SDC
STORAGE DEVELOPER CONFERENCE
SNIA SANTA CLARA, 2016

Introducing the view of SNIA Japan Cold Storage TWG on "Cold Storage"

19 Sep 2016

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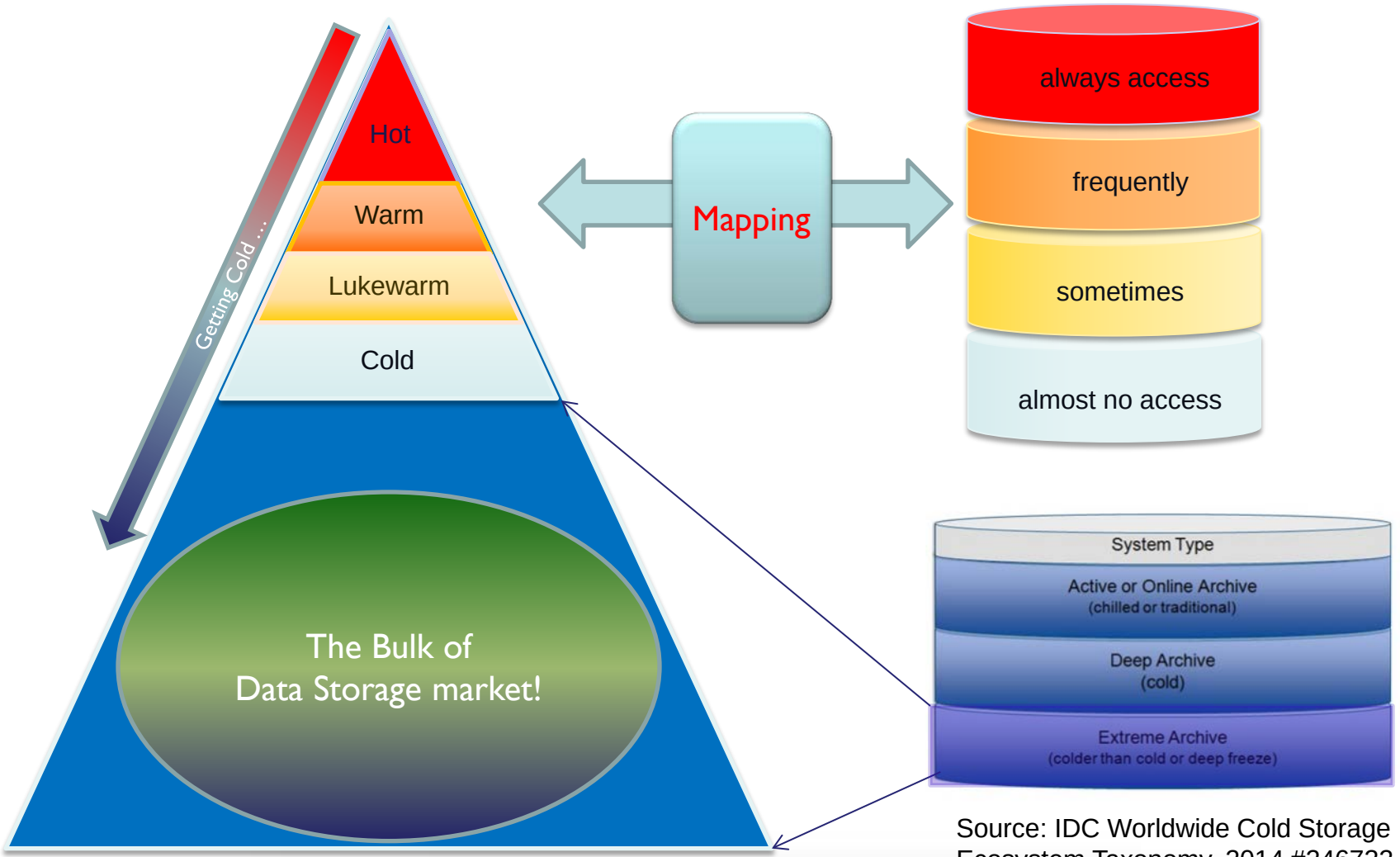
Sony Corporation

COLD STORAGE
IS
STORAGE FOR COLD DATA

Agenda

1. Introduction
   - Why we are focusing on Cold Storage?
   - About us (SNIA-J CSTWG)
2. Discussion Part-1
   - Definition of Cold Storage
3. Discussion Part-2
   - Taxonomy for Cold Storage
     - Activity summary and next steps
4. Latest optical technology (Sony's approach to Cold Storage)
   - Archival Disc Technology
     - Trial mapping of Cold Storage media

Your data can be Cold, Colder, Coldest..



Source: IDC Worldwide Cold Storage Ecosystem Taxonomy, 2014 #246732

What's your image for Cold Storage?

Why you don't care for Cold data?

- Excuse 1
  - There are **no clear border lines** between hot, warm and cold data and you think **you can't help** this situation.
- Excuse 2
  - Cold data is **old and not mission critical**, thus it is something you **can defer your decision**.
- Excuse 3
  - Some imagines that **Cold data is useless**, simply because it is **not earning money** for now.

➢ ***Where is cold data …***

Cold data should be found everywhere!

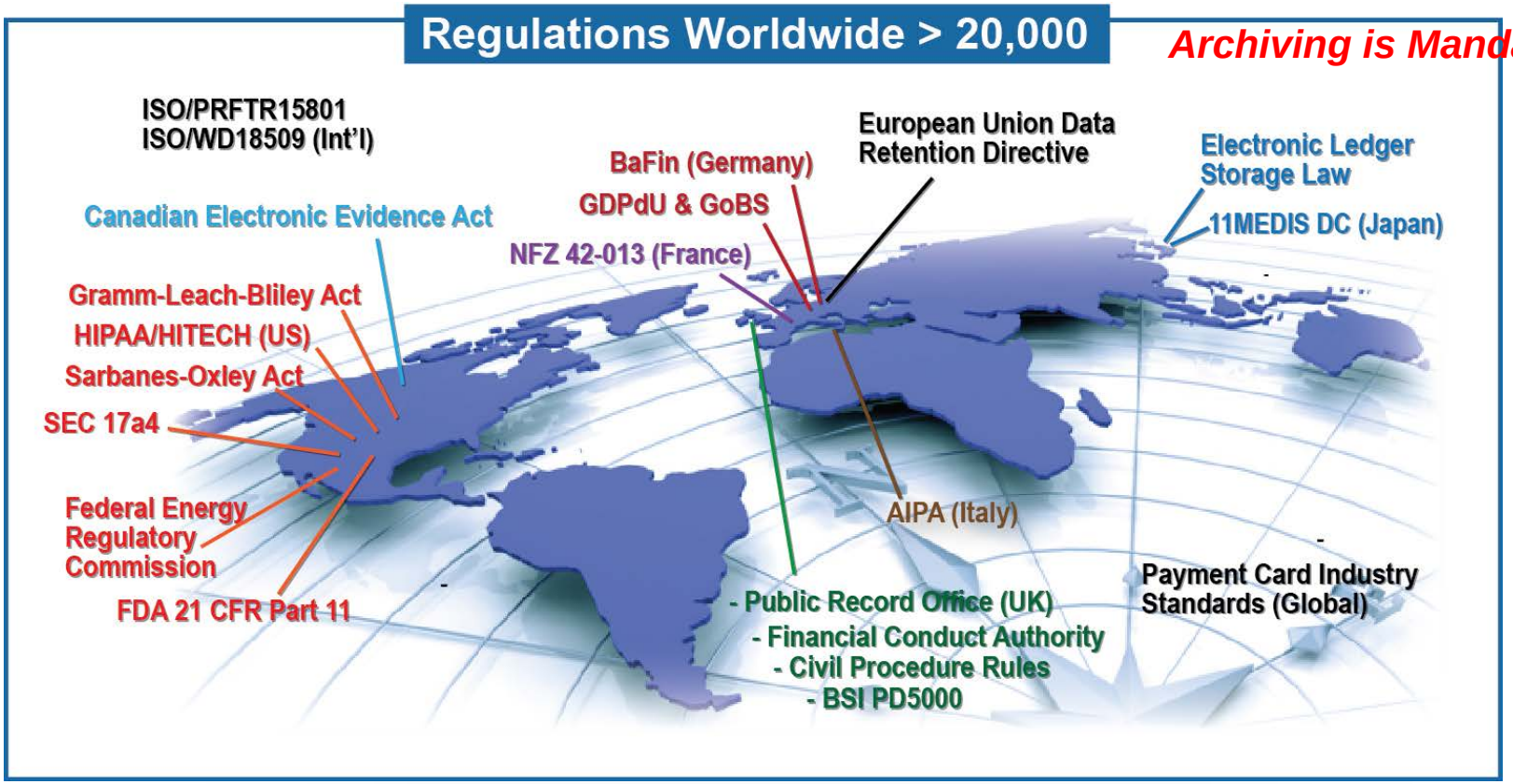
Minefield of Regulatory Compliance

Compliance with 20,000 regulations worldwide

- Scope: Data retention and data security
- Level: International, national, state and local regulations
- Depth: Industry-specific, Private, Public, Government

This results in:

- Cost to comply or remediate
- Significant penalties for non-compliance
- Potential damage to business reputation



