Optical Backplanes

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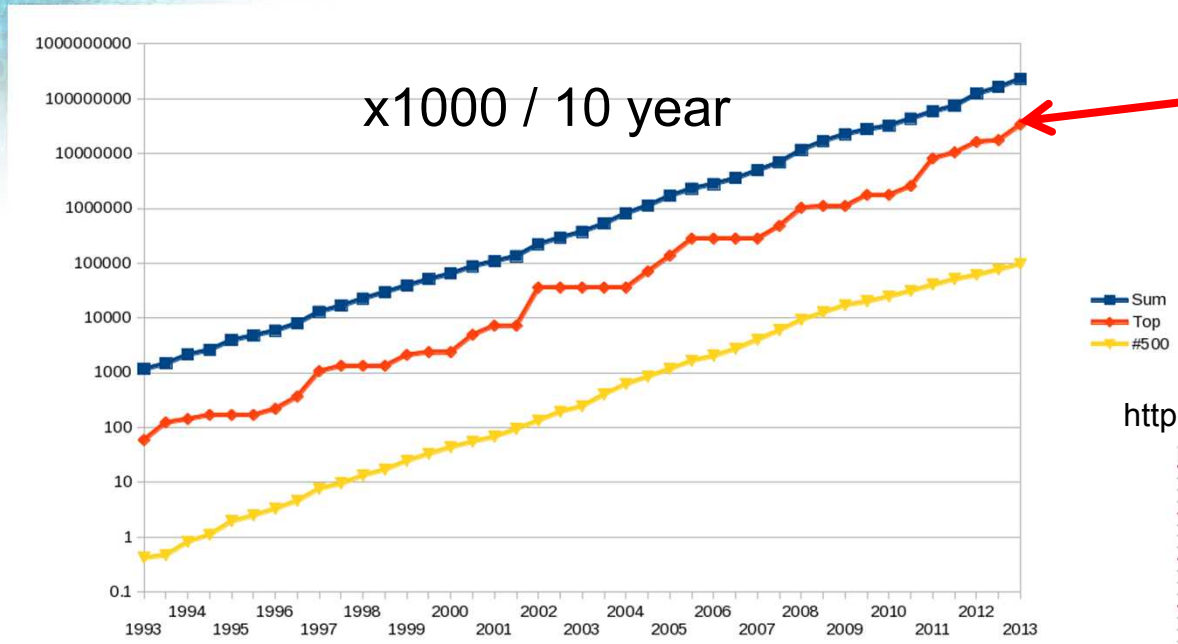
National Institute of Advanced Industrial Science and Technology (**AIST**)
Convenor of IEC TC86 JWG9 (with TC91)

Contents

Contents

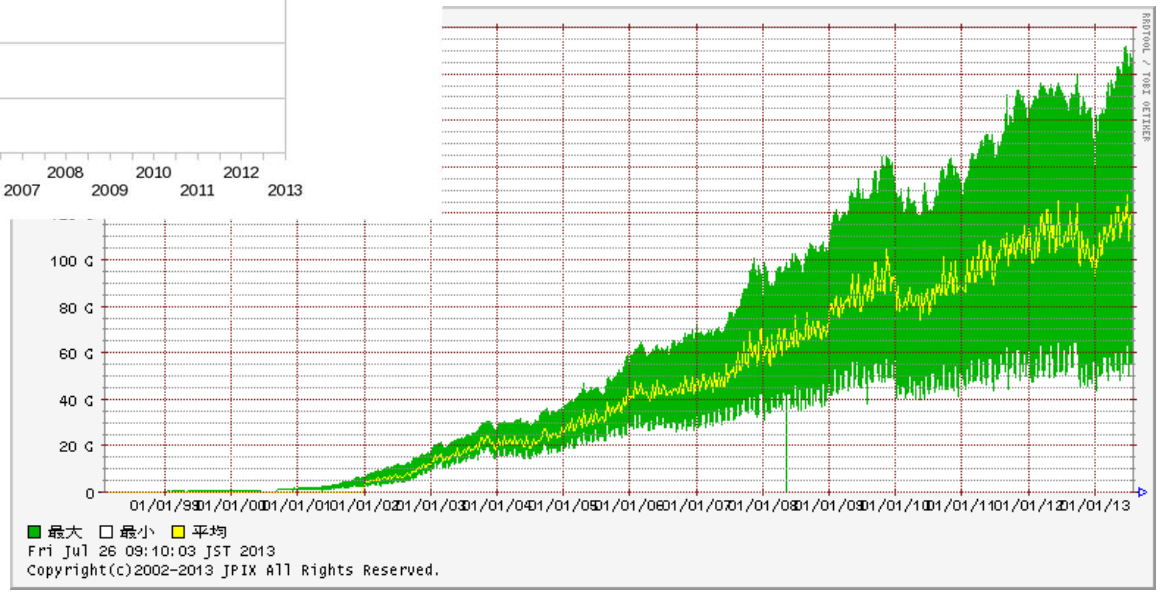
Background (1)



Performance of Super Computers (Top500)
http://www.top500.org/

天河2(Tianhe-2)
Linpack33.86PFLOPS
(2013)

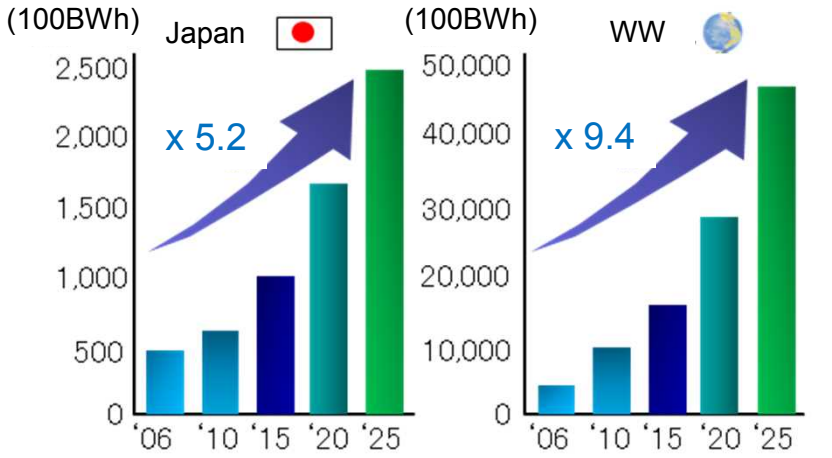
http://japanese.cri.cn/881/2013/06/17/161s209613.htm



Growing of Internet traffic (Japan Internet Exchange)
http://www.jpix.ad.jp/jp/technical/traffic.html

Background (2)

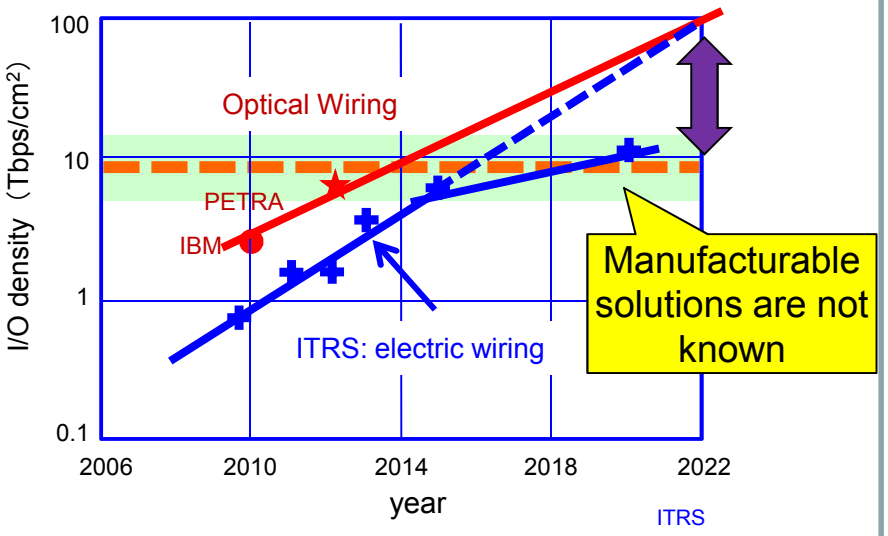
Increase in power consumption of IT equipment



Green IT Promotion Council (2009)

Limit of power supply

Request for high-density high-speed wiring



Limit of electrical wiring

Optical Backplane

Breakthrough of limits of metal interconnection ?

Metal interconnection has…

- Crosstalk
- Signal reflection
- Signal dissipation
- Skin effect
- EMC, EMI

Contents

Definition of Backplane

a support surface in a computer with the electrical connections necessary to join the internal components of the computer (Merriam-webster)

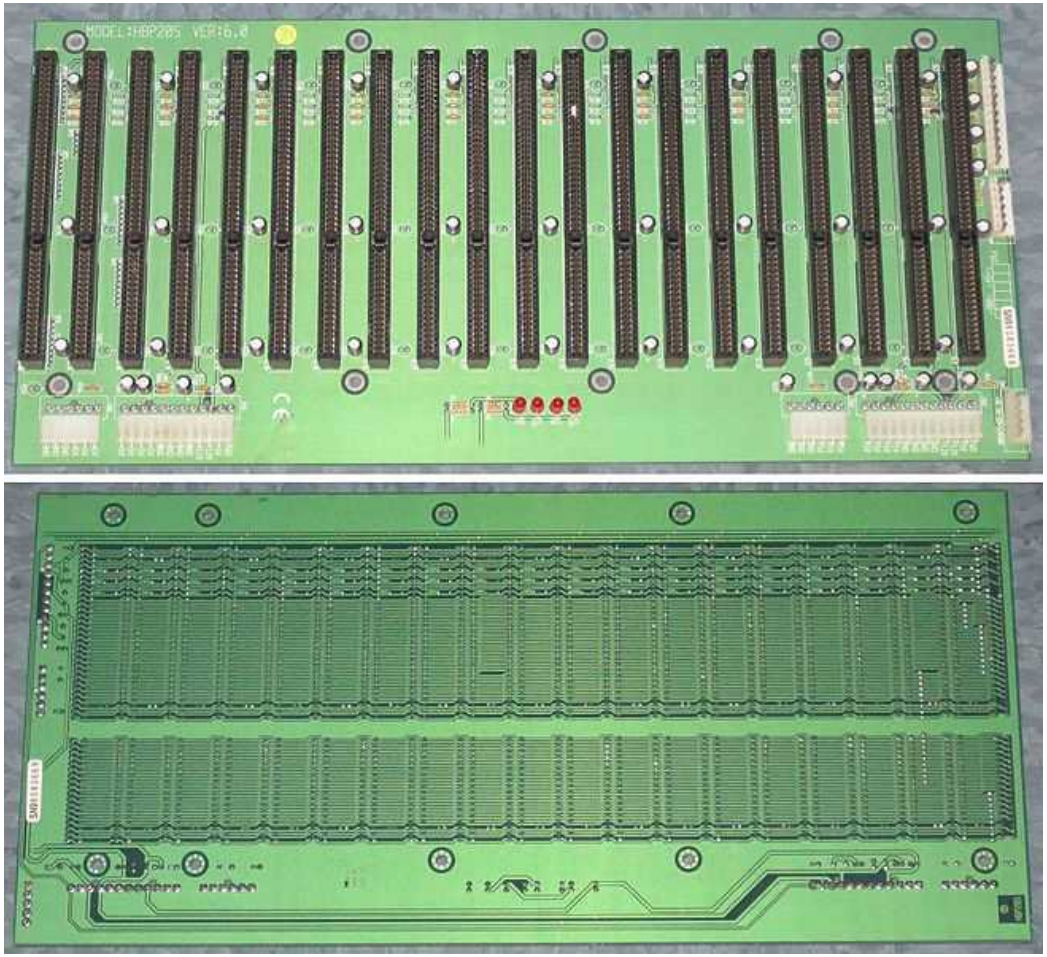
http://www.merriam-webster.com/dictionary/backplane

a group of electrical connectors in parallel with each other, so that each pin of each connector is linked to the same relative pin of all the other connectors forming a computer bus. It is used as a backbone to connect several printed circuit boards together to make up a complete computer system. Backplanes commonly use a printed circuit board but wire wrapped backplanes have also been used in minicomputers and high reliability applications.(Wikipedia)

http://en.wikipedia.org/wiki/Backplane

http://en.wikipedia.org/wiki/Backplane

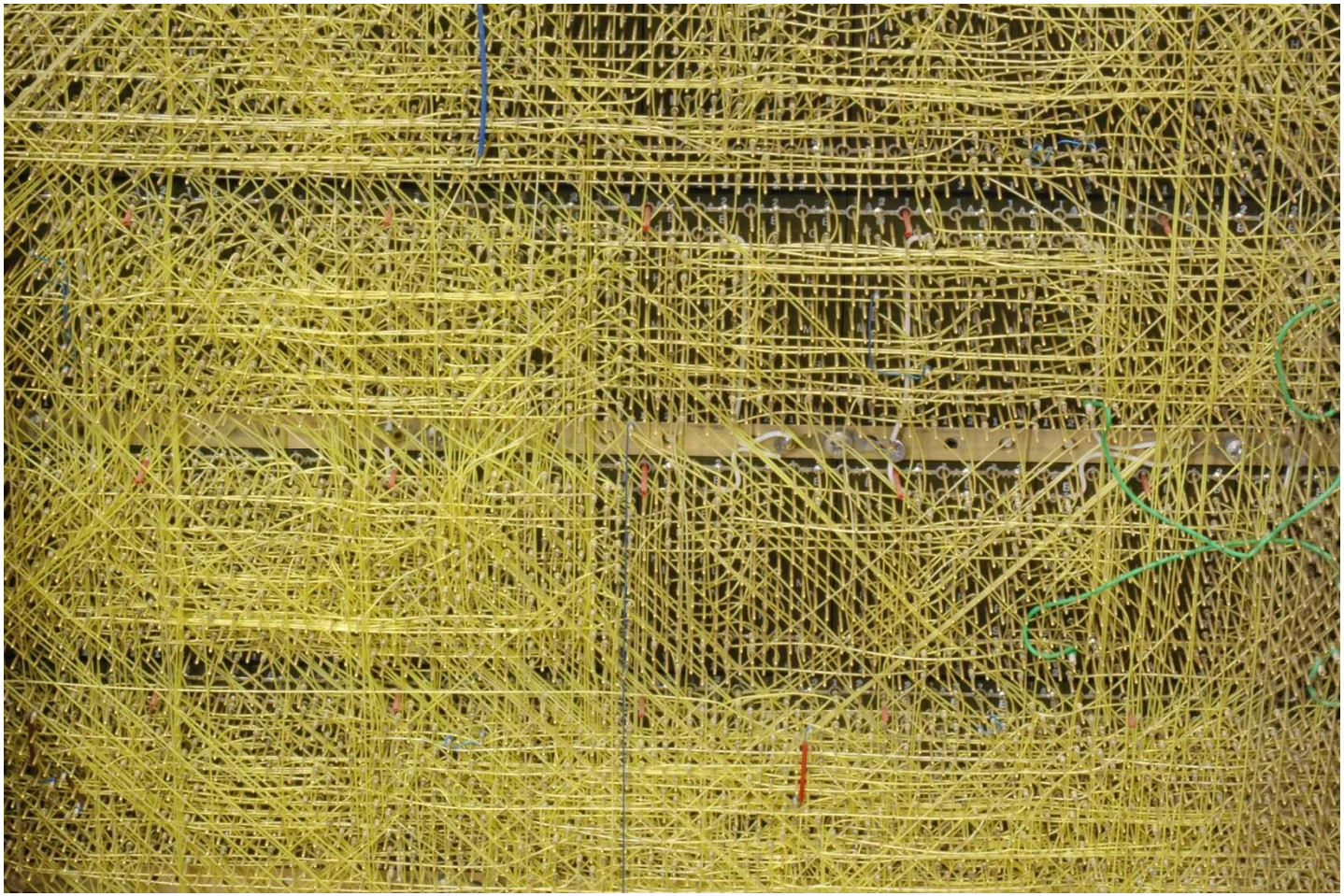
ISA Bus Backplane



ISA: Industrial Standard Architecture

http://en.wikipedia.org/wiki/File:ISA-Backplane.jpg

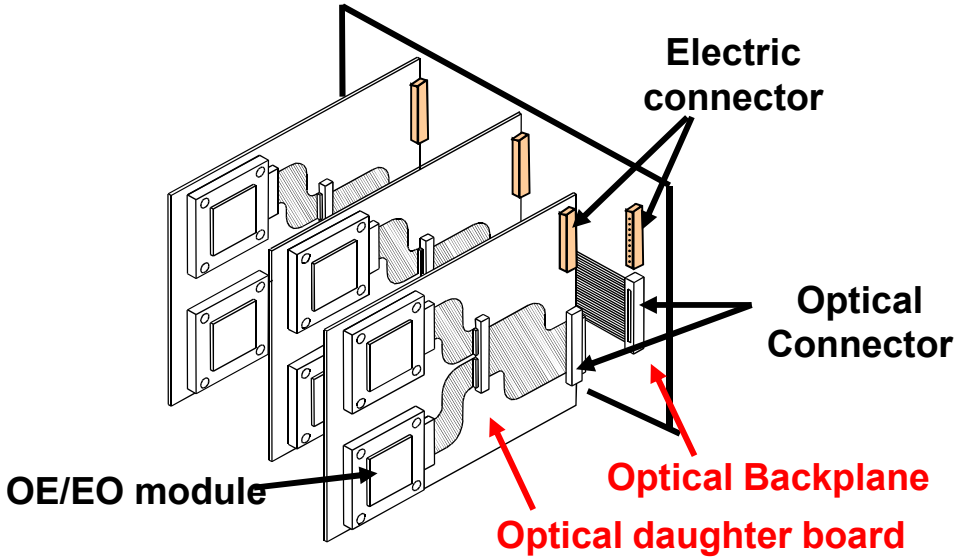
Example of Backplane of a minicomputer (PDP-8)



http://upload.wikimedia.org/wikipedia/commons/2/23/PDP-8I-backplane.jpg

Definition of Optical Backplane

An optical **backplane** (or "backplane system") is a circuit board with group of optical connectors in parallel with each other, so that each signal connection of each connector is linked with optical interconnection. It is used as a backbone to connect several optical daughter boards together to make up a complete computer or server system. Optical backplane commonly use electric interconnection with electric connectors.



Patents of Optical Backplanes

- (Passive fiber optic data bus configurations US 4457581 (Her Majesty The Queen In Right Of Canada, 1981))
- Electronic apparatus with circuit cards and signals optically coupled therebetween US 4733093 A(Northern Telecom, 1984)
- Optical backplane US 4870637 A(AT&T Bel Lab. 1987)

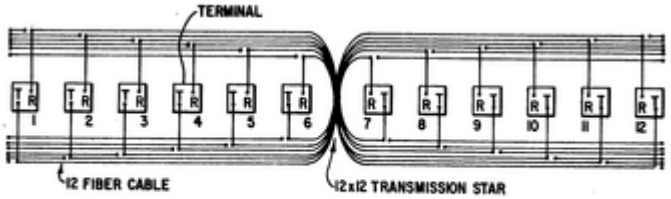
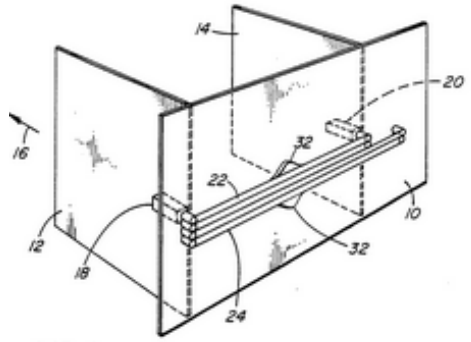
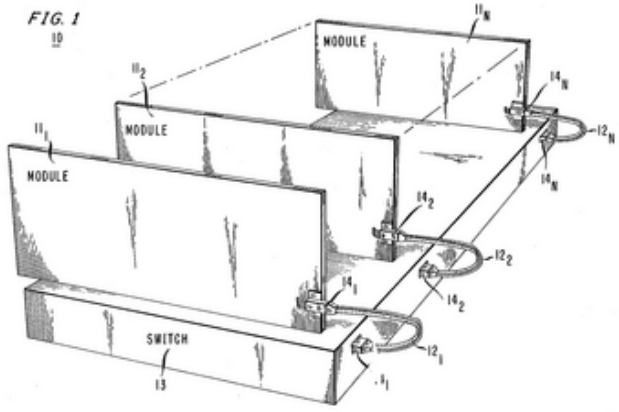
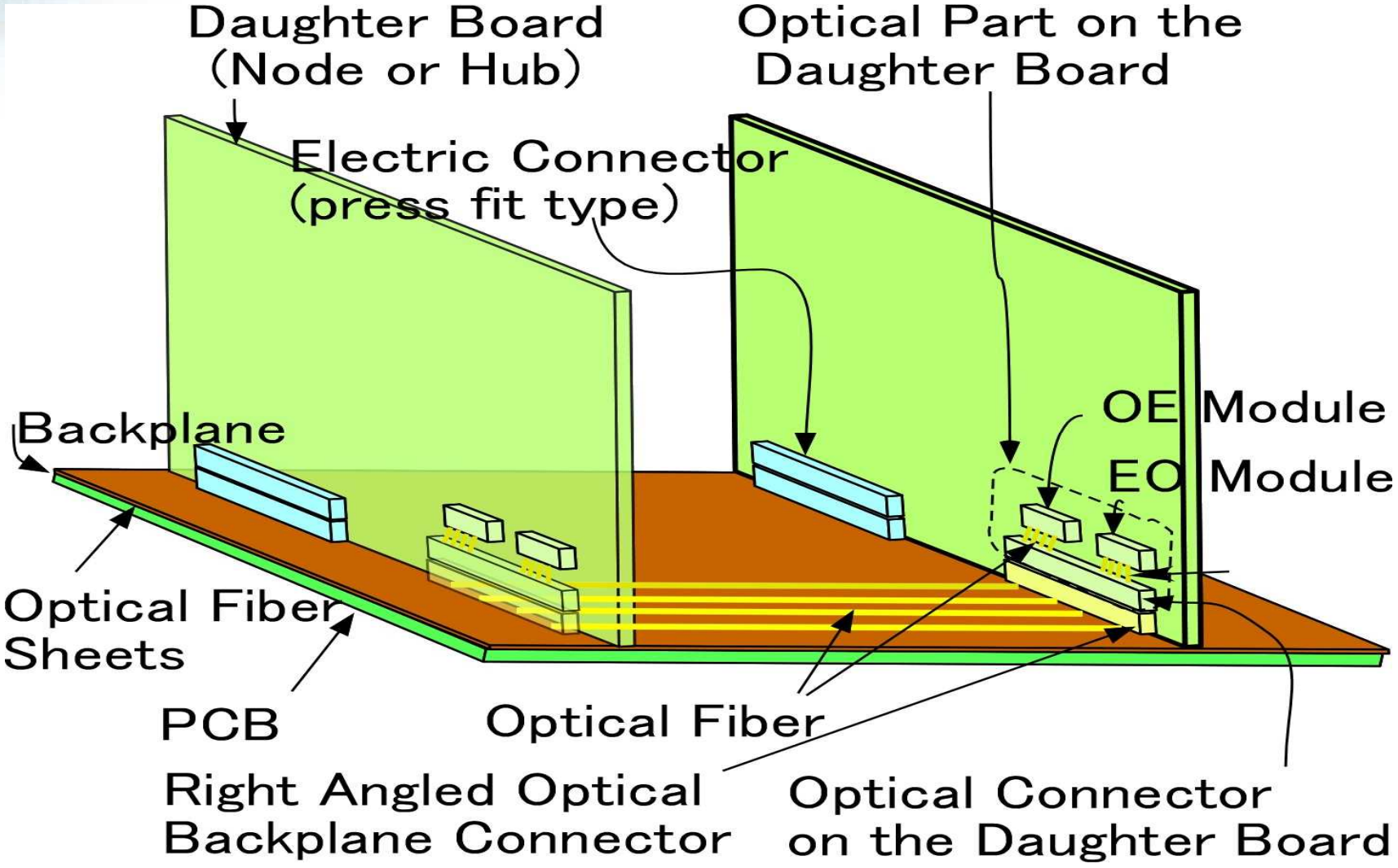


