SMPTE 33TS: Time Label & Synchronization

Presentation to IEEE P1722

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SMPTE 33TS History & Organization

- **EBU/SMPTE Joint Task Force on Time & Synchronization**
  - First meeting held November 2007
    - New Time Label
    - New Synchronization Standard
  - Issued report and Request for Standardization in October 2009
- **SMPTE 33TS Technology Committee**
  - First meetings held December 2009
  - Current chairs: John Fletcher, BBC & Bob Edge, Bob Edge TV Consulting
  - 33TS-10: Time Label Working Group
    - Chair: Bob Edge, Bob Edge TV Consulting
  - 33TS-20: Synchronization Working Group
    - Chair: John Snow, Xilinx
  - Current membership = 175

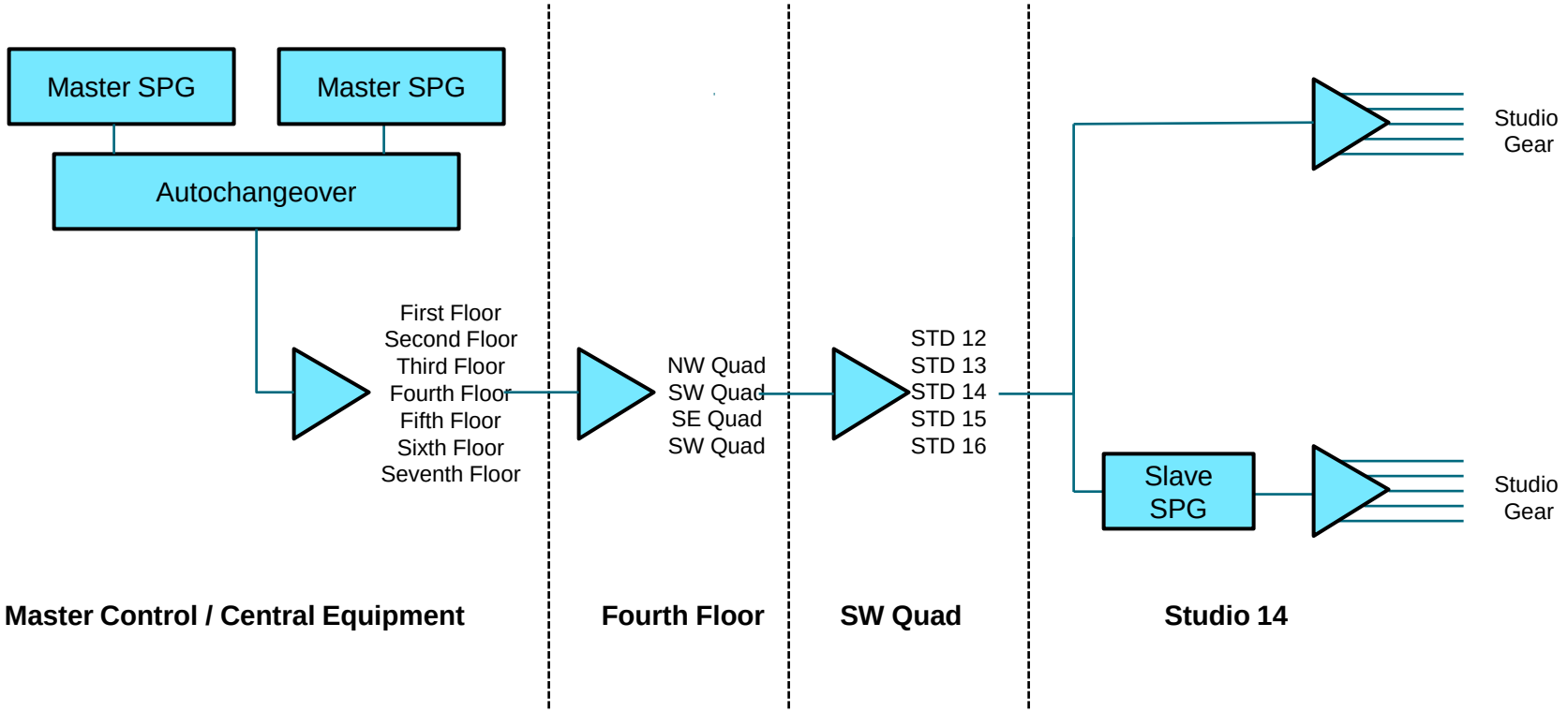
Why do we need synchronization?

