

中大光電所廿週年慶演講

光收發模組封裝技術發展趨勢

光磊科技 微機電事業部
伍茂仁

2002.10.09

光通訊產業現況

中時電子報 news.chinatimes.com

同時瘦身又健身

2002.09.26 工商時報

4家電信公司 股價徘徊1美元

張秋康/綜合外電報導

美國財經新聞網站CNNMoney週二報導，全球電信市場需求的持續不振，連帶拖累電信設備類股的股價跌跌不休。朗訊與北電網絡兩家公司的股價，目前已告跌落至不及一美元的價位。而JDS Uniphase與康寧兩家公司的股價也都面臨一美元關卡保衛戰。分析師悲觀指出，電信部門景氣恐將至二〇〇四年才會回穩，這些公司的股價近期內還可能進一步下探。

報導指出，在電信市場全盛時期，朗訊、北電網絡及JDS的市值都超過二千億美元，而康寧也有逾一千億美元。不過，由於電信市場需求持續疲弱，導致這些業者的業績不佳，股價也跟著一路崩跌，現在這四家公司的市值合計已不及一百一十億美元。

電信設備製造商朗訊與北電網絡，週一

這麼Q的汽車你也想要嗎？

• Lucent, Nortel, JDS Uniphase, Corning股價皆面臨一美元關卡保衛戰

• 景氣預期於2004年回穩？

• 減產

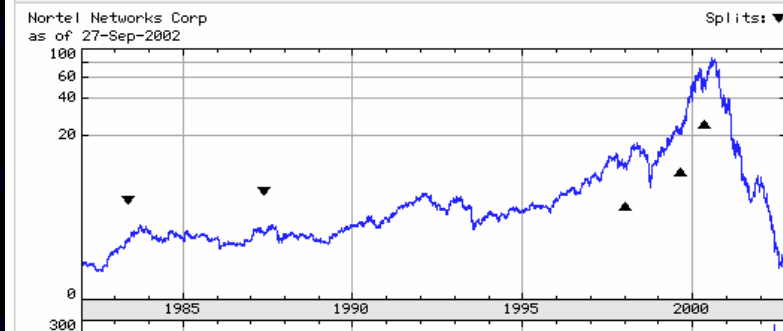
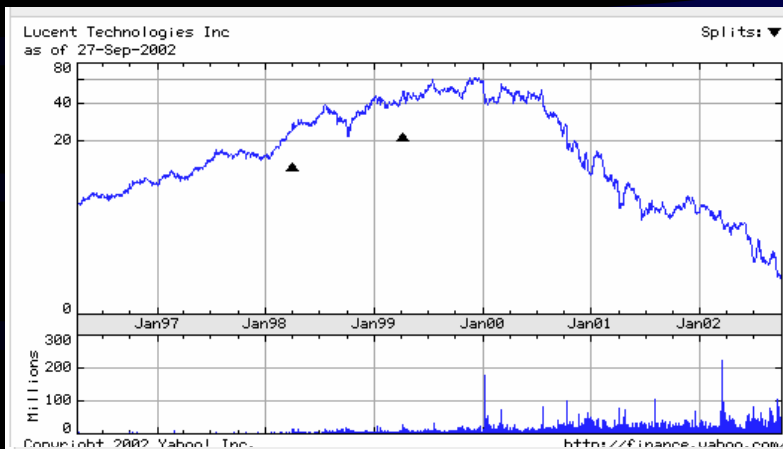
• 裁員

• 關廠

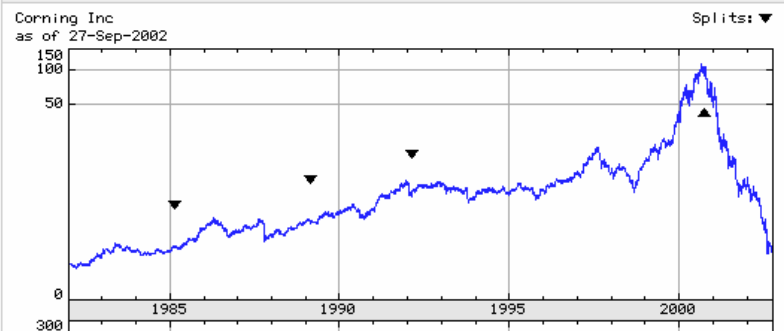
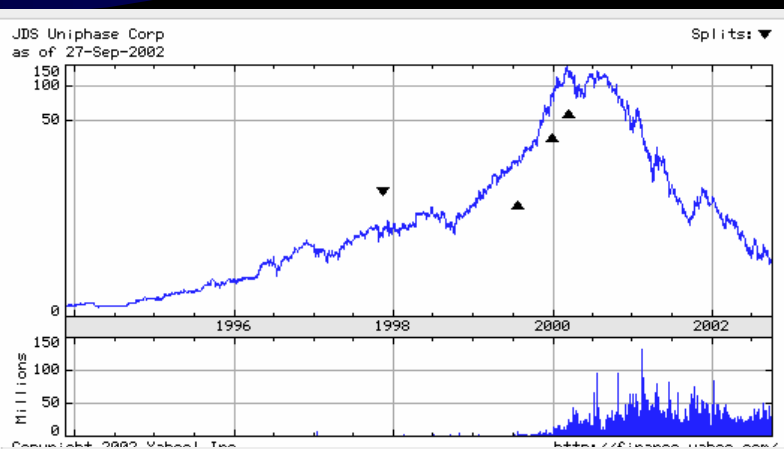
• 退出市場