FIG. 9





Optical components for the backplane system



Classification of Optical Backplanes

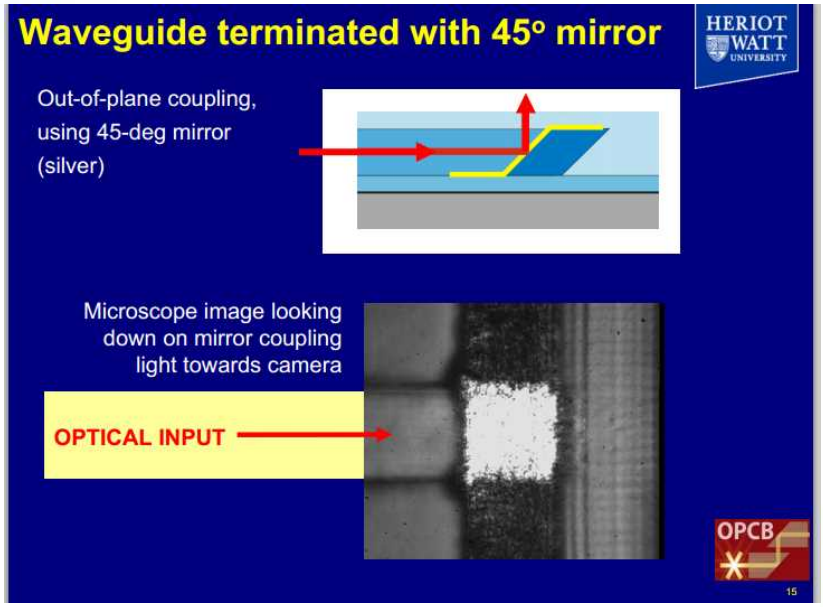
- Light guiding Method
  - Passive
    - Optical fiber
      - Polymer
      - Glass
    - Waveguides
      - Polymer
      - Glass
    - Spatial
  - Active
    - Edge emitting LD,LED and PD
    - Vertical emitting LE, LED and PD

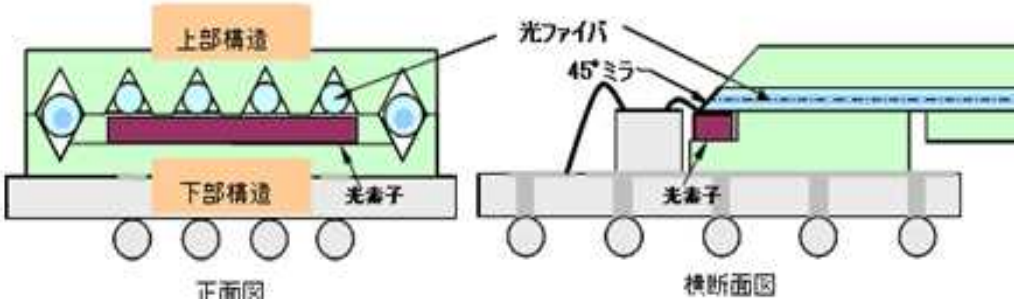
Classification of Optical Backplanes

- Right angle optical coupling
  - Mirror reflection
  - Bended lightguide
  - Hologram

Classification optical backplanes

- Right angle optical coupling
  - Mirror reflection



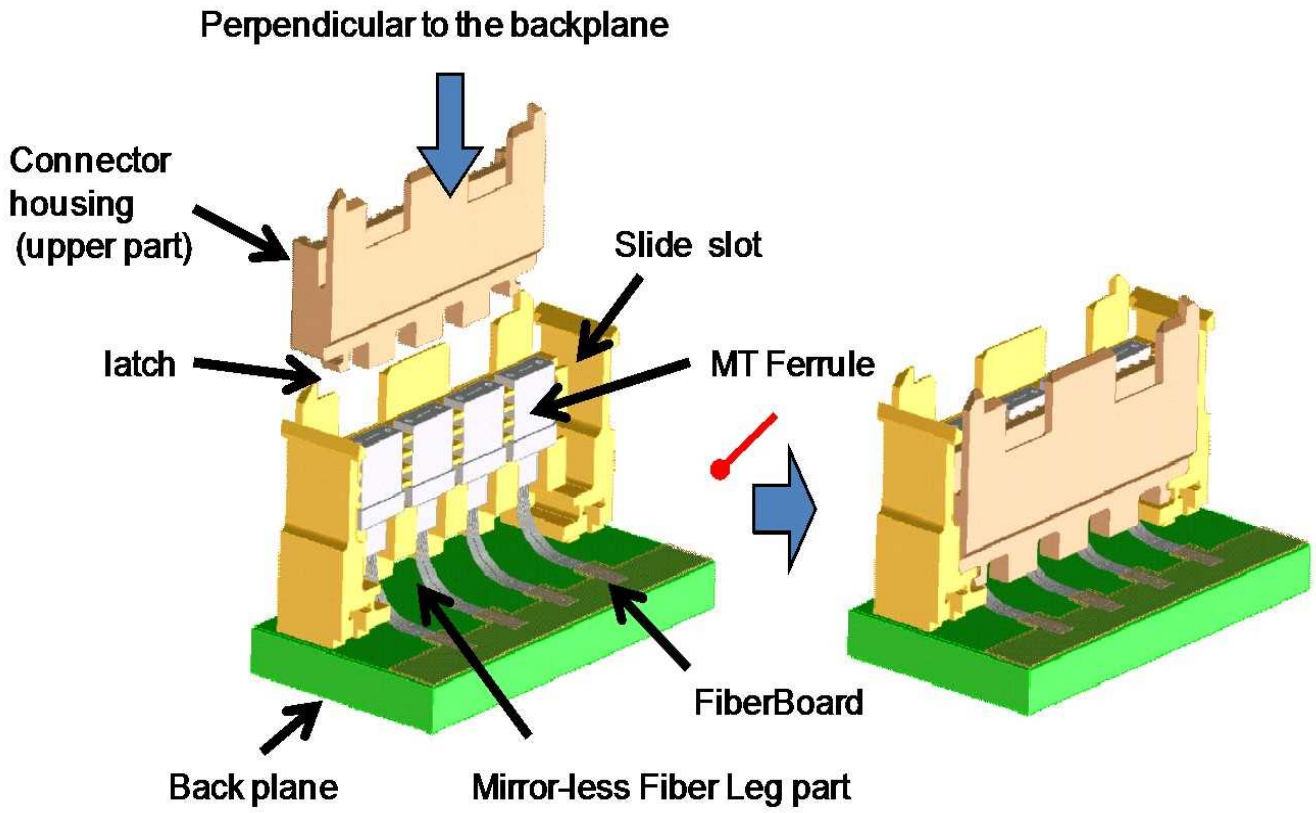


VGPAS:V-Groove Passive Alignment Structure

http://www.lboro.ac.uk/research/iemrc/documents/EventsDocuments/SUMEEP%20wkshop%20Mar08/Integrated%20Electrical%20-%20Optical%20Substrate%20Manufacture%20final%20final%20version%20for%20web.pdf

Classification optical backplanes

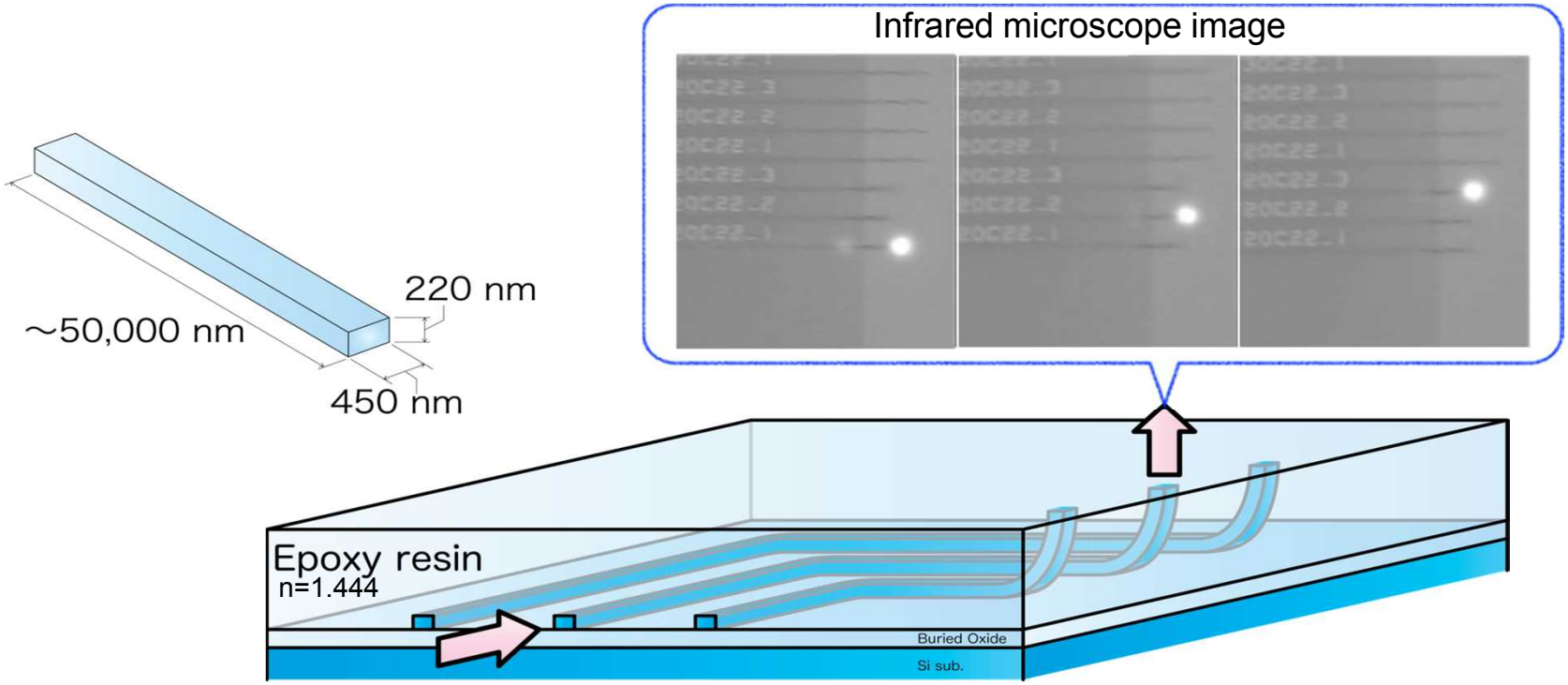
- Right angle optical coupling
  - Bended lightguide
    - Optical fiber



n=1.444

Classification optical backplanes

- Right angle optical coupling
  - Bended lightguide
    - waveguide

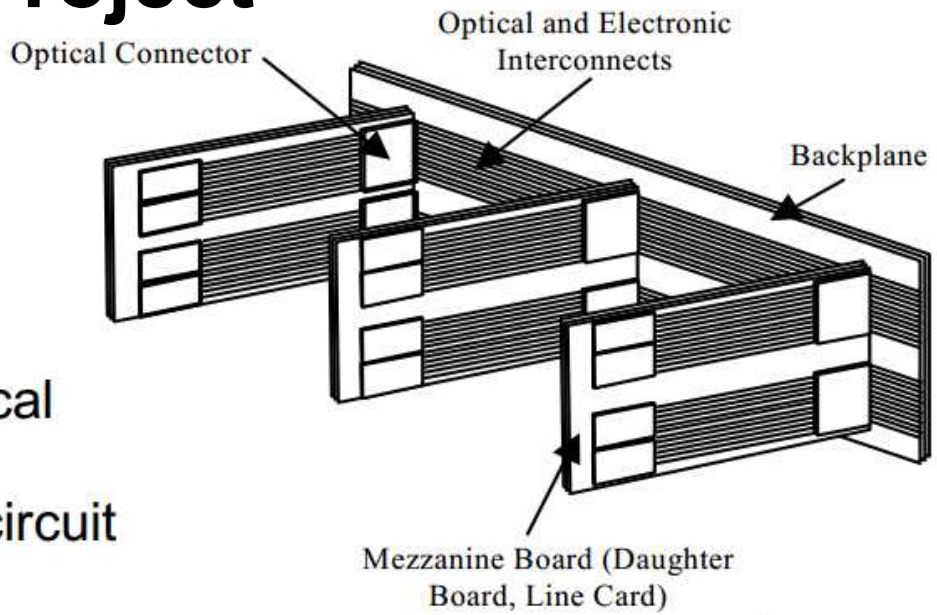


λ=1.55 μm (TE)

Silicon Photonics Research in AIST, M. Mori, Feb. 18th, 2014

Contents

The OPCB Project



- IeMRC, 3 year, Flagship Project
- 3 universities, 8 companies
- Integration of optical waveguides with electrical printed circuit boards
- Integrated Optical and electrical interconnected PCB (OPCB) for 19 inch backplanes and daughter cards
- High bit rate (10 Gb/s), error-free, reliable, dense connections
- CAD design tools, Fabrication Techniques, Optical-Electrical connectors

IeMRC: Innovative electronics Manufacturing Center http://www.lboro.ac.uk/research/iemrc/

http://www.lboro.ac.uk/research/iemrc/documents/EventsDocuments/SUMEEP%20wkshop%20Mar08/Integrated%20Electrical%20-%20Optical%20Substrate%20Manufacture%20final%20final%20version%20for%20web.pdf

High Density Package User Group

(2013)

HDP USER GROUP INTERNATIONAL, INC.®

Technology Development In Today's Global Environment

About Us | Become A Member | Information Center | Meetings | Projects | Online Store

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E-mail: *

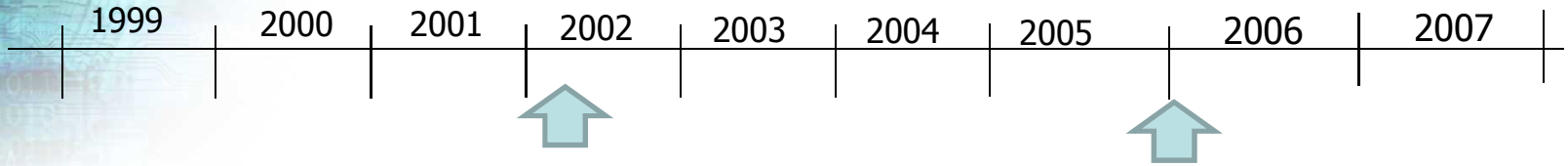
High Density Packaging User Group International, Inc.

Optical Backplane Concept:

Opto Interconnect
HDP User Group Project
Facilitator: Jack Fisher

http://hdpug.org/content/optoelectronics

National Research Projects in Japan



Domestic committee of Optical Backplane

IEC TC86/TC91 JWG9

Standardization of passive Optical Devices (ASET)

Standardization of Optical backplane System (AIST)

Ultra High density Electronic System Integration Project (ASET)

Reliability tests and standardizaiton of Optical Jisso cimponents

Hyper SI 1 (AIST Collaboration Research Team)

Hyper SI 2 (AIST Collaboration Research Team)

Fundamental Jisso Technology for Optical interconnections (Active Interposer, Optical Waveguide Circuit Board, Opcical connectors, etc.)

Application R&D of Optical Backplane and Optical Interconnection

Seeds Research

Application Research

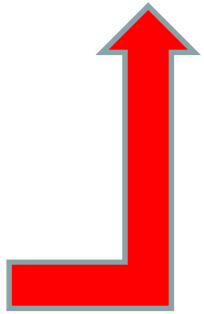
Joint Research Organization

Development of optical backplane technology has been done by Optoelectronic System Integration Collaborative Research Team, AIST.

(2004-2009)

By 20 researchers from **AIST & 11 companies:**

Ibiden Co.,LTD.
NEC Co.,LTD.
NTT Advanced Technology Co. , LTD.
Hirose Electric Co.,LTD.
Sumitomo Electric Industries, LTD .
NGK Spark Plug Co.,LTD.
Fuji Xerox CO., LTD .
Fujikura LTD.
Hitachi Chemical CO., LTD.
Ricoh CO., LTD.
Mitsui Chemicals, INC.



Researchers
Research
Funds

National Research Projects in Japan

2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

Optical Network Research

Vertically Integrated Center for Technologies of Optical Routing toward Ideal Energy Savings (VICTORIES) 2008-2017

Optical Interconnection Research

Development of Next-generation High-efficient Network Device Technology 2007-2011

Photonics and Electronics Convergence System Technology2010-2014

Photonics-Electronics Convergent System Technology (PECST) 2009-2013

Photonics Electronics Convergence Technology for Power Reducing Jisso System (Optoelectronics Jisso Pj.) 2012-2021

Development of Next-generation High-efficient Network Device Technology

- Term:FY2007 to FY2011
- Project leader: Tohru Asami, Professor of the University of Tokyo
- Sponsor: New Energy and Industrial Technology Development Organization (NEDO)
- Joint research organization:

  PETRA (National Institute of Advanced Industrial Science and Technology (AIST))
  Hitachi Ltd., FUJITSU LIMITED
  Mitsubishi Electric Corporation, NEC Corporation
  NIPPON TELEGRAPH AND TELEPHONE CORPORATION (NTT)
  Optoelectronics Industry and Technology Development Association (OITDA))
  ALAXALA Networks Corporation
  International Superconductivity Technology Center (ISTEC)
  The University of Tokyo, Japan Broadcasting Corporation

Development of Next-generation High-efficient Network Device Technology

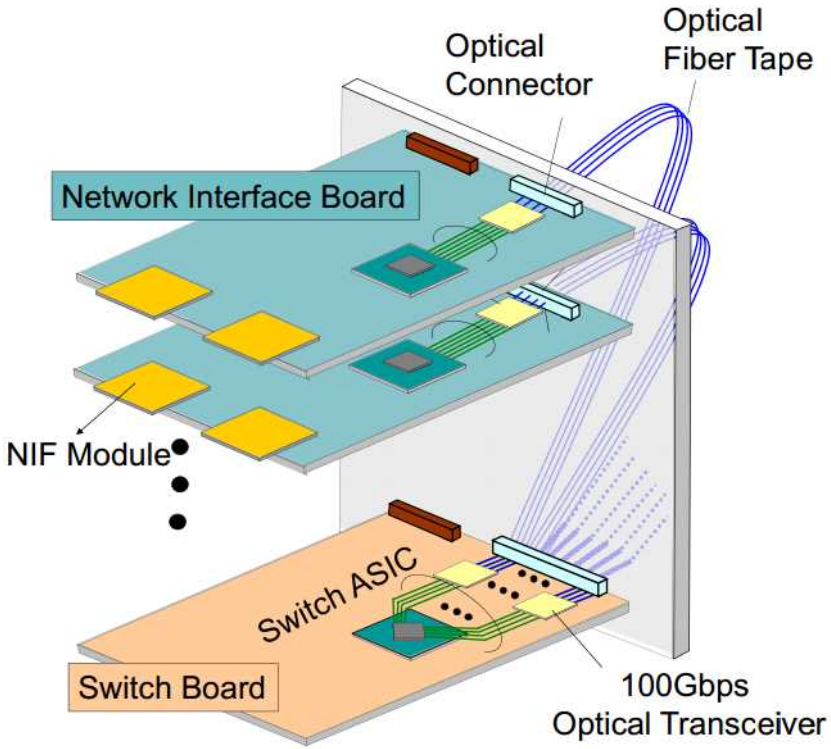
Projects

- OTDM LAN-SAN System for Ultra-high Definition TV Distribution in Broadcasting Station
- 40GbE Serial and 40G VSR Compact Optical Transceiver
- High-speed Directly Modulated Lasers and Highly Efficient Semiconductor Optical Amplifiers
- 40G LAN-WAN and I/F conversion technologies
- Wide dynamic range wavelength converter
- 100Gb/s Micro-Optical-Module for High-Density Optical Backplane
- Key Device Technologies for 100Gb/s Micro-Optical Module
- High-Definition Video Transmission Demo

100Gb/s Micro-Optical-Module for High-Density Optical Backplane

Technical Challenges
Realize 100Gb/s transceiver with very small form factor, and low power consumption

KEY ACCOMPLISHMENTS
- Micro-package : W9 x L14 x H5.3 mm
  Pluggable (Electrical and optical)
- Low power consumption of 2 W
  with highly integrated LSI (20mW /Gbps)
- 1/100 area and 1/15 power consumption
  of CFP transceiver



High Capacity Edge Router with Optical Backplane

Photonics and Electronics Convergence System Technology

- Project Leader: Yasuhiko Arakawa, Professor of the University of Tokyo
- Term: FY2010 to FY2014
- Sponsor: "Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program)" by Japan Society for the Promotion of Science (JSPS)
- Organization: PETRA
- Joint research organization:
  National Institute of Advanced Industrial Science and Technology (AIST)
  The University of Tokyo, Kyoto University
  Tokyo Institute of Technology, Yokohama National University
  UC Santa Barbara, Technical University of Munich

Photonics Electronics Convergence Technology for Power-Reducing Jisso System

- Project Leader : Prof. Yasuhiko Arakawa, University of Tokyo
- Term : FY 2012～2021
- Sponsor: METI for FY2012, NEDO from FY2013.
- Organization: PETRA
- Member companies:

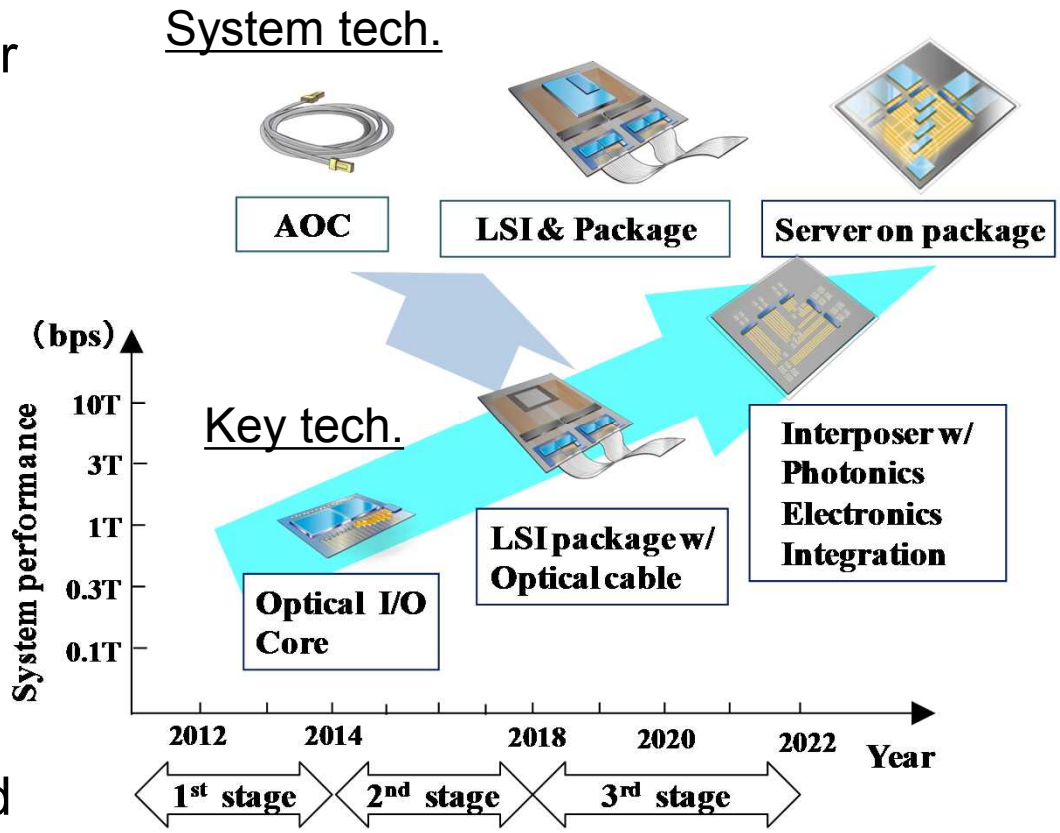
  AIST, Fujitsu, Furukawa Electric, NEC, NEL, NTT, OITDA, OKI, Toshiba
- Joint research organization:

  Univ. of Tokyo, Kyoto Univ., Tokyo Institute of Technology, Yokohama National Univ., WASEDA Univ.

