Agenda

1. IP NGN & Carrier Ethernet
2. Cisco ASR 1000
3. Cisco ASR 9000
4. Key Takeaways
IP NGN & Carrier Ethernet
SP Network Evolution

1. Historic Growth
2. Not built for packet initially
3. Different Departments
4. High OPEX due to layering

Yesterday

- L1/L2/L3 Services via IP/MPLS
- High Bandwidth Optical Services
- Optical Layer

IP NGN

1. Evolution not revolution
2. Minimal Layering
3. Similar control plane in aggregation and core

Optical Layer
- cWDM
dWDM
- Fibre

Optical Layer
- ATM
- SONET/SDH
- L1 Services

Optical Layer
- cWDM
dWDM
- Fibre

Optical Layer
- L2 Services
IP NGN: Converged Topology & Services

1. Optical layer
   - Dark fibre and/or DWDM
   - Basic non-oversubscribed point to point high bandwidth services
   - Under lying transport for IP/MPLS infrastructure

2. IP/MPLS
   - Based on an end to end IP/MPLS control plane
   - Concurrent support of L1, L2, L3 services
   - QoS to support real-time services (voice & video)
   - Access agnostic
# Cisco IP NGN Convergence Layers

<table>
<thead>
<tr>
<th>Application Layer</th>
<th>Video and Gaming</th>
<th>Data Center</th>
<th>Presence-Based Telephony</th>
<th>Web Services</th>
<th>Mobile Applications</th>
<th>IP Contact Center</th>
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<tbody>
<tr>
<td>Service Layer</td>
<td>Self-Service</td>
<td>Identity</td>
<td>Policy</td>
<td>Billing</td>
<td>Open Framework</td>
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<td>Video, Mobility)</td>
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<td>Customer Element</td>
<td>Access/</td>
<td>Intelligent</td>
<td>Multiservice</td>
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<td>Aggregation</td>
<td>Edge</td>
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**Intelligent Networking**
What is Carrier Ethernet?

- Carrier Ethernet is short for Carrier Grade Ethernet
- Carrier Ethernet is a set of extensions to Ethernet to enable SPs/Carriers to provide large scale Ethernet services and use Ethernet in their networks
- Carrier Ethernet has five attributes:
  1. Standardized Services (E-Line & E-LAN)
  2. Scalability
  3. Reliability (rapidly detect & recover from failures)
  4. Advanced Quality of Service (to offer SLAs)
  5. Service Management (provisioning, diagnosing faults, and measuring performance)
Cisco ASR 1000
ASR1000 Series SPA Interface Processor: SIP10

1. Physical termination of SPA
2. 10Gbps aggregate throughput
3. Supports up to 4 SPA’s
   - 4 half-height, 2 full-height, 2 HH+1FH
   - full OIR support
4. Does not participate in forwarding
5. Limited QoS
   - Ingress packet classification – high/low
   - Ingress over-subscription buffering (low priority) until ESP can service them.
   - Up to 128MB of ingress oversubscription buffering
6. Capture stats on dropped packets
7. Network clock distribution to SPA’s, reference selection from SPA’s
8. IOCP manages Midplane links, SPA OIR, SPA drivers
ASR1000 Building Blocks

1. **RP (Route Processor)**
   - Handles control plane traffic
   - Manages system

2. **ESP**
   - Handles forwarding plane traffic

3. **SIP**
   - Houses the SPAs

4. **SPAs**
   - Provide interface connectivity

5. **Centralized Forwarding Architecture**
   - All traffic flows through the ESP
Cisco Quantum-Flow Processor (QFP) Architecture

<table>
<thead>
<tr>
<th>Popeye – Packet Processor</th>
<th>QFP S/W Architecture</th>
<th>Spinach – Traffic Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 custom multi-threaded cores</td>
<td>QFP Driver &amp; Client</td>
<td>128K Three Parameter Q’s</td>
</tr>
<tr>
<td>Non-Pipelined, Parallel Processing w/ Shared Memory</td>
<td>QFP Feature Array (runs on Popeye)</td>
<td>Across 10s of Gbps of flexible queue hierarchies</td>
</tr>
</tbody>
</table>

System Bandwidth and Oversubscription

1. ESP bandwidth denotes the total ‘output’ bandwidth of the system, regardless of the direction.
2. As long as High priority traffic long is not over-subscribed, i.e., <=10G for ASR1000-ESP10.

