A Network Infrastructure for the Future with 5G
Introducing the NCS 500 Series of Routers

Priya Kesavan, Yatendra Bihani, David Jakl
Cisco Service Provider Networking Product Management
Global Internet Growth and Trends

By 2021

More Internet Users

- 2016: 3.3 Billion
- 2021: 4.6 Billion

More Devices & Connections

- 2016: 17.1 Billion
- 2021: 27.1 Billion

Faster Broadband Speeds

- 2016: 27.5 Mbps
- 2021: 53.0 Mbps

More Video Viewing

- 2016: 73% of Traffic
- 2021: 82% of Traffic

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021
Time For The Next Generation of Mobility

Market Disruptors
- Open Platforms
- Hyper Connectivity
- Internet of Everything

1980s 1G
- Analog
- AMPS
- Voice

1990s 2G
- Digital
- GSM, IS-95, IS-136
- Voice capacity

2000s 3G
- WCDMA, CDMA2000
- Voice & data

2010s 4G
- LTE/LTE-A, 802.16m
- Broadband data & video

2020s 5G
- User Experience
- AR / VR

Business Models
- Consumption based
- Agile & On Demand
- Software Innovations
- New Partnering Arrangements

Technology Landscape
- Virtualization / NFV & SDN
- Cloud Workloads
- Programmability
- Enhanced Video
- ICN

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<table>
<thead>
<tr>
<th>Market Shifts Led by New Services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ultra Reliability</strong> (Wherever + Whenever)</td>
</tr>
<tr>
<td>Broadband access in dense areas</td>
</tr>
<tr>
<td>Broadband access everywhere</td>
</tr>
<tr>
<td>Ultra Capacity and Coverage</td>
</tr>
<tr>
<td>Ultra High-Speed (up to 10 Gbps to cell site)</td>
</tr>
<tr>
<td>Extreme real-time communications</td>
</tr>
<tr>
<td>Average 1 Gbps per device</td>
</tr>
<tr>
<td>Ultra Low Latency (1 ms End-to-End)</td>
</tr>
<tr>
<td>Tactile Internet</td>
</tr>
<tr>
<td>Lifeline communications</td>
</tr>
<tr>
<td>Natural Disaster</td>
</tr>
<tr>
<td>Massive Device Connectivity</td>
</tr>
<tr>
<td>Massive Internet of Things</td>
</tr>
<tr>
<td>Ultra-reliable communications</td>
</tr>
<tr>
<td>Broadcast Services</td>
</tr>
<tr>
<td>Broadcast Services</td>
</tr>
<tr>
<td>E-Health Services</td>
</tr>
<tr>
<td>Lifeline communications</td>
</tr>
<tr>
<td>Tactile Internet</td>
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Mobile Operator Revenue growth Opportunities

Today
Operator business mostly focused on the saturated consumer market

Video drives traffic... but not revenue

2025
Vertically targeted services will accelerate operator business growth

53% CAGR 2015-2020

- Mobile File Sharing (1%, 2%)
- Mobile Audio (8%, 6%)
- Mobile Web/Data/VoIP (36%, 17%)
- Mobile Video (55%, 75%)

Exabytes per Month

0 5 10 15 20 25 30 35


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Next Generation Cisco SP Access Router Portfolio
5G, Carrier Ethernet, Cable & FTTx

Carrier Ethernet
Mobile Backhaul
Cable/RPhy
FTTx

Key Access Requirements:
- Cost
- Power
- Form Factor
NID/Carrier Ethernet Deployment with NCS 520

Why Cisco?
- Unmatched Security at HW and SW level
- Zero Touch Provisioning and Programmable NIDs
- End to end Segment Routing to simplify network provision and operations

Cisco Solution
- Dense 1/10G NID MEF Certification Ready with Layer2 and Layer3
- Higher Scale with Deep Buffer of up to 180MB
- Ruggedized Hardware for deployment in harsh environments

Market Evolution
- Bandwidth increase due to Video / IOT and Cloud applications.
- Densification of network leading to large number of devices
- New models of Operation/ Management and deployments

100GE
Access

NCS 540

MPLS core

NCS 560
Small CO/Aggregation

NCS 560

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# Introducing NCS 520 – “The Most Secure NID/CES”

