1.11        0.0
                   SsdIntelS4510          YES   11.20   11.20        0.0
                   ssdIntelS4520          YES    1.11    1.11        0.0
                   SsdMicron5300          YES    0.01    0.01        0.0
                   StdbyFpga              YES    0.24    0.24        0.0
                   StdbyFpgaGolden        YES    0.24    0.24        0.0
                   TamFw                  YES    6.05    6.05        0.0
                   TamFwGolden            YES    6.05    6.05        0.0
-----------------------------------------------------------------------------
NCS-57C1-48Q6-SYS  ADM1_Config            YES    0.07    0.07        0.0
                   ADM2_Config            YES    0.07    0.07        0.0
                   IoFpga                 YES    0.53    0.53        0.0
                   IoFpgaGolden           YES    0.47    0.47        0.0
                   Primary-BIOS           YES    3.07    3.07        0.0
                   SsdIntelS4510          YES   11.32   11.32        0.0
                   ssdIntelS4520          YES    1.11    1.11        0.0
                   SsdMicron5300          YES    0.01    0.01        0.0
                   StdbyFpga              YES    0.32    0.32        0.0
                   StdbyFpgaGolden        YES    0.31    0.31        0.0
                   TamFw                  YES    7.17    7.17        0.0
```

```
                       TamFwGolden               YES    7.10    7.10       0.0
-------------------------------------------------------------------------------
NCS-57D2-18DD-SYS      ADM1-DBConfig             YES    1.92    1.92       0.0
                       ADM2-DBConfig             YES    1.92    1.92       0.0
                       ADM3-DBConfig             YES    1.92    1.92       0.0
                       ADM4-MBConfig             YES    1.92    1.92       0.0
                       ADM5-MBConfig             YES    1.92    1.92       0.0
                       ADM6-MBConfig             YES    1.92    1.92       0.0
                       FtFpga                    NO     0.20    0.20       0.0
                       FtFpgaGolden              NO     0.20    0.00       0.0
                       IoFpga                    YES    0.06    0.06       0.0
                       IoFpgaDB                  YES    0.07    0.07       0.0
                       IoFpgaGolden              YES    0.05    0.05       0.0
                       IoFpgaGoldenDB            YES    0.05    0.05       0.0
                       Primary-BIOS              YES    4.10    4.10       0.0
                       SsdIntelS4510             YES    11.32   11.32      0.0
                       ssdIntelS4520             YES    1.11    1.11       0.0
                       SsdMicron5300             YES    0.01    0.01       0.0
                       StdbyFpga                 YES    0.96    0.96       0.0
                       StdbyFpgaGolden           YES    0.83    0.83       0.0
                       TamFw                     YES    7.09    7.09       0.0
                       TamFwGolden               YES    7.09    7.09       0.0
-------------------------------------------------------------------------------
PSU1100W-ACPI          EM-PrimMCU                NO     1.01    1.01       0.0
                       EM-SecMCU                 NO     1.05    1.05       0.0
-------------------------------------------------------------------------------
PSU2KW-ACPE            PO-PrimMCU                NO     1.03    1.03       0.0
                       PO-SecMCU                 NO     1.10    1.10       0.0
-------------------------------------------------------------------------------
PSU2KW-ACPI            PO-PrimMCU                NO     1.03    1.03       0.0
                       PO-SecMCU                 NO     1.13    1.13       0.0
                       QC-PrimMCU                NO     2.00    2.00       0.0
                       QC-SecMCU                 NO     4.00    4.00       0.0
-------------------------------------------------------------------------------
PSU2KW-DCPE            PO-PrimMCU                NO     1.11    1.11       0.0
-------------------------------------------------------------------------------
PSU2KW-DCPI            PO-PrimMCU                NO     1.11    1.11       0.0
-------------------------------------------------------------------------------
PSU950W-DCPI           EM-PrimMCU                NO     1.00    1.00       0.0
```

This sample output is for **show hw-module fpd** command from the Admin mode:

```
sysadmin-vm:0_RP0# show hw-module fpd
Mon Dec 16 16:59:03.654 IST

Auto-upgrade:Enabled,PM excluded
Attribute codes: B golden, P protect, S secure, A Anti Theft aware
                                                             FPD Versions
                                                             ==============
Location   Card type            HWver FPD device      ATR Status   Running  Programd  Reload Loc
-------------------------------------------------------------------------------------------------
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   ADM1_Config          CURRENT   0.94    0.94      NOT REQ
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   ADM2_Config          CURRENT   0.94    0.94      NOT REQ
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   ADM3_Config          CURRENT   0.94    0.94      NOT REQ
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   IoFpga               CURRENT   0.09    0.09       0/RP0
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   IoFPgaGolden     B   NEED UPGD         0.02       0/RP0
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   Primary-BIOS     S   CURRENT   1.11    1.11       0/RP0
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   SsdMicron5300    S   CURRENT   0.01    0.01       0/RP0
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   StdbyFpga        S   CURRENT   0.24    0.24       0/RP0
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   StdbyFpgaGolden  BS  NEED UPGD         0.00       0/RP0
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   TamFw            S   CURRENT   6.05    6.05       0/RP0
0/RP0/CPU0 NCS-57B1-6D24-SYS    0.1   TamFwGolden      BS  NEED UPGD         0.00       0/RP0
0/PM0      PSU2KW-ACPI          0.0   PO-PrimMCU           CURRENT   1.03    1.03      NOT REQ
0/PM0      PSU2KW-ACPI          0.0   PO-SecMCU            CURRENT   1.13    1.13      NOT REQ
0/PM1      PSU2KW-ACPI          0.0   PO-PrimMCU           NOT READY                     N/A
```

