NCS 5500 Update

SP Product Management
NCS 5500 Positioning
Service Provider Routing Portfolio
IOS XR: Built for All Deployments

Virtual RR/PE/DC Forwarder
Cisco IOS-XRv 9000

Cisco NCS 5500 & NCS 5000

Cisco ASR 9000, CRS & NCS 6000

OPTIMIZED Cisco XR Software

Elastic
Cost Optimized
Ultra-high Density
Carrier Grade
Programmability and Automation
Service Provider Platforms per Place in Network

- **Capex**
  - Density, Low Cost/Bit, PayG, OpenPay

- **Opex**
  - Low Watt/Bit, Automation, ASR 9K - Swiss Army Knife

- **Security**
  - Trustworthy systems in XR, MacSec, Anti-DDoS

- **Converged**
  - All in one - Multiple services at scale

- **Programmable**
  - Simplified Control & Transport Plane with SR/EVPN

- **Time to market**
  - On demand network SLA with SR-TE and Open APIs
NCS 5500: Platform Evolution
Innovations in Software, Hardware, and System Design

High density and low power
- Integrated forwarding and fabric interface
- Full portfolio breadth - 800G to 57.6T systems

Feature parity among NCS 5500 systems

Deep virtual output queue buffers

Base and scale options for modular & fixed

MACSec /1588/SyncE timing support

10/25/40/50/100GE interface support

Support for IPoDWDM, CFP2 DCO

Future – 400GE and 153.6T!
NCS 5500 Position and Portfolio of Services

SP Data Center
- IP/MPLS LSR, EVPN/SR, MACsec, IPoDWDM
- EVPN/SR-TILFA/TE/ODN
- Sticky EMCP
- VXLAN DC GW/GPE

SP Peering
- v4/v6 Scale ACL/LPTS/
- LI, uRFP, Hybrid ACL, Storm Control
- BGP FlowSpec, QPPB
- Ingress/Egress Netflow

SP Aggregation
- VPWS, EVPN P2MP, L2/L3 VPN
- L2 MCAST, BGP PIC-Edge, mVPN
- SRV6

SP LSR/Core
- IPv4/v6 MPLS, BFD, LSR, MPLS-TE, PIM
- TI-LFA, LDPoTE
- IPv6 BFD, SRv6

SP Access / 5G
- VPWS, L2/BVI
- TWAMP, Y.1732, Eth Loopback, Timing
- G.8032, DHCP, GTP Hashing
- IP-SLA, Y.1564

R-PHY (CIN)
- L2 MCAST, IGMP Snooping
- 802.1X, Dual v6 Source, DHCP snooping
- MLD Snooping
NCS-55A2-MOD & MPA
Introducing NCS-55A2-MOD (Peyto)

- Cisco IOS-XR based Pre-Agg/Agg Router for Mobile Backhaul, Carrier-Ethernet and R-Phy
- Modular Port Adaptors (MPA) provides flexibility to choose different type of interfaces based on requirements, MPA shared across fixed and modular chassis
- IPoDWDM Capability using CFP2 DCO (200G/100G options)
- Scale version to provide enhanced higher FIB scale
- Temperature hardened version for extended reach to locations without environmental control
- 5G Ready with dense 1/10G, 25G, 40G and 100G interfaces
- Next generation timing capabilities “Class B” timing capabilities for improved clocking accuracy for 5G
- Simplified network management with zero-touch provisioning and automated device onboarding
Enhancing NCS 5500 with Modularity

