Technical Introduction to DVD+RW/+R

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RICOH CO., LTD.

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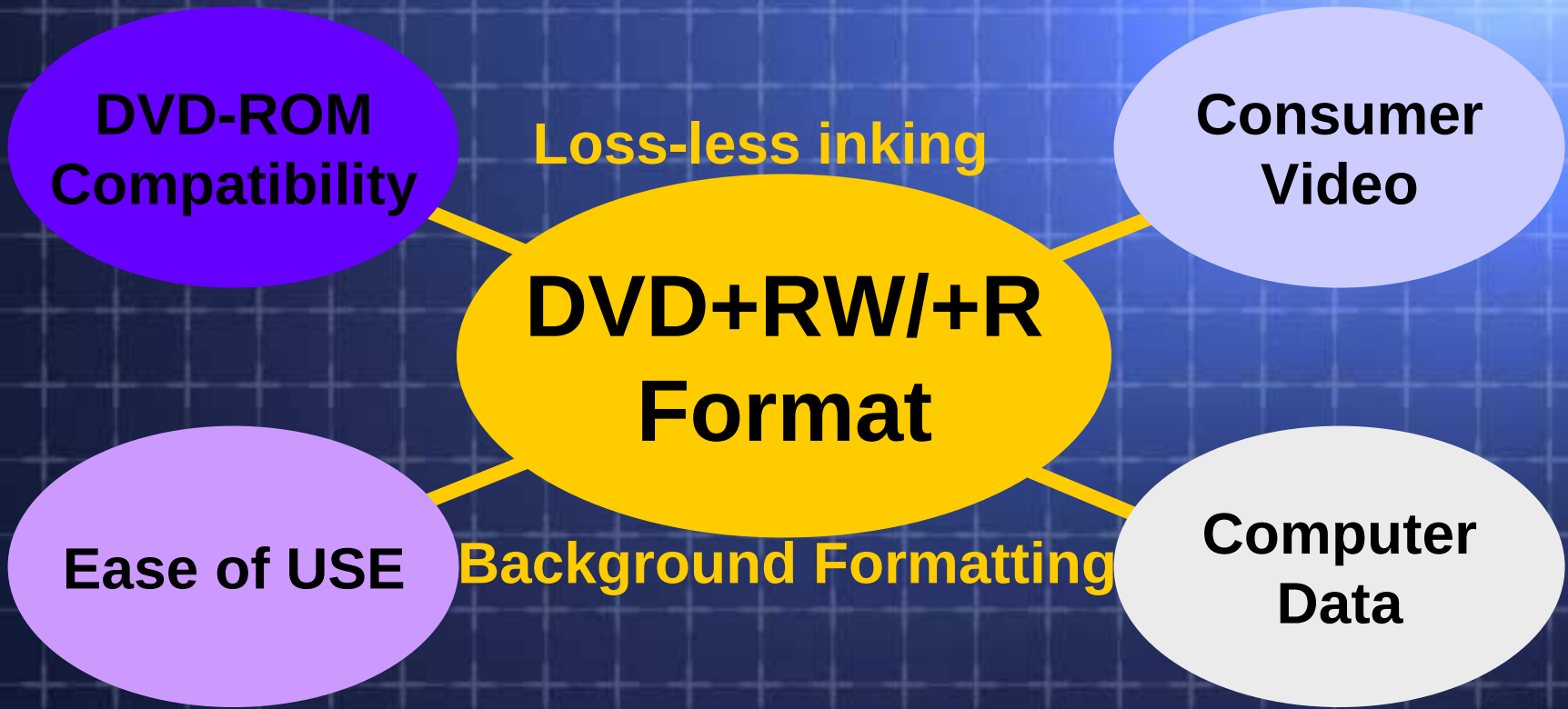
Why DVD+RW/+R Formats have been developed?



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Technical Introduction to DVD+RW/+R

- Features of DVD+RW/+R Format
- Physical Format Overview
  - DVD+RW
  - DVD+R
- Logical Format Overview
  - DVD+RW
    - DVD+MRW
  - DVD+R

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Features of DVD+RW/+R Formats

- Compatible with DVD-ROM
  - Loss-less linking
  - HF Wobble Groove
- Ease of use
  - Background Format for DVD+RW
  - Multi Session for DVD+R
- Convergence between PC and CE platforms
  - Same discs can be used for both PC drives and CE video recorders

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DVD+RW/+R Physical Specifications

- DVD+RW
  - Rewritable media using phase change materials
- DVD+R
  - Write once media using dye materials
- Write Speed
  - 1.0X to 2.4X, CAV/CLV
    - Higher recording speed at CLV 2.4X recording
    - Quick access time for CAV random access recording
- Data capacity and physical parameters
  - Capacity: 4.7GB (Data Zone)
  - Reflectivity: 18-30% (DVD+RW)
    45-85% (DVD+R)
  - Basic physical parameters same as those for DVD-ROM

