LET’S BUILD TOMORROW TODAY
Introduction to NCS 6008

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BRKARC-2022
“With the new 10Gbps capabilities, Cisco is providing the highest performance router architecture available.”

“With its technology breakthroughs and industry-leading performance, the Cisco CRS-1 enables reliable, large-scale delivery of high-bandwidth applications.”

“Cisco CRS-3 offers unparalleled traffic capacity and network intelligence, enabling it to cost-effectively deliver the latest service innovations.”

“400Gbit/s nPower X1 processor behind the NCS brings performance to handle "Internet of Things"-scale transactions, but also puts greater programmability into play.”

<table>
<thead>
<tr>
<th>Platform</th>
<th>Previous Century</th>
<th>2004</th>
<th>2010</th>
<th>2013+</th>
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<tbody>
<tr>
<td>GSR</td>
<td>320 GBPS</td>
<td></td>
<td></td>
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<tr>
<td>CRS-1</td>
<td>1.2 TBPS</td>
<td></td>
<td></td>
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<tr>
<td>CRS-3</td>
<td>4.5 TBPS</td>
<td></td>
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<tr>
<td>NCS 6008</td>
<td>8-128 TBPS</td>
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</table>
Agenda

• What is Network Convergence System
• NCS 6008 Hardware Architecture
• Virtualized IOS XR on NCS 6008
• Packet Path and HA
• Summary
What is Network Convergence System

Family of Hardware & Software Offering
Integrated, Resilient & Scalable Architecture

Hardware
Platforms for High Bandwidth Routing & Optical Networks
NCS 6000, NCS 4000

Software
Virtualized Cross-platform Operating System: Virtualized IOS-XR
Cisco Routing Technology

Key Innovation Investments

Cisco NPU
Custom Silicon Family

Virtualized IOS-XR

Optics
NCS Family of Platforms

**NCS 6000**
- IP Transport Router
- Up to 5 T/slot
- 1.2 Pbps
- MC Systems

**NCS 4000**
- Converged Packet Optical Solution
- OTN + WDM + SONET + Ethernet
- Up to 500 G/slot

**NCS 2000**
- Next Gen ROADM
- 200 G/slot
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NCS 6008 Line Card Chassis

- 8x 1Tbps Line Cards
  - Custom purpose-built NPUs
  - High scale forwarding & services
- High-speed Switch Fabric
  - Fully redundant
  - 3 Variations
    - SC/B2B/MC
- Redundant Route Processors
NCS 6008 – Chassis Overview

- Power Tray
- Touch Screen Display
- 2 Trays
- 8 Line Cards
- Air Filter
NCS 6008 – Chassis Overview

- Power Tray & Feed
- Air Deflectors
- 2 Route Processors
- 6 Fabric Cards
NCS 6008 – Touch Screen Display

- 7” Touch Screen Read-Only Display
- System Status and Alarm Monitoring
NCS 6008 – Touch Screen Display
NCS 6008 – Fan Trays

- Redundant Fan Trays
- 6 Fans per tray
NCS 6008 – Fan Trays

• Air Flow
NCS 6008 Architecture at a glance
NCS 6008 – Route Processor

- 2 RP per system
  - Inserted in both side slots in rear
- 8-Core x86 CPU @ 1.8 GHz
- 3 Console Ports
- 2 Management Ports
  - RJ45 – 1G
  - SFP+ - 10G
- 48GB DRAM (3x16)
- 32GB (System) & 200GB (Data) SSD
- USB 2.0
NCS 6008 – Route Processor
• Ports & Connections

- Expansion Ethernet for Multi-chassis
- Console Ports
- Management Ethernet
- Future – Interface Shelf
- USB Port
- Timing and Synchronization
- Alarm
- Admin Console
- XR (SDR) Console
- Unused
- Admin Mgmt. Port
- XR Mgmt. Port
- 10G-SFP-SR
- 10G-SFP-L
- SFP-GE-T
- 10G-SFP-SR-X
- SFP-GE-S
- 10G-SFP-LR-X
- SFP-GE-L
NCS 6008 – Line Cards

- 8 LineCard slots
  - Up to 1Tb/Slot in 1st Generation cards
- Powered by Cisco nPower X1 & nPower X1e Network Processor
- Various flavors based on
  - Scale and feature capabilities
  - Port Speed
  - Optic types
NCS 6008 – Line Cards

Two flavors

LSR – Lean Core applications
  Limited CEF and L3 Scale
MSC – Full IP/MPLS support
  Edge Features (L3/L2 VPN support)
  Higher L3 interface support
  Higher TE mid point scale, Netwflow scale etc.

