Designing Next Generation Carrier Ethernet Access Network

Benjamin Lee
Consulting Systems Engineer
Agenda

- Cisco ME3600/3800 Platform introduction
- Cisco IP NGN Network Design with ME3600/3800
- Cisco ME3600/3800 Scale Profiles
Cisco ME3600/3800X Platform
Introduction
What is Carrier Ethernet Access?

Unified Access

ME36/3800 Roles in the Network
- CPE
- UPE
- Pre-Aggregation

Applications
- Ethernet Access Node
- Broadband Aggregation
- Pre-Aggregation for Mobile Applications
- Metro Ethernet Aggregation
Introducing ME3800 / 3600X
Flexible Service Delivery at 10G

Carrier Ethernet Switch Routers:
• Cisco ME 3800X
• Cisco ME 3600X (Copper & Fiber)

• Small Form factor
  1RU, 20” deep
• Interfaces Configurations
  24 GE and 2 10GE SFP+
  24 10/100/1000 and 2 10GE SFP+
• Power Options
  AC or DC modular
  includes +24VDC option

• Key Highlights
  MPLS on all ports
  H-QoS with Deep Buffers
  Timing: SynchE, BITS
  EVC
  Ethernet OAM
ME 3600X Build for the Access

- Service Termination
  Ethernet Virtual Circuit
  QoS Policies
  Security
- OAM
  Fault Monitoring
  Performance Monitoring

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC addresses</td>
<td>16,000</td>
</tr>
<tr>
<td>VLAN mappings</td>
<td>4,000</td>
</tr>
<tr>
<td>Bridge Domains</td>
<td>4,000</td>
</tr>
<tr>
<td>IPv4</td>
<td>20,000 IPv4 routes</td>
</tr>
<tr>
<td>MPLS</td>
<td>512 PW</td>
</tr>
<tr>
<td></td>
<td>128 MPLS VPNs</td>
</tr>
<tr>
<td>Qos</td>
<td>4,000 queues</td>
</tr>
<tr>
<td></td>
<td>2,000 ingress policers</td>
</tr>
<tr>
<td></td>
<td>4,000 egress shapers</td>
</tr>
<tr>
<td>Multicast groups</td>
<td>1,000</td>
</tr>
</tbody>
</table>
ME 3800X in the aggregation

- Aggregation
  - EVC
  - QoS Policies
  - Multicast
  - Resiliency

### Scale for the Aggregation

<table>
<thead>
<tr>
<th>Feature</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC addresses</td>
<td>256,000</td>
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<tr>
<td>VLAN mappings</td>
<td>16,000</td>
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<tr>
<td>Bridge Domains</td>
<td>8,000</td>
</tr>
<tr>
<td>IPv4</td>
<td>80,000 IPv4 routes</td>
</tr>
<tr>
<td>MPLS</td>
<td>16,000 PW</td>
</tr>
<tr>
<td></td>
<td>2,000 MPLS VPN</td>
</tr>
<tr>
<td>QoS</td>
<td>32,000 queues</td>
</tr>
<tr>
<td></td>
<td>16,000 ingress policers</td>
</tr>
<tr>
<td></td>
<td>32,000 egress shapers</td>
</tr>
<tr>
<td>Multicast groups</td>
<td>4,000</td>
</tr>
</tbody>
</table>
# Product Comparison

<table>
<thead>
<tr>
<th>Name</th>
<th>Ethernet Access Switch</th>
<th>Carrier Ethernet Switch Router</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deployment</td>
<td>Access</td>
<td>Aggregation</td>
</tr>
<tr>
<td>Features</td>
<td>Same Features: Ethernet, L2VPN, IP, MPLS, OAM, Timing, QoS</td>
<td></td>
</tr>
<tr>
<td>Scalability</td>
<td>Medium</td>
<td>Large</td>
</tr>
<tr>
<td>Performance</td>
<td>Line rate performance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Throughput: 44Gbps Full Duplex</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forwarding Capacity: 65Mpps</td>
<td></td>
</tr>
</tbody>
</table>
IP/MPLS Features

IPv4 Unicast
- IGP
  - OSPF
  - ISIS
  - EIGRP
- BGP
  - IP/MPLS Fast Convergence

IPv6 Unicast

MPLS
- L3VPN/L2VPN
  - Carrier Supporting Carrier
    - RFC 3107
- Flat VPLS & H-VPLS
- MPLS TE/FRR
- MPLS TP (Roadmap)

