

次世代光ディスク規格 Archival Discの解説

Panasonic AVC Yasumori Hino

Sony Semiconductor Solutions Jun Nakano

Agenda

+ Backgrounds

- Data 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

45ZB@2020



Global Environmental Problems



More POWER CO2 Emission

Data Center



No Idea, No Solution

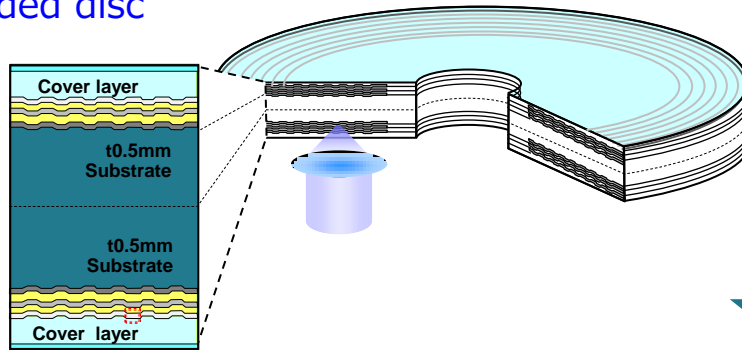
Advantages of Optical Discs



- ✚ 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

3 Layers / side
Both sided disc



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

Disc Structure

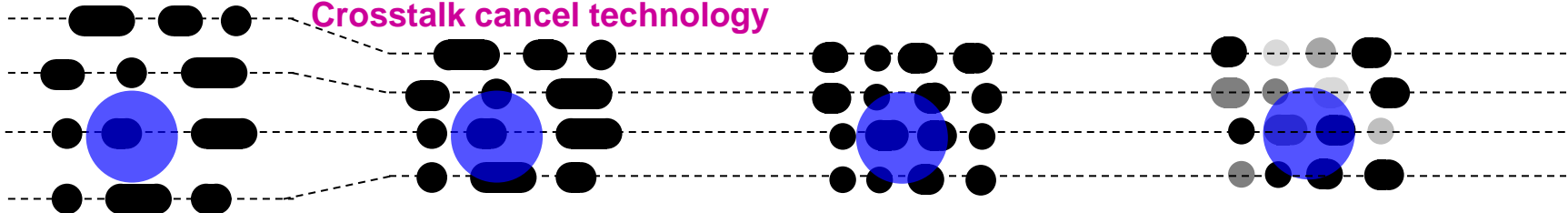


Track Density
320nm/Track

Track Density
225nm (1.42Tims)

Keep same track density

Crosstalk cancel technology



Liner Density
83.8 nm/bit

1.05Tims
79.8nm/bit

1.75Tims
47.9nm/bit

2.0Tims
23.9nm/bit

Intersymbol interference
cancel technology

Multilevel recording
technology

Track Layout

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 50year lifetime and robustness against disasters

