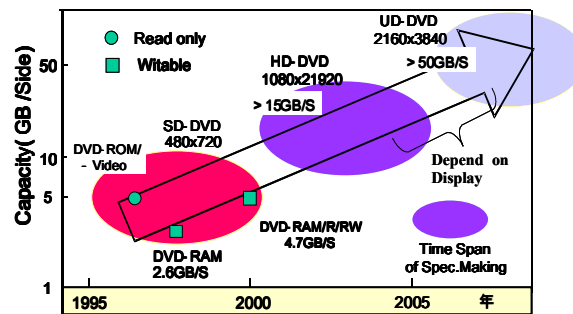


## A Basic Concept for Next Generation DVD



September 3<sup>rd</sup> ~ 4<sup>th</sup>, 2001

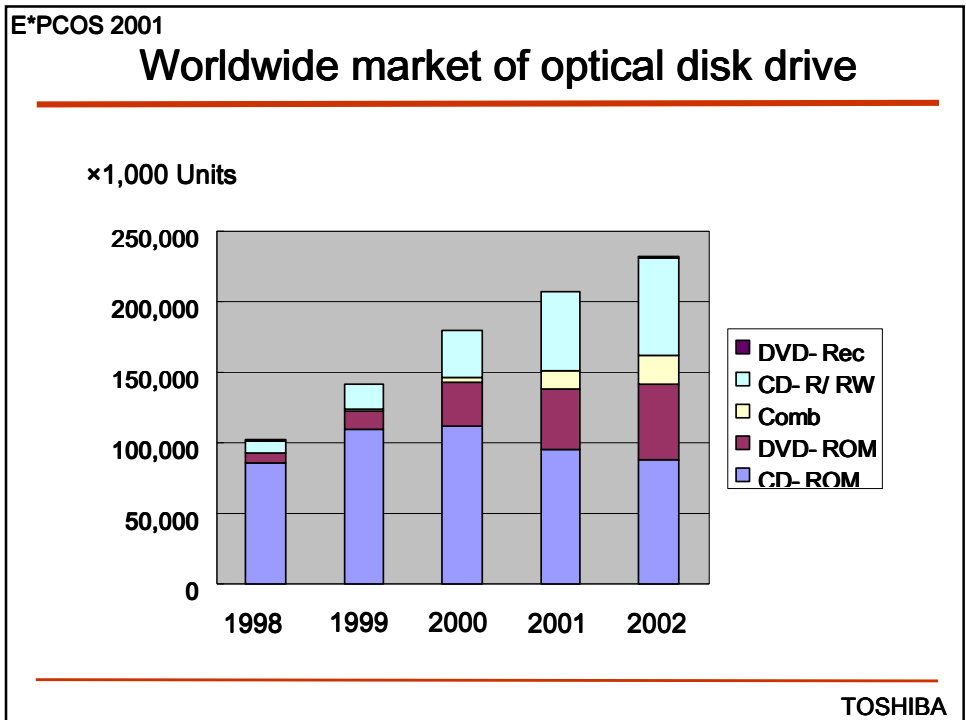
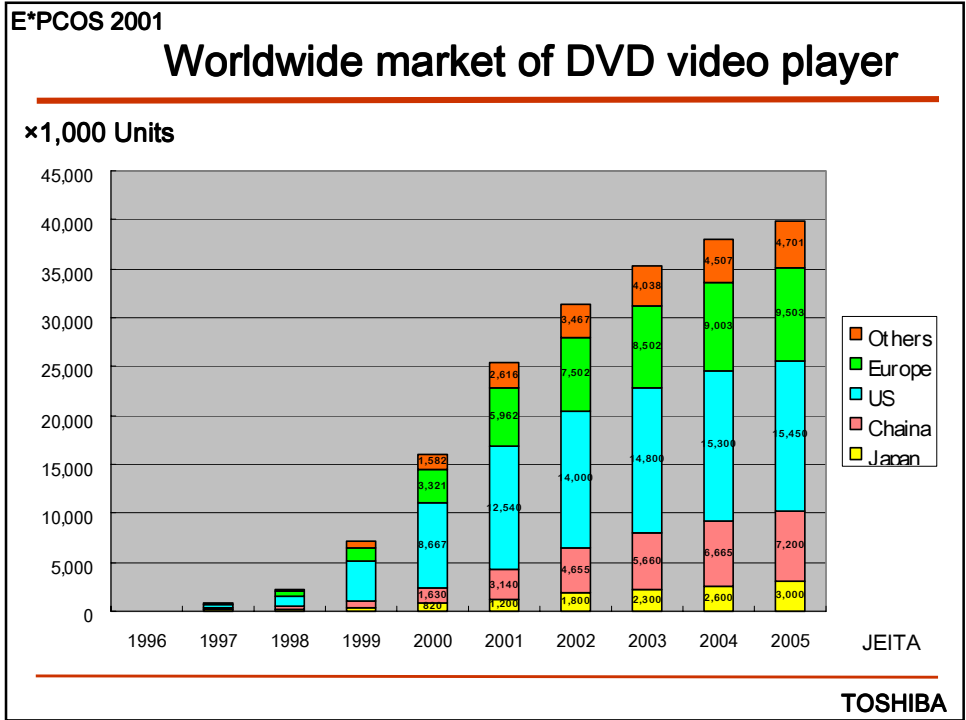
Toshihiro Sugaya  
Toshiba Corporation

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## Contents

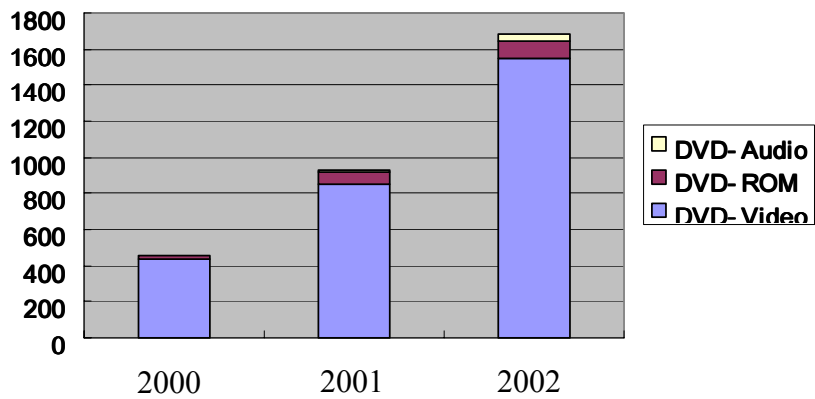
1. CD/DVD/HDTV market
2. Optical disc application
3. Capacity and data rate for HD-DVD /HDTV TS recorder
4. Capacity upgrade technology
5. Comparison of two candidates
6. Future trend for DVD
7. Conclusion

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## Worldwide DVD replication

Millions of units

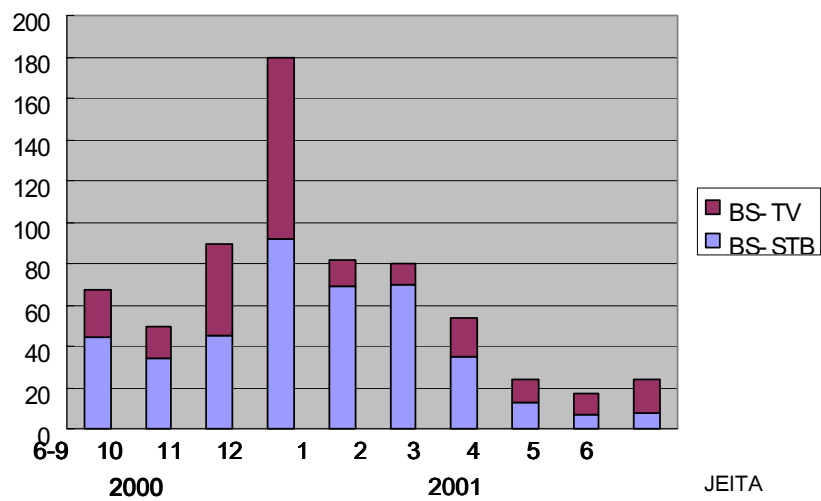


TapeDISC 2001

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## Released BS digital equipment in Japan

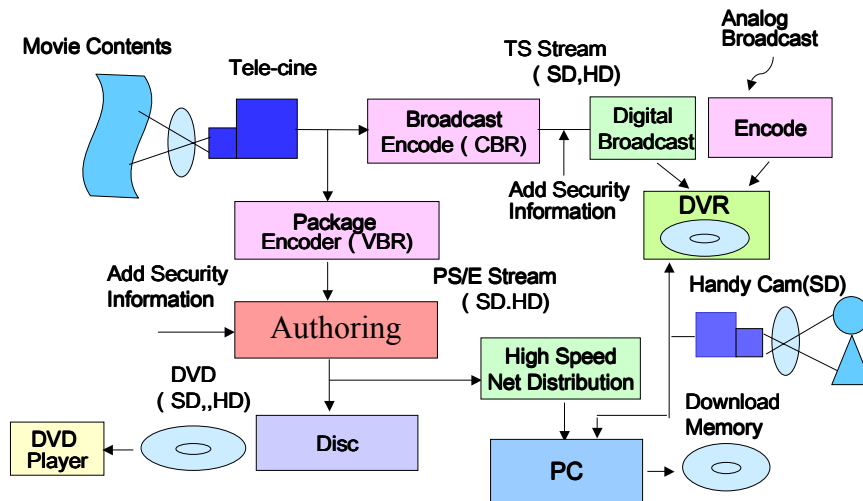
×1,000



JEITA

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## Next generation DVD for video application



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## Capacity and data rate of HD-DVD

Ave. video rate : 4 times of DVD  
 DTV : 3 times (18Mbps/6Mbps)  
 BS digital : 3.7 times (22Mbps/6Mbps)

Audio rate and sub title : same as DVD

Ave. data rate for HD-DVD : 15.2Mbps

Video rate ( . Ave. ) + Audio + Sub Title  
 ( 14Mbps + 1.15Mbps + 0.04Mbps = 15.2Mbps )

Max data rate for HD-DVD : over 35Mbps

Video rate ( Ave. ) × 2 + Audio + Sub Title ) × 1.2  
 ( 28Mbps + 1.15Mbps + 0.04Mbps ) × 1.2



Capacity ( 130 Min. × 15.2Mbps )

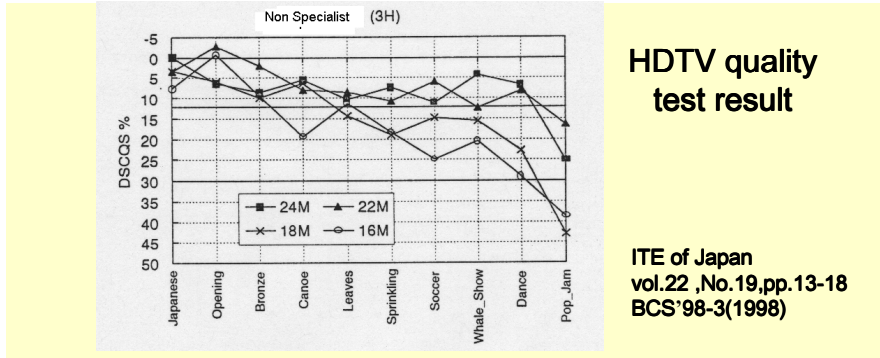
Data rate(Max.)

over 15GB

over 35Mbps

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## HD image quality vs. video rate

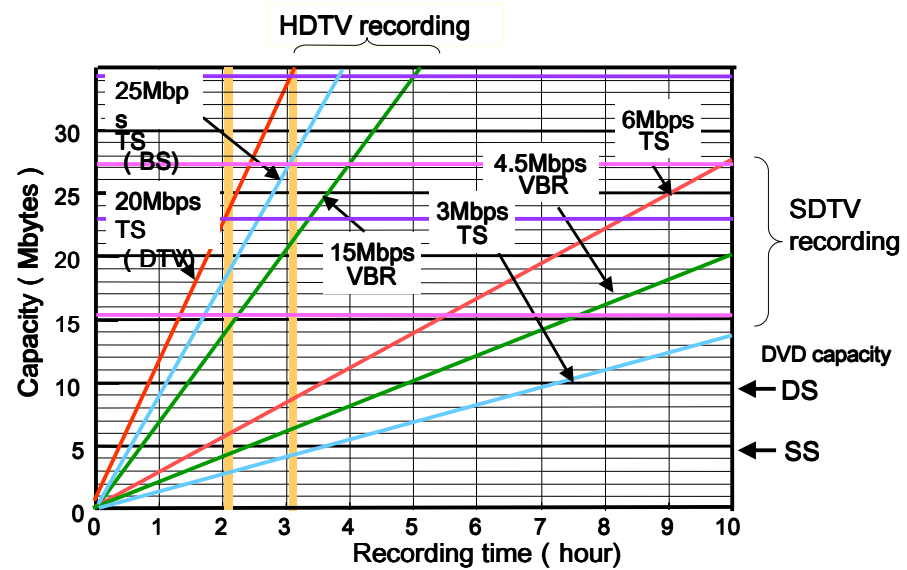


### Image quality vs. video rate

TV method	Image quality	Video rate	Times
SDTV	Same as ITU-R TV condition	6Mbps	1
HDTV	Same as ITU-R TV condition	22Mbps	3.7
	Same as DTV in USA	18Mbps	3

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## HDTV/SDTV rec. time v.s. capacity



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E\*PCOS 2001

## Applications vs. capacity

Application	MPEG2	Capacity
Package media HD-DVD (130min.)	VBR	> 15GB
Digital TV recording BS digital (HD) (2H/3H) DTV (HD) (2H/3H)	CBR(TS)	> 23GB/34GB > 18GB/27GB
Net distribution HD download (130min)	VBR	> 15GB
Mobile media (<64mm) Handy Cam (SD video)(1H)	VBR	> 3GB

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## Capacity Upgrade Technology

### Mastering

i-line resist, CEL(Contrast enhance layer) , RIE(Reaction ion etching) ,  
266nm deep-UV laser , SIL(Solid immersion lens) , EB(Electron beam)

### LD wavelength

Violet LD(400nm), Ultra-violet LD

### Optical head

High NA , Optical super resolution, Tilt detection, Tilt compensation  
Cross talk canceller,

### Media and Substrate

2 layer structure , Media super resolution, Improving media CNR,  
Erase ratio, Cross erase, Jitter  
Improving substrate noise, 0.1mm cover, Low tilt substrate

### Signal processing and Servo

Adaptive equalizer, Non-linear equalizer, CTC , PRM ,  
Modulation

Tilt servo, High accuracy F/T servo

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## Recording density and aberration

	DVD-RAM	Case1	Case2
Optical parameter	660nm 0.6mm NA0.6	405nm 0.6mm NA0.7	405nm 0.1mm NA0.85
Optical spot size $\propto \lambda/NA$	1	0.526	0.433
Recording density $\propto (NA/\lambda)^2$	1	3.61	5.33
Coma aberration caused by tilt $\propto d \times NA^3/\lambda$ d: Substrate thickness	1	2,59	$4.63 \times 1/6$ =0.77
Spherical aberration caused by thickness error $\propto NA^4/\lambda$	1	3.02	6.56

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## Comparison between Case1 and Case2

	Case 1	Case 2
Optical cover	0.6mm substrate	0.1mm
Parameter	NA : 0.65 ~ 0.7	NA : 0.85
Capacity/side (2 layer)	14.6GB ~ 19GB (26.3GB ~ 34.2GB)	~ 28GB ( 50.4GB)
Data rate 2 layer	over 35Mbps Easy	over 35Mbps Possible
Compatibility	Easy	Possible
Cartridge	No necessary	Necessary
Mastering	Deep UV laser	EB(ROM)
Subject	Tilt aberration	Bare disc

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## 2 8 G B /side condition

Wave length of light source I	401 nm
NA of objective lens	0.85
Thickness of cover layer	0.1 mm
Track format	Land and groove
Track pitch	0.3 mm
Minimum mark length	0.144 mm
Modulation code	RLL(1,7)
Linear velocity at recording	5.2 m/sec
Linear velocity at reproducing	4.8 m/sec
Channel frequency at recording	72MHz
Data detection method	PR(1,2,2,1)ML

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## Candidate for next generation DVD

### Conditions

Capacity: ROM over 15GB (130min.)  
RAM over 23GB (2H)/34GB(3H)