Multicast
- IPv4 Multicast
- Layer 2 Multicast
ME3800X/3600X Architecture Overview
Cisco Carrier Ethernet ASIC

- Deep Buffers
- Multiple PQ
- Control Plan Security
- Loopbacks

Carrier Ethernet ASIC

- 802.1q
- 802.1ad
- 802.1ah
- VPLS

Statistics Collection
HA: Fast Failure Detection
Service Scale
H-QoS

- Multi Layer Support
  - L2 Routing
  - MPLS

- Hardware Acceleration
  - Line Rate performances
    - (44Gbpps Full Duplex, 65Mpps)
  - Low Latency
  - Low jitter

- Comply to Cisco IOS Baseline
  - Feature consistency across CE platforms

Most comprehensive CE feature set in an ASIC

Purposely build for the Carrier Ethernet
ME3800X/3600X Architecture Overview
Cisco Carrier Ethernet ASIC

1. Ingress Packet processing
   - Parsing packets
   - Access Control List
   - QoS Classification
   - QoS Policing
   - Lookup operations
   - L2/L3/MPLS forwarding

2. Buffering

3. Multicast Replication

4. Traffic management
   - Queuing
   - Scheduling

Egress Packet processing
   - Packets Rewrite

Performance with all Service enabled
   - 24Gbps
   - 32.5 Mpps
   - Low latency/Jitter (<20us)
Cisco Ethernet Virtual Circuit (EVC) Framework Enables Service

- Service Identification
- Service Transport
- Service Policies

Frame classification
VLAN tag manipulation
→ Many Services on same port

Service Instance associates:
- Encapsulation
- VLAN rewrite
- Bridge Domain

EFP (Ethernet Flow Point)
Flexible VLAN tag classification
Flexible VLAN tag rewrite
Flexible Ethertype (.1Q, QinQ)

VPLS
VPWS
EoMPLS PW
EoMPLS PW
EoMPLS PW

Bridging
Routing
IP/MPLS
MPLS VPN

SI

Bridge Domain
Cisco Ethernet Virtual Circuit (EVC) Framework Enables Service

- Service Identification
- Service Transport
- Service Policies

**Bridge Domain**

**Ethernet over MPLS (VPWS)**
**Virtual Private Lan Services (VPLS)**

→ Many Transport Options

Routing
→ L2 to L3 Option

**Service Instance associates:**
- Encapsulation
- VLAN rewrite
- Bridge Domain
Cisco Ethernet Virtual Circuit (EVC) Framework Enables Service

- Service Identification
- Service Transport
- Service Policies

QoS Policies Per EFP
OAM
- Fault Monitoring
- Performance Monitoring
- E-LMI

Service Instance associates:
- Encapsulation
- VLAN rewrite
- Bridge Domain

EFP (Ethernet Flow Point)
Flexible VLAN tag classification
Flexible VLAN tag rewrite
Flexible Ethertype (.1Q, QinQ)

Bridge Domain

Flexible VLAN tag classification
Flexible VLAN tag rewrite
Flexible Ethertype (.1Q, QinQ)
# EVC Implementation on ME3800X/3600X

## Encapsulation
- Untagged
- Single tagged
- Double tagged
- Default
- Priority tag CoS
- Ethertype

## Rewrite
- Pop 1
- Pop 2
- None
- Push
- Translate

## Bridge Domains
- Up to 8,000 BD*
  * With QoS, 4000 only

## Protocol Tunneling
- Per EFP
- cdp, dtp, lacp, pagp, stp, vtp, udld, lldp
- Peer
- Tunnel
- Forward

---

```plaintext
interface GigabitEthernet0/2
service instance 10 ethernet
capsulation dot1q 11
rewrite ingress tag pop 1 symmetric
bridge-domain 12
```

---

**Doubled tagged with VLAN List**

```
ENCAPSULATION DOT1Q 100 SECOND-DOT1Q 1000,1001,1002
```

**Priority Tagged with CoS list**

```
ENCAPSULATION PRIORITY-TAGGED COS 0-3
```

**Ethertype IPv6**

```
ENCAPSULATION DOT1Q 10 ETYP EP IPv6
```
High-Level QoS Support

- 3 level hierarchy
- QoS Available on all ports
- Deep buffers
  - 44MB on ME3600X
  - 344MB on ME3800X
- Large number of queues
- Cisco standard MQC cli
- QoS for Ethernet, IP and MPLS

