

Synchronizing the Super Bowl: A Look into Large-Scale Live Broadcast Synchronization



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Agenda

- Live remote broadcast size and scale.
- Are we still using legacy reference signals?
- Challenges specific to remote broadcast.
- How do we solve some of these problems?



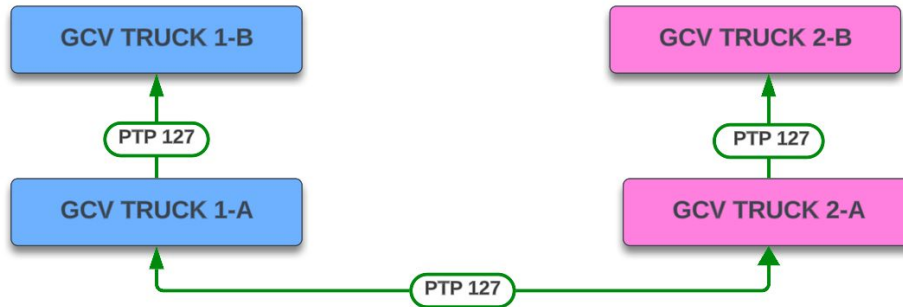
Small-Scale OB Reference Distribution

SMPTE 2110 OB

- PTP handles all reference needs between OBs.

Requirements

- Same PTP domain.
- Coordinated PTP profile.



In-band distribution

- 2110 high bandwidth media links also transport PTP over 100g interfaces.
- Every network switch runs as a boundary clock.