Bare disc available  
Compatibility with CD and DVD  
Usable for AV and PC

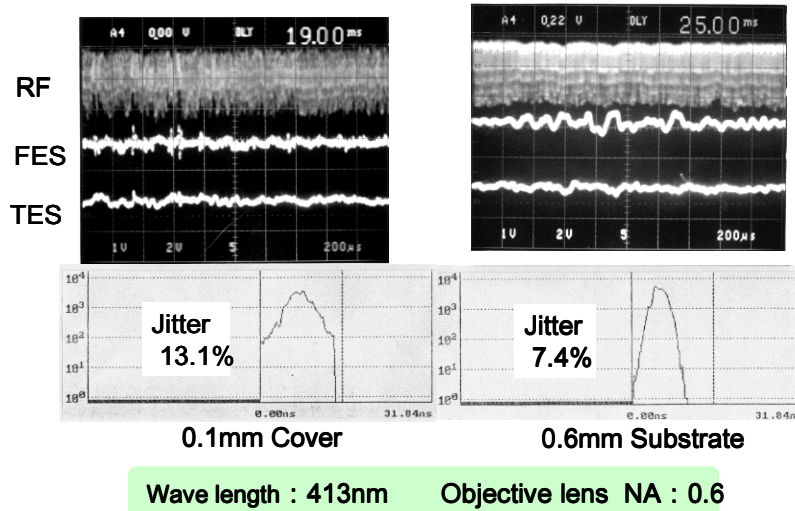
- 1) 0.6mm substrate + NA0.7  
Capacity :19GB/side, 34.2GB/2 layer(Must)  
Subjects : Tilt aberration, 2 layer disc
- 2 ) 0.1mm cover + NA0.85  
Capacity : 28GB/side, 50GB/2 layer (if possible)  
Subjects : Bare disc, Small WD,

### Compatibility

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## Influence for finger print



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## Capacity decided by application

Present	Capacity	Application
CD-DA	780MB	Audio
MD	140MB	Compressed Audio
DVD ( SD )	4.7GB	Video ( Movie ) (480×720)

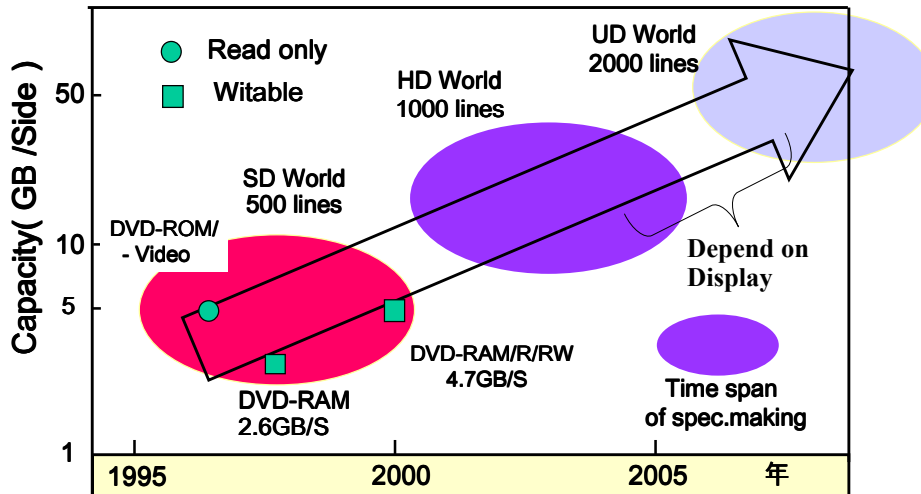
R/RW/RAM are followed these capacity



Future	Capacity	Application
HD-DVD	15GB	Video ( Movie ) (1080×1920)
UD-DVD	50GB	Video ( Movie ) (2160×3840)

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## Future prospect for DVD



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## Conclusion

- 1) Next generation DVD market will be expected to rise in ~2005. Format will be required ~2003.
- 2) Required items for next generation DVD
  - Capacity : ROM over 15GB (130min.)
  - RAM over 23GB (2H)/34GB (3H)
  - Data rate : over 35Mbps
  - Bare disc available
  - Compatibility with CD and DVD
  - Usable for AV and PC
- 3) There are two candidates.
  - 0.6mm substrate + NA0.7
  - 0.1mm cover + NA0.85
- 4) UD world will be expected in the future.

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