100BASE-X over SMF
5 Criteria

Ulf Jönsson	**Ericsson**	**Matthew Squire**	**Hatteras Networks**
Hans Mickelsson	**Ericsson**	**Steve Jackson**	**Hatteras Networks**
Craig Easley	**Extreme Networks**	**Gerry Pesavento**	**Alloptic**
David Cunningham	**Agilent Technologies**	**Sergiu Rotenstein**	**Nbase Xyplex**
Brock Myers	**Harmonic Inc.**	**Wenbin Jiang**	**E2O Comm.**
Curtis Knittle	**Harmonic Inc.**	**François Ménard**	**IMS Experts-Conseils**
K. Seto	**Hitachi Cable**	**Gabriel Papandrea**	**OKI Network Tech.**
Thomas Murphy	**Infineon**	**Philip Yim**	**Turin Networks**
Dora van Veen	**Lucent**	**Trung Nguyen**	**National Semiconductor**
Erland Sundberg	**Telia**	**David Horne**	**Intel**
Meir Bartur	**Zonu**	**George Eaton**	**Intel**
Lisa Peng	**Corning**	**Tad Szostak**	**3M**

IEEE 802.3ah Interim Meeting

Raleigh, NC.

14-16 January, 2002

Proposal for New Objective

- EFM lacks one solution - The optical subscriber line optimized for low-cost P2P fiber access

- Add new objective:

100BASE-X >= 10 km over SM fiber

Broad Market Potential

- Operators' business case
  - Consumer market extremely sensitive to cost
  - Low first installation cost
  - Support for several physical layers
  - Support for a wide variety of services
  - Flexible L2 topology
  - Only one type of fiber for the entire network (i.e. SMF)

- P2P 100Mbps FTTH is happening now!
  - Where: In Europe, Japan, US and elsewhere
  - Large incumbents
    - e.g. NTT, KPN, Telia
  - Entrant operators
    - e.g. KingCom, Bredbandsbolaget, WINfirst

Broad Market Potential

- Current market projections for public P2P fiber access
  - 20K lines already installed in Sweden
  - Expect up to 400,000 lines installed by Q4 2002
  - >1M lines world-wide in 2-3 years (maybe even before IEEE 802.3ah is approved standard)
  - 100Mbps P2P fiber prominent access technology in Japan by 2005
    - Source: "*Ministry of Public Management, Home Affairs, Post and Telecommunications of Japan". Broadband News 10/16/2001*

Broad Market Potential

- 100Mbps sufficient for short and medium term services

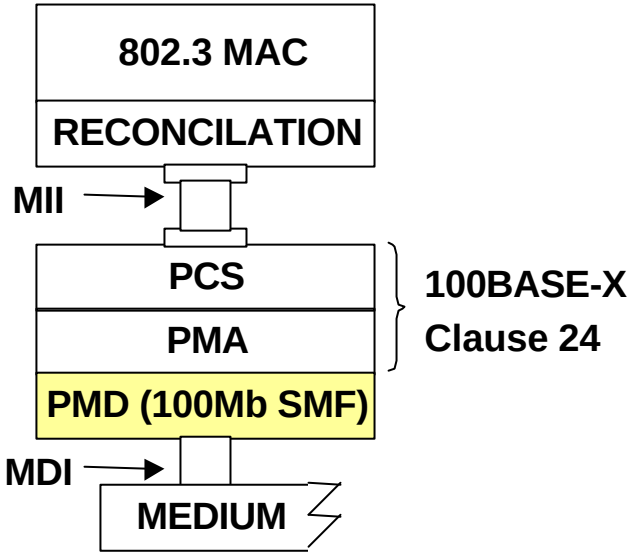
	Example worst case scenario	**Generated traffic, DL (Mbps)**
TV & VoD	2 * HDTV (20Mbps/ch) + 2 TV (5Mbps/ch)	50
Video Conferencing	~2Mbps	2
Web browsing	<10Mbps	10
Streaming sound	CD quality (200kbps)	0,2
Telephony	~100kbps	0,1
Approximate total		**62,3**