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<tr>
<th></th>
<th>LSR</th>
<th>MSC</th>
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<tr>
<td>Hierarchical Policy</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Vlan QoS</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>L2/L3 vpn</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Max Routes</td>
<td>64K</td>
<td>4M</td>
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Platform

Per Port Speed:

Scale/Feature:

Number of ports

Optics:

K = CPAK
P = CXP
S = SFP+

M = Multiservice
L = LSR

Ciscollive!
NCS 6008 – 100G Line Cards

10x100G CXP
100G and 10G port capacity
CXP Short Range Optics (SR10)
Powered by nPowerX1 Network Processing Unit (NPU)

10x100G CPAK
Anyport Technology: 100G, 10G and 40G port capacity
10 x 10G interfaces per port
1 x 100G interface per port
2 x 40G interfaces per port
CPAK Short Range (SR10) and Long Range (LR4/LR10) Optics
Powered by nPowerX1 NPU
NCS 6008 – 10G Line Cards

- 60x10G SFP+
  - SR, LR, ZR SFP+ Options
  - WANPHY and OTU-2 Support
  - Tune-able DWDM 10G (future)
  - Powered by nPowerX1e NPU

<table>
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<tr>
<th>Product</th>
<th>Distance</th>
<th>Wavelength</th>
<th>10GE Mode</th>
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<tr>
<td>SFP-10G-SR</td>
<td>Up to 400m</td>
<td>850nm</td>
<td>LAN</td>
</tr>
<tr>
<td>SFP-10G-SR-X</td>
<td>Up to 400m</td>
<td>850nm</td>
<td>LAN/WAN/OTU</td>
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<tr>
<td>SFP-10G-LR</td>
<td>10Km</td>
<td>1310nm</td>
<td>LAN</td>
</tr>
<tr>
<td>SFP-10G-LR-X</td>
<td>10Km</td>
<td>1310nm</td>
<td>LAN/WAN/OTU</td>
</tr>
<tr>
<td>SFP-10G-ER</td>
<td>40Km</td>
<td>1550nm</td>
<td>LAN</td>
</tr>
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<td>SFP-10G-ZR</td>
<td>80Km</td>
<td>1550nm</td>
<td>LAN/WAN/OTU</td>
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</tbody>
</table>
NCS 6008 – 100G PAYG Line Cards

• PAYG Line cards
  • 10 Physical ports ; with 2 or 4 usable port
• Add more ports through software license
  • License with granularity of 2 ports
NCS 6008 – Line Cards

Slices

• “Slice” based architecture
  • 200Gbps capable bi-directional
  • Independent packet processing for slices
  • 10x100G
    5 Slices
    2 Interfaces per slice
  • 60x10G
    4 Slices
    15 Interfaces per slices

• HA on slice granularity
  • Single failure will take down only slice
NCS 6008 – Line Cards

Slice Details

Ingress PLA + PPE + Egress Q

FabricQ + Ingress Q
NPUs

nPowerX1 & nPowerX1e
- 336 packet processor engines (PPE) @ 800MHz
  - Two threads per PPE
- 130 Mpps ; 200 Gbps Full Duplex
- Integrated MAC
  - 15x10G , 5x40GE, 2x100GE
- nPowerX1:
  - On-chip TCAM
- nPowerX1e:
  - Off-chip TCAM
NCS 6008 Line Card

- Two boards per LC
- Mainboard
  - 2 Slices
  - CPU complex
- Daughterboard
  - 3 Slices
NCS 6008 – Interfaces & Optics

- CFP
  - Density: 1-2 per line card
  - ~24W per CFP
  - (<8W for CFP2)

