# GCCG working group Readout to the VSF May Meeting – May 17th , 2021

Goal of the group:

- Document common methods and practices for transferring A/V essence
- From Ground to Cloud, Within-a-Cloud, and Cloud-to-Ground



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## What are the "operating points" we see (G-C,C-G) (for TV)

- Uncompressed (2022-6 or 2110-20) (already defined)
- **"PremiumCompressed" – super low latency, super high quality**
  - **JXS for (1080i @ 200m?) (UHD @ 1000-1500M)**
  - **Dual-path reliability model for super-good reliability @ *minimum delay***
- J2K-ULL (
- J2K (full-frame
- AVCI @ 10

**Premium Compressed (JPEG XS)**
**VSF TR-08: codec & LAN 2110-22 base**
**VSF TR-09: WAN 2110-x extension**
*** reference TR-08**
*** opt: with 2022-7**
*** opt: with FEC (small intl, 1D)**
*** opt: GRE Tunnel (ref RIST)**
*** opt: encryption (ref RIST)**

**Interactive Latency (small GOP or Prog Refresh)**
- **(HD) H264 (constrained VBV, 4:2:2, 10bit)**
- **(UHD) H265 (constrained for latency)**
- **2022-2(TS-RTP)**
- **RIST-FEC (+/- multi-path)**

**Bandwidth Optimized**
- **(HD) H264 (420/8 standard vbv)**
- **(UHD) H265 ()**
- **2022-2(TS-RTP)**
- **ARQ**
- **Opt: encryption (ref RIST)**

Focus on these

- **Interactive Latency ~20Mbit(HD) (ULL restricted VBV buffer) $$**
  - **ARQ/RIST or dual-path model or FEC? (Typical 4:2:2/10 profile)**
- **Rate Optimized (longer latency @ lower rate) (HD@3-10 Mbits, more delay)**
  - **ARQ/RIST or dual-path model or FEC? (Typical 4:2:0/8 profile)**
- Zoom / GoToMeeting / Webex – whatever gets a picture on the screen
  - Internet best-effort reliability work



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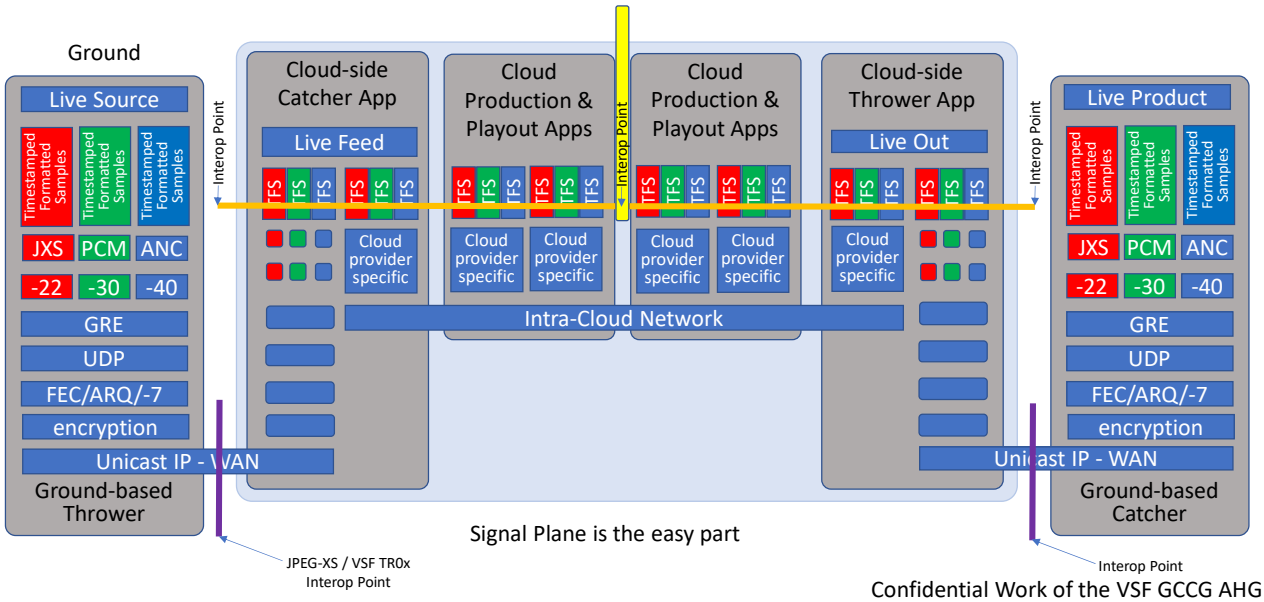
**JXS/-22 covers the ultra-low-latency, ultra-high-quality G-C and C-G cases "Premium Compressed"**
**But what about the C-C case? How to send things between applications within a cloud?**



