

Cisco Network Convergence System NCS 5500 Fixed Platform Architecture



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NCS 5500 Family Introduction

The Network Convergence System 5500 Series offers industry-leading density of routed 1/10/40/100G ports for high-scale WAN aggregation. The NCS 5500 Series is designed to efficiently scale across Data Centers, Large Enterprise, Web, Service Provider WAN and Aggregation Networks.

The Cisco NCS 5500 is a family of routing platforms including fixed and modular chassis. The platform offers high port density, high performance forwarding, low jitter and the lowest power consumption per Gigabits/sec at a very cost-effective price point.

The NCS 5500 leverages the industry-leading IOS XR Operating System with a full suite of standard layer-2 and layer-3 protocols, plus new features and functions such as:

- Application Hosting
- Programmability
- Enhanced Automation
- Machine to Machine interface (M2M)
- Telemetry
- Flexible Package Delivery

This white paper focuses on the hardware architecture, characteristics and packet forwarding of NCS 5500 fixed form factor platforms. There are currently four fixed form factor platforms available offering performance and scale. Following is the naming convention for the fixed platform and the table summarizes the available models.

NCS 55xx:

xx : 01 - 1 RU platform

xx : 02 - 2 RU platform

SE : Platform with feature scale support

NCS 5500 Fixed Platform	Ports
NCS 5501	48x 1/10Gbps SFP Ports 6x 40/100Gbps QSFP Ports
NCS 5501-SE	40x 1/10Gbps SFP Ports 4x 40/100Gbps QSFP Ports
NCS 5502	48x 40/100Gbps QSFP Ports
NCS 5502-SE	48x 40/100Gbps QSFP Ports

Table 1- NCS 5500 Fixed Platforms

NCS 5501/5501-SE Platform Architecture

The NCS 5501/5501-SE is a 1 RU fixed form factor routing platform that supports industry-leading performance with 1/10/40/100G ports. The NCS 5501/5501-SE has SFP and QSFP form-factor ports; the SFP ports can be used as 1G or 10G ports while the QSFP form-factor ports can be used for either 40G, 4x 10G ports in breakout mode or 100G speeds.

NCS 5501/5501-SE has a System-on-a-Chip (SoC) single Forwarding ASIC that delivers up to 800Gbps of throughput and up to 720 million packets per second (Mpps). This ASIC uses a 16MB on-chip packet buffer for normal operation and a 4GB external deep buffer to handle up to 50ms of packet queuing in case of interface congestion.



Figure 1- NCS 5501 Base Platform



Figure 2- NCS 5501-SE Platform

The NCS 5501/5501-SE platform has Intel multi-core CPU with 32GB of RAM. There is a built-in 64GB of Flash SSD storage which is part of the file system to provide additional on-board space for persistent storage. The high-speed multi-core CPU and large memory base builds the foundation for a highly robust platform that runs Cisco's 64-bit IOS XR Operating System. The 64-bit IOS XR enables better processing performance and faster access to system memory. It also provides the ability to create containers to run third-party applications. These advantages plus the new feature enhancements such as telemetry, programmability and flexible packaging in IOS XR, builds a solid foundation for NCS 5500 platforms.

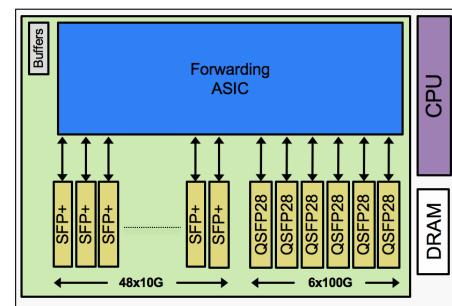
In the NCS 5501 Platform Family, there are two variants which are as follows.