## Highlights

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 Gbps (Saber 2+ BCM56461) with Secure JTag FPGA</td>
<td></td>
</tr>
<tr>
<td>Cisco IOS® XE Software (Polaris)</td>
<td></td>
</tr>
<tr>
<td>NXP (1Ghz Quad Core CPU - LS1043A) with 4G RAM</td>
<td></td>
</tr>
<tr>
<td>Secure UDI, Secure Boot, TAm, Runtime Defenses</td>
<td></td>
</tr>
<tr>
<td>ZTP, Dying Gasp, Netconf/Yang</td>
<td></td>
</tr>
<tr>
<td>4x1G + 4x1G/10G Interfaces (NID)</td>
<td></td>
</tr>
<tr>
<td>20x1G + 4x1G/10G Interfaces (CE Switch)</td>
<td></td>
</tr>
<tr>
<td>AC/DC variants, Conformal Coated, C-Temp/I-Temp</td>
<td></td>
</tr>
<tr>
<td>1588/SyncE/1PPS/ToD/10MHz</td>
<td></td>
</tr>
</tbody>
</table>

**Dimensions:**
- **Width:** 12.2 Inches / 17.5 Inches
- **Height:** 1.75 Inches (1RU)
- **Depth:** 9.0 Inches

Shipping Apr 2018
Service Demarcation

Services can be configured on the controller and distributed to the NID. The operator can take advantage of platform and service templates on the controller.
Cloud Based Services

As more advanced network services move into the cloud or data center, there is a need for a device with a low port density with carrier grade Ethernet, advanced QoS, and performance measurement capabilities.

With low latency and OAM performed in hardware, the Cisco NCS 520 Series Ethernet Access Device resides close to the customer, providing service assurance while network services are remote in the data center.
NCS520: Hardware & Software Security

Secure Boot & Integrity Check
- Attack Vector: Compromised Software
- Attack: Device Spoofing/Boot Hijack
- Solution: Ensures that only authentic Cisco software boots up on a Cisco platform

Image Signing
- Attack Vector: Compromised Software
- Attack: Device Spoofing/Boot Hijack

Run time Defense
- Attack Vector: Code Manipulation
- Attack: Malware/Botnet Injection
- Solution: ASLR, BOSC, X-SPACE

Secure Storage
- Attack Vector: Deletion of Data
- Attack: Route Leak

TAm (Trust Anchor Module)
- Attack Vector: Compromised Hardware
- Attack: Counterfeit
- Solution: Anti-Theft and Anti-Tamper Chip Design

Secure JTag
- Attack Vector: Compromised Hardware
- Attack: Counterfeit
- Solution:
  - Program FPGAs
  - Provide a CPU debug access
# NCS 520 SKUs

<table>
<thead>
<tr>
<th></th>
<th>10G NID</th>
<th>10G CE Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base</td>
<td>Premium</td>
</tr>
<tr>
<td># of Cu GE</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td># of SFP GE</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td># of GE/10GE SFP+</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>0 to 50C</td>
<td>-40C to 65C</td>
</tr>
<tr>
<td>Conformal Coating</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>1588/SyncE/1PPS/ToD/10MHz</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Fixed Power Supplies</td>
<td>Single AC / Dual DC</td>
<td>Fixed redundant AC &amp; DC</td>
</tr>
<tr>
<td>Expected Dimensions</td>
<td>12.2” x 9.0” x 1.75” / 17.5” x 9” x 1.75” (W x D x H)</td>
<td></td>
</tr>
</tbody>
</table>
The Foundation for IOS XR 64bit
Innovations in Software Hardware and System Design

64bit Cisco IOS-XR

Virtual data plane
Virtual RR/PE/DC Forwarder

Physical cost-optimized merchant data plane
NCS 540
NCS 560
NCS 5500
NCS 5000

Physical high touch data plane
ASR 9000
NCS 6000
CRS

Common SP operating system across physical and virtual data planes

Elastic
Cost Optimized
Ultra-high Density
Carrier Grade
Programmability and Automation

Cisco
# NCS 540 Highlights

## Guiding Principles

<table>
<thead>
<tr>
<th>Simple, scalable design to support future growth</th>
<th>Ready for 5G, smart city, M2M communications &amp; IoT</th>
<th>Increased reliability and security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services agility with guaranteed SLAs</td>
<td>SDN ready for better application and network interaction</td>
<td>Modern network automation and orchestration for lower TCO</td>
</tr>
</tbody>
</table>

## Elements

<table>
<thead>
<tr>
<th>High capacity and port density</th>
<th>Application awareness to support network slicing</th>
<th>&lt;50ms convergence protection with TI-LFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full path programmability with Segment Routing</td>
<td>Programmable controller based architecture with Netcong/YANG</td>
<td>Network Visibility and analytics with Telemetry</td>
</tr>
</tbody>
</table>

## Additional Features

- Simplification
- Investment Protection
- Increase Profitability
What's New??