By developing optical wiring and optical devices, we realize photonics electronics convergence tech. and this leads to power-reduction, high-performance, and small form factor for electronics components, and significantly reduction of their power consumption.

Project Roadmap (Optoelectronics Jisso PJ)

- 10 years are divided 3 stages.
- 1st stage: Develop optical IO core for key tech. and AOC for system tech.
- 2nd stage: Develop LSI package with optical IO cores and LSI with optical fiber cables.
- 3rd stage: Develop photonics electronics convergence interposer and photonics electronics printed-circuit board.
- PJ results in the 1st stage and the 1st chip will be exhibited this year.



Exhibition of Optoelectronic Jisso Projects at OFC2014

Date: Mar.11-13, 2014

Place: Moscone Center, San Francisco, CA, USA

Site: http://www.ofcconference.org/

Results of the NEDO Project “Development of Next-generation High-efficiency Network Device Technology (FY2007-2011)”

Theme1: Optoelectornic I/O core and the future outlook

Micro transceiver 5mm□

Mock of future onboard server

Theme2: 100Gbps Digital coherent technology DSP LSI and transceiver

Booth # 2114

Contents

Goals and Developed Components

High Throughput (over Several Hundreds of Line) & Low Cost Optical Backplane

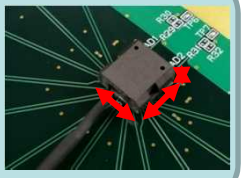
High Density (125um pitch) & Downsizing

Simple & Adjustment Free Manufacturing

Easy Maintenance

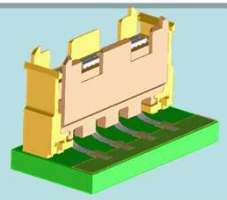
Optical Connector with Fine (125um) Pitch Ferrule

Small & Vertically Pluggable EO/OE Modules (12ch 1x1x0.6cm module)



Dense (125um Pitch) Wiring Fiber Sheet

Small Size Mirror-less Right-angled Optical Connector Housing



Monolithic Two Wave Length VCSEL

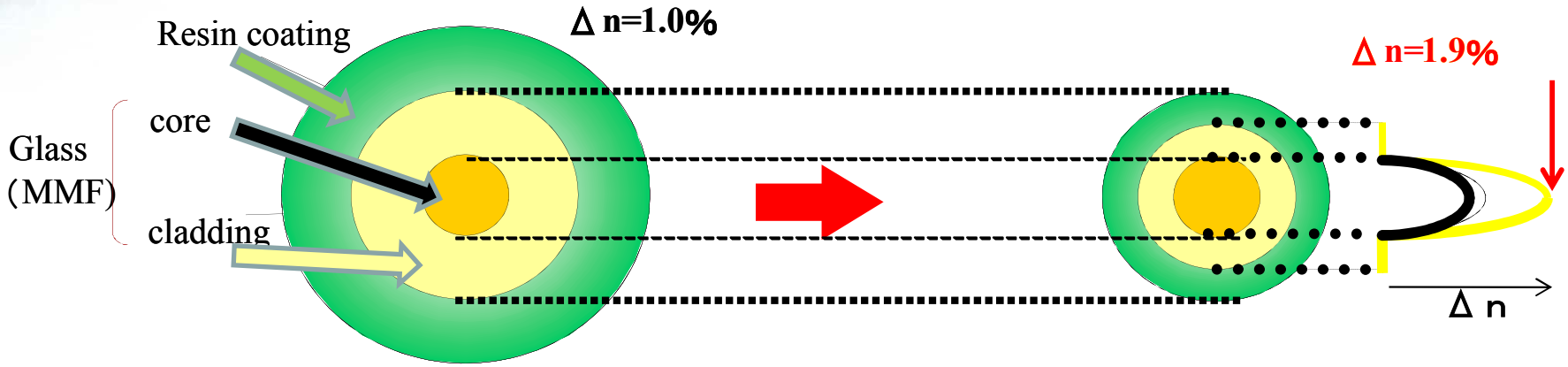
Bending Loss Insensitive Fine Optical Fiber

Cleaner of Optical Connector

Bending Loss Insensitive Optical Fiber

Conventional fiber

Developed fiber



coating/cladding/core
＝250/125/50μ m

coating/cladding/core
＝ 125/80/50μ m

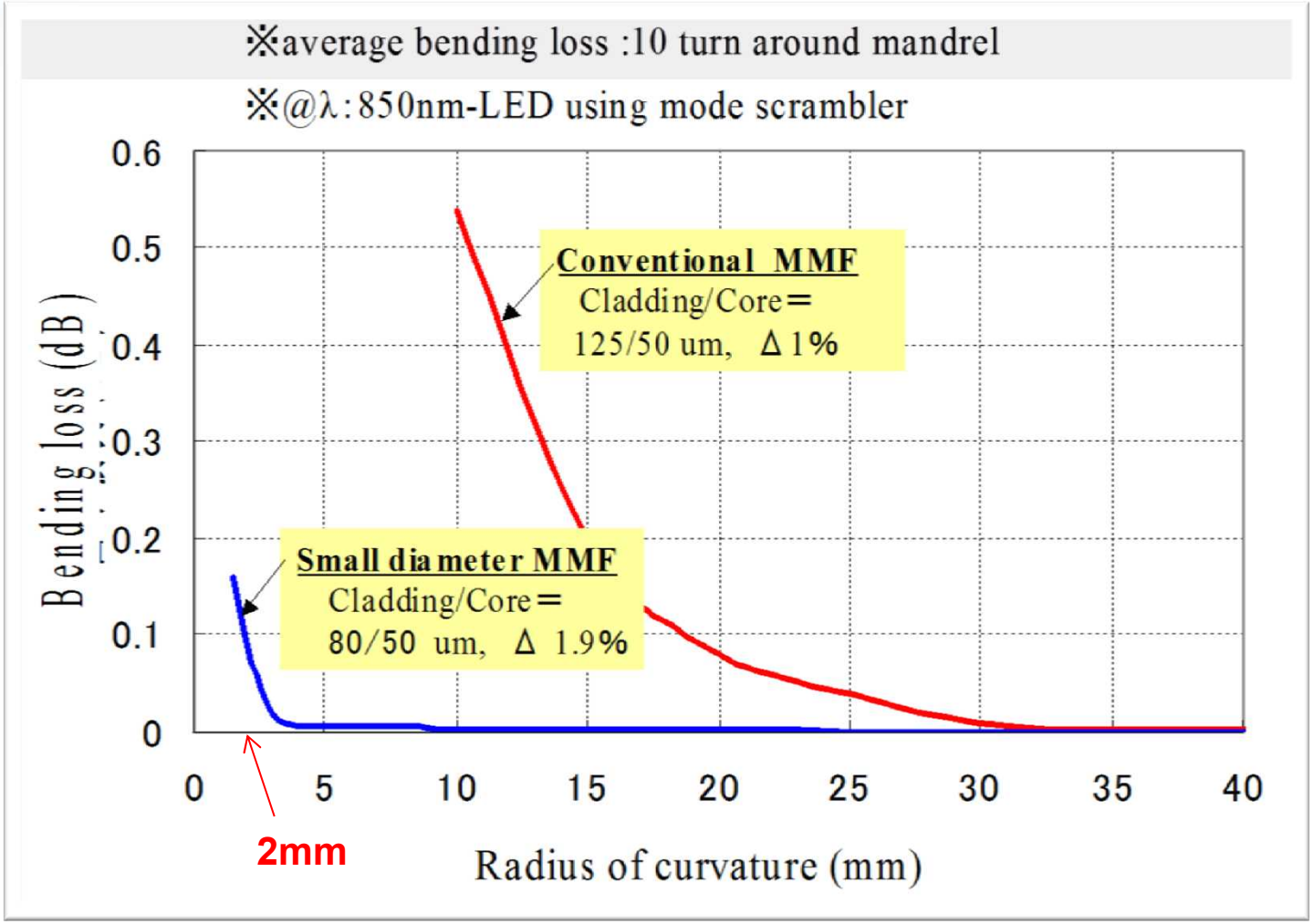
High Δ : Smaller admissible radius of bending
20mm → 5mm

Equal Core size : little connection loss when it is connected with conventional fiber

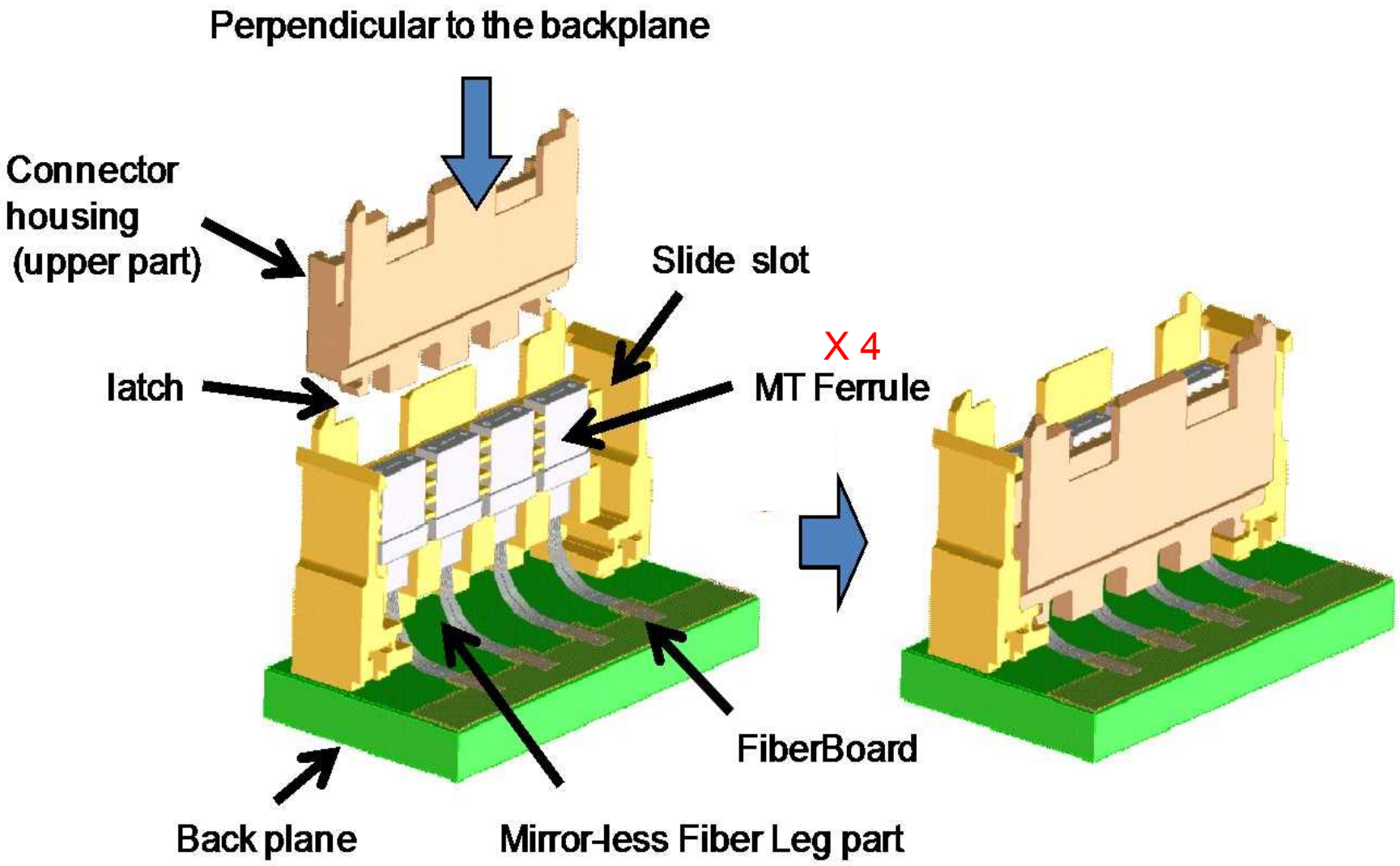
Radius of Conventional Cladding > Coating : No need to stripping of coating

→ Fine Fiber board , Connector, OE module

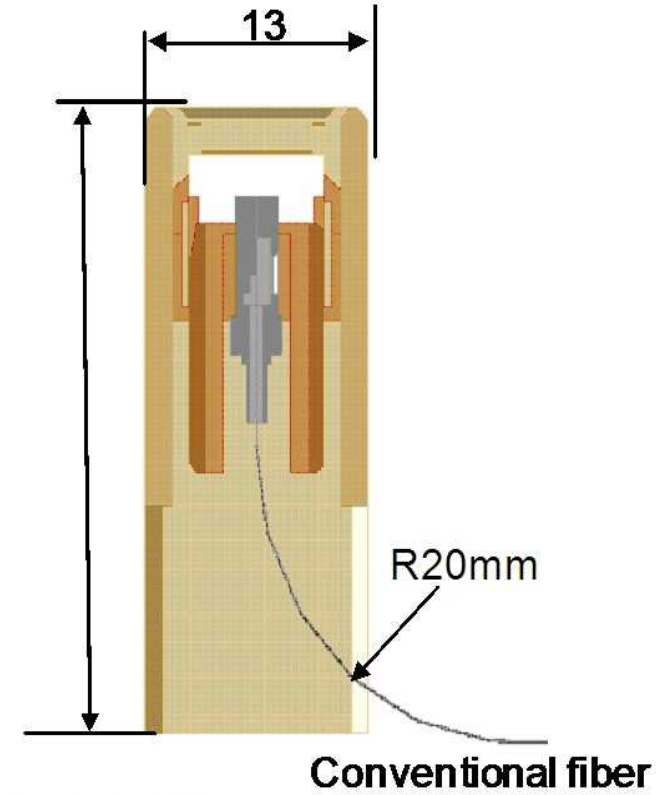
Bending Loss of Developed Fiber

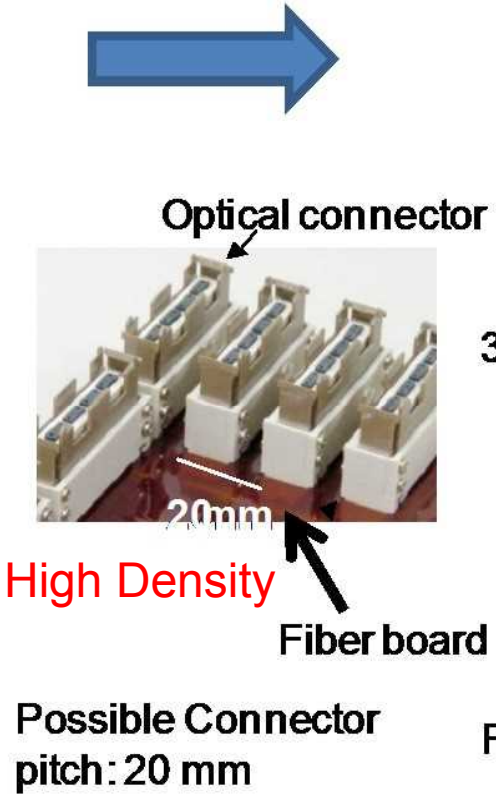


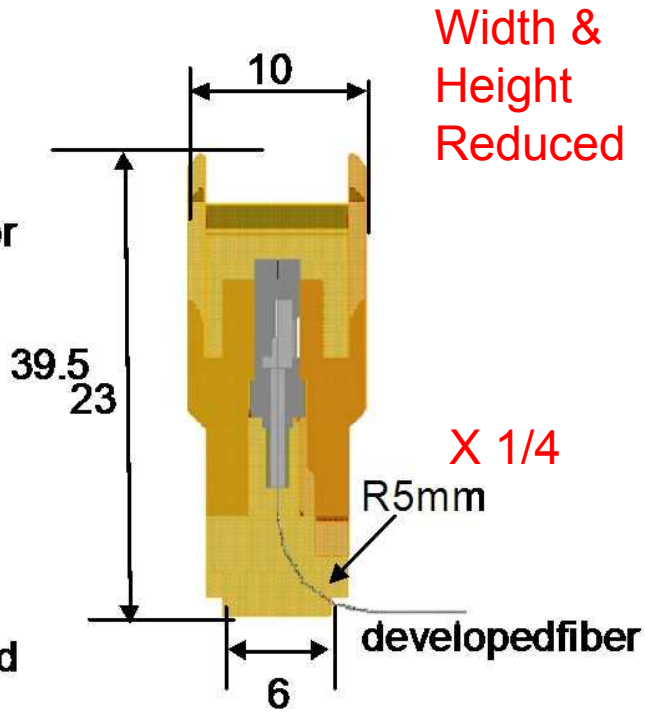
Right-angled connector housing



Cross section of the developed connector







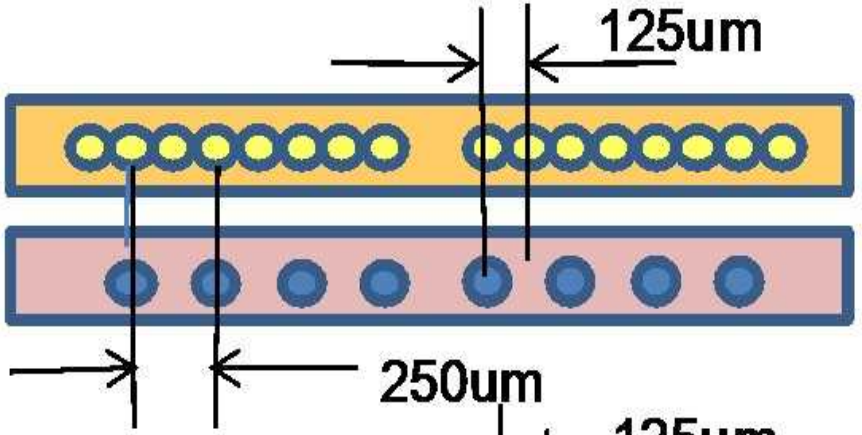
Conventional

Developed

Fine Pitch Ferrules

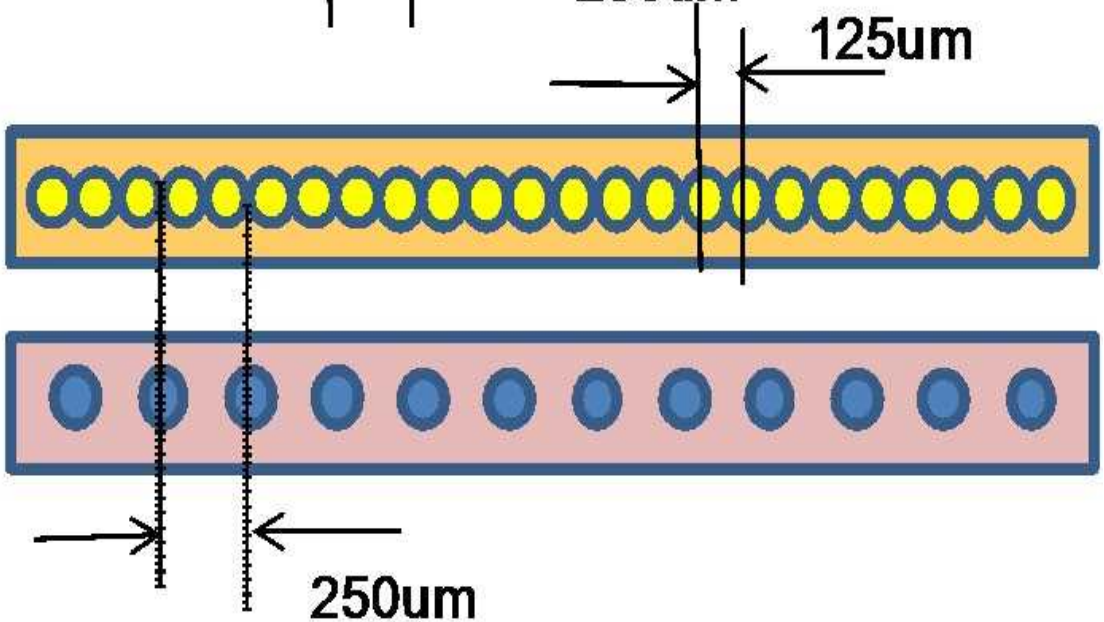
Developed (16 channel):
X 2 density 125um pitch

