

# Laser Enterprise

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# Laser Enterprise

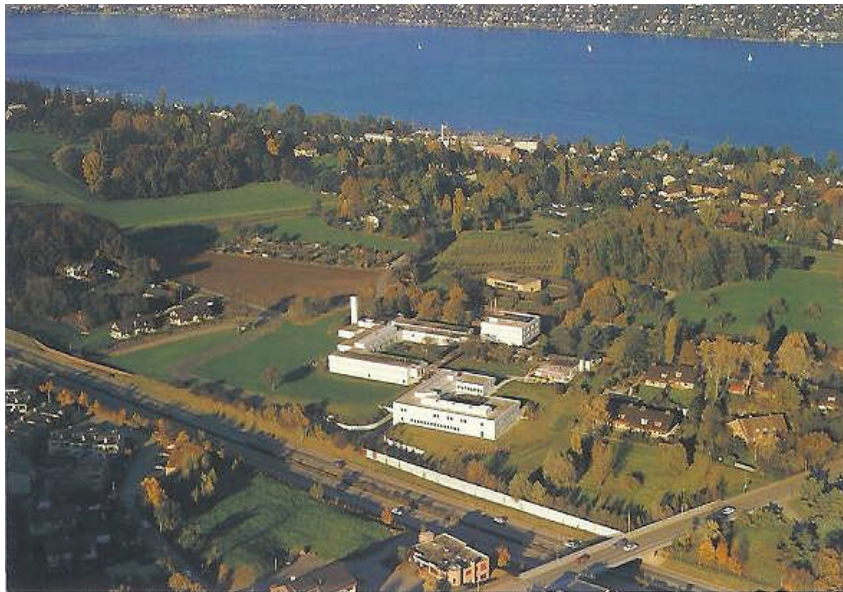
1. IBM Research Laboratory:
  - The golden 80's, E2
  - The IBM crisis
  - IBM Independent Business Unit
2. Telecom:
  - Bubble
  - Bubble Burst
3. Turn Around:
  - Survival of the fittest
  - E2: Competitive advantage

## Lessons learned

- Innovation: Customer valuation
- What went well, What was missing
- Ideas

# IBM Research Laboratory: The golden 80's

IBM: Vertically integrated company to produce mainframes



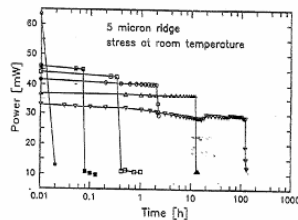
- 1983: MESFETs (Logic and memory)
- In 1985: Silicon CMOS will dominate
  - My manager told me to start “skunk” optoelectronics
- Opto-electronics: “In-Plan”
  - Optical interconnects: 830nm lasers
  - MO storage: 780nm 630nm and **976nm** (frequency doubling)
  - Printers: Array of lasers
  - E2
- Widenend technology base
  - OLEDs (for displays)
  - High index waveguides
  - GaN (for MO storage)
  - 1.3 and 1.55um laser diodes
- 1986: Nobel Prize for STM/AFM
- 1987: Nobel Prize for High Tc

# IBM Research Laboratory: The golden 80's

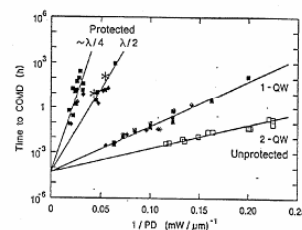
## Physicist and Chemist

### Mirror Passivation

Time to COMD



Arrhenius Plot

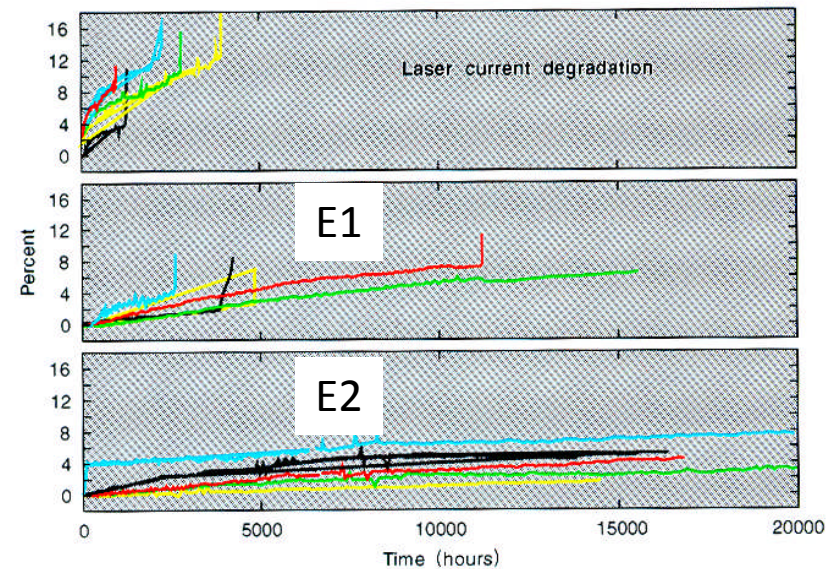


Surface chemist  
fixed problem of  
980nm laser  
diodes

IBM

11/81 (Ch. Harder)

## E2 passivated



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

# IBM Research Laboratory: The IBM crisis

## Chronology

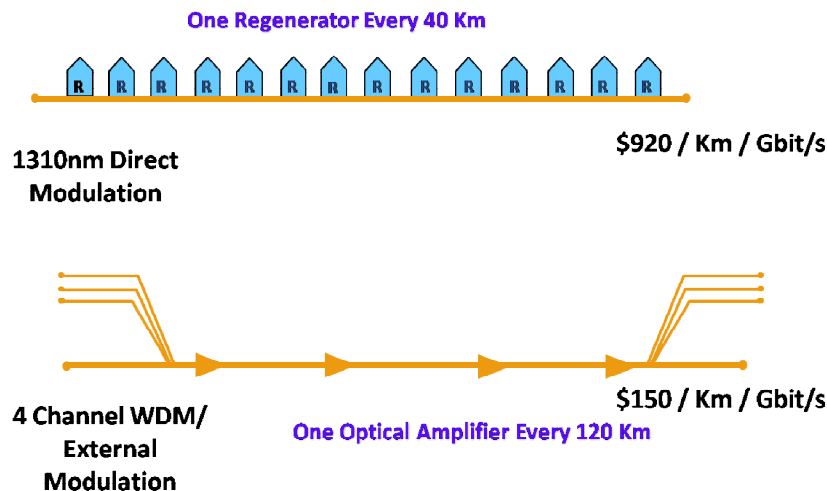
- 1990: > 150 people in IBM on laser diodes
- 1991: Downsized to 15 people
- What happened
  - Economics: IBM downturn
  - Technology obsolete
    - Interconnect problem solved by VLSI and RISC architecture
    - Printers: Commodity
    - Storage: PC-Mini Harddisk for storage is successful technology (MO used for exchangeable (commodity))
- 1992: About to dissolve group, but:
  - 976nm pump had been developed for frequency doubling in KTP (MO storage)
    - Monopole for 980nm EDFA pump for telecom
    - Corning contacted us

## After the compression: Laser Enterprise 1994



# IBM Research Laboratory: IBM Independent Business Unit

## Disruptive Technology: Optical Amplifier

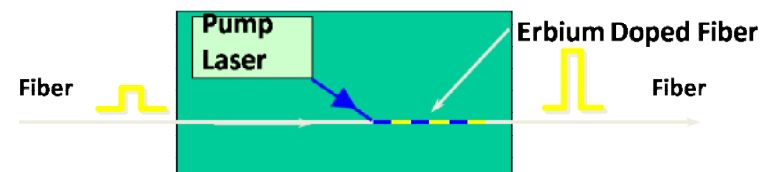


Today:

A few hundred channels at 10Gb/s  
over a few thousand km!

## Magic Fiber: Erbium doped fiber

### Optical Amplifier



### Optical Amplifier:

Needs **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

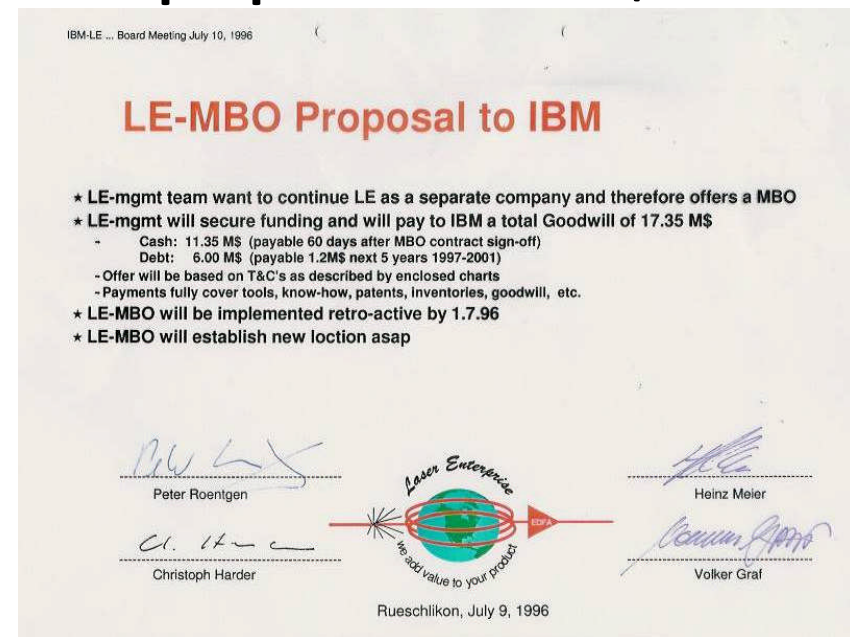
## Business case 1997

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 developped 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\$



Failed!

- No CFO(MBA) in Laser Enterprise
- Lack of support from local banks

# Telecom Bubble

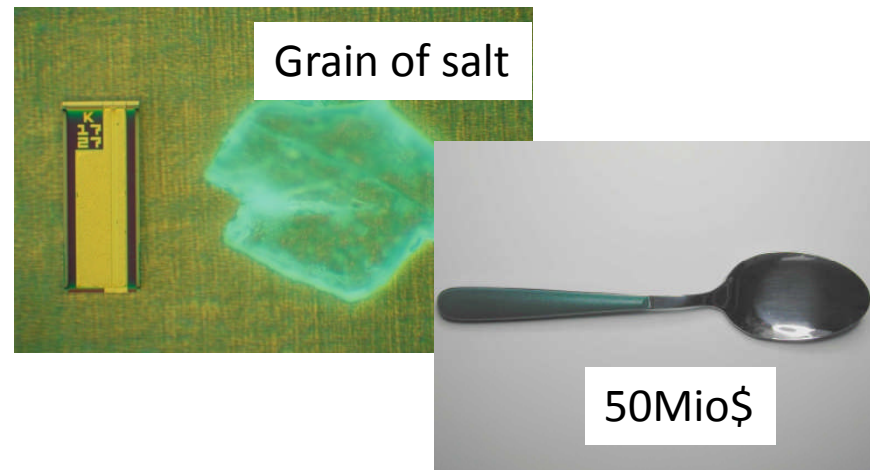
## JDS Uniphase



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
- Value created by know-how and IP



# Telecom Bubble

**Empty Building**



29.10.2007

**1.5 years, 100Mio\$ later**



Laser Enterprise



# 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)



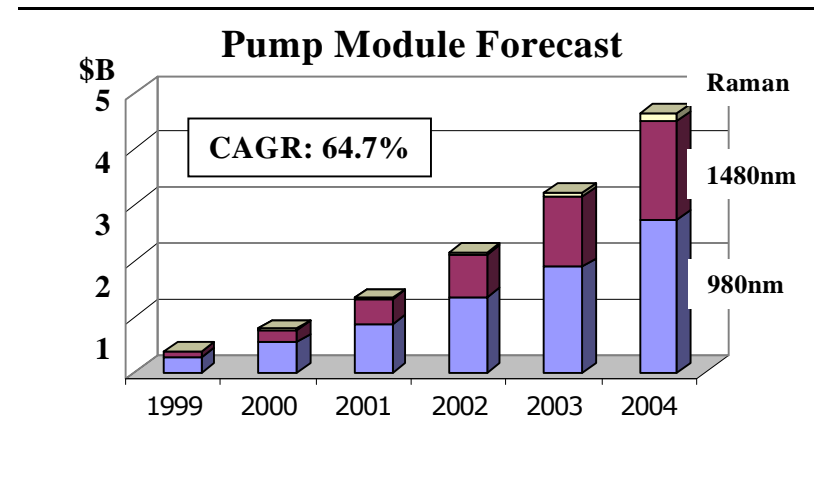


# Telecom Bubble

## Laser Enterprise sold in 2000



## Market Prediction in 1999



Prediction in 1999 for 2004:

4B\$

Actual in 2004:

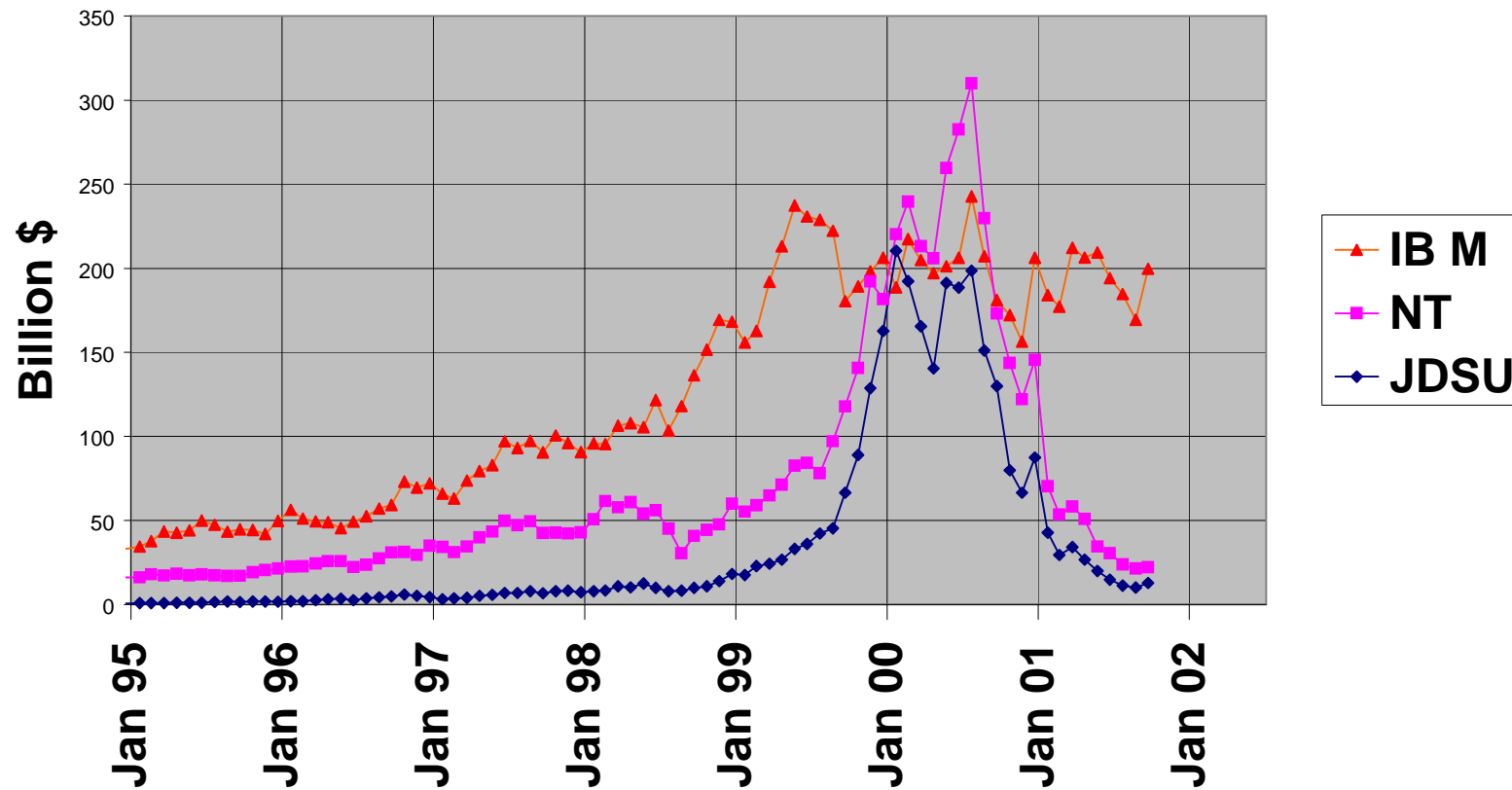
Pump Module: 40 Mio\$

Begin of 2000: Based on DCF

From 40Mio to 4'000Mio\$ in 3 years!

# Telecom Bubble burst

Market Capitalization of IBM, NT and JDSU





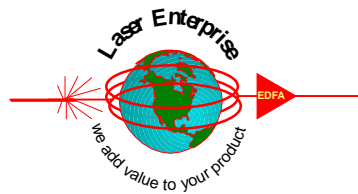
# Telecom Bubble burst

## 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

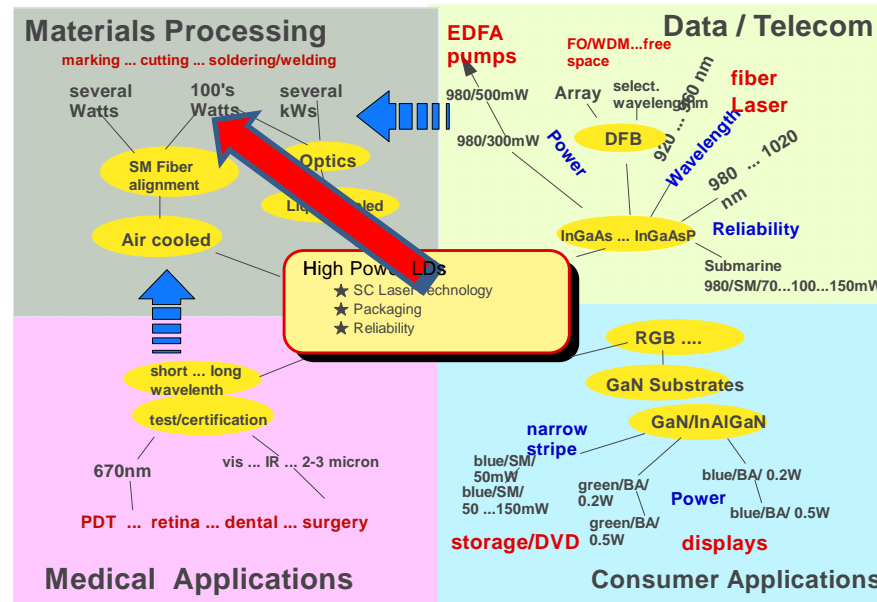
Packaging  
Heatsink  
Optics

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

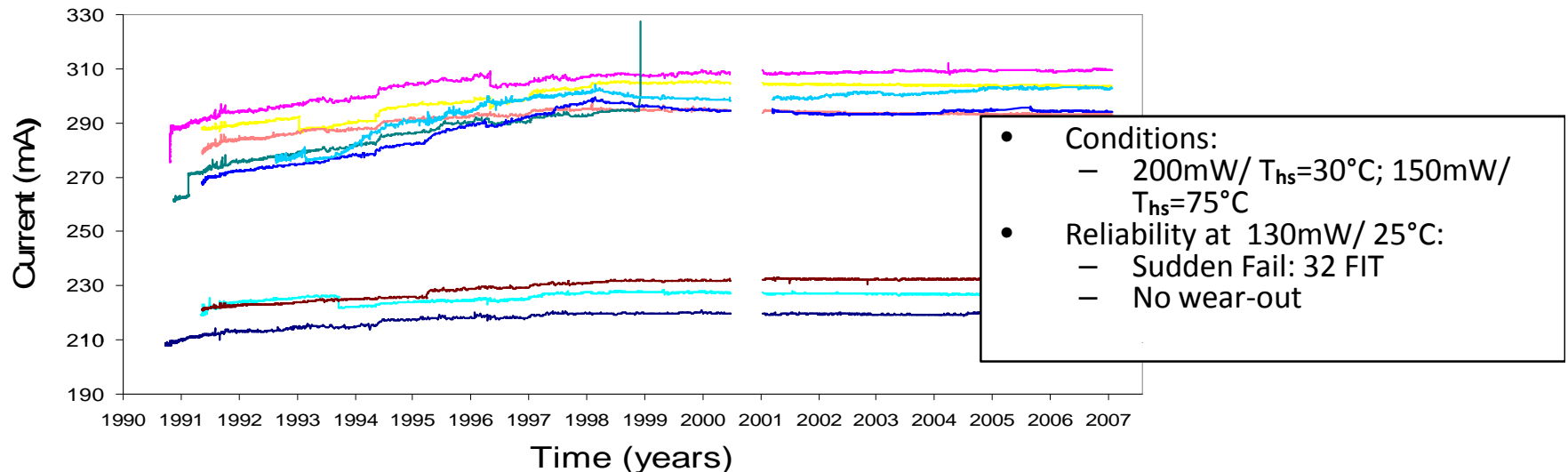
R&D  
Reliability

Single device company

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

# Turn around

## E2: 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 Licencees
- Still 50% market share

# Turn around

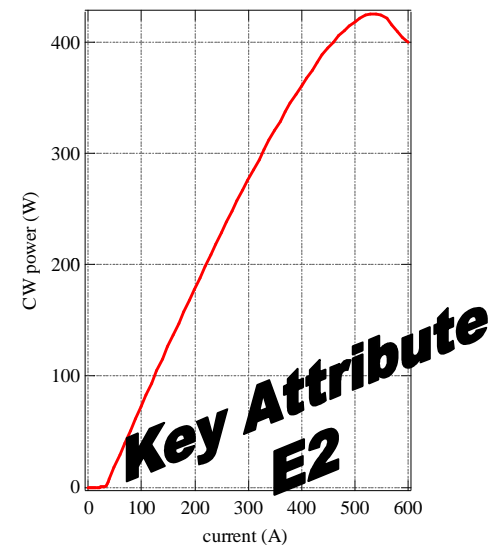
## E2: Competitive advantage

### Pump diodes for material processing



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

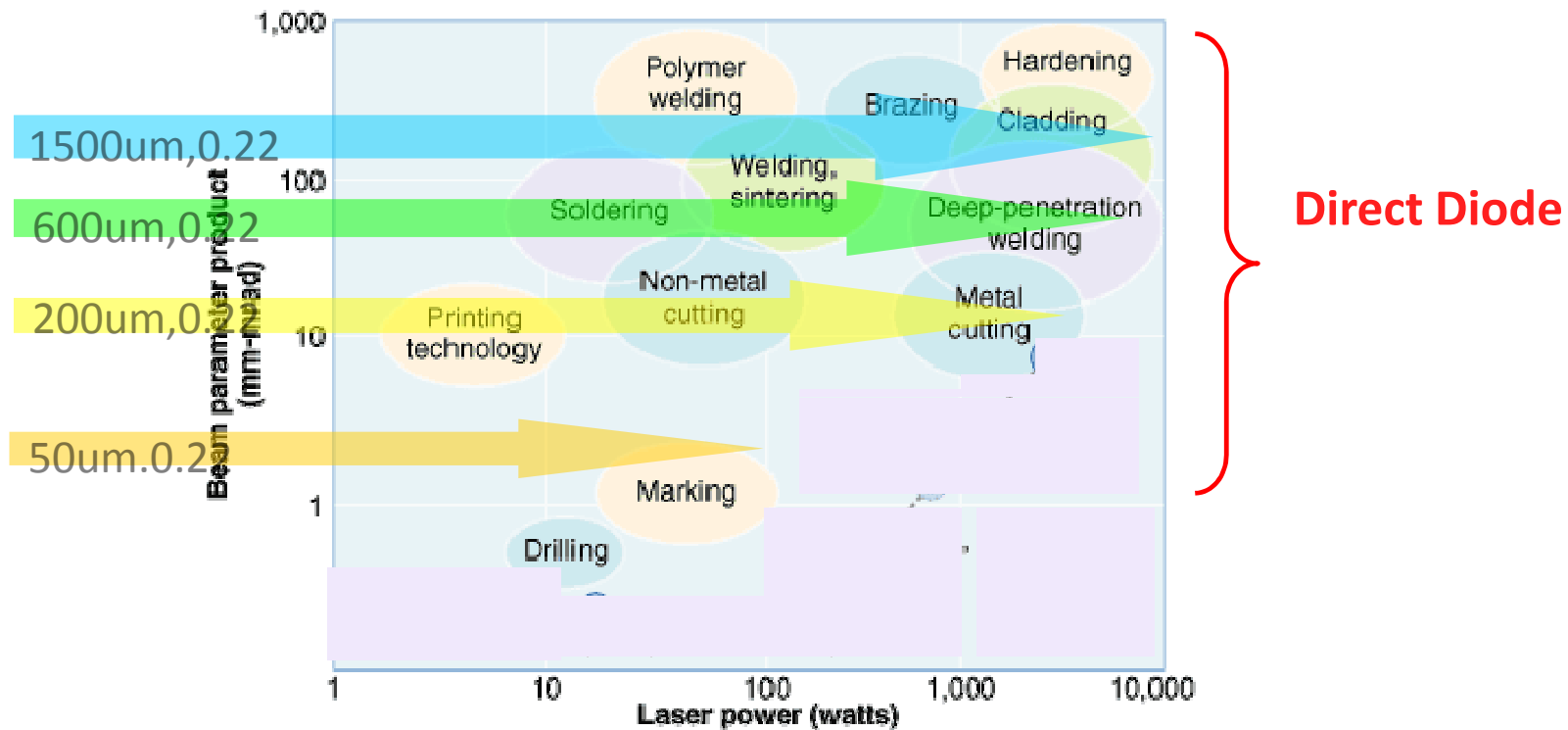
### Record power and reliability



Unique selling position  
For fiber lasers

# Turn around

## E2: Competitive advantage



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

- Direct Diode Material Processing
- Fiber laser pump



# Lessons learned:

## Innovation: Customer Valuation

- IBM: Vertically integrated company:
  - Headcount method
    - „Not in-plan“ vs „In-plan“ Need key device on time for system
      - 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 of 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 to 2
      - Laser Enterprise would be 50M\$ to 100M\$ worth in 2007
  - P/E
    - Rather used for established business

# Lessons learned:

## What went well

1. Basic technologies were researched at IBM. Good teambuilding
2. Divers management team at IBM, Volker Graf (dealmaker), Heinz Meier (business), Christoph Harder (innovator) (according to HR)
3. Microswiss program (1MioCHF) was key for survival
4. Fight for survival was (barely) won
5. Build up Laser Enterprise Binz (today 150 people), but in hands of US company (Bookham)
6. Stock options gave participation

## What was missing

1. IBM did stop MBO for financial reasons
2. We lacked CFO (MBA). Local banks/VC had no know how to support us. Both inferior to Silicon valley banks/VC
3. US, Germany: Much bigger programs for national industry dominance
4. Offensive positioning
5. Missed special opportunity to build up new Swiss photonic component industry.
6. Risk management, corporate gov.

# Ideas

## 1. Swisslaser Network

- CTI sponsored network to support Swiss photonic industry to become more competitive. Just started (I have been elected president recently).

## 2. Technology+Money

- Bring Applied Physics (ETH) and MBA (HSG) closer together
- Establish joint University HSG/ETHZ
- Attract money from Swiss banks (no need to invest /lose in subprime US real estate)

## 3. Fulbright scholarship

- I did learn during my education (MS and PhD) in the US how to make laser diodes, paid for by Fulbright Fellowship
- Without this Fellowship there would be no Laser Enterprise
- Establish Swiss Fellowship, like Fulbright (one has to return after PhD)