



# 802.3 Higher Speed Study Group Objectives and Work Areas

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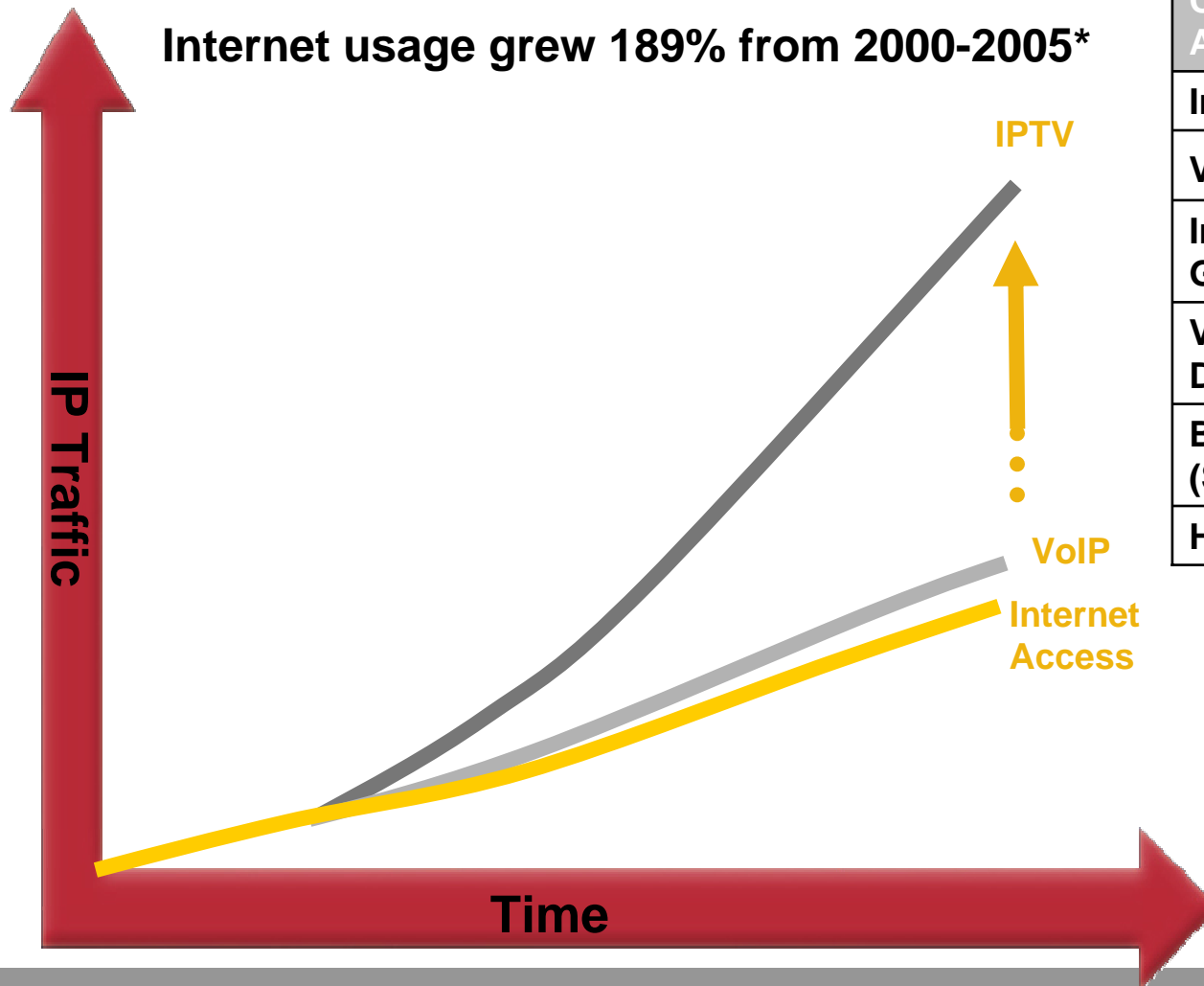
**Knoxville, September 20-21, 2006**

# Topics

- **Market Drivers for 100GE**
- **Why 100GE?**
- **Some proposed objectives for HSSG**