- **Switching between signal sources without anomalies**
  - Switching between two cameras
  - Switching between live shot and recorded video or commercials
  - Audio frames may span multiple video frames
- **Mixing of signals**
  - Weatherman in front of weather graphics

How do we synchronize today?

- **Synchronization signals are distributed throughout the facility**
  - Color black
    - For phase alignment within about +/-100 video samples
  - SMPTE 12-1 timecode
    - For frame alignment
    - Distributed as LTC
  - Digital Audio Reference Signal (DARS)
    - Digital audio alignment
- **External asynchronous signals must be synchronized**
  - Frame synchronizers

Sync signal distribution



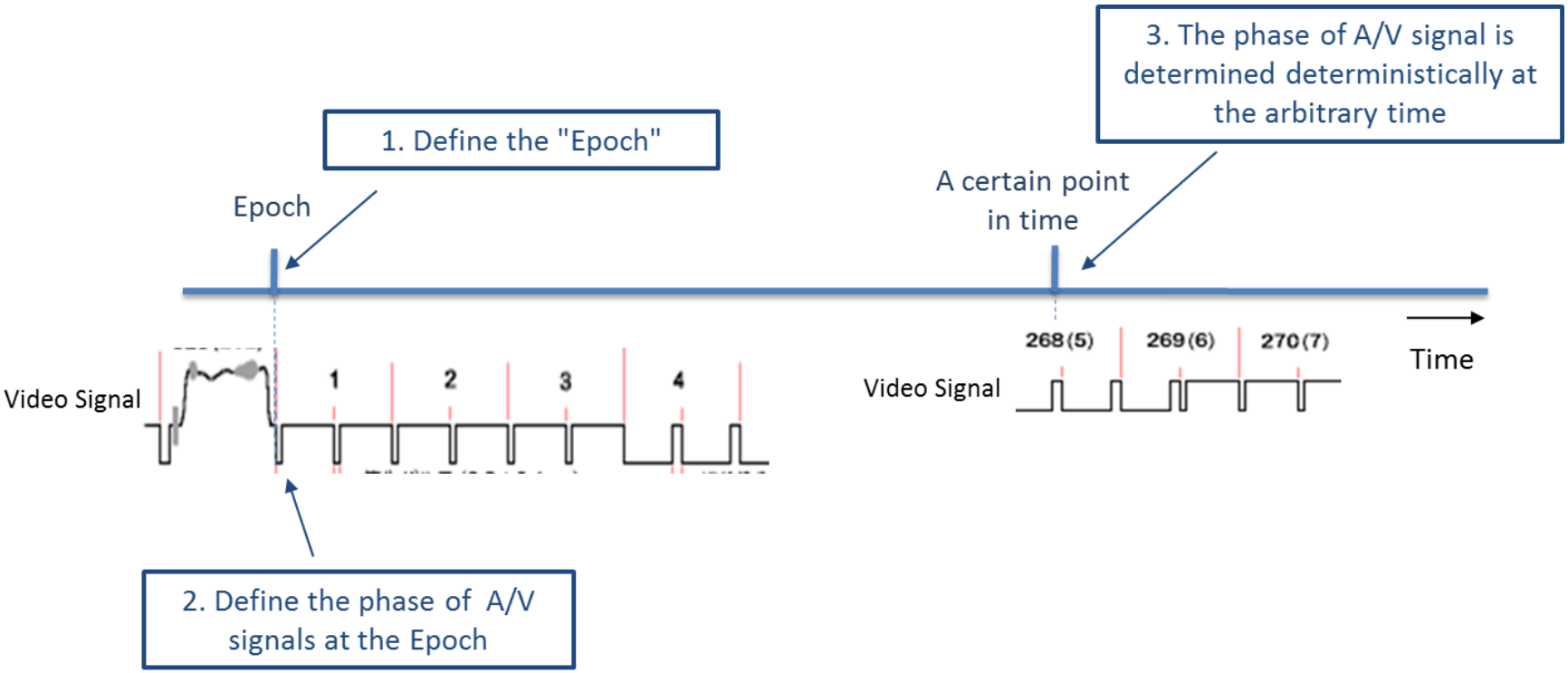
Why do we want a new sync standard?