谷底確認？

光通訊產業回顧



- 1998年之前呈穩健成長
- 1998年隨.com風潮而急遽擴張
- 2000年達到頂點
- 2000年之後翻轉直下
- 2002年Q4股價到達谷底

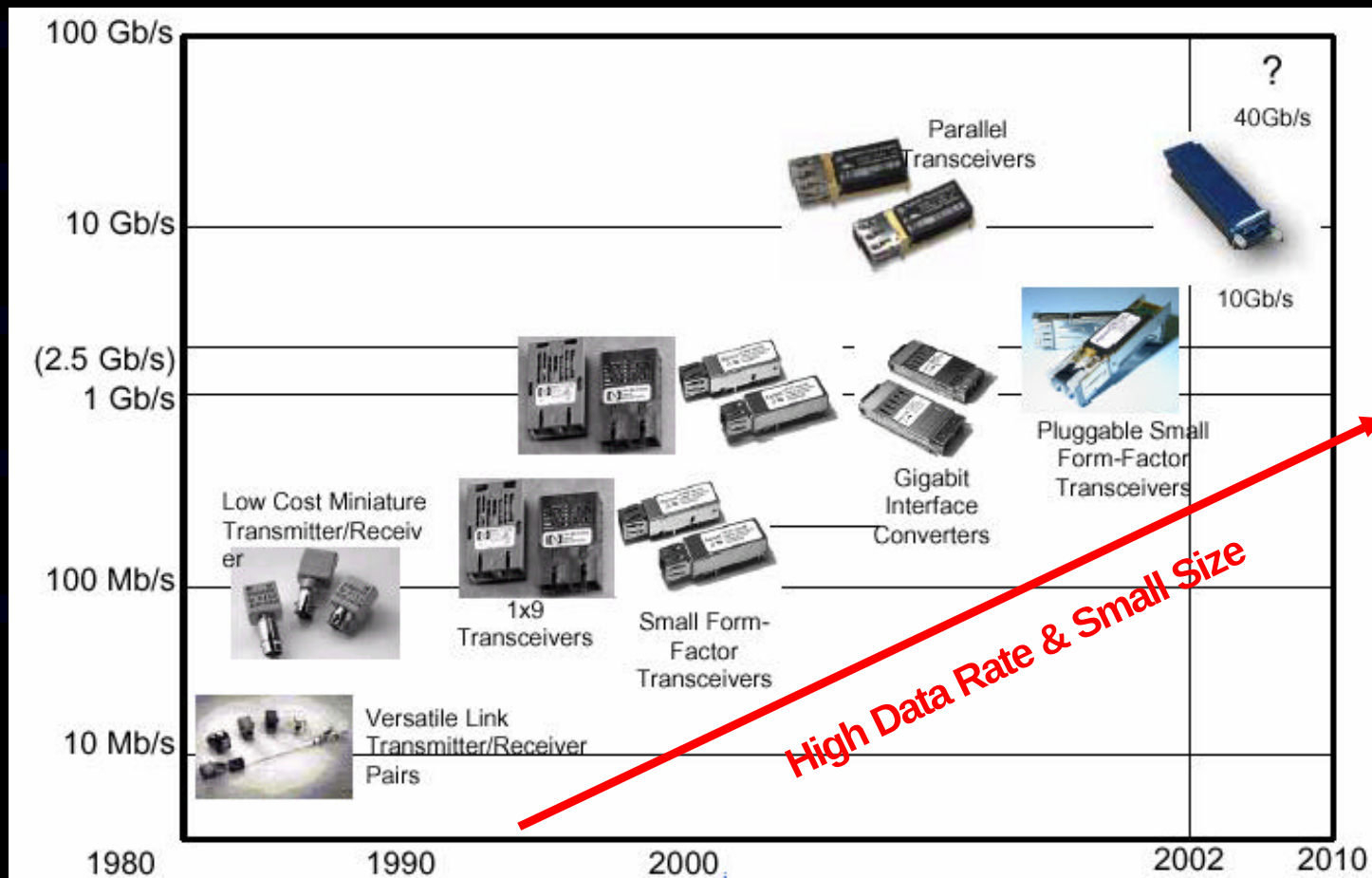


- 研發過度集中於Backbone, DWDM系統
技術進步迅速
- 市場過度預期, 長途光纖通訊容量過剩
- 大廠過度強調產業垂直整合, 元件品質
要求高, 價格不利用戶端要求
- 用戶端市場尚無利基應用出現

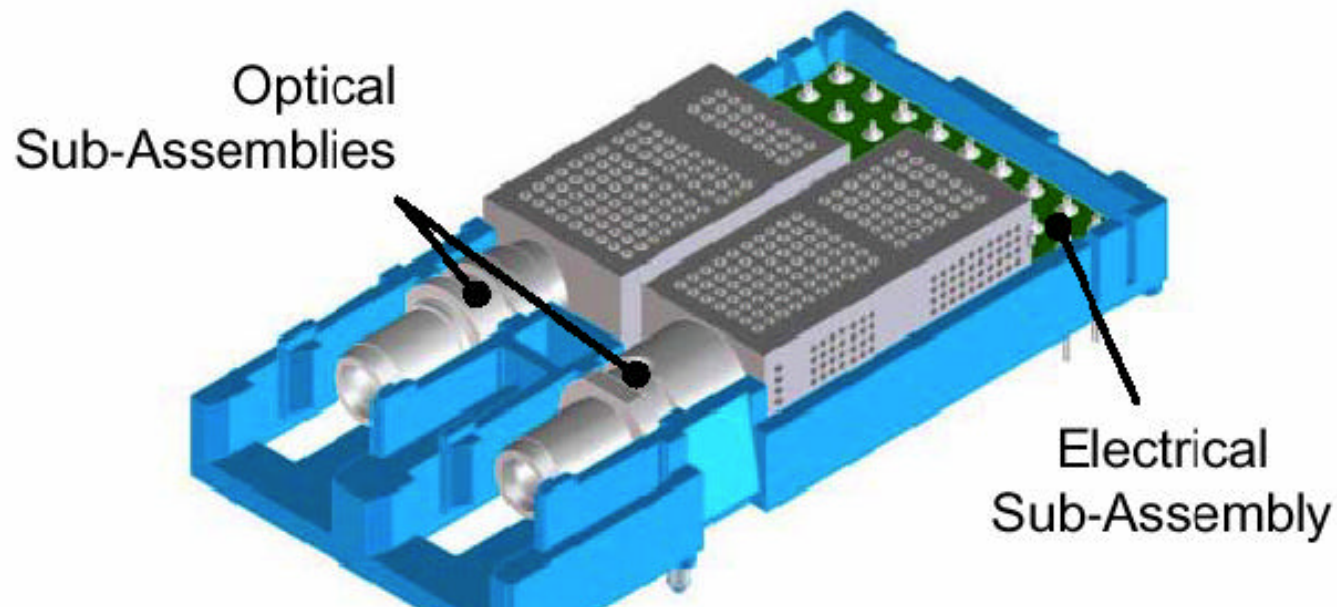
光通訊產業趨勢

- 市場重心將由 Backbone 轉至 Access Network
- 產品發展將由強調可靠度轉至強調價格
- Lucent 及 Nortel 等設備大廠相繼退出光通訊元件市場，將使元件製造轉向低製造成本國家
- 國際間產業垂直分工模式可望建立
- 自動化大量生產方式可望建立

Roadmap of Optical Transceiver - Prospective of Agilent

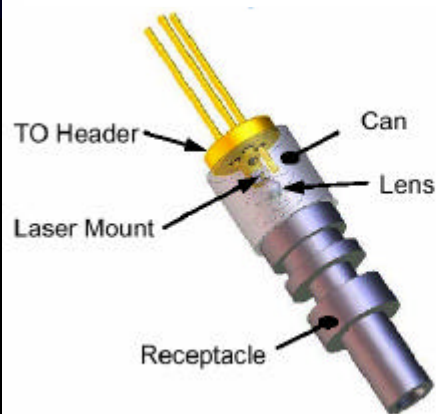


Conventional Optical Transceiver Module



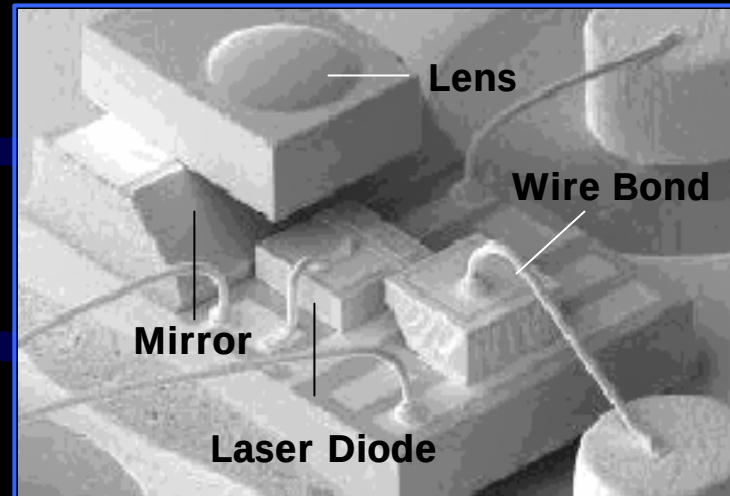
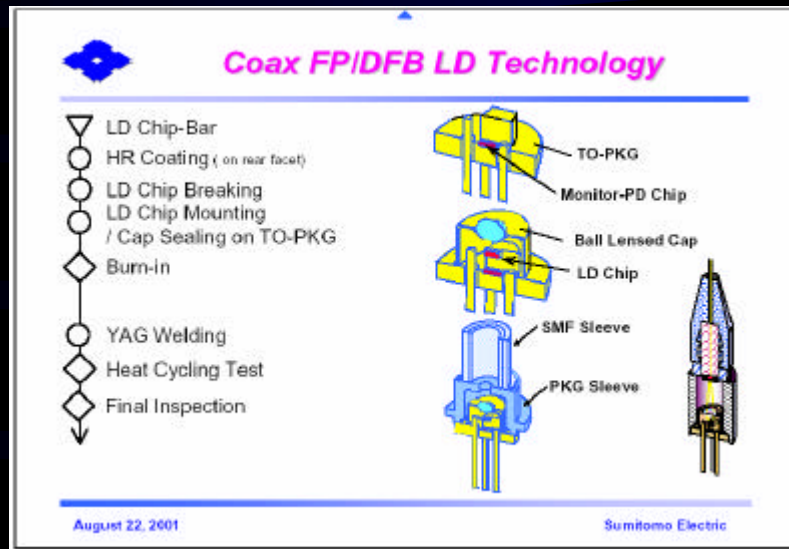
Optical Sub-Assembly, OSA