# Global Traffic Growth

## Video and IP Rich Media Drive Growth



Consumer Applications	Bandwidth Required
Internet	.500 - 1.5 Mbps
VoIP	8Kbps-64 Kbps
Interactive Gaming	128k - 6.0 Mbps
Video on Demand	3.0 - 6.0 Mbps
Broadcast TV (SD-TV)	3.0 – 5.0 Mbps
HDTV MPEG-4	6.0 – 7.0 Mbps

\*Source: <http://www.internetworldstats.com/stats.htm>

# Dawn of “Video Age”

## Household Bandwidth Needs in 2010 (U.S.)

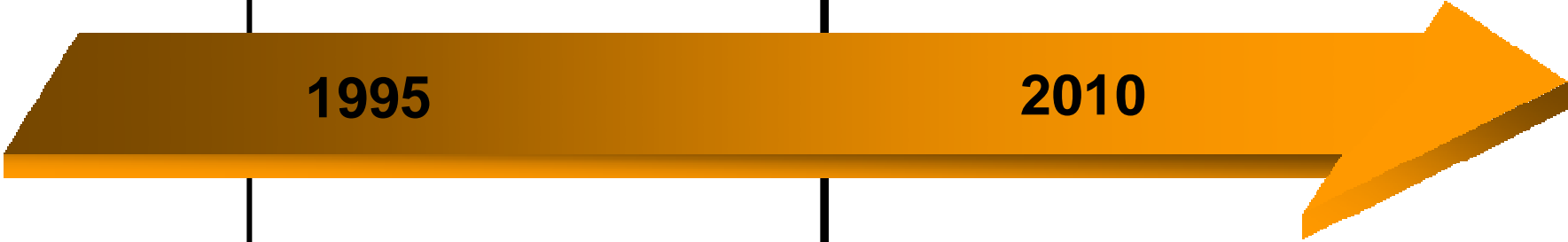
1x HDTV + 1x SDTV +  
2x PVRs + 1x VoIP Phone + 1x HSD =  
*Overwhelming Capacity Requirements*

**Twenty such homes would generate more traffic than traveled the entire Internet backbone in 1995.**

# Network Impact

## Video will Redefine the Next-Generation Network

<b>Services</b>	<b>Internet and Business</b>	<b>IPTV (HDTV / SDTV), HSD, VoIP, Business VPN</b>
<b>Customers</b>	<b>Less than 10M</b>	<b>Over 300M</b>
<b>Devices</b>	<b>Few: PC, TV, Mobile</b>	<b>Many: PC, IPTV, Dual Mode Handset, iPod, Xbox...</b>
<b>Access</b>	<b>Leased Lines and Dial-Up</b>	<b>Carrier Ethernet, Broadband, Wireless</b>
<b>Speeds</b>	<b>56K- OC3 / 12</b>	<b>1M- 10GE</b>