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# Work for this and adjacent groups

- Define Requirements for (Premium Compressed) TR-08 & TR-09 for G-C and C-G use cases
  - TR-07 & 08 are nearly done. Defines JPEG-XS over TS and over 2110-22 with interop points and capability sets
  - TR-09 in progress. RIST elements in the data plane, plus Control plane
  - TR-07 & 08 include a list of "interop points" including some non-tv cases from IPMX
- Is there something more to document about the TS/IP/H.264 case? Or is it good enough already?
  - The standards for the parts are ok, just a list of more details of the operating points within them might be handy.
  - Should we document the supported "interop points" ? (maybe overcome by reality)
  - Is there something to write down? Probably yes, but its mostly pointers to other things and constraints.
  - Can the new data-plane work in TR-09 (ARQ, FEC, -7) be applied to this class of streams ? (yes)
  - How about the control-plane work above? YES, hopefully, but what is the NMOS-equivalent for TS ?
- Time-Flow / Time-Transport / Time-Tagging model
  - How do we treat time in the concatenated virtualized systems
  - How do we integrate "real-time" on the ground with "floating time" in the cloud?
  - This requires a vocabulary and some modeling/specification effort
  - The use cases include how to catch up / manage drift / manage change / re-integration to timeline
- The Media Containers / Object Format structures for hand-off from application to application
  - The github part of AWS CDI is a step in this direction
  - And also how this handoff interacts with latency and latency accumulation



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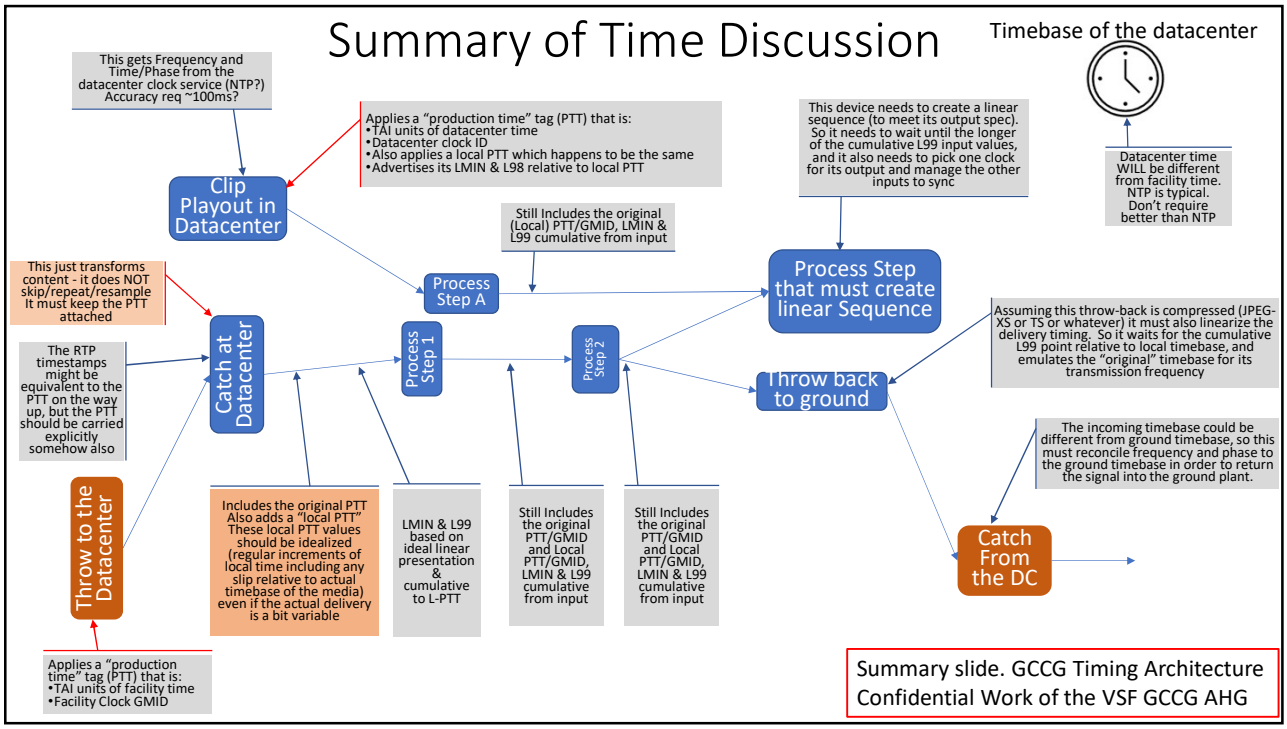


