

**Delivering Data and Streaming Video
over a
P2P Switched Fast Ethernet
First Mile Network**

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A Switched P2P Architecture

Agenda

- Provide a better understanding of the services
- Provide a better understanding of the traffic types
- Evaluate the traffic distribution in a P2P network
- Evaluate the bandwidth required per network segment
 - Backbone
 - Distribution to subscriber
- Conclusions regarding P2P distribution links

A Switched P2P Architecture

Services and Requirements

- Services

- High Speed Unicast IP traffic
 - ◆ Internet/Intranet
 - ◆ Video On Demand
 - ◆ Voice(VoIP)
- Streaming Video - Multicast IP traffic

- Bandwidth Assumptions

- Internet/Intranet/VoIP traffic is not problematic
- Streaming Video requires very high bandwidth
 - ◆ 1000+ MPEG-2 channels @ 7 Mbps
 - ◆ VoD MPEG-2 Channels @ 7 Mbps
 - ◆ HDTV channels (@ 20 Mbps)
- Different QoS/CoS requirements for each traffic type

A Switched P2P Architecture

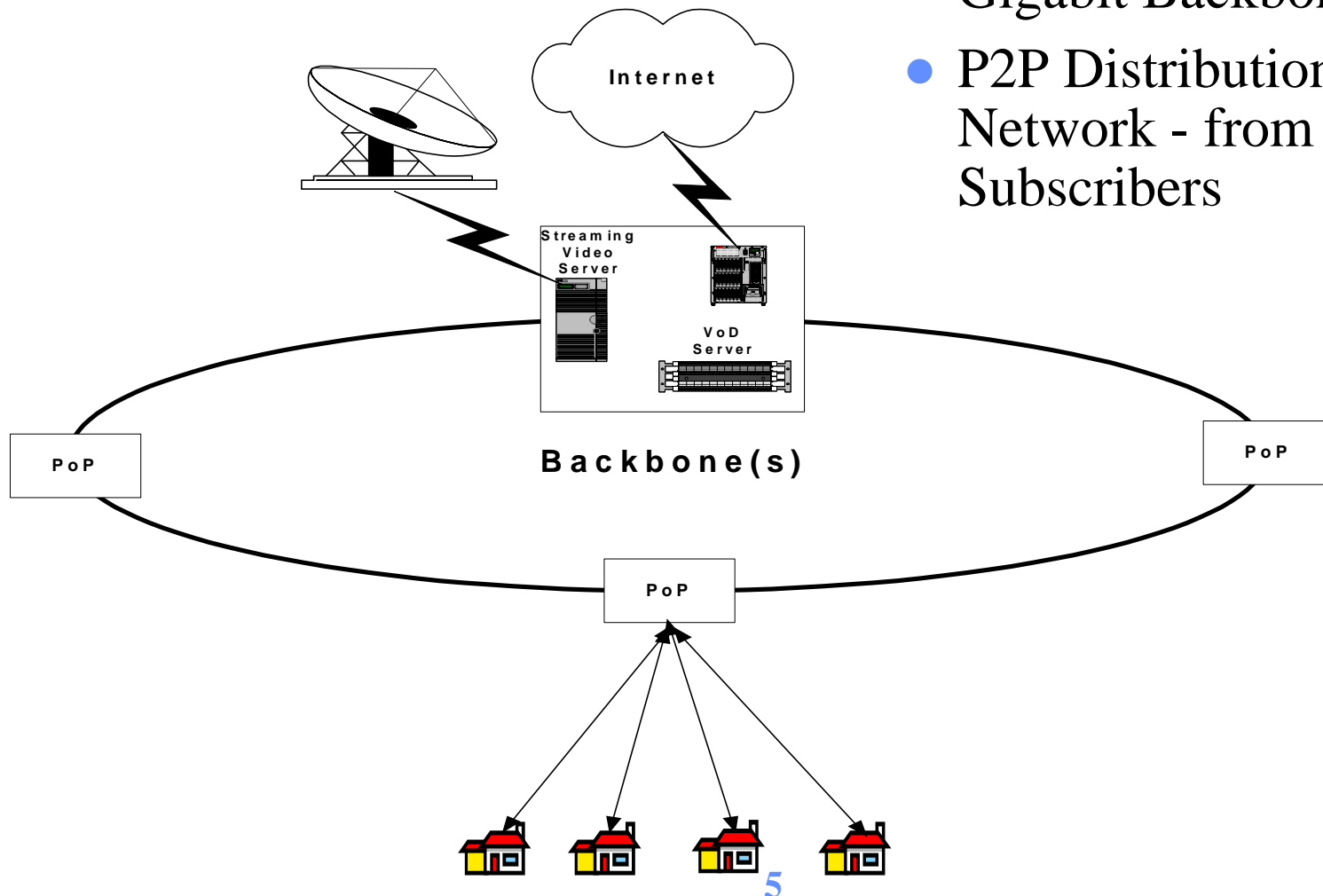
Services Sources and Traffic Requirements