For larger capacity

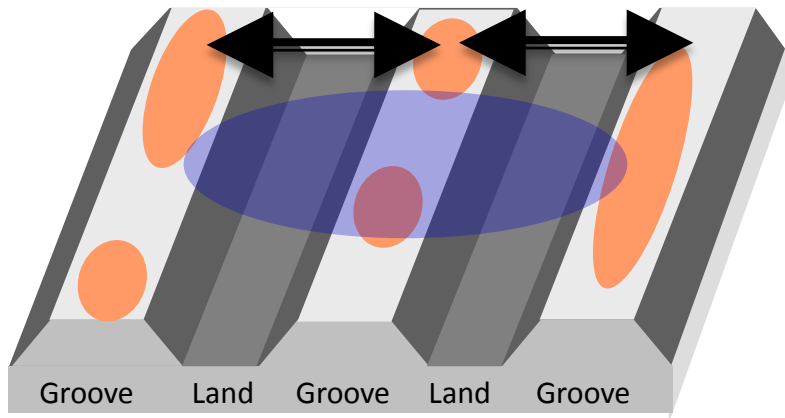
Land & Groove format

- Cross-talk cancellation technology
- Track-pitch: 225nm



Will adopt the format over all generations

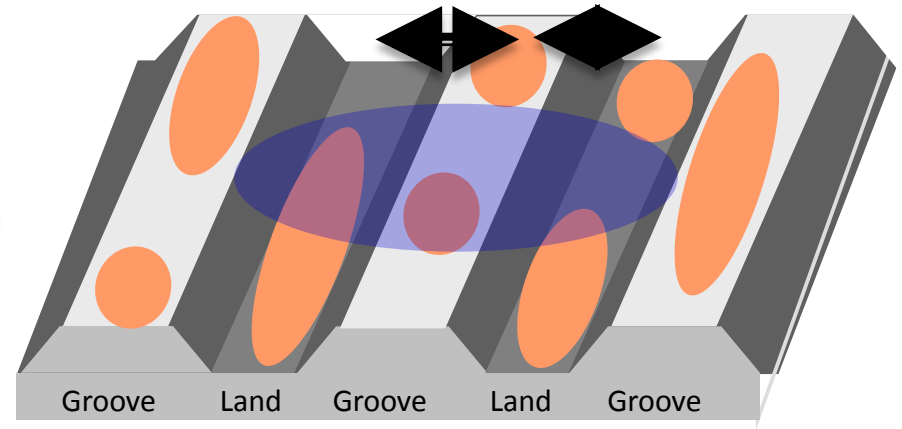
Track Pitch 320nm



Blu-ray™ format
Groove Recording 83.81nm
Data bit length



Track Pitch 225nm

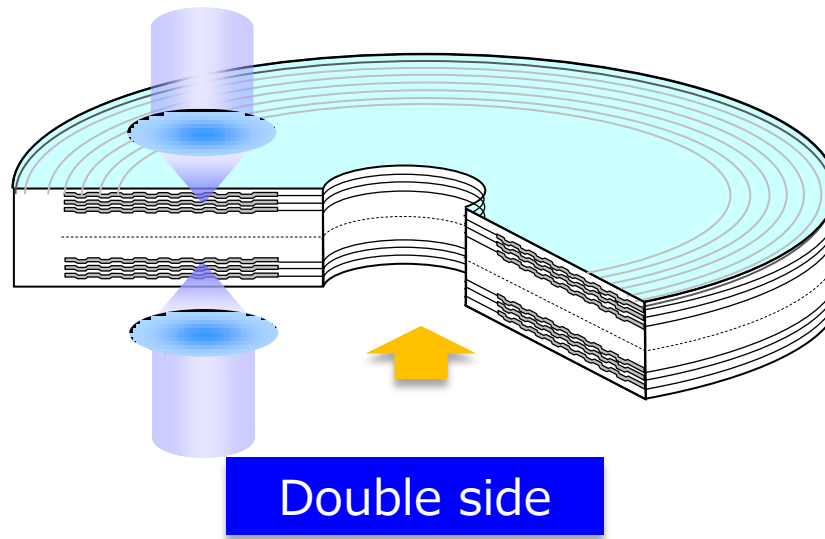


Archival Disc format
Land & Groove Recording 79.46nm
Data bit length

For higher data transfer rate

✚ Key technologies

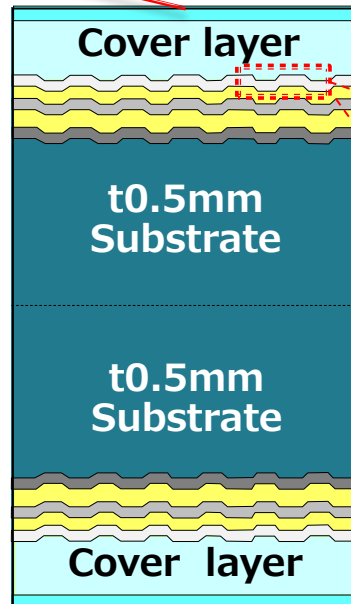
- Simultaneous recording on both sides
- Newly developed LSI with advanced signal processor
 - Realizes 45MBps/Head