Electrical Sub-Assembly, ESA



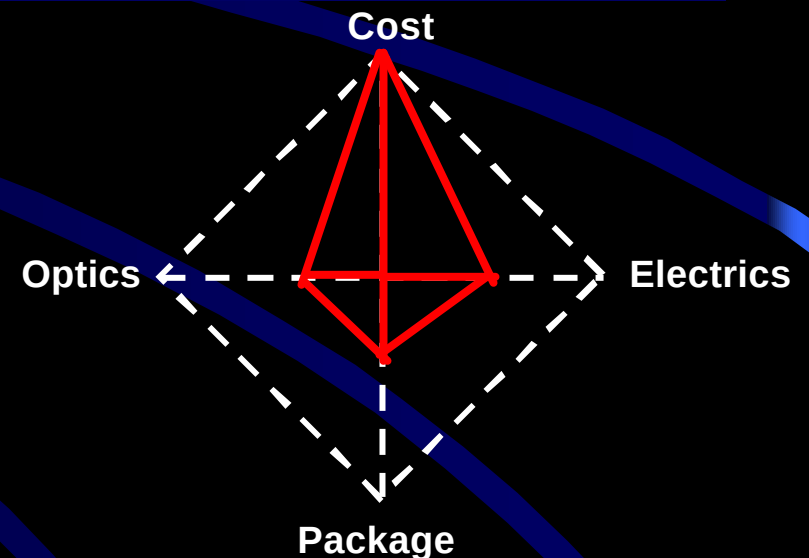
Source: Marilyn Owen, Agilent Technologies Networking Solutions Division.

TO-CAN Laser Diode Package - Cost v.s. Performance

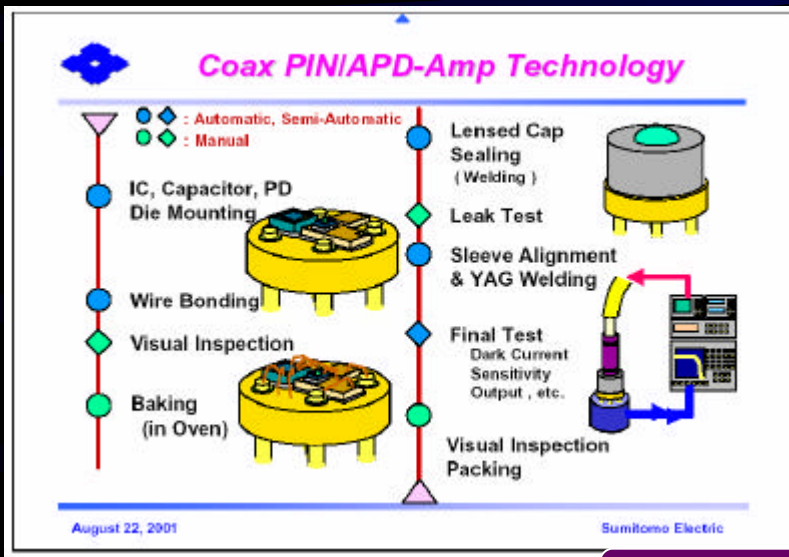


Siemens TO-CAN LD based on MEMS for FTTH BIDI Module

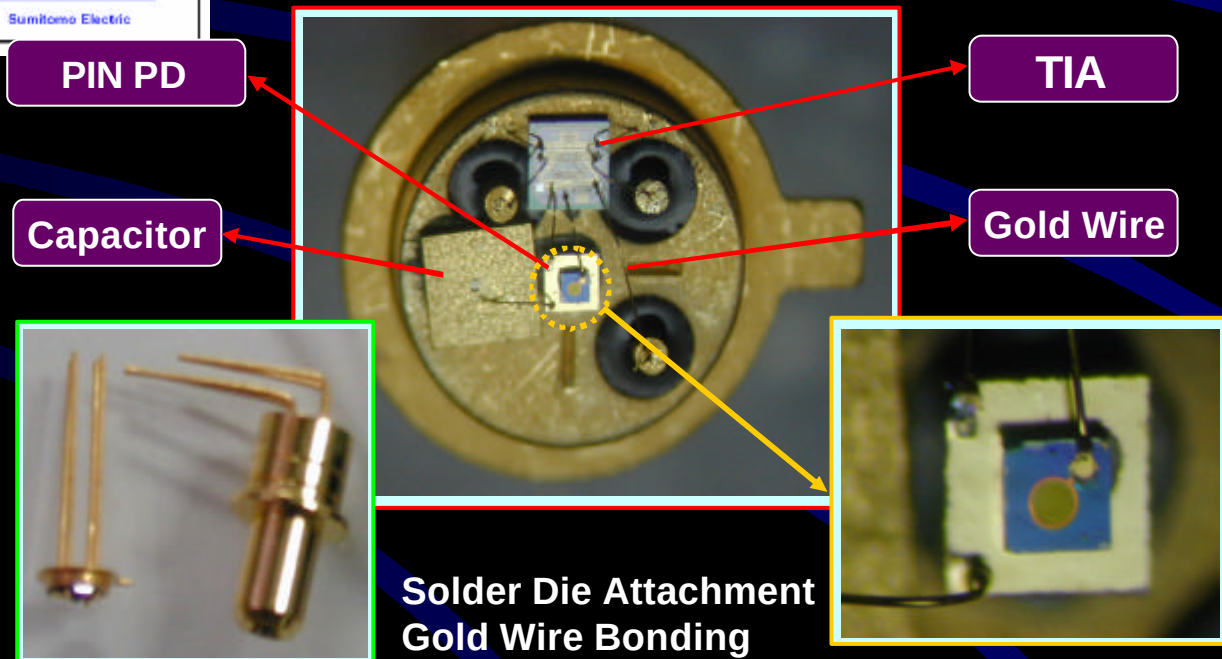
- **Data Rate:** 155 Mbps ~ 2.5 Gbps
- **LD to Fiber Alignment:** Laser Welding & Active Alignment
- **Components Assembly:** Fully Automated
- **More function designed into OSA:** Poor
- **Integration of OSA and ESA:** Poor
- **Automated Module Surface-Mount to Board:** Poor