- Services Sources and Location
 - Servers local to the metro network
 - ◆ Internet/Intranet Access
 - ◆ VoD Servers
 - ◆ Streaming Video Servers
 - High bandwidth requirements over the backbone
 - Selected traffic reaches the distribution links

- Traffic Requirements
 - Data - no special CoS/QoS
 - Streaming Video
 - ◆ Packet multiplication & pruning processing
 - ◆ High bandwidth and strict CoS/QoS
 - Voice - low bandwidth, CoS/QoS requirements

A Switched P2P Architecture Network Architecture

- High Speed Multi-Gigabit Backbone(s)
- P2P Distribution Network - from PoP to Subscribers



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Backbone Network Architecture

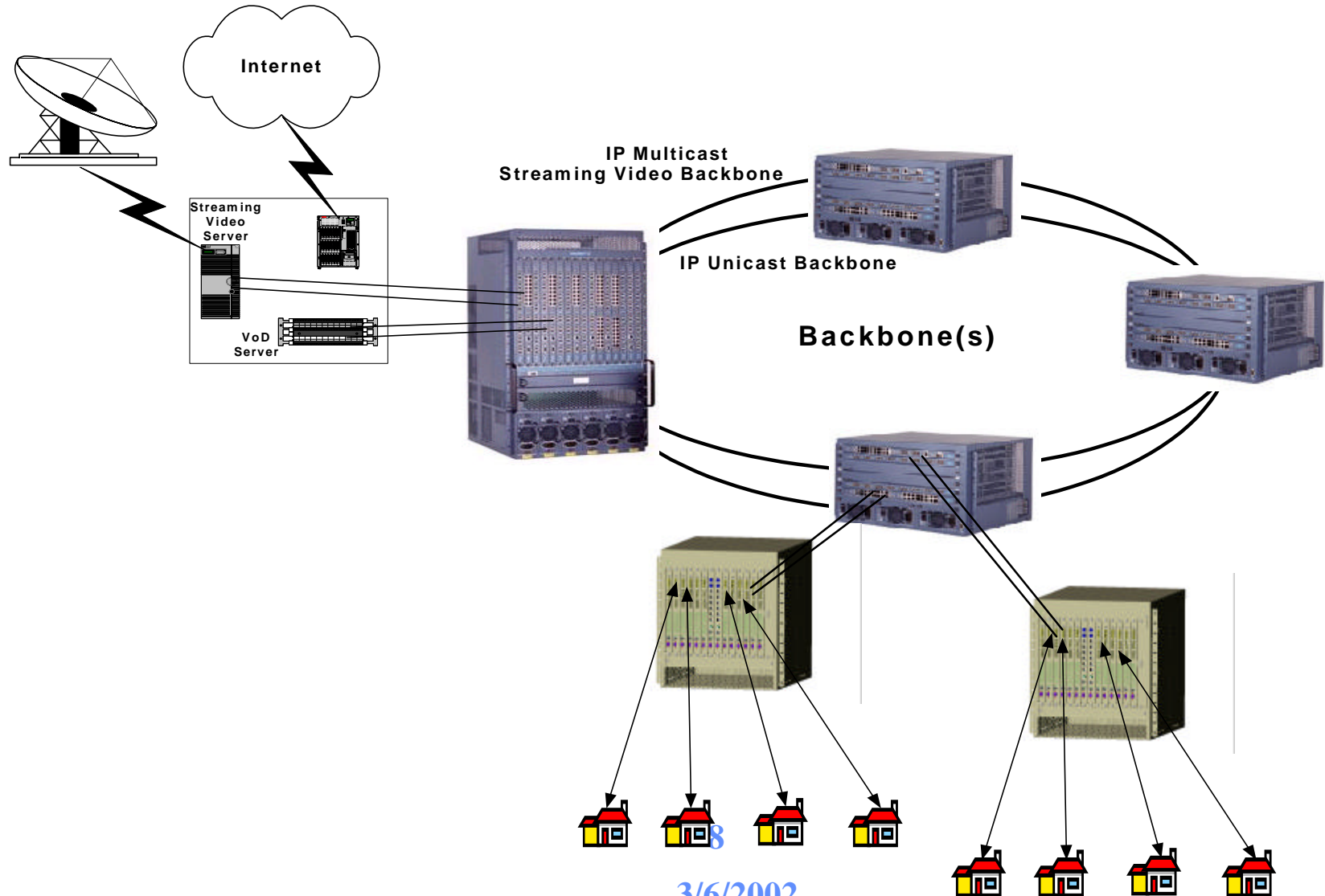
- High Bandwidth - Multi-Gigabit Ethernet
- Services Connected straight into the Metro Backbone
- IP Unicast and Multicast Routing in the Backbone
- Layer 3+ Routing to Layer 2 switching connectivity @ PoP
- Interconnects the Distribution PoPs
- PoP serves tens/hundreds/thousands subscribers
- Desirable
 - Physical or virtual separation of the Unicast and Multicast traffic
 - Two backbones - Unicast Backbone & Multicast Backbone
 - Assures QoS/CoS for each type of service