Traffic generated to one subscriber

Compatibility

Backward Compatibility

- 100BASE-X PCS & PMA assumed, and the 802.3 MAC
  - No change to Clause 24
  - Retain all state machines, 4B/5B coding etc. of 100BASE-X
- Only need to add a new PMD to the 100BASE-X family



- Auto-negotiation restrictions
  - Full Duplex only, cannot be negotiated to HD (CSMA/CD)
  - 100Mbps only, rates cannot be negotiated (neither 10/100 nor 100/1000)

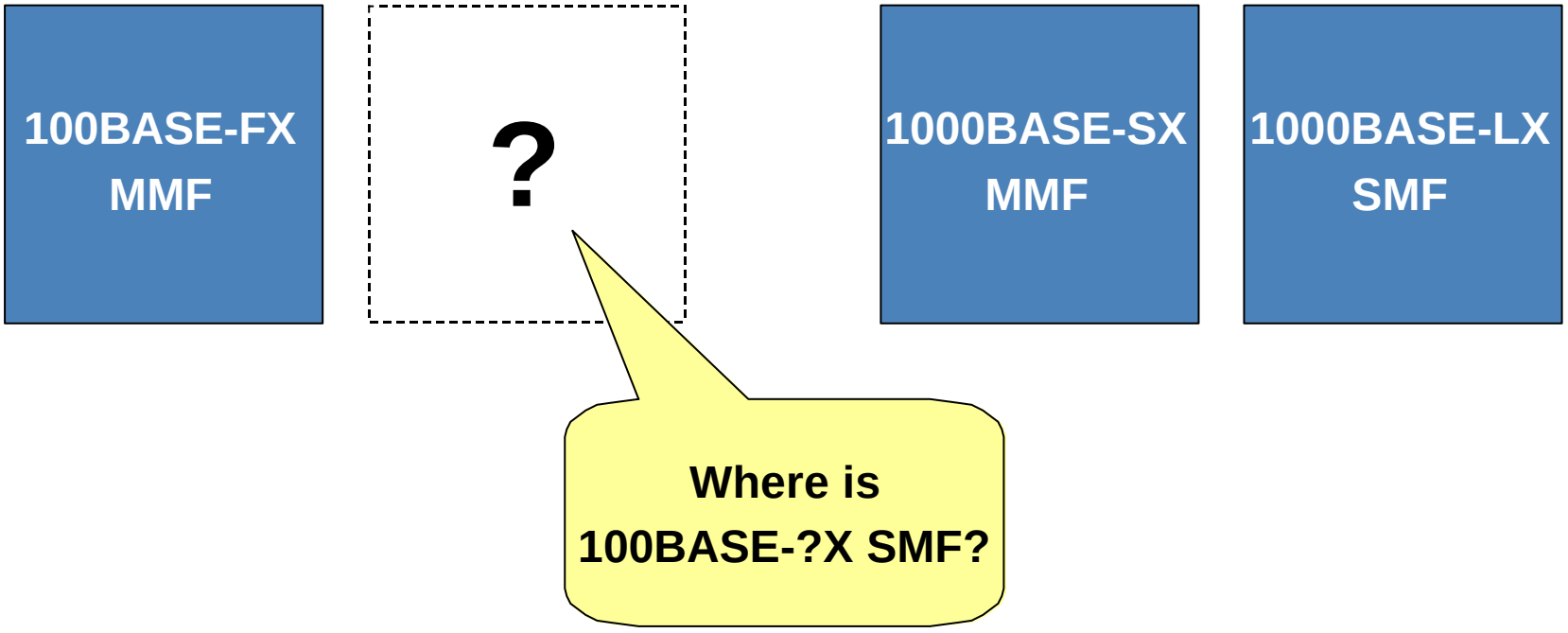
Compatibility

Forward Compatibility

- EFM OAM mechanism supported
  - Included in the PMD, if required (i.e. if the EFM 1000BASE-X PMD does this)
- Physical medium compatibility through SMF
  - Compatible with existing 1000BASE-LX
  - Provides upgrade paths to higher speeds and multiple wavelengths, with fiber plant untouched