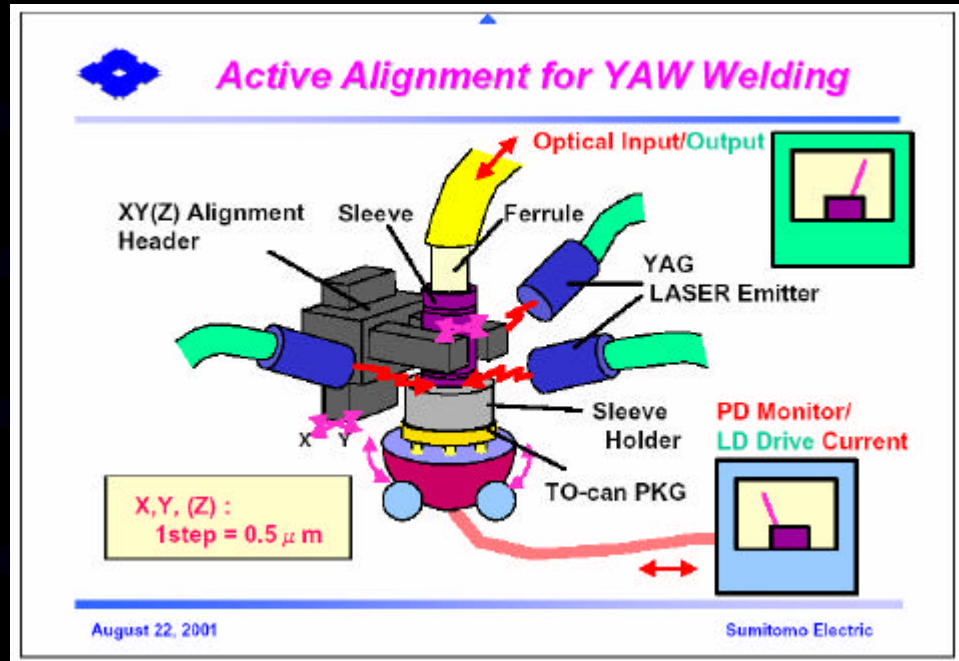
TO-CAN PIN Photodetector Package - Cost v.s. Performance



- Data Rate: 155 Mbps ~ 2.5 Gbps
- LD to Fiber Alignment: Laser Welding & Active Alignment
- Components Assembly: Fully Automated



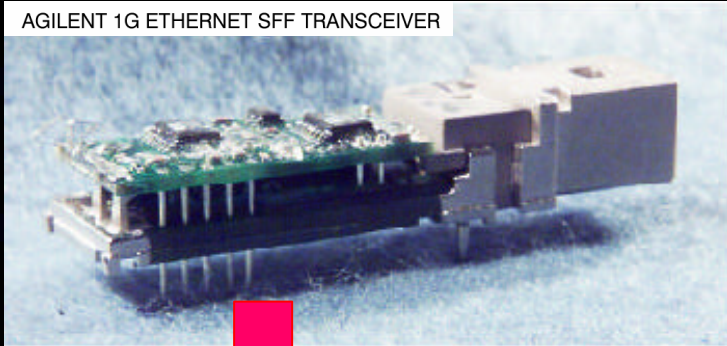
Laser Welding - Cost v.s. Package



- Housing Material/Cost
- Batch Manufacturing
- Automated Production
- Cycle Time for Active Alignment

Agilent's Solution for Transceiver Package

AGILENT 1G ETHERNET SFF TRANSCEIVER



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IEEE TRANSACTIONS ON ADVANCED PACKAGING, VOL. 23, NO. 2, MAY 2000

Agilent Technologies' Singlemode Small Form Factor (SFF) Module Incorporates Micromachined Silicon, Automated Passive Alignment, and Non-Hermetic Packaging to Enable the Next Generation of Low-Cost Fiber Optic Transceivers

Martyn Owen

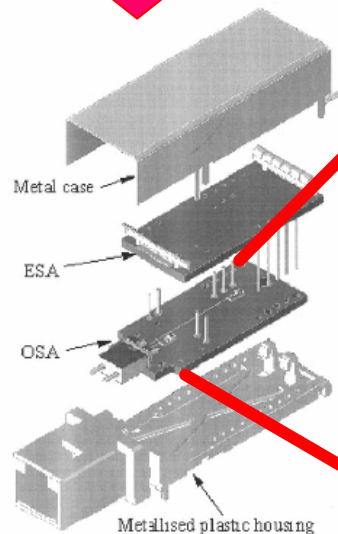


Fig. 1. Module component parts.

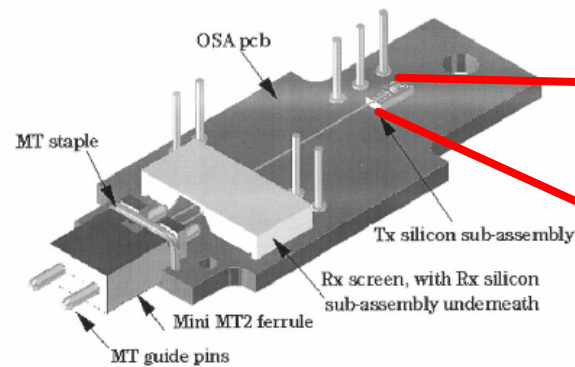
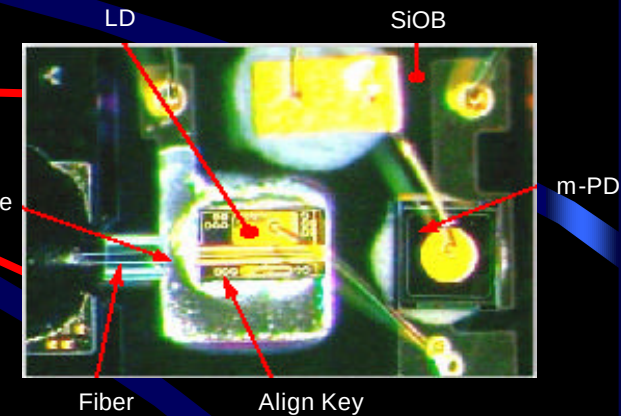
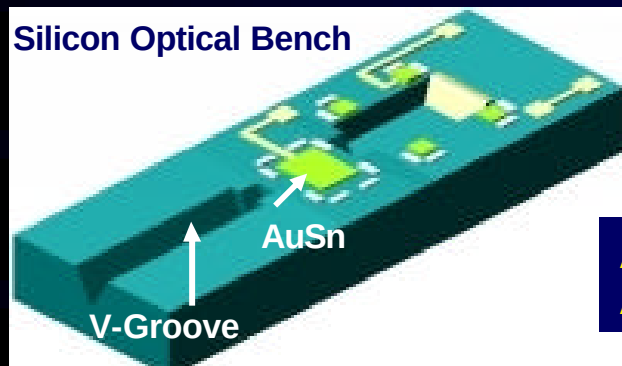


Fig. 2. OSA design.



Micromachined Silicon Optical Bench & Passive Alignment



Challenge: Submicrometer Process Requirement

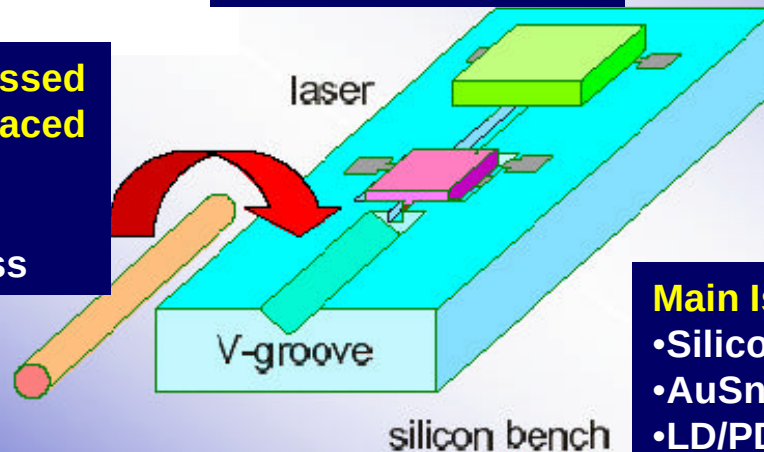
Semiconductor Submount Processed Replaced Mechanical Housing:

- Batch Process
- High Precision Process

Automated Assembly

LD/PD

monitor diode



Passive Alignment for LD to Fiber Coupling

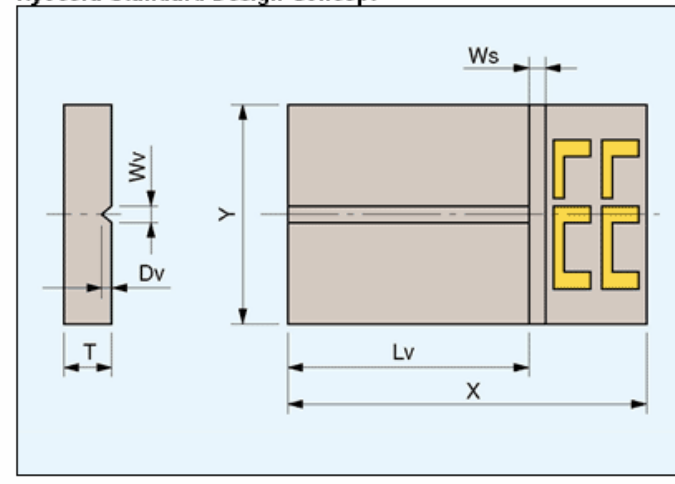
Main Issues:

- Silicon Optical Bench Fabrication
- AuSn Evaporation
- LD/PD Flip-Chip Bonding
- Epoxy Assembly for Fiber Mounting
- Coupling Efficiency
- Reliability

Requirements for Silicon Optical Bench - Kyocera's Specification



Kyocera Standard Design Concept



Specification Chart

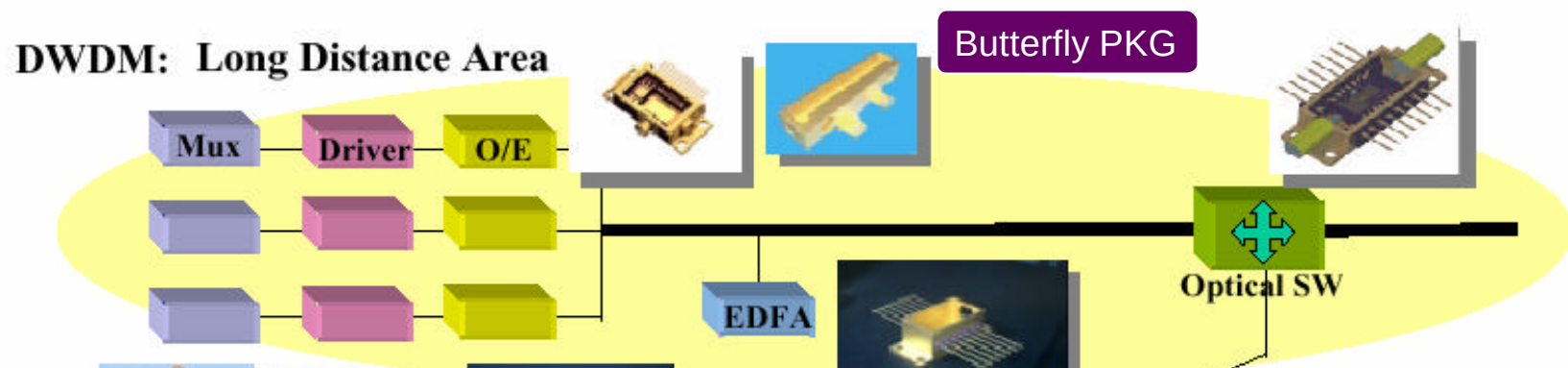
		Code	Typical Figure	Range	Unit
Platform	Length	X	5	3.5 -	mm
	Width	Y	3.5	2 -	mm
	Thickness	T	1±0.025	0.38 - 2	mm
	SiO ₂ Thickness			0.38 - 1	μm
V-Groove	Width	Wv	141.5±0.7	- 153	μm
	Depth	Dv	100±0.5	- 109	μm
	Length	Lv		- 3.5	mm
Rectangular Groove	Width	Ws	100±10	100 - 300	μm
	Depth	Ds	125±25	100 - 300	μm
Pads	Structure		Cr-Au, Ti-Pt-Au		
	Thickness		0.3±0.1		μm
	Positioning tolerance (to V-Groove)		±0.5		μm
Solder	Material		Au-Sn		
	Thickness		2±0.5		μm
	Positioning tolerance (to V-Groove)		±2		μm

Specifications or data are subject to change without notice.

Package Types for Laser/Photodetector Modules

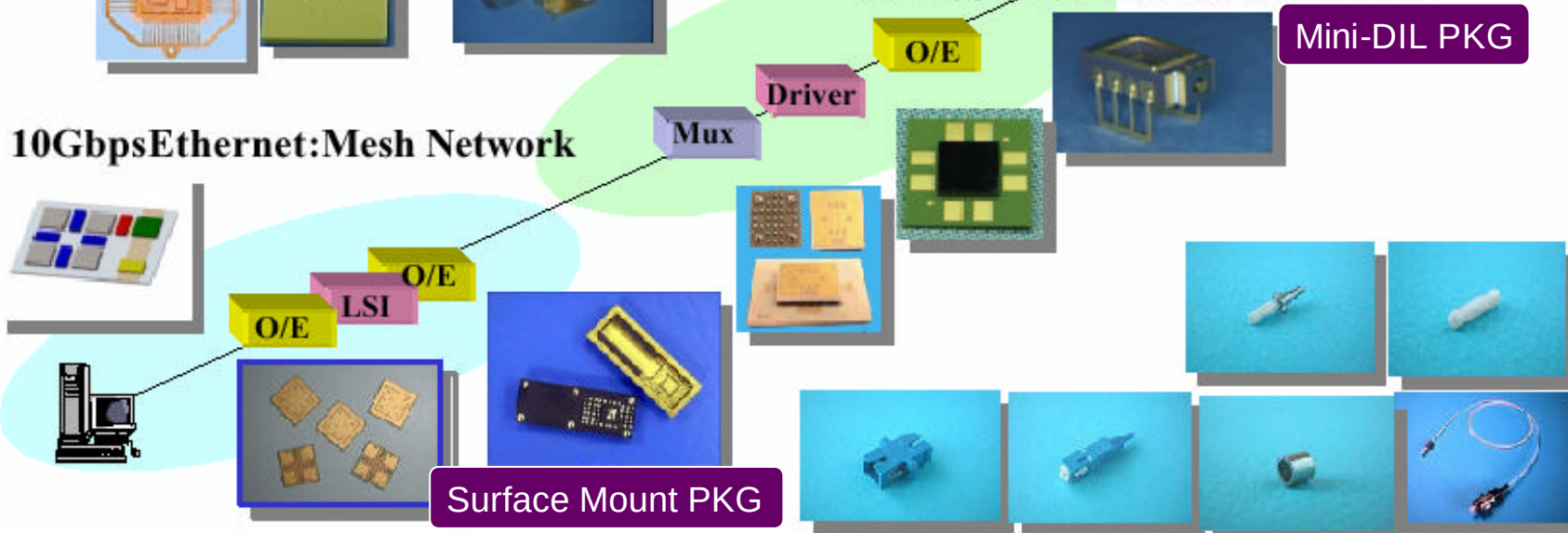
Kyocera Packaging Line Up for Optical Networks