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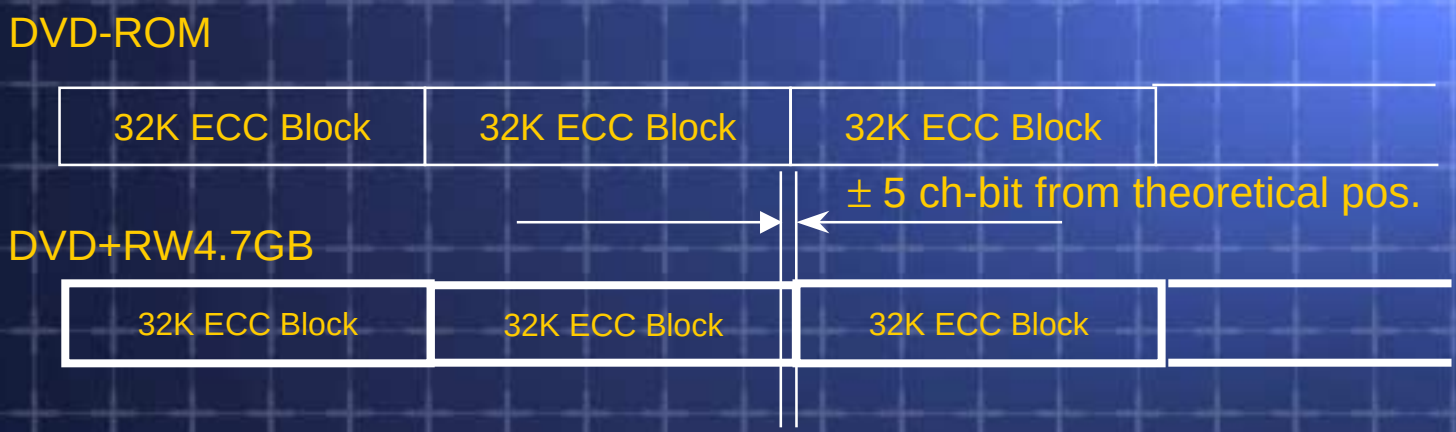
Compatibility with DVD-ROM

- Addressing and Linking Rule -

- Addressing
  - HF (1/32T) wobbled groove and ADIP (ADress In Pre-groove)
  - Accurate within +/- 5ch bit (Loss-less linking) by PLL synchronizing



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Logical Format Overview

- DVD+RW Logical Format
  - Formatting
    - Background Formatting
    - Sequential Recording
  - Defect Management
    - DVD+MRW
- DVD+R Logical Format
  - Multi Session
- File System
- Command Set

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DVD+RW Logical Overview

- Formatting for Random Access Recording
  - Background formatting
- Sequential Recording

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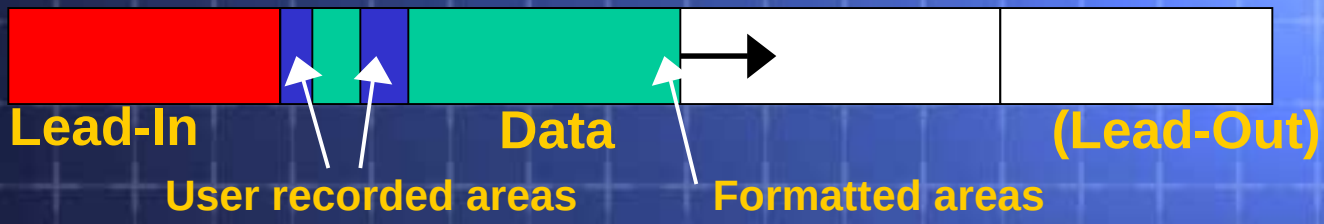
Background Formatting

Background Formatting

- Format will proceed background by the drive.



- De-icing*:
  - The Data Zone shall be filled with ECC blocks containing all (00) bytes or with User Data when requested.
  - When the application requests disc access, the De-icing process is suspended and the control of the disc is returned to the application.
  - Random access is always available even in background formatting.

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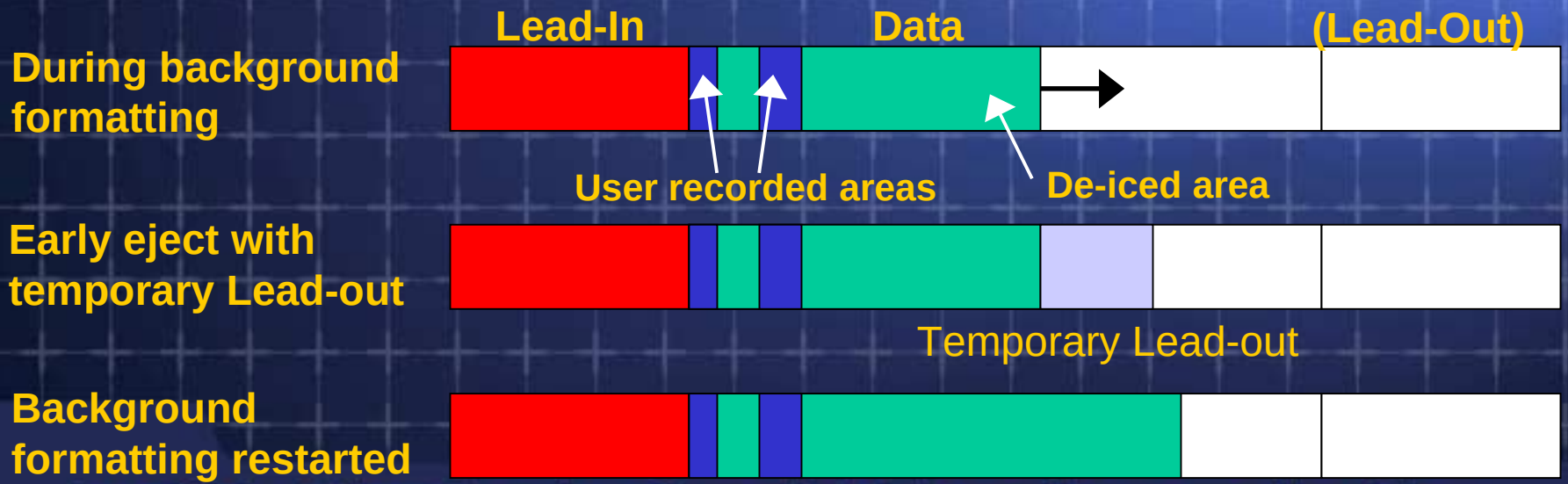
Background formatting
- Early Eject/Temporary Lead-out