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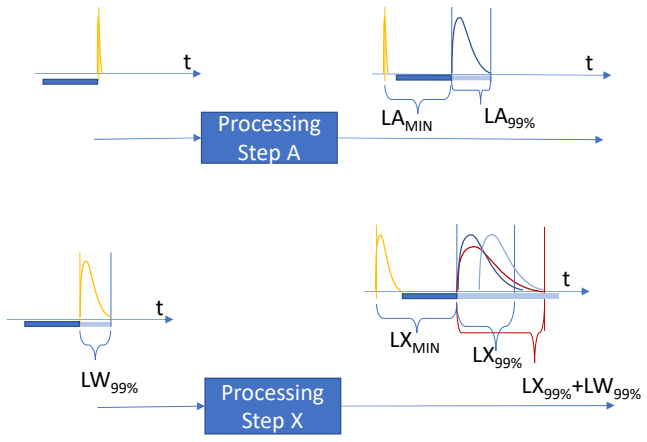
Confidential Work of the VSF GCCG AHG

# What is the "spec" of latency and variability?

- Assuming Push model (not backpressured)
- Based on (uniform) content "chunks"
  - might be frames, fields, stripes
  - might be blocks of audio samples
- $L_{MIN}$ = the soonest/shortest amount of time from input to output
  - Input time = buffer 100% arrived to me
  - Output time = buffer left me 100%
  - Includes the egress transit time
- $L_{99\%}$ = the amount of variability ***beyond*** the $L_{MIN}$ for 99th percentile case




*Variability on the input can accumulate into the output!!!*

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## What is the "contract" at the input of a (in-cloud) receiver ?

- Data content spec (e.g. 4:2:2/10 SDR 709 1080p 50Hz whole-frames)
  - Setup time: everything
  - Runtime variable: (HDR format? )

Mix of setup-time and in-band

- Data format spec (frames or stripes, and how formatted in object?)
  - Declare at setup time

Application convention, *setup time*

- $L_{MIN}$, $L_{99}$ parameters of each incoming signal
  - These are relative to the local PTT value
  - These may include any $L_{MIN}$, $L_{99}$ of the upstream signals, depending on the sender



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## What is the right way to organize the data?

- Packed like 2110 PGROUPS ?
- SW Friendly – 10-bit values mapped in 16i?
  - Or 8-bit components when that's all you need?
  - Planer or interleaved ? How to describe?
- Stripes or whole frames (or both)?
- What metadata is at session setup
  - (the 2110 SDP stuff) plus stripe setup, stride –vs- bounding box, etc
  - 4CC or other packing info, stride over-packing?
- And What (dynamic) Metadata travels alongside it in the bundle?
  - Coordination Time Value (represented in TAI units) & Coordination Time Source (GMID or equivalent)
  - Interpretation Metadata (HLG Rec2100 YCbCr)
  - AFD & related PAR variability

Path to Closure:
1) document the set of data in the "contract" at startup
2) Document the set of data communicated live with the essence
3) Compare to current CDI recommended spec for example - (analyze deltas and see if possible)
4) Compare to other cloud providers as can



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# G-C-C-G Finishing Up

- Transport Specs for G-C and C-G (VSF TR-07, TR-08, and TR-09)
  - Underway, coming along well, done soon
- Connection Setup for G-C and C-G
  - Could be the WIP TR-09
- C-C – Content handoff Spec
  - The content format(s) to be specified/described
  - The content transport is cloud-infrastructure dependent
- C-C – Connection Setup
  - Somewhat cloud-provider specific
  - But parts can/should be specified



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Thank You

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