Conventional (8 channel):
250um pitch

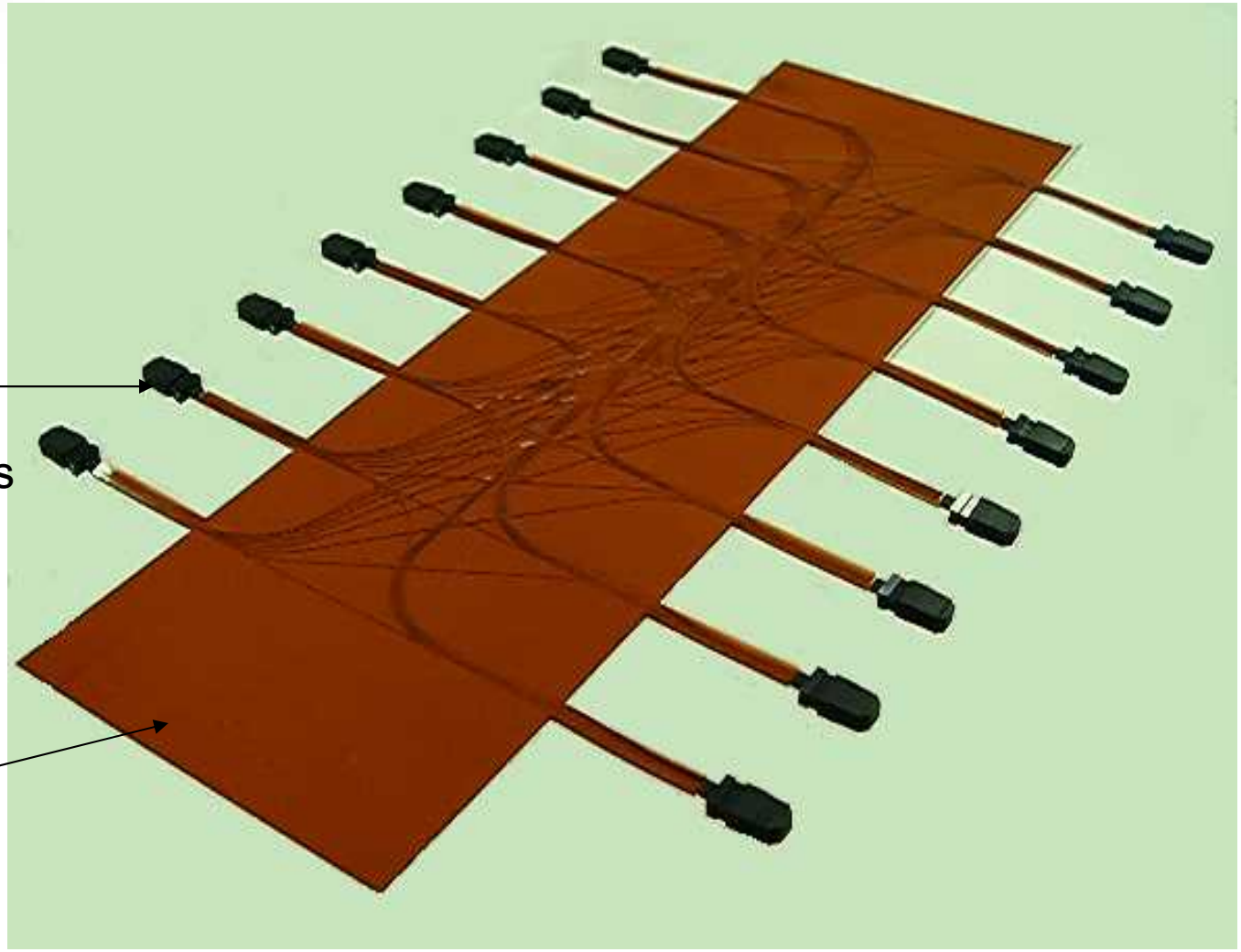


Developed (24 channel):
X 2 density 125um pitch

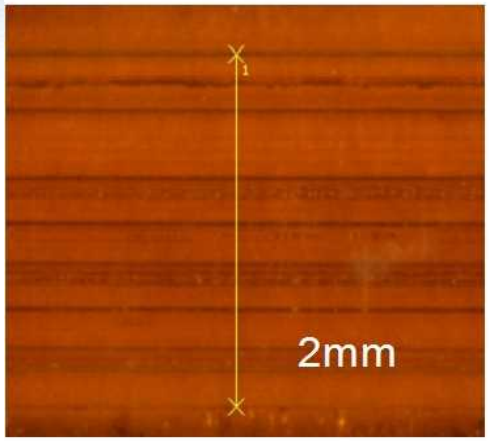
Conventional (12 channel):
250um pitch



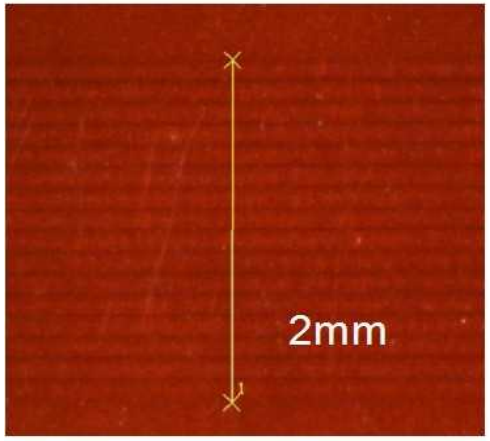
Optical Circuit Boards



Optical Fiber Sheets

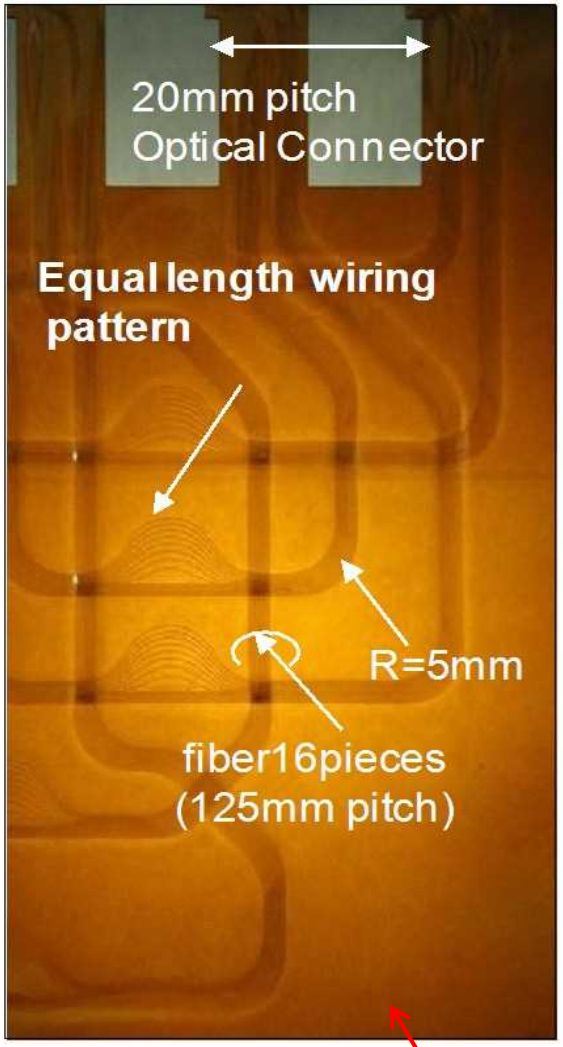


Fiber sheets with Conventional 250um pitch, 8pieces



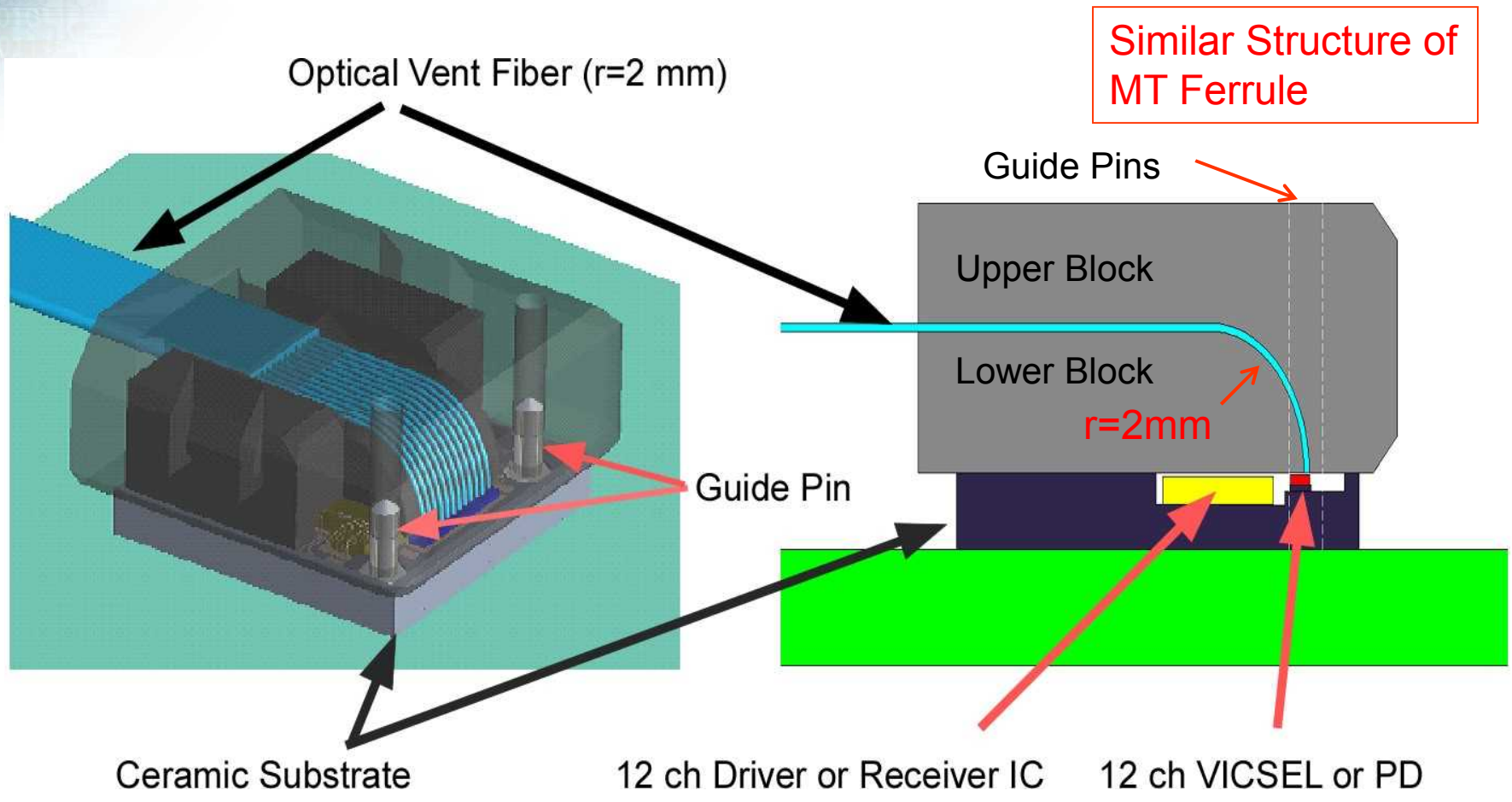
This work 125um pitch, 16pieces

X 2 density



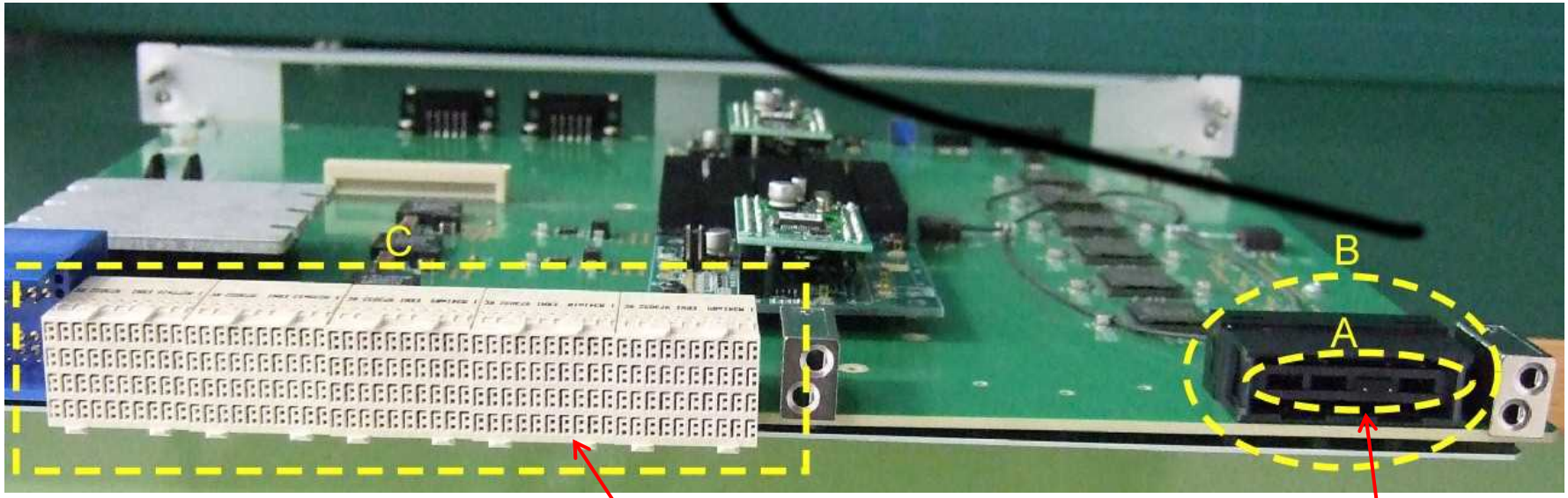
Polyimide Sheet

Structure of OE/EO Modules



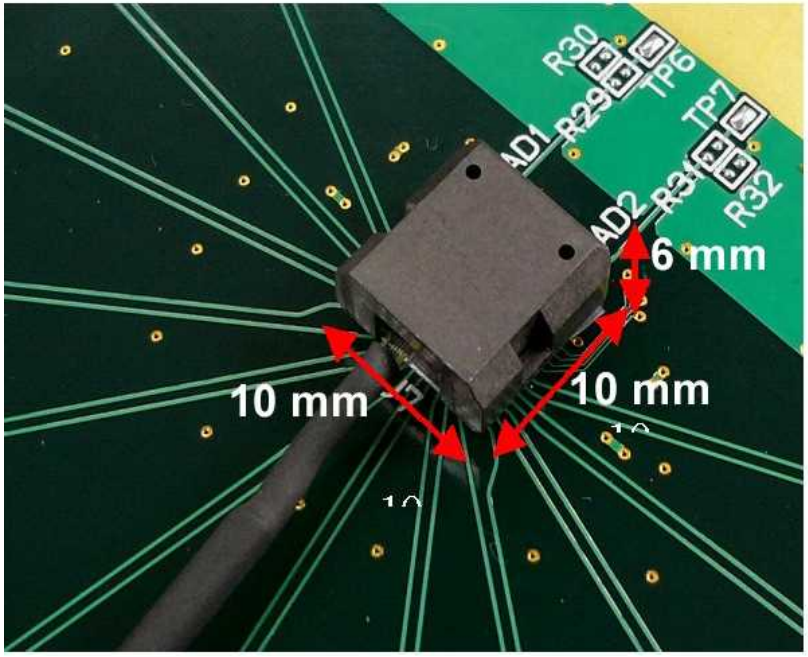
Possively aligned butt-coupling
Upper block pluggable

Optical Connector Assembled on ATCA™ Daughter Board



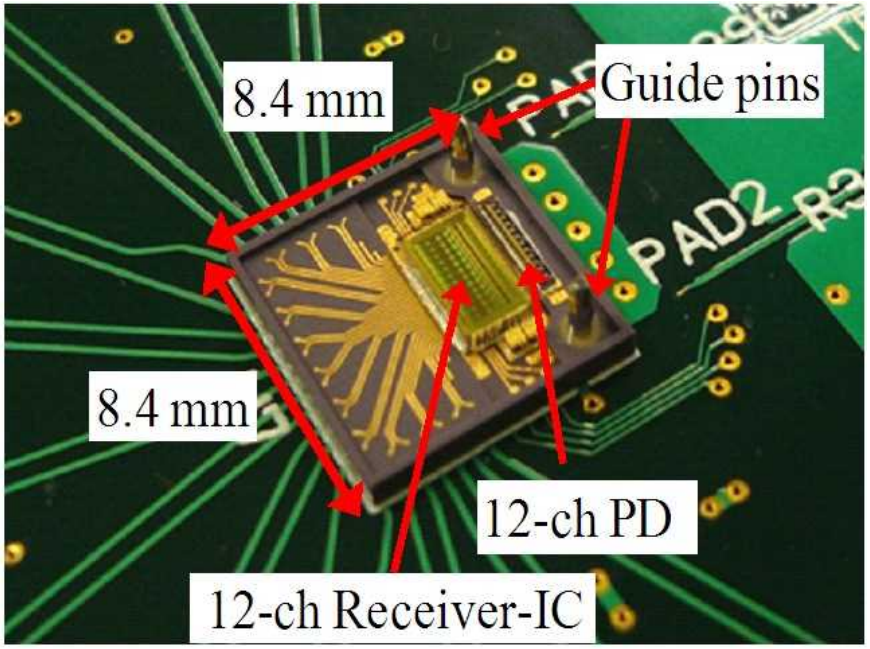
A; four optical ferrule,
B; optical connector housing which can accommodate four 24 or 16 signal ferrules,
C; five electrical connector each of which contain 40 pairs of electrical signals)

View of the Developed OE/EO Modules



Small Size 10mm x 10mm x 6mm

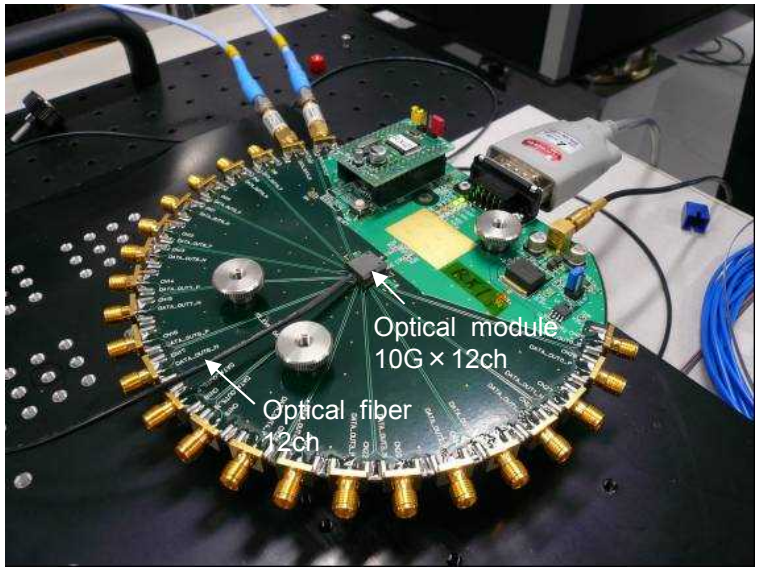
High transmission density
120Gbps/cm2



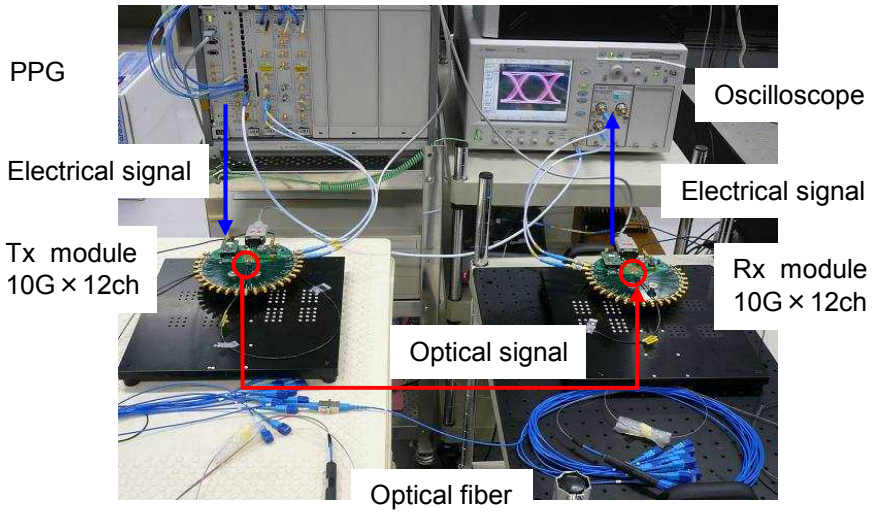
Receiver Module

SMT by Reflow Soldering

Tx-Rx Signal Transmission Experiment



Test Board



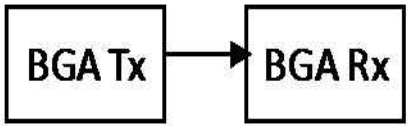
Tx-Rx evaluation system

Experimental Setup

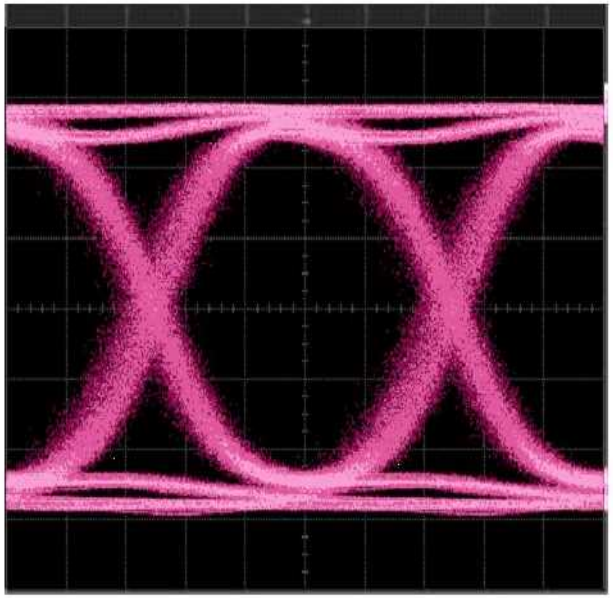
10Gbps transmission

Tx-Rx Experimental Results

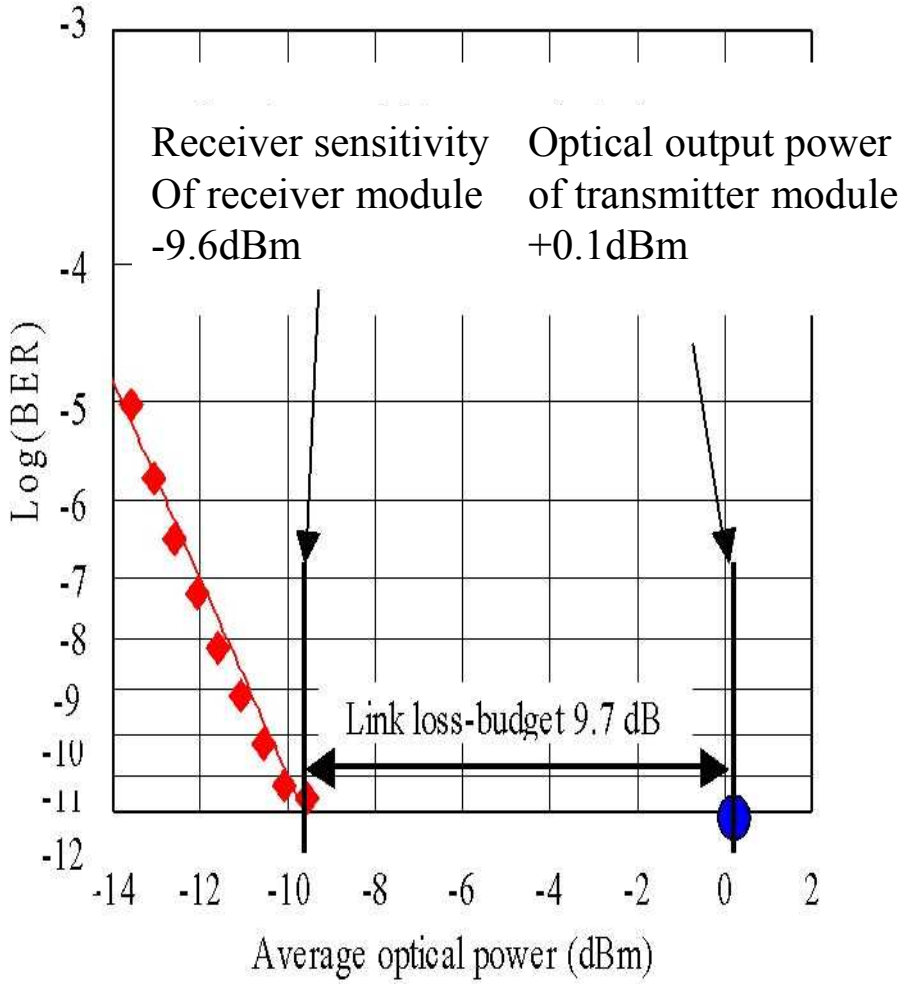
Result of Tx-Rx Back-to-Back experiments