- If the user wishes to remove the medium prior to format completion
  - Temporary Lead-out can be recorded for read compatibility with DVD-ROM drives
  - Temporary Lead-out shall contain “00”
  - Temporary Lead-out will be De-iced or overwritten by user data when formatting is restarted.



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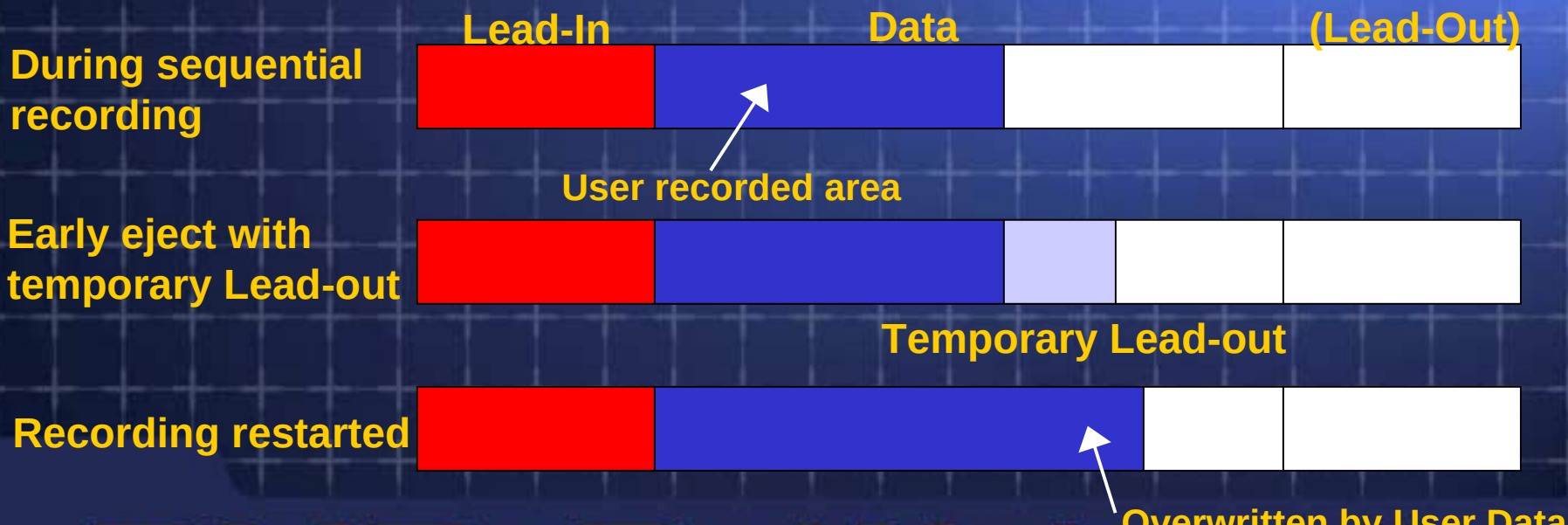
Sequential Recording

- The recording mode, in which user data is recorded contiguously from the inner to the outer of the disc
  - Temporary Lead-out can be recorded for read compatibility with DVD-ROM drives
  - Temporary Lead-out shall contain “00”
  - Temporary Lead-out will be overwritten by user data when recording is restarted.



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Defect Management System

- Host Based Defect Management
  - UDF 1.50/2.00/2.01 provide for defect management
  - Follow the CD-RW manner

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DVD+MRW (Mt. Rainier)

- What is Mt. Rainier?
  - The original Mt. Rainier specification was defined for CD-RW (CD-MRW)
    - Defect management in the drive
    - 2k addressing handled by the drive
    - Background formatting
- DVD+RW adopted the similar defect management of CD-MRW
- Read-out by current DVD-ROM drives
  - Re-mapper driver will be provided for reading the data in spare area.