- Color black is the last bit of analog in an otherwise digital studio
- 50+ year old technology
- Dedicated, wideband distribution network – distance limited
- Separate distribution networks required for color black, DARS, and timecode
- Based on difficult frequencies of 3.579545454… or 4.43361875MHz
- No defined synchronization between audio & video

New sync standard

- **Carried via standard packet switched networks**
- **IEEE 1588 PTP distributes time to all devices on the network**
- **SMPTE Epoch has been defined**
  - Phase of all video formats, audio formats, & ST 12-1 timecode is specified at the SMPTE Epoch
- **All signals have a fixed period**

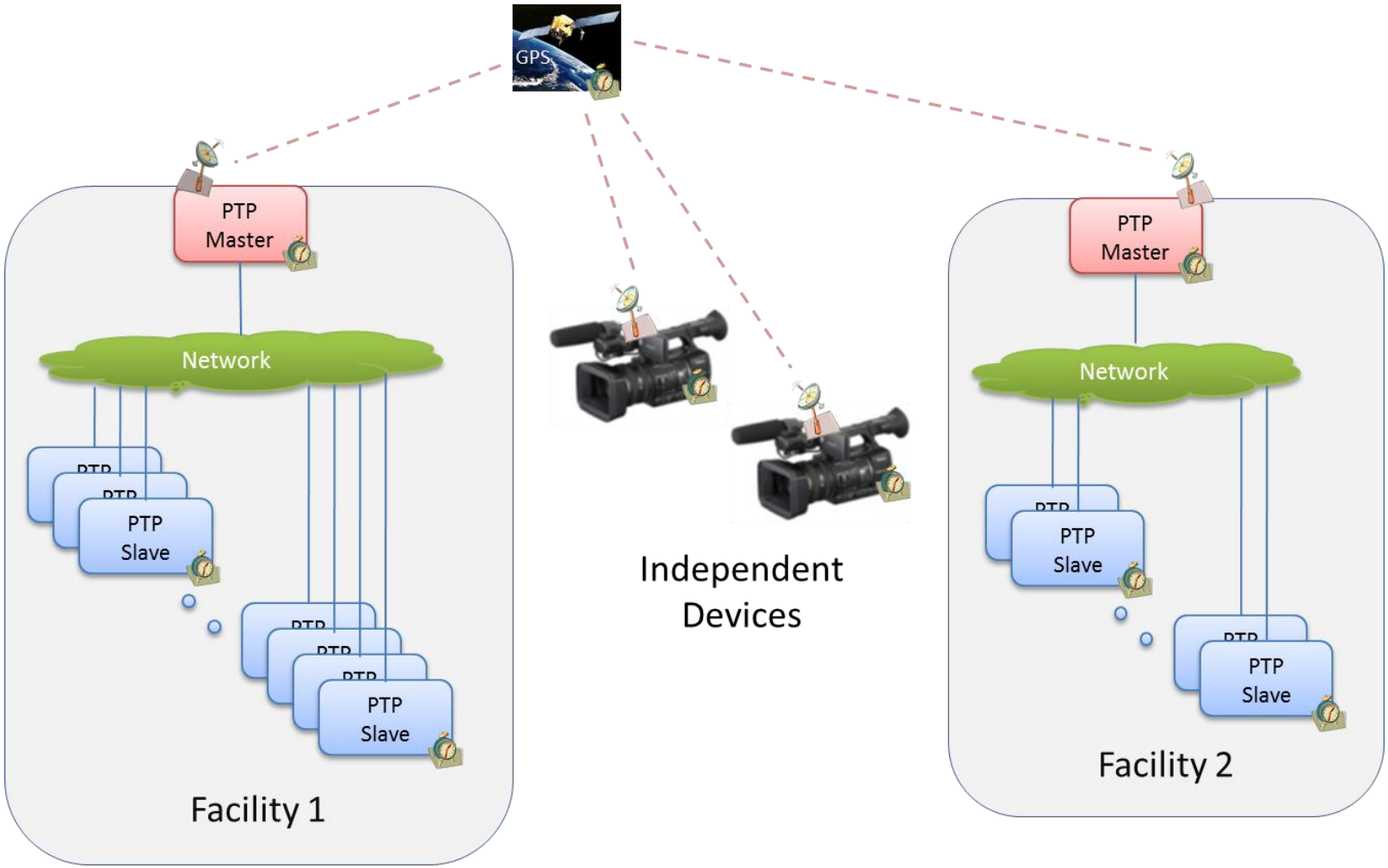
Signal generation from time



Advantages of New Sync Standard

- **Replacement of legacy sync signals & dedicated distribution networks with a modern networking technology**
  - Most broadcast devices already have one or more network interfaces
  - These are used for SNMP, control, data transfers…
- **Elimination of separate sync signals networks for audio, video, and timecode**
- **PTP is self tuning**
  - Don’t have to hand tune network delays
- **Synchronization of audio & video signals is defined**
- **Synchronization across longer distances**
  - Can we elimination need for some frame synchronizers?

Long distance synchronization



Why do we want a new time label standard?

- 35 years old
- Designed for linear audio tape track (bidirectional, self-framing)
- Does not nicely support > 30Hz rates
- Does not support time durations > 24 hours
- Does not support anything but simple non-varying rates
- Has been poked, prodded, amended, loaded, paged, etc. for 35 years and is overloaded and a mess
- Not a sound basis for a time-labeling system for the future

Advantages of new time label

- **A better Time Label to replace SMPTE 12-1 for most applications**
  - Higher frame rates
  - Time duration greater than 24 hours
  - Off-speed acquisition support
  - Maybe limited additional metadata (GPS position, etc)
- **Specify binary, human readable, and XML representations**
