



EuroView2008 Higher Speed Ethernet – Requirements and Standardization.

BMBF Project: 100GET – OCTET

July 21st, 2008, UNI Würzburg
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Higher Speed Ethernet – Requirements and Standardization

Overview.

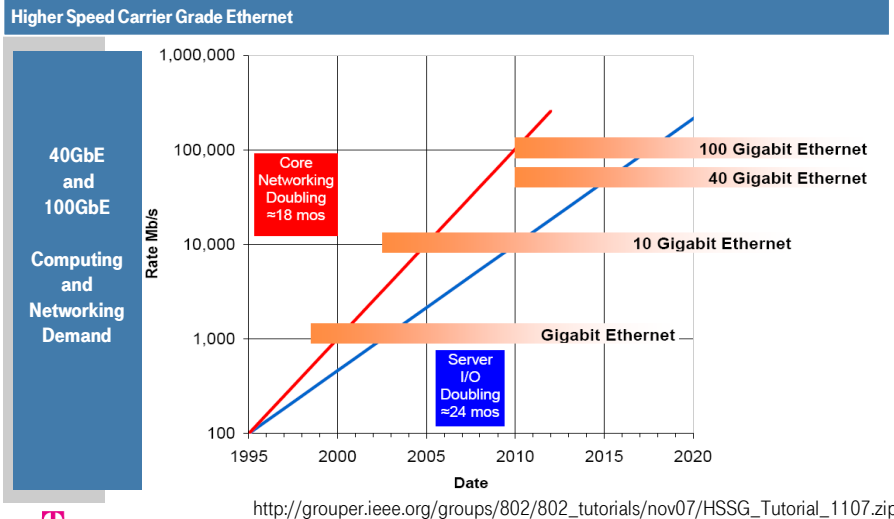
- Introduction
- Requirements
- Standardization
- Conclusion





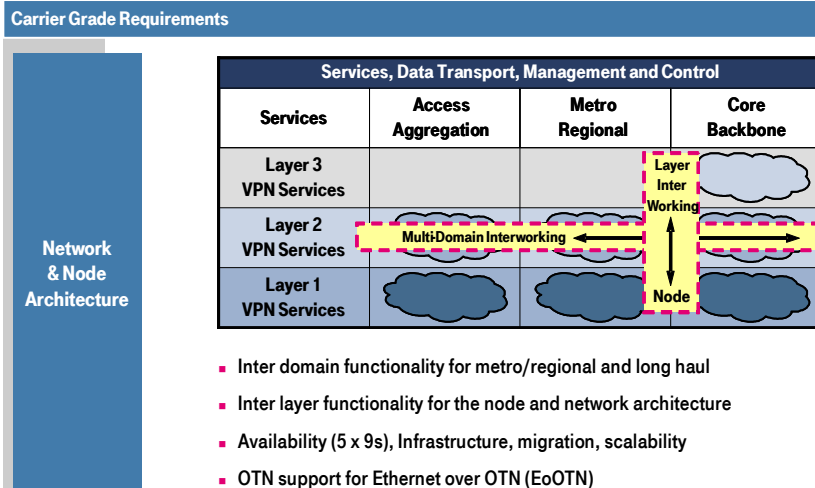
Higher Speed Ethernet – Requirements and Standardization

Introduction.



Higher Speed Ethernet – Requirements and Standardization

Requirements – Architecture.



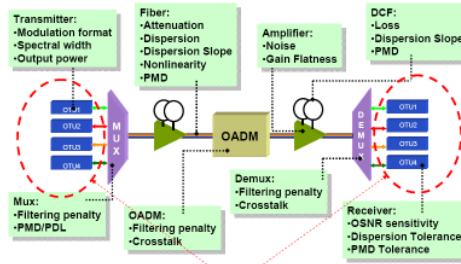


Higher Speed Ethernet – Requirements and Standardization

Requirements – Layer 1 Transmission.

Carrier Grade Requirements

Layer 1 Transmission



- Serial/Parallel transmission over DWDM systems/channels (e.g. 50GHz grid)
- Robust and co-existing formats on adjacent WDM channels
- Impairments: Transmitter, Receiver, Mux, Demux, Fiber, Amplifier, OADM
- Energy efficiency



Higher Speed Ethernet – Requirements and Standardization

Requirements – Layer 1 Modulation Formats.

