Changes in Peering
Cisco Intelligent Peering

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TME SPNSA
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Peering Traffic Growth and Distribution
The “Flattening” of the Internet

Traditional content peering

Video will be 82% of internet traffic by 2021

Subscriber BW consumption growing at a CAGR of 31%

Direct interconnection, less reliance on transit backup

Optimized content peering
While video dominates . . .

... other trends are driving advancements in peering design:

- Increasing use of SaaS creates stricter SLAs on peering performance
- 5G requirements accelerate relocation of network functions and data storage to distributed Multi-Access Edge Computing (MEC) locations
Peering moves deeper into the network

Peering placement in *Metro* locations reduces ISPs long-haul costs and assists with SLA assurance

Shift to Regional and Metro Peering drives new requirements in Peering network design

- Flexible port density to satisfy variable local user base sizes
- Low environmental footprint
- Resilient network design to avoid long-haul backup cost
- More sites require Automation to operate, optimize, and plan

Traditional single peering location transforms into 3 metro peering locations
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**Shift to Regional and Metro Peering drives new requirements in Peering network design**

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Traditional single peering location transforms into 3 metro peering locations
Trends in content distribution

Source of Distribution

<table>
<thead>
<tr>
<th>Year</th>
<th>Traditional content peering</th>
<th>Optimized content peering</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>76%</td>
<td>22%</td>
</tr>
<tr>
<td>2016</td>
<td>58%</td>
<td>23%</td>
</tr>
<tr>
<td>2021</td>
<td>41%</td>
<td>35%</td>
</tr>
</tbody>
</table>

vs

- Long-Haul Core
- Regional Core
- Metro

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IPv4 and IPv6 networks continue to grow
- 5G, IoT, Remote PHY will increase number of infrastructure device endpoints 5-10x
- Global routing table and device scale not the only concern
  - Internal routing will continue to grow as more services are distributed and cloud-native

Router longevity requires route scale without compromise
Cisco’s Intelligent Peering Solution

Distribution & Traffic Growth
- Resilient network design
- Simplified control-plane with Segment Routing
- Flexible high density and low environmental footprint routers
- RIB and FIB scale for 5+ years

Cisco Intelligent Peering
Cisco Intelligent Peering Design Guidelines

- Resilient, Scalable and Cost Effective
- Simplified deployment and operation
- Proactive security through analytics, automated remediation, and IOS-XR capabilities
- Intelligent analytics-driven traffic engineering
Peering Fabric Design Building Blocks

**Cisco Hardware**
- Highly dense and scalable NCS 5500 routers

**Automation**
- Programmability and analytics with YANG data models and telemetry

**Segment Routing**
- Unified forwarding plane with network abstraction and TE capabilities

**Prescriptive Configuration**
- Configuration best practices covering control-plane, telemetry, and security

End-to-End networking operations with IOS-XR
Cisco Intelligent Peering – Network Design
Evolution to Integrated or Distributed Peering Fabric

Traditional Peering

- Horizontal scaling adds resiliency
- Less reliance on long-haul backup for metro or DC Peering
- Reduced blast radius during maintenance or failure
- Simplified SR control-plane

Greater resiliency and capacity scale
- Optimized feature sets at each layer
- Optimized fabric for both ingress and egress content delivery

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Collapsed Edge vs. Distributed Network Functions
**Cisco Intelligent Peering**

**Segment Routing**

Foundation for Network Operations Simplification and Automation, and Service Agility via Programmability

<table>
<thead>
<tr>
<th>Simplification of network protocols</th>
<th>Automated 50ms convergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved scalability</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Simplification of Traffic Engineering</th>
<th>Built-in Redundancy &amp; HA</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Application enabled policy using SDN techniques</th>
<th>Support MPLS &amp; v6 Forwarding</th>
</tr>
</thead>
</table>

**Universal Forwarding Plane**

**From Access to Peering**
Place In The Network

- Traditional IXP Location
- Peering Fabric Extension
- Localized Peering Location
- Edge Datacenter Peering
Cisco Peering Fabric Validation
Continuous validation

Network Automation
Network Analytics

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Cisco Intelligent Peering – NCS-5500 Routers

Class-leading density and power efficiency

Peering scale buffers, FIB longevity of 5+ years

Trustworthy Systems Certified

Powered by IOS-XR
Peering Fabric Hardware – Fixed Chassis Detail

NCS-55A1-36H-SE
- 36x100GE QSFP28
- 144x10GE QSFP+
- 4M IPv4 / 1M IPv6 FIB
- Enhanced scale
- 1150W Typical
- 64GB RAM
- MACSEC Capable
- Jericho+ w/OP eTCAM

NCS-55A1-24H
- 24x100GE QSFP28
- 96x10GE QSFP+
- 2x900Gbps NPU
- 12x100G per NPU
- 1.3M+ IPv4 / 256K IPv6
- 675W Typical
- 32GB RAM
- Jericho+ No eTCAM