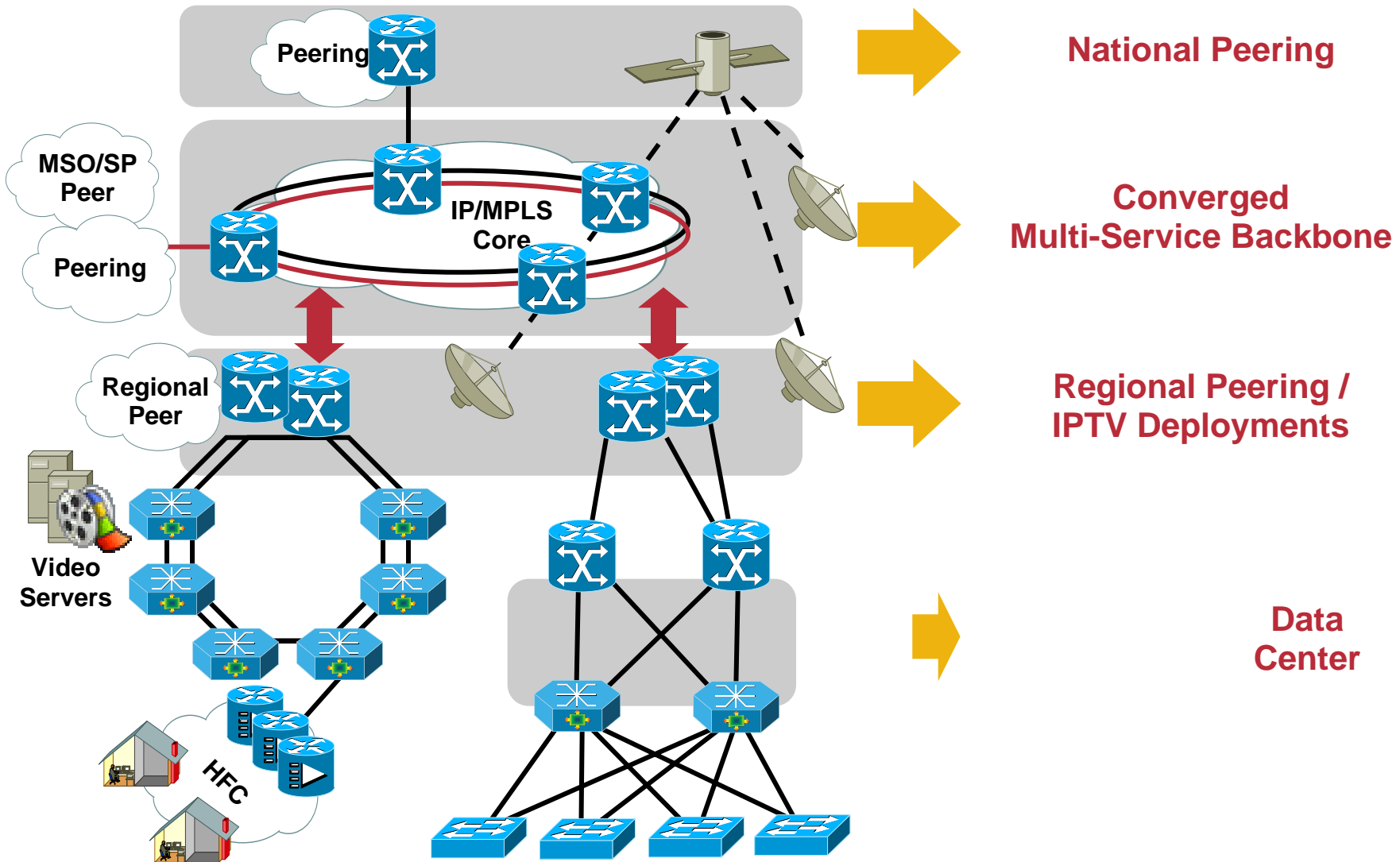
**1995** **2010**

# Impact of Video and IP Rich Media on SP networks

- **Worldwide SPs are enhancing their service offering (VoIP, HSD, Video, VPNs, etc...)**
  - Significant increase in network bandwidth**
  - Continual increase in per flow bandwidth**
  - Duration of flows continues to increase**
- **High bandwidth flows reduce the number of active flows that can be supported per 10Gig link**

Flow Type	w Bandwidth (Mbps)	#Flows/ 10G Link
Raw HD-TV	1 Gbps	10.00
HD-TV (MPEG-2)	13 Mbps	769.23
HD-TV (MPEG-4)	6 Mbps	1666.67
SD-TV	3 Mbps	3333.33
Video Conference	384 kbps	26041.67
VoIP	32 kbps	312500.00

# Where does 100GE fit? SP View



# Why 10x10GE is not 100GE

- **Interpop Interconnect**
  - Meshing routers at Nx10GE could cause scale issues
  - More fiber or wavelengths needed between POPs
- **Intrapop Interconnect**
  - As routers scale, intrapop links between them can get large
  - If a 320G pair of routers uses 30G between them, a 2.4T multichassis could need upwards of 200G interconnect.