- 5G Unicast in each direction
  - Total Output bandwidth 5+5=10

- 1G Multicast with 8X replication in one direction
  - 2G unicast in the other direction
  - Total Output bandwidth 8+2=10G

- 5G Unicast in one direction & 6G Unicast in the other direction
  - Total output bandwidth (5+6=11) exceeds 10G; Only 10G will go through

- 1G Multicast with 10X replication in one direction
  - 1G Unicast in the other direction
  - Total bandwidth (10+1=11) exceeds 10G; only 10G will go through

Oversubscribed
ASR 1000 Overview

Next-generation of Midrange router family
1. 2RU / 4RU / 6RU chassis
2. 2.5 / 5 / 10 / 20+ Gbps forwarding with services
3. Simple scale: 2.5-20-(40G) just by changing ESP
   [2.5 and 5G in 2RU]
4. Dual AC or DC power supplies

Differentiators
1. Designed for High Availability
   Hardware redundancy for 6RU (RP and ESP) with ISSU
   Software redundancy for 2RU/4RU: In-service software upgrade,
   even with one RP
2. State of the art H-QoS (multi-level, 128K+ Q’s)
3. Integrated hardware based services (no service blades), (SBC, FW, IPSec, WAN Optimization, etc.)
4. Powerful control plane in RP –Route Reflector apps

Simple Migration
1. SPA support – same interfaces as 7600/12K/CRS-1
2. IOS features, CLI – simple migration from existing 7200 deployments
# ASR 1000 Series Models Comparison Matrix

<table>
<thead>
<tr>
<th>Chassis</th>
<th>ESP2.5</th>
<th>ESP5</th>
<th>ESP10</th>
<th>ESP20</th>
<th>RP1</th>
<th>RP2</th>
<th>Integrated GigE</th>
<th>SPAs</th>
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<tr>
<td>ASR 1002-F</td>
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Max Encryption Throughput

<table>
<thead>
<tr>
<th></th>
<th>1.0Gbps</th>
<th>1.8Gbps</th>
<th>4.0Gbps</th>
<th>7.0Gbps</th>
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<tr>
<td>ESP2.5</td>
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<td>ESP10</td>
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<td>ESP20</td>
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<td>RP1</td>
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<td>Integrated GigE</td>
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<tr>
<td>SPAs</td>
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An IOS XE Innovation—Dual Cisco IOS

1. An option to run dual IOS images on single RP HW for 2/4 RU chassis results in zero service disruption during IOS upgrades

2. Failover of IOS instance or RP doesn’t cause service impact to IOS FW or NAT
**Solution Objective**
1. Offer a carrier class platform which continues to forward traffic during planned or unplanned events.

**Solution Benefits**
1. Software Redundancy for 2RU/4RU
2. NSF/Graceful Restart
   - BGP, OSPF (Cisco/IETF), OSPFv3, IS-IS, EIGRP, LDP
3. SSO/ISSU: (generally follow each other)
   - CEF, SNMP, ARP, NAT
   - Stateful ISIS
   - MPLS, MPLS VPN, LDP, VRF-lite
   - IPv6 (NDP, uRPF)
   - FR, PPP, MLPPP, HDLC, VLAN
   - Broadband: PPPoE, AAA, DHCPv4, DHCPv6 PD
   - IPSec (SSO), FW/NAT (SSO/ISSU)

4. Network
   - IP event dampening
   - BGP & SPF optimizations
   - Multicast sub second convergence
   - GLBP, HSRP, VRRP
   - BFD for BGP, ISIS, OSPFv2 & static v4/v6
ASR 1000 in Service Provider IP Next Generation Network

- **Mobile Subscriber**
- **Business Corporate**
- **Residence**
- **Wireless**
  - WiMAX
- **Access & Aggregation**
  - ETTx
  - xDSL
  - xPON
- **Wireline**
  - DSLAM
  - OLT
- **Cable**
  - DOCSIS
  - M-CMTS
- **High Speed CPE**
- **Edge**
  - BRAS
  - IPSEC
  - PE
  - SBC
- **ISP**
  - LNS
  - RR
  - IP/MPLS Core
  - Content Farm
  - LNS
  - Route Reflector
  - Internet Peering
- **Internet Peering**
  - E丁T Tunnel

- **Content Farm**
  - VOD
  - TV
  - SIP

- **Service Provider**
  - ASR 1000 in Service Provider IP Next Generation Network
Cisco ASR 9000
ASR 9000 At a Glance

1. Optimized for Aggregation of Dense 10GE and 100GE

2. Designed for Longevity: Scalable up to 400 Gbps of Bandwidth per Slot

3. Based on IOS-XR & ANA for Nonstop Availability and Manageability

4. Enables Network Convergence of Business and Residential Services
ASR 9000
The (R)evolution Begins!

- Carrier Ethernet Focus
  - High Density GE/10G
  - Extensive L2VPN Services
  - Incorporated SynchE
  - IPoDWDM Ready

- Carrier Class
  - IOS-XR Modular OS Absolute
  - HW Redundancy Broad
  - Network Resiliency Schemes

- Power Reduction
  - Industry Leading Watts/Gbps
  - "Green"
  - Pay as You Grow Power
  - Minimal Carbon Footprint

- Built to Last
  - 6.4Tbps Capable System
  - Engineered for Nx100G
  - Superior H-QoS/Scale

- Purpose Built
  - Converged
  - Resilient
  - Simplicity

- Minimize Operational Expense
  - Complete EMS/NMS Support
  - Consistent Provisioning Model
  - Comprehensive OAM

- Integrated Video
  - Video Quality Monitoring
  - Optimal Intelligent Multicast Forwarding
  - VoD Streaming/Cache