![Diagram showing QoS actions at ingress and egress]

- Replication
- Egress Queue/Schedule Congestion Control

QoS Actions at Ingress

Classification → Policing → Marking

QoS Actions at Egress

Classification → Policing → Marking
QoS Scalability

<table>
<thead>
<tr>
<th></th>
<th>ME3600X</th>
<th>ME3800X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffers</td>
<td>44MB</td>
<td>344MB</td>
</tr>
<tr>
<td>Queues*</td>
<td>4,000</td>
<td>32,000</td>
</tr>
<tr>
<td>Classifications*</td>
<td>4,000</td>
<td>24,000</td>
</tr>
<tr>
<td>Policers*</td>
<td>2,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

* Per system. Per ASIC is half these values

ME3600X#sh policy-map interface gigabitEthernet 0/1

Service-policy input: ingress-stats-policer

Class-map: cos-0 (match-all)
- 0 packets
  Match: cos 0
  police cir 1000000000 bc 1000000
  conform-action transmit
  exceed-action transmit
  conform: 4572455 (packets) 1152258660 (bytes)
  exceed: 0 (packets) 0 (bytes)
  conform: 83823667 bps, exceed: 0 bps

Class-map: class-default (match-any)
- 0 packets, 0 bytes
  5 minute offered rate 0 bps, drop rate 0 bps
  Match: any

<table>
<thead>
<tr>
<th>Egress QoS Parameter</th>
<th>Maximum Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit and Drop Statistics: Packets, Bytes and Rates</td>
<td>Per-queue, per-threshold</td>
</tr>
<tr>
<td>Queues per Subscriber or Service</td>
<td>8</td>
</tr>
<tr>
<td>Shapers</td>
<td>No limitation</td>
</tr>
</tbody>
</table>
Cisco IP NGN Design
with ME 3800X / ME 3600X
Converged SP Network Architecture

Services

- Residential: IPTV/VoD, VoIP, HSI
- Ethernet VPN: E-Line
- Ethernet VPN: E-LAN/-Tree
- IP and IP-VPN

Access
Aggregation
Distribution
Edge
Core

L2+L3 MPLS Aggregation Service Model

- 802.1ad (Q-in-Q) Ethernet
- MST/LAG/REP

L2 MPLS Aggregation Service Model

- EoMPLS
- IP or IP-VPN

Core

Services

- Residential: IPTV/VoD, VoIP, HSI
- Ethernet VPN: E-Line
- Ethernet VPN: E-LAN/-Tree
- IP and IP-VPN

Converged SP Network Architecture

- EoMPLS
- 802.1ad
- IP or IP-VPN

Converged SP Network Architecture

- EoMPLS
- H-VPLS
- VPLS

Converged SP Network Architecture

- IP or IP-VPN

Converged SP Network Architecture

- EoMPLS
- H-VPLS
- VPLS

Converged SP Network Architecture

- IP or IP-VPN
Cisco NGN Carrier Ethernet System

- **Carrier Ethernet Aggregation**
  - Aggregation Node
  - MPLS/IP Transport
    - Transport Deployment: VPWS, VPLS
  - Service Aware Deployment: VPWS, VPLS, MPLS VPN/IP

- **IP Edge**
  - HSI Service Edge Node
  - Optional Video Service Edge Node
  - Optional Business Service Edge Node

- **Multiservice Core**
  - Core Node
  - IP / MPLS
  - Content Network

- **MPLS/IPoDWDM Optical Network**

- **OAM Subsystem**
  - ACS
  - AAA, DHCP, DNS,
  - EMS
  - NMS
  - Service Management Performance Management

- **Other Components**
  - Cell Site Gateway
  - STB
  - BSC/RNC

- **Networks**
  - DSL Node
  - PON Node
  - MPLS/IP/Ethernet
  - Core Network
  - TV
  - SIP
  - VoD
  - Corporate
  - Residential
  - Mobile
  - 2G/3G/4G Node
  - Corporate
  - Business
  - Residential

- **Additional Features**
  - MPLS/IP Transport
  - Service Aware Deployment: VPWS, VPLS, MPLS VPN/IP
  - Carrier Ethernet Aggregation
  - Aggregation Node
  - Distribution Node
  - Core Node
  - Optional Business Service Edge Node

