Agenda

- Market Trends and Introduction
- Service Provider Transport Requirements
- Value Proposition of the Evolved Programmable Network
  - Simplification
  - Zero Touch Provisioning
  - Resiliency
  - Architecture Description
- SDN Enabled Architecture Evolution
- Q and A
Introduction, Market Trends and SP Transport Requirements
Evolving Services Create New Opportunities

**IP Traffic**
Global IP traffic will grow 3X to 1.4 zettabytes annually by 2017

**Cloud**
Global cloud traffic will grow 6X by 2016

**Video**
By 2017, the world will reach 3 trillion Internet video minutes per month

**4G Mobile Adoption**
4G will account for 45% of global mobile data traffic

**M2M**
Trillions of new "connected events" will occur over IP networks throughout the next decade
## Service Provider Challenges

<table>
<thead>
<tr>
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<th>Kbps</th>
<th>Mbps</th>
<th>10’s GE</th>
<th>100’s GE</th>
<th>Tbps</th>
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<td>Increasing OPEX</td>
<td>0s</td>
<td>10s</td>
<td>100s</td>
<td>1,000s</td>
<td>10,000s</td>
<td>Decreasing ARPU</td>
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<td>Explosive BW Grow</td>
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<td>Increasing Device Scale</td>
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Cisco EPN Carrier Ethernet Infrastructure

All in 1 infrastructure reduction

Cut down truck rolls by up to 75%

Service deployment down from months to minutes

Always Available

End to End Portfolio – Scale, Performance, Flexible form factors
Compelling Event of LTE

• Communications requirements are changing
• Old generations required hierarchical point to point
• New generation requires flat communications and high performance any to any connectivity
Value Proposition of the Evolved Programmable Network
Carrier Ethernet EPN Foundation
What is different?

SIMPLE like L2
- Zero Touch
- Auto-Testing

SCALABLE
- Multi-dimensional multiservice scale
- HW Design

PROGRMMABLE
- Agility, cross-layers efficiency

AVAILABLE
- Plug&play 50ms resiliency

Converged Infrastructure Foundation: Unified MPLS
Converged infrastructure
Increase profitability

Mobile Backhaul
Business / Private Cloud
Residential Triple Play
SONET/ATM

Multiple underutilized networks
No integration between services
Different operational skill sets

Decoupled service and infrastructure
• One efficiently utilized network
• One operational model
• All services on single network

EPN Converged Infrastructure

EPN convergence benefits
• Up to 70% capex savings
• Opex efficiency – one skill set
• Revenue opportunities – one access, multiple services
Converged infrastructure
What Cisco EPN does better?

Simple Convergent End-to-End Network Design

- **MPLS + BGP**: common control and data plane
- **HW longevity**: integrate with legacy, move to EPN without HW upgrades

Scalable, Resilient HW

- **M-D Scale**: separate HW resource management per service
- **High Density**: 1G-100G density leadership
- **99.999% resiliency**: system, SW, network level

Agile, Programmable

- **onePK**, **OpenFlow**, **PCEP**, **Netconf**
Seamless Migration
EPN CE integrates with Legacy

Progressively enable MPLS overlay
- Enable VLAN with MPLS
- Benefit from MPLS services: ELINE, CES, TDM, L3VPN

Deploy Cisco EPN devices in today architecture seamlessly:
- VLAN, QinQ
- STP/MST, G.8032, REP, MCLAG

Benefit from end to end MPLS infrastructure
- Remove VLAN when all elements are MPLS enabled
- Benefit from rFLA 50ms resiliency, Auto-IP, Autonomic Networking
MPLS L2VPN Evolution: PBB-EVPN
Powering DCI and NG-CE

- **Simplified Operation**: common data and control plane, MPLS + BGP
- **Better Resource Utilization**:
  - All-active Redundancy and Load Balancing
    - Optimal Path selection
    - **Always on**: Fast Convergence
    - **High Scalability**: MAC, VLAN, PW
Automate Device Deployment
Up to 70% OPEX savings

Simplicity

- Weeks vs. Minutes
- Downtime vs. Error Free
- Complex vs. Plug&Play
- Manual vs. Automated

EPN with Plug&Play nV Satellite
Auto-Discovery, Auto-Provisioning and Auto-resiliency

One Virtual System

Cisco Connect, Riyadh, Saudi Arabia, April 29-30, 2014
nV Satellite: Simplify Cell Site Router Activation

Today: 4-6 truck rolls to install a cell site router

- Router Physical Installation, Power, and Data Cabling
- Router Configuration
- EVC SLA Testing
- Ready for cut-over

nV Satellite: configuration and testing is done remotely.