* Please refer to Road Map for time line of feature support
IOS-XR Powers the Edge with ASR 9000
A Fully Distributed, Microkernel-Based Architecture

- **Modular Components**
  - **Routing Composite**
    - RIP
    - OSPF
    - BGP
    - ISIS
  - **Host Composite**
    - Manageability
    - Security
    - Forwarding
    - Base
    - Admin
  - Line Card

- **Applications Architecture**
  - IS-IS
  - Multicast
  - Distributed Middleware
  - QoS
  - BGP

- **Distributed Service Separation**
  - OAM
  - MAC
  - VLAN
  - Subs

- **Next Generation Architecture**
  - Microkernel-based design
  - Highly modular, highly extensible
  - ‘Service-enabled’ blade architecture

- **Designed for Scale, HA, and Performance For IP NGN Applications**
  - Scale through distribution
  - Unique address tables per linecard
  - Process-level, stateful subscriber HA
ASR 9000 System Scalability
Outlasting the Future

Source: Cisco Visual Networking Index — Forecast, 2007–2012

<table>
<thead>
<tr>
<th>Linecards per Chassis</th>
<th>10 slots</th>
<th>6 slots</th>
<th>18 Slots</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 LC + 2 RSP</td>
<td>4 LC + 2 RSP</td>
<td>16 LC + 2 RSP</td>
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<tr>
<td>Linecard Density</td>
<td>200 Gbps</td>
<td>200 Gbps</td>
<td>200 Gbps</td>
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<tr>
<td>Bandwidth per Slot</td>
<td>400 Gbps</td>
<td>400 Gbps</td>
<td>400 Gbps</td>
</tr>
<tr>
<td>Bandwidth per Chassis</td>
<td>6.4 Terabits</td>
<td>3.2 Terabits</td>
<td>12.8 Terabits</td>
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</table>
ASR 9000 GA Hardware
10-slot and 6-slot Systems

1. 10-slot (8 LC + 2 RSP) and 6 slot (4 LC + 2 RSP)
2. 180 Gbps/slot
3. AC & DC systems

Chassis Options

Linecard Options
- 40xGE, 4x10GE, 8x10GE,(2x10GE + 20GE) options

Route Switch Processor
- Active/Active Switch Fabric
- Control Plane Redundancy
ASR 9000 Modular SPA Carrier Linecard
Extending the Interface Options

ASR 9k Modular SPA Carrier Card Overview
- 20G Modular SPA Carrier Card
- 4 SPA Bays for Mix & Match I/O Capability
- Fully-distributed data and control plane

QFP-based for Premium Application Delivery
- High Programmability & Flexible Microcode Architecture
- Premium L3 Edge MPLS Services
- CHOC-12 for TDM-based cell site aggregation
- Flexibility to add Timing for Mobile Backhaul
- 128K Policers & 128K Queues

Future SPA Plans
- 1H2010 – CHOC12
- 2H2010 – POS, GE, RPR, 1588v2
- 1H2011 – ATM
Extending IPoDWDM to the Edge
Cost Efficient Transport Solutions

Traditional Solution

Transponder Integrated into ASR9k

- CWDM/DWDM Pluggables
- G.709 OTN Framing
- EFEC, FEC support
- Tunable XFPs Planned for 2H CY ‘10

Interoperable with Cisco 7600 and CRS-1 deployments
IOS XR Architecture Overview
Single OS for Core, MSE and Aggregation

Policy Control Plane

Mobile
Residential
Business
Corporat
Residential

Portal
Monitoring
Billing
Subscriber Database
Identity
Address Mgmt
Policy Definition

Access
Aggregation
Edge
Core

PSTN
National / International Peer
Regional Peer

STB
DSL
WIMAX
ETT x
PON

WIMAX
ETT x
PON

ASR 9000
XR 12K
CRS-1

VOD
TV
SIP

BSC
RNC

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Key Takeaways
Key Takeaways

1. **IP NGN** is a converged packet network capable of providing L1, L2, & L3 services with QoS and is access agnostic

2. Carrier Ethernet is a set of extensions to Ethernet to enable SPs to offer large scale Ethernet services and use Ethernet in their networks

3. **ASR 1000** is Cisco’s strategic next-generation Midrange router leveraging ground-breaking hardware capabilities of QFP
   - Horsepower of 40 Cisco 7200 on a single chip
   - State-of-the-art QoS and High-Availability

4. ASR 1000 is positioned for both Service Provider and Enterprise Architectures and is using IOS-XE technology
   - SP: Broadband Network Gateway, PE, Manage CPE,
   - Enterprise: WAN aggregation / optimization, Unified Communications

5. The Cisco ASR 9000 Series facilitates the evolution of Carrier Ethernet networks by setting a new foundational baseline for the edge.

6. The Cisco ASR 9000 Series uses the **Cisco IOS XR** Software Operating System, comprehensive system redundancy, and a full complement of network resiliency schemes.
Q and A
Thank You!