NCS 5501 Base Model

The NCS 5501 base model is a 1 RU fixed form factor platform that supports 800Gbps of bandwidth and up to 720 million packets per second forwarding. It has 48x 1/10G SFP Ports and 6x 40/100G QSFP Ports. The NCS 5501 base model has an Intel 6-Core CPU operating at 1.9GHz with 32GB of RAM. This model is based on an 800Gbps System-on-a-Chip (SoC) single ASIC, supporting on-chip tables of minimum 256K IPv4 or 64K IPv6 routes (350K IPv4 or 160K IPv6 with internet prefixes distribution) and 750k for IPv4 /32 and /24 routes shared with MPLS and MAC. Globally, the system supports 1M+ prefixes.



Figure 3- NCS 5501 Base Model Front View



NCS 5501-SE Scale Model

The NCS 5501-SE is a 1 RU fixed form factor scale model that has 40x 1/10G SFP Ports and 4x 40/100G QSFP Ports. It is based on Intel 8-Core CPU operating at 2GHz with 32GB of RAM. This model is based on System-on-a-Chip (SoC) providing 800Gbps of bandwidth at 600 million packets per second forwarding. The difference between NCS 5501 base model and NCS 5501-SE scale model is that NCS 5501-SE provides the extended feature scale capability along with line rate performance on each port. The extended scale is achieved for FIB, ACL and QoS by utilizing a 10MB external-TCAM. This external-TCAM is used in addition to the on-chip table. The off-chip/external-TCAM provides up to 2M entries that can be shared between IPv4, IPv6 routes, ACL and QoS. Globally, the system supports up to 2.75M prefixes.

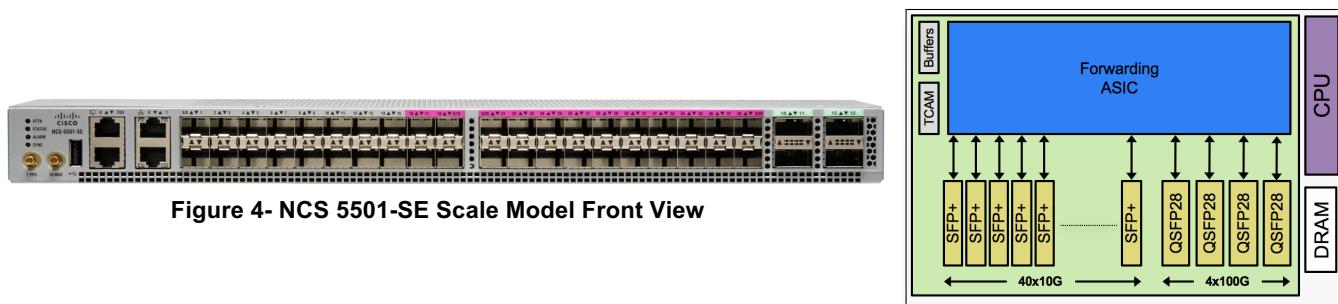


Figure 4- NCS 5501-SE Scale Model Front View

NCS 5501-SE has the capability to support 1G and 10G ZR/DWDM¹ optics. ZR and DWDM support is only available on ports from 16 till 39 which are highlighted with pink color on the chassis. NCS 5501-SE also supports timing via the timing ports available at the front of the chassis.

	NCS 5501 Base	NCS 5501-SE
Chassis Height		1 Rack Unit
Chassis Dimensions		21.70 x 17.40 x 1.72 inches 55.12 x 44.20 x 4.37 cm
Ports	48x 1/10Gbps SFP Ports 6x 40/100Gbps QSFP Ports 24x 10G SFP Ports via Breakout	40x 1/10Gbps SFP Ports 4x 40/100Gbps QSFP Ports 16x 10G SFP Ports via Breakout
Forwarding ASICs		800Gbps single Forwarding ASIC
Packet Forwarding Rate	720Mpps	600Mpps
Max Throughput		800Gbps
Resources	On-chip tables for a minimum of 256K IPv4 or 64K IPv6 routes (350K IPv4 or 160K IPv6 with internet distribution) On-chip tables for 750K IPv4 routes, MAC and MPLS labels	FIB scale up to 2M IPv4 or 1M IPv6 routes (FIB scale up to 2.75M IPv4 routes if combined with on-chip tables) On-chip tables for 750K IPv4 routes, MAC and labels

¹ Refer to NCS 5500 Optics Compatibility Matrix data sheet for support roadmap.