Source: Alliance Storage Technologies Inc. Corporate presentation 2016

facebook

amazon

Linked in

Twitter

Microsoft

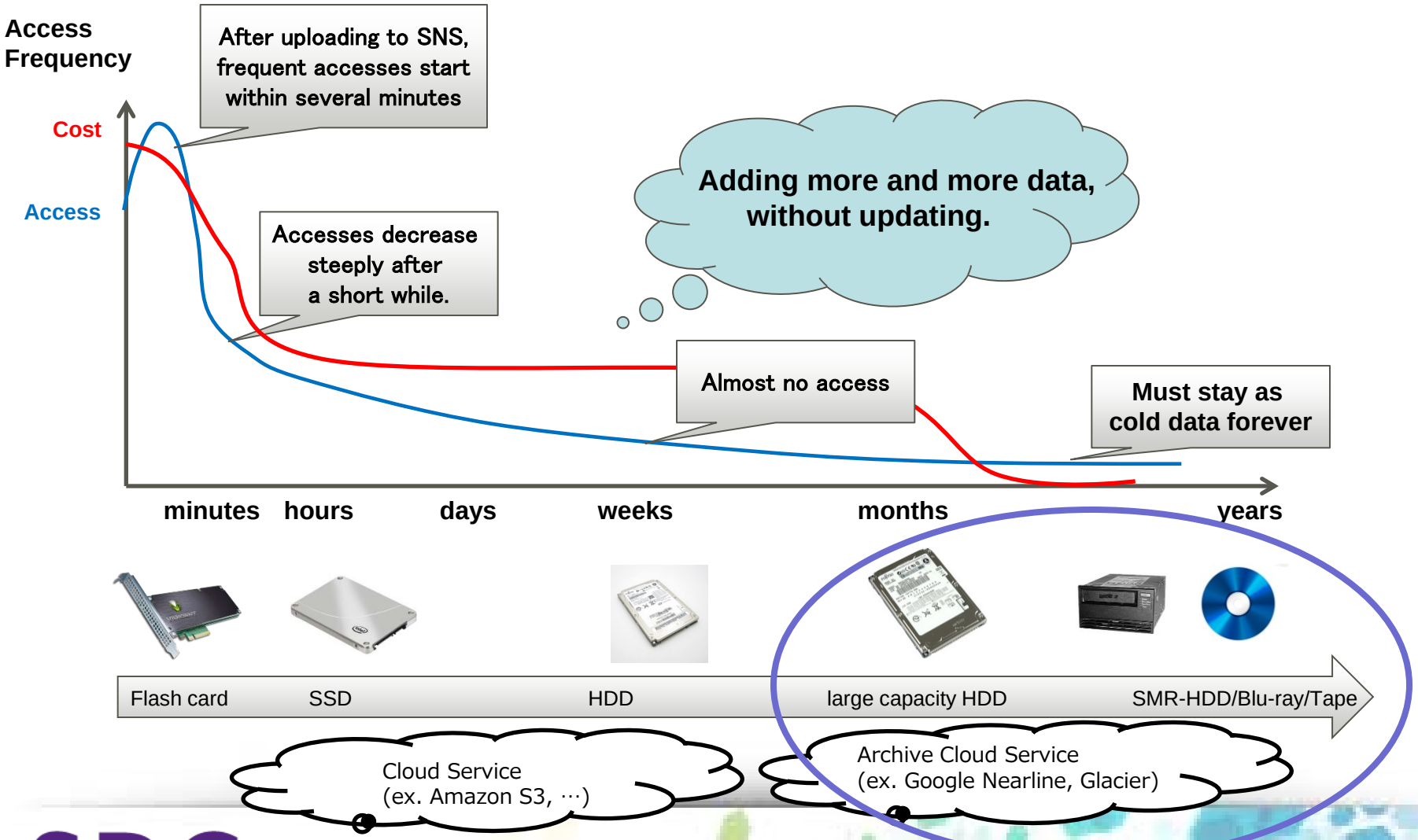
Instagram

Google

LINE

Baidu

Cold data is accumulating



There is no single device for all needs

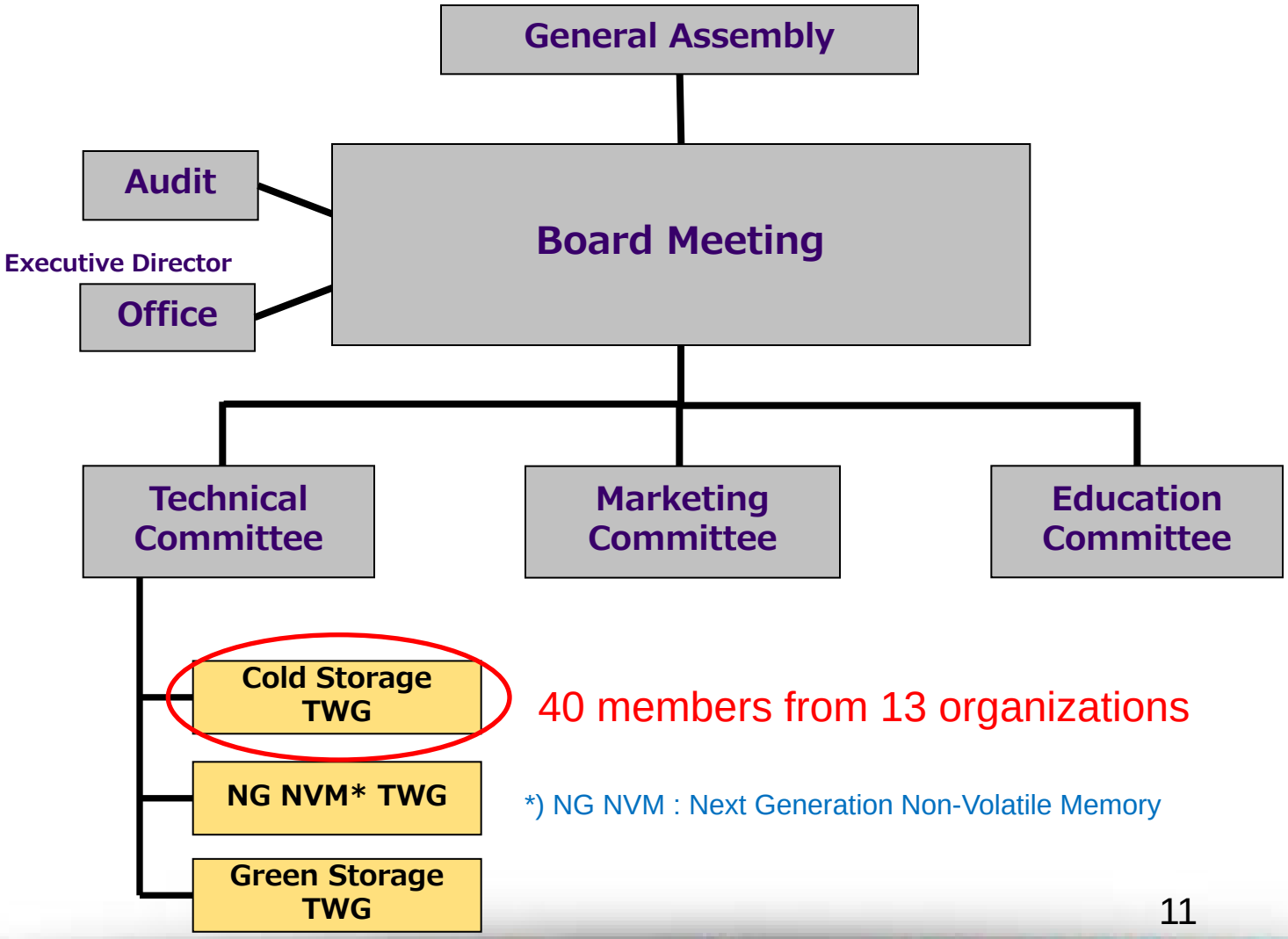
- Ideal device for **Hot**, **Warm** to **Cold** data?
  - Nano-sec latency
  - Great throughput
  - Large capacity, Unlimited expansion
  - Data migration free
  - Excellent tolerance to any disasters

  ..and at an **affordable cost**.

Do you believe it??

Forget about "one-size-fits-all" type of approach.
We should combine multiple devices for efficient data management.

2016 SNIA-Japan Organization



40 members from 13 organizations

*) NG NVM : Next Generation Non-Volatile Memory

Cold Storage Technical Working Group

Academic / Others

- Shibaura Institute of Technology
- National Institute of Informatics
- TUV Rheinland

Research for Long-term Archive

Hardware / System vendors

FUJITSU	Tokyo Electron Device	TOSHIBA
HITACHI	HITACHI LG	SONY
Panasonic	HGST	NEC

Tapes, Optical, HDD, Memory, Cloud, Object Storage

Media vendors

FUJIFILM	**Tapes**
MITSUBISHI KAGAKU MEDIA	**Optical Discs**

Discussion Part-1: (2014.7 – 2015.7)

Definition of Cold Storage

(“SNIA Japan” official version)

Tape vendors' opinions

- **Strong market demand for Tape-based Cold Storage**
  - **Most commonly used media** as low-cost storage, large-capacity, and suitable **for long-term archive**.

