

Laser Enterprise: Lessons Learned

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Laser Enterprise

1. IBM Research Laboratory (1980..1994):
 - The golden 80's
 - E2: Key patent
 - The crisis
 - Independent Business Unit

2. Telecom (1995..2002):
 - Bubble
 - Bubble Burst

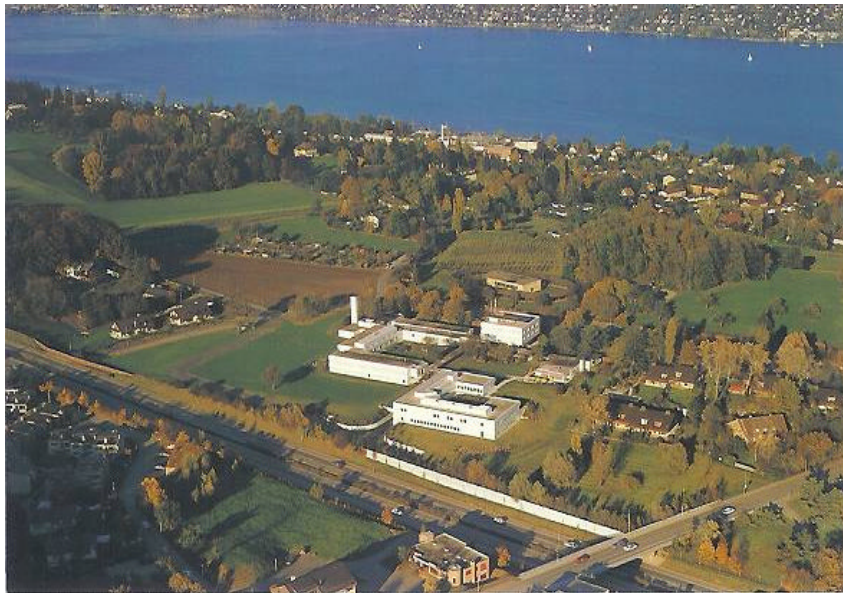
3. Turn Around (2003..2005):
 - Survival of the fittest
 - E2: Competitive advantage

Lessons learned

- Innovation: Value to owner and value to customer
- What went well, What was missing

IBM Research Laboratory: The golden 80's

IBM: Vertically integrated company to produce mainframes



- 1986: Nobel Prize for STM/AFM
- 1987: Nobel Prize for High Tc

- 1983: MESFETs (Logic and memory)
- In 1985: Silicon CMOS will dominate
 - My manager told me to start “skunk” optoelectronics
- Opto-electronics: “In-Plan”
 - Optical interconnects: 830nm lasers
 - MO storage: 780nm 630nm and **976nm** (frequency doubling)
 - Printers: Array of lasers
 - E2
- Widenend technology base
 - OLEDs (for displays)
 - High index waveguides
 - GaN (for MO storage)
 - 0.6, 1.3 and 1.55um laser diodes

