A Historical Perspective of Ethernet

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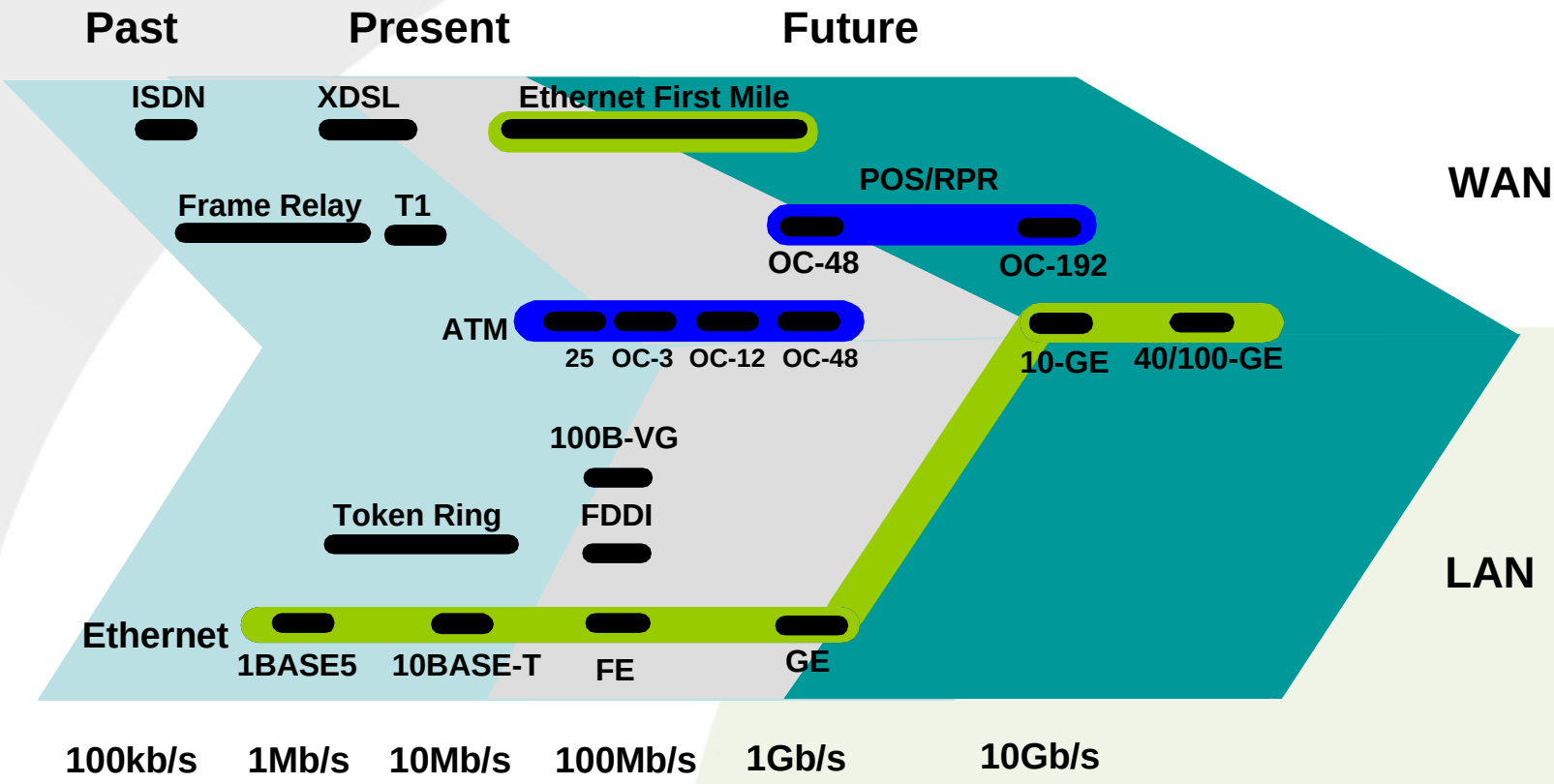
Network Technologies Overview