- **Good features for Cold storage**
  - Large capacity : Max **10TB** (30TB with data compression)
  - High transfer rate : Max **360MB/s** (1080MB/s with compression)
  - Low cost : Low-cost media, Low power consumption
  - Long-term data preservation: More than **30 years** of shelf life
  - Security : Anti-Tamper specification（WORM）, Encryption
  - Availability : Data durability
    - Verify while Writing, Strong error correction

Linear Serpentine recording technology

Optical vendors' opinions

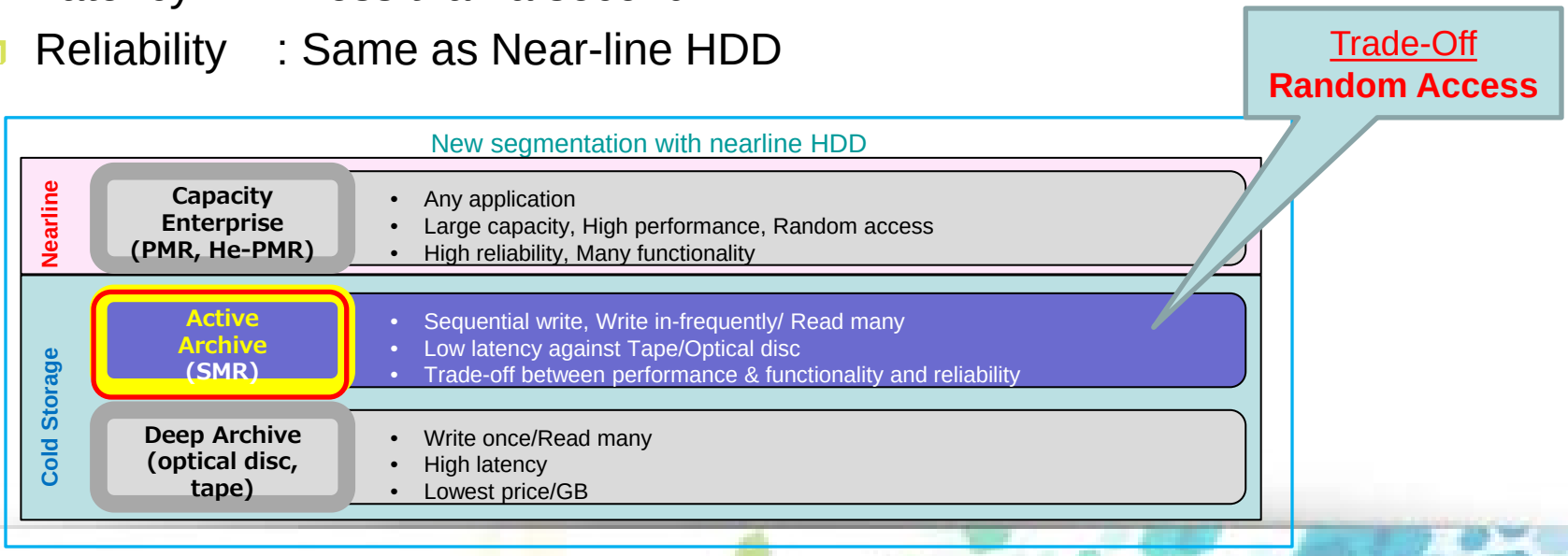
- **Long-life and Highly reliable media**
  - Media life is **over 50 years at normal temperature**
  - Excellent **tolerance to any disasters**
  - Non-contact reading
- **Most suitable media for compliance purpose**
  - True **WORM**
  - Highly compatible between generations

    The first CD 34 years ago can be played back on current BD players!!
- **Environmentally friendly media**
  - Can be stored OFFLINE without air-conditioning
  - Reduced waste thanks to its **migration free feature**
- **Advent of next generation optical technologies**
  - Much larger capacity & greater throughput

Archival Disc

HDD vendors' opinions

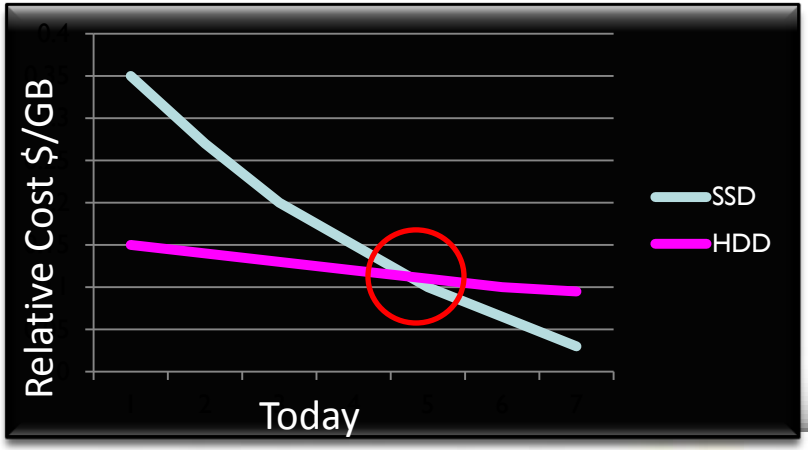
- **Background of HDD based Cold Storage market demand**
  - Explosion of data requires **Active Archive**
  - **"Cold data" is getting warmer.**
  - When data becomes more accessible, its value increases.
- **Required specification for HDD as Cold Storage**
  - Lower Cost : 20~30% lower cost against Near-line HDD
  - Latency : Less than a second
  - Reliability : Same as Near-line HDD



SMR(Shingled Magnetic Recording)

SSD vendors' opinions

		SSD by NGD Systems *formerly NxGn Data*	HDD Source: OCP
		2x PCIe/NVMe FH-FL	30x 3.5" (4TB) SAS
Capacity	The same	128TB	120TB
Active Power	90% savings	50 W	500 W
Idle Power	99% savings	2 W	240 W
Peak Power	91% savings	50 W	600 W
Physical Space	95% savings	112 cubic inches	2400 cubic inches
Weight	96% savings	1.5 lbs	43 lbs



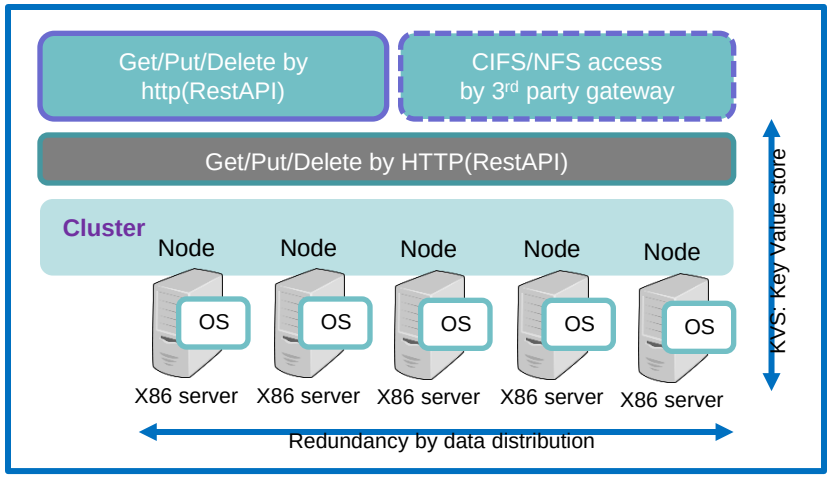
Trade-Off
DWPD
(Drive Writes Per Day)

Operational Savings:

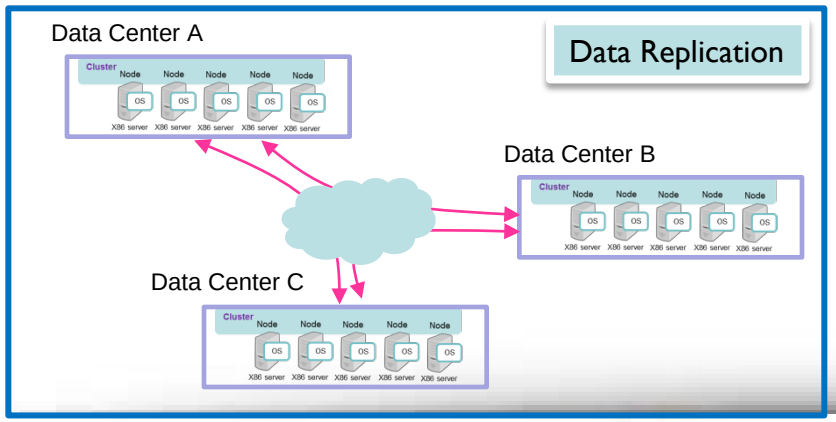
- Energy Savings (for operation)
- Energy Savings (for cooling)
- Mechanical Failures
- Physical space

