Metro Ethernet deployments and challenges

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Agenda

• SP Ethernet and applications
• Metro Ethernet Basics and Service definitions
• Challenges and Approach to Metro Ethernet
What Is SP Metro Ethernet?

- Delivers an Ethernet UNI to businesses/subscribers for WAN/Broadband connectivity
- SP has multiple transport, access and service offering options

100 Mbps Ethernet

Remote Worker/Subscriber

Regional Headquarters

Multi-Tenant Unit (MTU)

10 Mbps Ethernet

Remote Office 1

Remote Office 2

STBSTB

L3VPN

PSTN

Hosting

VolP

INTERNET

Ethernet UNI

Subscriber

Ethernet
Benefits to Residential customers

Content screening – Parental control

Family management; Home-Network Device Management

Streaming:
Audio, Video
Virtual VCR
Video on Demand
Conferencing

Corporate access:
IP VPN, Voice, Video

Security; Video Surveillance

Internet access

Entertainment - Gaming

Ethernet UNI
Benefits to Business customers

- Ethernet everywhere – in the LAN and the WAN
- Cheaper Bandwidth
- New services viz L3VPN, L2VPN, Ethernet Private Line ...and more to come
  - Handle traffic according to business objectives
  - Support mix of different applications with different QoS requirements and traffic profiles – delay/jitter/loss/bandwidth/availability/sequence preservation – bursty & non-bursty traffic types
## Not just connectivity… its all about packaging

<table>
<thead>
<tr>
<th>Large Business and Business Parks</th>
<th>Schools, Hospital Libraries, Public</th>
<th>Universities, Research Institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Centralization of servers</strong></td>
<td><strong>Reduced Local Loop Cost</strong></td>
<td>Intranet: lectures, materials</td>
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<tr>
<td>Storage, video transfer</td>
<td>- Mega Internet</td>
<td>Internet - surf, research, E-mail</td>
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<tr>
<td>Disaster recovery</td>
<td>- Web hosting, e-mail</td>
<td>IP video, telephony</td>
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<td>Mega Internet, Web hosting, e-mail</td>
<td>- HD images - telemedicine</td>
<td>E-learning</td>
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<tr>
<td>Branch-office VPNs</td>
<td>- IP phone on each teacher’s or doctor’s desk</td>
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<tr>
<td>IP telephony, SANs, CDNs</td>
<td>- Surveillance real time</td>
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<table>
<thead>
<tr>
<th>Small Business, Shops and SOHO</th>
<th>Buildings Owners Buildings Managers</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Internet – surf</td>
<td>- Surveillance real time</td>
<td><strong>Triple Play</strong></td>
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<tr>
<td>- E-commerce</td>
<td>- Digital recording</td>
<td>Basic package: Internet, mailboxes, voice +</td>
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<tr>
<td>- Hard-disk storage</td>
<td></td>
<td>Captive portal +</td>
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<tr>
<td>- Videoconference</td>
<td></td>
<td>Video on demand DVD</td>
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<tr>
<td>- Voice flat fee</td>
<td></td>
<td>Video broadcast</td>
</tr>
<tr>
<td>- Surveillance</td>
<td></td>
<td>Gaming</td>
</tr>
</tbody>
</table>

**Residential**

- **Triple Play**
  - Basic package: Internet, mailboxes, voice +
  - Captive portal +
  - Video on demand DVD
  - Video broadcast
  - Gaming
  - nPVR
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Some Basic Metro Ethernet Concepts

- User Network Interface (UNI)—Demarcation point between service provider and service user responsibilities
- Ethernet Virtual Connection (EVC)—Association of two or more UNIs; frames can only be exchanged among the associated UNIs
- VLAN transparency—Ingress and egress customer VLANs are identical
- Layer 2 control protocol tunneling—The SP tunnels customer L2 control protocols in a manner that is consistent with the data packets
- Bundling—Multiple customer VLANs can map through a single Ethernet service on the UNI; all-to-one bundling is a special case whereby all customer VLANs map to a single Ethernet service at the UNI
- Service multiplexing—The service provider can multiplex multiple EVCs per a single customer UNI
Ethernet Wire Service (EWS) – Leased Line equivalent

- Defines a **point-to-point, port-based** service
- **No service multiplexing**—“all-to-one” bundling
- **Transparent** to customer BPDUs
- Allows for **over-subscription** using stat muxing
- **Routers and/or switches** as CPE devices
Ethernet Private Line (EPL) – Leased line equivalent

- Defines a point-to-point, port-based service
- No service multiplexing—“all-to-one” bundling
- Transparent to customer BPDUs
- No oversubscription—delivered via EoS or WDM
- Routers and/or switches as CE devices
Ethernet Relay Service (ERS) – FR equivalent

