100 Gbit/s Carrier Grade Ethernet Transport

Introduction

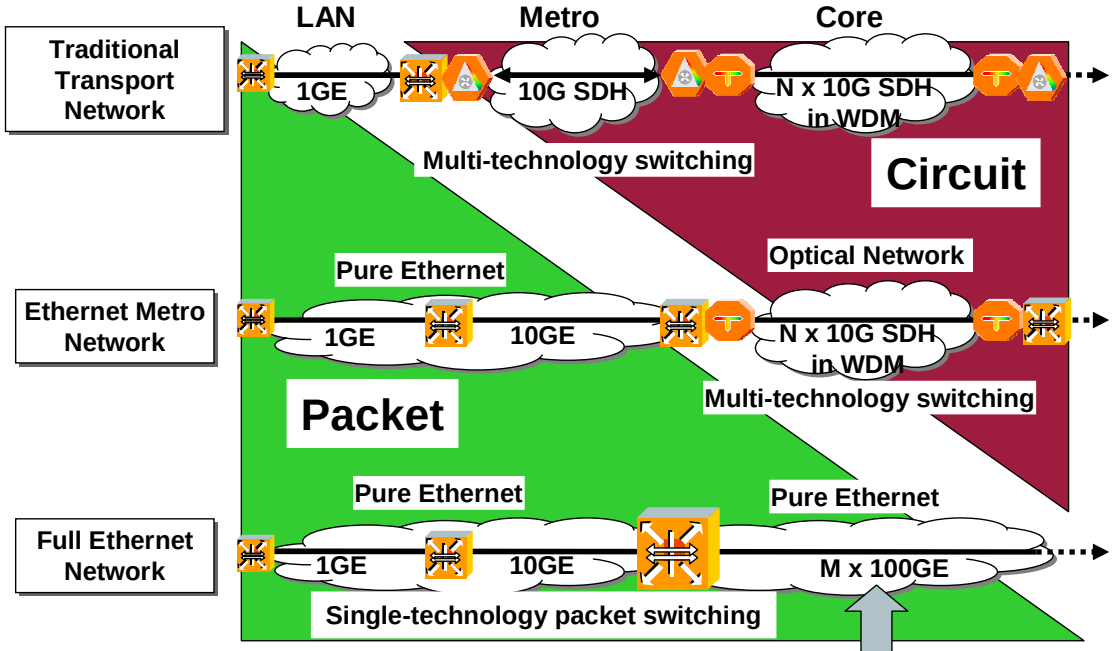
EuroView 2008

Würzburg, July 21st, 2008

Kurt Lösch,
Bell Labs, Germany
Alcatel-Lucent (Kurt.Loesch@alcatel-lucent.de)

ADVA Optical Networking · Alcatel·Lucent · Deutsche Telekom · ERICSSON TAKING YOU FORWARD · Nokia Siemens Networks

Overall Goal: Ethernet Evolution into the Core

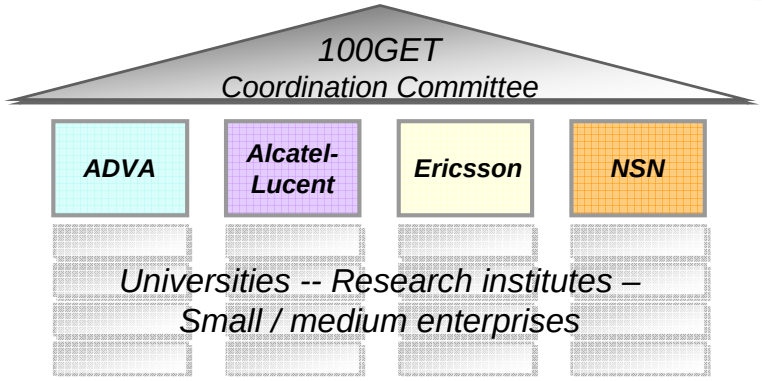


The main goal of 100GET is to develop **carrier-grade** transport networks based on a data transmission rate of 100 billion bits per second over Ethernet at high quality.