# How do you accommodate increases bandwidth demands in core networks?

- **Next-generation core routers provide >10G (40G) bandwidth per slot**
  - Largest IP interface available on the market is 40Gbps (OC768c)
- **2 options for addressing core bandwidth needs**
  - Native 40G interfaces
  - Multiple parallel 10G links
- **Both options are NOT equivalent when considering available bandwidth**
  - Available bandwidth = maximum bandwidth that can be utilized without any packet drops
  - 40Gbps interface provide full access to bandwidth
  - nx10Gbps available bandwidth non-deterministic

# Use of parallel nx10Gbps links

- **Effectiveness of load distribution depends on**
  - Hash algorithm**
  - Diversity of hash input (variability in SRC/DEST IP address)**
  - Number of flows/size of flows**
- **Flow-based hash mechanism CANNOT guarantee equal distribution of load**
- **Un-equal load distribution can result in under-utilization of available capacity**
  - May potentially cause artificial congestion and packet loss**
- **10x10Gbps is not the same as 1x100Gbps from a real throughput perspective**
- **How many parallel 10Gbps links do you need to match usable bandwidth on one 100Gbps link?**
  - Depends on traffic characteristics...**

# Ethernet's Success

## Why has Ethernet been so successful ?

### Ubiquity

- it's a standard and the dominant solution

### Simplicity

- The hard work is in done in the standard. Making user experience simple
- minimum number of flavors and options

### Interoperability

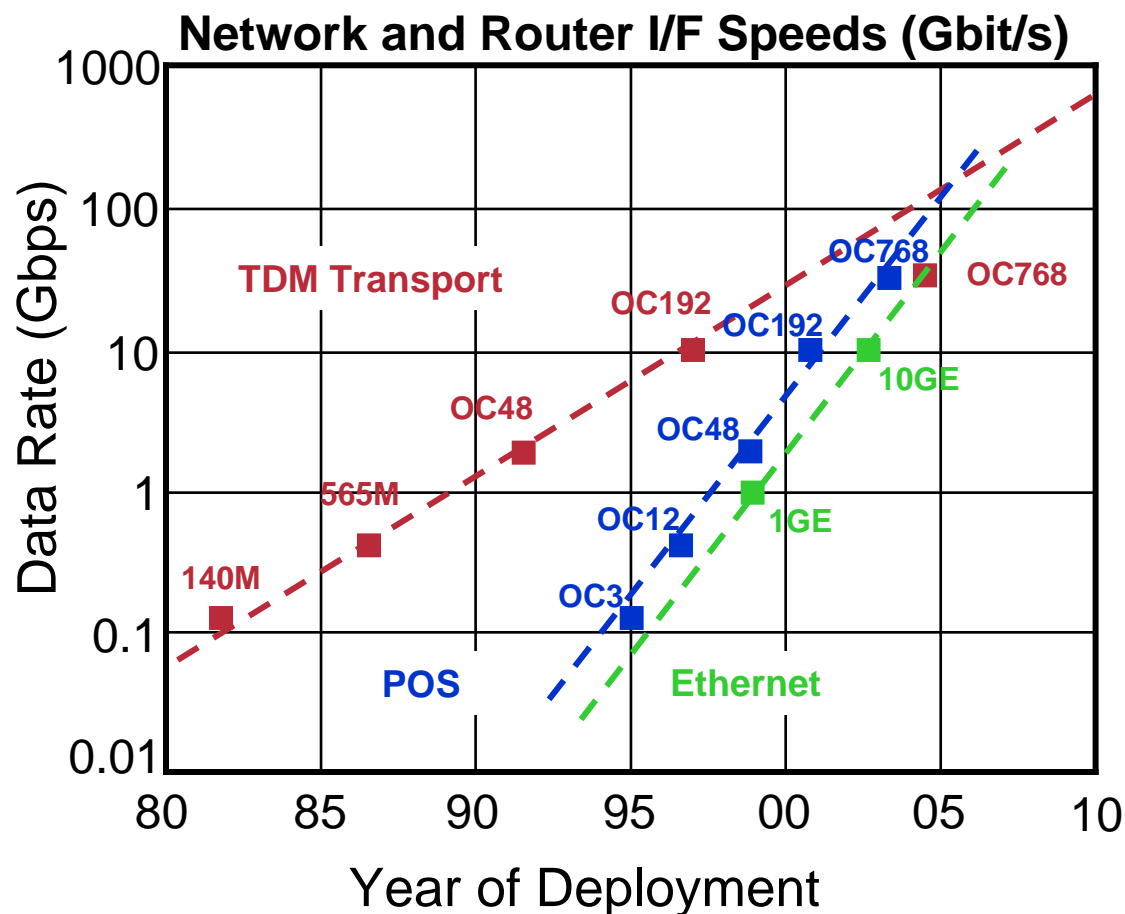
- plug-and-play. It just works.