Distinct Identity

- No 802 standard for 100BASE-X over SMF exists



Technical Feasibility

- Well proven technology
  - Many years experience with 100Mbps or higher rates on SMF
  - 100Mbps optical SMF components exist
  - Vendors can supply 100Mbps SMF Ethernet when needed
  - Links and systems in commercial operation

- Minimize EFM efforts - reuse of an existing PMD, e.g.:
  - FDDI 100Mbps SMF
  - SONET OC-3/STM-1

Technical Feasibility

- Lower complexity means easier manufacture & deployment
  - Link budgets easy to fulfil – generous margins for patching, splicing & aging
  - Low optical output power & sensitivity requirements – simplified transceiver design
  - Simplified design implies improved yield in manufacture & simpler assembly
- Low power consumption gives several indirect benefits
  - Lower operating power consumption, smaller battery plant @ ONU
  - Access networks more friendly to Global environment ;-)
  - Lower heat dissipation – relaxed cooling requirements (fans, AC)
  - Facilitates compact design of aggregation devices (ONUs)

Economical Feasibility

- Volumes of a simple low cost 100BASE-X SMF PMD will be driven by
  - P2P FTTH
  - Fiber to the desk
  - Fiber to the antenna (Used in the 3G access networks)
- Today, 100BASE-X NIC is outselling 1000BASE-X NIC more than 100 times
  - Source: Dell'Oro Market Report