Buffers	16MB On-chip Buffers 4GB Off-chip Buffers
Latency	2 to 8 usec
Processor	Intel 6-Core processor @ 1.9 GHz Intel 8-Core processor @ 2.0 GHz
System Memory	32GB DRAM
Flash Storage	64GB Flash SSD Storage

Table 2- NCS 5501/5501-SE Platform Specifications

NCS 5502/5502-SE Platform Architecture

The NCS 5502/5502-SE is a 2 RU routing platform that supports industry-leading performance and density of 100G ports in fixed form factor. Both the NCS 5502 base model and NCS 5502-SE scale model have 48 QSFP form-factor ports that can be configured as either 40G, 4x 10G in breakout mode or 100G ports.



Figure 5- NCS 5502 Platform

NCS 5502/5502-SE has eight Forwarding ASICs, each offering 600Gbps of bandwidth and up to 720Mpps of throughput. The platform delivers up to 5,760 million packets per second (Mpps) and up to 4.8Tbps of line rate forwarding. The eight Forwarding ASICs are connected to two Fabric ASICs called Switch Fabric Element (SFE). The Forwarding ASICs and Fabric Elements perform cell-based forwarding. The packets are segmented into smaller sized cells (64 to 256 bytes) and distributed evenly to the two Fabric Elements. This mechanism provides the required data path bandwidth and packet forwarding capacity to achieve a true non-blocking architecture. It also permits the router to forward single flows with no bandwidth limitation.

The Forwarding ASIC on NCS 5502/5502-SE has a 16MB on-chip packet buffer for normal operation and a 4GB external deep buffer to handle up to 50ms of packet queuing in case of interface congestion.

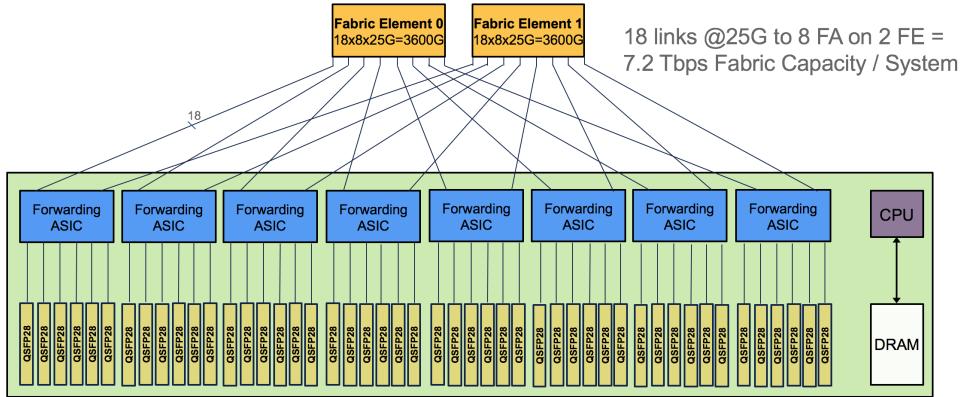


Figure 6- NCS 5502 Platform Architecture

The NCS 5502/5502-SE platform uses an Intel 12-core CPU operating at 1.6GHz with 64GB of RAM. It has 64GB of SSD Flash drive which is part of the file system to provide additional on-board space for persistent storage. The platform runs Cisco's 64-bit IOS XR Operating System that enables better processing performance and fast system memory access.

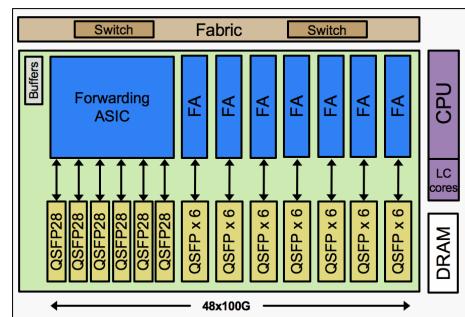
In the NCS 5502 Platform Family, there are two variants which are as follows.