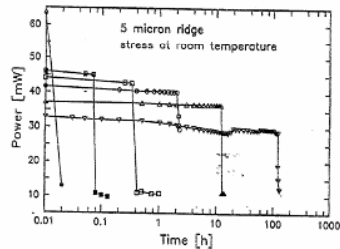
IBM Research Laboratory: E2 Key patent

Physicist and Chemist

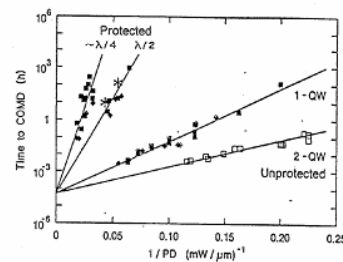
E2 passivated

Mirror Passivation

Time to COMD



Arrhenius Plot



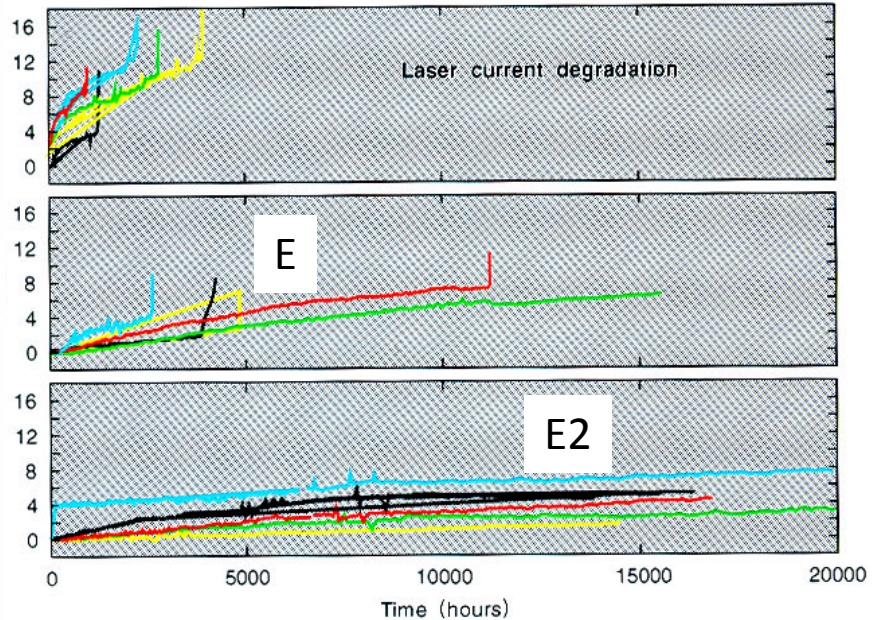
$$t_{\text{COMD}} \propto \exp\left(\frac{E_A/k}{T_M}\right)$$

$$T_M = c \times \text{Power density}$$

Surface chemist fixed problem of 980nm laser diodes



11/91 (Ch. Harder)



E. Latta discovered 1987 the E2 surface passivation of GaAs laser diodes

IBM Research Laboratory: The Crisis

Chronology

- 1990: IBM > 150 people on laser diodes
- 1991: Downsized to 15 people
- What happened
 - Economic downturn (Gulf war)
 - Optical technology became obsolete
 - Interconnects solved by VLSI and RISC
 - Printers: Commodity
 - Storage: Harddisk and MO : commodity
- 1992: Liquidate group, but:
 - 976nm laser diode was developed for frequency doubling in KTP
 - Corning contacted us
 - Monopoly on 980nm pump diode for telecom EDFA
 - Stopped GaN, Organic Display, Waveguides, 0.6, 13 and 1.55um

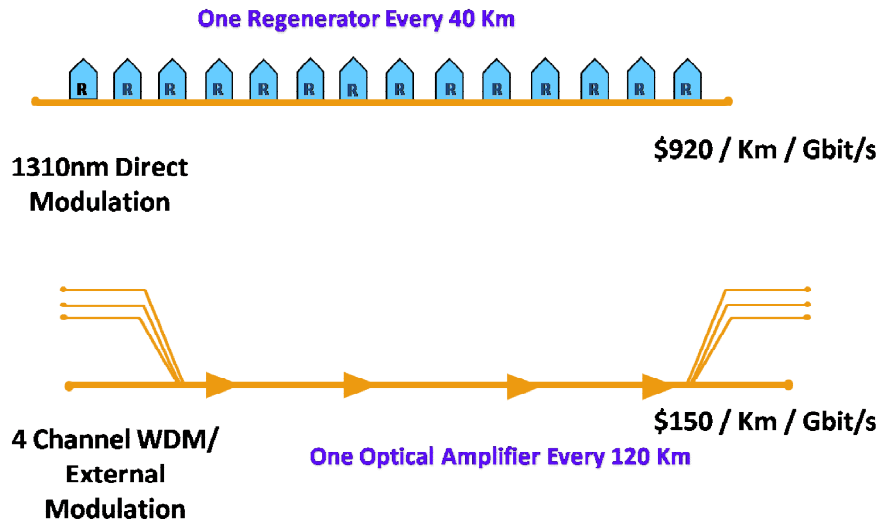
After the compression: Laser Enterprise 1994



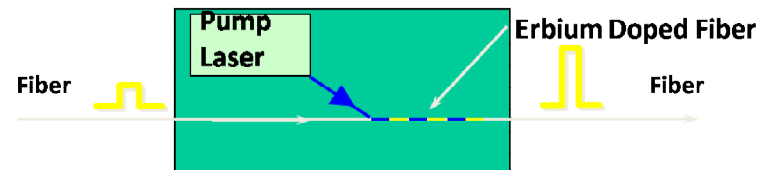
IBM Research Laboratory: 980 Diode Laser