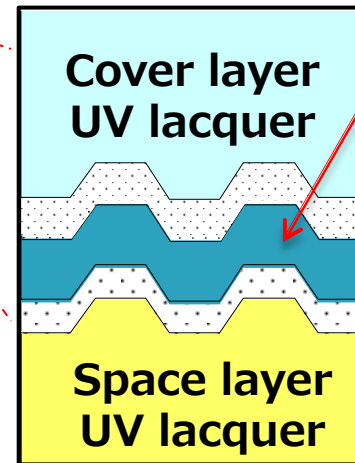
For higher reliability

- ✚ New recording material
 - Triple stacking of oxide materials

Protective Film



Very stable oxide recording material

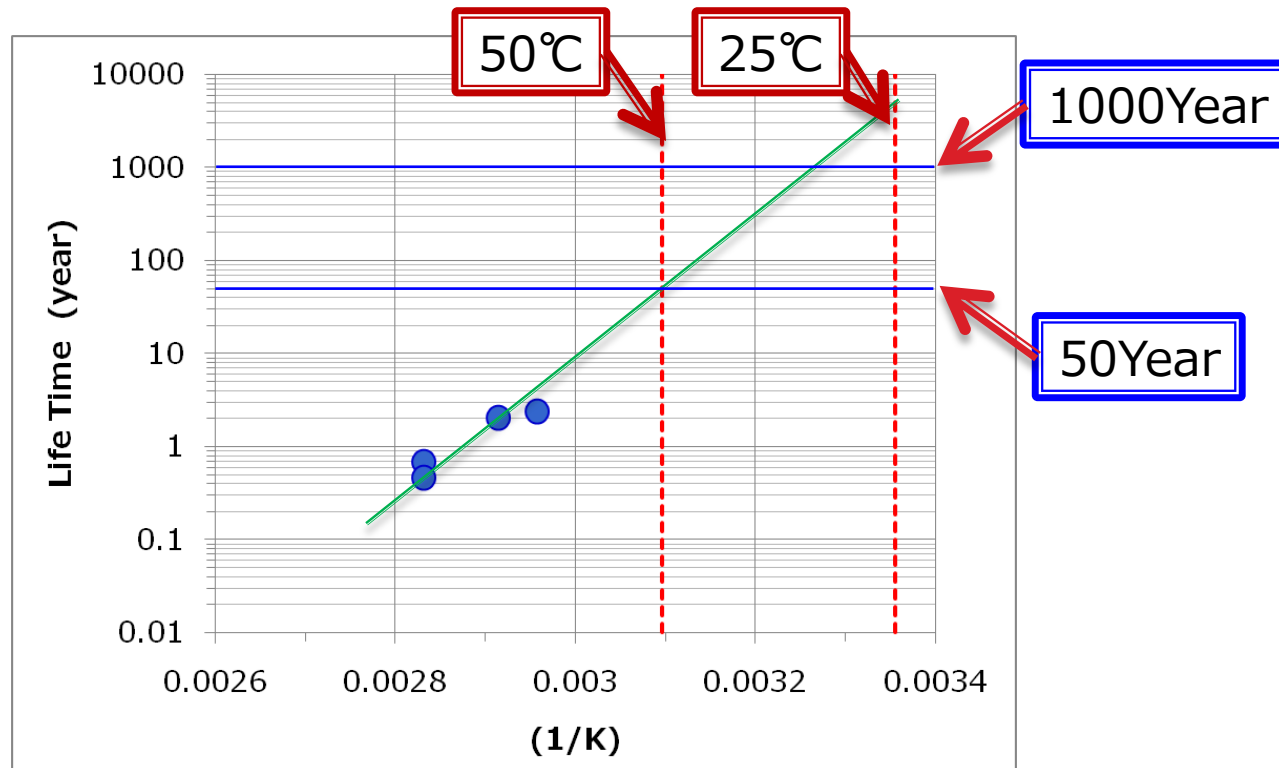


Dielectric film
Recording film
Dielectric film

Protective Film

For higher reliability

- # New recording material
 - No degradation observed under HT/HH condition