- **Branding**
  - Cisco NGN Carrier Ethernet System
  - © 2011 Cisco and/or its affiliates. All rights reserved.
  - Cisco Confidential
Trunk UNI, N:1 Service VLAN
Residential Service Aggregation Model

- Port-significant VLAN ids removed on ingress
- Some VLANs routed, other bridged
- Common Bridge Domain allows to use single MPLS PW per Aggregation Node
- VLAN id added on egress towards BNG
Residential Service Use Case
Trunk UNI, N:1 Data Service

Access Node assigns a single VLAN for Data service (e.g. 10). This VLAN is shared for all subscribers (N:1)

DATA Service Instance

Ingress direction:
- Match traffic from Access Node based on single VID (e.g. 10)
- POP the service VLAN
- Send traffic to DATA bridge domain (BD)

Egress direction:
- PUSH service VLAN (e.g. 10) on traffic received from DATA BD

Single EoMPLS PW carries traffic from all Access Nodes in a given AGG node

DATA Service Instance

Egress direction:
- PUSH VLAN representing AGG node (e.g. 310) on traffic received from PW

Ingress direction:
- Match traffic from BNG based on AGG VID (e.g. 310)
- POP AGG VLAN
- Send traffic to PW
Residential Services QoS Design

Ingress Classification
DSCP, COS, MAC, IP

By default, C-COS or DSCP is NOT propagated to EXP for VPWS.

Egress Classification
EXP

Egress Policing
For VoIP

Congestion Management
VoIP – Priority + Police
Broadcast-TV – High “bandwidth”
VoD – Medium “bandwidth”
HSI – “bandwidth remaining”

VoIP
PQ
CIR-H, EIR
CIR-M, EIR
EIR

VoD
PQ, POL.
CIR-H, EIR
CIR-M, EIR
EIR

VoD
PQ, POL.
CIR-H, EIR
CIR-M, EIR
EIR

IPTV
EIR
EIR

Ingress Classification
DSCP, QOS-GROUP

Egress Classification
DSCP, QOS-GROUP

Marking
EXP

Congestion Management
VoIP - Priority
Broadcast-TV – High “bandwidth”
VoD – Medium “bandwidth”
HSI – “bandwidth remaining”

Residential

Internet

EFP

ME-3600 / ME-3800

Residential

Port

Residential

NLI PORT

EoMPLS PW

Congestion Management
VoIP - Priority
Broadcast-TV – High “bandwidth”
VoD – Medium “bandwidth”
HSI – “bandwidth remaining”

SHAPING

Egress Policing
For VoIP

Marking
QOS-GROUP

Ingress Classification
EXP
## Business Services Architecture

**Efficient Access Network**
- Access Node: ME3600X
- DSL, PON, Ethernet

**Large Scale Aggregation Network**
- Aggregation Node: ASR9k, ME3800X, 7600
- 802.1ad NNI, MPLS / IP Transport

**Intelligent Services Edge**
- Distribution Node: ASR9k, 7600
- Business SEN, ASR9k

**Multiservice Core Network**
- Core Node: Business SEN, ASR9k
- Ethernet UNI
- Ethernet/MPLS NNI

---

**Transport Deployment**
- Port, 1Q, QinQ
- Ethernet

**Service Aware Deployment**
- Port, 1Q, QinQ

**Business E-LAN**
- Port, 1Q, QinQ
- H-VPLS or VPLS

**Business E-LINE**
- Port, 1Q, QinQ
- EoMPLS

**MPLS VPN**
- Port, 1Q, QinQ
- MPLS VPN

---

### Business Services
- **L3 VPN**
- **E-LAN**
- **E-LINE**

### Protocols
- PPP, IP, MPLS
- 802.1ad NNI, MPLS / IP Transport
- DSL, PON, Ethernet
- Port, 1Q, QinQ
## Business L2-VPN Services Design