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Pre-Historic Times

- Experimental Ethernet (1976)
  - "Ethernet: Distributed Packet Switching for Local Computer Networks"; Metcalfe & Boggs, Xerox PARC
  - Ethernet protocol definition
    - ALOHA packet-based network access protocol over a wired shared medium
    - 3 Mb/s operation
- Original Ethernet (1982)
  - "The Ethernet Blue Book"; Digital, Intel, Xerox (DIX)
    - 10Mb/s operation based on the Xerox PARC concepts

Ancient History

- First IEEE Standard (1985)
  - 10 Mb/s operation over a shared medium
    - Based on the “Ethernet Blue Book”
    - Shared bus topology
- 10BASE-T (1990)
  - 10 Mb/s half-duplex operation over Unshielded Twisted Pair (UTP) cables
    - Star topology
  - Removed the cabling infrastructure constraint from network deployment

The Middle Ages

- Fast Ethernet (1995)
  - Scaled the operating speed of Ethernet by an order of magnitude (take one!)
  - 100 Mb/s half-duplex operation over:
    - UTP --- 100BASE-T
    - Multimode fiber (MMF) --- 100BASE-F
- Full Duplex Ethernet (1997)
  - Speed-independent Ethernet protocol enhancement
  - Relies on the full duplex nature of the physical link
    - Star topology
  - Provides dedicated bandwidth to end nodes
  - Potentially doubles the link throughput

Recent History

- Gigabit Ethernet (1998/1999)
  - Scaled the operating speed of Ethernet by another order of magnitude (take two!!)
  - Supports both half-duplex and full-duplex operation
    - Only full-duplex has been deployed
  - 1000 Mb/s operation over:
    - UTP --- 1000BASE-T
    - MMF --- 1000BASE-SX
    - Single-mode fiber (SMF) --- 1000BASE-LX
    - Coax --- 1000BASE-CX

Recent History (continued)

- Link Aggregation (2000)
  - A.K.A. Trunking
  - Speed-independent Ethernet protocol enhancement
  - Allows to configure multiple physical links into one logical link
    - Unlimited scaling of network pipes
    - Benefits realized only in environments where lots of networking flows are aggregated

Recent History (continued)

- Power Over Ethernet (2003)
  - Provides a limited amount of DC power (~15W) to network attached devices
    - Interoperable with the installed base
  - Useful for environments where power is at premium or is hard to get to
    - Wireless hubs
    - Mobile devices (PDAs/laptops)
    - Sensors
    - Industrial applications

Recent History (continued)

- Ethernet in the First Mile (2004)
  - Cheapest/fastest solution to the “last mile problem” in the access space
  - Phone lines:
    - 2 Mbps – 10 Mbps dedicated (full duplex)
    - VDSL-based
  - Fiber:
    - 1 Gbps shared among 16-32 customers
    - Based on a new fiber deployment topology for Passive Optical Networks (PONs)

Currently

- 10 Gigabit Ethernet (2002/2006)
  - Scaled the operating speed of Ethernet by yet another order of magnitude (take three!!)
  - Supports full-duplex operation only
  - Expands the application space of Ethernet to Wide Area Networks (WANs)
    - A simplified SONET/SDH framer (WIS) provides data rate and transmission format compatibility with existing SONET transmission networks

Currently (continued)

- 10 Gigabit Ethernet (2002/2006) - continued
  - Data Rates
    - 10,000 Mb/s for LAN applications
    - 9,584.64 Mb/s (OC-192) for WAN applications
  - Media
    - SMF --- 10GBASE-LR, -ER
    - MMF --- 10GBASE-SR, -LX4, -LRM
    - UTP --- 10GBASE-T
    - Coax --- 10GBASE-CX4
    - FR4 backplanes --- 10GBASE-KX4, -KR

Future

- Higher Speed Ethernet
  - Market needs – 2010 - ???
  - Development Efforts – 2006 ???
  - Will scale the operating speed of Ethernet by yet another order of magnitude (take four!!)
  - Will support full-duplex operation only
  - Data Rates - ???
  - Media
    - Single-mode fiber
    - Multimode fiber --- ???
    - Copper --- ???
    - Backplane --- ???
  - Never say never...

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