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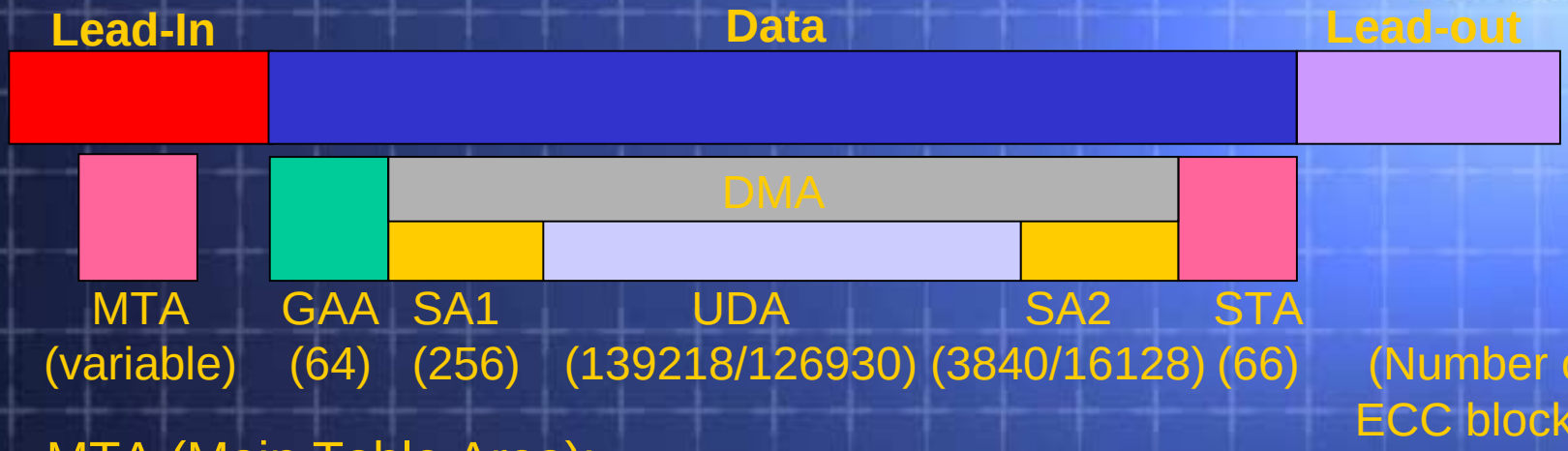
DVD+MRW Disc Layout (1)



- MTA (Main Table Area):
  - Reserved from the lead-in
  - Contains structures that identify the media format and structures for management of the defect replacement system.
- STA (Secondary Table Area):
  - A backup copy of the MTA
  - Provides a way for a host to access the MRW structures when connected to a read-only device that is not MRW capable

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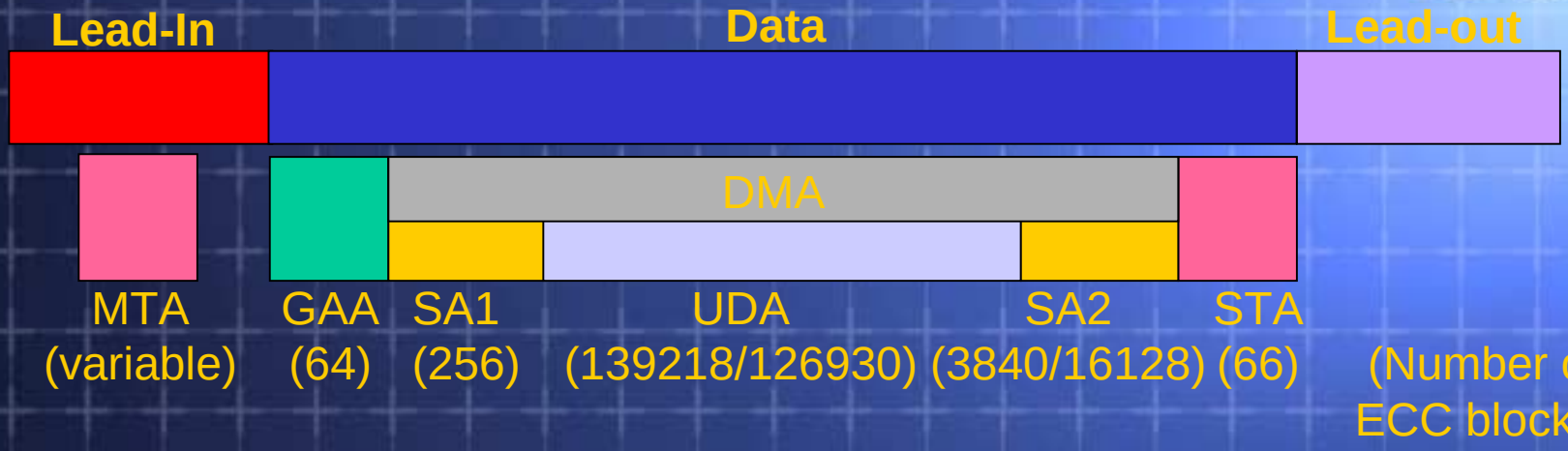
DVD+MRW Disc Layout (2)



- GAA (The General Application Area):
  - Provides minimally 2 MB of user space and must align its logical address space exactly with the logical address space associated with the traditional media format
- DMA (The Defect Managed Area):
  - Contains both UDA (User Data Area) and SA (Spare Area 1/2)
  - The DMA is independently addressable, so it contains its own, well-defined LBA 0.