SDS vendors' opinions

Lower cost configuration by using Common PC servers



Example of distributed object storage

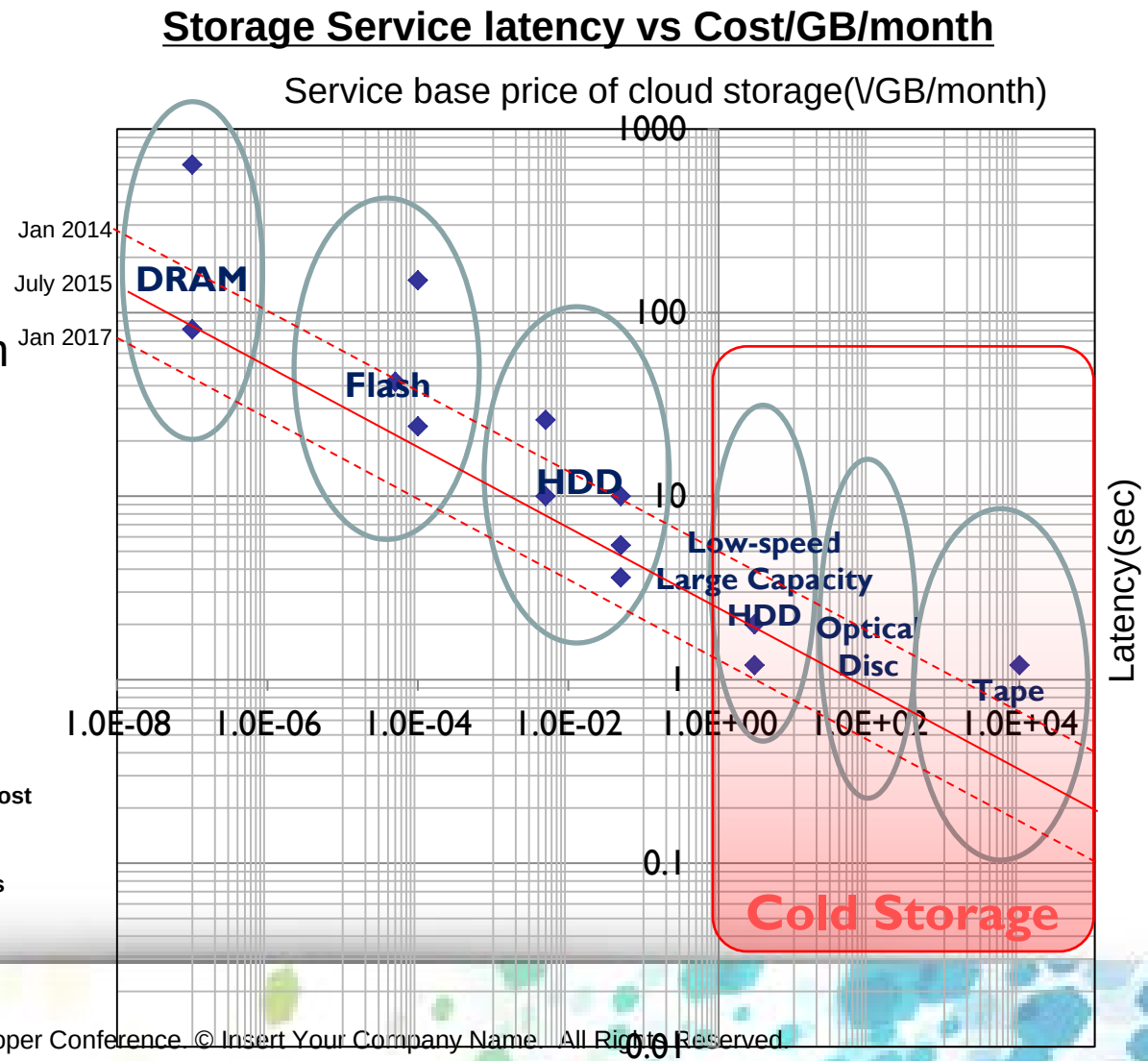


- **Scale-out storage** for unstructured data
- **Expandability**
  - Automatically adding data-node up to PB class capacity
- Access by **RESTful API**
  - CIFS/NFS are supported via gateway
- Availability
  - Error correction, Replication among Datacenters
- Media
  - Integrated HDDs in PC servers
  - **Trial to combine Optical storage**

Issue
Heat Dissipation

Cloud vendors' opinions

- Graph shows relationship between **Cloud Service Cost** and **Latency**, media by media
- Devices aligned in a line on logarithmic scale.
- Good matching with SNIA Japan Forum End Users survey result.



#1 Storage service price includes not only storage unit cost but also operation cost, electricity cost, DC facility cost, maintenance cost, and margin.

#2 This does not include additional/optional cost such as optional data transfer cost, communication cost, etc.

Definition of Cold Storage

Cold Storage is …

"Data storage to store data which has relatively less demand for access (i.e. cold data) **at a low cost."**

- It can be a Hardware, System or even Service.
- Sacrifice performance to achieve lower cost
- It typically includes features like below.
  - **Large capacity**
  - **Long-term data preservation**
  - **Lower power consumption, etc.**

Not always needed!

Cold Storage Seminars (in 2015)

Turnout: 176

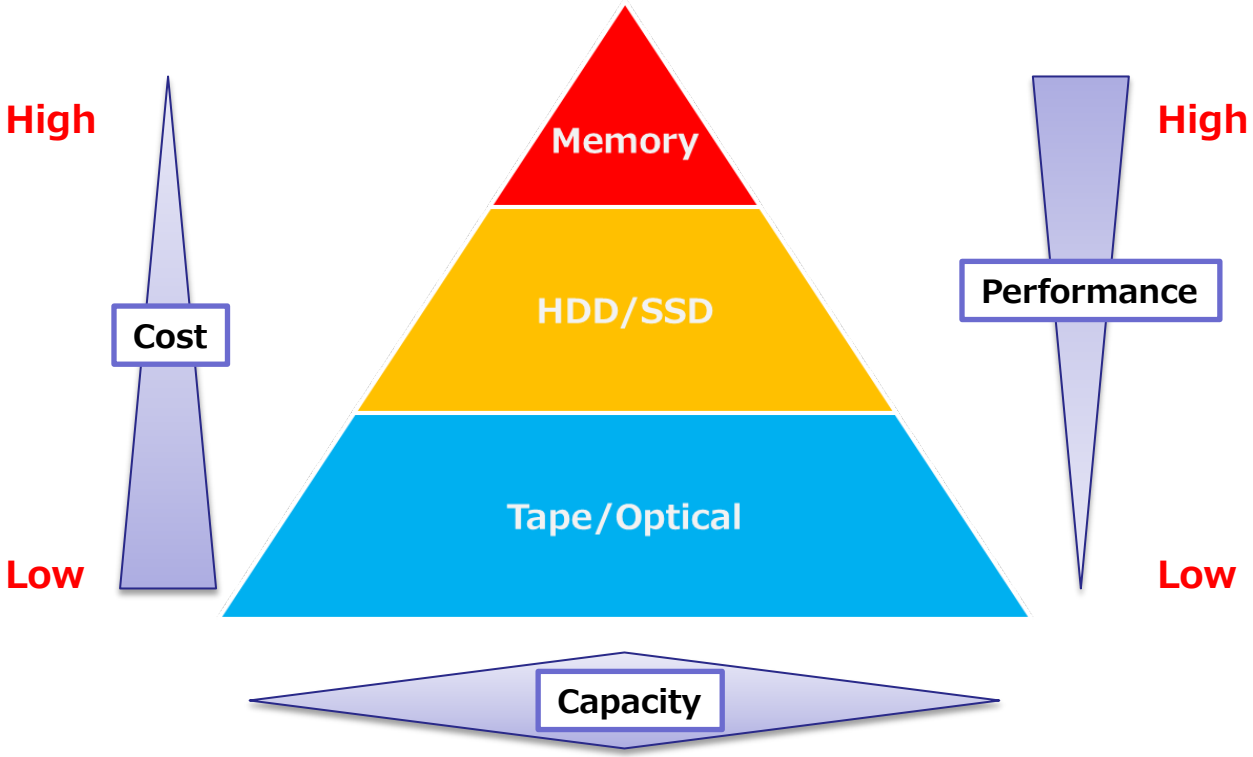
Cold Storage Seminar at Panasonic hall in Tokyo in July 2015.

Discussion Part-2: (2016.5 – ongoing)

Taxonomy for Cold Storage
(on the way..)