<table>
<thead>
<tr>
<th>Modular Port Adapters (MPA)</th>
<th>Modular 2RU Chassis, Depth &lt;300 mm</th>
<th>Modular Linecard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modular Port Adapters (MPA) options:</strong></td>
<td><strong>Fixed 24x 1/10GE + 16x 1/10G/25GE</strong></td>
<td><strong>Fixed 12x 1/10GE + 2x 40G</strong></td>
</tr>
<tr>
<td>- 2x 100/200G CFP2 DCO DWDM</td>
<td>- 2 MPA bays, 400G each</td>
<td>- 2 MPA bays, 400G each</td>
</tr>
<tr>
<td>- 1x 100/200G DCO + 2x 100G QSFP28</td>
<td>- Jericho+ based (900G), MACSec</td>
<td>- Jericho+ based (900G), MACSec</td>
</tr>
<tr>
<td>- 12x 10GE w/ WANPHY, OTN</td>
<td>- Variants -</td>
<td>- Variants -</td>
</tr>
<tr>
<td>- 4X100G QSFP28</td>
<td>- Base version/non-SE version</td>
<td>- Base version</td>
</tr>
<tr>
<td>- 4X100G QSFP28 temperature hardened</td>
<td>- Temperature Hardened version, Conformal Coated</td>
<td>- MACSec</td>
</tr>
<tr>
<td></td>
<td>- SE variant with Enhanced Scale TCAM, Stats FPGA</td>
<td>- SE variant adds Enhanced Scale TCAM, Stats FPGA</td>
</tr>
</tbody>
</table>
ACO to DCO evolution of CFP2

**Trunk Transceiver:**
- CFP2 format
- 96 chs grid-less tunable
- Coherent Transmission

**DSP:**
- OTN framing/FEC
- SW reconfigurable modulation format

**CFP2-DCO**
- 100/200Gbps
- QPSK/8QAM/16QAM
Use Cases
Access/Aggregation IPoDWDM with NCS 5500

IP+Optical

Vs.

NCS-55A2-MOD IPoDWDM

Transponder Shelf

Aggregation Router
## NCS-55A2-MOD IPoDWDM vs Router+TXP

### IPoDWDM vs IP+DWDM Transponder 6 Year TCO

<table>
<thead>
<tr>
<th></th>
<th>NCS 55A2-MOD IPoDWDM</th>
<th>IP + DWDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>CapEx Savings</td>
<td>49%</td>
<td>N/A</td>
</tr>
<tr>
<td>Opex Savings</td>
<td>36%</td>
<td>N/A</td>
</tr>
<tr>
<td>TCO Savings</td>
<td>45%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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Cisco SP Router Positioning
5G xHaul, Cable & Carrier Ethernet

Carrier Ethernet

Mobile xHaul

Cable

Converged Interconnect Network (CIN)
E2E IPoDWDM Deployment Scenario with Segment Routing

- Core
  - NCS 5508
  - 2x200G DWDM Trunks
  - CFP2 ACO
  - 4 x QSFP28 + 6 x QSFP client
- Core
  - NCS 5516
  - CFP2 DCO
  - 1x200G DWDM E/W
- Peering
  - ASR 9922
- Peering
  - ASR 9922

- Highly distributed compute
- Optimised CDN Aggregation
- 100G → 200G PaYG Wavelengths
- 6x200G DWDM Trunks
- CFP2 ACO

IP TV Traffic bypasses BNG

PaYG Wavelengths

EVPN

IOS-XR & Segment Routing (SR)
CIN Transport Architecture & Requirements
NCS-55A2-MOD for Aggregation Router

- High capacity & Low Power: 10G, 25G, 40G & 100G options, Low Power Consumption
- Long reach: 10G & 100G DWDM Optics, IPoDWDM Capability
- Timing: SyncE, 1588v2, BC support
- Remote Locations: Temperature hardened systems, Reduced physical footprint
- Security: 802.1X, MACSec
- Low latency: Low latency transport
- Multicast: Scalable, non-blocking

Diagram:
- CCAP CORE
- Aggregation Router
- Field Router A
- Field Router B
- MuxP
- HUB / HEADEND
- OUTSIDE PLANT
- HDC NODES: 8-18 RPD's
- HFC NODES: 8-18 RPD's
- 10G, 10/25G DWDM
- 100G, 100G/200G DWDM
CIN Architecture – IPoDWDM Field Aggregation