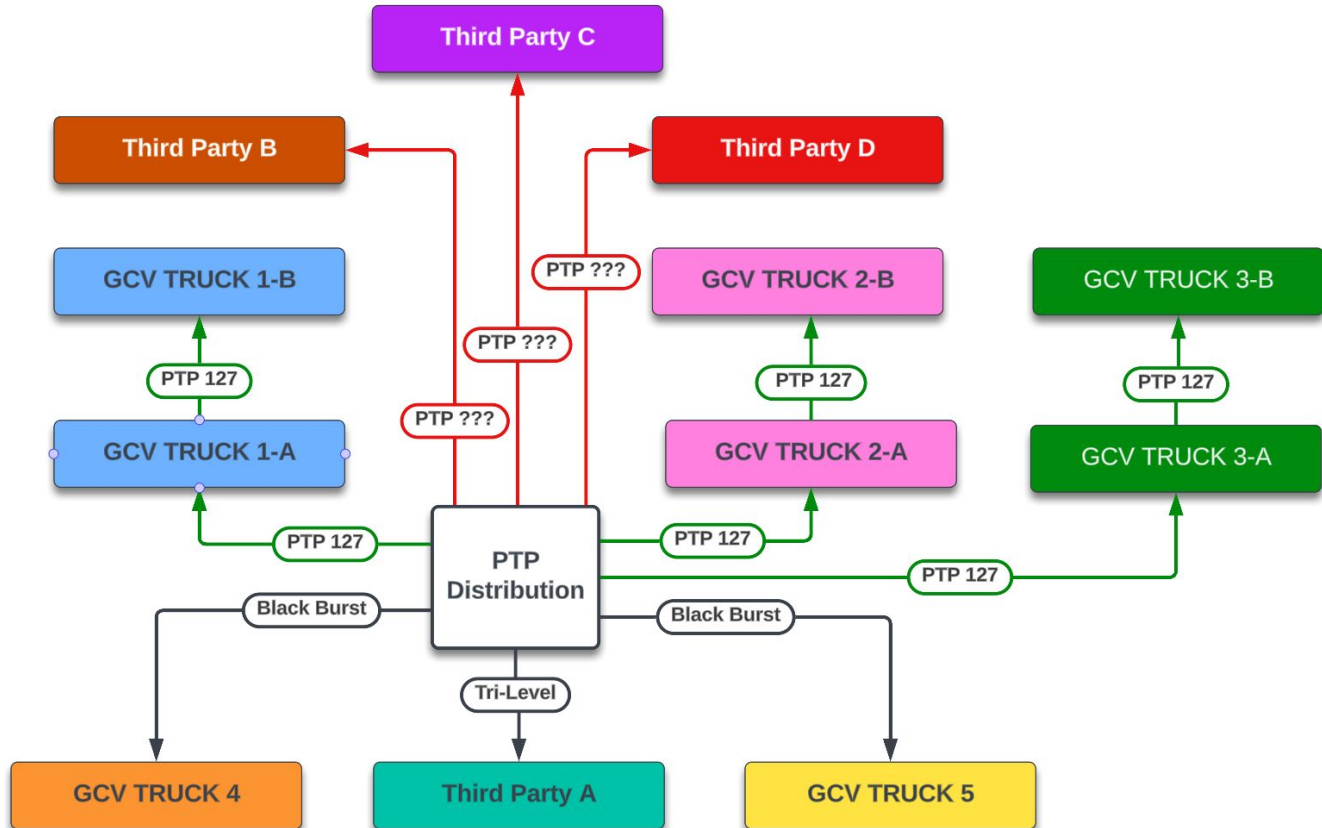
Large-Scale OB Reference Distribution

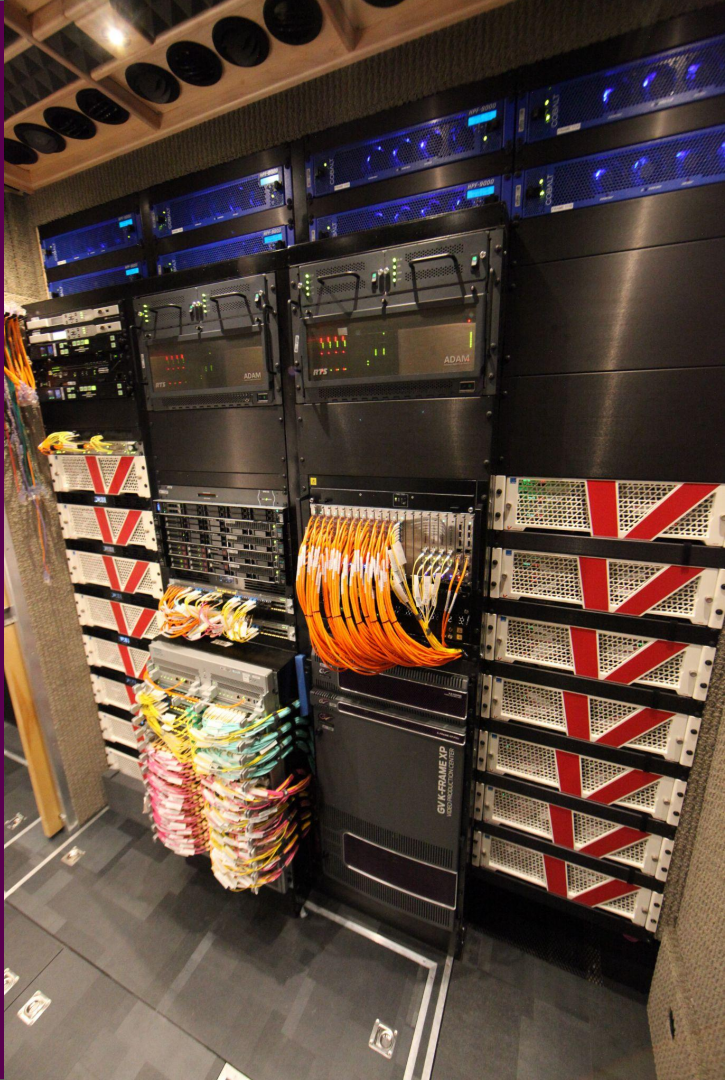
Hybrid OB

- PTP handles top level reference needs.
- PTP to baseband GM for legacy needs.

Challenges

- PTP domain mismatch.
- Deterministic failover.
- Unknown and hard to control variables from other vendors.





Systems Requiring Synchronization

PTP

- 2110-20 cameras, vision mixer, replay servers
- 2110-30 mixing board, audio processing
- 2110-40 closed captioning
- Intercom systems