NCS 5502 Base Model

The NCS 5502 base model has 48 QSFP Ports that can operate at 40/100G or in 4x 10G break out mode. NCS 5502 base model supports 1M+ prefixes; it has on-chip tables to support a minimum of 256K IPv4 or 64K IPv6 routes (350K IPv4 or 160K IPv6 with internet prefixes distribution) and 750k for IPv4 /32 and /24 routes shared with MPLS and MAC addresses.



Figure 7- NCS 5502 Base Model Front View

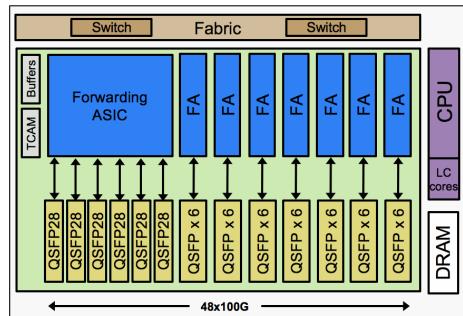


NCS 5502-SE Scale Model

NCS 5502-SE scale model is exactly the same as NCS 5502 base model in terms of port-count, form-factor and architecture. The major difference between the two platforms is that NCS 5502-SE provides extended scale capability for FIB, ACL and QoS by utilizing a 10MB external-TCAM. This external-TCAM is used in addition to the on-chip table. The off-chip memory provides up to 2M entries shared between IPv4, IPv6 routes, ACL and QoS. Globally, the system supports up to 2.75M prefixes.



Figure 8- NCS 5502-SE Scale Model Front View



	NCS 5502	NCS 5502-SE
Chassis Height	2 Rack Unit	
Chassis Dimensions	30 x 17.30 x 3.45 inches 76.20 x 43.94 x 8.73 cm	
Ports	48x 40/100Gbps QSFP Ports 192x 10G SFP Ports via Breakout	
Forwarding ASICs	8 Forwarding ASICs x (600Gbps bandwidth each)	
Packet Forwarding Rate	5,760 Mpps (8 x 720 Mpps)	4,800 Mpps (8 x 600 Mpps)
Max Throughput	4.8Tbps	
Resources	On-chip tables for a minimum of 256K IPv4 or 64K IPv6 routes (350K IPv4 or 160K IPv6 with Internet distribution) On-chip tables for 750K IPv4 routes, MAC and MPLS labels	FIB scale up to 2M IPv4 or 1M IPv6 routes (FIB scale up to 2.75M IPv4 routes if combined with on-chip tables) On-chip tables for 750K IPv4 routes, MAC and labels
Buffers	16MB On-chip Buffers 4GB Off-chip Buffers	
Latency	2 to 8 usec	
Processor	Intel 12-Core processor @ 1.6 GHz	
System Memory	64GB DRAM	
Flash Storage	64GB Flash SSD Storage	

Table 3- NCS 5502/5502-SE Platform Specifications

Fan Trays and Power Supplies

Fan Trays:

NCS 5501/5501-SE platforms are based on redundant 1+1 while NCS 5502/5502-SE platforms are based on N+1 redundant hot-swappable fan trays. The fan trays provides front-to-back or back-to-front airflow choices to adapt to any hot-aisle and cold-aisle configuration. The routers can be installed with ports facing the rear or with the ports facing the front of the rack based on the desired airflow. The tabs of the fan tray can be either red or blue; these colors indicate the front-to-back or back-to-front air flow.

Power Supplies:

The power supply modules of NCS 5500 fixed form-factor platforms deliver fault tolerance, high efficiency, load sharing, and hot-swappable features to the platform. The fixed platforms have options for AC or DC power supply providing 1+1 redundancy for NCS 5501/5501-SE and N+N redundancy for NCS5502/5502-SE platforms. The power supplies provide internal component-level monitoring, temperature sensors, and intelligent remote-management capabilities. Both the AC and DC power supplies are platinum-rated and offer 91% plus efficiency, so less power is dissipated as heat and more power is available for the system to use than with typical power supplies.