- IPoDWDM with NCS-55A2-MOD field endpoints and NCS5500 modular chassis with 6x200G or MOD line cards for aggregation
- CFP2 DCO provides long reach for 100G or 200G
- NCS-55A2-MOD with CFP2-DCO provides flexible capacity upgrade from 100G to 200G
- NCS-55A2-MOD supports up to 40 gray and DWDM 10GE
NCS-55A2-MOD & MOD LC
Technical Overview

Vincent Ng, TME SPNS
Nov 6, 2018
Agenda

• 55A2-MOD/LC Technical Overview
• Optics Support
• OTN Support
• Coherent IPoDWDM Support
• Timing Support
• MACsec Support
NCS-55A2-MOD-S Technical Overview

- 2RU 11” Depth Base Unit with one Jericho+ NPU @900Gbps 825Mpps, 4GB packet buffer
  - Fixed ports: 16xSFP28 and 24xSFP+, 2x MPA Slots @400G
  - MPA Types: 12xSFP+ / 4xQSFP28 / 2xQSFP28+1xCFP2 / 2xCFP2
  - 6-core Intel Broadwell-DE CPU, 32GB GDDR5 memory, 128GB M.2 SSD
- MACsec Capable on 16xSFP28 fixed ports
- MACsec Capable on all MPA ports
- SyncE support
- IEEE 1588-2008 PTP support
- External Satellite Inputs – 1PPS, 10MHz, TOD
- Built-in GNSS/GPS Receiver (Trimble) Hardware
- ZL30363 IEEE 1588 and SyncE Packet Clock Network Synchronizer with Stratum 3E OCXO Clock
- Dual redundant 1200W AC or 930W DC PSU, hot swappable
- 8 Fan modules with N+1 redundancy, hot swappable
- Future SE version with eTCAM and stats FPGA
NCS-55A2-MOD-HD-S Differences

- Temperature hardened, GR 3108 Class 2, -40C to +70C
- 8-Core CPU, DDR4 memory, MSATA SSD
- Alarm port (RJ45)
- HD 900W AC or 900W DC PSU
- MPA: 4xQSFP28 / 2xCFP2
- Future SE version with eTCAM and stats FPGA
- Conformal Coating
NC55-MOD-A-S Technical Overview

- Modular Line Card with one Jericho+ NPU @900Gbps 825Mpps, 4GB packet buffer
  - Fixed ports: 2xQSFP+ and 12xSFP+, 2x MPA Slots @400G
  - MPA Types: 12xSFP+ / 4xQSFP28 / 2xQSFP28+1xCFP2 / 2xCFP2
  - 6-core Intel Broadwell-DE CPU, 32GB memory, 128GB SSD

- MACsec Capable on all fixed ports
- MACsec Capable on all MPA ports
- SyncE support
- IEEE 1588-2008 PTP support
- Timing Support requires RP-E on same Modular Chassis:
  - Dedicated 1GE 1588 Port
  - External Satellite Inputs – 1PPS, 10MHz, TOD
  - Dual BITS/DTI inputs – T1/E1/2MHz
  - ZL30704 IEEE 1588 and SyncE Packet Clock Network Synchronizer with Stratum 3E OCXO Clock

- No power supply or fan tray upgrade required
- Future SE version with eTCAM and stats FPGA
NCS-55A2-MOD-S Block Diagram with Interface Naming
NC55-MOD-A-S Line Card Block Diagram with Interface Naming

Fabric Card 0
Fabric Card 1
Fabric Card 2
Fabric Card 3
Fabric Card 4
Fabric Card 5

Forwarding ASIC

eTCAM

MACsec

MPA0
0/x/1

MPA1
0/x/2

Statistics FPGA

MACsec

MACsec

QSFP+

QSFP+

8x1/10G 0/x/0/0-7

4x1/10G 0/x/0/8-11

2x40G 0/x/0/12-13

x = slot # (0-15)