X:20ps/div.
Y:100mV/div.
0mV Offset

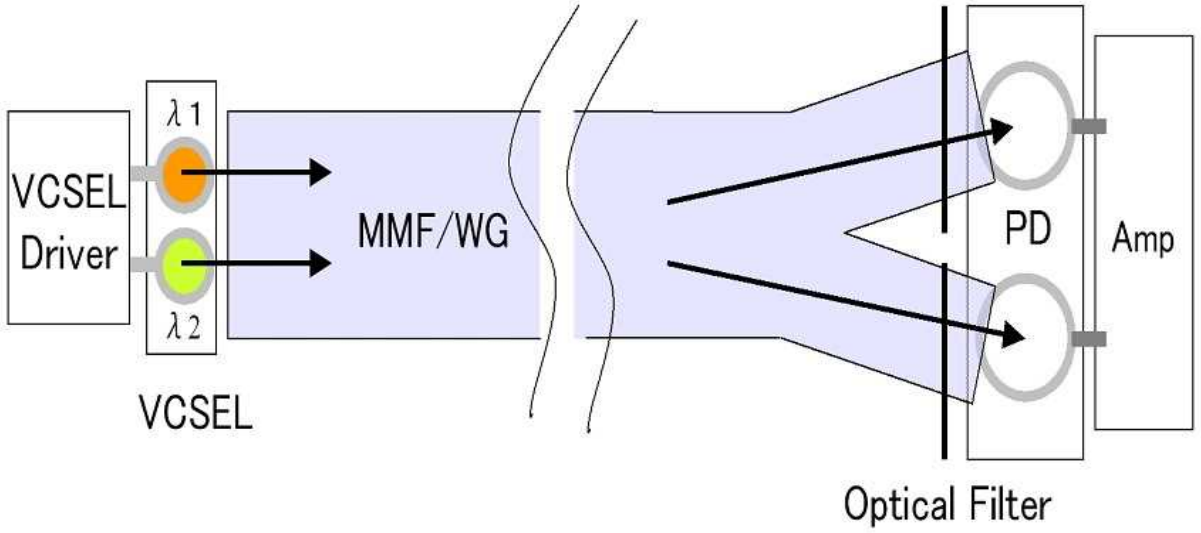


10Gbps eye diagram



Monolithic Two Wavelength VCSELs and Densely Packaged CWDM Configuration

30 μm pitch

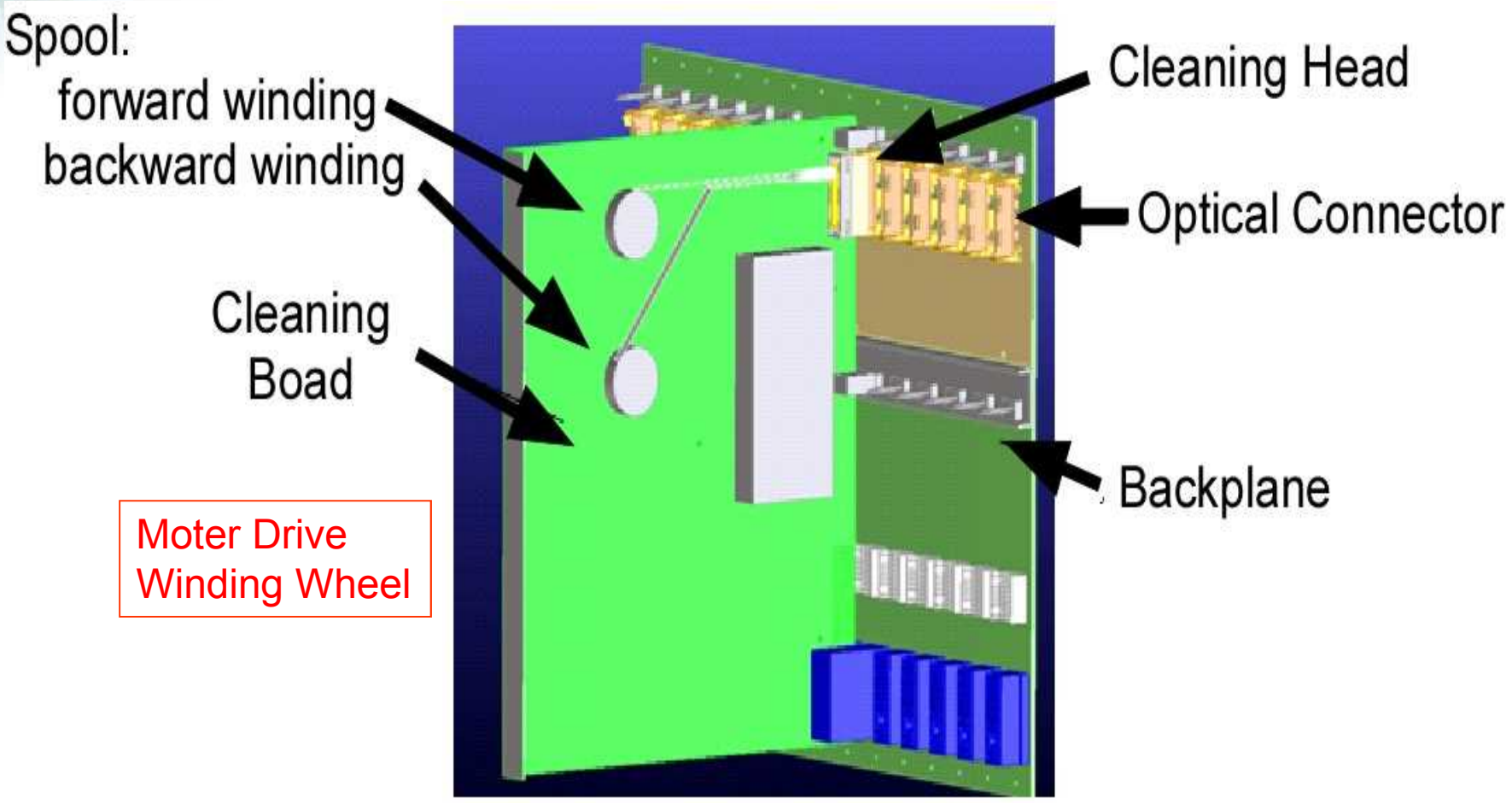


Photograph of monolithic two wavelength VCSELs

848nm and 862nm
Cavity structure modified

Densely packaged CWDM configuration

Diagram of Backplane Connector Cleaner



Optical Interconnection of NEC (2007)

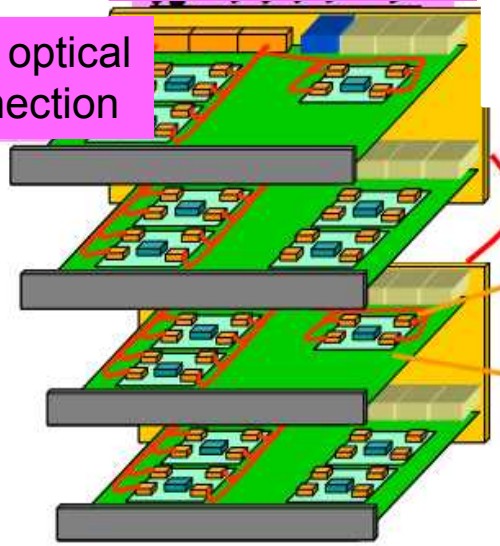
Optical interconnection using PETIT module

1. Increase of switching capacity without re-design of backplane
2. Seamless backplane connection without cabinets

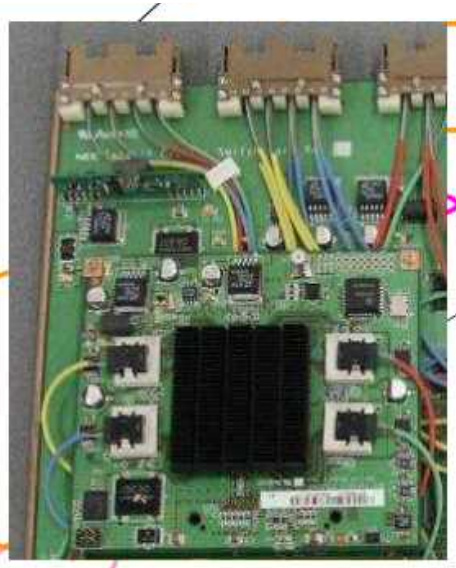
Optical connector for backplane
4x24coresx10G=960G

Inter cabinet optical backplane

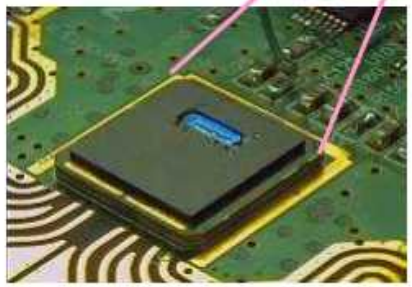
Onboard optical interconnection



Inter cabinet optical interconnection



Optical fiber



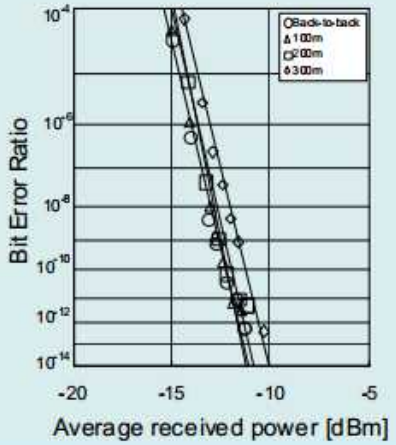
PETIT
(Photonic/Electronic
Tied InTerface)
4x3.125Gbps、4x10Gbps
12x12mm

http://akari-project.nict.go.jp/document/akari_event/2007_06/akari_ws_2007/0202_araki_opticalnw.pdf

Micro-packaging technology

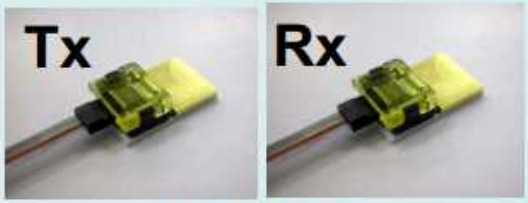
APPLICATION OF THE MICRO-PACKAGING TECHNOLOGY (NEC)

- 10Gb/s x 12ch transmitter (Tx) and receiver (Rx) with the same form factor
  - 10G x 12ch electrical signal ←→ 10G x 12ch optical signal (850 or 1050nm)
  - Optical devices and LSI are 12ch VCSEL or PD array, LDD or TIA/Lim, for Tx or Rx
  - Faster release planning



Example of 10Gb/s Optical Transmission Characteristics

- 1050nm-Tx to Rx, up to 300m

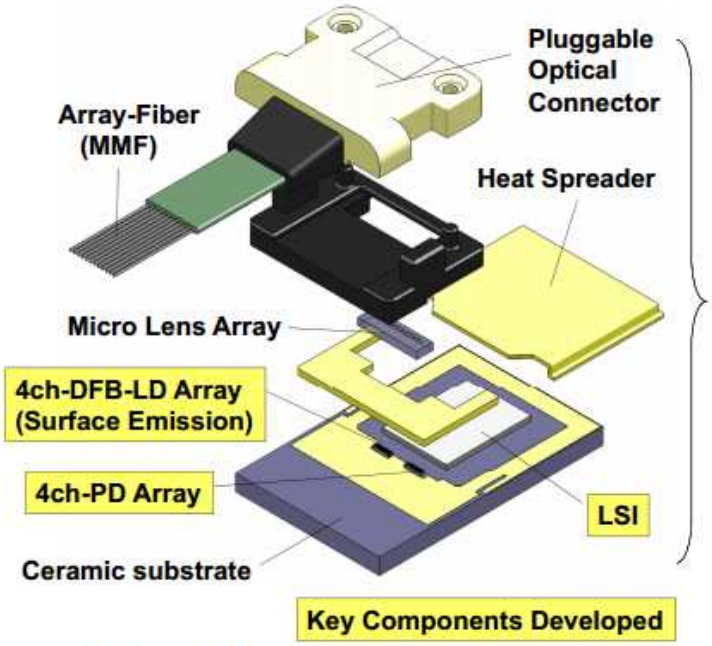


W9 x L14 x H4 mm

AlaxalA Empowered by Innovation NEC HITACHI Inspire the Next PETRA

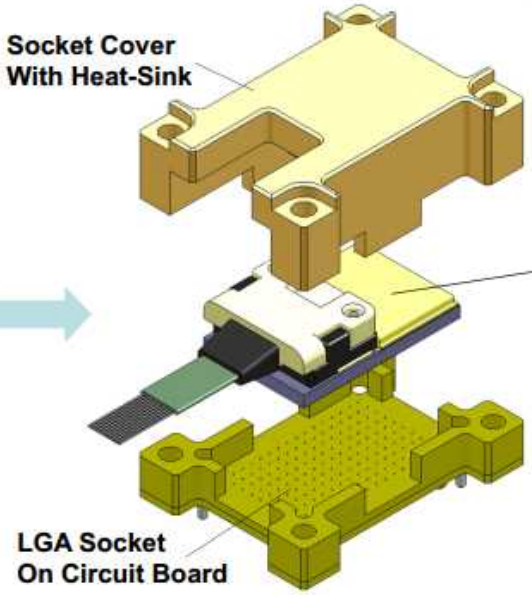
http://www.petra-jp.org/doc/closePJ_1-6.pdf

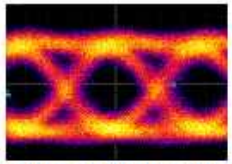
100Gbps OE/EO Module



Optical Module schematic structure

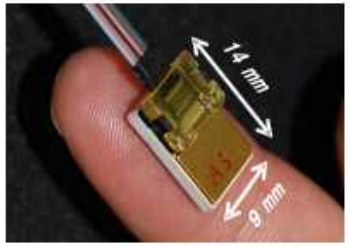
High Capacity Edge Router with Optical Backplane





25 Gb/s optical output

Optical Module (TRx)
W9 x L14 x H5.3mm

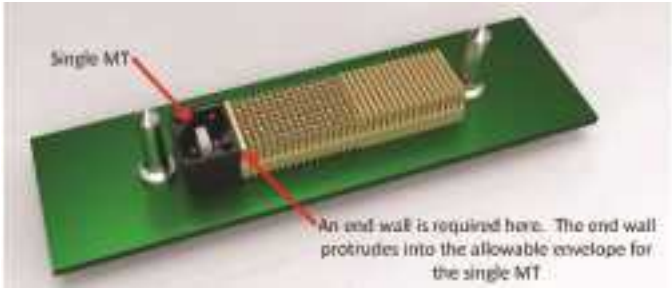


Socket Mounting on Circuit Board

http://www.petra-jp.org/doc/closePJ_1-6.pdf

Optical interconnection to VPX architecture (2013)

Proposed alternate optical connector, with a single MT ferrule

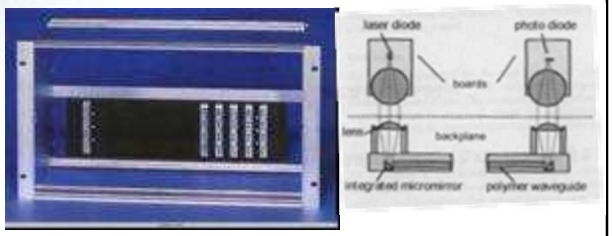
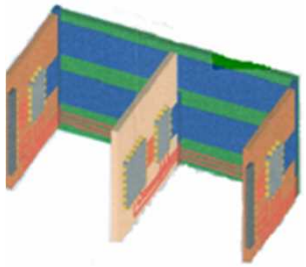
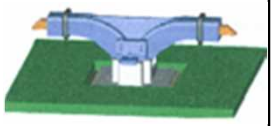
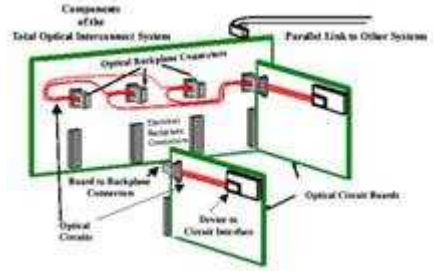
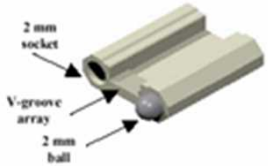


6U VPX switch card from Annapolis Microsystems is the first VPX switch capable of switching either 40GBASE-KR4 Ethernet channels or 56Gbps InfiniBand FDR channels

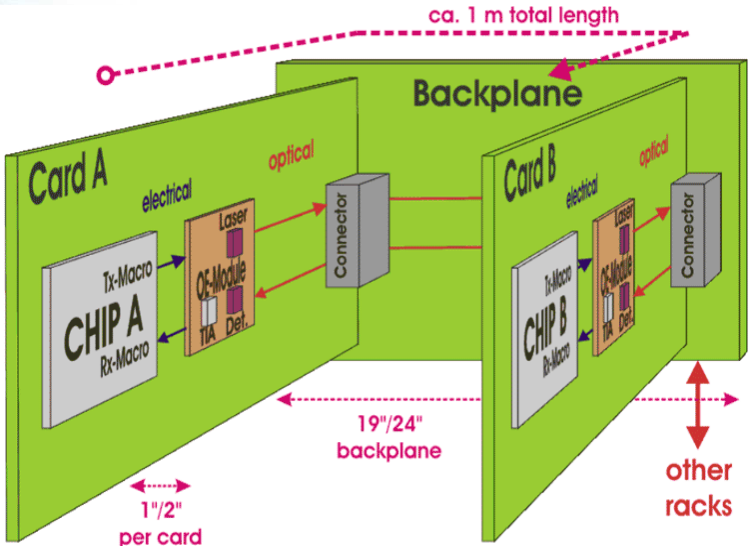
http://eecatalog.com/vme/2013/02/15/vpx-backplanes-go-optical/

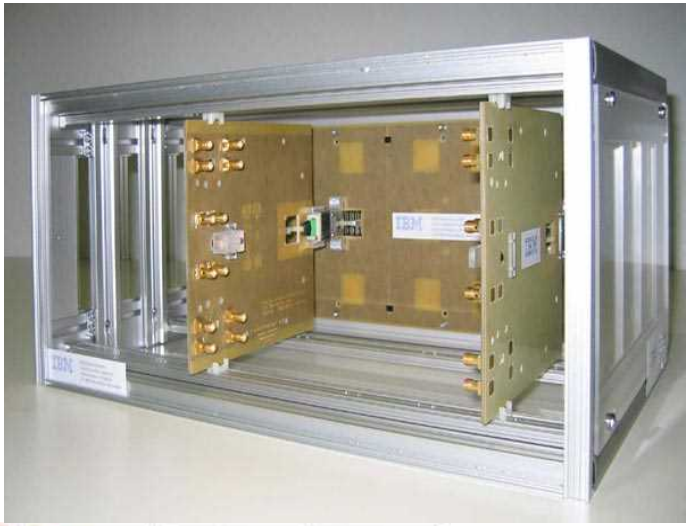
Contents

Former research of optical backplanes

Organiuzation	Features	Subjects
Daimler-Chrysler（2001） 	・Optical interconnection using molded MM polymer waveguide ・Right angle light direction using 45degree mirror ・E/O active connector	・Multimode only ・Short wavelength ・I/O pitch 7.6 mm ・Optical loss: 0.04dB/cm
IST-IO Project（2002）   Butt joint connector	・board to board interconnection using POF matrix（8×8 or 16×16） ・Technology for Router 7770 of Alcatel	・Reliability ・Stability
3M（2003） 	GGP fiber board and the right angle connector  Ball and socket ferrule	・Multimode ・Nonstandard ferrule ・Connection loss: ～1dB

Backplane research at IBM Zurich (2005)



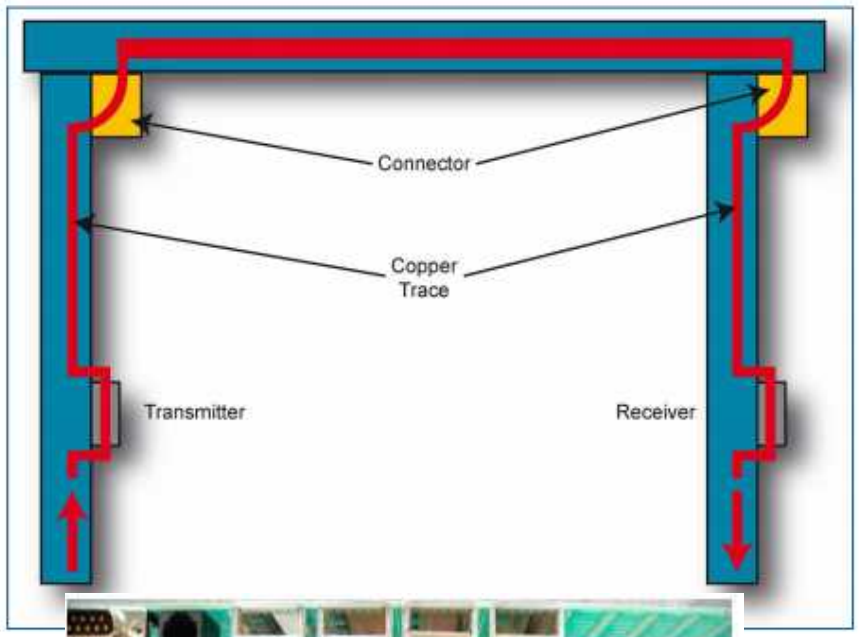


	Internet, Wide Area Network	Local Area Network	Rack-to-Rack	Card-to-Card	On-Card	On- MCM	On-Chip
							
Distance	multi-km	10 - 2000 m	30+ m	1 m	0.1 - 0.3 m	5 - 100 mm	0.1 - 10 mm
Number of lines	1	1 – 10	~100	~100-1000	~1000	~10'000	~100'000
Use of optics	Since the 80s and the early 90s	Since the late 90s	Now	2010+	2010-2015	Probably after 2015	Later, if ever

Our Focus

http://www.zurich.ibm.com/st/server/interconnects.html

Optical Backplane Research in UK (2006)