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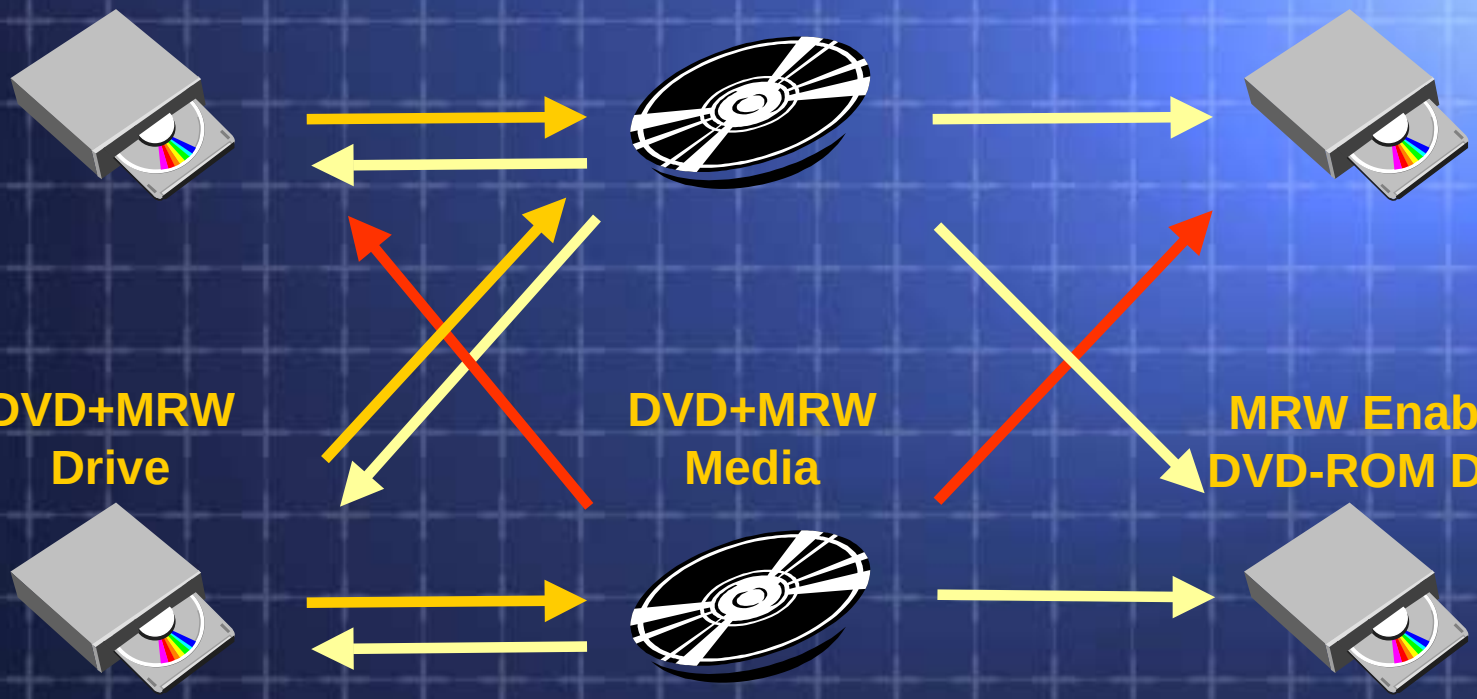
Compatibility of DVD+MRW



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DVD+R Logical Overview

- Compatibility with DVD-ROM
  - Disc Layout
- Writing Mode
  - Disc at once
  - Incremental Recording
  - Multi-Session
- File System
- Command Set

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DVD+R Disc Layout

Lead-in Zone:

- Guard zones, reserved zones
- Inner Disc ID zone
- Reference code zone, buffer zones and control data zone

Inner Drive Area:

- Disc Test zone
- Disc Count zone
- Disc Administration Zone
- Table of Contents zone

Outer Drive Area:

- Disc Test zone
- Disc Count zone
- Disc Administration Zone

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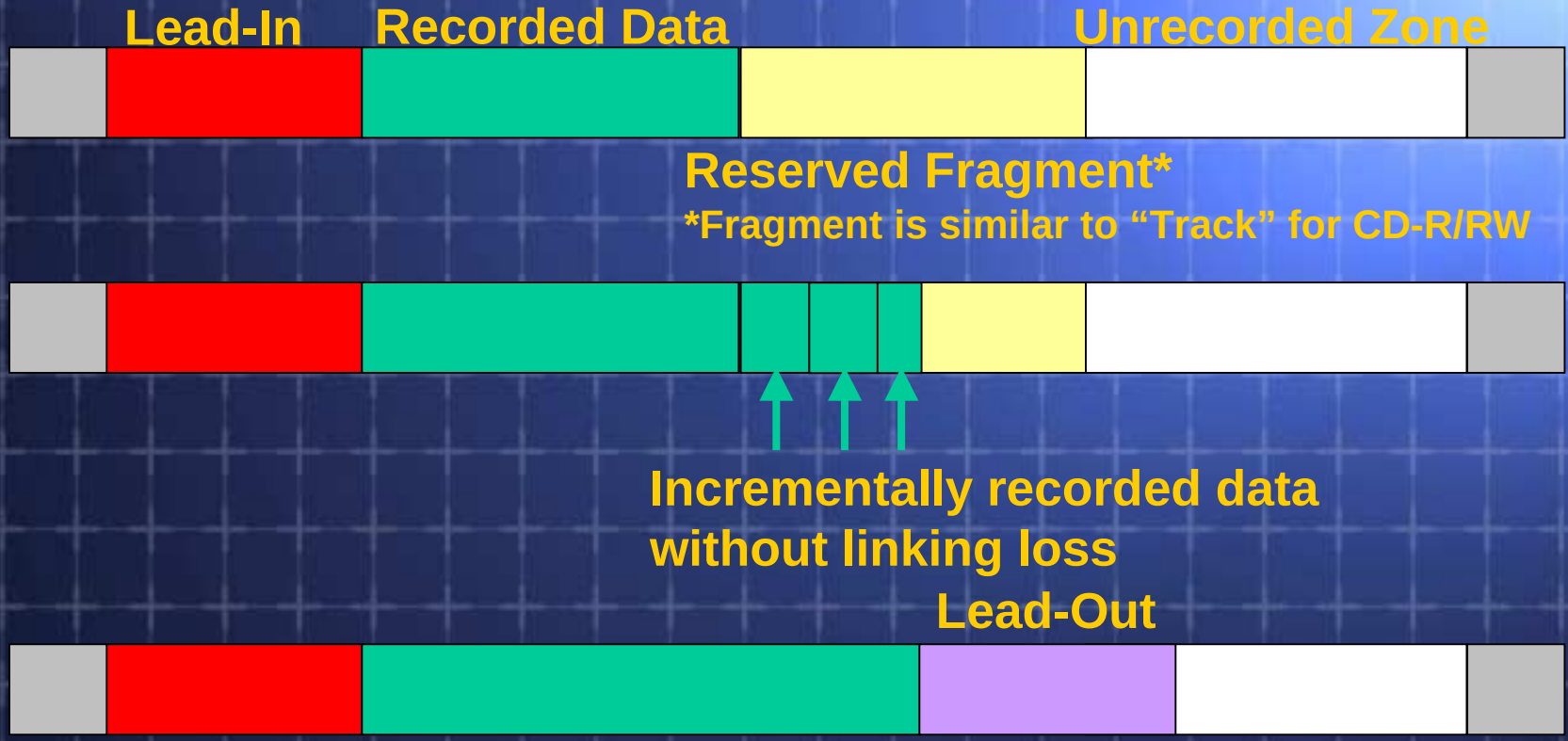
DVD+R Incremental Recording