CPU

DRAM
MPA Block Diagram with Interface Naming

- **NC55-MPA-12T-S Connector**
  - OTN, MACSec
  - 12 ports SFP+ 0/x/m/0-11

- **NC55-MPA-2TH-S Connector**
  - MACSec
  - 2港 QSFP28 0/x/m/0-1
  - 1 port CFP2 0/x/m/1/0-1

- **NC55-MPA-1TH2H-S Connector**
  - MACSec
  - 2港 QSFP28 (100G) 0/x/m/0-1
  - 1 port CFP2 (2x100G) 0/x/m/1/0-1

- **NC55-MPA-4H-S Connector**
  - MACSec
  - 4 port QSFP28 (100G) 0/x/m/0-3

x = Slot # (0-15)  m = MPA # (1-2)
Optics Support
NCS 5500 Family Interface Support

- Optimized for ultra-dense 100G
- QSFP form factor
  - 20% of CPAK dimensions, 44% of CFP4
  - Low power
- QSFP28 / QSFP+
  - 4x25G / 4x10G electrical interface
  - 1x100G & 4x25G / 1x40G & 4x10G via breakout
- SFP28 / SFP+
  - 1x25G / 1x1G/10G electrical interface
- CFP2
  - 8x 25G electrical interface
  - 100 – 200G IPoDWDM

NCS 5500 Support for 25G Optics

- 100m MMF: 25G SR-S SFP28
- 10km SMF: 10G/25G LR-S SFP28
- 1-5m Passive Copper: CR H25G CU SFP28
- 1-10m Active Fiber: H25G AOC SFP28
NCS 5500 Support for CFP2 Optics

- **CFP2-ACO** – only for 6xDWDM LC
  - Coherent DWDM – Analog
  - Requires host DSP for IPoDWDM
  - 100G QPSK
  - 150G 8QAM
  - 200G 16QAM

- **CFP2-DCO** – only for 1x/2xCFP2 MPA
  - Coherent DWDM – Digital
  - Integrated DSP for IPoDWDM
  - TOF and non-TOF version
  - 100G QPSK
  - 200G 8QAM
  - 200G 16QAM
OTN Support
What is OTN?

- OTN = Optical Transport Network
- Standards docs:
  - G.709 → Hierarchy and frame structures
  - G.872 → Architecture
  - G.798 → Management functions etc
- OTN defines a framing technology that is very similar to SONET/SDH (TDM)
- OTN started as a digital wrapper around WDM client signals to improve reach and manageability
- Evolved to a complex multiplexing hierarchy that enables a service layer

<table>
<thead>
<tr>
<th>$k$</th>
<th>OTU$k$</th>
<th>OPU$k$ Payload</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>1,238,954 k</td>
</tr>
<tr>
<td>1</td>
<td>2,666,057 k</td>
<td>2,488,320 k</td>
</tr>
<tr>
<td>2</td>
<td>10,709,225 k</td>
<td>9,995,277 k</td>
</tr>
<tr>
<td>3</td>
<td>43,018,414 k</td>
<td>40,150,519 k</td>
</tr>
<tr>
<td>4</td>
<td>111,809,974 k</td>
<td>104,355,975 k</td>
</tr>
</tbody>
</table>
NCS-5500 OTN Support