- 5x increase in switching capacity to 300G, 10 increase in port bandwidth in 1RU form factor to enable (5G, remote PHY etc, next level detail smart city, machine to machine comms IoT) applications
- All in 1 ports Introduces 25, 40 & 100G ports into fixed form factor access portfolio as uplinks outgrow 10G ports
- Next generation timing capabilities “Class B” timing capabilities for improved clocking accuracy for 5G
- Introduces IOS XR into the Cisco access portfolio for advanced features such as
  - Programmability with Netconf/Yang
  - Application aware, SDN-centric network with Segment Routing
  - Simplified, unified L2 and IP VPN Services with EVPN
  - Increased security and threat protection
  - Real time network visibility with telemetry enabling analytics
  - Automated SW upgrade and network health check with NSO, WAE, Morph
  - End to end feature parity from access to edge to core
NCS 540 5G Readiness

- **High bandwidth**: 10Gbps peak data
- **Ultra low latency**: 1-5ms RTT
- **Stringent timing & sync**: 10-500 nsec
- **Ultra Reliability**: Secure, reliable, carrier class IOS-XR
- **Network Slicing**: Application aware network with traffic engineering
- **Programmability & Automation**: IOS XR with Telemetry, WAE/XTC Integration

**Temp hardened high capacity systems 300 Gbps**
Dense 1/10G UNI with 25/40/100G NNI

**Low latency switching**
Switching latency not a bottleneck for RTT

**G8265.1, G8275.1 & 2, G.8273.1 (Class B)**
1PPS, 10MHz, ToD, Inbuilt GNSS

**Secure, reliable, carrier class IOS-XR**
Reduced down time with SMUs

**Application aware network with traffic engineering**
SR enabled differentiated SLAs

**IOS XR with Telemetry, WAE/XTC Integration**
SDN ready with Netconf/Yang Interfaces
Enable NG Carrier Ethernet with NCS 540

High capacity
- 300 Gbps with 640G port capacity
- Dense 1/10G UNI with 25/40/100G NNI

Service Agility
- Application-based service creation with SR
- Unified L2 and IP VPN Services with EVPN

Reliability
- Full SR path programmability & guaranteed SLAs
- <50ms convergence with TI-LFA protection

Operational Simplicity
- IOS XR with Telemetry, WAE/XTC Integration
- SDN ready with Netconf/Yang Interfaces
Enable Remote PHY Underlay with NCS 540

- Industry moving towards deep fiber nodes
- Industry coalescing around CableLabs architecture

- Remote Locations: Temperature hardened systems
- Long reach: DWDM limiting optics support
- Timing: SyncE, 1588v2, BC support
- High capacity: 25G and 100G NNI options

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NCS 560
Introducing NCS 560
Next Generation Modular Aggregation Router

• Unprecedented capacity, density and scale
  • Dense combination of 1, 10, 40 & 100G ports
  • lowest power & cost per Gigabit

• Converged services delivery
  • Carrier Ethernet, Mobile Backhaul, Cable/Remote Phy and FTTx

• Highly secure and available
  • OS developed with critical components to deliver Security, Reliability, Stability

• Simplified and Programmable
  • Simplified & application aware networking – Segment Routing
  • Network Programmability – NC/YANG

• Intent driven automation
  • ‘Open’ infrastructure to deliver automated network & services intent through orchestration
NCS 560
What’s New?

• 4th generation of RSP for Service Provider Access
  • delivering 100% capacity increase
• Modular and fully redundant chassis
  • High Density of 1, 10, 40 & 100 Gigabit Ethernet
• Unprecedented services scale to support converged services delivery for Carrier Ethernet, Mobile Backhaul, Cable/Remote Phy and FTTx applications.

• Introducing IOS-XR in modular Service Provider Access routing platforms, delivering a modular, highly secure and highly available operating system for service provider networks with advanced features such as:
  • Network and device Programmability through Netconf/Yang, Restconf
  • Simplified, Application aware & SDN-centric routing with Segment Routing
  • Enhanced VPN services capabilities with EVPN
  • Real time network visibility & analytics with streaming telemetry
  • Network Services intent automation with NSO, WAE, Network Health Check with Morph
  • In Service Software Upgrade capability
## NCS 560 5G Readiness