<table>
<thead>
<tr>
<th>Category</th>
<th>Design Requirement</th>
<th>Design using ME 3800X/ME 3600X</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EVC Service L2CP Handling</strong></td>
<td>Ensure Subscriber L2 control protocols are not terminated and sent transparently in the EVC across the CEN</td>
<td>Enable L2PT at the EFP for L2 protocols that need to be tunneled transparently</td>
</tr>
<tr>
<td></td>
<td>“tunnel” – MAC-translated to Cisco MAC “forward” – MAC preserved (inter-op with non-Cisco devices)</td>
<td></td>
</tr>
<tr>
<td><strong>Service Security on the UNI</strong></td>
<td>Prevent <strong>MAC flooding attack</strong> whereby a subscriber intentionally or unintentionally floods the Bridge-domain with a large number of “Bogus” Source-MACs</td>
<td>Enable EVC MAC Security</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Specify the source-MACs allowed on a EFP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Specify the MAC-limit per-EFP</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Enable Per-bridge-domain MAC Learning control</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Disable MAC Learning</td>
</tr>
<tr>
<td></td>
<td>Prevent a <strong>broadcast storm</strong> (large amount of traffic with broadcast, multicast or unknown destination unicast) in the subscriber network from affecting other subscribers and the system</td>
<td>Enable Storm-control on the port</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blocks the port when broadcast, multicast or unknown unicast traffic exceeds the configured threshold</td>
</tr>
</tbody>
</table>

**MAC Flooding Attack**

- 132,000 Bogus MACs

**Broadcast Storm Attack**

- Broadcast, Multicast, Unknown Destination MACs
Business L2-VPN Services QoS Design

By default, C-COS or DSCP is NOT propagated to EXP for VPWS.

Congestion Management
- VoIP – Priority + Police
- Video-conf. – High “bandwidth”
- Critical Data – Medium “bandwidth”
- Internet and Data – “bandwidth remaining”

Ingress Classification
- COS

Policing & Marking
- EXP

Egress Classification
- EXP

Egress Policing
- For VoIP

Internet and Regular Data
- EFP
- MEGE-3600 / MEGE-3800

Congestion Management
- VoIP - Priority
- Video-Conf. – High “bandwidth”
- Critical Data – Medium “bandwidth”
- Internet and Data – “bandwidth remaining”

Ingress Classification
- EXP

Egress Classification
- COS, QOS-GROUP

Marking QOS-GROUP

Congestion Management
- VoIP

By default, C-COS or DSCP is NOT propagated to EXP for VPWS.

VolP – Priority + Police
- Video-conf. – High “bandwidth”
- Critical Data – Medium “bandwidth”
- Internet and Data – “bandwidth remaining”

Ingress Classification
- EXP
Mobile IP RAN Transport Services
Ethernet bridged RAN Access Network

- REP enabled Ethernet FTTX rings are used for direct Node B or eNode-B or CSGs aggregation
- Aggregation Network implements MPLS VPNs transport for LTE or UMTS and VPLS/H-VPLS transport for UMTS transport focused deployments
- CE Aggregation provides frequency distribution with SyncE
Resiliency for Layer2 VPN Deployment

- EoMPLS from the access
- VPLS in the Core

### Fast Convergence Configuration

**Global Configuration**

```plaintext
ip routing protocol purge interface mpls ldp session protection
router ospf 1
    ispf
timers throttle lsa all 10 20 5000
timers throttle spf 50 50 5000
timers lsa arrival 10
timers pacing flood 5
int Te0/1
carrier-delay msec 0
```

<table>
<thead>
<tr>
<th>Failure</th>
<th>Link Failure</th>
<th>Node Failure</th>
<th>Core Link Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure</td>
<td>24ms</td>
<td>60msec</td>
<td>132msec</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enabled on the U-PE</th>
<th>Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup Pseudowire</td>
<td>Node</td>
</tr>
<tr>
<td>Primary and backup</td>
<td>Link</td>
</tr>
<tr>
<td>tunnels</td>
<td></td>
</tr>
<tr>
<td>PW to TE tunnel</td>
<td>Link</td>
</tr>
<tr>
<td>association</td>
<td></td>
</tr>
</tbody>
</table>

**Diagram**

- **Primary PW**
- **Backup PW**
- **Primary TE Tunnel**
- **Backup TE Tunnel**

- **CPE**
  - Gi0/2

- **PE1**
  - Gi0/2
  - Te0/1
  - Te2/1

- **PE2**
  - Te2/1
  - Te1/2

- **PE3**
  - Te1/1
  - Te3/2

- **UPE1**
  - Gi0/1
  - Te0/1

- **UPE2**
  - Gi0/2
  - Te0/1

- **VPLS**

- **Carrier Delay**
  - msec 0
L2 Rings from CPE to PE with the Resilient Ethernet (REP) Protocol

- Double-ring network design.
- Fast L2 convergence using REP protocol in the access rings
- VPLS on 7600 PEs.