After finalizing by recording Lead-out, the disc seems like those discs that was recorded in disc at once recording mode.

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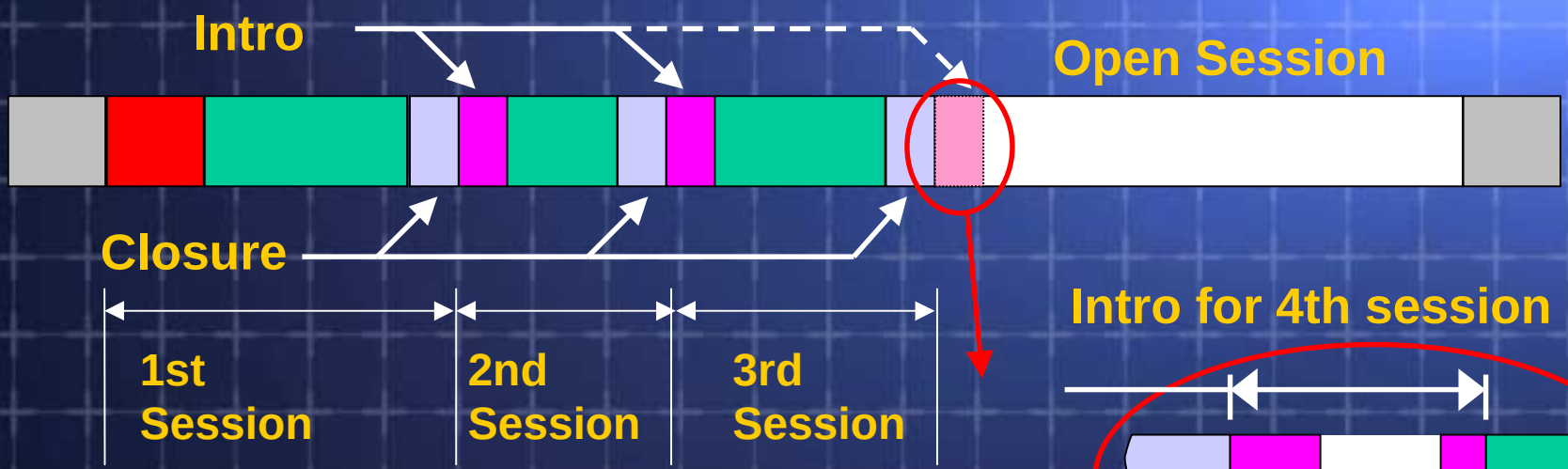
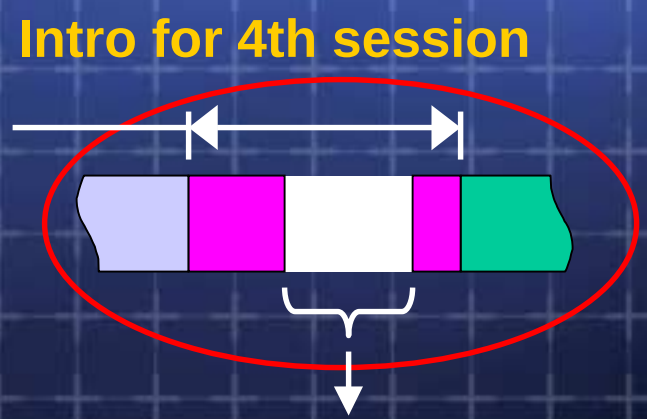
DVD+R Multi-Session Disc Layout