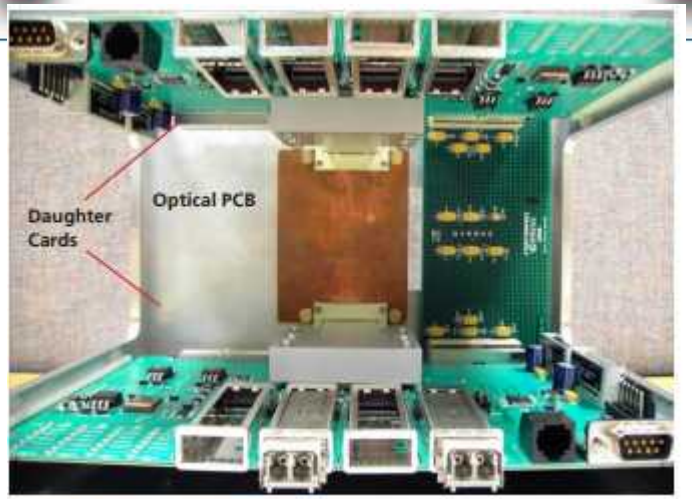


Figure 8: Optical Connector Test Rig

Figure 6a: Parallel optical transceiver circuit

Figure 6b: Optical interface platform

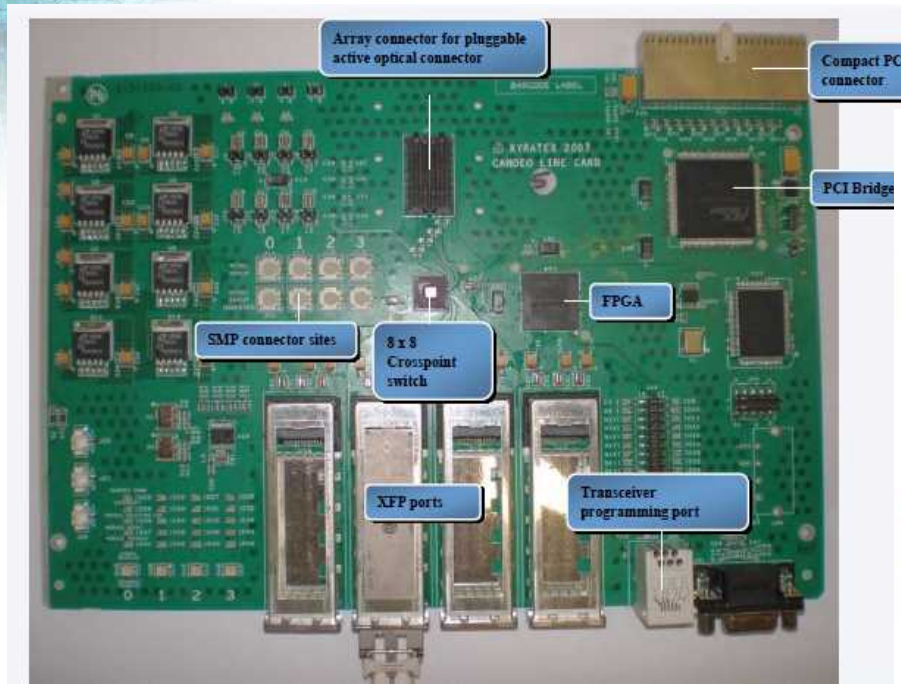
Figure 7a: Pluggable optical backplane connector

Figure 7b: Optical backplane connector on line card

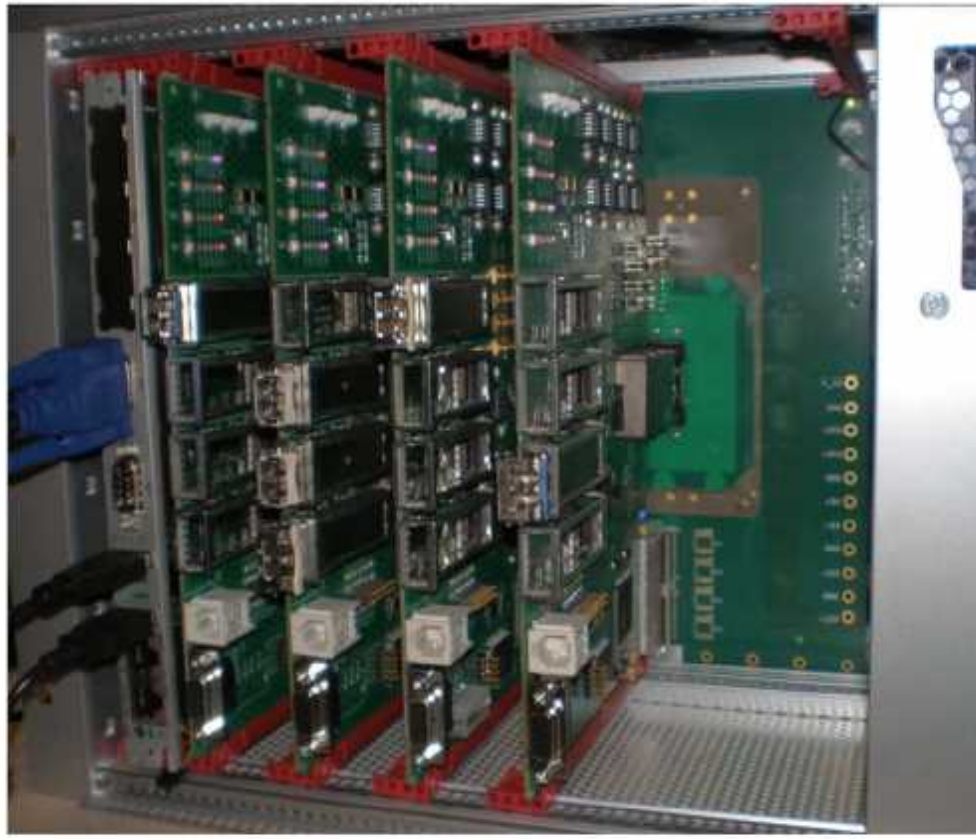
https://www.xyratex.com/sites/default/files/Xyratex_white_paper_Pluggable_Optical_Backplane_2-0.pdf

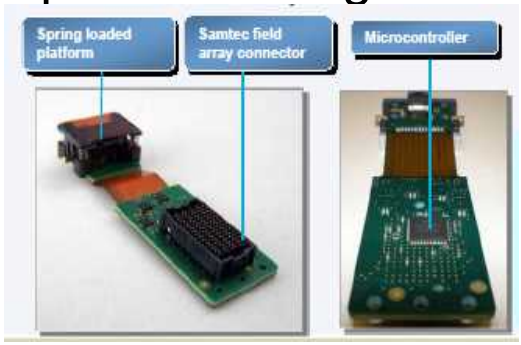
xyratex

Optical Backplane Research in UK (2007)



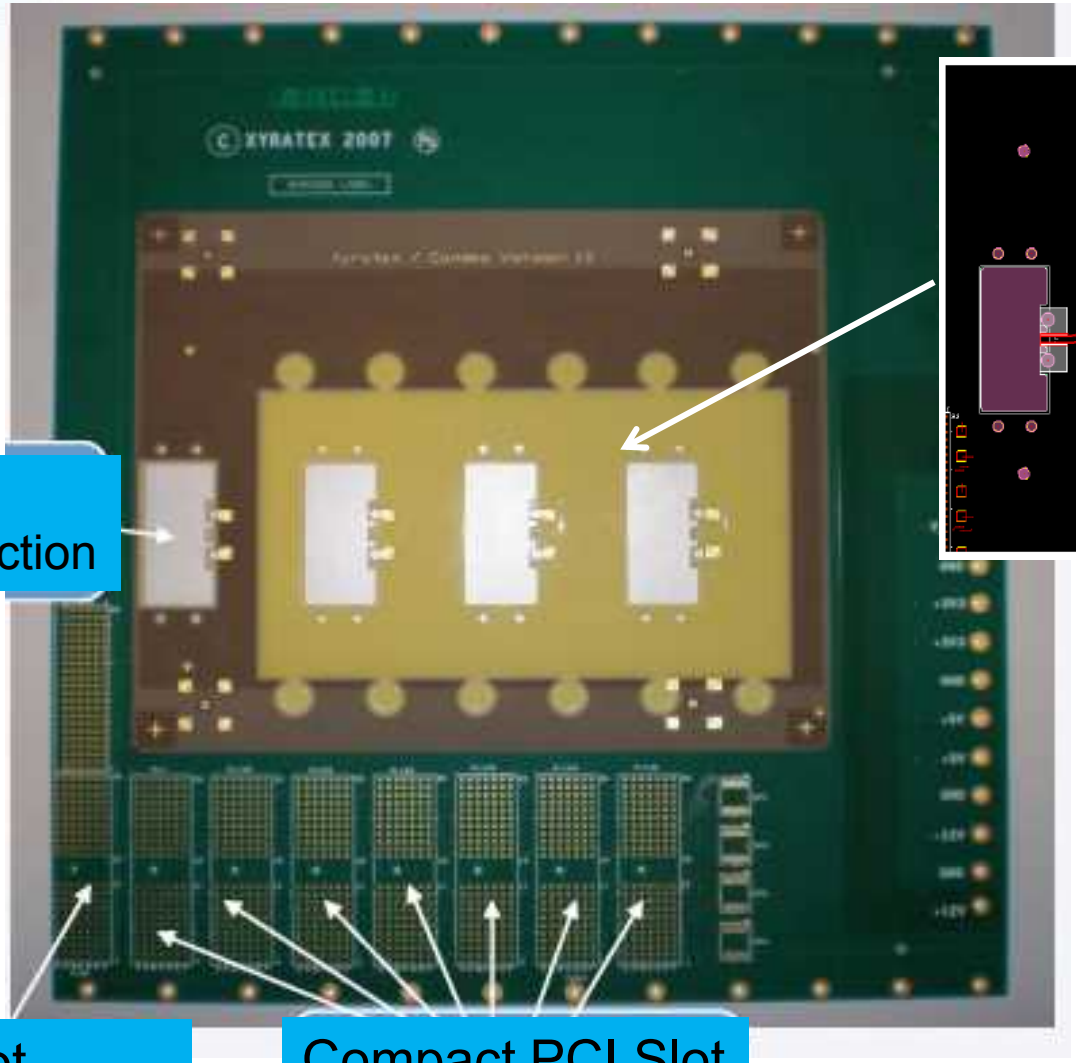
Highspeed Switcing line card

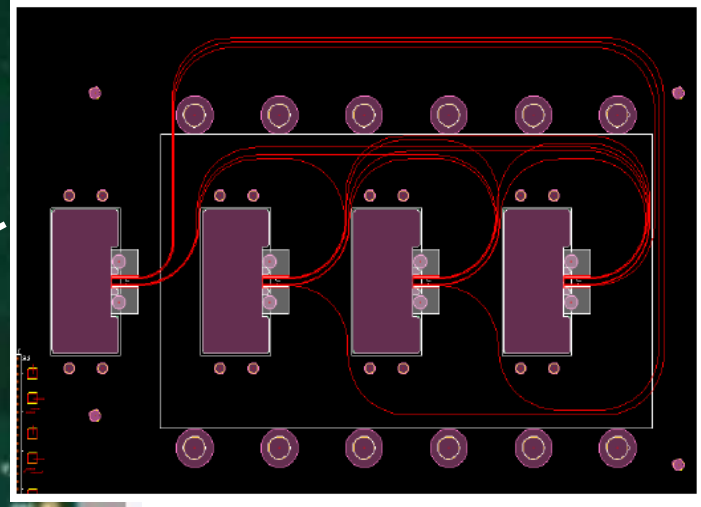




4-parallel optical transceiver module

Optical backplane in UK (2007)



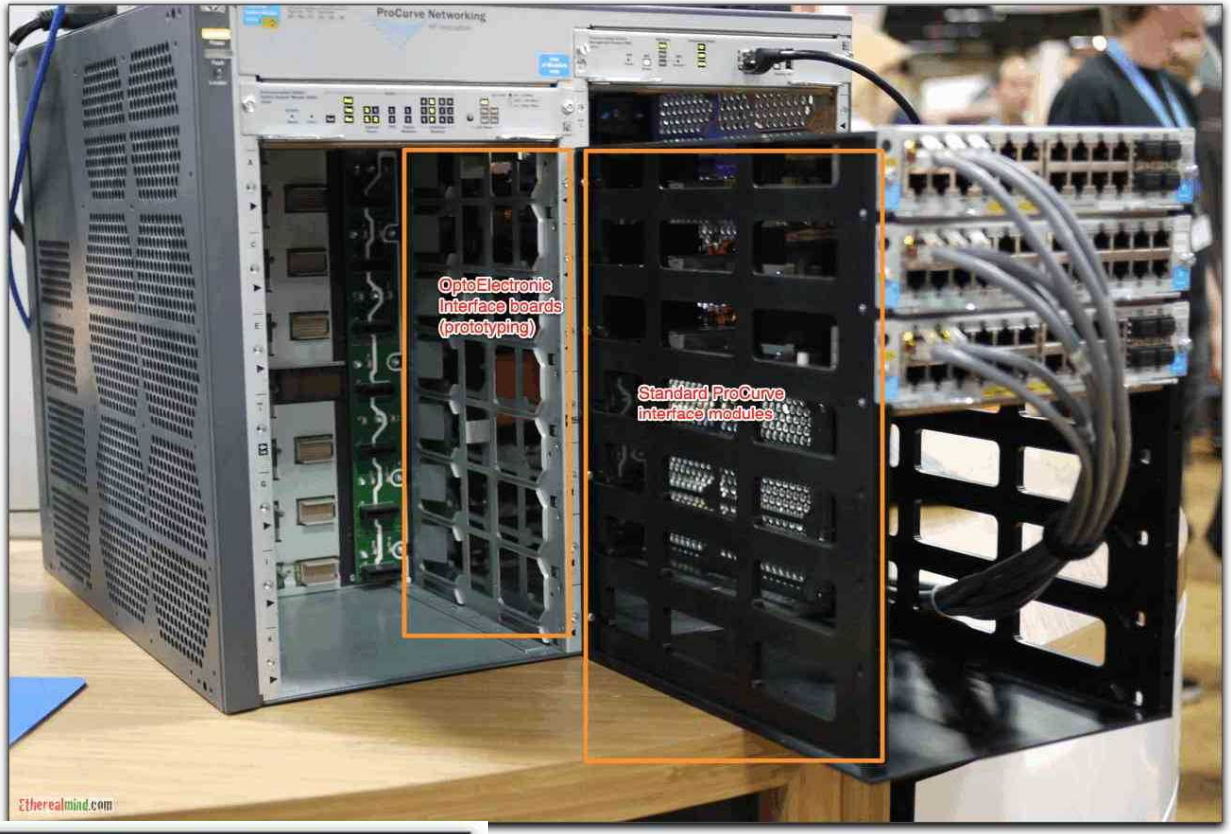


Optical interconnection

PCI Slot for Control PC

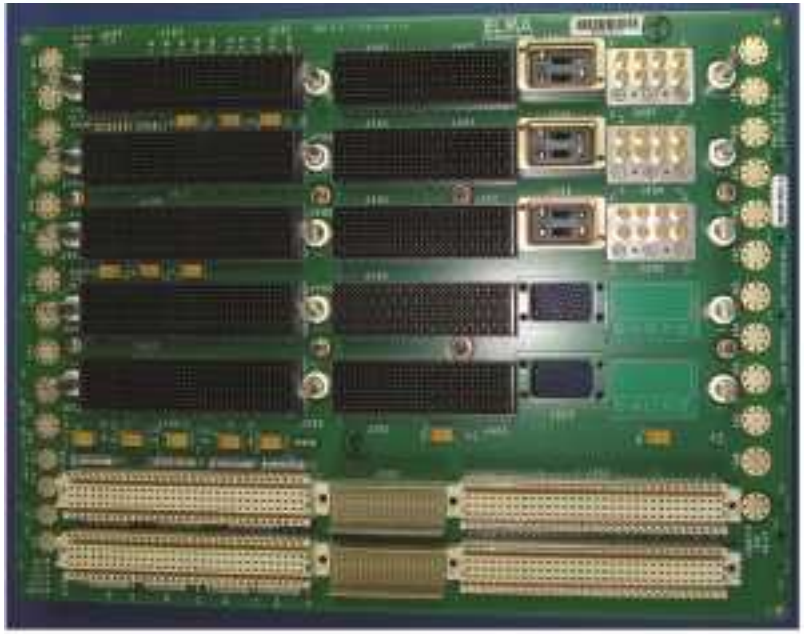
Compact PCI Slot

Prototype E8212 ProCurve switch with fully optical backplane of HP（2011)



http://etherealmind.com/hp-optical-backplanes/

Optical Interconnection to VPX Architecture (2013)

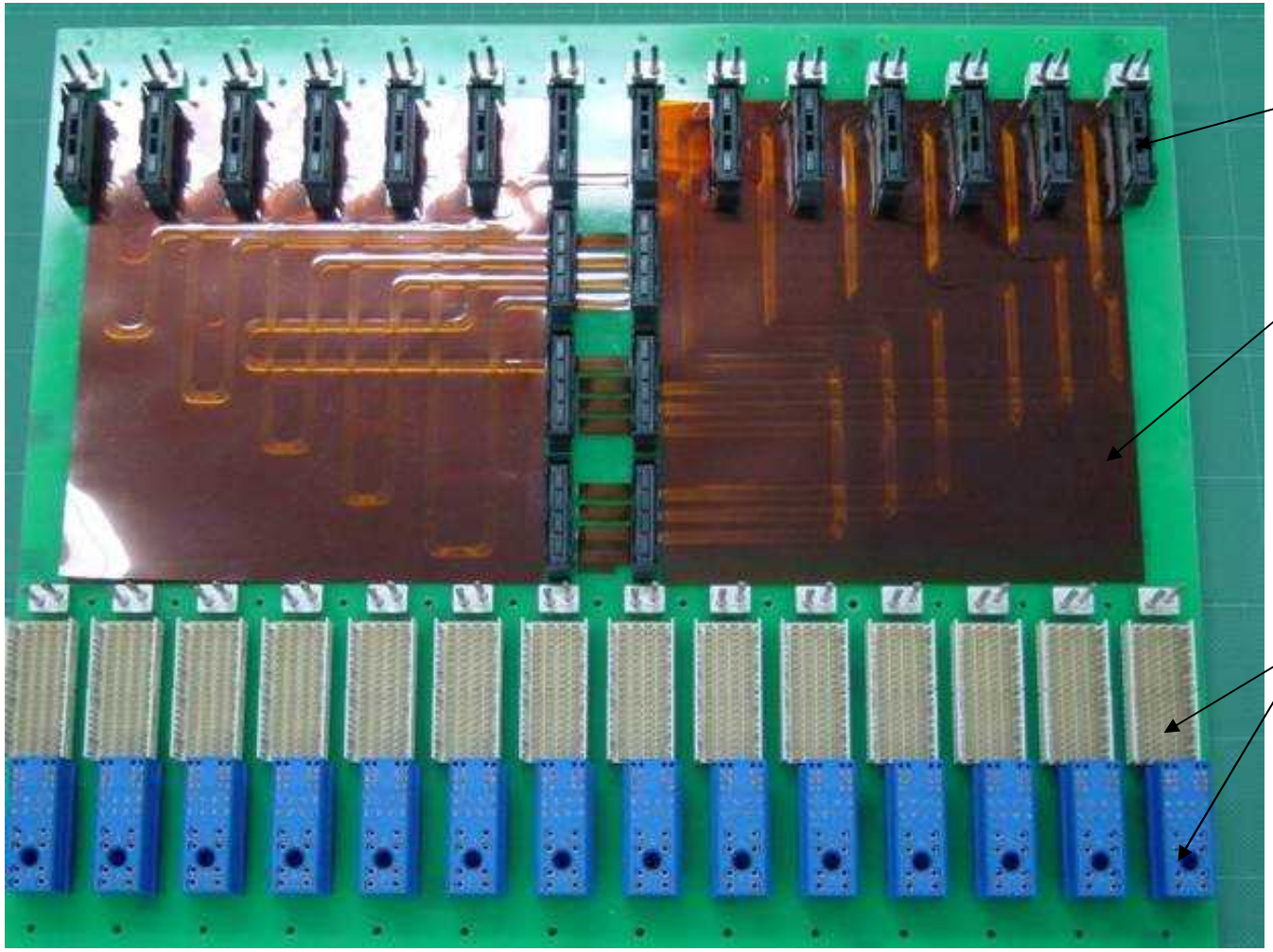


Hybrid VME/VPX backplane with VITA 66.1 optical connectors and VITA 67.2 coaxial copper connectors and standard VITA 46 MultiGig connectors in positions J0-J4.