- Router Physical Installation, Power, and Data Cabling
- Zero-Touch Router Boot and Configuration
- Integrated loopback for SLA Testing
- Ready for cut-over
- And much more: simple upgrades, single code, single configuration…
Steps to Simplify MPLS Turn-UP

- Zero Touch Provisioning: Auto configuration and IP address assignment
- Autonomic Network: Scalable and secured node insertion
- Service Activation: Fast service turn-up and troubleshooting
Auto-IP
Self assigning IP address

1. Assign unique IP address to node being inserted
2. Neighboring nodes and inserted node negotiate physical link addresses
3. Connectivity established to the new node without manual intervention to existing nodes

Auto-IP
LLDP based Auto-IP negotiation

Easy node insertion and IP address assignment in L3 rings
Autonomic Network
Secured Discovery and Configuration

1. Device shipped from Cisco manufacturing to branch with no configuration
2. Device auto-discovered by neighbors and establishes secure configuration channel
3. Device receives Configuration Engine location and securely registers
4. Device downloads configurations from Configuration Engine

Auto-discovery and Secure Configuration Channel

Zero-touch access auto-configuration
Service Activation
Easy SLA verification

1. Traffic generation in network element eliminate need for extra test equipment
2. Ability to test end to end QoS for service assurance
3. Remote device send the traffic back to the source
4. Source measures throughput, jitter, and latency for SLA
5. Analytic and police engines collect data from nodes for more detailed analysis and take appropriate actions

Service turn up and verification without need for extra equipment
Virtual Service Interface – Pseudowire HE
Any Service Anywhere

Simplified Operations for Access & Aggregation
Converged PE and ESER
Less Touch points and single service definition
MEF CE2.0 Services, L3 VPN, Multicast

L2 access, MPLS Access, nV Sat
Agile: Deploy Services Faster

Slow time to market? where the time goes?

Before

New Service Definition
Per Device Configuration Development
Interoperability testing
Per Box Physical infrastructure
Configuring E2E Service per Box
Activation Test and Troubleshooting

After: Cisco EPN

MEF CE 2.0 Services
EPN CVD Configurations
EPN CVD Test Results
Converged Physical Infrastructure
Flexible service enablement PW-HE virtual interface
Integrated SAT

Reduce from months to minutes
EPN Infrastructure Programmability

Increase profitability

Evolved Programmable Network

Guaranteed Network SLA

Virtual Private Cloud

Nfv Services

GI-LAN | Consumer

Cloud Datacenter

SP Data Center

Service Chaining

Program & Control

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Reduce downtime in your network
Profitability only with 24x7 networks

Downtime cost to your customer

$11,441* = cost of each computer and network downtime to businesses

Critical Applications on Cloud

Cloud and storage distribution make network reliability even more relevant

Access Everywhere

All networks are equally important. Customer access networks via wired Ethernet, WLAN or 3G/4G

**Source: Current Analysis, March 2012, With Network Dependence Critical, is downtime acceptable?
### EPN Built-in Network High Availability

Always on without compromising simplicity

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<th>Simple</th>
<th>Multi-service</th>
<th>50ms</th>
<th>Cost</th>
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#### EPN with Loop Free Alternate Resiliency

- 3 simple lines to enable
- Always ON with 50 ms convergence
- Multiservice, multi-topology
MPLS Access: Resiliency Simplified

Remote LFA

- Operator Action: Enable R-LFA for a set of prefixes to protect
- rLFA Algorithm finds a PQ node, best alternate loop free path, and pre-installs secondary path/label for a prefix in HW
- Result: Local repair with 50ms convergence
Cisco ASR 9000 Carrier Ethernet Resiliency

HA solution for every network

- **Access Resiliency Mechanisms**
  - LFA/rLFA, MPLS-TE/TP
  - G.8032, REP-AG
  - Performance Optimized MST-AG, PVST-AG, MST-AG, MST, RPVST
  - Feature Enabled LAG and MC-LAG

- **Node Resiliency Mechanisms**
  - Protocol Inclusive NSF/NSR/SSO
  - In-Service SMU/ISSU
  - Fully Redundant Hardware

- **Core Resiliency Mechanisms**
  - MPLS TE/FRR
  - PW Redundancy w/ MAC withdrawal
  - MoFRR
  - Fast IGP Convergence/IP FRR