Basic HSM pyramid

- *Is your requirement simple enough like this?*

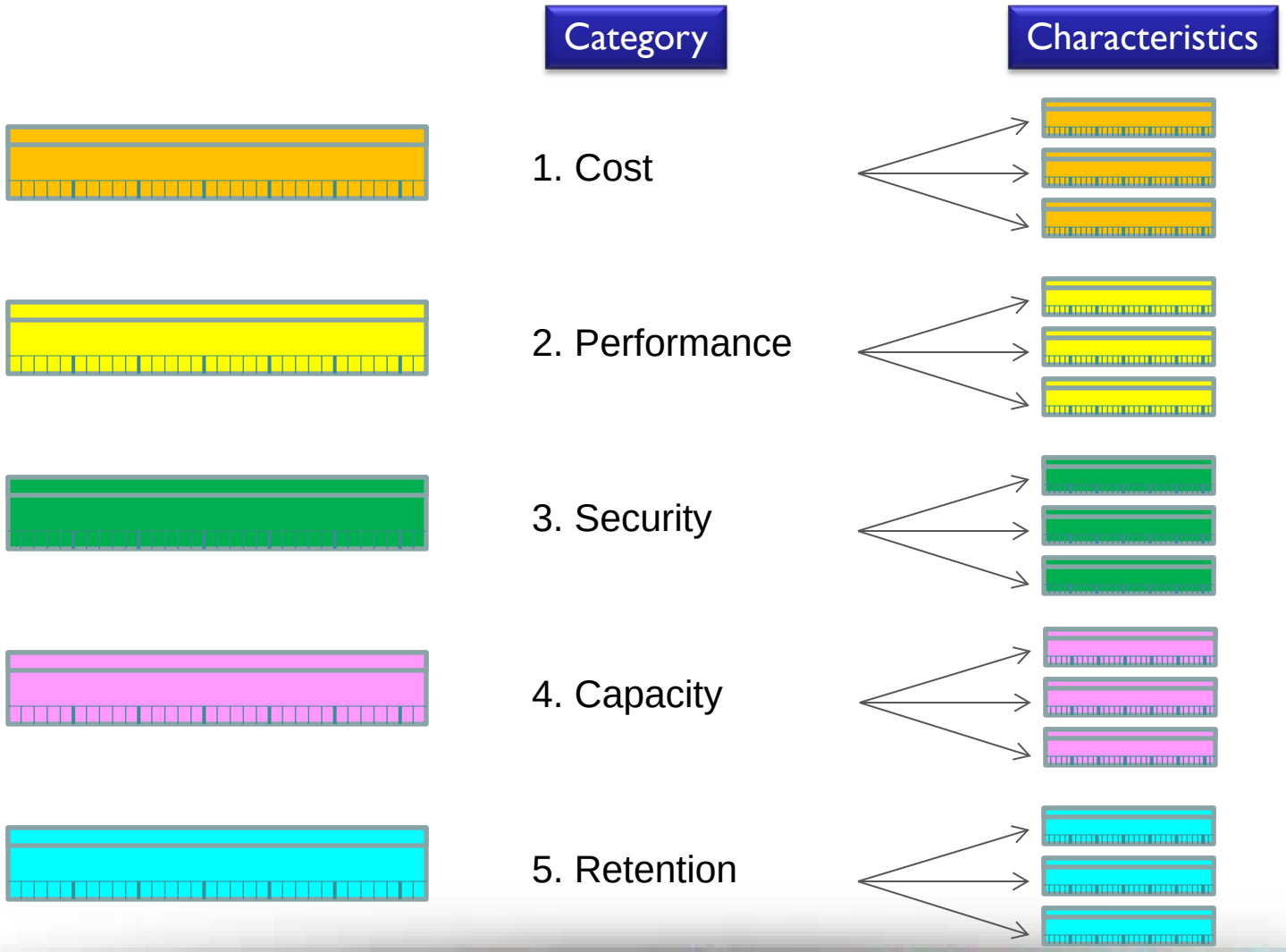


In reality,
Things are not always so simple..,

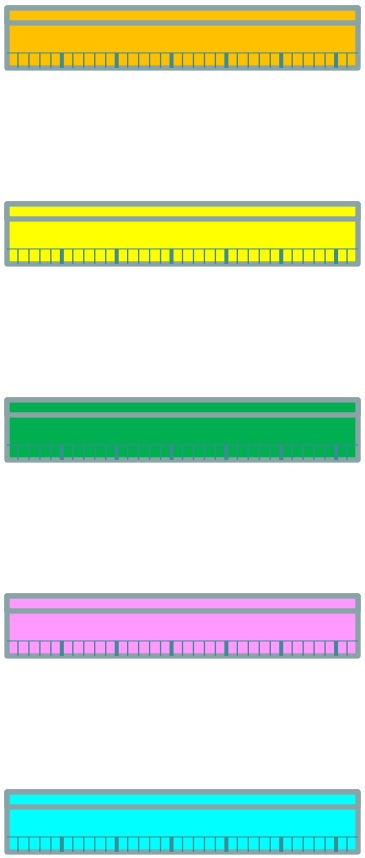
“Cold Storage” yardstick

- Prepare various yardsticks for “Cold Storage”

“Cold Storage” yardsticks



Yardsticks we should consider (under review)



No.	Characteristics	Example of included items	Unit example
Cat-1	**Cost**		
1.1	**Initial Cost**	System Cost, Installation Cost	$$
1.2	**Running Cost**	Maintenance, Electricity, Media, Subscription	Cost/GB/Year
1.3	**Recall Cost**	Unique cost for Cloud services	Cost/GB
1.4	**Migration Cost**	Cost for system upgrade, data migration	Years
Cat-2	**Performance**		
2.1	**Latency**	Time to access the first 1 byte	Sec
2.2	**Throughput**	Time to restore the whole file	MB/s
2.3	**Random Access**	Seek time, Media exchange time	IOPS
Cat-3	**Security**		
3.1	**Error rate**	Bits written per error	$2x10^{28}$
3.2	**Media Lifetime**	Average shelf life under normal environment	Years
3.3	**Tolerance to disaster**	Heat, Humidity, Air pollution, UV light, EMI	N.A
3.4	**Tamper-proof**	Strength of tamper-proof	N.A
Cat-4	**Capacity**		
4.1	**Media Capacity**	User data capacity per media	GB
4.2	**Scalability**	Expansion by libraries, servers or software	PB
Cat-5	**Retention**		
5.1	**by Compliance**	Regulated retention period by law	Years
5.2	**by Other reasons**	Data value may arise in future	Years

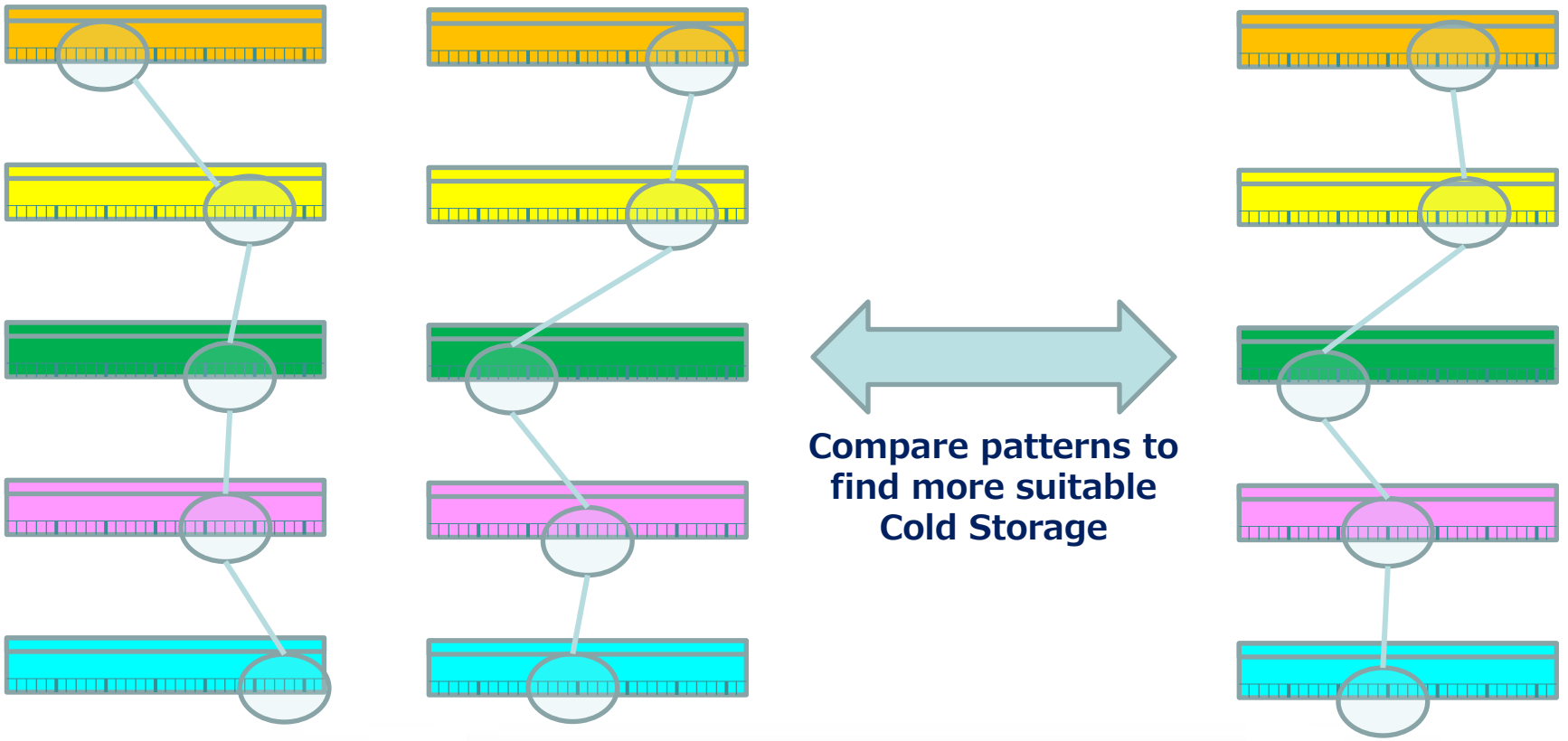
How to utilize yardsticks

Which one has a better fit!?

