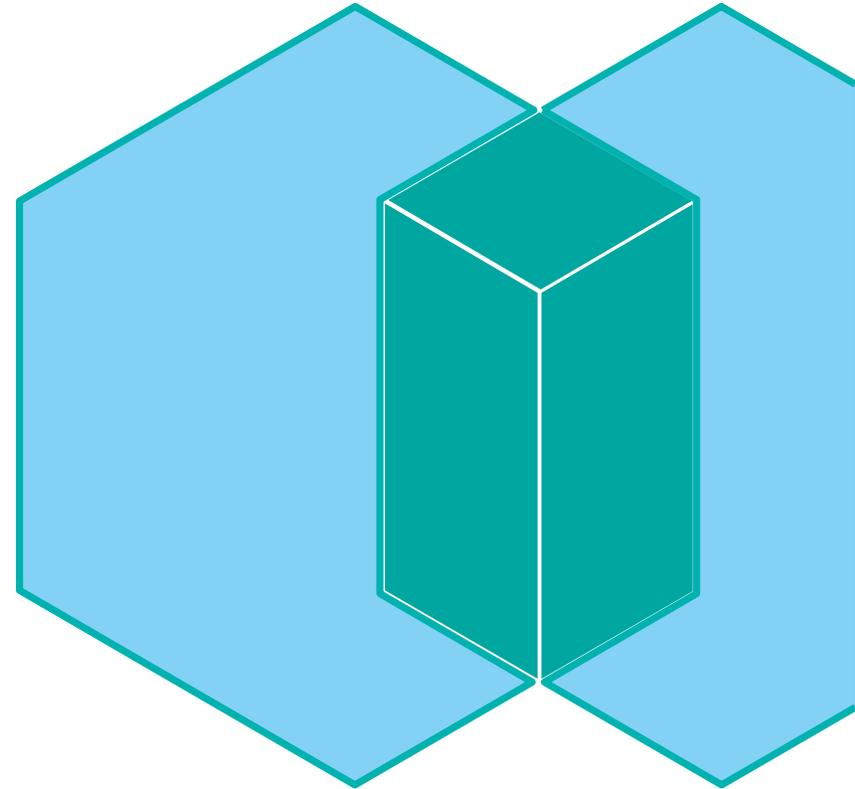# Tape Health Monitoring

OCP Discussion - Jan 2019

Ed Childers
IBM Tucson
STSM, Manager Tape Development

Tape Drive Health Monitoring - Background

Tape Drives' fundamental architecture is designed to maximize the probability of committing data to tape with quality and reading data from tape without a permanent error.

- Multi-channel dataflow with ECC (think erasure coding across tracks and down tape) realtime in dataflow provides ability to read compromised data
  - Eg. data can be read 2 dead tracks realtime
    - ➢ Great for data read reliability
  - small/medium degradation of read performance/reliability is masked by ECC
    - ➢ Complicates assessing health of tape system

- Read-after-write realtime thru ECC allows assessment of quality of written data
  PLUS
- A streaming, variable block length format allows re-writing of data packets not meeting criteria
  - Data will be committed to tape with high quality at the expense of capacity if necessary
    - ➢ Great for protecting data quality in a variable media quality environment
    - ➢ Complicates assessing differences between normal media defects, transient media debris, marginal media, or marginal drive

Tape Drive Health Monitoring – Background (con't - 2)

- A read or write operation can be impacted by multiple variables
  - Quality/SNR, channel sync, offtrack of data (same as HDD)
  - # of tracks with impacted SNR, channel sync, offtrack (not same as HDD)
  - ECC effectiveness (not same as HDD)
  - Normal media defects (same as HDD, though probably more variability in tape media)
  - Transient debris impacts (definitely not the same as HDD = data loss failure in HDD)
  - Transient head/tape interface effects (ie. Sticky tape) (definitely not same as HDD = data loss)
  - plus more..

As a result, tape drives have an extensive Error Recovery Procedure (ERP) menu which is exercised in the event of a problem. A transient problem may be logged as a temp (recovered) error indicating some action has been taken. However, a full investigation of the ERP actions a drive may undertake is very complex and difficult even for highly experienced tape engineers to investigate.

Tape Drive Health Monitoring - Strategy

- Robustness of tape architecture + transient effects + ERP operation + removable media
  - ➤ It can be difficult to distinguish between bad media or a bad drive in any given event in isolation
    - ➤ Tracking health and trends in a tape environment is best achieved by comparisons in the population (ie. the high nail analysis)
  - ➤ "Robustness" of tape architecture makes it harder to find predictive trends indicating failure than in a single channel, single head/disk interface

- Capture of data indicative of individual drive/media R/W performance across a large population may yield insight to predict failures (aka – we'll see if Big Data works)

Tape Drive Health Monitoring - Strategy

- Phase 0 - What Tape Applications Should Do Today

  - Monitor Capacity Written/Read and the Time it takes

    This is a very effective means of gaining insight to health of a given operation. Because of the way a tape drive manages degradation in media, drive, and/or transient events the effect of degradation will be an impact in time to complete the operation and/or the ability to reach the cartridge capacity. This is easiest to see in a complete cartridge read/write but can also be done with smaller operations.

  - Monitor Tape Alerts

    Tape alerts are used extensively by traditional tape applications (ie. Backup applications) and by the tape automation system to monitor drive health.

    See Tape Health Monitoring 20190124 Ver 1 for details.

Tape Drive Health Monitoring - Strategy

- Phase 1 – What The Tape Drive Can Provide Today
    - Statistical trends across the drive and media population using
        - Volume Statistics Log Pages
        - Static Capacity Log Pages
        - Error Recovery Log Pages

        These existing log pages could be considered the Darwinian result of 20+ years of logging parameters found to be of interest in understanding tape health.

        See Tape Health Monitoring 20190124 Ver 1 for details.

Tape Drive Health Monitoring - Strategy

- Phase 2 – What We Can Do Together To Grow Capability

  - Collect data, work together to determine what is best, what is needed to manage system health and add necessary parameters to log pages
  - ➢ Our goal is to have whatever is necessary to monitor and manage system health be in standard tape log pages available to all clients