Timecode

- Video editing servers
- Audio editing servers
- TOD clocks

NTP

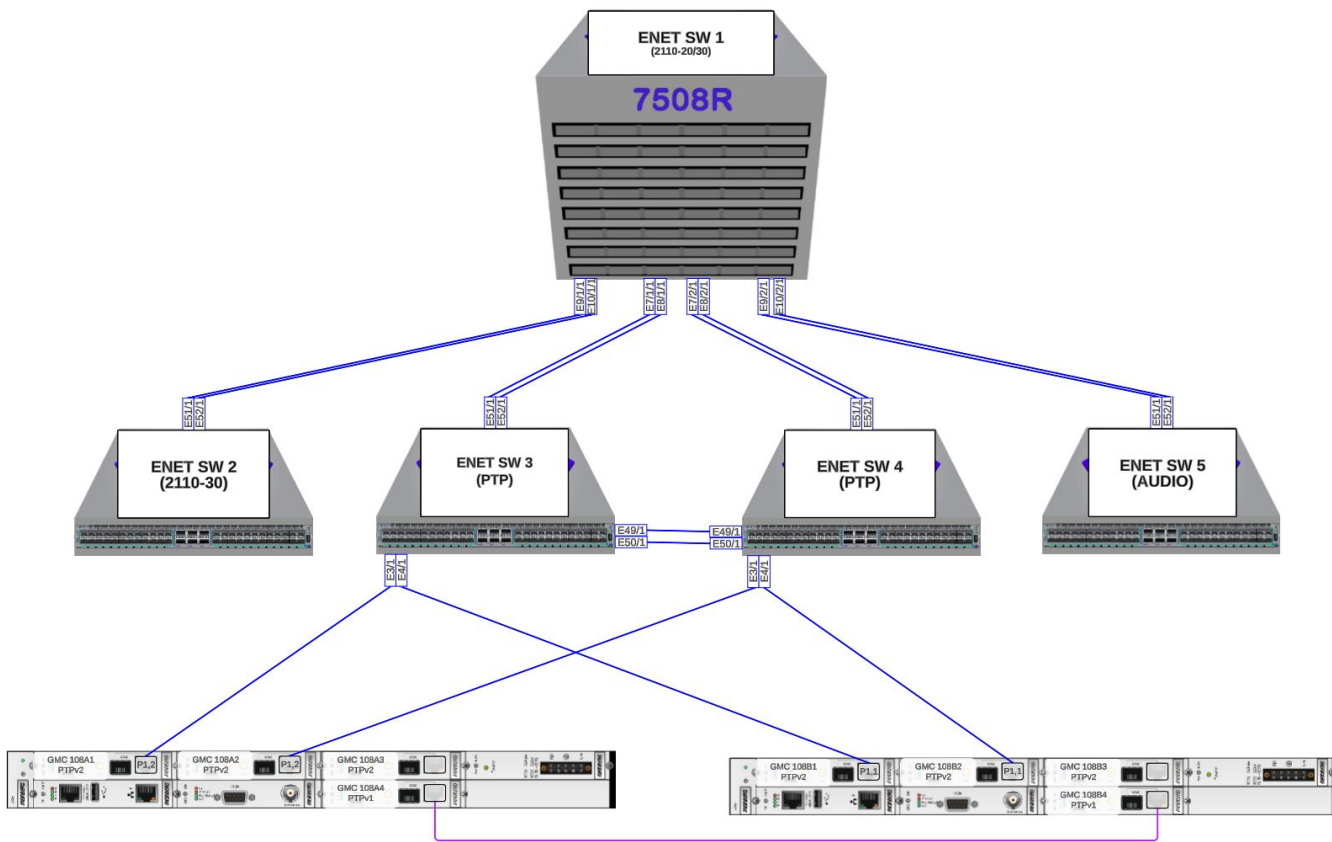
- Active-active control system servers
- Network switches

Black Burst / TLS

- SDI broadcast equipment



Basic OB 2110 Network Topology



Monolithic Spine

- High bandwidth 2110-20, -30 and -40.
- PTP boundary clock.
- Not 2022-7 redundant.