Disruptive Technology:

Magic Fiber: Erbium doped fiber



Optical Amplifier



Optical Amplifier:

980nm pump laser as power supply

We were the only laser supplier for high power and high reliability

IBM Research Laboratory: IBM Independent Business Unit

Business case 1997

Scenario 3		1998	1999	2000	2001	2002
Revenue Growth 30% per year	\$20,000	\$26,000	\$33,800	\$43,940	\$57,122	\$74,259
Operating Income	10,000	10,400	10,140	13,182	17,137	22,278
Taxes @ 30%	3,000	3,120	3,042	3,955	5,141	6,683
Net Income	7,000	7,280	7,098	9,227	11,996	15,594
Capital Investment	(20,000)	2,600	3,380	4,394	5,712	7,426
Working Capital Required		1,560	2,028	2,636	3,427	4,456
Cash Flow		3,120	1,690	2,197	2,856	3,713
3 YEAR PLAN CASH FLOW	2500	-12000	10000	20000		
Present Value of Cash Flows, Years 1 through 5						\$8,914
Present Value of Residual Value (Perpetuity Method)						\$51,688
Gross Value						\$60,602
Initial Capital Investment						(\$20,000)
Net Value						\$40,602

980nm pump laser

- Laser Enterprise had developed such a device for MO storage
- **Power source for optical amplifier.**
Disruptive technology in telecom!
- Laser Enterprise had monopoly due to E2

MBO proposal: 17.35M\$

IBM-LE ... Board Meeting July 10, 1996

LE-MBO Proposal to IBM

- * LE-mgmt team want to continue LE as a separate company and therefore offers a MBO
- * LE-mgmt will secure funding and will pay to IBM a total Goodwill of 17.35 M\$
 - Cash: 11.35 M\$ (payable 60 days after MBO contract sign-off)
 - Debt: 6.00 M\$ (payable 1.2M\$ next 5 years 1997-2001)
 - Offer will be based on T&C's as described by enclosed charts
 - Payments fully cover tools, know-how, patents, inventories, goodwill, etc.
- * LE-MBO will be implemented retro-active by 1.7.96
- * LE-MBO will establish new location asap

Rueschlikon, July 9, 1996

Failed!

- **Entrepreneur missing**
- **Lack of support from local banks**

Telecom Bubble

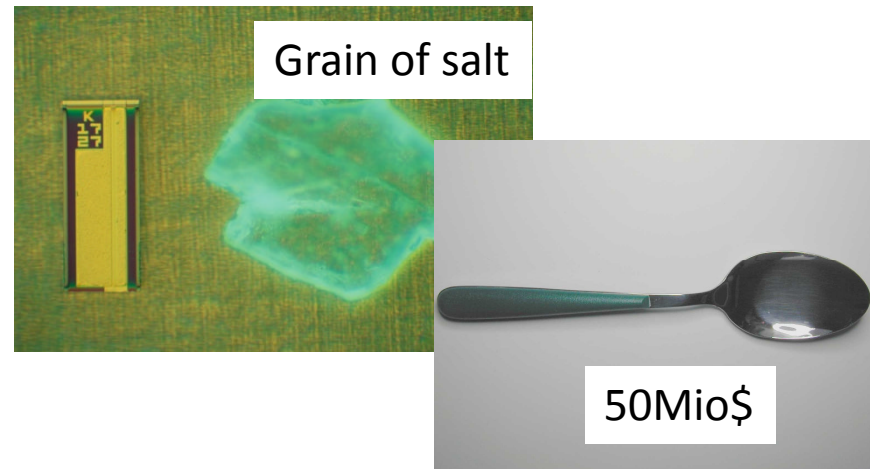
JDS Uniphase



Kevin Kalkoven: Visionary CEO

- Paid 40Mio\$ to IBM for Laser Enterprise
- JDS Uniphase grew from
 - 300 in 1997 to 30'000 in 2001

Pump Chip:



140'000 chips sold in 1999 for 50M\$

- 1 teaspoon of laser chips for 50M\$
- Value created by know-how and IP

Telecom Bubble

Empty Building



11/17/2008

1.5 years, 100Mio\$ later

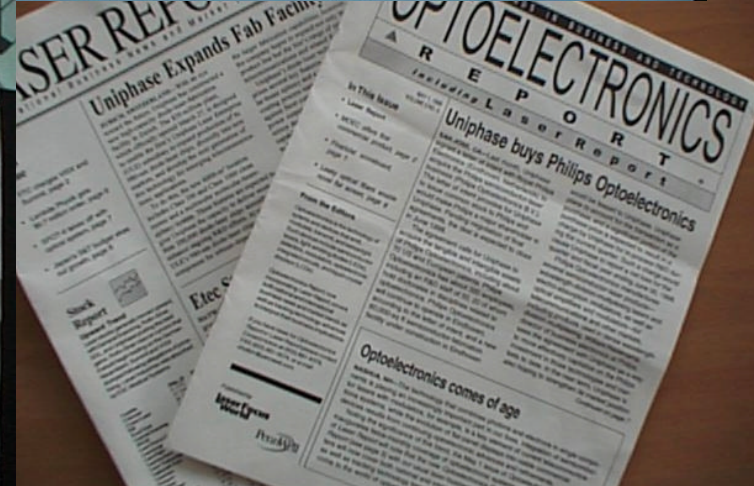
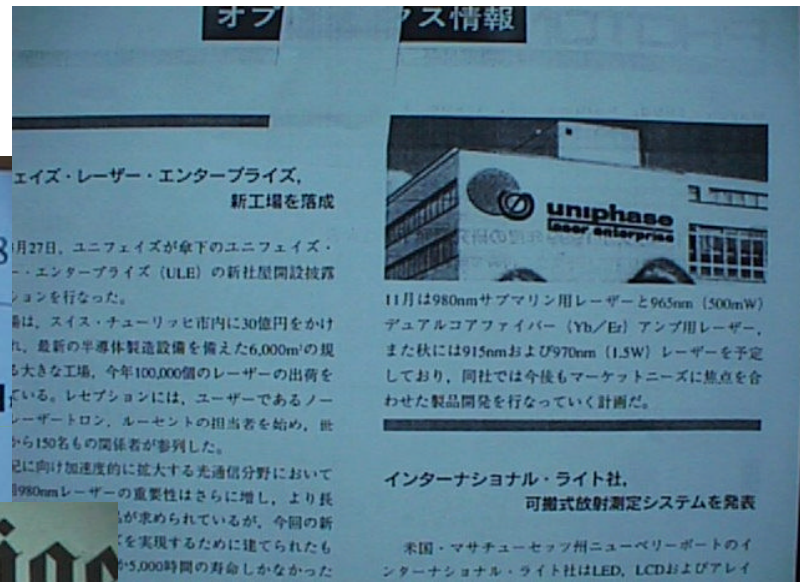


HPP

9

Telecom Bubble

Press



Telecom Bubble



People in Zürich:

Doubling every year

- 1997: 45people / 20M\$
- 2000: 450people/ 100M\$

It can be done in Switzerland!

(JDSU: 300 > 30'000 in 4 years)



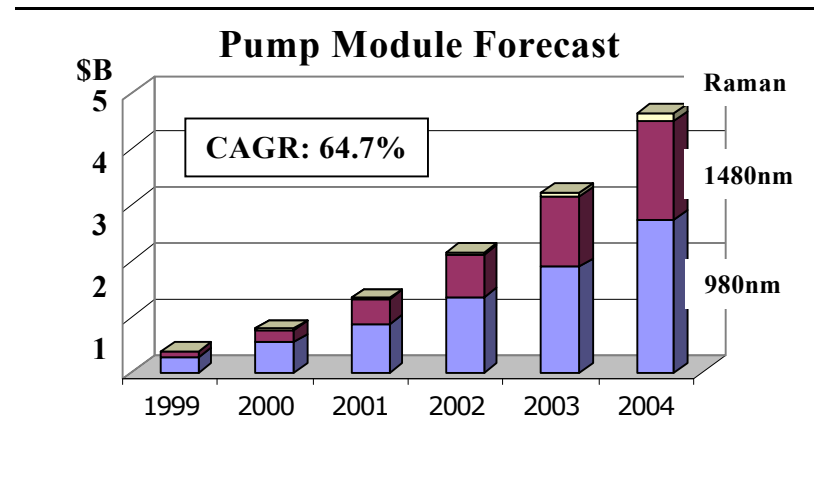
Telecom: Bubble

Laser Enterprise sold in 2000



Begin of 2000: Based on DCF
 From 40Mio to 4'000Mio\$ in 3 years!

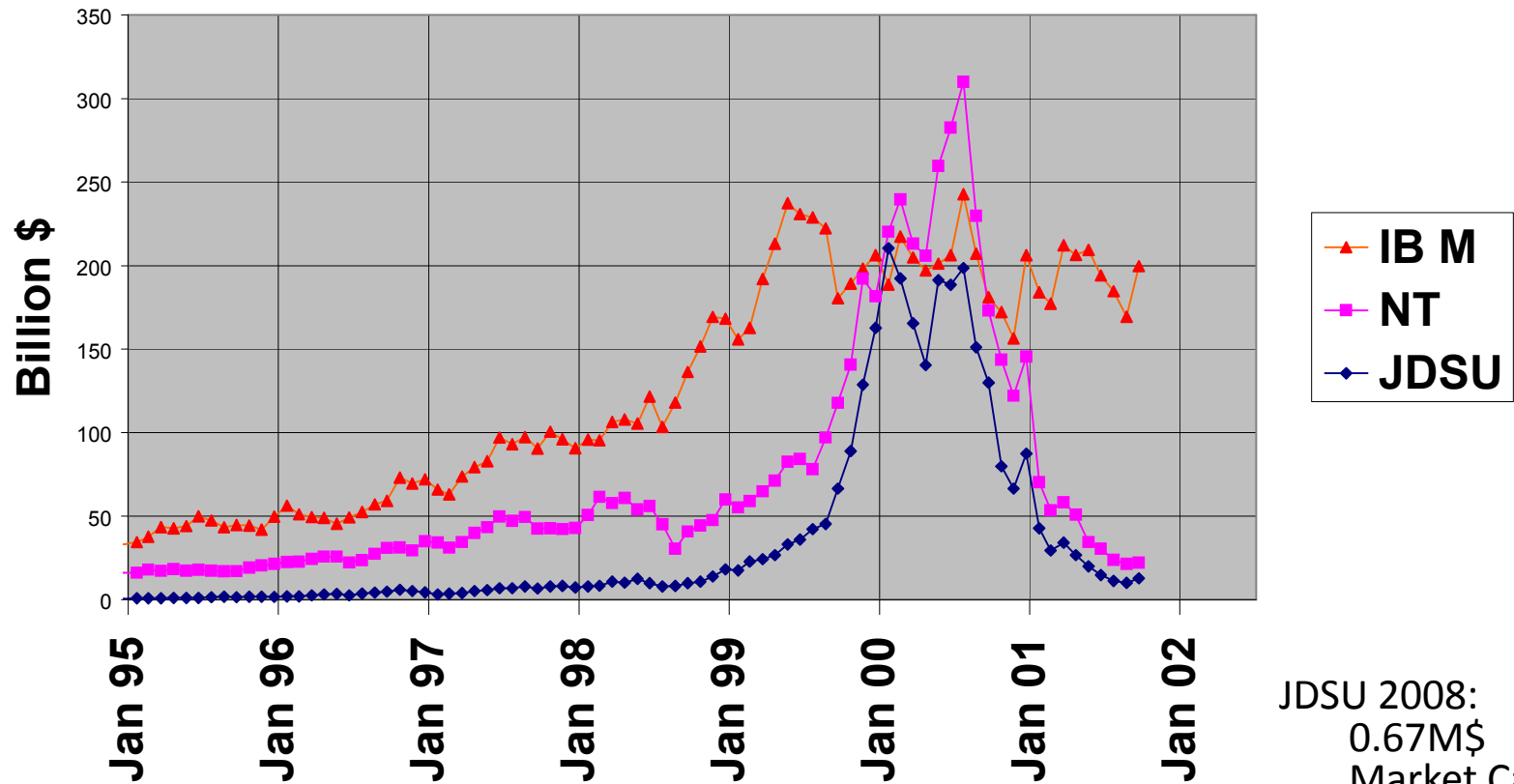
Market Prediction in 1999



Prediction in 1999 for 2004:
 4B\$
 Actual in 2004:
 Pump Module: 40 Mio\$

Telecom: Bubble burst

Market Capitalization of IBM, NT and JDSU



JDSU 2008:
0.67M\$
Market Cap

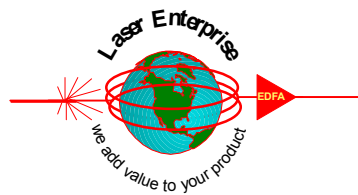
Telecom. Bubble burst

History of companies

NORTEL
NETWORKS™

JDS Uniphase

uniphase
laser enterprise



IBM - IBU

IBM Research

In 2002: Sold to Bookham

Based on liquidation value

- Valued at 10Mio\$
- From 4000Mio\$ to 10Mio\$ in 2 years

Downsizing

- From 450 down to 100 people in 1.5years
- All products continued, did not loose receipie

(JDSU: From 30'000 > 5'000 in 2 years:
Tremendous amount of technology
destroyed)

Turn around: Survival of the fittest

Packaging
Heatsink
Optics

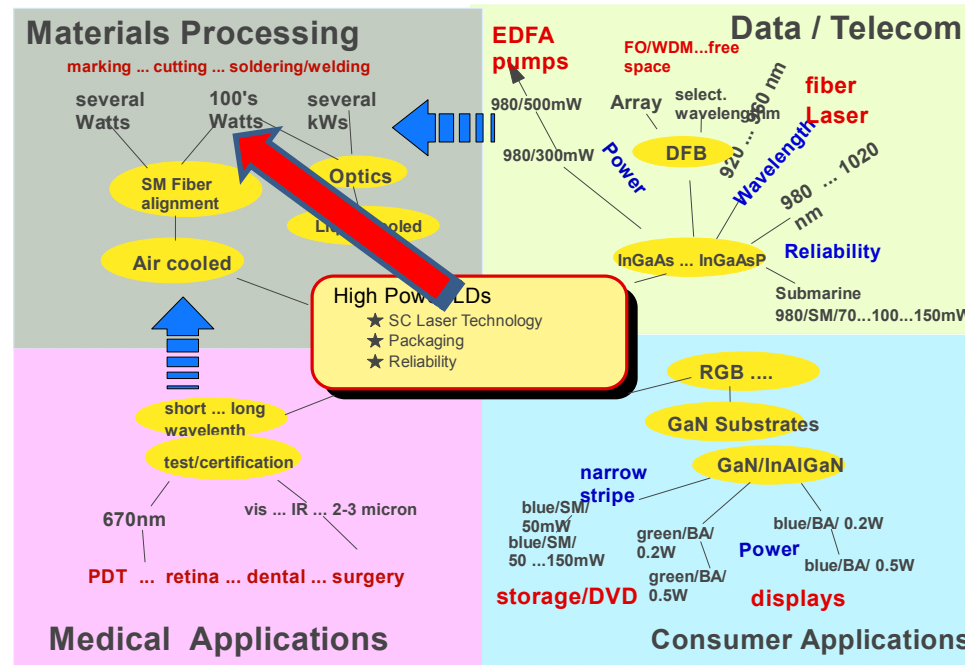
Reliability
Cost

Market:
20M\$
↓
800M\$
displacement of
gas/SS lasers

High margin?
Niche Mkt.
specialities

Large Market
Huge Growth
a lot of
competition
(Japan,USA)