<table>
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<tr>
<th>Feature</th>
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<tbody>
<tr>
<td><strong>High bandwidth</strong></td>
<td>10Gbps peak data Temp hardened high capacity systems 800 Gbps Dense 1/10G UNI with 40/100G NNI</td>
</tr>
<tr>
<td><strong>Ultra low latency</strong></td>
<td>1-5ms RTT Low latency switching 2 – 8 usec Switching latency not a bottleneck for RTT</td>
</tr>
<tr>
<td><strong>Stringent timing &amp; sync</strong></td>
<td>10-500 nsec G8265.1, G8275.1 &amp; 2, G.8273.1 (Class B) 1PPS, 10MHz, ToD, Inbuilt GNSS</td>
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<tr>
<td><strong>Ultra Reliability</strong></td>
<td>Secure, reliable, carrier class IOS-XR Reduced down time with SMUs</td>
</tr>
<tr>
<td><strong>Network Slicing</strong></td>
<td>Application aware network with traffic engineering SR enabled differentiated SLAs</td>
</tr>
<tr>
<td><strong>Programmability Automation</strong></td>
<td>IOS XR with Telemetry, WAE/XTC Integration SDN ready with Netconf/Yang Interfaces</td>
</tr>
</tbody>
</table>
Enable NG Carrier Ethernet with NCS 560

- **High capacity**: 800 Gbps with full port capacity. Dense 1/10G UNI with 40/100G NNI.

- **Service Agility**: Application and Intent based service creation with automation, using with SR, NSO for enhanced VPN Services.

- **Reliability**: Full SR path programmability & guaranteed SLAs. <50ms convergence with TI-LFA protection.

- **Operational Simplicity**: IOS XR with Telemetry, WAE/XTC Integration. SDN ready with Netconf/Yang Interfaces.

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**Diagram:**
- NCS540
- NID
- CE Switch
- Pre-Aggregation
- NCS560
- 10GE/100GE
- Aggregation
- N x 100GE
- UPE
- EDGE
- ASR9K
- NCS 5500
- IPoDWDM

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Enable Remote PHY Underlay with NCS 560

- Industry moving towards deep fiber nodes
- Industry coalescing around CableLabs architecture
- RPD nodes are necessary for FDX, expect rest of the world to follow
NCS 500 Key Differentiators
Application Awareness with Segment Routing

Applications express requirements – bandwidth, latency, interactive …

Controller maps applications to a path defined by a list of segments via standard programmable interfaces

The network does not maintain state

- # of protocols reduced by 75%
- # of TE tunnels by 1000x

Differentiated service tiers & policies for millions of apps
Self-protected (TI-LFA)

Simplified

Highly scalable & reliable

Distributed intelligence

SR

Centralized control

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Service Unification with EVPN

- EVPN a common Services Platform
- Unified L2 and IP VPN Services
- Single Control Plane
- Common EVPN operation, troubleshooting and provisioning

EVPN L2

IPVPN Services

EVPN L3

Ethernet Services

EVPN L2VPN Services

EVPN L3VPN Services

E-Line and E-LAN Services

Common Operation

Common policies

Easier Provisioning

Network efficiency

Opex Saving
NSO Service Orchestration & Network Automation

- Management Applications
- Network Engineer

- Single Pane of Glass for
  - L1-L7 networking, Hardware Devices, Virtual Appliances

- Automation for
  - L3VPN service activation
  - L2VPN service activation
  - Internet access activation
  - LTE activation

- Abstractions based on
  - Standard Data models (YANG RFC 6020) for devices & services
  - Transaction: ensures fail-safe operations & network configuration accuracy

Automation based on accurate real-time view of service and network state
Stringent Synchronization

Frequency, Time & Phase Synchronization

GNSS (GPS)
- High accuracy
- Poor indoor signal quality
- Susceptible to jamming

PTP
- High reliability
- On path or partial path support
- Boundary clock capability per hop

Macro Site Router
IP/MPLS Transport
Ethernet
Zero Touch Provisioning

- **Zero-Touch Deployment**

- **Applications**
  - **Secure**
    - SUDI/UDI authentication
    - Domain Certificates
  - **Simple**
    - Zero startup configuration
    - Topology independent
  - **Reliable**
    - Consistent Reachability
    - Indestructible, virtual out-of-band channel

- **Management/Customization**
  - (EPNM/SDN controller)
Network Visibility with Telemetry
Proactive Escalation for Improved Efficiency

- Automated remediation and policy enforcement
- Big data aggregation and analysis
- Telemetry
- Flexible, efficient, extensible data and transport
- Real-time inspection

Efficient Network Operations
- Near real-time insight
- Traffic analysis, fault prediction, “gray” failure
- Fault mapping to right expertise
- Complete and deep view of infrastructure

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Summary
Why Cisco Mobile Solution?

- More than 200 operators across more than 75 countries
- More than 300,000 Cell Site Routers deployed
- Top 22 of the 30 Tier-1 Mobile Operators
- 80% of Global LTE subscribers
- Over 1 Billion mobile broadband subscribers