Long Term Archival Storage Using Holographic Data Storage

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innovations in holographic storage

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Why Holographic Storage?

High capacity and performance
- Capacities from 300 GB to 1.6 TB
- Transfer rates to 120 MB/s
- Fast Replication (coming)

Unique formats possible because don't have to spin

Long archival life
- 50+ years
- No special handling required
- No media wear issues

Robust content protection & security
- Write once archival media
- Drive & media security options

Random access to data
- Millisecond access; no need to restore data

Excellent Total Cost of Ownership (TCO)
- Low cost media
- Reduced migration frequency

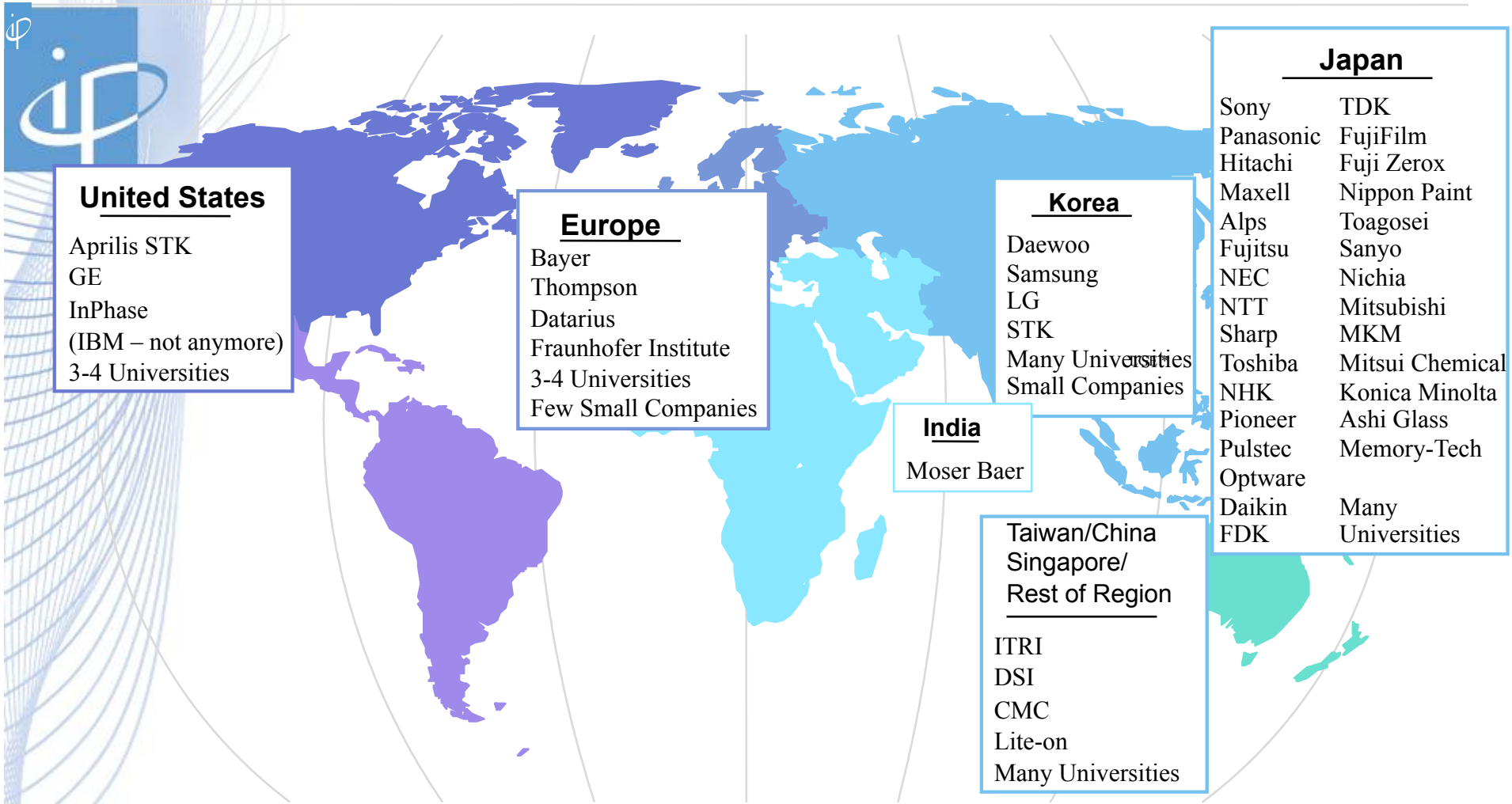
Competing Archive Technologies

 Tape		 Hard Drives		 CD/DVD	
Pros	***Cons***	***Pros***	***Cons***	***Pros***	***Cons***
• High Capacity • High Transfer Rate • Low Cost Media	• Media Reliability • High Media Maintenance $ • Slow Data Access • Not True WORM	•High Capacity • Low Cost/GB for device • Easy to use • Random Access to Data	•High Power Usage • Device Life 3-5 yrs • Not Archival Format	•Good Media Archive Life • Low Cost • True WORM Format	•Low Capacity • Low Transfer Rate

Holographic Benefits

Pros	***Cons***
• High Capacity = 300 to 1.6TB on a single disk • Long Media Archive life = +50yrs (7 yrs. for tape & hard drives) • Millisecond Random Access to data (minutes for tape) • True WORM Format Protects Archive Data • Low $/GB media competitive against tape and existing optical • Highest Optical Transfer Rate • Low power requirements	• New Technology • WORM only format at Introduction • Slower transfer rate than magnetic

Development Activities in HDS



United States

Aprilis STK
GE
InPhase
(IBM – not anymore)
3-4 Universities

Europe

Bayer
Thompson
Datarius
Fraunhofer Institute
3-4 Universities
Few Small Companies

Korea

Daewoo
Samsung
LG
STK
Many Universities
Small Companies

India

Moser Baer

Taiwan/China Singapore/ Rest of Region

ITRI
DSI
CMC
Lite-on
Many Universities

Japan

Sony	TDK
Panasonic	FujiFilm
Hitachi	Fuji Zerox
Maxell	Nippon Paint
Alps	Toagosei
Fujitsu	Sanyo
NEC	Nichia
NTT	Mitsubishi
Sharp	MKM
Toshiba	Mitsui Chemical
NHK	Konica Minolta
Pioneer	Ashi Glass
Pulstec	Memory-Tech
Optware	
Daikin	Many
FDK	Universities

Tapestry™ Product Roadmap

worm

Gen 1	Gen 2	Gen 3
tapestry™ 300r 300 GB @ 20 MB/sec	**tapestry™** 800r 800 GB @ 80 MB/sec	**tapestry™** 1600r 1.6 TB @ 120 MB/sec

rewritable

Gen 1	Gen 2
tapestry™ 300rw 300 GB @ 20 MB/sec	**tapestry™** 800rw 800 GB @ 80 MB/sec

- r-drive backward read compatible for 3 generations
- rw-drive backward read compatible with r-media
- 18 to 24 months between generations

tapestry™300r Drive

Capacity

- 300GB

Read/Write Performance

- transfer rate - 20MBps or 160 Mbps
- avg exposure per page- 1 millisecond
- avg seek time - 250 ms
- bit error rate (BER) $<10^{-18}$
- 2GB buffer

Operational Characteristics

- looks like a drive letter
- drag and drop capabilities
- emulates MO WORM, LTO Tape
- interfaces:
  - SCSI Parallel 320
  - Fibre Channel
  - Gig-E, FTP