Cloud Contribution
Who Drove #43?
NASCAR LIBRARY

• 300 hours a week of new content
• 1% of new footage is used the week acquired

*For purposes of this presentation we are only discussing video. Should we include audio, our archive would surpass 760,000 hours of content*
Should we move our entire library to the Cloud?
Where Do We Use Our Content?

- Live Production
- Post Production
- Live Steaming
- Logging
- Officiating

Content (camera source).future
Current High Level Workflow - Library

Acquisition
Primary Sources
- File Based Cameras - Cineo / Alexa / GoPro
- Live Footage - Broadcast feeds / Stem Audio

Secondary Sources
- Linear Tape - Historical Archives

Ingest
Media Operator
- Data Transfer (IP / Serial)
- ASI (Satellite / Fiber)
- Manual Ingest

Asset Management - Reach Engine
- Elasticsearch - Search Engine
- PostgreSQL - Asset Metadata
- MongoDB - Asset Metadata

Generated Files
- Mezzanine - Apple ProRes @ 100mb
- Edit Proxy - H.264 @ 2.5mb
- Streaming Proxy - H.264 @ 2.5mb
- Audio Proxy - MP3 @ 64kb
- Thumbnail Image - jpg @ 128 x 256
- Thumbnail Video - jpg @ 128 x 256

On-Site Storage
- 'Online' Storage - SNFS Disk
- 'Nearline' Storage - SNFS Nearline Disk
- 'Cold' Storage - Robust w/o LTO-6 Tapes
- 'Proxy' Storage - NFS/VMware Primary Disk

Off-Site Storage
- 'Warehouse'
- 'Cold' Storage - LTO-4 & LTO-6 Tape

Current Telestream Cluster contains 13 nodes

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Current High Level Workflow - Streaming
Can we be more efficient?
Cloud Contribution - High Level Workflow

Encoded Video Stream → The Internet → Cloud Platform

- RTP Stream → Object Detection
- HLS Stream → Content Delivery Network
- Mezzanine Archive → Nearline Storage
- RTP Stream → Officiating Software
- Future Formats → Future Software
Cloud Contribution – The Constraints

Bandwidth

Latency

Quality
How it works – Option 1

• Encode as HEVC
• Deliver as RTP
How it works – Option 2

• Encode as HEVC
• Deliver as TIFO
Quality - Signal To Noise Ratio

$$\text{SNR} = \frac{P_{\text{signal}}}{P_{\text{noise}}}$$
Quality - Signal To Noise Ratio

Apple ProRes @ 100
- 720P @59.94 -

HEVC @ 33mb
- 720P @59.94 -

Apple ProRes 100
- 720P @59.94 -

SNR >= 1/2 DB ✅
Open Architecture
Detailed Workflow – Delivery Times

- Ground Encoder to Cloud Encoder = 500 milliseconds
- Ground Encoder to Proxy = 1 to 2 seconds
- Ground Encoder to Mezzanine = 1 to 2 seconds
- Ground Encoder to Fan (HLS) = 4 to 9 seconds
- Ground Encoder to ML = < 1 second
Advantages of Cloud Contribution

• More efficient use of bandwidth from event (track)
• Trigger multiple workflows from one source
  • Reduce staff?
  • Reduce ability for mistakes?
• Reduce CapEx
• Allow future workflows/deliverables by harnessing the Cloud
Questions?