DWDM: Long Distance Area



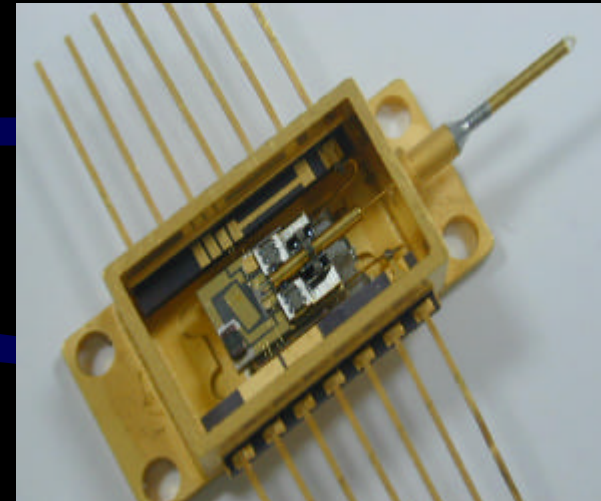
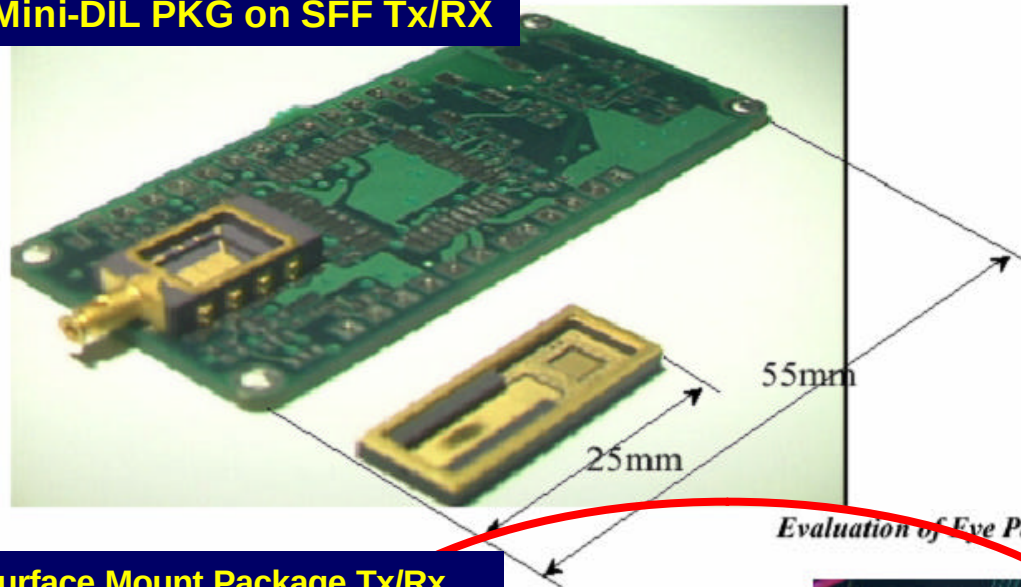
Sonet/SDH: Short Distance Area

10Gbps Ethernet: Mesh Network



Integrate Package Concept - Market Requirement: Cost Reduction/Size Reduction

Mini-DIL PKG on SFF Tx/RX



Butterfly PKG LD Module

Surface Mount Package Tx/Rx

OSA based on SiOB

ESA

10 Gbps Surface Mount PKG
Transmitter: Hybrid OEIC

Evaluation of Eye Pattern

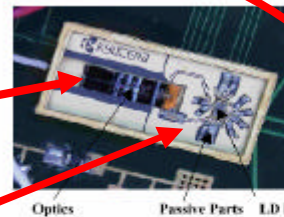
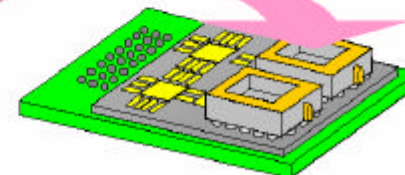
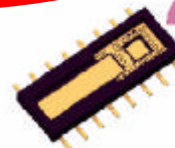
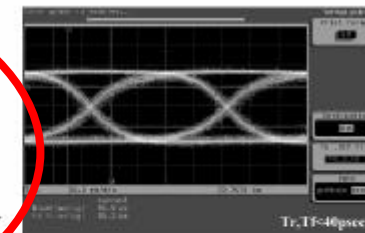


Image of Package on Board



Comparison of Package Technologies for Laser Diode

Package Type	Butterfly/DIP	DIP/Mini-DIL	TO-CAN
Application/Data Rate	2.5/10 Gbps	155 Mbps ~ 10 Gbps	155 Mbps ~ 2.5 Gbps
LD to Fiber Alignment	Active alignment	Passive Alignment: V-groove in silicon optical bench	Active alignment
Alignment Tolerance (μm)	0.25	0.25~2	1~2
Components Assembly	Largely manual	Automated flip-chip	Fully automated
More function designed into OSA	Good	Good	Poor
Integration of OSA and ESA	Good	Good	Poor
Automated Module Surface-Mount to Board	Good	Good	Poor
Packaging Cost	High	Low	Minimalist