NCS 5501 Platform Rear View



NCS 5501-SE Platform Rear View



NCS 5502 Platform Rear View



NCS 5502-SE Platform Rear View

Management Ports:

On NCS 5501/5501-SE platforms, Out-of-band management is available via two 10/100/1000Mbps Management Ethernet interface; there is a serial RS-232 console port and a USB2.0 interface. In NCS 5501 the management, console and USB ports are at the back of the chassis, while in NCS 5501-SE there ports are at the front.

The Out-of-band management on NCS 5502/5502-SE platforms is available via two 10/100/1000Mbps Management Ethernet interface and a serial RS-232 console port at the front of the chassis. There is one USB2.0 interfaces that can be used for disaster recovery and also to transfer system images and logs. In NCS 5502/5502-SE the management, console and USB ports are at the front of the chassis.

	NCS 5501	NCS 5501-SE	NCS 5502	NCS 5502-SE		
Power Supply Units	2x 1100W AC or DC		4x 2000W AC or DC			
PSU Redundancy	1 + 1 Redundancy		N + N Redundancy			
Input Voltage AC PSU	90 to 265V (min-max) 100 to 240V (nominal)		90 to 265V (min-max) 100 to 240V (nominal)			
Input Voltage DC PSU	-40 to -75V DC (min-max) -48 to -60V DC (nominal)		-40 to -75V DC (min-max) -48 to -60V DC (nominal)			
Output Power AC PSU	1100 Watts		2000 Watts			
Output Power DC PSU	1100 Watts - DC PSU for reverse airflow 950 Watts - DC PSU for forward airflow		2000 Watts			
Typical Power Consumption	243 Watts	320 Watts	1450 Watts	1850 Watts		
PSU Efficiency	Platinum Rated - 91% plus efficiency					
Fan Trays	2 hot-swappable fan trays		3 hot-swappable fan trays			
Fan Trays Redundancy	1+1 Redundancy		N+1 Redundancy			
Air Flow	Front-to-Back or Back-to-Front Airflow					
Out of Band Management	2x 10/100/1000Mbps Management Ethernet					
Console Port	1x RS-232 Serial port					
USB Port	1x USB 2.0 slots					

Table 4- NCS 5500 Fixed Platform Fan & Power Supply Specifications

Conclusion

The Network Convergence System 5500 Series fixed form factor platforms are designed to provide highest performance and scale in 1RU and 2RU configurations. The fixed platforms offer 1/10/40/100G ports speeds with low-latency forwarding and lowest power consumption per Gigabit/sec.

The NCS 5500 fixed platforms support front-to-back and back-to-front airflows. The fixed platforms have options for AC or DC power supply. Both the AC and DC power supplies are platinum-rated and offer 92% plus efficiency, so less power is dissipated as heat and more power is available for the system to use than with typical power supplies.

NCS 5500 fixed platforms have base and scale models giving network operators the flexibility to choose based on port speed, scale and cost needs. The NCS 5501 and NCS5502 base models support more than a million routes while the NCS 5501-SE and NCS 5502-SE scale models are available to cater to the requirements of multi-million routes and large ACLs. In addition to that all the fixed platforms have on/off-ASICs buffers to provide deep queuing in case of network congestion.

NCS 5500 platforms run on Cisco IOS XR operating system. IOS XR is 64-bit Linux kernel based highly modular and fully distributed operating system that provides a virtualized environment to independently run system administration and routing functions on separate virtual containers. The IOS XR software also offers features that enable innovations such as automation, telemetry, application hosting and programmability.

Based on the hardware/software attributes and capabilities, NCS 5500 is an ideal platform to position in data centers, large enterprise, Web and service provider's networks to achieve efficient performance and scale for growth.