- **Reasonable integration with the IEEE 1588 sync standard**
- **Work with others on interface and file format bindings**

TV Time, Drop Frame, Daily Jam & Leap Seconds

- **In North America & Japan, timecode has discontinuities to minimize errors resulting from the ~59.94 Hz frame rates**
  - SMPTE ST 12-1: “To minimize the NTSC time deviation from real time, the first two frame numbers (00 and 01) shall be omitted from the count at the start of each minute except minutes 00, 10, 20, 30, 40, and 50.”
  - Once a day facilities “jam” the timecodes to minimize the remaining error
- **Drop frame and daily jam do not go away with new standards**
  - They now become a distributed problem instead of a centralized one
- **Leap seconds occur at an inconvenient time in North America**
  - Delay mechanism is required
  - All devices need to factor leap second in signal generation calculations at the same instant in time

Current status

- **33TS-20 Sync**
  - Documents are now emerging from WG for review prior to ballot
- **33TS-10 Time Label**
  - Documents are being drafted, but are not yet ready for review

Technologies From IEEE and SMPTE

- **SMPTE 33TS provides the technology needed to build a IEEE 1588 sychronized broadcast facility that interoperates with existing TV technologies**
- **IEEE 1722/AVB/TSN provides the technologies to transport real-time audio, video and data on 802 networks**
- **We need to work together to succeed**

The future of synchronization

- **New sync standard is currently focused on replacing legacy sync signals but used with existing SDI infrastructure**
- **Mixed facilities (sync via color black and PTP) are a critical part of the transition plan**
- **Any SDI replacement must do more than simply transport media**
  - Switching & mixing without audio & video anomalies must be possible
  - Must not add large amounts of latency (must be << 1 frame)
- **What does it mean to synchronize cameras that use packet networks for media transport?**
  - Do we synchronize the shutter?
  - Or do we still synchronize the interface? And how?

Questions?