Ethernet or EtherNot: Ethernet the PacMan of Network Technologies

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Ethernet continually evolves:
- Adds functionality from high-end protocols
- Drives prices for this functionality way down (driven by Ethernet’s huge scale and open source cost advantages)
- Makes the once high-end protocols obsolete and/or scrambling to establish the next high-end standard

It’s happened since 1970s
- 20+ Project 802 Subcommittees
- 8 Currently Active 802.3 Subcommittees!
- Tens of thousands of staff years of time
- Hundreds of millions of dollars

It will happen again!
Serial digital transmission
- High reliability: earlier approaches were parallel digital
- Takes advantage of Moore’s law

High speed
- 1 mbps-20 mbps
- 3 mbps in 1980 was cost effective->10 mbps in 1985

Local
- Up to three segments each five hundred meters maximum extent
- Slot time tied to electromagnetic propagation time

PHY (Physical Layer)
- Physical Medium: Six Shield Orange Coaxial Cable
- Limited Coaxial Cable Availability: drive for new media!

Layer One
- Electrical: Manchester Encoding to insure collision detection

Layer Two
- Distributed state: Collision Detection and Binary Backoff
- Media Access Control: 48 bytes
High-End Protocols, Circa 1980

- **Token Ring**
  - Star shaped ring: low cost management
  - Predictable performance
  - High reliability/availability
  - Performance scales with semiconductor technology advancement

- **Token Bus**
  - Predictable performance
  - High reliability/availability
  - Performance scales with semiconductor technology advancement
IEEE Computer Society Local Network Standards Committee Project 802—Founded Feb 1980
Open Networking Before Open Software!

- 802.1-Higher Level Interface (HLI)
- 802.2-Logical Link Control (Dormant)—B.W.Stuck Member
- 802.3-Carrier Sense Multiple Access/Collision Detection Bus
- 802.4-Token Passing Bus (Disbanded)—B.W.Stuck Member
- 802.5-Token Passing Ring (Dormant)
- 802.6-Metropolitan Area Network (Disbanded)
- 802.7-Broadband Technical Advisory Group (Disbanded)
- 802.8-Fiber Optics Technical Advisory Group (Disbanded)
- 802.9-Integrated Services LAN (ISLAN) (Disbanded)
- 802.10-Standard for Interoperable LAN Security (SILS) (Disbanded)
- 802.11-Wireless Local Area Network (WLAN)
- 802.12-Demand Priority (Dormant)
- 802.14-Cable-TV Based Broadband Communication Network (Disbanded)
- 802.15-Wireless Personal Area Network (WPAN)
- 802.16-Broadband Wireless Access (BWA)
- 802.17-Resilient Packet Ring (RPR)
- 802.18-Radio Regulatory Technical Advisory Group
- 802.19-Coexistence Technical Advisory Group
- 802.20-Mobile Wireless Access
- 802.21-Media Independent Handover
# Ethernet Enhancements: 1980->2005

<table>
<thead>
<tr>
<th>Attribute</th>
<th>1980 Ethernet</th>
<th>2005 Ethernet</th>
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</thead>
<tbody>
<tr>
<td>Bit Rate</td>
<td>10Mbps</td>
<td>10Gbps</td>
</tr>
<tr>
<td>Physical Media</td>
<td>Coax</td>
<td>Coax, copper wire, optical fiber, microwave</td>
</tr>
<tr>
<td>Topology</td>
<td>Bus</td>
<td>Switch/star</td>
</tr>
<tr>
<td>Quality of Service (QoS)</td>
<td>Binary Backoff</td>
<td>Multiple priorities, QoS per flow, lossless switch</td>
</tr>
<tr>
<td>Distance</td>
<td>1500 meters</td>
<td>Thousands of kilometers</td>
</tr>
</tbody>
</table>
So What Are the Challenges Today?

<table>
<thead>
<tr>
<th>Features</th>
<th>Infiniband</th>
<th>Myrinet</th>
<th>Fiber Channel</th>
</tr>
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<tbody>
<tr>
<td>Latency</td>
<td>5 μsec HCA</td>
<td>3 μsec NIC</td>
<td>7 μsec HBA</td>
</tr>
<tr>
<td>Throughput</td>
<td>1-25 Gbps</td>
<td>1-20 Gbps</td>
<td>1-8 Gbps</td>
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<tr>
<td>QoS</td>
<td>Four priority</td>
<td>Proprietary</td>
<td>Credit based flow control</td>
</tr>
<tr>
<td></td>
<td>levels with 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>channels</td>
<td></td>
<td></td>
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<tr>
<td>Interoperability</td>
<td>Common Drivers</td>
<td>Proprietary</td>
<td>Vendor Specific</td>
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<tr>
<td>Topology</td>
<td>Star/switch</td>
<td>Bus</td>
<td>Star/switch</td>
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8 Currently Active 802.3 Subcommittees

- IEEE 802.3, Residential Ethernet Study Group.
- IEEE 802.3, Power over Ethernet plus Study Group.
- IEEE P802.3REVam, Maintenance #8 (Revision).
- IEEE P802.3an, 10GBASE-T Task Force.
- IEEE P802.3ap, Backplane Ethernet Task Force.
- IEEE P802.3aq, 10GBASE-LRM Task Force.
- IEEE P802.3ar, Congestion Management Task Force.
- IEEE P802.3as, Frame Expansion Task Force.
So What Are the Challenges Today?

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<td>1-40 Gbps</td>
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<td>QoS</td>
<td>Four priority levels with 16 channels</td>
<td>Proprietar y</td>
<td>Credit based flow control</td>
<td>Thousands of flow based priority levels; lossless switch</td>
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<tr>
<td>Interoperability</td>
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<td>Vendor Specific</td>
<td>YES</td>
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<td>Topology</td>
<td>Switch/star</td>
<td>Bus</td>
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Ethernet Historical Price Trends: Lowest Total Cost of Ownership

![Price/Port-Mbps Graph]

- $100.00
- $10.00
- $1.00
- $0.10

Years: 1985, 1992, 1999, 2005
Conclusion

- The question is when, not if
- ‘When’ is sooner than many people think
- There will always be room for higher-end extensions
- Ethernet will adopt the best of these new extensions: the lifetime of extensions are limited by the inevitable onslaught of Ethernet.