次世代光ディスク規格
Archival Discの解説

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Agenda

Backgrounds
- Dara Center Issues
- Advantages of Optical Discs
- Technology Road Map

300GB
- Disc Structure, Data Transfer Rates, and Media Reliability

Future Technologies
- 500GB and 1TB Technologies

Conclusion
Data Center Issues

45ZB@2020

Global Environmental Problems

More POWER  CO2 Emission

No Idea, No Solution

OCP Japan meet-up 2016 Panasonic/Sony   2016/6/23
Advantages of Optical Discs

- Backward compatibility
  ➞ No data migration required.

- Wide tolerance of operation and storage conditions
  ➞ Ecological and economical data centers

- Highly reliable and long life recording media
Archival disc roadmap

Disc Structure

Archival Disc keeps the same disc structure and material for three generations

3 Layers / side
Both sided disc

Cover layer
0.5mm Substrate
Cover layer
0.5mm Substrate

Track Layout

Track Density
320nm/Track

Liner Density
83.8 nm/bit

Crosstalk cancel technology

1.05Tims
79.8nm/bit

Intersymbol interference cancel technology

1.75Tims
47.9nm/bit

Multilevel recording technology

2.0Tims
23.9nm/bit

Track Density
225nm (1.42Tims)

Keep same track density

100GB
BD

300GB
AD1

500GB
AD2

1TB
AD3

OCP Japan meet-up 2016 Panasonic/Sony 2016/6/23
300GB Archival Disc
Feature of Archival Disc

Larger Capacity and Lower Bit Cost
- Land & Groove format over all generations
- Simple recording layer structure
  - 300GB/disc, 1TB/disc in the future

Higher data transfer rate
- Double-sided recording
  - 90MB/s by 2 optical heads, 360MB/s in the future

Higher reliability for protecting important data
- Stable oxide materials
  - Over 50 year lifetime and robustness against disasters
For larger capacity

- Land & Groove format
  - Cross-talk cancellation technology
  - Track-pitch: 225nm

Will adopt the format over all generations

- Track Pitch 320nm
  - Blu-ray™ format
  - Groove Recording
  - Data bit length: 83.81nm

- Track Pitch 225nm
  - Archival Disc format
  - Land & Groove Recording
  - Data bit length: 79.46nm
Key technologies

- Simultaneous recording on both sides
- Newly developed LSI with advanced signal processor
  - Realizes 45MBps/Head
For higher reliability

- New recording material
  - Triple stacking of oxide materials

![Diagram](image)

- Cover layer
- t0.5mm Substrate
- Cover layer
- t0.5mm Substrate
- Space layer
- Dielectric film
- Recording film
- Dielectric film
- UV lacquer
- Protective Film

Very stable oxide recording material

OCP Japan meet-up 2016 Panasonic/Sony  2016/6/23
New recording material

- No degradation observed under HT/HH condition

For higher reliability

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Technology for 500GB/1TB
Technology for 500GB

Higher Reliability by 4 times longer ECC

Data Reliability

AD 500GB: 1 uncorrectable error bit in >10²⁰ read bits

500GB AD ECC Cluster

295Bytes

PI

5Bytes

256kB User Data
Code Rate = 91%

AD 500GB: 1 uncorrectable error bit in >10²⁰ read bits

HDD
LTO-6
LTO-7

AD 300GB
AD 500GB
Technology for 500GB

500GB = 300GB x 1.667

Archival Disc

<table>
<thead>
<tr>
<th>Track Dens.</th>
<th>Capacity Expansion</th>
<th>Key Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format Efficiency</td>
<td>1.075x</td>
<td>Higher Efficiency ECC</td>
</tr>
</tbody>
</table>

Total 1.667x

Effect of higher format efficiency

300GB Transfer rate (87.2MB/s Av.)

500GB Transfer rate (96.6MB/s Av.)

Transfer rate enhancement by higher format efficiency

Effect of higher format efficiency

500GB = 300GB x 1.667
System margins of 500GB

Confirmed that all margins are wide enough.

<table>
<thead>
<tr>
<th></th>
<th>AD–500GB</th>
<th>AD–300GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disc Tilt (Radial dir.)</td>
<td>±0.38°</td>
<td>±0.3°</td>
</tr>
<tr>
<td>Disc Tilt (Tangential dir.)</td>
<td>±0.49°</td>
<td>±0.47°</td>
</tr>
<tr>
<td>Focus Error</td>
<td>±223nm</td>
<td>±223nm</td>
</tr>
<tr>
<td>Cover Thickness Error</td>
<td>±4.2um</td>
<td>±4.1um</td>
</tr>
</tbody>
</table>
The current optical disc technology use only the light intensity difference for the read-out. The next generation optical disc use the light phase difference to improve the SNR read-out. Optical head can realize the significant improvement for the detection SNR by using the optical phase detection method. Experimental result

<table>
<thead>
<tr>
<th>Detection method</th>
<th>Intensity detection</th>
<th>Phase detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNR</td>
<td>34dB</td>
<td>46dB</td>
</tr>
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</table>

12dB = 4 times capacity

HDD was realized the significant growth by GMR/TMR Head that was the breakthrough for the SNR limit.
PanasonicとSonyは、Blu-rayの3倍容量のArchival Discを共同開発し、2015年に規格化を完了した。

このArchival Discは、様々な環境において長期信頼性を発揮し、データセンターの直面する課題解決に貢献できる。

Archival Disc 500GBは、現時点で十分なシステムマージンを有し、規格化完了は目前となっている。

Archival Disc 1TBは、光の新たな自由度を利用することにより実現可能である。