100GE Switching — NETWORKING Part

100GE Transport — PHYSICAL LAYER Part

Project Structure



4 Project Clusters

+

Cross-Project Activities

+

Common testbed (DTAG) and technologies

Total Effort (3 years)	356 Person x Years
Total Budget *:	63 M€*

4 Working Committees for technical exchange:

1: Network aspects and standardization (lead: Gert Eilenberger, Alcatel-Lucent)
2: 100GbE system technology and transmission (lead: Bernd Spinnler, NSN)
3: 100GbE technologies, comp. and measurements" (lead: Martin Schell, Fraunhofer–HHI)
4: Reference scenarios and test environment (lead: Ralf-Peter Braun, Deutsche Telekom)

* Funded in part by BMBF (Germany), MEFI (France), VINNOVA (Sweden), TEKES (Finland)

100GET Partners

French Partners:
- Alcatel THALES III-V Lab
- IntexyS SA
- University of Limoges

Swedish Partners:
- Ericsson AB (EAB)
- Chalmers Univ. of Technology (CTH)
- Royal Institute of Technology (KTH)
- Acreo AB
- SP Devices (SPD)

Finnish Partners (contracts under negotation)
- NSN
- Nethawk
- Tellabs
- VTT
- TKK, University of Helsinki

German Partners:
- ADVA Optical Networking AG
- Agilent Technologies R&D and Marketing GmbH & Co. KG
- Alcatel-Lucent Deutschland AG
- Atesio GmbH
- CoreOptics
- Deutsche Telekom
- Ericsson GmbH (EDD)
- FhG - Heinrich Hertz Institut (HHI)
- IHP GmbH
- JDSU Deutschland GmbH
- Konrad Zuse Zentrum für Informationstechik (ZIB)
- Ludwig-Maximilians-Universität München (LMU)
- MICRAM Microelectronik GmbH
- NSN - Nokia Siemens Networks
- Technical University Braunschweig
- Technical University München
- Technische Universität Dresden
- TUHH (Technische Universität Hamburg-Harburg)
- u2t Photonics AG
- Uni Kiel - Christian Albrecht Univ. (CAU)
- Universität Dortmund
- Universität Stuttgart (IKR & INT)
- Universität Würzburg
- VPIsystems

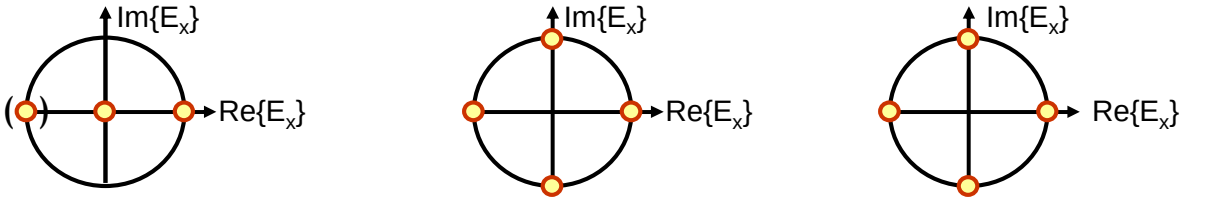
Main Challenges in the Networking Domain

- Carrier-grade and core-compatible Ethernet:
  - Multi-layer network management, operation, and interworking
  - Multi-domain operation and interworking
- Ethernet/DWDM network architecture optimized for total cost of ownership
  - Combination of service/application-oriented L2 switching with cost-efficient L1 switching
  - Algorithms for NW migration and capacity planning (grooming, routing and resilience)
  - Multi-layer optimisation
  - Automated network management & control ("plug & play")
- Prototyping & lab trials; field trials
- Joint standardisation effort of major European players
  - ITU-T SG 15,
  - IEEE 802.1/.3 Higher Speed Study Group → **IEEE802.3ba 40Gb/s and 100Gb/s Ethernet Task Force** since Dec.'07 http://www.ieee802.org/3/ba/)

Physical Layer Challenge: „more bits in a given frequency channel"

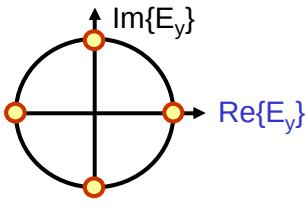
100 Gb/s on existing wavelength grids (100 or even 50 GHz spacing)

1 bit/symbol	2 bits/symbol	4 bits/symbol
~107-112 Gbaud	~53.5-56 Gbaud	~26.75-28 Gbaud
(OOK, DPSK, DB/PSBT, …)	(DQPSK, pol-muxed OOK, …)	(pol-muxed (D)QPSK, 16-QAM, …)



New optical measurement systems needed
e.g. constellation analysis

→ **Horizontal activity (JDSU)**



E_x … Optical field, x-polarization
E_y … Optical field, y-polarization

Main Challenges for Components and Electronics

- Very high bandwidth devices for On/Off Keying
  3dB corner frequency = 70 GHz;
- Integration of complex transmitter and receiver optics for coherent polarisation multiplexing systems
- High speed Analog/Digital Converters and Digital/Analog Converters
  e.g. 4 channels in one device: sampling rate 28 GSample/s, resolution 4 bit/Sample → Total Throughput = 448 Gb/s
- Packaging and subsystem assembly