NCS-5501-SE
- 40x10GE SFP+
- 4x100GE QSFP28
- 4M IPv4 / 1M+ IPv6 FIB
- Enhanced scale
- 320W Typical
- 4x25G Capable
- 32GB RAM
- Qumran w/ eTCAM
Peering Fabric Hardware – Modular Chassis / LC

NCS-5504
7RU
4 line card slots
5310W w/144x100GE

NCS-5508
13RU
8 line card slots

NC55-36X100G-A-SE
36x100GE QSFP28
4M IPv4 / 1M+ IPv6 FIB
Enhanced scale
Jericho+ with eTCAM
Previous Generation vs Next Generation Peering Routers

Previous Generation Modular Peering Router
- 16 RU
- 44 x 100GE Ports
- ~11.7kW Typical
- ~260 Watts per Port

NCS-5508 Next Generation Modular Peering Router
- 13 RU
- 288 x 100GE Ports
- ~8kW Typical
- ~28 Watts per Port

- 1 RU
- 36 x 100GE Ports
- ~1,360 Watts Typical
- ~38 Watts per Port

89% Reduction in Power per Port
Cisco’s Intelligent Peering Solution

**Distribution & Traffic Growth**
- Resilient network design
- Simplified control-plane with Segment Routing
- Flexible high density and low environmental footprint routers
- RIB and FIB scale for 5+ years

**Traffic Optimization**
- SR enables SDN programmability end to end
- SR Traffic Engineering for optimal forwarding
- SR provides in-network application SLA
Optimization and SLAs drive Peering SDN

Egress
Best network exit path that is both cost-efficient and provides good user experience metrics (latency, link utilization & traffic loss)

Optimal exit link chosen:
• Low cost (private peer)
• Low utilization link

Ingress
Optimal path across SP network for ingress traffic from peering location to SP end users

Optimal exit link chosen:
• Latency
• Cost
SR-TE SP Ingress Peering Traffic Optimization

**Problem:** Engineering optimal path across SP network for ingress traffic from peering location to SP end users

**Solution:**
- Cisco WAE – Collect and optimize
- Cisco XR Traffic Controller - PCE
- Segment Routing TE - Transport

Optimal exit link chosen:
- Latency
- Cost

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**Problem:** Engineering the best network exit path that is cost-efficient while providing good user experience metrics (latency, link utilization & traffic loss).

**Solution:** Segment Routing Egress Peer Engineering (EPE).

[Diagram showing network topology with advertising routes and optimal exit link choices.]
Egress Peer Engineering Low Level

10.0.0.0/24 BGP NH: 172.16.1.1

Peer-Adj-SID: 5001

DSTIP: 10.0.0.1

SID: 5001

DSTIP: 10.0.0.1

SID: 16001

DSTIP: 10.0.0.1

SID: 17001

Push {17001,16001,5001}

Pop {17001}

Pop {16001}

Pop {5001}

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Peering Security
Your network is under attack, and Peering is the gateway

Route Hijacking in 2017

13,935 route leaks and hijacking incidents
38% were considered attacks

Source: Arbor 2018 Worldwide Infrastructure Security Report

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Security
- Trusted Hardware
- IOS-XR Control and Data Plane Security
- DDoS Protection
- Crosswork Network Insight BGP Analytics and Monitoring
Cisco Intelligent Peering - Security

Leading 2017 SP Concerns*

- DDoS Attack (88%)
- Compromised Network (37%)
- BGP Route Hijacking (25%)

Cisco Peering Solutions

- Arbor DDoS Mitigation
  - Cloud and Local DDoS detection and remediation tool
- Trustworthy Systems
  - Prevent supplier counterfeits and tampering
- Crosswork Network Insight
  - Real-time network health monitoring and remediation
- BGP Flowpsec
  - Automated Distributed Threat Filtering
- XR Control Plane Security
  - Restricting access to network interfaces and packets
- RPKI BGP Route Origin Authorization
  - BGP Prefix Origin ASN Validation
- Netflow @ 1:1000 Sampling
  - High Rate of Traffic Flow Information for Analysis
- Arbor Threat Detection
  - Real-Time visibility into threat activities
- User-Defined Payload Filters
  - Granular payload filters for surgical mitigation at edge

* Arbor 2018 Worldwide Infrastructure Security Report - SP Survey
Peering DDoS Mitigation

- Granular Netflow helps identify attacks faster
- High scale 5-tuple ACLs block high-volume identified traffic
- Full BGP Flowspec support for automated traffic filtering, policing, and redirection
- SR-TE to steer and load-balance traffic to end scrubbers
Address Route Hijacking using BGP Monitoring

Cisco Crosswork Network Insights

- Prefix and ASN monitoring to identify BGP prefix anomalies including **prefix hijacking**
- Global Internet BGP monitoring reveals scope and impact of Internet BGP routing events