Cold Storage A

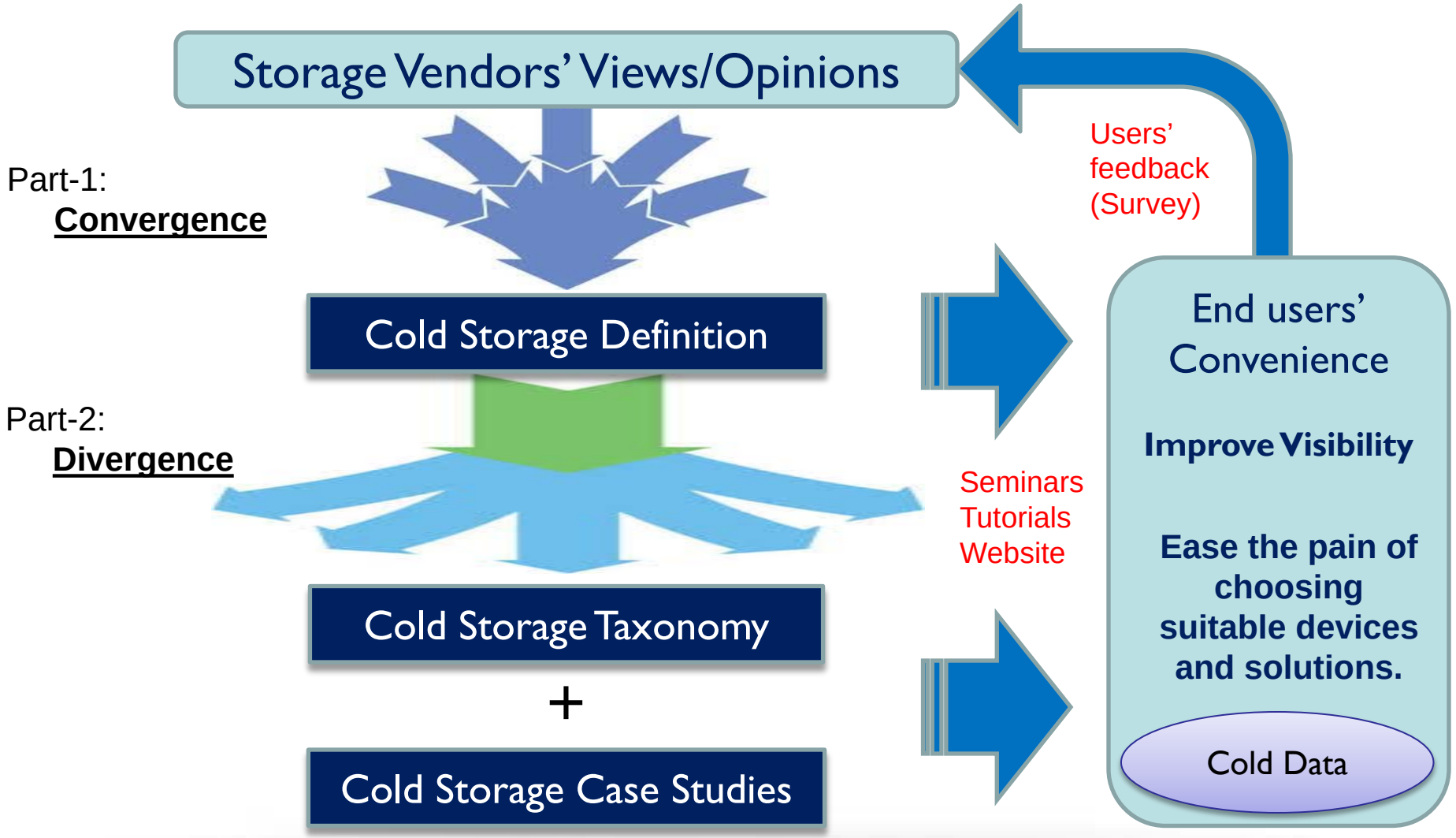
Cold Storage B

User Requirement for Cold Data



Compare patterns to find more suitable Cold Storage

Summary of our activities



Next steps..

- Put existing products on each yardstick and find **appropriate calibration**. Prepare more **case studies** and choose Cold Storage yardsticks to compare.
- Discuss **Auto-tiering** technology, which is another important item for managing cold data and storage.
- More seminars to **raise awareness** for Cold Storage!

Our discussion continues..

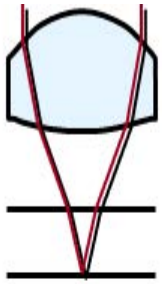
Latest Optical Technology

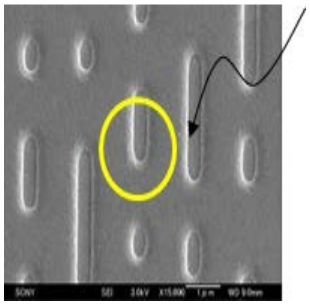
Archival Disc

History of Optical technology

Consumer

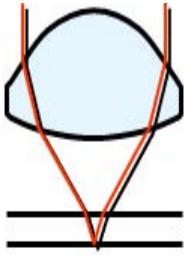
CD(1982)

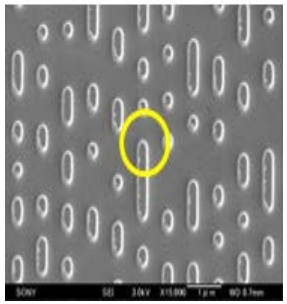




650MB

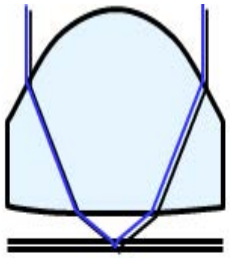
DVD(1996)

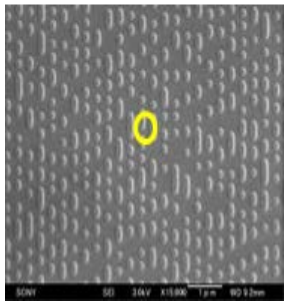




4.7GB

Blu-ray™(2003)





50/100GB

Professional

Archival Disc (2015)

Archival Disc

300GB

Archival Disc technology

Archival Disc

Disc structure

- 6 layers in Double-sided structure
- Protective cover layer
- Land & Groove recording format

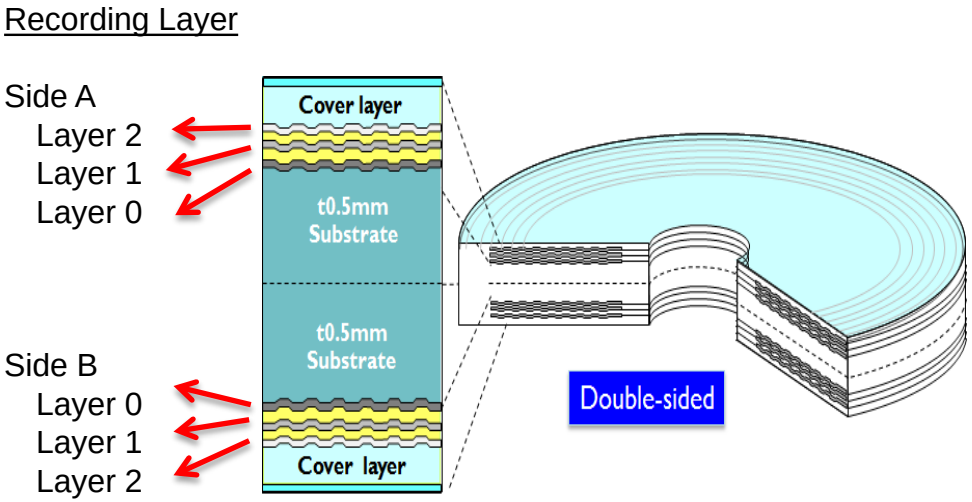
300GB / disc

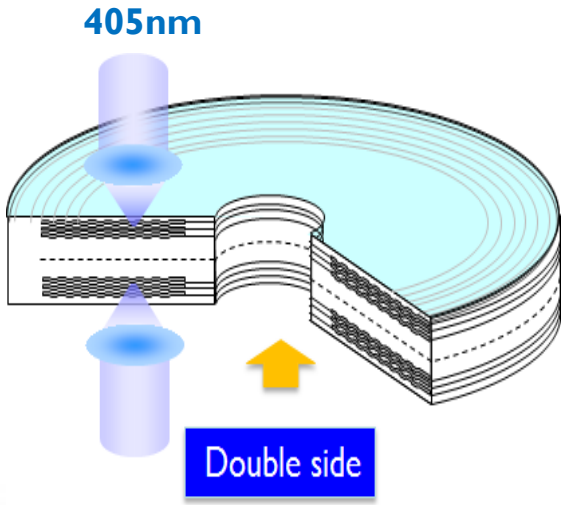
Drive

Key technologies

- 8ch Optical Array Heads
- Simultaneous access on both sides

Read: 2Gbps
Write: 1Gbps (with verify)





Archival Disc based products

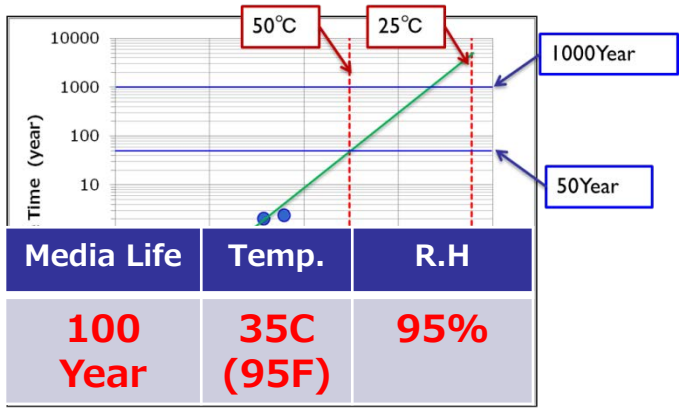
Cartridge type
for general ID purpose.