Carrier Grade Requirements

Layer 1 Transmission
 100 Gbit/s Modulation Formats

	OOK	PSBT	DPSK	DQPSK	QPSK	PM-DQPSK	PM-QPSK
Spectral Efficiency	0.4 bits/s/Hz	1 bits/s/Hz	0.8 bits/s/Hz	1.6 bits/s/Hz	1.6 bits/s/Hz	3 bits/s/Hz	3 bits/s/Hz
OSNR sensitivity	20dB/0.1nm	20dB/0.1nm	17dB/0.1nm	18dB/0.1nm	15.5dB/0.1nm	18dB/0.1nm	15.5dB/0.1nm
PMD tolerance	1ps	1ps	1ps	2ps	2ps	2.5ps	2.5ps
CD tolerance	15ps/nm	50ps/nm	12ps/nm	35ps/nm	35ps/nm	140ps/nm	140ps/nm
Analogue electronics complexity	HIGH	HIGH	HIGH	MEDIUM	MEDIUM	LOW	LOW
Digital electronics complexity	LOW	LOW	LOW	LOW	HIGH	MEDIUM	HIGH
Optical complexity	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	MEDIUM	HIGH
Reach estimate	400km	400km	800km	700km	1,000km	700km	1,000km
Cost estimate	0%	+10%	+20%	+50%	+70%	+90%	+110%

Selected for OIF implementation agreement

Ross Saunders, et al [StrataLight & Cisco], SPIE Optics East 2007





Higher Speed Ethernet – Requirements and Standardization

Requirements – Layer 2 Services and Functionality.

Carrier Grade Requirements

Layer 2 Network Services

- Carrier Ethernet Services defined e.g. by Metro Ethernet Forum (MEF) specifications
 - E-Line, E-LAN, E-Tree
 - Circuit Emulation Services (TDM Services via a packet based Ethernet)
 - Virtual private wire service (VPWS), and virtual private LAN service (VPLS)
- CoS/QoS, SLA, performance monitoring/reporting
- Service OAM, transparency, EoOTN

Layer 2 Network Functionality

- Topology: Mesh, star, ring
- Technologies: PBB/PBB-TE, MPLS-TP, L2-MPLS
- Bandwidth profiling at ingress and egress
- Mapping/tagging: CoS, C-VLAN, S-VLAN, B-VLAN, L2-MPLS-Labels
- Synchronization and timing



7

Higher Speed Ethernet – Requirements and Standardization

Requirements – Layer 2/3 Control.

Carrier Grade Requirements

Layer 2/3 Network Control Functionality

- Multi domain and multi layer resiliency
- OAM functionalities, protection mechanisms,
- Control plane, GMPLS
- Management systems, EMS, NMS
- Fault identification, localization, and signaling
- Route optimization, resource reservation, flow and bandwidth engineering

Key Challenges

- Serial transmission via 50/100 GHz DWDM channel (modulation format, bandwidth)
- Standardized carrier grade specifications for
 - Layer 2 Ethernet services and functionalities
 - Interfaces for multi domain interoperability
 - Multi layer interworking functionalities, control plane, GMPLS



8



Higher Speed Ethernet – Requirements and Standardization

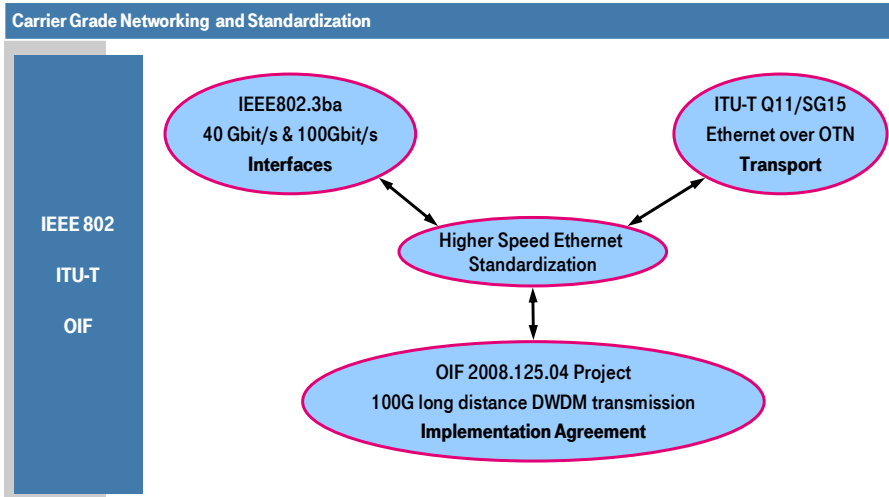
Overview.

- Project Introduction
- Project Environment
- Related Standardization
- Conclusion



Higher Speed Ethernet – Requirements and Standardization

Related Standardization – Overview.





Higher Speed Ethernet – Requirements and Standardization

Related Standardization – IEEE802.3ba Higher Speed Ethernet Interfaces.