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Cisco Connect, Riyadh, Saudi Arabia, April 29-30, 2014
Cisco ASR 9000 Carrier Ethernet SLA Management at Glance

Ethernet OAM
- 802.3ah Link OAM
- ELMI
- CFM 802.1ag /w Ethernet Fault Detection
- Y.1731 Fault Management

Performance Monitoring
- Y.1731 Delay Measurement
- Y.1731 SLM and LMM
- IP SLA

Interworking
- CFM-ELMI
- 802.3ah-CFM
Driving Innovation for Ethernet Transport
Improved Service Revenues, Reduced CapEx + OpEx Costs

**nV**
Virtualization in Edge and Access for Operational Simplicity

**PW-Head End**
Virtual interface for any service anywhere

**Activation Framework**
Zero-touch provisioning and integrated testing

**IP Fast Reroute**
Scale and protect any topology with 50ms and minimal provisioning

Plug and play infrastructure

Deploy services faster

Reduce Truck Rolls

Resilient and simple
SDN Enabled Architecture Evolution
The Evolution of EPN Transport (CE) Architecture

Native Ethernet Solution → Ethernet over MPLS Solution → nV Satellite Solution → What’s next?

Legacy
Converged but Complex
Simple but limited applicability

Simple, Agile, Programmable, Cloud Integrated

Architecture Evolution w SDN/NFV and Segment Routing
Nodal segment: Operator allocates a label from the SR registry to each node. For example Z is given label 65

Adjacency segment: Node automatically allocates a local label for each adjacency. For example Label 9001 allocated for adjacency O

Network (Physical and Virtual Infrastructure)
Segment Routing (SR)

Forwarding state (segment) is established by IGP
- LDP and RSVP-TE are not required

MPLS Dataplane is leveraged without any modification
push, swap and pop: all what we need
segment = label

A packet injected anywhere with top label 65 will reach Z

A packet injected at node C with label 9001 is forced through datalink CO
The Evolution …

Existing Solution
- BGP
- T-LDP
- RFC 3107 BGP (opt)
- RSVP-TE
- MPLS LDP
- IGP
- IP

EPN 3.0 (Cisco Unified MPLS)
- BGP
- T-LDP
- RFC 3107 BGP (opt)
- MPLS LDP (FRR)
- IGP (FRR)
- IP (auto-IP)
- AN

The Evolution
Simple, agile, programmable
Cloud Integrated
- SDN
- SR (IPless)
- AN

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Vision of the EPN Transport (CE) Architecture Evolution

- **Autonomic Network (physical):** secure, auto discovery, plug-n-play
- **Segment routing (transport):** IPless, 50msec self-protected, Agile on-demand TE
- **SDN controller (service):** static service label (or NSH) with cloud integrated

Simple, Agile, Programmable Transport
CE EPN Evolution to full Plug&Play Segment Routing and SDN

AN Auto-Bootstrap

No need for link addresses

Only one protocol

Enhanced LFA

Reduce touch points and Automate

PW-HE Service

Segment Routing and SDN

SEGMENT ROUTING

AN Auto-Bootstrap

Auto-Loopback

SR

Topology Independent LFA

Per Port Service Label

Service Multiplexed Labels

SDN orchestration

SR+Service Label

SR+VPN label+BGP

SR+Service Label

All in One Protocol

Unlimited Scale

Zero-Touch

AN Auto-Bootstrap

Auto-Loopback

Service Multiplexed Labels

Topology Independent LFA

Per Port Service Label

Enhanced LFA

Reduce touch points and Automate

PW-HE Service

Cisco Connect, Riyadh, Saudi Arabia, April 29-30, 2014
Cisco Prime: A Comprehensive Tool Kit
End-to-End Service Fulfillment and Orchestration Across Evolved Programmable Network

Zero-Touch Service Fulfillment
Automated Service Orchestration
Integrated Service and Network Assurance

Cisco Unique Value

OPEN APIs
NCS CRS ASR Nexus UCS Mobile Video 3rd Party

Accelerate Time-to-Market and Revenue
Simplify Operations and Cost of Ownership
Improve Customer Experience

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Roadmap/Vision

- Simplify further Routing and MPLS infrastructure
- Streamline and Automate Services and Infrastructure
- Advanced nV Satellite functions
- Enhance Bandwidth management capability
- End-to-end solution management portfolio
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