**Need to always keep these factors in mind during the development of the 100G standard.**

# Why 100GE now?

- **100GE will not be an easy effort to undertake**
- **There is a need for a solution in the timescales that we can complete a standard if we start now**
  - lower rate solutions will not address the market need
  - proprietary solutions will fragment the market. More difficult business model.
  - 40G already exists (OC768). If we do 40GE do we have to do a LAN PHY and WAN PHY again?

# Observations about interface rates



- Data interfaces were able to leverage telco technology investment
- SONET enabled interface progression to advance with technology
- Beyond 10G, data interfaces are pushing the optical technology. This isn't new for 802.3 - just new for optical PMDs. (1000Base-T, 10GBase-T)

# Objectives for HSSG: MAC

- **Only one MAC rate**
- **100GE**
- **Lower rate alone does not meet market need**
- **Two MAC rates – can the industry support a dual development cycle?**
- **Scalable MAC**
  - **simplicity, interoperability?**
  - **Technically this is feasible.**
  - **From a network sense how do you prevent major confusion.**
  - **Fragmentation and inconsistent application of industry R&D efforts?**

# Objectives for HSSG: MAC (2)

## From Haddock 03/99 presentation:

- **802.3 Full Duplex operation is very nearly speed and distance independent as currently specified.**
  - *InterFrame Gap (IFG) and Preamble Size should be specified in bit times. Probably should be managed variables with specified minimum and default values.*
  - *MAC Control Pause Operation response time should be specified in bit times.*
- **We should never have to touch the MAC clauses again.**
- **So are we done ?**
- **Need to specify interfaces -> 100G equivalent of XGMII (CGMII)**

# Objectives for HSSG: PMD

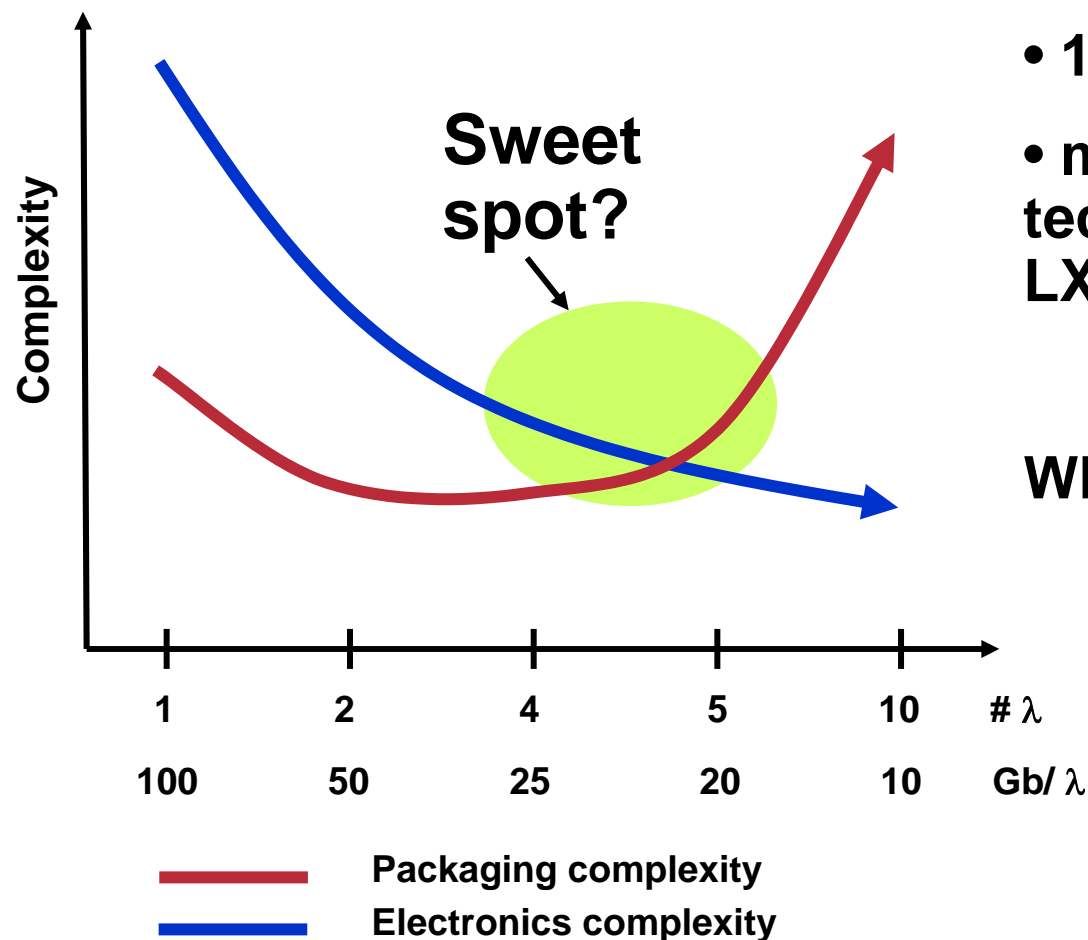
- **There is technology available today to implement 100GE**
- **In 2010, there will be better, more cost effective technology**
- **We do not want to create a wide range of PMDs too early that take significant effort to develop and then become obsolete.**