*Crosswork Network Insights Screen Shots*
Automation & Analytics:
Not to Replace, but Enhance Value
# Peering Locations and Devices Require Automation

## What’s the Shortcoming

<table>
<thead>
<tr>
<th>Issue</th>
<th>Description</th>
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<tbody>
<tr>
<td>Incomplete and slow data collection</td>
<td>Incomplete and slow data collection from many locations and devices</td>
</tr>
<tr>
<td>Monitoring individual routers or locations</td>
<td>Monitoring individual routers or locations gives a fragmented network routing view</td>
</tr>
<tr>
<td>Lack of centralized real-time and historical BGP routing data</td>
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<tr>
<td>Traditional peering data lacks real-time agility to operate faster</td>
<td>Traditional peering data lacks real-time agility to operate faster with reliability</td>
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## What’s Needed

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<th>Description</th>
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<td>A better way of getting router metrics than SNMP</td>
<td>A tool to collect BGP prefix data and unify the view for route analysis at scale</td>
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<td>Route event visibility past, present, and trending to identify immediate issues and plan for future growth</td>
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<td>Automatic response and automation of tasks</td>
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**Peering Automation**
- High-Frequency Network Data
- NSO Peering Service Models and Task Automation
- Crosswork Network Insight

**Security**
- Trusted Hardware
- IOS-XR Control and Data Plane Security
- DDoS Protection
- Crosswork Network Insight BGP Analytics and Monitoring
Cisco Intelligent Peering - Extracting Data

Advanced automation, analytics, and visibility requires network data

Granular periodic and event driven data @ much higher scale and speed vs SNMP
Peering Automation Using Cisco NSO

- Peer Management
- Peering Telemetry Deployment
  - Deploys peering-specific Model-Driven Telemetry and BMP
- Peering ACL Deployment
- Peering AS-Set and Prefix-Set Deployment
- Peering Route-Policy Deployment
- Netflow Enablement

Deployment services can load templates with pre-defined policies or allow the creation of new elements for deployment to peering nodes.
Peering Automation

Peer Management Service

• Manage peering sessions like any other service type
• Configures interfaces and BGP using recommended attributes and configuration

```
services peering-service test-peer-1
  pfl-list pfl1
    peer-interface-type Bundle-Ether
    peer-interface-id 1
    member-interface member-interface-type TenGigE
    member-interface bundle-mode on
    member-interface bundle-member 0/0/0/1
    !
    member-interface bundle-member 0/0/0/2
    !
  !

admin@ncs(config)# show configuration
devices device pfl1
  address 192.168.100.101
  device-type cli ned-id cisco-ios-xr
  !
services peering-service test-peer-2
  pfl-list pfl1
    peer-interface-type TenGigE
    peer-interface-id 0/0/0/1
    int-ipv4-address 1.1.1.1/30
    service-policy reset-ipp
    ipv4-in-access-group peer-interface-in
    ipv4-out-access-group peer-interface-out
    bgp-id 65000
    peer-bgp-neighbor 1.1.1.2
    bgp-description Peer #1
    remote-as 65501
    neighbor-group peers
    in-route-policy peer-in
    out-route-policy peer-out
    !
    !
```
Cisco Network Insights provides network operators insightful real-time and historical BGP routing data analytics to enhance operations and reduce the mean time to repair.
Network Insight Monitoring

Example from Spark room notifications

spnaa-cto-ni  Yesterday, 9:53 AM

⚠️  Monitored ASN: 37215 (MAREN, MW)  Country: MW
   - 2018-06-04 13:45:45.159 - Origin 37215 withdrawn for prefix 41.70.16.0/20: Possible outage (No longer active) [Prefix History]

spnaa-cto-ni  Yesterday, 10:03 AM

⚠️  Monitored ASN: 37215 (MAREN, MW)  Country: MW
   - 2018-06-04 13:52:41.000 - Origin 37215 withdrawn for prefix 41.70.16.0/20: Possible outage (No longer active) [Prefix History]

⚠️  Monitored ASN: 49206 (PeakFactory, a MSP on IPTV, OTT and VOD with its own CDN, NL)  Country: NL
   - 2018-06-04 13:58:50.000 - Offending ASN - New upstream 60068 detected for prefix 185.41.49.0/24 affected origin 49206: Possible Leak [Prefix History]

⚠️  Monitored ASN: 262493 (Global Tech Internet Banda Larga EPP - Itda, BR)  Country: BR
   - 2018-06-04 13:49:51.000 - Offending ASN - New upstream 28287 detected for prefix 177.55.48.0/20 affected origin 262493: Possible Leak [Prefix History]
Cisco Intelligent Peering Resources

Cisco Peering Fabric 1.0 high level design:

Cisco NCS 5500 information:

Cisco Crosswork Network Automation: