Talking storage

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HOCHSCHULE DARMSTADT
UNIVERSITY OF APPLIED SCIENCES

fbi
FACHBEREICH INFORMATIK

University of Applied Sciences
approx. 13,000 students
11 faculties
44 courses of study
(20 bachelor, 7 diploma, 17 master)
2,300 freshmen p.a.
730 professors and employees
12% international students

Faculty of Information Sciences
approx. 1,500 students
55 professors and employees
-Bachelor (B.Sc.)
-Cooperative Course (B.Sc.)
-Master (M.Sc.)
-Joint Intern. Master JIM (M.Sc.)
-PHD programs

Applied research (selected)
-Incar Multimedia
-Embedded Systems
-Storage technologies
-Geo data
-RFID
-CASED (IT security)
-Natural language proc.
-Onthologies
-CMMI

Top ranking
2nd place in Germany 2013

http://www.wiwo.de/ranking-die-besten-unis-und-fachhochschulen/8046582.html

International partners
Universities in Australia, China, Finland, France, Greece, UK, Irland, Poland, Russia, Sweden, Spain, Hungary, USA

Darmstadt - Mathildenhöhe

Center of the „Jugendstil"

**Confusion of tongues -
Specialists on their islands**

Information science

aka „Informatik" (germ.)

**introduced 1957
by Karl Steinbuch**
**(1958-1980 professor at Karlsruhe
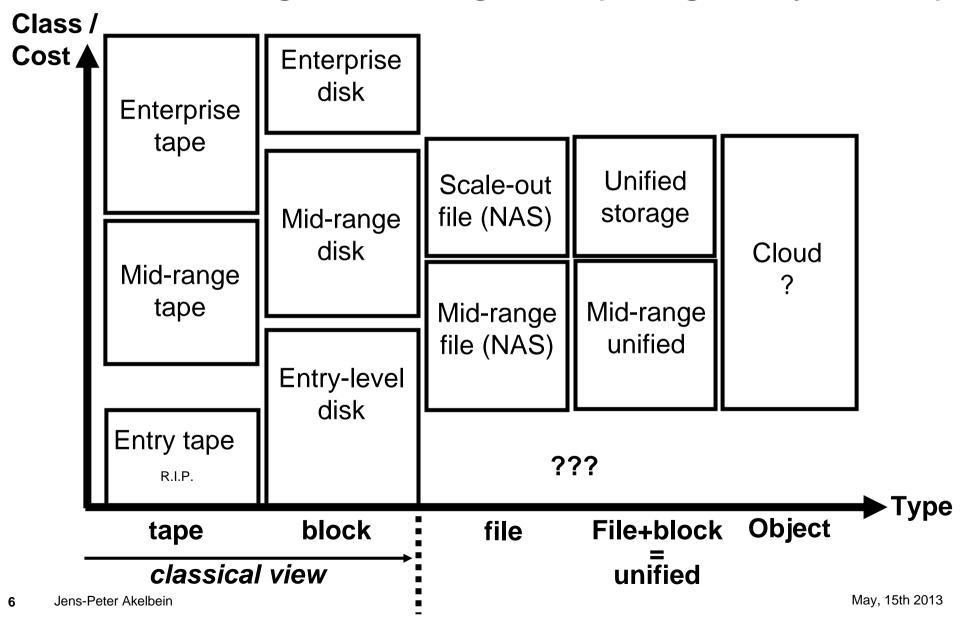Institute of Technology KIT)**

Competition

And the winner is ...?
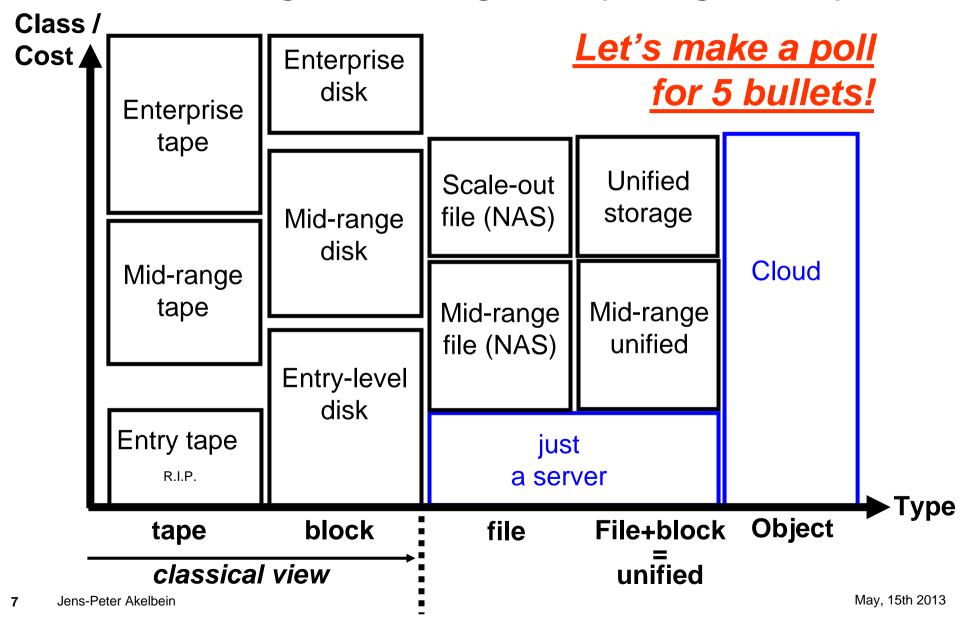
What is storage?

- **Non-volatile storage devices...**
  ...*punch cards*, hard disk drives, tapes, *floppy disks*, storage controllers, storage area networks, automated tape libraries, optical and magneto-optical storage, solid state disks,...

- **A 20-25 billion dollar business mainly driven by hardware-centric business models**

- **Boxes shipped with microcode**

- **Boxes shipped with complex system software**

- **Storage software (~$3,5 billion)**

Selected storage market segments (storage analysts view)

Selected storage market segments (adding servers)

Class / Cost

Enterprise tape

Enterprise disk

Mid-range tape

Mid-range disk

Entry tape

R.I.P.

Entry-level disk

Scale-out file (NAS)

Mid-range file (NAS)

Unified storage

Mid-range unified

Cloud

just a server

Let's make a poll for 5 bullets!

Type

tape   **block**   **file**   **File+block = unified**   **Object**

classical view

The "classical" block storage perspective

- **A large portion of storage is still block**

- **File means unstructured data. Even if analysts forecast file gets the dominant player block storage is still growing significantly.**

- **Midrange block grows significantly driven by growing businesses in emerging countries.**

- **Boxes are shipped with Microcode.**

- **Servers are the easy side of the world - How do you reboot your storage?**
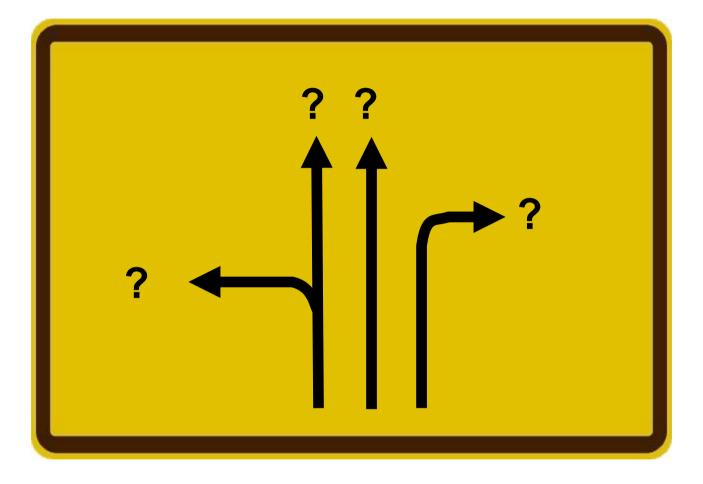
The NAS perspective

- **Nearly all storage is consumed as file today. NAS boxes provides the best and fastest implementation.**

- **Protocols including the handling of user directories, access rights, locks etc. are far more complex than block protocols.**

- **File perfomance is critical and complex.**

- **The newer versions of NAS protocols provide a reliability similar to block protocols.**

- **Block protocols are served as options on top of file.**

The tape perspective

- **„Tape is dead". People are telling this since 20 years while tape is vital.**

- **Tape needs no power to store data.**

- **Enterprise tape is much more reliable than hard disks garantueeing 30 years for storing data.**

- **Virtual tape libraries can be used to fullfil performance requirements.**

- **Standardized file system interface allows to use file semantics for accessing the data.**

The storage software perspective

- **At the end everything is software.**

- **Today's commercial of-the-shelf hardware provides good-enough quality for the majority of reliability requirements.**

- **Software is the better business. Once being developed there is no manufacturing cost required.**

- **Software provides new features more easy desparately required by customers.**

- **You can achieve a vendor lock-in much better in a software eco-system due to the complexity of migrations for feature-rich environments.**
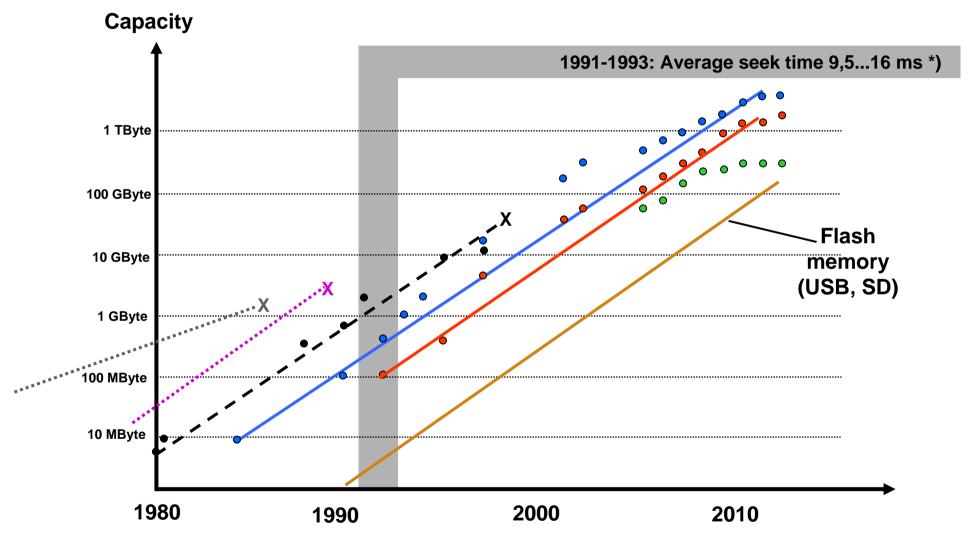
Who is right?

It depends. There is more than one storage island.

Moore's law for storage

HDD format factor 14´´ 8´´ 5,25´´ 3,5´´ 2,5´´ 1,8´´

Capacity

1991-1993: Average seek time 9,5...16 ms *)

1 TByte

100 GByte

10 GByte

X

1 GByte

X

X

100 MByte

Flash memory (USB, SD)

10 MByte

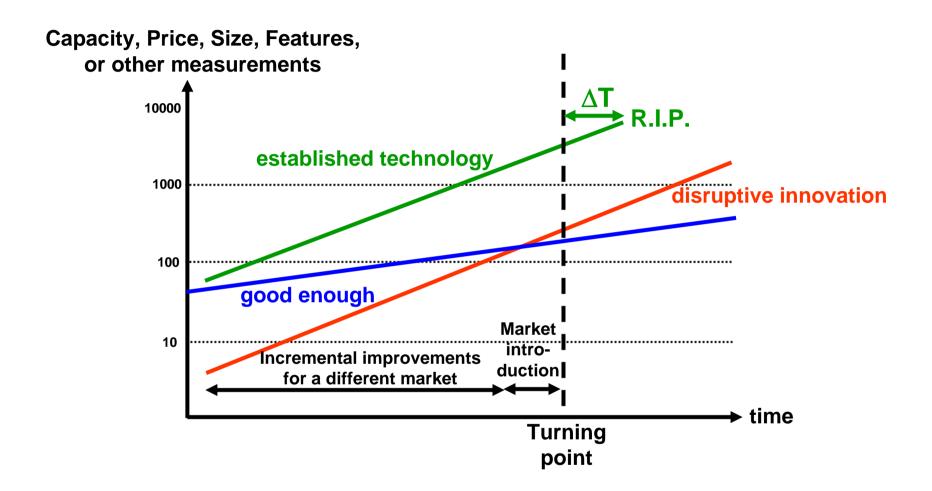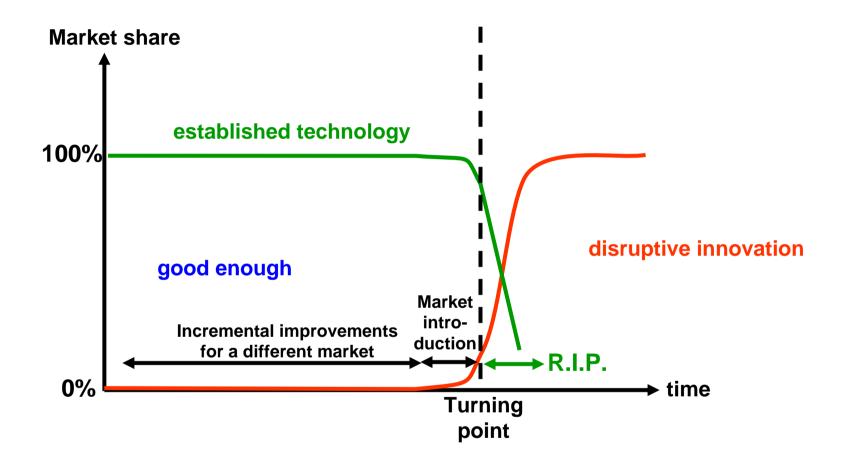**1980   1990   2000   2010**

***) IBM Model 3380/3390**
(http://www-03.ibm.com/ibm/history/exhibits/storage/storage_3390.html)
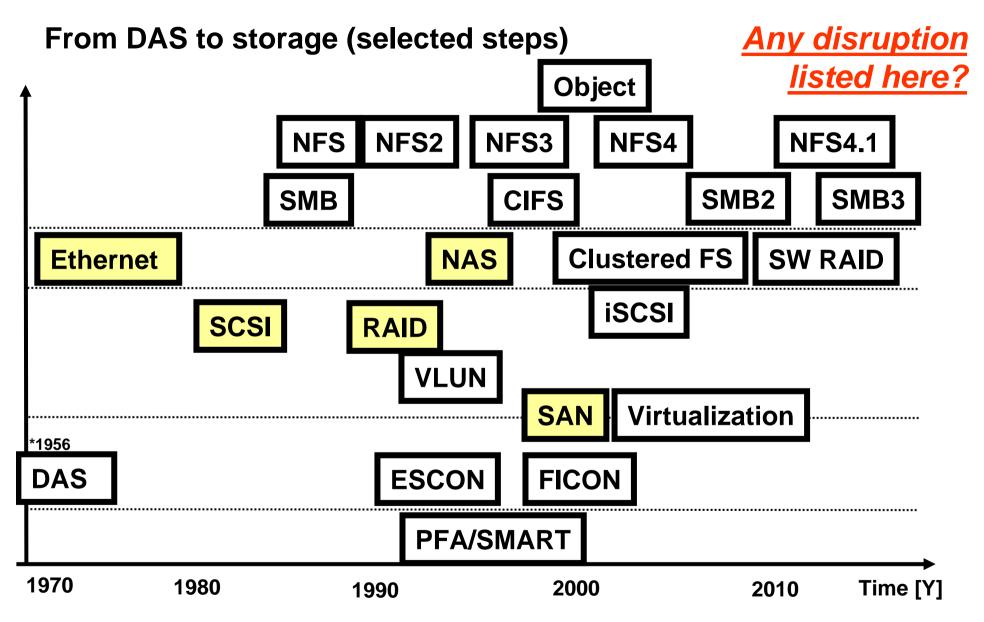
Moore's law for storage [outlook]

- **Technology outlook still shows high potential for continued capacity growth (Heat-Assisted Magnetic Recording HAMR leads to 100 TB hard disks)**

- **Mechanical parts limit I/O's per second -> will remain or even slowed down**

- **RAID rebuild time becomes a limiting factor**

- **Flash memory is the dominant mobile storage device. SSD storage introduces another storage tier in large compute environments**

- **Hybrid HDD in your laptop/PC – Do you need 100TB of hard disk with 1 TB of flash or do you need just 1 TB?**

Capacity, Price, Size, Features, or other measurements

Clayton .M. Christensen (professor at the Harvard University), chose the HDD industry as example in his book „The Innovator's dilemma" (1997) because of their rapid innovation cycles.

Don't believe in linear trends when faced with disruptive innocations (and recognize wording like from flash memory to SSD storage).

From DAS to storage (selected steps)

Any disruption listed here?

Object

NFS   NFS2   NFS3   NFS4   NFS4.1

SMB   CIFS   SMB2   SMB3

Ethernet   NAS   Clustered FS   SW RAID

iSCSI

SCSI   RAID

VLUN

SAN   Virtualization

*1956

DAS   ESCON   FICON

PFA/SMART

1970   1980   1990   2000   2010   Time [Y]

Disclaimer: some date of invention/introduction might deviate from shown starting points, corrections are warmly welcome ☺
DAS=Direct Attached Disk   VLUN=Virtual LUN   PFA=Predictive Failure Analysis   SMART=Self-monitoring analysis and reporting technology

B2B, B2C, C2C

>500,000 cores
>100,000 HDD's

HPC

Enterprise business

Virtualized SW stack

Large cloud& Internet

Analytics & big data

Medium business

Business

Billions of unconnected people

Every-where

Small business

Emerging countries

Smart traffic

Consumer

Intelligent providers

Cyber-physical

Personal computer

Smart office & the app of the day

Smart-phone

Tablets

Laptop

Trends? Questions!

- **Do we have reached Peak Disk? Does flash storage drive big data analysis, and more?**

- **Do cloud services become „good" enough to replace the majority of IT equipment for small and medium businesses?**

- **Do we see RAID storage controllers replaced by P2P redundancy concepts provided with storage software?**

- **What changes are implied by introducing cyber-physical systems and getting more and more people connected?**

- **How does Samba fit into this landscape?**

It is difficult to make predictions, especially about the future.

Niels Bohr
Mark Twain
Albert Einstein
Winston Churchill
Groucho Marx
Enrico Fermi
Woody Allen
Confucius
Dan Quayle
and many „famous" analysts