# Objectives for HSSG: PMD (2)

- **Propose a limited PMD space for 1<sup>st</sup> phase of 100GE**
  - one SMF based PMD to address DC, Campus core
  - Ideal would be that it could support MMF too
- **One PMD covers the bulk of the near-term identified application spaces but not all:**
  - WAN (>100's km )
    - Typically a proprietary solution. Standard will enable common attach points.
  - cost optimised short interconnect

# Optical Technology trade-offs

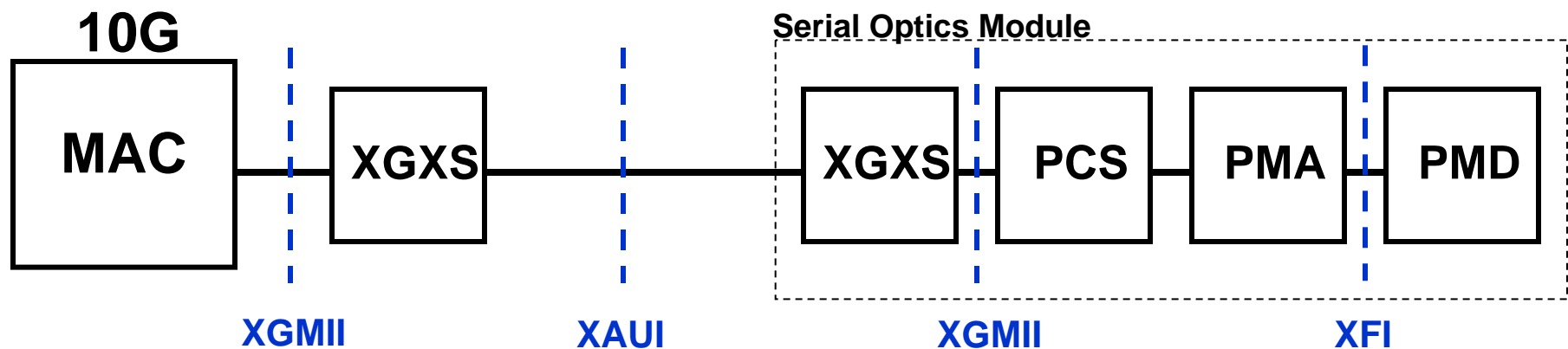


- 10G technology maturing
- 100G serial technology is...
- multi-λ packaging technology experience from LX4 technology

Where is the sweet spot?

# Objectives for HSSG: Interfaces

- Given the uncertainty about how the PMD will evolve over the lifetime of 100GE, we should try to define a PCS and interface solution that is not optimised for a particular, near term, PMD.
- For example. XAUI & LX4



**XAUI forced complex XGMII and PCS into optics module**

➤ **let's try for a more generic solution**

# Key Points

- **There is a market need for 100GE driven by the projected video and IP rich media BW demands.**
- **Must standardize 100GE**
  - lower rate solutions will not address the market need. Industry needs to prevent fragmentation of solutions.
- **Providing a standard, cost effective, ‘simple’ solution is the best way to make 100GE successful**
- **Technology is feasible. Phased approach to allow more maturity.**
- **We need to start now.**