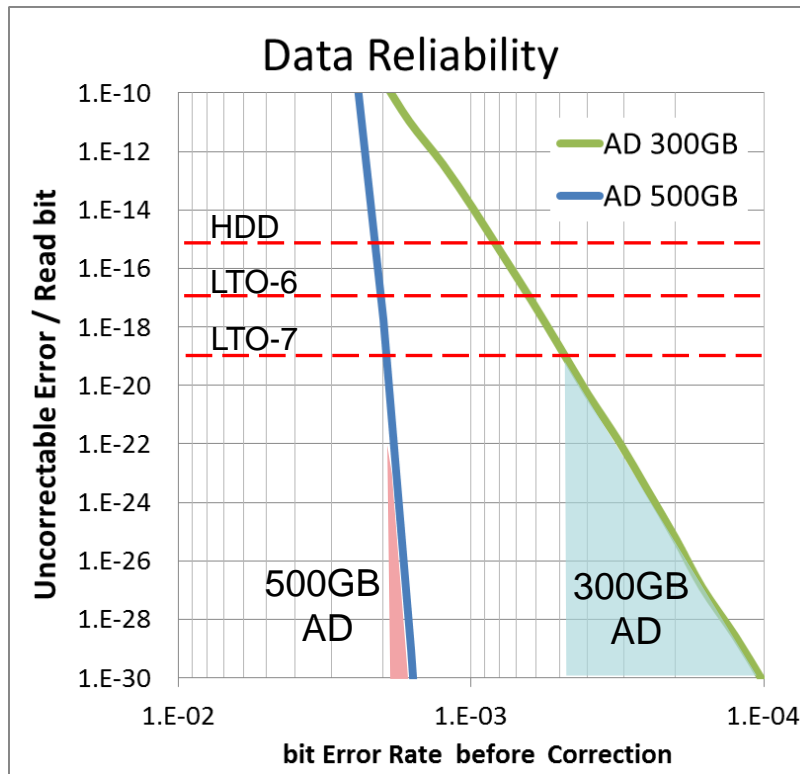


Technology for 500GB/1TB

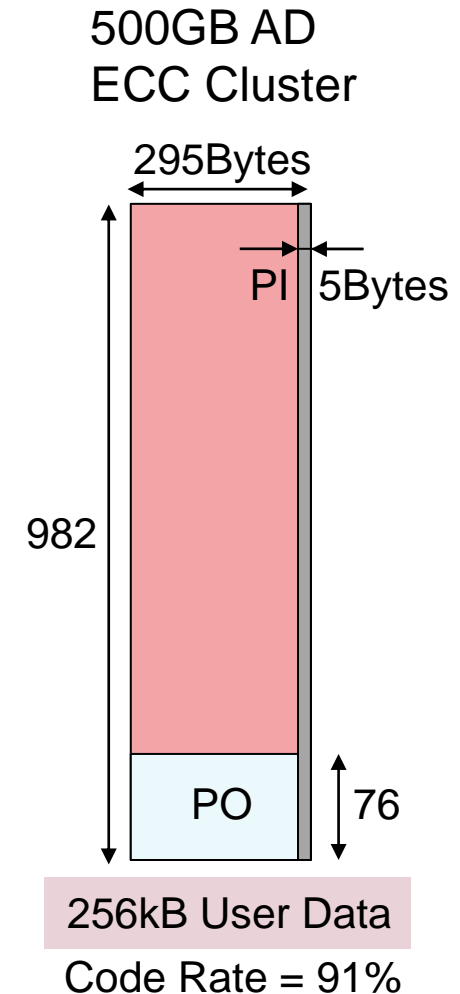
Technology for 500GB

ECC

Higher Reliability by 4 times longer ECC

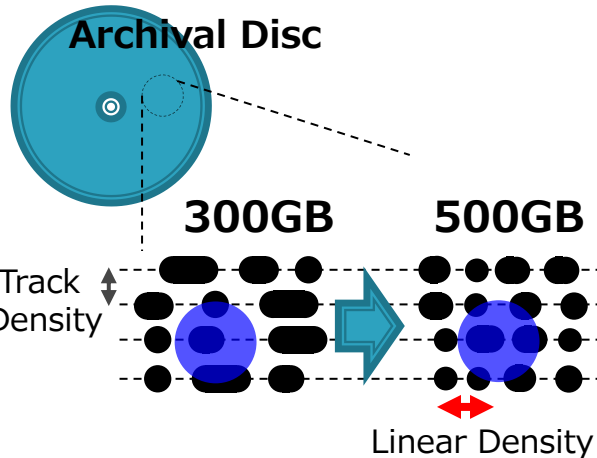


**AD 500GB: 1 uncorrectable error bit
in $>10^{20}$ read bits**



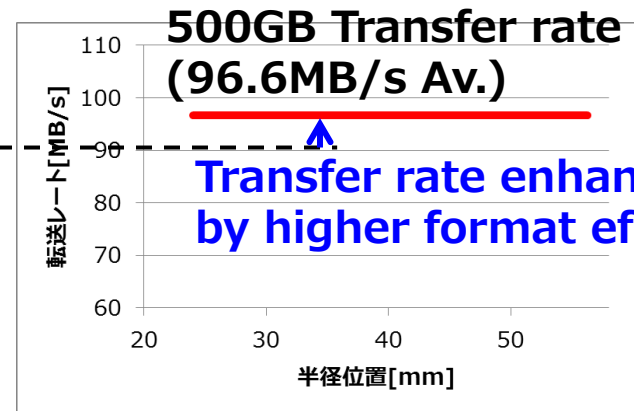
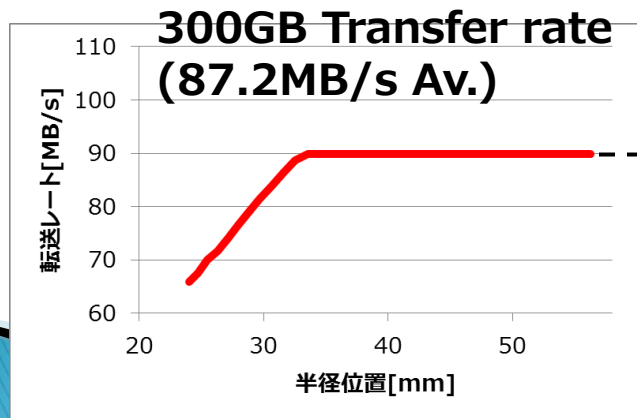