- OTN support on NCS-5500 is for G.709 OTN Framing/Wrapping of Ethernet interfaces
- Ethernet client signal is mapped into a G.709 OTN framing payload
- OTN transport provides better performance monitoring and alarms handling via G.709 built-in OAM capabilities
- OTN also provides longer reach with built-in FEC (forward error correction) capabilities
- For 55A2/MOD LC, the 12xSFP+ MPA has 10G OTN support
- OTN Framing support
  - ITU-T G.709 10GE LAN PHY over OTU2e (over-clocked direct mapping with stuffing 11.0957 Gbps)
  - ITU-T G.Sup43 10GE LAN PHY over OTU1e (over-clocked direct mapping without stuffing 11.0491 Gbps)
  - ITU-T G.Sup43 10GE LAN PHY over OTU2 (GFP-F mapping non-transparent transport 10.709 Gbps)
- OTN Tri-FEC support
  - ITU-T G.709 GFEC 7% Overhead
  - ITU-T G.975.1 I.4 EFEC 7% Overhead (aka AMCC / APM FEC)
  - ITU-T G.975.1 I.7 UFEC 7% Overhead (aka Cortina / Intel / Altera / Inphi FEC)
OTN Support and 10G IPoDWDM

- OTN capable 10GE port with SFP+ DWDM optics will provide 10G IPoDWDM capabilities
- This will eliminate the need for a transponder on the DWDM system
- 10G Tunable DWDM optics supports 96 tunable ITU-T wavelengths with 50GHz spacing
- 10G Fixed DWDM optics support 40 fixed ITU-T wavelengths with 100GHz spacing
- Enables long haul transmission with G.975.1 enhanced FEC
- Target distance with active DWDM depending on chromatic dispersion and OSNR
- Performance monitoring support
- Alarms handling support
- SNMP MIB and Yang models support
Coherent IPoDWDM
100G/200G Support
IP over DWDM Benefits

- Design simplifications
  - Transponder shelf elimination
  - Dual grey interface elimination
  - Lower amount of actives in the system → higher reliability

- Operational simplifications
  - No transponder shelf means no additional shelf to setup, configure and manage
  - Reduced power consumption

- Side effects of IPoDWDM technology
  - 100G/200G solution with ZR reach in P2P connections over dark fiber
Existing IPoDWDM solutions on NCS-5500

- NCS-5500:
  - 6 Port DWDM 1.2T Line Card with CFP2-ACO Coherent Optics
  - Up to 6 x 100G/150G/200G IPoDWDM interfaces

- Key IPoDWDM technologies
  - Coherent Detection and DSP Technologies, with advanced CD and PMD compensation
  - Advanced optical modulation QPSK/8QAM/16QAM and Diff/Non-Diff encoding
  - OTN transport with advanced HD-FEC and SD-FEC support
  - Proactive Protection (Pre-FEC FRR), GMPLS-UNI-C Signaling
New IPoDWDM solutions on NCS-5500

- Based on latest CFP2-DCO coherent optics
- CFP2-DCO combines in single optical module
  - CFP2-ACO optics
  - DSP chipset and technology
- Made possible by the introduction of Modularity on NCS-5500
- NCS-55A2-MOD and NC55-MOD-A LC supports CFP2 based MPA
  - NC55-MPA-2TH-S 2xCFP2
  - NC55-MPA-1TH2H-S 1xCFP2 and 2xQSFP28
  - CFP2 ports 200G capable by supporting 8x25G
Radical Evolution – CFP2 DCO Coherent Optics

- Pluggable Coherent front end optics evolves from CFP2-ACO (Analog Coherent Optics) to CFP2-DCO (Digital Coherent Optics)

- Variants of CFP2 DCO optics
  - 100/200G TOF version
  - 100/200G non-TOF version
  - 100G with Staircase FEC version
  - 100/200G temperature hardened version

- TOF version (tunable optical filter) is required in combination with CCOFS modules or coupler/splitters of NCS2k/4k or other active DWDM transport systems. The non-TOF version can be used in all other applications, including point-to-point (back-to-back) direct fiber connections
TOF vs non-TOF, when to use what

- TOF version has a tunable optical filter at the output of the TX
- TOF suppresses out of band noise
- When overlaying multiple signals on single fiber then TOF is best option

Clean all-TOF output example

One channel Non-TOF impacting neighboring channels
(very simplified model)
## CFP2 DCO Traffic Modes