Performance
Cost



Market

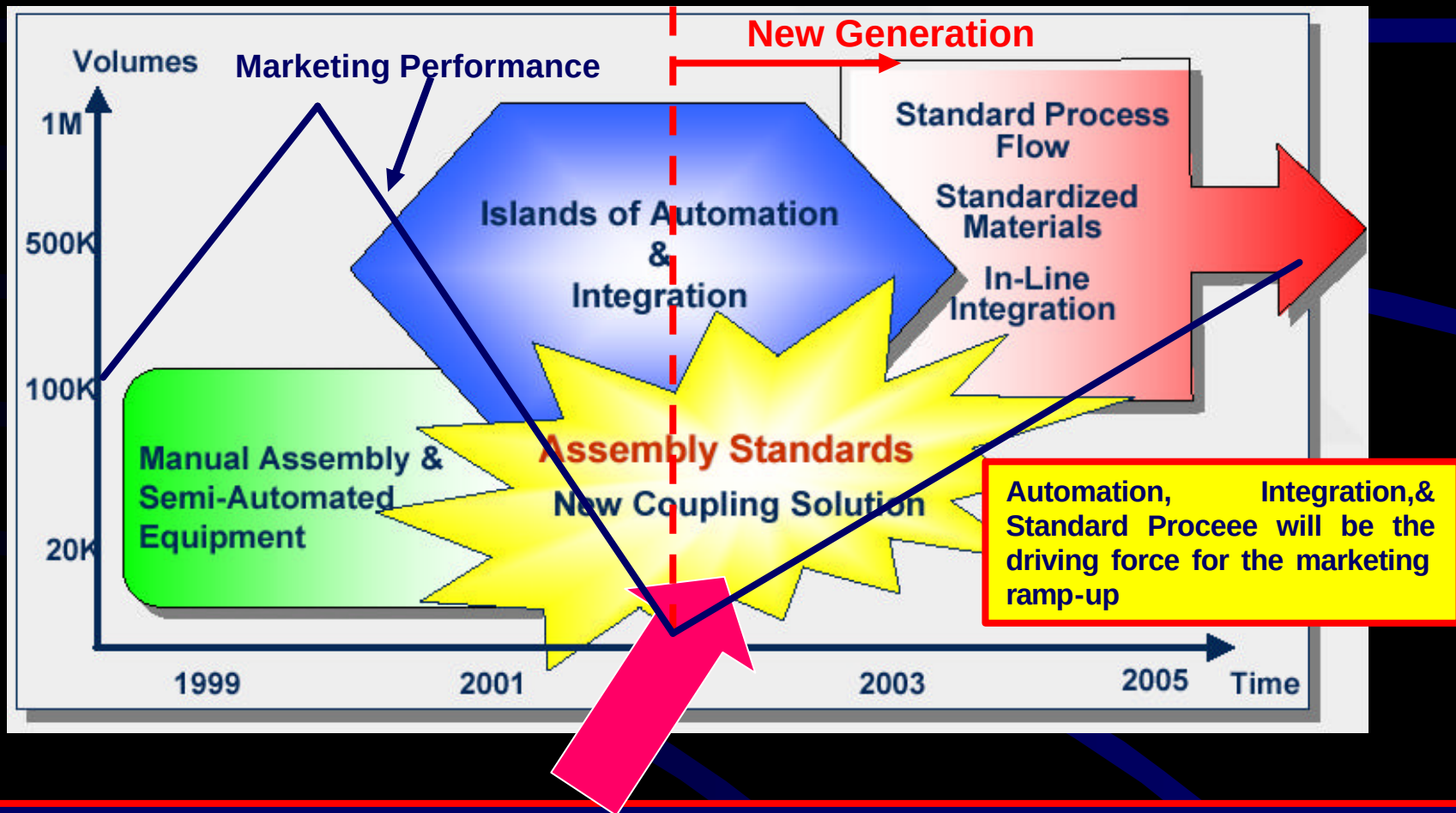
overview

manufacturer	typecode	size	speed	type	connector	level	~ price/ch	available	tested
LUCENT	1417K4A	SFF	2.5Gb/s	TRX	LC Duplex	LVPECL	710\$		
	1417G4A	SFF	155Mb/s	TRX	LC Duplex	LVPECL	220\$	hopeless	
AMP	269086-1	w:25.4 h:9.8	156Mb/s	TRX	SC Duplex	PECL	140\$		2 ✓
	269085-1	w:25.4 h:9.8	125Mb/s	TRX	SC Duplex	PECL	140\$		2 ✓
AGILENT	HFCT-52158/D	w:25.4 h:9.8	155Mb/s	TRX	SC Duplex	LVPECL	280\$		
	HFCT-5905E	SFF	155Mb/s	TRX	MT RJ	LVPECL	280\$		2 ✓
	HFCT-5903E	SFF	125Mb/s	TRX	MT RJ	LVPECL	230\$		1 ✓
	HFCT-5201A	w:25.4 h:9.8	155Mb/s	TRX	SC Duplex	LVPECL	400\$		2 ✓
INFINEON	V23818-N15-L17	SFF	2.5Gb/s	TRX	LC Duplex	LVPECL	500\$		2 ✓
SUMITOMO	scm6001glb	SFF	155Mb/s	TRX	LC Duplex	LVPECL		mid 2001	
	scm6101gla1								
	scm6201b.pdf								
METHODE	MLC-25-4-2-TL	SFF	1.25Gb/s	TRX	LC Duplex	LVPECL	280\$		1
	SF3-LT12H	SFF	700Mb/s	TRX	LC Duplex	LVPECL	260\$		
	SF2-LT12H	SFF	200Mb/s	TRX	LC Duplex	LVPECL	200\$		2 ✓
HITACHI	MDS/R2211A		200Mb/s	12*Tx->Rx	MPO		1000\$/500\$		1
	(product cancelled)						no red./ red.		
OPTOBAHN	(product under dev.)			4*Tx<->Rx	MPO		650\$/325\$	Apr 01	
							no red./ red.		

thomas.bauer@cern.ch

Source: CERN 04.03.2001

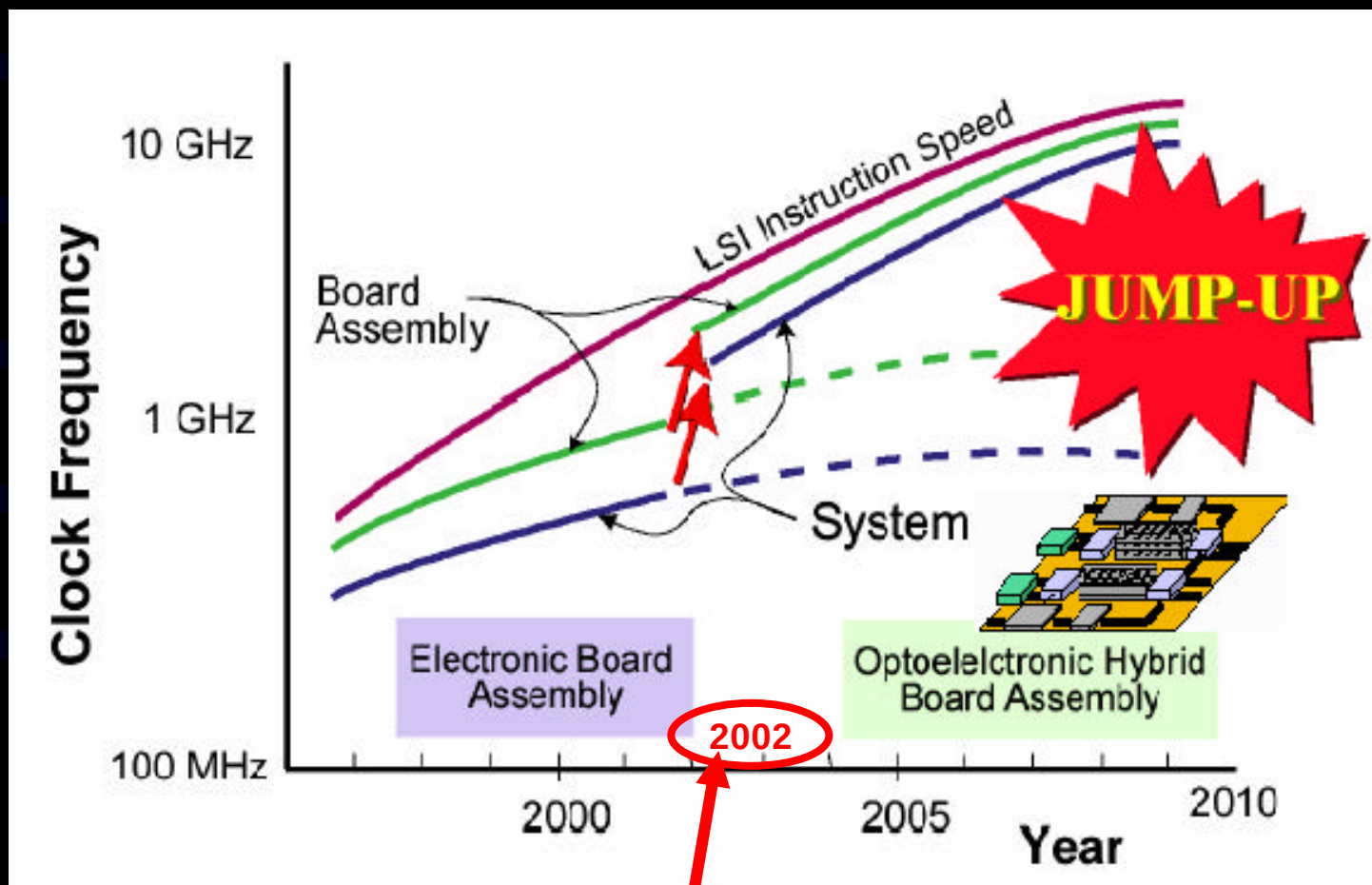
Optoelectronic Assembly Roadmap Predicted by Flextronics



What's the action we should take in optoelectronic assembly development?