- CXP Short Reach
  - ~3.5W power consumption

- CPAK Short/Long Reach
  - 70% less power than CFP (~7W)
  - 70% smaller than CFP
NCS 6008 – Interfaces & Optics

Available Optics Options in 5.2.1

CPACK
100G – SR10
100G – LR10
MPO Connector

CXP
100G – SR10
MPO Connector

CPACK
100G – LR4
SC Connector

SFP+
10 G
SR, LR, ER, ZR, SR-X, LR-X
LC Connector
NCS 6008 – Interfaces & Optics

Breakout Mode – SR10 & LR10

- CLI Configurable
- Each Slice configured independently
- Converts all interfaces in the slice
NCS 6008 – Interfaces & Optics

Breakout Mode – Cable Management

• Passive Patch Panel
• 3RU Rack Mountable
• 10 MPO (100G) Connectors → 100G LC (10G) Connectors
NCS 6008 – Power System

- Fully redundant power system
- Six Power Trays
  - Grouped into two Shelves (Shared switch)
  - Individually replaceable
- AC and DC Power Tray options
- DC:
  - -40V -- -72V Input @ 60A Max
- AC:
  - 200V – 240V Input @ 16A Max
NCS 6008 – Power System

- Individual Power Module (PM)
- Field replaceable
- Provides power to common power bus
- 1 Power Feed per PM
- No placement restriction
  - Minimum 4 PM required
- 4 DC Power Module per Tray
  - 24 PM per chassis (12+12 redundancy)
- 3 AC Power Module per Tray
  - 18 PM per chassis (9+9 redundancy)
NCS 6008 – Switch Fabric

- Three fabric types:
  - NC6-FC for standalone,
  - NC6-MC (Multi-chassis)

- Six fabric cards
  - 5+1 planes (one plane/card)

- Non blocking three stage fabric

- VOQ Based
  - Distributed credit scheduler
  - 64-256B Variable size packets

- Each “slice” connects to all planes
NCS 6008 – Three Stage Switch Fabric

- F1,F2,F3 for Back-to-Back and Multichassis
- Collapsed F123 for Single Chassis
Single Chassis Fabric Card connections

60G through each plane
10G per link (11.5G raw)
3 links to each SFE
2 SFE per plane
360G using six planes
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Virtualization …

… ability to run multiple operating systems on top of a single physical platform by providing an abstract view to each.

The software layer providing virtualization is called a “virtual machine monitor” or “Hypervisor”.

The operating system instances are called “virtual machines (VM)” or “guest OS”
Virtualization…

- Effective resource utilization by splitting across multiple Operating Systems
  - Hypervisor is the Virtualization abstraction layer
  - Hypervisor runs on bare metal or inside Host OS
NCS 6008 – Software Concepts

- **Host**:  
  - 64 bit architecture  
  - Linux Kernel  
  - Runs on x86 CPU on RP and LC  
  - Hosts the Qemu/KVM Hypervisor

- **Admin VM**:  
  - Allows network slicing  
  - Detect hardware insertion, inventory etc  
  - SDR management (creation/deletion)  
  - Common software functionality (fan/alarms etc.)  
  - Active on all RP and LC – service based redundancy
NCS 6008 – Software Concepts

- SDR / XRVM
  - L1/L2/L3/DWDM services
  - Will interact with LC VMs through XR IPC
  - Runs control plane of interfaces
  - Multiple Instances can be spawned
    - SOST
    - SOMT
    - ISSU

Linux (Host OS)

SysAdmin VM

SDR : XRVM

SDR : XRVM

Hypervisor (KVM)

x86 CPU

SOST

SOMT
Virtualized IOS XRv Evaluation

- Independent Admin/XR
  - Fault isolation
  - XR Scalability for multiple tenants
- Admin VM:
  - System management and monitoring
- XR VM:
  - Routing application and management
  - Consistent IOS-XR user interface
Benefits of Virtualization

Service Integration
- Multiple, highly secure and isolated app containers
- Co-existence of multiple XR versions

In-Service Software Upgrade (ISSU)
- Zero topology and packet loss upgrade

Reliability
- Improved system reliability with separate admin and application virtual machines (VMs)

Control Plane Expansion
- Flexible XR/service VM placement on dedicated compute device