<table>
<thead>
<tr>
<th>PID</th>
<th>Traffic Mode</th>
<th>Baud Rate [GBd/s]</th>
<th>Line Rate [Gb/s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFP2-WDM-DET-1HL=</td>
<td>Diff 15% SD-FEC QPSK 100G</td>
<td>30.144</td>
<td>100G</td>
</tr>
<tr>
<td>CFP2-WDM-DET-1HL= (non-TOF)</td>
<td>Non-Diff 15% SD-FEC QPSK 100G</td>
<td>31.379</td>
<td>100G</td>
</tr>
<tr>
<td>CFP2-WDM-D-1HL=</td>
<td>Non-Diff 15% SD-FEC 16QAM 200G</td>
<td>31.379</td>
<td>200G</td>
</tr>
<tr>
<td>CFP2-WDM-D-1HL=</td>
<td>Non-Diff 15% SD-FEC 8QAM 200G</td>
<td>41.839</td>
<td>200G</td>
</tr>
<tr>
<td>ONS-CFP2-WDM-D= (Staircase FEC)</td>
<td>Diff 15% SD-FEC QPSK 100G</td>
<td>30.144</td>
<td>100G</td>
</tr>
<tr>
<td>ONS-CFP2-WDM-D= (Staircase FEC)</td>
<td>Non-Diff 15% SD-FEC QPSK 100G</td>
<td>31.379</td>
<td>100G</td>
</tr>
<tr>
<td>ONS-CFP2-WDM-D= (Staircase FEC)</td>
<td>Diff 7% Staircase FEC QPSK 100G</td>
<td>27.952</td>
<td>100G</td>
</tr>
</tbody>
</table>
CFP2 DCO Features

- ITU-T Grid C-Band 96 channels 50GHz spacing tunable 1528.773 nm – 1566.723 nm
- Flex Spectrum 6.25 GHz spacing and 0.1 GHz resolution from 191.25 – 196.10 THz
- Tx power Range -10 dBm to 1 dBm
- Performance Monitoring and alarms handling support
- Management support with SNMP MIB and Yang data models
- Loopback support
- Proactive Protection (Pre-FEC FRR)
- GMPLS-UNI-C signaling
- Third party interoperability with Open Roadm MSA support
CFP2 DCO Third Party Interoperability

- **Open Roadm MSA** goals
  - The disaggregation and opening up of traditionally proprietary ROADM systems
  - The SDN-enablement of traditionally fixed ROADs

- Disaggregated functions
  - Pluggable optics, transponder, ROADM, OTN Xponder/switch, in-line amplifier

- Optical Specifications
  - W – single-Wave, to define pluggable optics or transponders
  - MW – Multi-Wave, to define ROADMs

- Basic Transponder/W-Specs requirement applicable for CFP2-DCO
  - 50GHz fixed ITU grid, OTU4/OTL4.4, NRZ-DP-QPSK, Differential encoding, Cortina Staircase 7% HD-FEC
  - Proposed netconf/yang data models
  - Performance Management and Alarms functions
Proactive Protection (Pre-FEC FRR)

Enabling Zero Loss Protection

**Reactive Protection**
- Gray Port
- Non-Cisco router
- Transponder
- FEC
- DWDM / ROADM

**Working route**
- Pre-FEC Bit Errors
- Time
- FEC Limit
- LOF

**Failing-over**
- Router Bit Errors

**Protect route**
- Pre-FEC Bit Errors

**Proactive Protection**
- Cisco IPoDWDM
- DWDM Router Interface
- FEC
- DWDM / ROADM

**Working route**
- Pre-FEC Bit Errors
- Time
- FEC Limit

**Protect route**
- Pre-FEC Bit Errors

**Hitless Switch**
- Protection Trigger
nLight Control Plane - GMPLS-UNI-C Signaling

- Out-of-band IP Control Channel based on RSVP-TE with GMPLS extensions
- Share and leverage information across layers – Routing and Optical
- Router can signal a path dynamically through an optical network
- Multi Layer Restoration for optical failures
Timing Support
IEEE 1588-2008 Precision Time Protocol
Packet-Based Time Transfer
ITU-T Telecom Profiles