Source: Flextronics

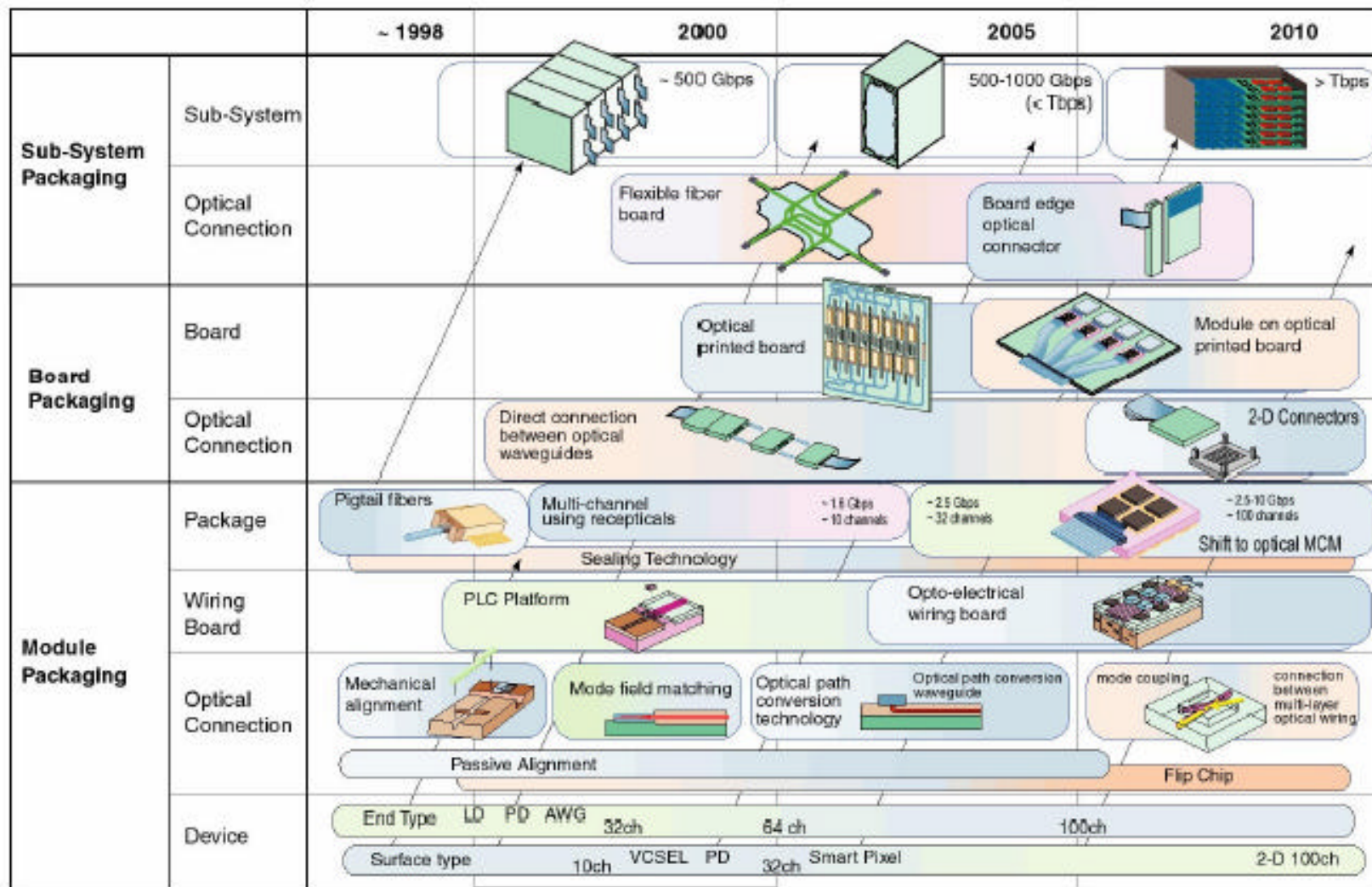
Optoelectronic Assembly Roadmap Predicted by Techsearch International, Inc.



New Assembly Technology Introduced

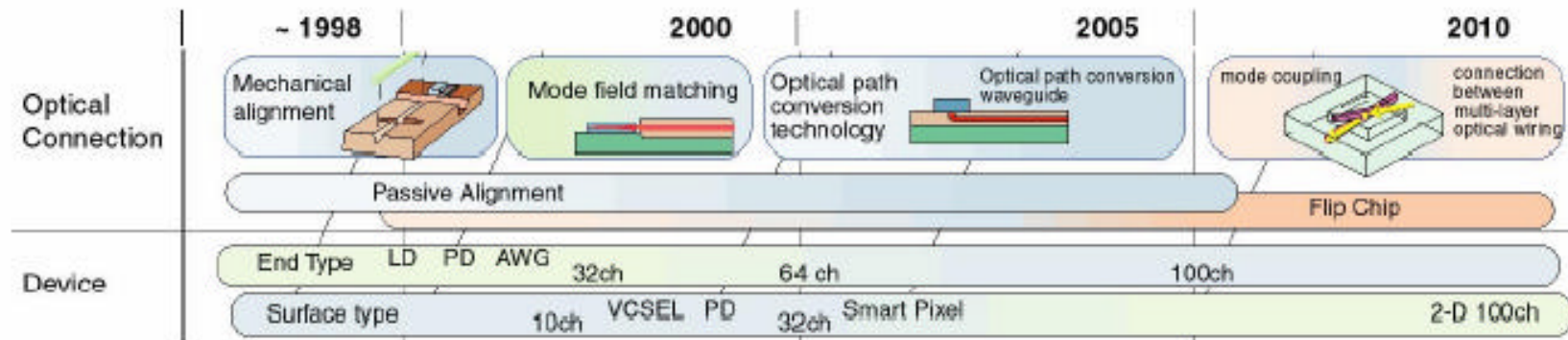
Source: Techsearch International, Inc.

JIEP Optical Packaging Roadmap



Source: Japan Institute of Electronics Packaging & SEMI

Active Device Interconnection



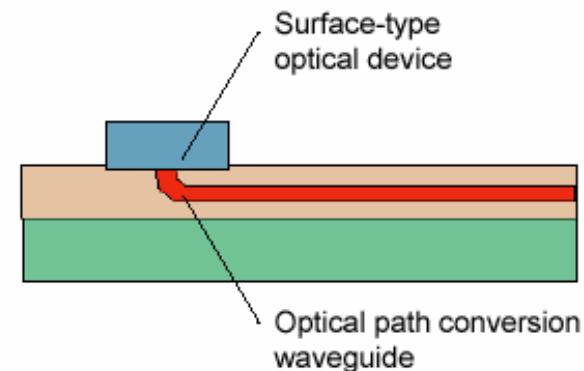
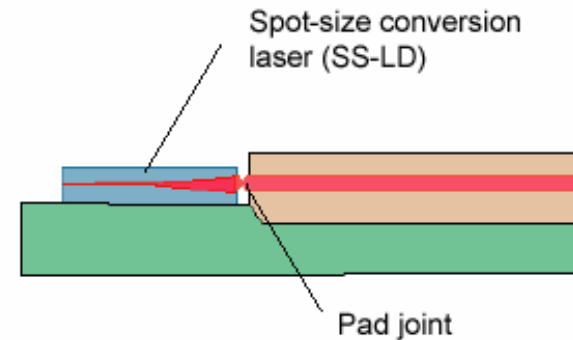
- Optical alignment (active & passive)
- Mode field matching
- Optical path conversion
- Multi-layer wiring

Key Technologies:

- Passive Alignment
- Flip-Chip Bonding

Optical Connection

- **Mode field matching**
 - Lens bonding
 - Tapered waveguides (SS-LD, etc)
- **Optical path conversion**
 - Curved waveguides
 - Mirrors
 - Development:
 - Mirror waveguides
 - Flexible waveguides
 - Photonic crystal



Key Technologies:

- Spot-Size Conversion Laser
- Optical path conversion waveguide

Source: Japan Institute of Electronics Packaging & SEMI

The background of the slide features a series of dark blue, wavy, horizontal lines that flow across the frame. These lines vary in thickness and curvature, creating a sense of movement and depth against the solid black background.

Thanks!