High Risk/
high pay-off?
Inventions
doping
substrates
low cost



Certification
Applications

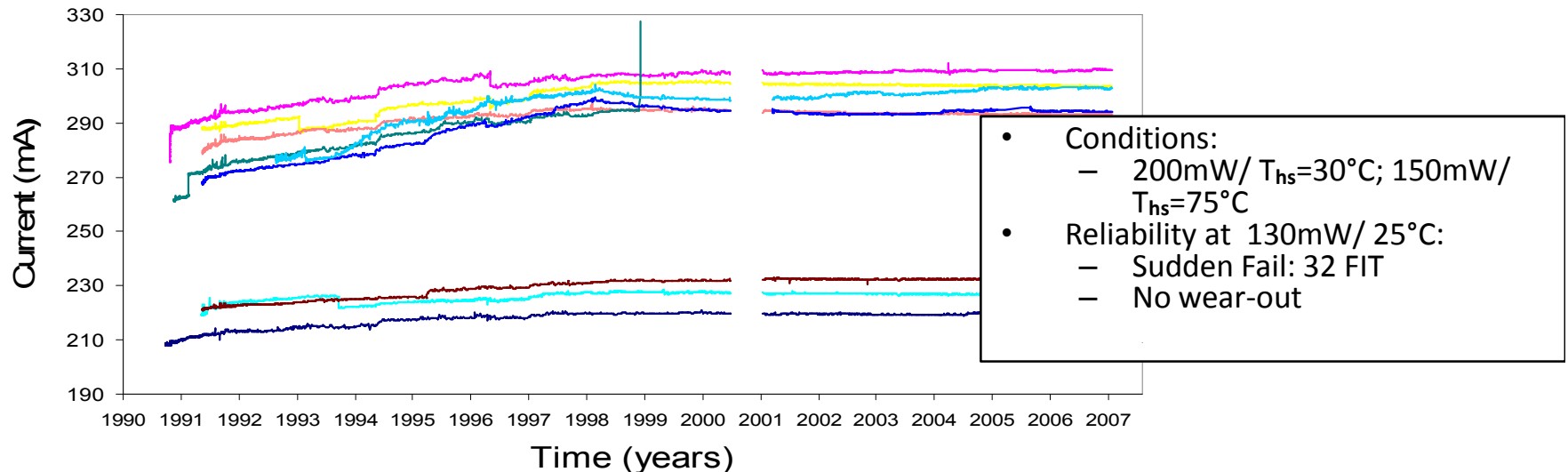
R&D
Reliability

Single device company

but Material Processing back-up plan: **Paid by MicroSwiss program (1MioCHF)**

Turn around

E2 IP: Competitive advantage



Reliability Track Record

- First field deployment of 980nm pumps in 1993 (MCI from Chicago to Sacramento)
- Shipped from Zurich over 1'000'000 devices into terrestrial deployments
 - Field reliability: <25FIT (0.05% return/year)
- 50'000 pumps in underwater transcontinental links : No fail of consequence

Widespread Use

- 50% of internet powered up by 980 pumps from Laser Enterprise or Licensees
- Still 50% market share