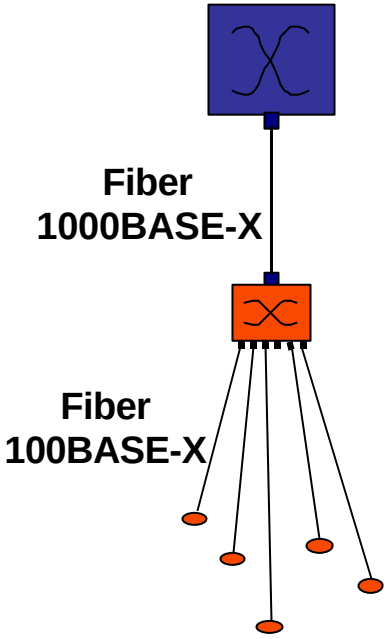
Economical Feasibility

- Consider both transceiver cost and cost of switching components

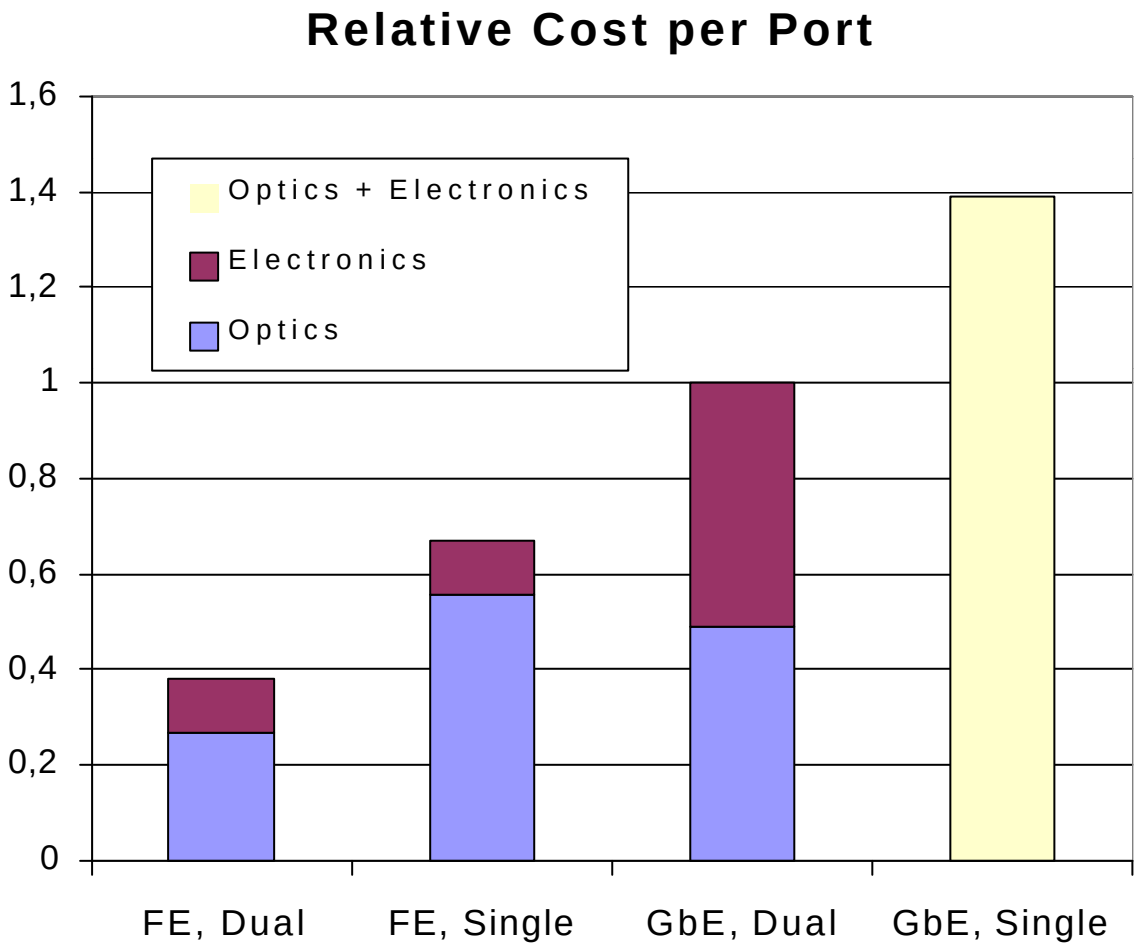
- Lower speed and relaxed link budget facilitates low cost TRx
  - Lower assembly costs
  - Low cost silicon processes for the module ASICs
  - Low-cost components, e.g. connectors, mechanical splices, etc.
  - Lower power consumption, thereby lower operating costs

Economical Feasibility

- Low-cost switching components
  - Lower power consumption of switching components
    - GbE consumes roughly twice as much power as FE
  - Lower cost switch core
  - Less memory required
- Enables a low-cost P2P public Ethernet access architecture
  - Low cost switches in the field (aggregation switches in the network)
  - Low cost switches at customer premises (demarcation switch)



Economical Feasibility



Sources:

- Component Vendors
- Passive Network Vendors
- System Integrators
- Dell'Oro Market Report

Economical Feasibility

- 1000BASE-X P2P fiber not economically feasible for a majority of the subscriber lines
  - 100Mbps sufficient for short and medium term services
  - No point in having subscribers pay for a more expensive 1Gbps connection
- P2P fiber must be treated separately from PON P2MP
  - P2P cannot afford the premium TRx costs that PON requires

Conclusion

New 100BASE-X SMF PMD Needed!

- There is a broad market for 100Mbps P2P
- 100Mbps P2P accommodates current services with headroom for future growth
- 100BASE-X SMF can be specified based on existing stds
- No changes reqd. to Clause 24 (100BASE-X PCS & PMA)
- 100BASE-X SMF makes the P2P architecture economically feasible
- 100BASE-X over SMF meets the 5 criteria