–1st session compatible to existing DVD-ROM drives and Video Players

–Session overhead is ~ 4 MB per session

–Maximum number of session is 191





Written on opening of the session

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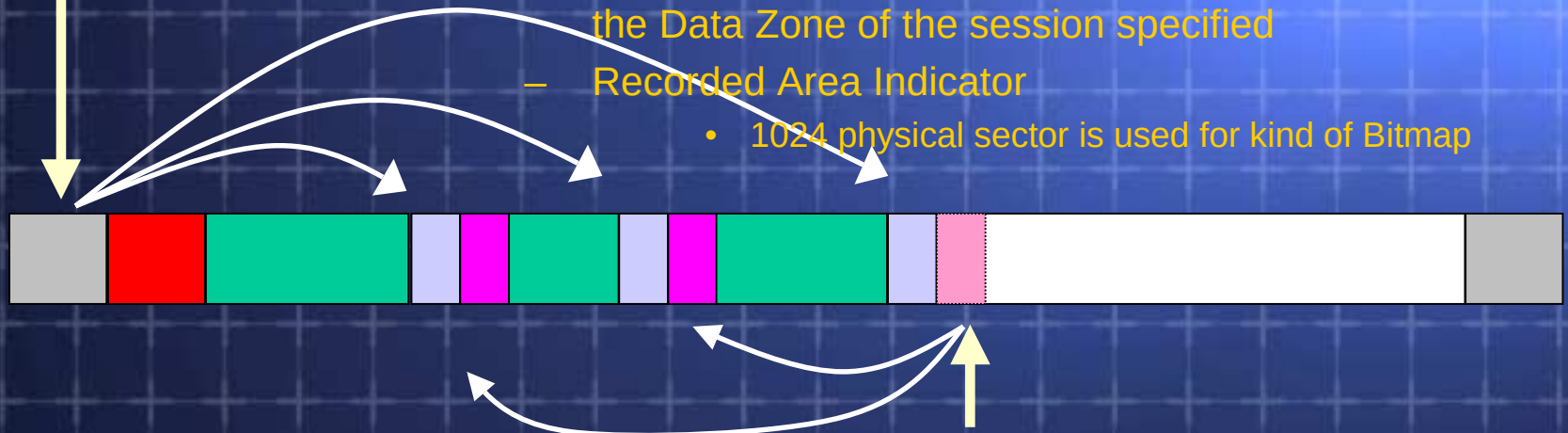
Multi-Session Session Information

TOC (Table of Contents)

- new session is allowed or not
- session start address: PSN of the first physical sector in the Data Zone of the session specified
- session end address: PSN of the last physical sector in the Data Zone of the session specified
- Recorded Area Indicator
  - 1024 physical sector is used for kind of Bitmap



Session DCBs
(Disc Control Blocks)

- DCB's are provided as a structure on the disc to include additional information for interchange
  - type 1: specifies the Fragments in the current Session
  - type 2: specifies the start and end addresses of all previous Sessions.

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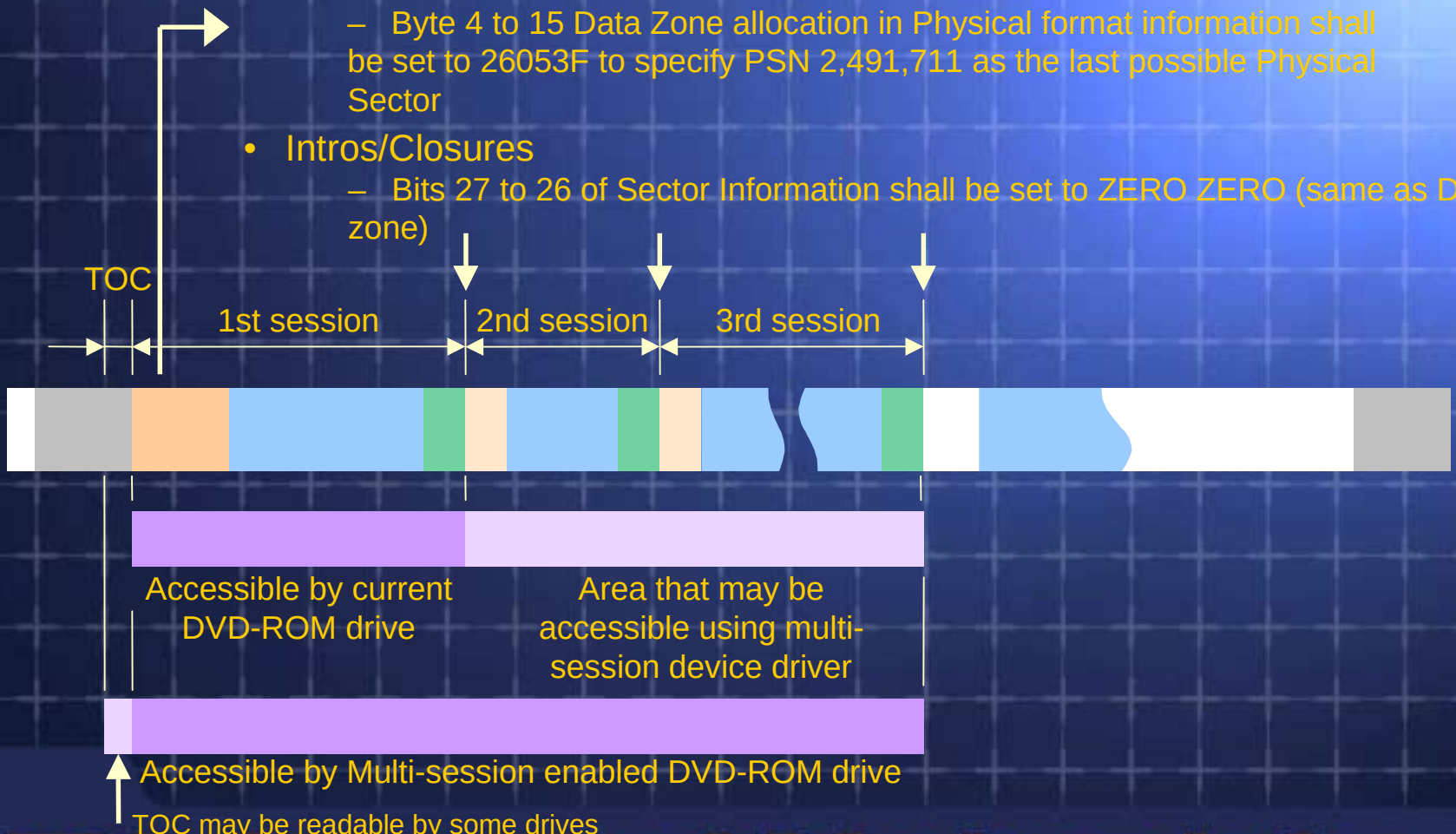
Read Compatibility by current DVD-ROM drive