Turn around

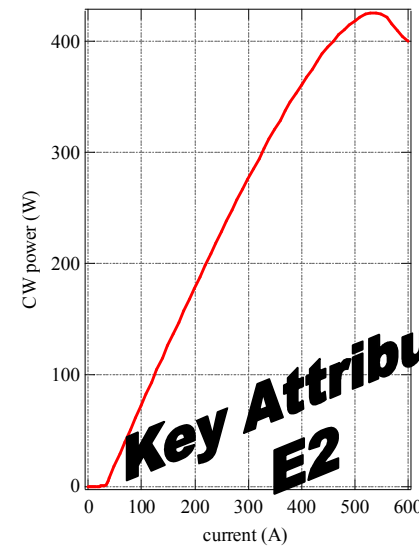
E2 IP: Competitive advantage

Pump diodes for material processing



- 425W at 980nm, 1cm, 50% FF

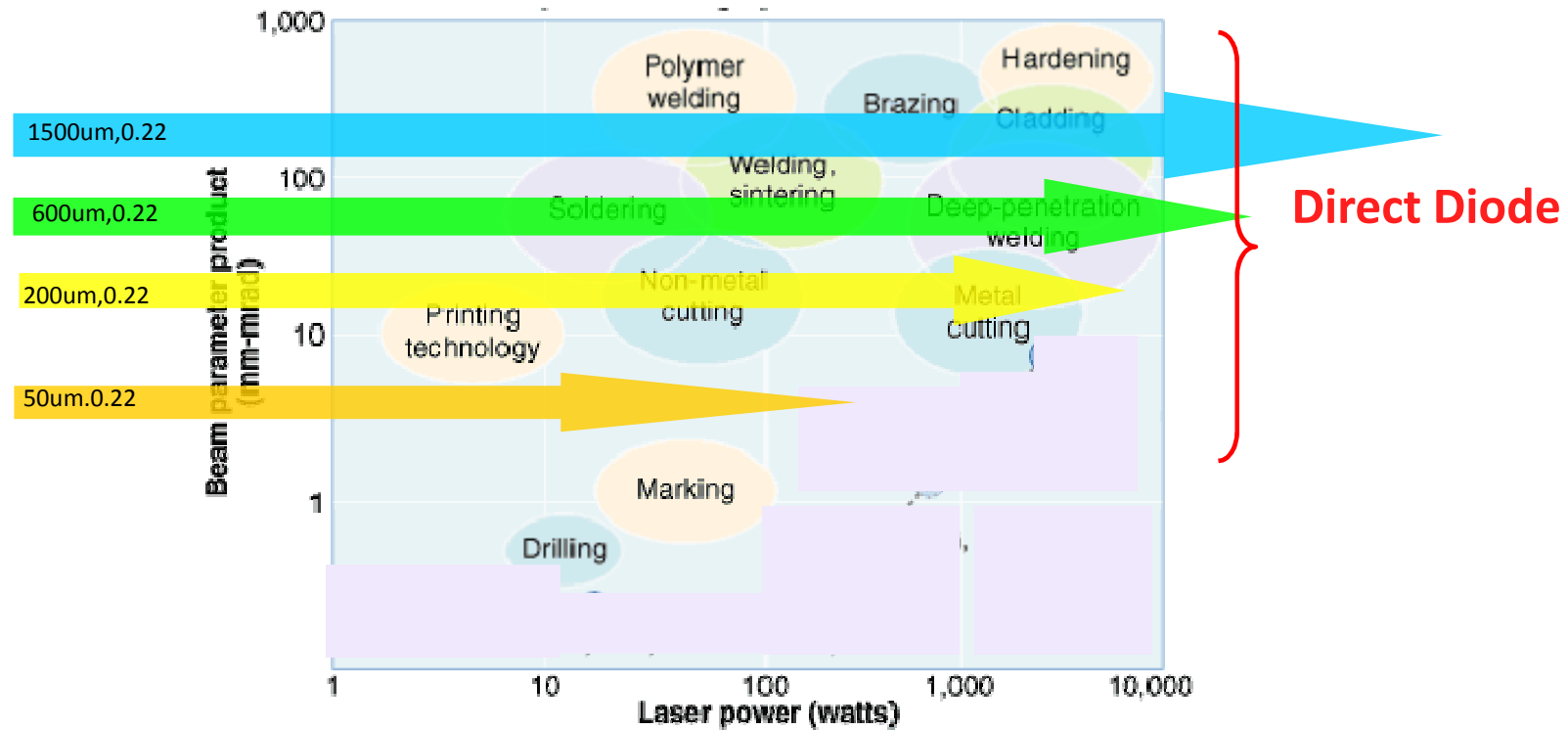
Record power and reliability



Unique selling position
For fiber lasers

Turn around

E2 IP: Competitive advantage



Source: P. Loosen, Fraunhofer Inst., Fuer Lasertechnik, Aachen, Germany

- Power efficient, Fiber delivery, Solid state reliability

Lessons learned:

Innovation: Value to Owner

- IBM: Vertically integrated company, run by headcount:
 - „Not in-plan“ vs „In-plan“: Need key device on time for system
 - Start
 - Not „In-plan“: 0 to 15 people in R&D
 - **Need key device on time for system** :
 - „In-plan“ : 150 people in R&D and manufacturing
 - Obsolete: 15 to 0 people in R&D
- Laser Enterprise: Publically traded company
 - DCF Method (discounted cash flow)
 - Depends on accepted business plan
 - 40M\$ in 1997: Sale (cash) to Uniphase
 - 4B\$ in 2000: Sale (stock) to Nortel
 - Liquidation value
 - Equipment counts positive (for second hand market), each engineer counts negative!
 - 10M\$ (stock) in 2002 (together with 10M\$ loan): Sale to Bookham
 - Revenue multiple
 - Today Laser Enterprise multiple is round 1
 - Laser Enterprise would be 50M\$ worth in 2008
 - P/E
 - Rather used for established business (need to generate profit)
- Laser Enterprise survived because of **value to customer**

Lessons learned:

What went well

1. Developed key technology (E2 patent) at IBM research. Key differentiator
2. Different skills in mgmt at IBM,
 - V. Graf (dealmaker)
 - H. Meier (business)
 - Ch. Harder (technology innovator)
3. Microswiss program (1MCHF): Was key for survival
4. Build up Laser Enterprise Binz (today 150 people)

What was missing

1. IBM gave E2 licences to other companies
 - Small companies need to own IP
2. Our team had no entrepreneur. We were not able to do MBO.
 - Need to get entrepreneur on board
 - Swiss banks need smart VC arm
3. US, Germany: Much bigger programs for national industry dominance
 - CTI: Leadership support needed
4. Company owned by foreigners. Missed special opportunity to build up new Swiss photonic component industry.