End-to-end Data Protection and Tapes (07-373r1)

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End-to-end data protection

• T10 standardized end-to-end data protection for blocks transferred to disk
  – This is getting adopted by an increasing number of vendors
  – An increasing number of customers are asking for this protection on tape
  – Tape solutions are losing to pure disk solutions because of a perceived data integrity advantage by disk systems

• T10 did not standardize end-to-end data protection for blocks transferred to tape
  – During the work on end-to-end for disk, the tape group was told a common solution for disk and tape was not going to happen and if tape wanted end-to-end data protection the tape group needs to do a unique solution for tapes.
Why Disk end-to-end solution does not work for Tapes

• Disk devices
  – measure performance by I/O operations per second
  – use fixed block transfers
  – use 512 byte blocks
  – LBAs for blocks are known a priori
  – blocks are not expected to have their LBAs change

• Tape devices
  – measure performance by MB/s
  – use variable block transfers (most common) as well as fixed block transfers
  – Performance varies by block size
  – LBA’s are not known a priori
    • LBA is determined by where the medium is currently positioned
Typical Data Rate vs Block Size (Tape)
End-to-end data protection is needed on tape devices

• Potential data corruption between the application and the HBA’s (same on tape as disk)
• Potential data corruption on the interfaces to the data delivery subsystem on both ends of the wire (same on tape as disk)
• Potential data corruption internal to the device (same on tape as disk)
• Potential data corruption as block is transferred between intermediate devices (e.g., protocol bridges)
Is Protection Embedded by Application Sufficient?

• Many backup applications embed a CRC or other form of protection into their data stream
  – Allows the application to detect bad data stream when the data is read
  – Does not guarantee that the data written to medium is not corrupted
  – Generating this information adversely effects performance because it is done in software
What does end-to-end data protection need to cover?

- **Application to HBA**
  - Needs supported same as in disk solution
  - Likely will not be supported by applications for a long time

- **HBA through service delivery subsystem to tape device**
  - Needs supported to cover memory buffers in source and destination

- **Tape drive interface through internal workings of tape drive and onto medium**
  - To get true end-to-end logical block protection the protection information needs to be saved on medium with the logical block
Likelihood that protection information be saved with logical block

- Tape drives today save protection information with data blocks.
  - ECC
  - CRC
- Making the protection information fit into existing schemes in use today would greatly accelerate adoption and increase the likelihood of adoption.
Existing vendor-specific methods

- IBM has been providing end-to-end logical block protection for over ten years in its enterprise tape drives.
  - Began with 3480 Tape drives
  - Continued in 3590 and 3592
  - 4-byte CRC placed on logical block and transferred with the block
    - Writes: generated at host; validated at drive and written to medium with logical block
    - Reads: read from medium and validated at the drive; validated at the host and stripped from block for application use
    - Validated at multiple points along the path
Benefits to IBM with this solution

• Prior to solution
  – Data Integrity Issues
  – Difficult to find where the problem occurred

• After solution
  – Quickly find where problems occur
  – Data Integrity issues disappeared (Integrity was assured)
  – When there is bad memory or such, it is discovered before host is told the data is on medium
Diagram of IBM Solution
(logical representation)

zSeries (Mainframe)

- Logical Block
- HBA (FICON)
- HBA (ESCON)

4-byte CRC calculated and placed as last 4-bytes of logical block – LBA size = LBA size + 4 and transferred with block (or validated and stripped if Read)

Controller

- HBA (FICON)
- HBA (ESCON)

4-byte CRC validated at multiple points between source and destination (exact points not necessarily shown)

Buffer

- Transferred Logical Block
- Transferred Logical Block
- Transferred Logical Block

Port (FC)

- HBA (FC)
- Transferred Logical Block

Port (pSCSI)

- HBA (pSCSI)
- Transferred Logical Block

Enterprise Tape Drive

- Buffer
- Transferred Logical Block

Format stuff

Data Saved to medium

Transferred Logical Block

Logical Block

4-byte CRC

Transferred Logical Block
Proposal – Implement end-to-end logical block protection on tape

- There is a proven method that has been in use for more than twelve years
- Leverage this proven solution
- Make sure that options are available to meet all vendors needs
- For proposal against SSC-3 see (http://www.t10.org/ftp/t10/document.07/07-374r1.pdf)