- Defines a **point-to-point** service (analogous to Frame Relay using VLAN tags as VC IDs)
- **Service multiplexed UNI** (e.g., 802.1Q trunk)
- **Opaque** to customer PDUs (e.g., BPDUs)
- **Recommend a router** as CPE device
Ethernet Multipoint Service (EMS) a.k.a. VPLS

- **Multipoint** service where all devices are direct peers
- **No service multiplexing**—all VLANs are presented to all sites ("all-to-one" bundling)
- **Transparent** to customer BPDUs
- Also called transparent LAN service (TLS), E-LAN, or VPLS
- Routers and/or switches as CPE devices
L2 Access to the Internet and L3 VPN

- **ERS UNI** that maps to MPLS VPN on PE
- **L3 multipoint** service that maps VLANs to VRFs
- **Service multiplexed** UNI (e.g., 802.1Q trunk)
- **Opaque** to customer PDUs (e.g., BPDUs)
- Recommend a **router** as CPE device
Summary of Ethernet-based Services

- **Ethernet Private Line**: Analogous to Private Line; transparent to customer BPDU
- **Ethernet Wire Service**: Similar to ERS only w/ VLAN transparency; transparent to customer BPDU
- **Ethernet Relay Service**: Analogous to Frame Relay; opaque to customer BPDU
- **Hybrid ERS+EMS**: Dedicated Private LAN
- **Dedicated Private LAN**: Transparent LAN Service

**Layer 2**
- **Point-to-Point**
- **Multipoint**

**MEF: E-Line**

**MEF: E-LAN**

**MPLS VPN**
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Residential & Business Service Ready Networks

Challenges faced by SPs today

Policy-Service

Customer Equipment

Access Aggregation Edge

Enterprise

Residential

Customer control protocol handling Service Definition LMI

How to Build the Ethernet Access

Standard IEEE Bridges Customer VLAN transp. DSL/Wireless/Fiber MAC address scalability Redundancy OAM&P,…

How to Build the Interconnect Media

MPLS/L2TPv3 Redundancy; PW – encap & signal. Auto-Discovery; EA & IM connection; OAM&P,…

Customer Equipment

Enable Home-Networking Multiple SP support Residential & Business

UNI Definition

Customer VLAN transp. Service Definition LMI

Enable Home-Networking Multiple SP support Residential & Business
Challenges of the Metro Ethernet Network Design

• Technology choice – Switching/Optical, MPLS/L2TPv3 to the access or in the aggregation, Interworking with FR/ATM/LL

• Deployment – Rings/FTTx based on density

• Where – Upto the end customer or only for DSL aggregation

• Scaling - # of VLANs and MAC addresses

• Security – Preventing IP address theft, MAC address limiting, DHCP Snooping, DDOS,

• OAM – Troubleshooting the service end to end

• QoS – DSCP transparency, CAC for VoD

• Multicast – Latency in joins

• Resiliency/Redundancy – faster convergence in the access with standards based deployments
MEN Life Cycle

Solution choice based on business needs

Service Definition

Service Definition: Layer 2 VPN - EMS/ERMS/EWS/ERS/EPL
Layer 3 VPN
Higher Layer Service Integration (Content etc.)

SLA Models
based on the business aspects

Solution Architecture

Cable layout – FTTX, CTTX
Physical layout – Rings/Spur, Hub and Spoke, Distances, Cable quality
Technology – QinQ, VLAN, MPLS, L2TPv3
Scalability - # of users, type of users, services (V/V/D) BRAS/PPPoE
Devices/Equipment – Roles
Optical – DWDM/CWDM/SONET/SDH/RPR

Technology Deployment

Service Interworking (Ethernet to leased line, Ethernet to FR, Ethernet to any),
Availability (95%/98%/99%/99.9%/99.999%), Multicast, QoS for SLA
delivery, VPLS/VPWS, Redundancy, Security, Cost identification and control

Solution Deployment

Delivery of service architecture: Optical, Switching, Routing
1) Start with the Service definition

- **Services**
  - **Business**
    - **VPN**
      - L2 VPN
      - L3 VPN
  - **SME**
    - **Triple Play**
      - Video (Broadcast VoD, VC, Surveillance)
  - **Residential**
    - **Single Play**
      - (Voice 2nd line, Fax, PSTN)
      - Data (Broadband, Local content, E-learn/game)
2) Continue with SLA definitions

- **Bandwidth profiles**
  Similar to Frame Relay—PIR/CIR/MBS
  Well-known, simple—limited traffic differentiation and per application network capacity planning

- **Service classes**
  Differentiate and traffic-engineer accordingly
3) Look at the architecture approach

Remember the KiSS principle
Case Study

- Metro Core connects the MANs to the Regional core
- Regional Core connects different type of access media to the service
- National Core connects various regional cores
- EADs connect to the NPE
- EVC/Internet access from the NPE