Optical ferrules

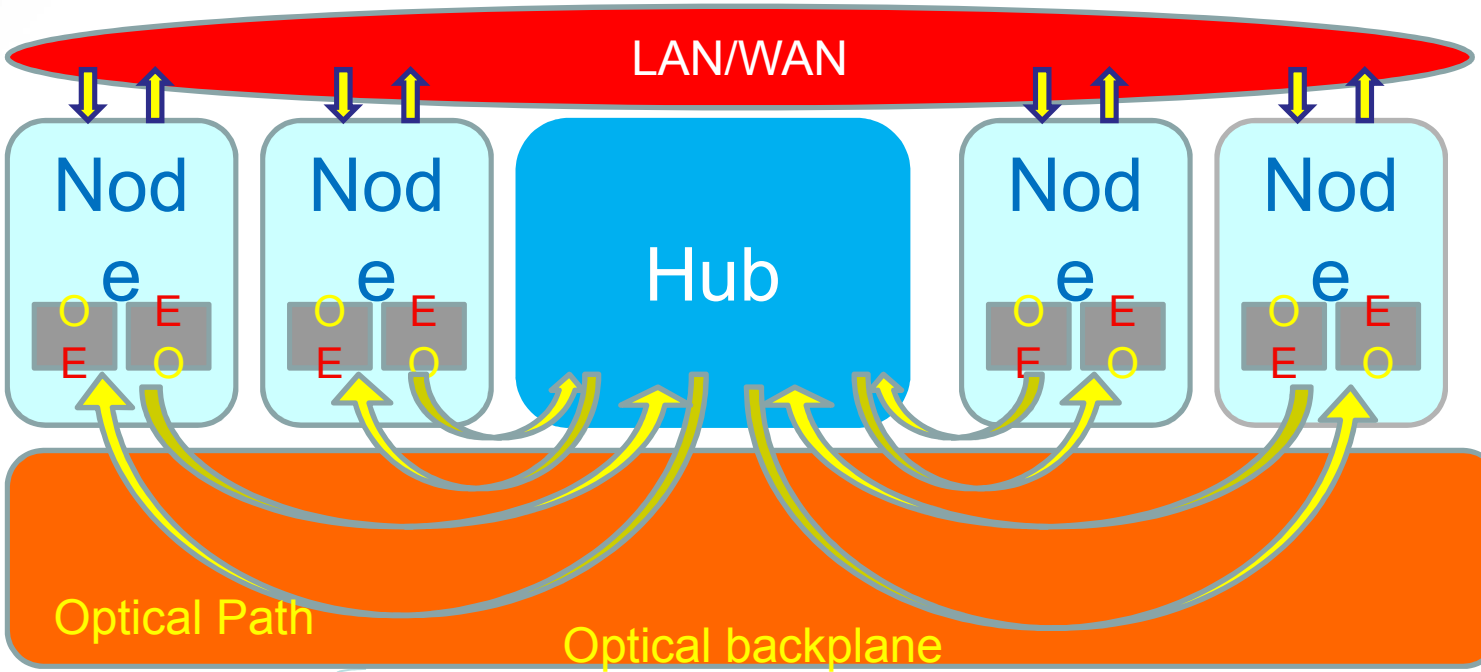
http://eecatalog.com/vme/files/2013/02/fig2.jpg

Optoelectronic Backplane Based on PICMG™3.0 ATCA



ATCA® : Advanced Telecommunications Computing Architecture,

Structure of Optical Backplane for Router/Switch



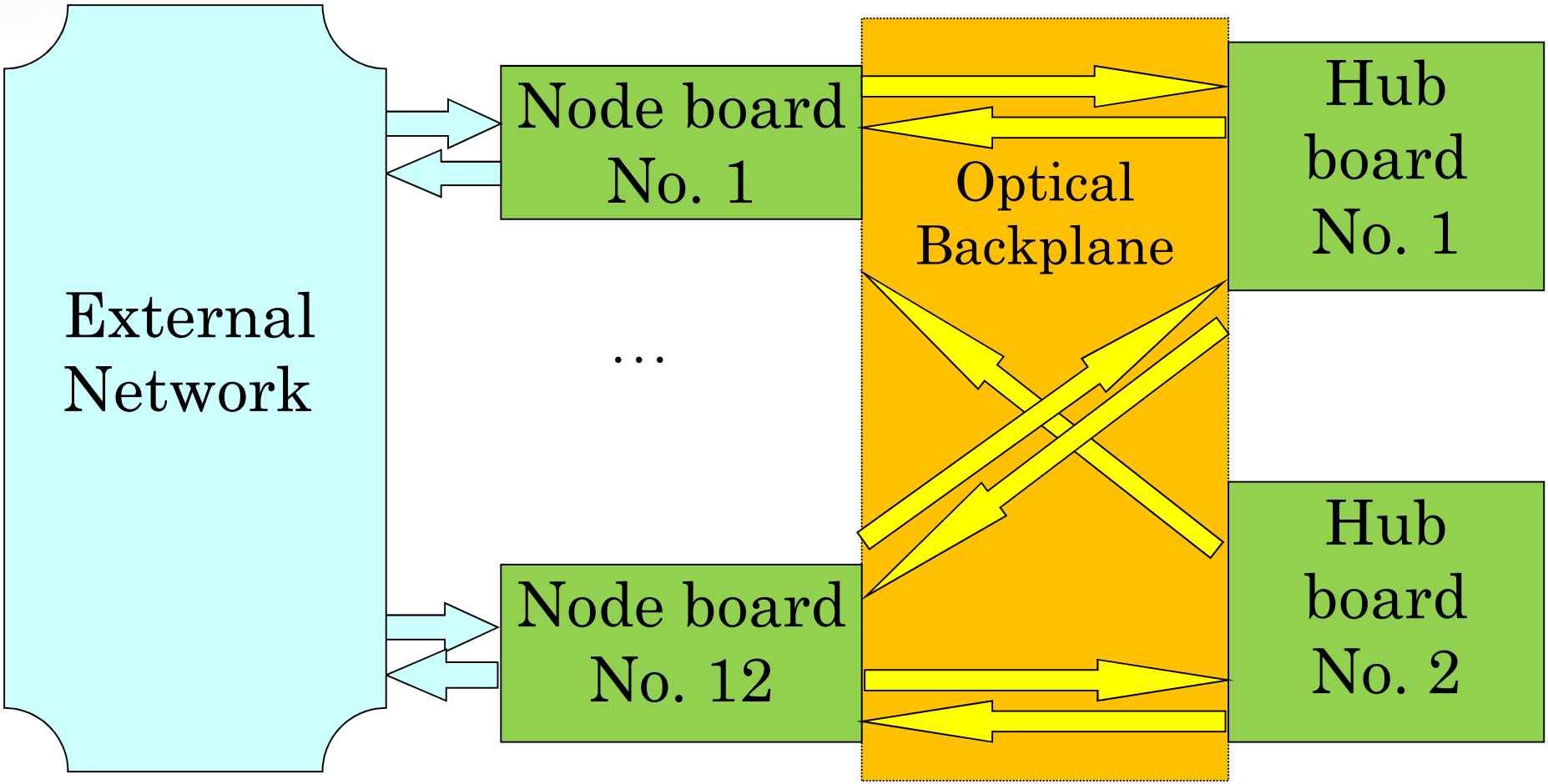
- Hub
  - All Optical
    - Optical Switch
    - Cyclic Wave
    - Full Mesh
  - EO Hybrid
    - EO/OE
    - +Switching LSI
- Optical Path
  - Optical Path Medium
    - Single/Multimode Fiber
    - Waveguide
  - Uni/Bi-direcional
    - Single/Multi Wave

Comparison of Optical Data Signals with Electrical Data Signals on the Developed Backplane

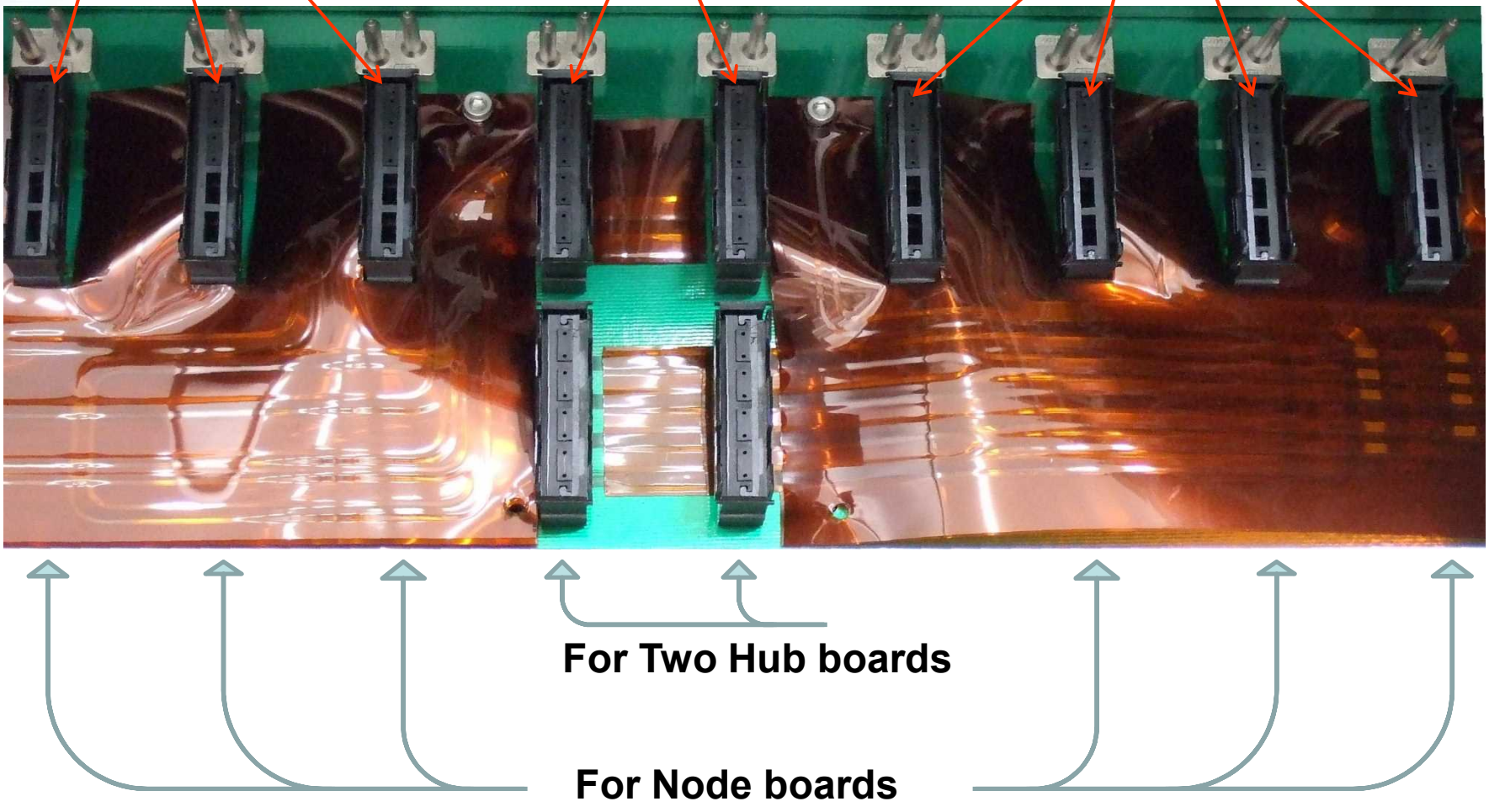
Items	Optical Data Signals in Zone 3	Electrical Data Signals in Zone 2
Transmission Medium	Multimode Optical Fiber	Differential Pair
Number of Slots	14(=12 Node + 2 Hub)	
Number of Data Signals	32 Lines / Node 192 Lines / Hub	16 pairs / Node 96 pairs / Hub
Total No. of Data Signals	384 Lines	192 pairs
Signal Speed	10 Gbps / line *	5 Gbps / pair**
Aggregate Throughput	3.84 Tbps*	0.96Tbps**

*: When 10Gbps/line OE/EO modules are used.
**: When 775-ATR14N, EBRAINS, Inc. is used.

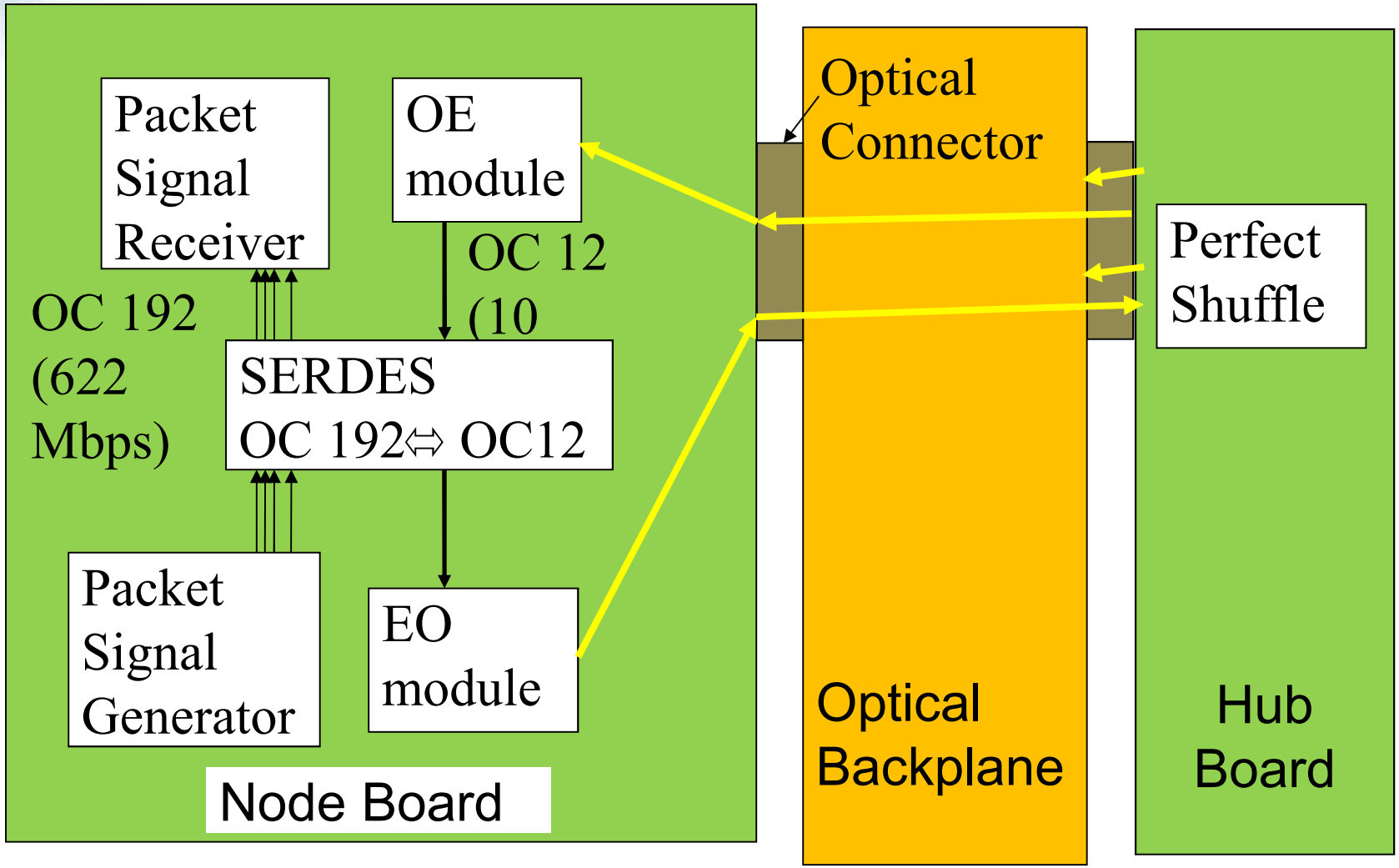
Optoelectronic 40 Gbps Dual Star Router/Switch Which Could be Realized by the Developed Backplane



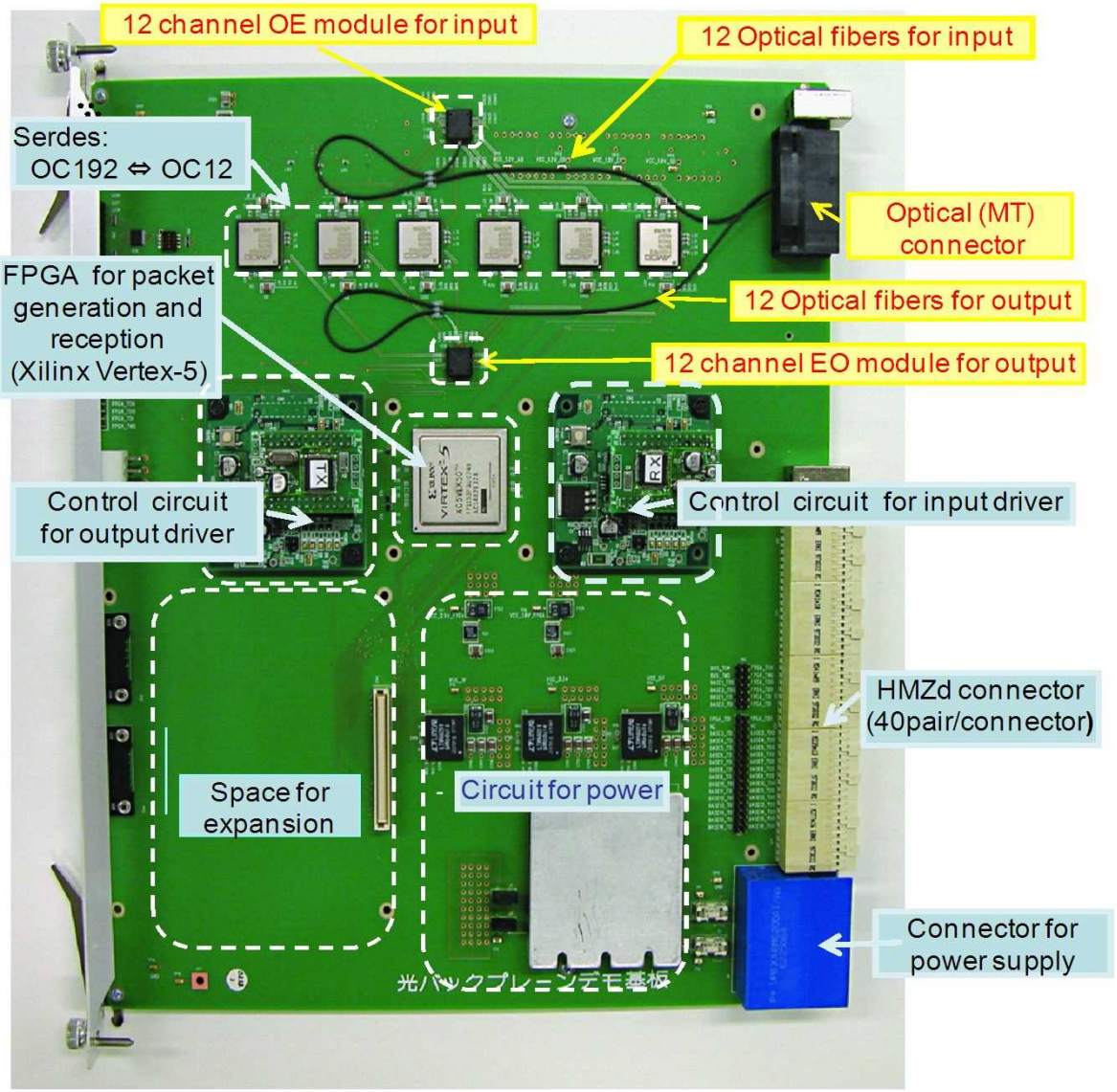
Developed Optical Backplane in Zone 3



Signal Path in the experimental System

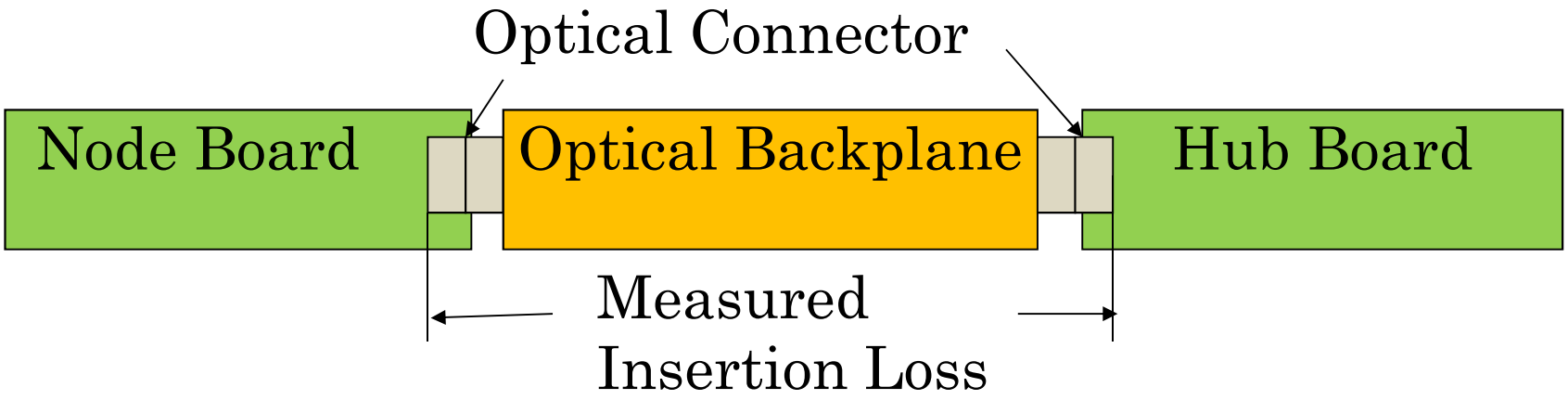


Developed Node Board



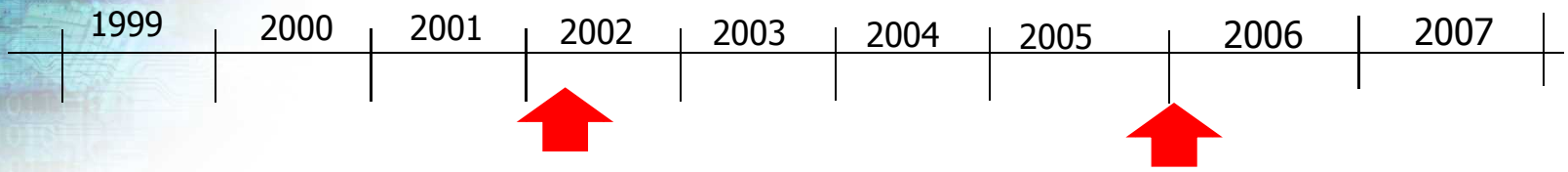
Insertion Loss of Optical Backplane Including Node and Hub Board Connectors

Number of Samples	131
Mean Value	1.86 [dB]
Maximum Value	3.31 [dB]
Minimum Value	0.5 [dB]
Standard Deviation	0.63



Contents

National Research Projects in Japan



Ultra High density Electronic System Integration Project

(ASET)

Standardization of passive Optical Devices (ASET)

Reliability tests and standardizaiton of Optical Jisso cimponents

Standardization of Optical backplane System

(AIST)

Hyper SI 1
(AIST Collaboration Research Team)

Hyper SI 2
(AIST Collaboration Research Team)

Application R&D of Optical Backplane and Optical Interconnection

Fundamental Jisso Technology for Optical interconnections (Active Interposer, Optical Waveguide Circuit Board, Opcical connectors, etc.)

Seeds Research

Application Research

International Standardization Organizations

ISO (International Organization for Standardization)

NGO of international Industrial standardization except electrical fields.