Technology for 500GB

500GB = 300GB x 1.667



		Capacity Expansion	Key Technology
Track Dens.		1.000x	Land/Groove Recording
Lin. Dens.	Rec. Dens.	1.551x	Higher Order PRML
	Format Efficiency	1.075x	Higher Efficiency ECC
Total		1.667x	

Effect of higher format efficiency

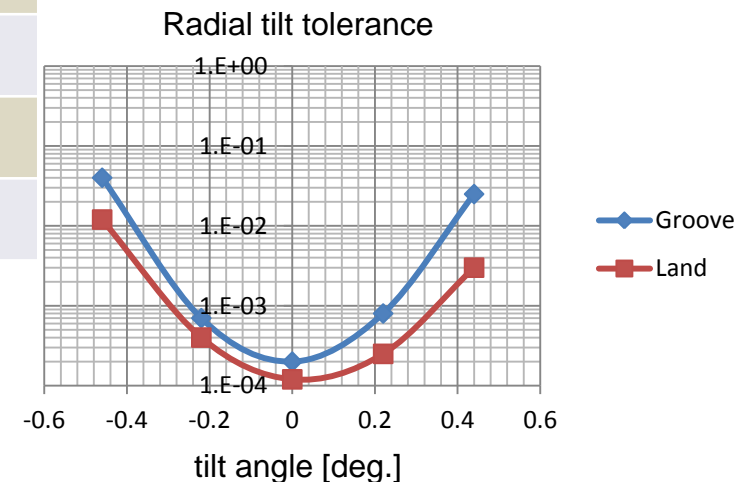
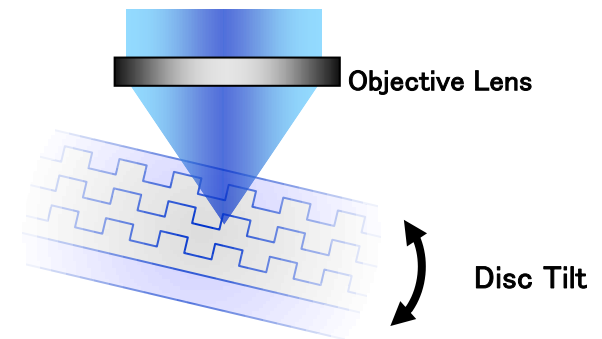


Technology for 500GB

System margins of 500GB

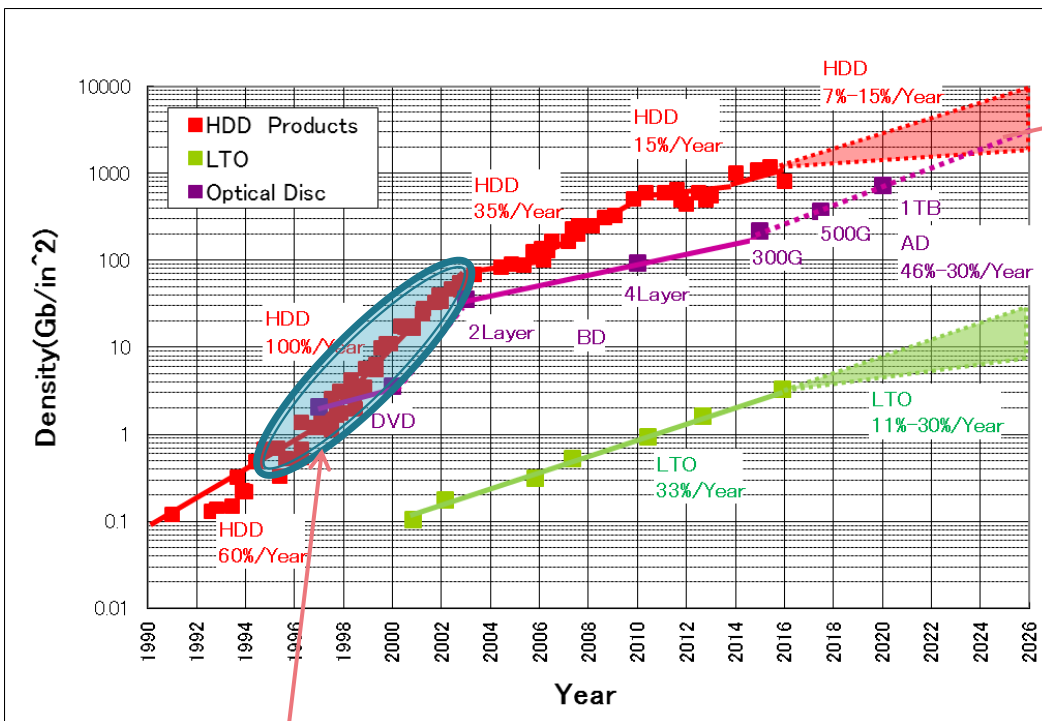
Confirmed that all margins are wide enough.

	AD-500GB		AD-300GB
	Land	Groove	Groove
Disc Tilt (Radial dir.)	$\pm 0.38^\circ$	$\pm 0.3^\circ$	$\pm 0.35^\circ$
Disc Tilt (Tangential dir.)	$\pm 0.49^\circ$	$\pm 0.47^\circ$	$\pm 0.60^\circ$
Focus Error	$\pm 223\text{nm}$	$\pm 223\text{nm}$	$\pm 200\text{nm}$
Cover Thickness Error	$\pm 4.2\mu\text{m}$	$\pm 4.1\mu\text{m}$	$\pm 6.0\mu\text{m}$



Technology for 1TB

- 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

Detection method	Intensity detection	Phase detection
SNR	34dB	46dB

12dB up

12dB = 4 times capacity



HDD was realized the significant growth by GMR/TMR Head that was the breakthrough for the SNR limit.

Conclusion



- ✦ 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