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Distribution Network Architecture

- Multi-Gigabit Connectivity to the Backbone
- P2P Link to the subscriber
- Layer 2 Switched Traffic
- Subscriber Separation: VLANs
- Layer 2 Multicast Traffic Pruning:
 - IGMP Snooping, from the distribution to the subscriber
- Multiple CoS required (4-8)
 - From the distribution to the subscriber
 - Per service

A Switched P2P Architecture Network Architecture



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Backbone Traffic Requirements

- Streaming Video/IP Multicast Backbone - 10 Gbps
 - 1000 MPEG-2 channels @ 7 Mbps = 7 Gbps
 - 350 HDTV channels @ 20 Mbps = 7Gbps

- IP Unicast Backbone -10 Gbps
 - VoD
 - ◆ 1000 MPEG-2 movies = 7 Gbps
 - ◆ 350 HDTV movies = 7 Gbps
 - Internet/Intranet traffic
 - VoIP traffic

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Distribution Traffic Requirements

- Do we need to have 100 TV channels to each home?
- A subscriber link needs to carry only the selected channels
 - VoD - IP Unicast traffic
 - Selected Video Streams
 - ◆ Multicast Pruning based on a subscription to the specific channel
- 3.5 TVs per household - worst case
 - 4 MPEG-2 channels/VoD movies @ 7 Mbps = 28 Mbps
 - 4 HDTV channels/VoD movies @ 20 Mbps = 80 Mbps

Subscriber Link Bandwidth

- With a 100 Mbps link - there is enough bandwidth left for:
 - Internet/Intranet access
 - VoIP
 - Other services
- Compression improvements reduce the video bandwidth requirements and/or enable more channels for the same bandwidth
- 100 Mbps P2P sufficient today and in the future

A Switched P2P Architecture

Fast Ethernet vs. Gigabit Ethernet P2P

- Cost components:
 - Backbone Network: multi-GbE vs.. multi-10GbE
 - Distribution Switching Fabric Cost
 - Distribution Switching Control: CPU & memories speed, etc.
 - Optics: Fast Ethernet vs.. GbE
- Same PMD should serve Fast and Gigabit Ethernet
 - Same Standard effort
 - Customization for cost reduction - probably not necessary !!

A Switched P2P Architecture

Single Fiber Distribution Architecture

- Cost of single fiber optics - insignificant addition
- Single wavelength FP 1310 nm - commodity
- Leaves open the 1550 nm for Analog CATV downstream
- VCSEL solution will be price & performance competitive
- Lowest cost solution
 - Fiber Cost
 - Connectors & Splicing Cost
 - Equipment Density - front panel real estate
- Major hurdle: optical reflection
- May be contained through optical infrastructure design
- System may incorporate inexpensive reflection detection

Single Fiber Distribution Architecture

PROPOSAL

The same

Single Fiber 1310 nm bi-directional PMD

should be approved to support both

Fast & Gigabit Ethernet

A Switched P2P Architecture

Single Fiber 1310 nm 125 Mbps - 1.25Gbps PMD

| <i>Description</i> | <i>ONU/OLT Module</i> | <i>Unit</i> |
|---|-------------------------|-------------|
| Transmitter Type | Bi-directional, 1 fibre | |
| Signaling Speed | 0.125 – 1.25 | GBd |
| Link Length (range) | 0.5 – 10,000 | m |
| Power Budget | 10 | dB |
| Wavelength (range) | 1270 to 1360 | nm |
| Trise/Tfall (Max, 20%-80% response time) | 0.26 | ns |
| RMS spectral width (max) | 2.4 | nm |
| Average launch power (min) | -9 | dBm |
| Average launch power (max) | -4 | dBm |
| Extinction ration (min) | 9 | DB |
| RIN (max) | -120 | dB/Hz |
| Receiver sensitivity (min) | -19 | dBm |
| Return loss of ODN (min) | 20 | dB |
| Return Loss of module | 18 | dB |