40Gb/s and 100Gb/s Ethernet Task Force Objectives

- | | |
|---------------------|--|
| Basic Objectives | <ul style="list-style-type: none"> Support full-duplex operation only Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC Preserve minimum and maximum Frame Size of current 802.3 standard Support a BER better than or equal to 10^{-12} at the MAC/PLS service interface Provide appropriate support for OTN |
| 40 Gb/s Objectives | <ul style="list-style-type: none"> Support a MAC data rate of 40 Gb/s Provide Physical Layer specifications which support 40 Gb/s operation over: <ul style="list-style-type: none"> at least 10km on SMF at least 100m on OM3 MMF at least 10m over a copper cable assembly at least 1m over a backplane |
| 100 Gb/s Objectives | <ul style="list-style-type: none"> Support a MAC data rate of 100 Gb/s Provide Physical Layer specifications which support 100 Gb/s operation over: <ul style="list-style-type: none"> at least 40km on SMF at least 10km on SMF at least 10m over a copper cable assembly at least 100m on OM3 MMF |

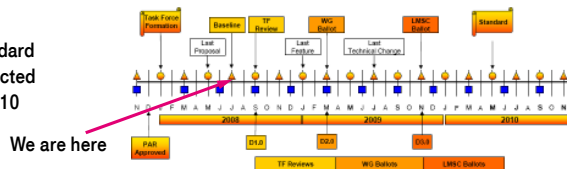


Higher Speed Ethernet – Requirements and Standardization

Related Standardization – IEEE802.3ba Higher Speed Ethernet Interfaces.

40Gb/s and 100Gb/s Ethernet Baselines and Timeline

- | | | |
|-----------------------|---|---|
| Adopted Baselines | <ul style="list-style-type: none"> MLD architecture for electrical interfaces 40G/100G media independent interface (XGMII/CGMII) logical interfaces LAN WDM (4x25G) for 100G SMF (10km & 40km) | <ul style="list-style-type: none"> Appropriate support for OTN architecture 40G & 100G parallel MMF (nx10) for 100m |
| Remaining Baselines | <ul style="list-style-type: none"> Physical media attachment (PMA) Physical media dependent (PMD) service interface 40G over > 10km SMF Extended reach of multimode fiber beyond 100m | <ul style="list-style-type: none"> 40G/100G attachment unit interface (XLAUI / CAUI) 40G/100G over > 10m Cu Cabling |
| IEEE 802.3ba Timeline | <ul style="list-style-type: none"> Standard expected in 2010 | |





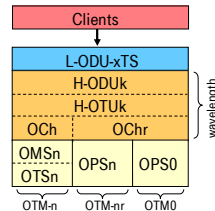
Higher Speed Ethernet – Requirements and Standardization

Related Standardization – ITU-T G.709 Optical Transport Network (OTN).

Enhanced G.709 OTN Hierarchy of ITU-T Standardization

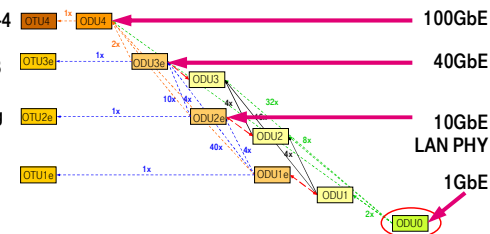
G.709 enhanced OTN Hierarchy proposed

- Mapping of clients into Low Order L-ODUs
- Mapping of L-ODUs in High order H-ODUs
- ITU-T and IEEE802.3ba coordination established
- ODU4 recommendation expected before the IEEE802.3ba standard



Ethernet over OTN Mapping

- 100GbE mapping in ODU-4
- 40GbE mapping in ODU-3
- 10GbE LAN PHY mapping in ODU-2e
- 1GbE Mapping in ODU0



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Related Standardization – OIF 100G Implementation Agreement.

OIF 2008.1 25.04 project proposal: 100G long distance DWDM transmission Implementation Agreement

Supporters

- AMCC, Ciena, Cisco, CoreOptics, Cortina, Juniper, Mintera, Nokia Siemens Networks, Opnext, Santur, StrataLight, Vitesse

Objectives

- Reasonable approach to establish a “100G Ecosystem”
- Suitable propagation performance for long-distance DWDM networks
- Dual Polarization – Quadrature Phase Shift Keying (DP-QPSK) modulation format with a coherent receiver
- Baseline Forward Error Correction (FEC) algorithm (may developed in the ITU-T)

Timeline

- Implementation agreement expected at the end of 2009





Higher Speed Ethernet – Requirements and Standardization

Conclusion.

Higher Speed Ethernet for Layer 2 Packet Transport

Carrier Grade
Higher Speed
Ethernet

Pro/
Merits

- Higher aggregation level for a better scalability
 - Reduced number of links between switches
 - Reduced number of switches
 - Reduced Opex due to a reduced number of network elements
- Increased spectral efficiency for a better network utilization
- Cost-efficient solutions with better cost per bit relation
- Enable migration paths towards Tbit/s networks

Carrier Grade
Higher Speed
Ethernet

Contra/
Open Issues

- Complex high speed technology
 - Serial or parallel transmission
 - Wide range of possible modulation formats
 - Transmission impairments (CD, DGD, PMD, filtering, etc.)
 - Power efficient devices
- Increased requirements for network resiliency
- Currently no standards available



Thank you!

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