Optical Disc Archive

Bare-disc type
for Data Centers

EverSpan

Acceleration Tests to prove “Robustness”



Media Life	Temp.	R.H
100 Year	35C (95F)	95%

ISO/IEC 16963 (65°C/80%, 70°C/75%, 80 °C/70%, 80 °C/80%)

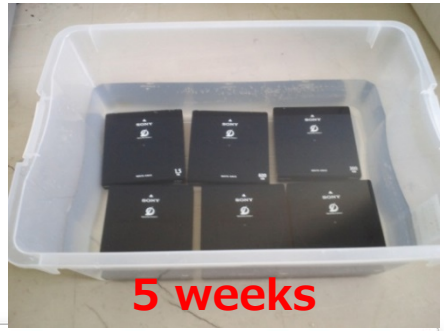
High Temp. & Humidity

Irradiance: 130W/cm²
Wave length: 300-400nm

Ultraviolet irradiation

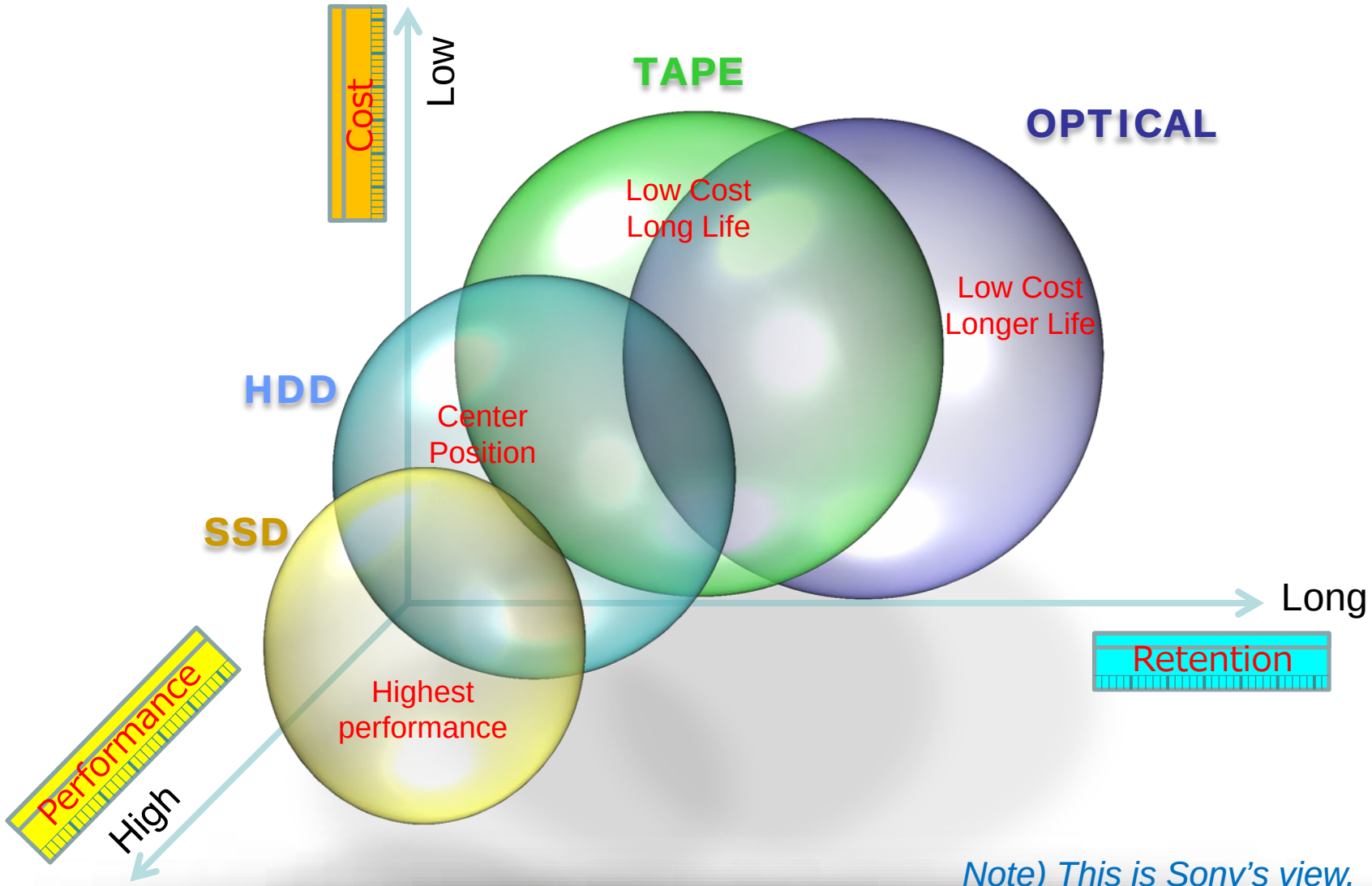
Ready for 100+ years archive

Under Corrosive Gases



Seawater soak test

Mapping of Cold Storage media (trial)



Note) This is Sony's view.

Thank you!

Backup

Variation of Archival Disc products

The cartridge type
offers Easy handling, Offline capability as well as scalable library system.

Optical Disc Archive

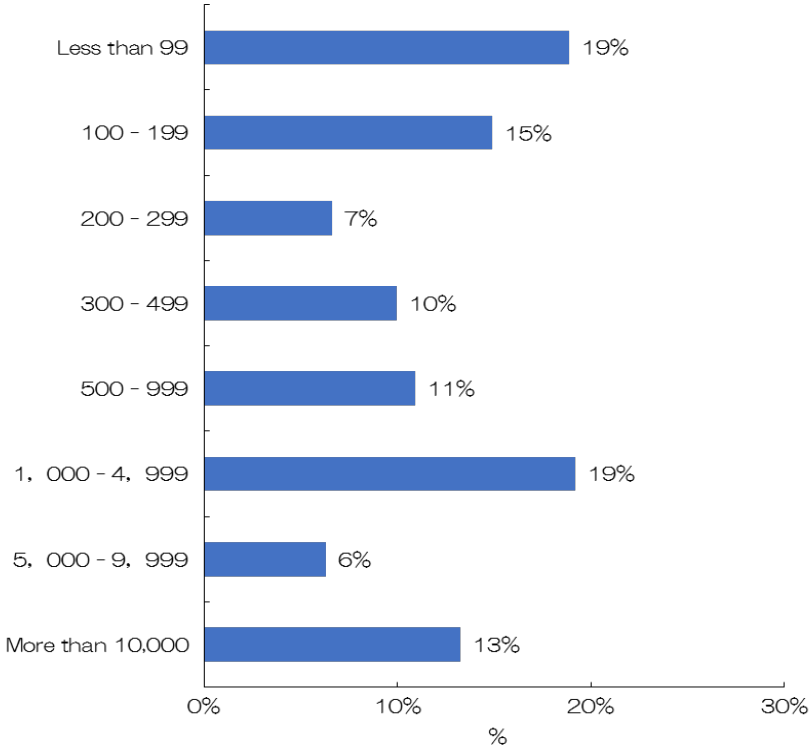
Everspan

The DC type offers excellent $/GB feature as well as enormous scalability.
(181PB)

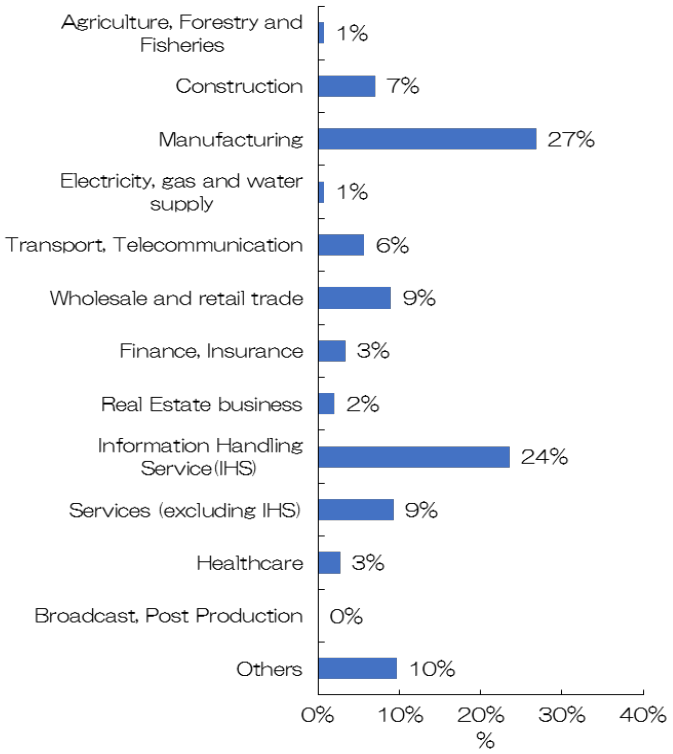
SNIA Japan Forum
End users survey 2016
(Excerpt)

Attributes of users

n=302
Employee number



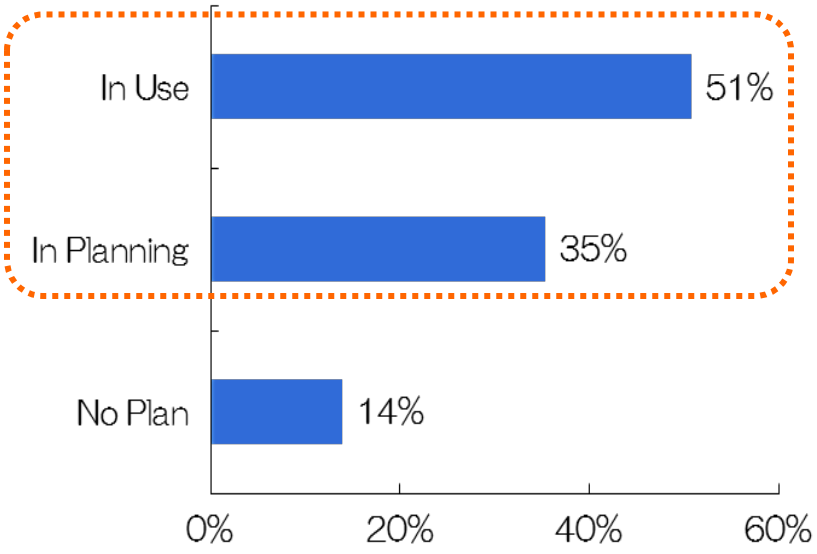
n=302
Category of Business



Survey Result (Usage situation)