IP Unicast, IPv4 mandatory, IPv6 allowed

PTP unaware
backhaul network

TP processed only at each end, G.8265.1 Telecom Profile

OC = Ordinary Clock, M = Master, S = Slave
BC = Boundary Clock
T-BC = Telecom Boundary Clock
T-GM = Telecom Grand Master
T-TSC = Telecom Time Slave Clock

Ethernet Multicast

PTP aware
backhaul network

TP with full on-path timing support, G.8275.1 Telecom Profile

IPv4 Unicast
IPv6 optional

PTP unaware

“G.8265.1 like”

TP with partial timing support, G.8275.2 Telecom Profile
## NCS-5500 Timing Support Matrix

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BITS/DTI Clock Interface</td>
<td>NA</td>
<td>On RP-E</td>
<td>NA</td>
<td>On RP-E</td>
</tr>
<tr>
<td>GPS External Clock Interface</td>
<td>10 MHz, 1PPS, TOD</td>
<td>RP-E 10 MHz, 1PPS, TOD</td>
<td>10 MHz, 1PPS, TOD</td>
<td>RP-E 10 MHz, 1PPS, TOD</td>
</tr>
<tr>
<td>GPS Internal Receiver</td>
<td>NA</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td>SyncE with ESMC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IEEE1588v2</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>G.8265.1 over IPv4</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>G.8275.1 over Ethernet</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>G.8275.2 over IPv4/IPv6</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>G.8273.2 Class A,B</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
MACsec Support
What is MACSec

- IEEE 802.1AE based Ethernet MAC Layer Encryption
- Strong cryptographic protection at layer 2
  - Anti-spoofing and Anti-snooping
  - Protect confidentiality and integrity of data
- Originally designed under TrustSec framework on the LAN
  - Hop by Hop, switch by switch encryption
- Router Use Cases focus on WAN deployment
MACsec Use Cases

**Link MACSEC in MPLS/IP Topology**

- MACSec over direct point-to-point physical links
- Per-link MKA sessions

**CE Port Mode MACSEC over P2P L2VPN**

- MACsec transport over point-to-point type L2VPN services such as PW which is MACsec unaware
- End-to-end MKA session

**Link MACSEC over LAG members**

- MACSec over bundles allows MACSec to be applied over LAG bundle members
- Provides ability to increase the MACSec support to Nx10G or Nx100G
NCS5500 MACsec Requirements

• Modular Chassis:
  • NCS 5508, NCS 5516, NCS 5504

• Line card:
  • NC55-36x100G-S
  • NC55-6x200-DWDM-S
  • NC55-MOD-A-S Base

• Standalone:
  • NCS-55A1-36H(-SE)-S
  • NCS-55A2-MOD-S Base

• MPA:
  • NC55-MPA-12T-S, NC55-MPA-2TH-S, NC55-MPA-1TH2H-S, NC55-MPA-4H-S
# NCS5500 MACSec Support Matrix

<table>
<thead>
<tr>
<th>Feature</th>
<th>36x100G-S</th>
<th>Coherent DWDM</th>
<th>55A1-36H</th>
<th>MOD SA/LC MPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>AES-256/GCM</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>XPN</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Link Bundle Member Support</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Physical Links</td>
<td>10/40/100GE</td>
<td>100GE</td>
<td>10/40/100GE</td>
<td>10/25/40/100GE</td>
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<tr>
<td>Breakout</td>
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<td>No</td>
<td>4x10 4x25</td>
<td>4x10 4x25</td>
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<tr>
<td>OTN</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>12xSPF+ MPA’s</td>
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<tr>
<td>Coherent IPoDWDM</td>
<td>No</td>
<td>CFP2 ACO</td>
<td>No</td>
<td>CFP2 DCO MPA’s</td>
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</tbody>
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