Ethernet Passive Optical Networks
EPON

Should it be an IEEE Standard?

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Bandwidth Bottleneck

Current Last Mile Constrains Bandwidth Delivery to the Customer

Increasing Bandwidth Demands

- **Residential**
  - Internet access – data, video
  - Multimedia downloads
  - Emergence of alternate voice offerings
  - Local Loop growth

- **Business**
  - Virtual LANs
  - Increased dependence on Internet
  - Multimedia applications (video conference)
  - CLECs

FTTx represents an aggregate $8B opportunity in the next 5 years

Bandwidth Bottleneck Requires Gigabit Ethernet Last Mile Solution

Ethernet in the Last Mile

Telephony Data Traffic

Metro Backbone

SONET ATM RPR IP VIDEO

Subscribers

Home Business Multi-Dwelling Units Building
Why Start an Ethernet Last Mile Standard Now

Answer: Because a data-IP-centric ubiquitous standard is needed, and no current standard covers the unique requirements of the last mile.
Last Mile Evolution: To Ethernet

- **TDM**
  - T1 (1.5 Mbps) - legacy

- **Cable Modem**
  - Ethernet (1-10 Mbps) (Video)

- **DSL Modem**
  - Ethernet (1-10 Mbps) (POTS)

- **Optical Modem**
  - IP/Ethernet (1000 Mbps) (POTS, Video)

Built in features:
Firewall, Routing, Switching, etc.
**EPON Optical Local Loop**

- Minimize fiber deployment
  - in the local loop
  - in the Local Exchange Office
- Minimize number of optical transceivers
- Low cost
- High bandwidth (can add WDM overlay)
- Fault tolerant: power loss
- Asymmetric or symmetric traffic
- Lowest initial deployment cost
- Broadcasts downstream (video)
- Eliminate loop electronics
- Voice, Data and Video
- Becomes point-to-point with one ONU
- Low maintenance
**EPON Standard requires**

1. upstream Multiple Access Protocol, current solutions available for 1.25 GBE, can extend to 10 GBE
2. WDM layer specification
3. Other: Encryption, management, signaling control, etc
4. Possible link to ITU G.983 FSAN
Several PON System Companies

Last Mile PON System Companies
1. Alloptic, Inc.
2. Quantum Bridge
3. Terawave
4. Marconi
5. Nortel
6. Optical Solutions
7. Lucent
8. Alcatel
9. Fujitsu
10. Hitachi
11. Eluminent
12. Paceon
13. OnePath
...and more about to announce
### APON vs. EPON Standard

<table>
<thead>
<tr>
<th></th>
<th><strong>Ethernet PON (EPON)</strong></th>
<th><strong>ATM PON (APON)</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Standard</strong></td>
<td>IEEE?</td>
<td>FSAN, ITU G.983</td>
</tr>
<tr>
<td><strong>Authors</strong></td>
<td>-</td>
<td>NTT, BT, etc.</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>-</td>
<td>1995</td>
</tr>
<tr>
<td><strong>Speed</strong></td>
<td>1.25 Gbps</td>
<td>155/622 Mbps</td>
</tr>
<tr>
<td><strong>IP efficiency</strong></td>
<td>good</td>
<td>not-so-good</td>
</tr>
<tr>
<td><strong>Multiple Access</strong></td>
<td>TDMA, Other</td>
<td>TDMA</td>
</tr>
<tr>
<td><strong>Scalable</strong></td>
<td>yes, 10 Gbps</td>
<td>difficult</td>
</tr>
<tr>
<td><strong>ONU Features</strong></td>
<td>routing, switching,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>firewall, etc.</td>
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<tr>
<td><strong>LANs</strong></td>
<td>Ethernet</td>
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<td><strong>Home PNA</strong></td>
<td>Ethernet</td>
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</tr>
<tr>
<td><strong>Components</strong></td>
<td>IP/Ethernet</td>
<td>ATM</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>Ethernet cost</td>
<td>ATM cost</td>
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**Conclusion:** ATM PON uses non-IP-optimized protocol (ATM) at low speeds (OC-3) and high cost, Ethernet PON uses the IP-optimized protocol (Ethernet) at high speeds (GBE) and low cost.
IEEE Ethernet Passive Optical Network (EPON) Standard

..... it’s time to bring broadband home.

- EPON is the next generation of FSAN APON: faster, cheaper, and IP-centric
- IEEE should own the EPON standard, but can expedite process with link to ITU APON.
- Allows for Optical IP/Ethernet for FTTH, FTTC and FTTB networks
- 1.25 Gbps TDMA technologies are available today, 10 Gbps in the future
- RBOCs and CLECs have requested standard, will support
- Large Telecom OEM equipment vendors have expressed interest in an IP PON standard
- Allows for low cost residential optical Ethernet delivery; <$300 Gigabit box is a realistic goal.