```
0/PM1      PSU2KW-ACPI        0.0   PO-SecMCU         CURRENT    1.13    1.13
```

Compatibility Matrix for EPNM and Crosswork with Cisco IOS XR Software

The compatibility matrix lists the version of EPNM and Crosswork that are supported with Cisco IOS XR Release in this release.

Table 6: Compatibility Matrix

Cisco IOS XR	Crosswork	EPNM
Release 24.4.1	Crosswork Optimization Engine 6.0	Evolved Programmable Network Manager 7.1.1

Important Notes

- The total number of bridge-domains (2*BDs) and GRE tunnels put together should not exceed 1518. Here the number 1518 represents the multi-dimensional scale value.

- The offline diagnostics functionality is not supported in NCS 5500 platform. Therefore, the **hw-module service offline location** command will not work. However, you can use the **(sysadmin)# hw-module shutdown location** command to bring down the LC.

Licensing

Starting with Cisco IOS XR Release 24.1.1, Smart Licensing Using Policy (SLP) is the default Licensing model. When you upgrade to the Cisco IOS XR Release 24.1.1 release or later, the Smart Licensing Using Policy is enabled by default.

You can migrate your devices to Smart Licensing with Policy model, see *Migrating from Smart Licensing to Smart Licensing Using Policy*, Smart Licensing Using Policy on Cisco IOS XR Routers.

We recommend that you update to the latest version of SSM On-Prem or Cisco Smart Licensing Utility.

> ✎ **Note** SSM On-Prem and CSSM both support SLP devices and SL devices. SLP devices and SL devices can coexist in a network. The Smart Licensing (SL) model is available in releases Cisco IOS XR Release 7.11.1 and earlier.

Supported Transceiver Modules

To determine the transceivers that Cisco hardware device supports, refer to the Transceiver Module Group (TMG) Compatibility Matrix tool.

Upgrading Cisco IOS XR Software

Cisco IOS XR Software is installed and activated from modular packages, allowing specific features or software patches to be installed, upgraded, or downgraded without affecting unrelated processes. Software packages can be upgraded or downgraded on all supported card types, or on a single card (node).

Before starting the software upgrade, use the **show install health** command in the admin mode. This command validates if the statuses of all relevant parameters of the system are ready for the software upgrade without interrupting the system.

Note
- If you use a TAR package to upgrade from a Cisco IOS XR release prior to 7.x, the output of the **show install health** command in admin mode displays the following error messages:

```
sysadmin-vm:0_RSP0# show install health
. . .
ERROR /install_repo/gl/xr -rw-r--r--. 1 8413 floppy 3230320 Mar 14 05:45 <platform>-isis-2.2.0.0-r702.x86_64
ERROR /install_repo/gl/xr -rwxr-x---. 1 8413 165 1485781 Mar 14 06:02 <platform>-k9sec-3.1.0.0-r702.x86_64
ERROR /install_repo/gl/xr -rw-r--r--. 1 8413 floppy 345144 Mar 14 05:45 <platform>-li-1.0.0.0-r702.x86_64
```

You can ignore these messages and proceed with the installation operation.

- Quad configurations will be lost when you perform a software downgrade on a NCS-55A1-48Q6H device from IOS XR Release 7.5.1 onwards to a release prior to IOS XR Release 7.5.1 due to non-backward compatibility change. The lost configuration can be applied manually after the downgrade.

Note A quad is a group of four ports with common speeds, 1G/10G or 25G. You can configure the ports speed for a the **hw-module quad** command.

Production Software Maintenance Updates (SMUs)

A production SMU is a SMU that is formally requested, developed, tested, and released. Production SMUs are intended for use in a live network environment and are formally supported by the Cisco TAC and the relevant development teams. Software bugs identified through software recommendations or Bug Search Tools are not a basis for production SMU requests.

For information on production SMU types, refer the Production SMU Types section of the *IOS XR Software Maintenance Updates (SMUs)* guide.

Cisco IOS XR Error messages

To view, search, compare, and download Cisco IOS XR Error Messages, refer to the Cisco IOS XR Error messages tool.

Cisco IOS XR MIBs

To determine the MIBs supported by platform and release, refer to the Cisco IOS XR MIBs tool.

Related Documentation

The most current Cisco NCS 5500 router documentation is located at the following URL:

https://www.cisco.com/c/en/us/td/docs/iosxr/ios-xr.html