PTP Leafs

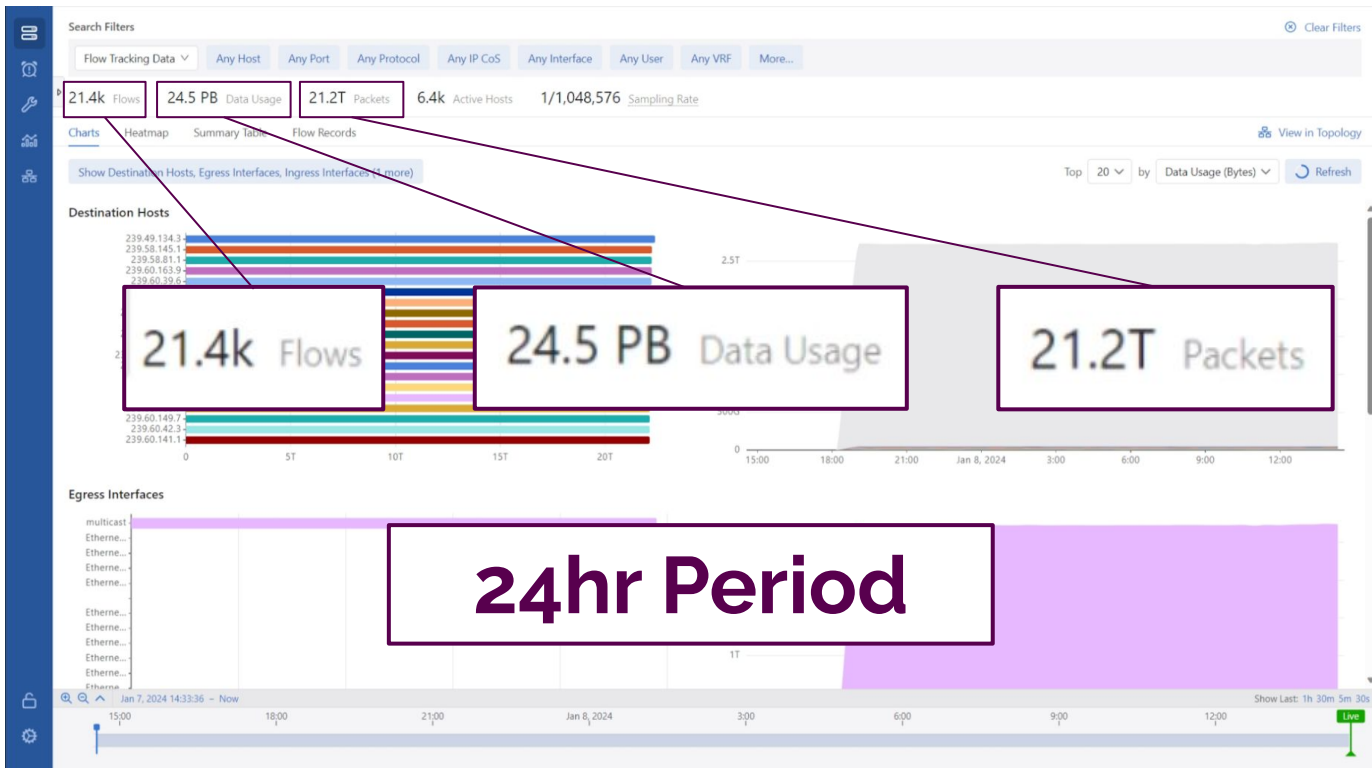
- PTP boundary clock.
- Layer 3 adjacent.
- Out-of-band PTP and downlink to spine for in-band PTP.

Grand Masters

- Network link for inter-frame synchronization.



How Much Data Are We Synchronizing?



- One OB (24hr)
- 21.4 thousand IP flow
- 24.5 petabytes of bandwidth
- 21.2 trillion packets

2024 College Football Championships

- (5) 2110 OBs

2024 Super Bowl

- (11) 2110 OBs

2024 Masters

- (17) 2110 OBs





Old Habits Die Hard (and new habits are expensive)

- OBs need to support **dynamic workflows** (3rd party and vendor equipment integration on a per-day basis).
- A lot of transient broadcast equipment is still SDI driven and **requires legacy reference**.
- **SDI** equipment is still **faster** to integrate and operate.
- 2110 migration is often **expensive and complicated**.





One OB Companies Make-up In 2024

- 59 OB facilities (single or multi-truck systems)
- 17 2110 PTP reference facilities
- 42 SDI legacy referenced facilities
- Last legacy system was built in **2019**



What Challenges Does OB Reference Face?

- Often parking and powering underground with **no GPS access**.
- Often powering with **no internet access** or ability to lock system time to some external reference.
- **No standards** between OB provider deployments.
- Operational staff has rudimentary knowledge of IP networks and IP timing systems.
- **GPS jamming** and interference can cause reference interruptions.
- We have little control over a system that receives IP reference from us and how they may affect our network or PTP distribution system when they connect.



How Do We Overcome These Challenges?

- Offer independent **legacy and IP reference signals** in most widely requested transport medium.
 - 10g fiber, 1g fiber, 1g copper, BNC BB or TLS, fiber BB or TLS.
- Offer **firewalled** reference signals from a single oscillator.
 - Each system receives their own primary and redundant GM on a dedicated VLAN on a transparent clock network switch.
- Offer **independent PTP domains** on each GM to support whatever domain a system requires.
- Offer independent legacy reference each with independent format and timing adjustment control.
- Offer **independent PTP profiles** per mobile facility.



OB Reference Distribution Center

The PTP Palace

- Independant OCXO DHQ.
- 10 redundant, domain independent, PTP GMs.
- Redundant transparent clock switches.
- Redundant SPGs locked to PTP GMs with legacy distribution and ACO.
- Copper and fiber optic configurable interface speed PTP transport.
- Copper and fiber optic legacy reference transport.
- Legacy distribution amplifiers.
- PTP and legacy capable broadcast scope.
- PTP monitoring software with port mirror and packet capture capabilities.



Thank You



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