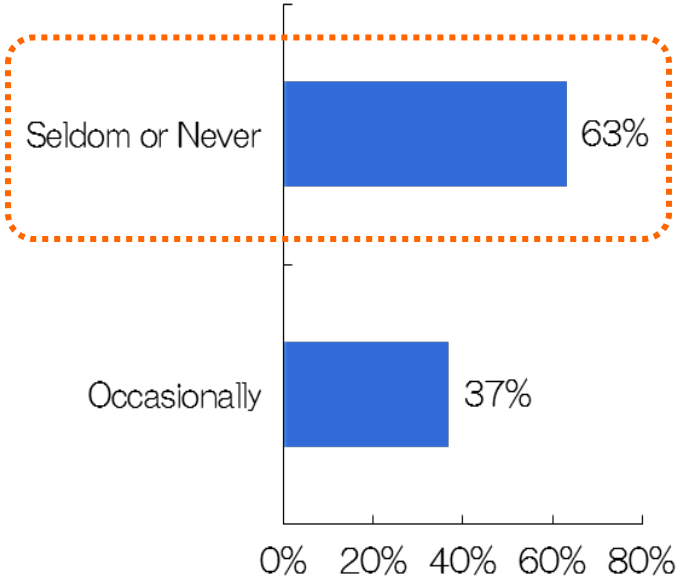
n=252

Usage situation for Cold Storage



n=217

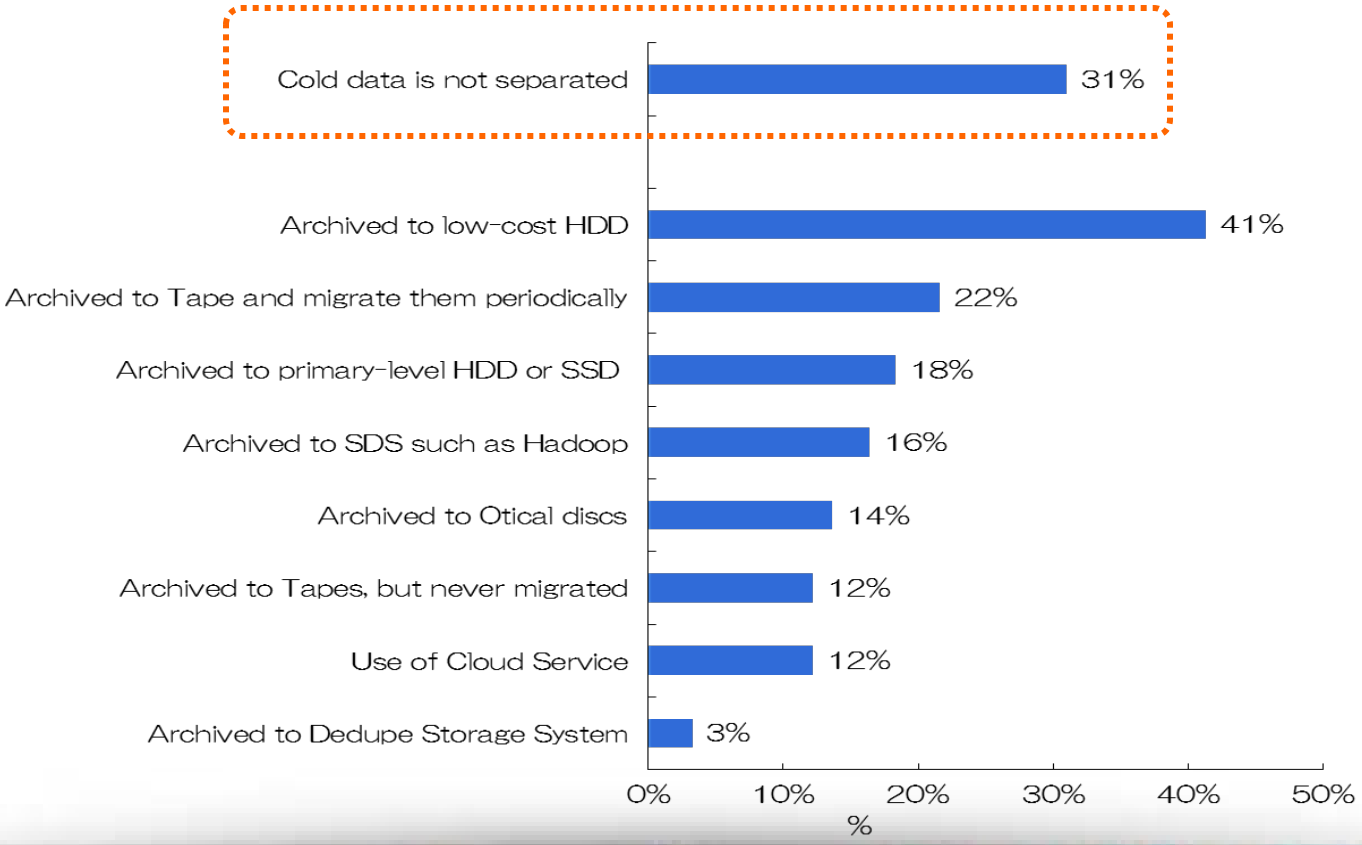
How often Cold Storage is accessed?



Survey Result (Storage devices in use)

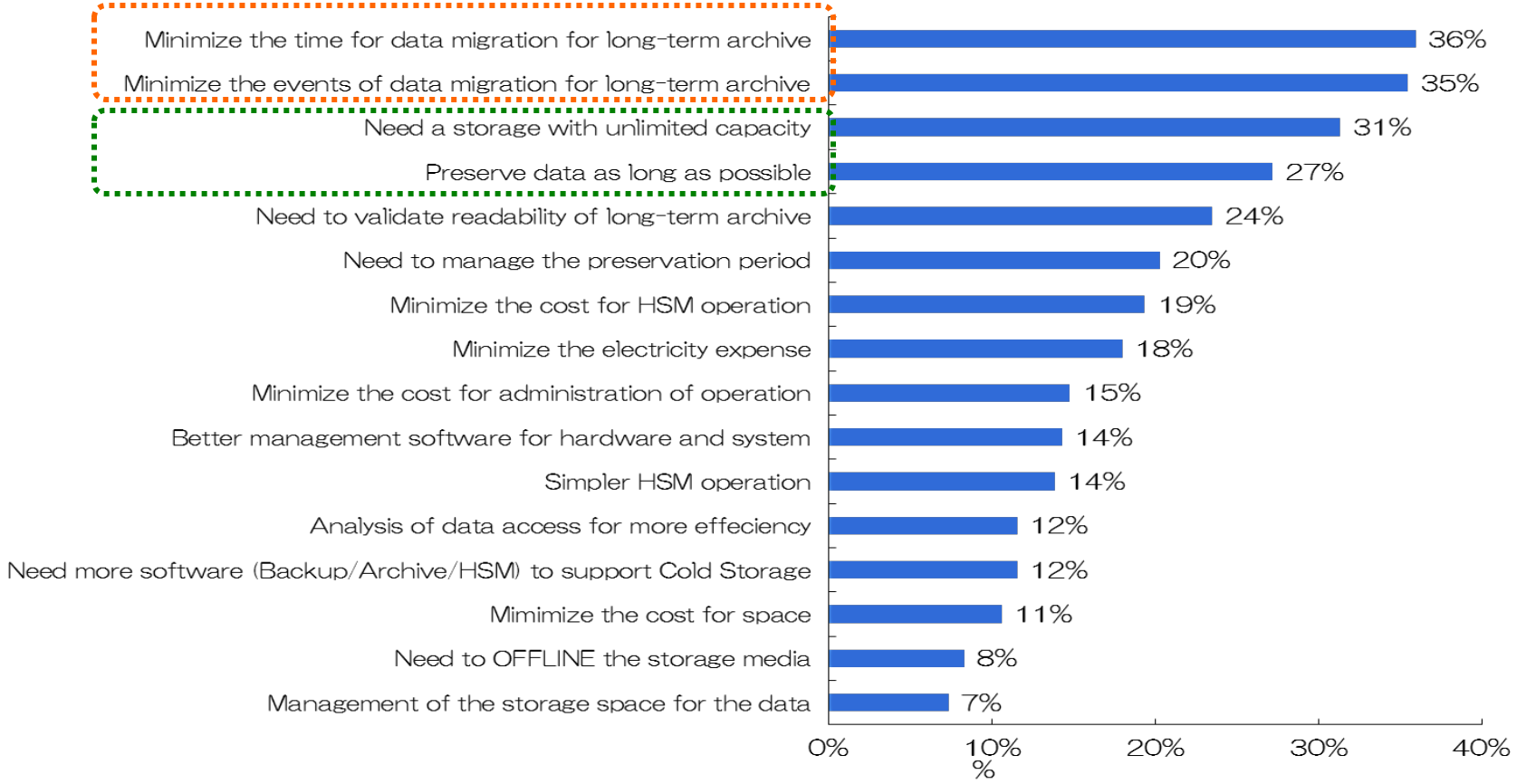
n=213

Storage Media or Device currently used for Backup and Archive



Survey Result (Issues for Cold Storage)

Issues about Cold Storage and its management (n=217)



- ***About 35% of users are concerned about the data migration .***
- ***About 30% are expecting unlimited capacity and indefinite preservation.***