- Control data zone
  - Byte 4 to 15 Data Zone allocation in Physical format information shall be set to 26053F to specify PSN 2,491,711 as the last possible Physical Sector
- Intros/Closures
  - Bits 27 to 26 of Sector Information shall be set to ZERO ZERO (same as Data zone)



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Multi-session file system and Read device driver

- File system for multi-session DVD+R
  - OSTA is discussing this issue.
    - DCN (Document Change Notice) will be issued
  - Based on multi-session CD-R.
- Device driver for reading multi-session
  - Current DVD-ROM drives will need drivers to access the sessions beyond the session boundaries.
  - Generic drivers may be provided by OS vendors or ISV's.

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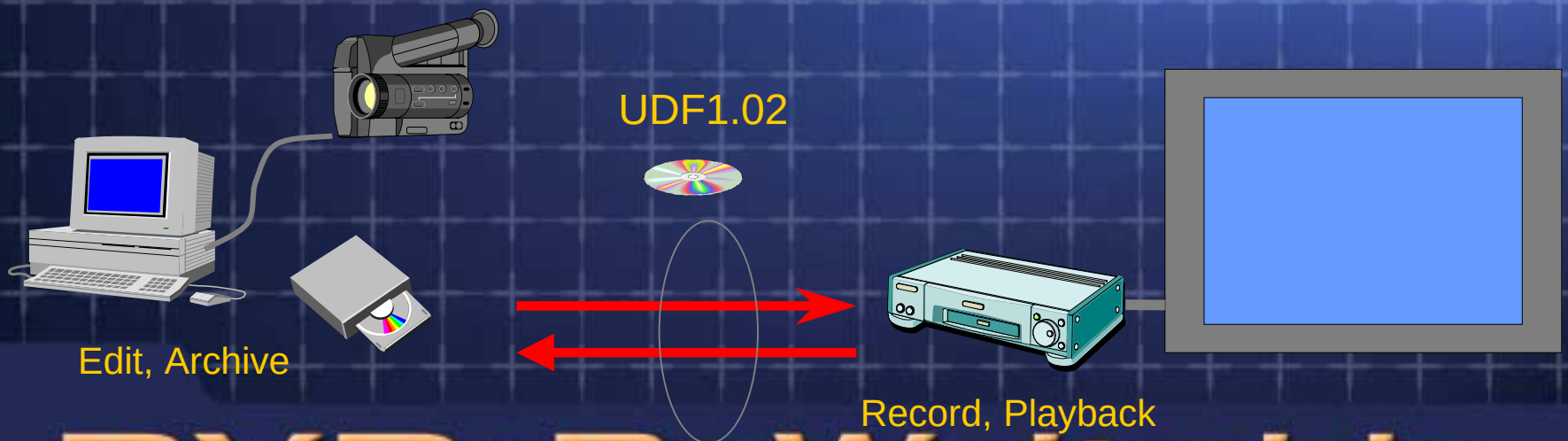
File System

- UDF file system is recommended. Can be bridged to ISO9660.
  - Recommendations to UDF implementations for DVD+RW/+R/MRW media are discussed in OSTA.
  - For compatibility with DVD-ROM drives and Video players UDF1.02 shall be used.



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Command Set

- DVD+RW command set was integrated into MMC3
- DVD+R command set draft will be proposed to MMC4
  - MMC drafts are available at www.t10.org
- New Feature/Profile for DVD+RW/+R/+MRW

- The following commands are modified for DVD+RW
  - FORMAT UNIT
  - CLOSE TRACK/SESSION
  - GET EVENT STATUS NOTIFICATION
  - READ (10) / READ (12)
  - READ CAPACITY
  - READ DISC INFORMATION
  - READ FORMATTED CAPACITIES
  - READ TOC/PMA/ATIP
  - START/STOP UNIT
  - WRITE (10) / WRITE (12)
  - WRITE AND VERIFY (10)
  - Read/Write Error Recovery Page

- The following commands will be modified for DVD+R
  - CLOSE TRACK/SESSION
  - READ (10)
  - READ (12)
  - READ CAPACITY
  - READ DISC INFORMATION
  - READ TOC/PMA/ATIP
  - Read/Write Error Recovery Page
  - RESERVE TRACK
  - WRITE PARAMETERS MODE PAGE

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Conclusions

- DVD+RW/+R formats provide for;
  - DVD-ROM Compatibility
    - Loss-less linking
  - Ease of use
    - High speed recording (2.4X)
    - Background formatting (DVD+RW)
    - Multi session recording (DVD+R)
  - More reliable
    - Drive based defect management by introducing Mt. Rainier
- And higher recording speed...

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