<table>
<thead>
<tr>
<th>Link Failure</th>
<th>Link Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE0/1</td>
<td>TE0/2</td>
</tr>
<tr>
<td>Failure</td>
<td>5ms</td>
</tr>
<tr>
<td></td>
<td>22ms</td>
</tr>
</tbody>
</table>

**REP FAST CONVERGENCE**

**Enabled on the U-PE and CPE**

<table>
<thead>
<tr>
<th>Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link and Node protection</td>
</tr>
</tbody>
</table>
L3VPN Resiliency with TE/FRR Tunnel

- MPLS L3VPN design using MP-BGP
- MP-BGP between UPE1, UPE2 and PE2
- PE1, PE3 and P act as LSR
- Traffic Flow
  - UPE1 Gi0/2 → PE2 Te2/1 (VRF)
- TE/FRR for link protection

Fast Convergence Configuration

Global Configuration

```plaintext
ip routing protocol purge interface mpls ldp session protection
router ospf 1
lspf
timers throttle lsa all 10 20 5000
 timers throttle spf 50 50 5000
 timers lsa arrival 10
 timers pacing flood 5
int te0/1
carrier-delay msec 0
```
Cisco ME3600/3800 Scale Profiles
### ME Converged PE Profile - 15.1(2)EY

<table>
<thead>
<tr>
<th>Feature</th>
<th>Tested Scaled Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSPF</td>
<td>100 sessions (28 instances being BFD aware)</td>
</tr>
<tr>
<td>Total Routes</td>
<td>32k</td>
</tr>
<tr>
<td>DHCP relay</td>
<td>6K</td>
</tr>
<tr>
<td>Xconnects</td>
<td>1k (Includes both EVC &amp; SVI xconnects); peers with 7600, asr9k and 7200.</td>
</tr>
<tr>
<td>VRFs</td>
<td>989</td>
</tr>
<tr>
<td>TE Tunnels</td>
<td>998 (HeadEnd) with TE FRR ; 901 (TailEnd)</td>
</tr>
<tr>
<td>Multicast</td>
<td>999 Groups ; 1997 routes</td>
</tr>
<tr>
<td>REP</td>
<td>1 Ring with multicast traffic &amp; ipv4 unicast traffic</td>
</tr>
<tr>
<td>MST EVC (portchannel &amp; normal intf. In access)</td>
<td>4 Instances with mcast traffic,ipv4 unicast traffic.</td>
</tr>
<tr>
<td>BFD</td>
<td>28 instances (50 * 3 ms)</td>
</tr>
<tr>
<td>QoS</td>
<td>Hqos on EVC in the access &amp; main intf. Towards core.</td>
</tr>
<tr>
<td>Xconnects per VFI</td>
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</tr>
</tbody>
</table>

---

**Diagram Description:**

- **Traffic Flows:**
  - Red arrows signify EoMPLS Pseudowire (SVI xconnect).
  - Orange arrows represent Primary tunnel.
  - Blue arrows indicate Backup tunnel.

**Key Points:**

- **ASR9000** acts as the core router.
- **ME3600X** and **ME3800X** represent access routers.
- **7600** and **7200** are mid-points in the network.
- The diagram illustrates the connectivity between these devices, highlighting the primary and backup tunnels for resilience.

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## Routing Protocol Adjacencies Scale

<table>
<thead>
<tr>
<th>Feature</th>
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<td>BGP Peers</td>
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<td>ISIS Adjacencies</td>
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<tr>
<td>OSPF Adjacencies</td>
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</table>

![Diagram showing network topology and traffic flows](image-url)
Key Takeaways

- **ME3600X** for the Access
- **ME3800X** for the Aggregation

- Diverse Applications
  - Residential, Business, Mobile

- Technical Reference
  - Convergence and Scale Profiles

Cisco IP NGN Architecture enables the next generation network to be more visual, mobile, virtual and simple.
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  Complete the evaluation form you were given when you entered the room
- This is session 5.3

Don’t forget to complete the overall event evaluation form included in your registration kit

YOUR FEEDBACK IS VERY IMPORTANT FOR US!!!  THANKS