Benefits of Virtualized Cisco® IOS-XR

Hypervisor
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NCS 6008 Data Path


Ingress Slice → Fabric → Egress Slice

CPAK / CXP / SFP+ Optics
NCS 6008 Data Path

Transceiver OEO conversion

Ingress packet processing:
- L2/L3 processing
- Lookups
- Ingress
- ACL/policing/other features

Packets to Cells, Scheduling through Fabric VoQ

Switching Cells Mcast replication

Cells reassembly Fabric Schedulers for VoQs

Egress packet processing:
- Egress
- ACL/policing/Queuing/Shaping/WRED/other features

Transceiver OEO conversion
Life of a Packet Overview - Transit
Life of a Packet Overview – LC Punt
Life of a Packet Overview – RP Punt

- VoQ credits from local FIA
- MAC/OTN
- NPU
- Control Ethernet 10GE VoQs
- Local Interfaces VoQs
- Outgoing Interfaces VoQs
- Optics
- PCIe Switch
- CPU Complex
- Ethernet Switch
- CPU
- Ethernet Switch
- CPU
- Ethernet Switch
- CPU
- Optics
- Optics
- Optics
- Optics
- Optics
- Optics
- Optics
- Optics
- Optics
NCS 6008 Data Packet Path

- NPU processing
  - MAC/OTN layer implementation
  - ACL filtering
  - QoS features:
    - Classification, Policing, Setting
  - Forwarding functions:
    - CEF, FIB lookups, VOQ selection, uRPF checks
  - Netflow
NCS 6008 Data Packet Path

- **FIA Processing**
  - Performs CRC operations
  - Segments packet to 64-256B cells
  - Sends cells towards fabric
    - Load-Balanced over all links

- **VOQs may de-queue based on credits**
  - Credits granted by credit scheduler on egress FIA
NCS 6008 Data Packet Path

- Routes cells to destination FIA
- Replicates multicast packets to FIAs
  - When more than one destination FIAs
NCS 6008 Data Packet Path

- Receives cells
  - CRC checks on received cells
- Reassembles into packets
  - CRC check on packets
NCS 6008 Data Packet Path

- NPU processing
  - MAC/OTN layer implementation
  - Forwarding functions:
    - L2 rewrite based on adjacency table
  - ACL filtering
  - QoS features:
    - Classification, Policing, Setting
  - Netflow
NCS 6008 Data Packet Path

show interface <type> <interface#>
show controllers <type> <interface#> stats
show controllers plim asic statistics interface <type> <interface#>
show controllers plim asic statistics summary location <r/s/m>
show controllers pse statistics summary instance <#> location <r/s/m>
show controller fia statistics instance <#> location <r/s/m>
(admin) show controller fabric plane all statistics detail
show controller fia statistics instance <#> location <r/s/m>
show controllers pse statistics summary instance <#> location <r/s/m>
show interface <type> <interface#>
show controllers <type> <interface#> stats
show controllers plim asic statistics interface <type> <interface#>
show controllers plim asic statistics summary location <r/s/m>
System High Availability

Hardware and Software redundancy

- RP Hardware is redundant by design
- XR-VM and SysAdmin-VM run on both RP’s
  - XR-VM takes “active” and “standby” role like classic-XR
  - Admin-VM is “active” on both RPs, redundancy is at service level
ZPL/ZTL ISSU concepts

- Multiple, highly secure and isolated application containers
- Co-existence of multiple versions of XR
- Synchronization between versions using NSR mechanisms
- Dedicated CPU, Memory and NPU resources to support ZPL/ZTL ISSU
ISSU with Virtualized IOS-XR

ISSU Operation: Normal ➔ Load/Run ➔ Switch/Commit
NCS 6008 Recap

- Customized High Performance Packet Processing CPUs
- High Scalability: Single & Multishelf Capability
- High Resiliency: Virtualized OS, Hardware Redundancy
- Best Power/Bit efficiency in the industry
- Highest throughput capability per chassis
- Environment Friendly: Green Mode, CPAK
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- BRKARC-2027 - CRS-X Architecture and Troubleshooting Overview
Thank you
TOMORROW starts here.