IEC (International Electrotechnical Commission)

not-for-profit, non-governmental organization
develops consensus-based International Standards and manages conformity assessment systems for electric and electronic products, systems and services,

ITU (International Telecommunication Union)

specialized agency of the United Nations that is responsible for issues that concern information and communication technologies

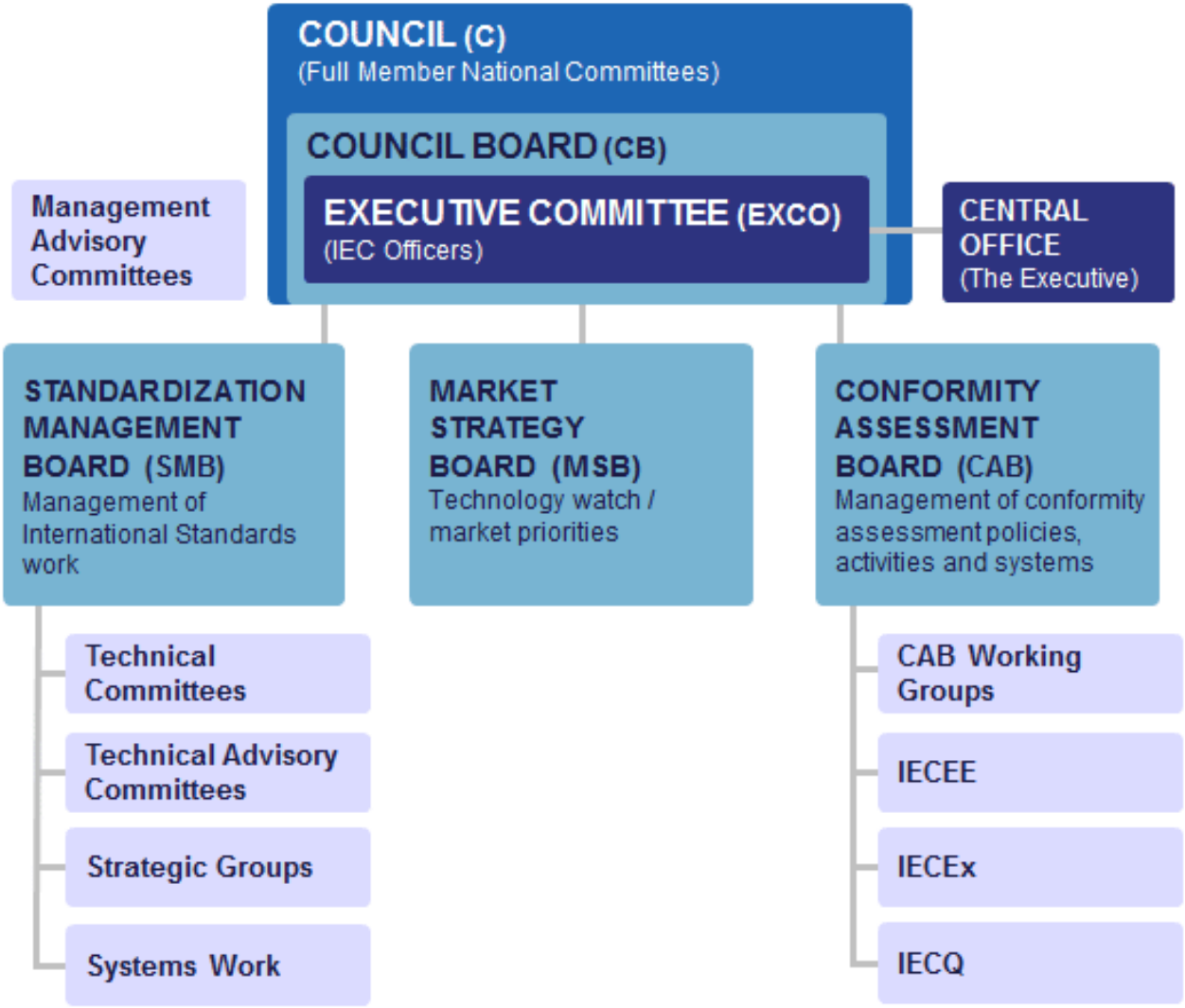
IEC :
International Electrotechnical Commission

- not-for-profit, non-governmental organization
- founded in 1906
- Annual budget: CHF 20 million.

- The IEC develops consensus-based International Standards and manages conformity assessment systems for electric and electronic products, systems and services, collectively known as electrotechnology.
- The IEC comprises one member National Committee per country, they each pay membership fees and in exchange can participate fully in IEC work.

http://www.iec.ch/

Organigramme of IEC



http://www.iec.ch/dyn/www/f?p=103:63:0##ref=menu

Technical Committees of IEC

TC（Technical Committee）

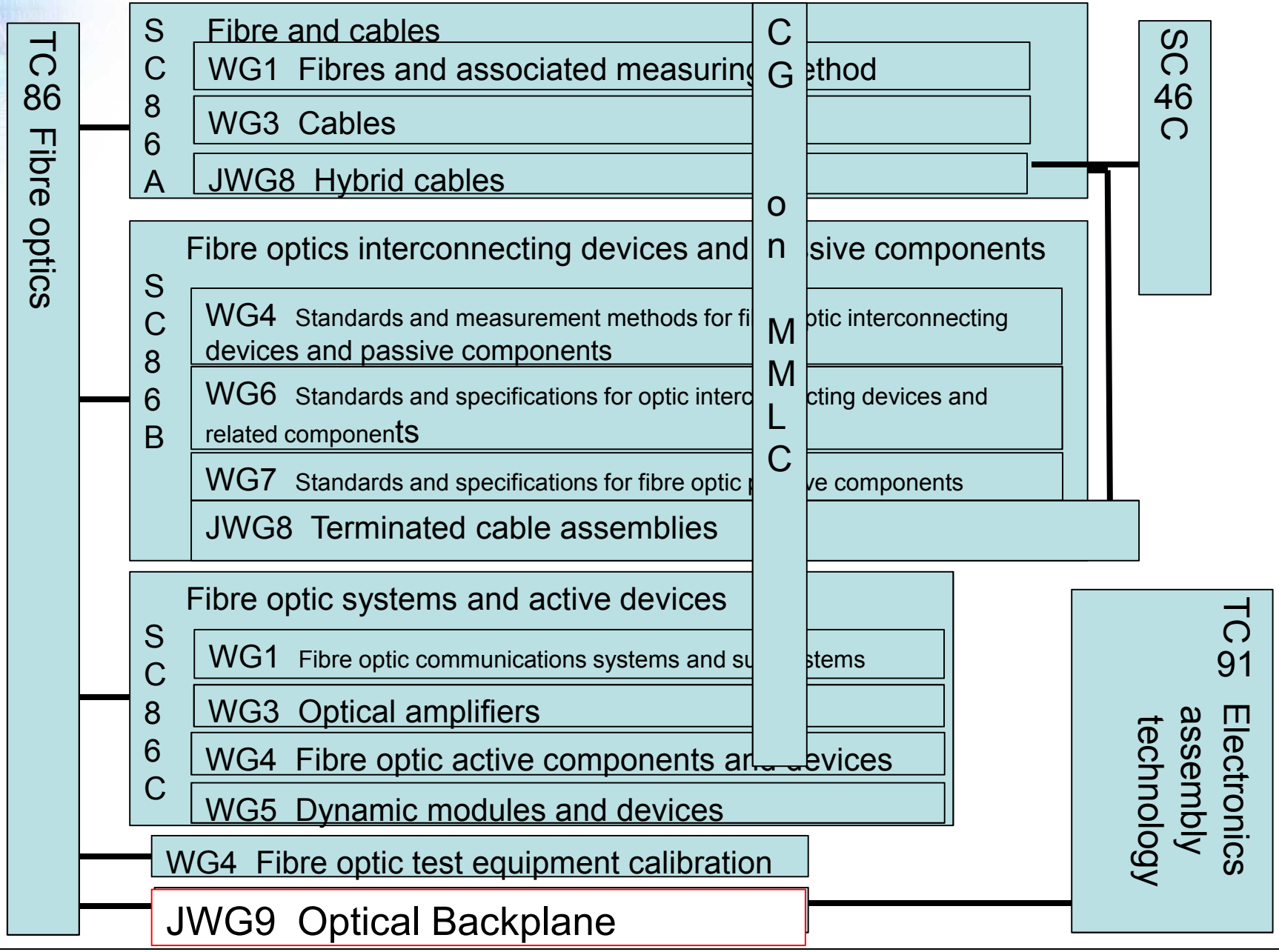
TC 1(Terminology) -TC 114(Marine energy - Wave and tidal energy converters)

Joint TC with ISO

TCs of information Tecnology（TC 53, 83,）⇒ ISO/IEC JTC 1（1987）

TC	SC	名称	name	Major IS	secretary（2006）
1		用語	Terminology		SPA
2		回転機	Rotating machinery		UK
3		情報構造、ドキュメンテーション及び図記号	Information structures, documentation and graphical symbols		SWE
	C	機器・装置用図記号	Graphical symbols for use on equipment		JPN
	D	電気・電子技術分野のメタデータライブラリ	Product classes and properties and their identification	IEC 61360	GER
4		水車	Hydraulic turbines		CAN
5		蒸気タービン	Steam Turbines (IN		UK

			equipment and systems		
81		雷保護	Lightning protection		ITA
82		太陽光発電システム	Solar photovoltaic energy systems		USA
85		電磁気量計測器	Measuring equipment for electrical and electromagnetic quantities		CHN
86		光ファイバ	Fibre optics		USA
	A	光ファイバケーブル	Fibres and cables		FRA
	B	光部品	Fibre optic interconnecting devices and passive components		JPN
	C	光ファイバシステム	Fibre optic systems and active devices		USA
87		超音波	Ultrasonics		UK
88		風力タービン	Wind turbines		HOL
89		耐火性試験	Fire hazard testing		CAN
90		超電導	Superconductivity		JPN
91		電子実装技術	Electronics assembly technology		JPN
93		デザインオートメーション	Design automation		USA
94		補助継電器	All-or-nothing		GER

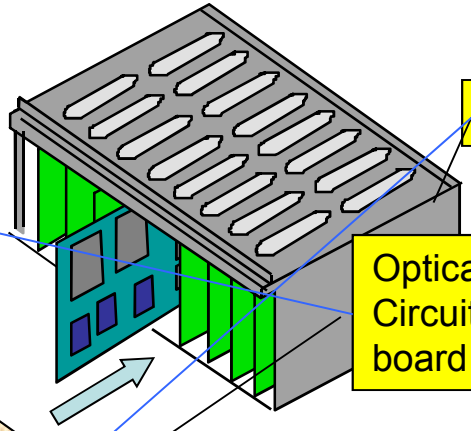

TC 86 Fibre optics
SC 86A
Fibre and cables
WG1 Fibres and associated measuring ethod
WG3 Cables
JWG8 Hybrid cables
SC 86B
Fibre optics interconnecting devices and sive components
WG4 Standards and measurement methods for fi otic interconnecting devices and passive components
WG6 Standards and specifications for optic interc cting devices and related components
WG7 Standards and specifications for fibre optic p ve components
JWG8 Terminated cable assemblies
SC 86C
Fibre optic systems and active devices
WG1 Fibre optic communications systems and su stems
WG3 Optical amplifiers
WG4 Fibre optic active components and devices
WG5 Dynamic modules and devices
WG4 Fibre optic test equipment calibration
JWG9 Optical Backplane
CG on MMLC
SC 46C
TC 91 Electronics assembly technology

Subjects for Standardization

Standard of Optical Circuit Board

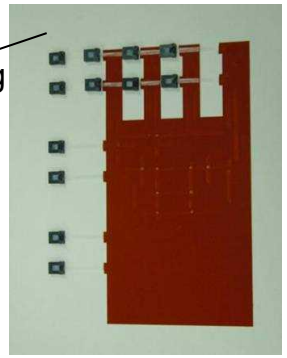
Standard of Connector for Optical backplane

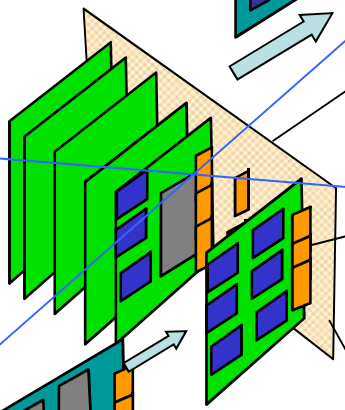
Standard of Optical Backplane



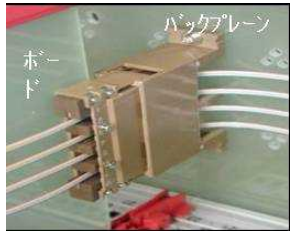
Sub-rack
- Dimensions of rack
- Implementation dimensions

Optical Circuit board
- Optical characteristics
- Optical connecting condition
- Durability



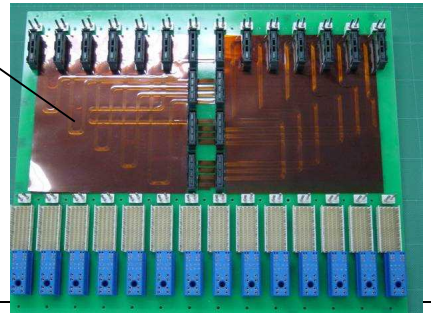


Optical connector Ferrule
- Dimensions of connector
- Optical connection
- Optical characteristics
- Mechanical characteristics
- Durability, etc.



光バックプレーン
- Board dimensions
- Numbering of interconnecting CH
- Optical characteristics

etc.



カード
- Card dimensions
- Position of connectors
- Numbering of interconnecting CH
- Optical characteristics

etc.

TC86/JWG9 (with TC91)

Title: Optical functionality for electronics assemblies

Scope: To prepare international standards and specifications for optical circuit boards and optical back planes, intended for use with opto-electronic assemblies. Other devices intended for use with optoelectronic assemblies such as fibre optic connectors, passive optical devices, active devices, dynamic devices, etc., are directly standardized at the existing WGs in TC86.

Strategy of JWG9

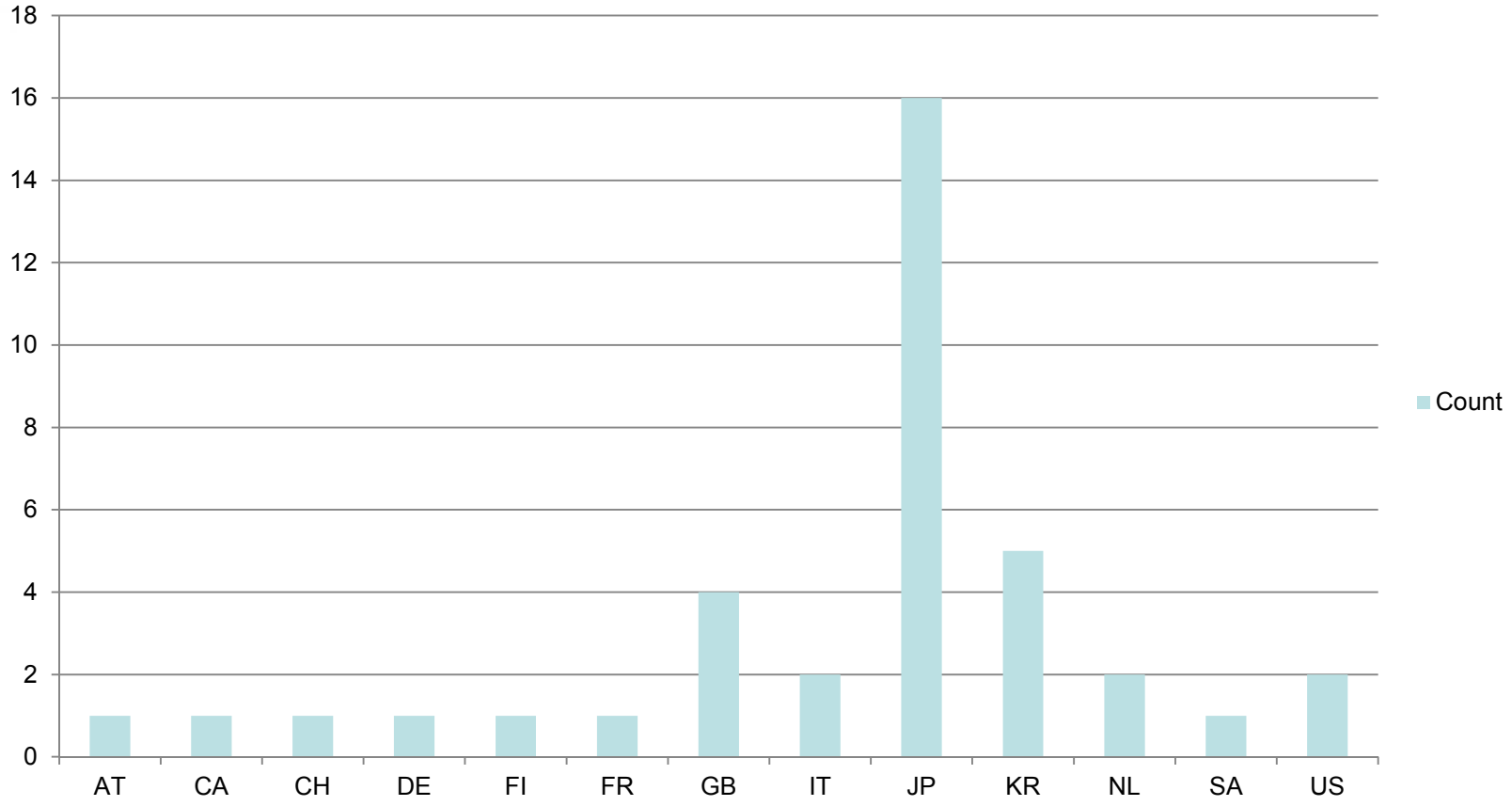
- To establish good relationship between systems TC, TC91, and products/components TC, TC86, according to “System approach concept” of IEC
- To be responsible for standardization for fibre optic products for use with all fields such as communications equipment, data processing equipments, etc.,
- To promote active standardization activities for optical products proposed by TC 91 for use with opto-electronic assembly.
- To harmonize standardization activities between SCs/WGs in TC 86 and TC91.

Relationship Between SC86A,B,C/WGs and JWG9

Tasks	Responsible	Support	Example
Existing Fields	WGs	JWG9	Connectors Modules
New Fields	JWG9 (Note)	WGs	OCBs, OBPs, their Test Methods, etc.

Note: This function may be also transferred to appropriate SC in the future.

Distribution of experts by National Committee



Total: 38 experts from 13 NCs

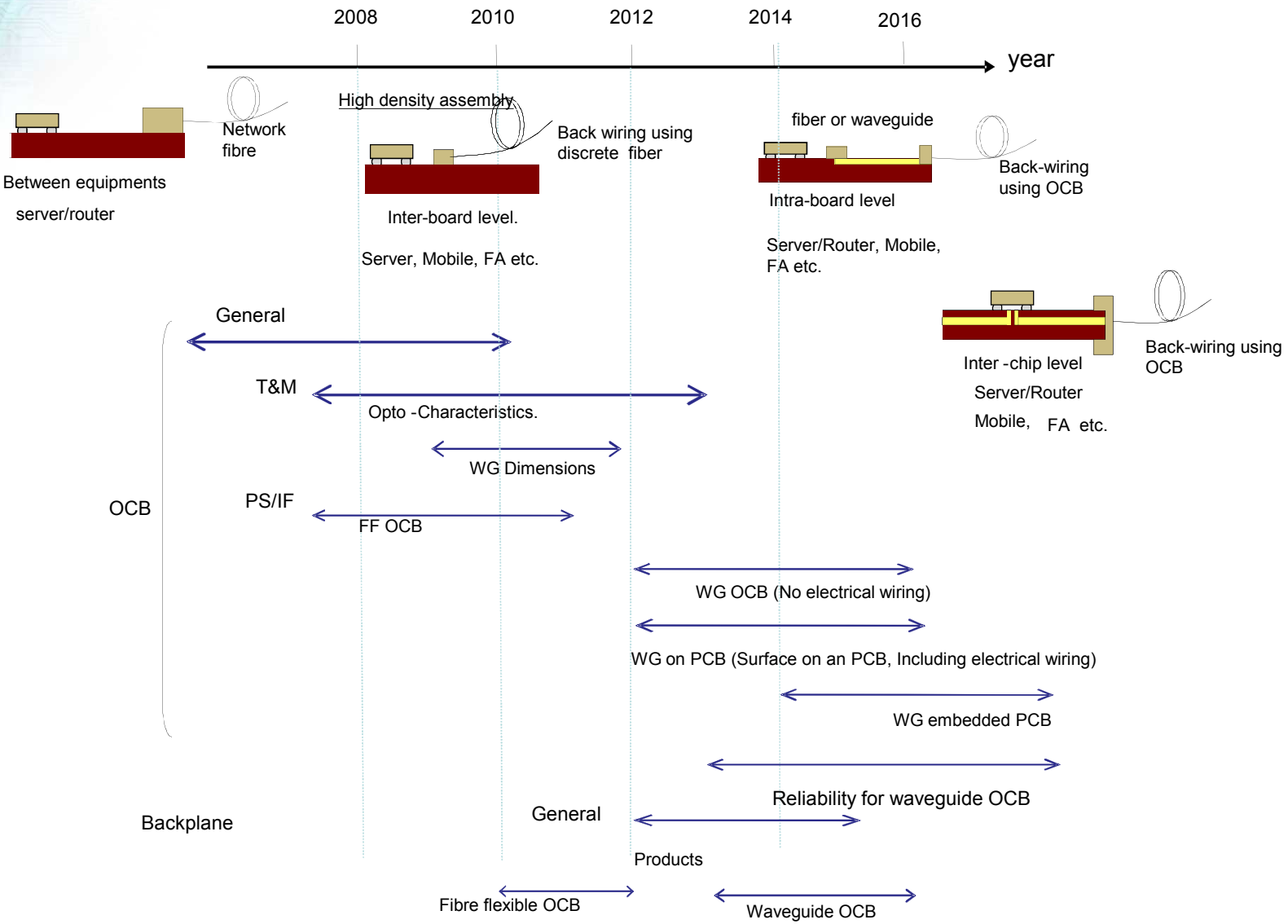
Publications

- IEC 62496-1/Ed1 (2008-12-09), Optical circuit boards - Part 1: General, SD: 2021
- IEC 62496-2-1/Ed1 (2011-07-28), Optical circuit boards – Part 2-1: Measurement procedures – Optical attenuation and isolation, SD: 2015
- IEC 62496-2-2/Ed1 (2011-01-27), Optical circuit boards - Part 2-2: Measurements - Dimensions of optical circuit boards, SD: 2015
- IEC 62496-3/Ed1 (2011-01-12), Optical circuit boards - Part 3: Performance standards - General and guidance, SD: 2015
- IEC 62496-3-1 Ed1 (2009-08-18), Optical circuit boards - Part 3-1: Performance standards - Flexible optical circuit boards using unconnectorized optical glass fibres, SD: 2021
- IEC 62496-4/Ed1 (2011-01-26), Optical circuit boards - Part 4: Interface standards - General and guidance, SD: 2015
- IEC 62496-2-4/Ed1 (2013-06), Optical circuit boards – Part 2-4: Tests – Optical transmission test for optical circuit boards without input/output fibres, SD: 2021
- IEC/TR 62658/Ed1 (2013-07): Standardization roadmap of optical circuit boards and related packaging technologies, SD: 2016
- IEC/TS 62661-2-1/Ed1(2013-07), Optical backplanes – Products specification – Part 2-1: Optical backplane using optical fibre circuit boards and multi-core right angle optical connectors, SD: 2016

Meeting place of TC86/TC91 JWG9

Apr. 2006	Stockholm, Sweden
Oct. 2008	Kyoto, Japan
Apr. 2009	Locarno, Switzerland
Oct. 2009	Tel Aviv, Israel
May 2010	Leuven, Belgium
Oct. 2010	Seattle, USA
Apr. 2011	Catania, Italy
Oct. 2011	Melbourne, Australia
Apr. 2012	Krakow, Poland
Nov. 2012	Queretaro, Mexico
Apr. 2013	Kista, Sweden
Oct. 2013	Sharlotte, USA
May 2014	Ixtapa, Mexico
Autumn 2014	Tokyo?, Japan

Standardization roadmap



Contents

Summary

- Optical Backplane technology from historic work to current work was introduced.
- Research projects in the world, especially, 3Tbps ATCA optical backplane project was introduced.
- As a standardization of optical backplane, activity of IEC TC86/TC91 JWG9 is introduced.

Contents

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Etsuji Sugita, Hakusan Mfg., Richard Pitwon, Xylatex
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Masahiko Mori, AIST, Kazuhiko Kurata, PETRA

Thank you very much for your kind attentions!

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