Timing in Broadcast and Finance

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Agenda

1. The need for packet timing in industry
2. Broadcast (media)
3. Finance

Every technical industry

- Timing is always needed in distributed control systems and/or communication systems
- Moving to datacom/telecom networks for cost reasons

Past

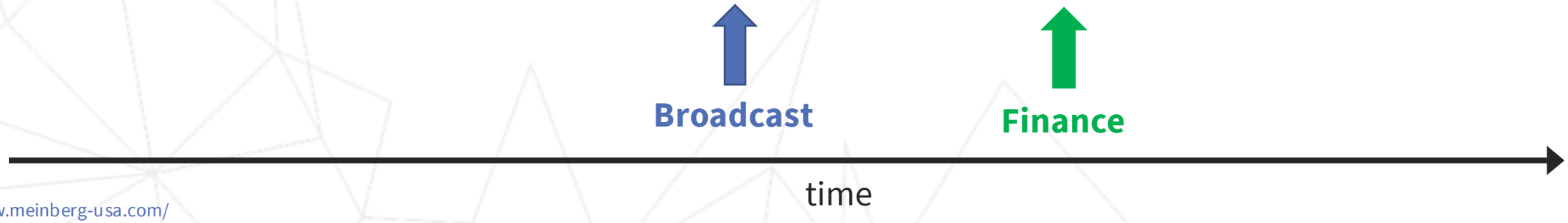
- Industry specific network technology
- Industry specific timing signals, usually in dedicated timing networks

Present

- Mixture of past and future
- Datacom networks with legacy timing signals

Future

- Ethernet, WIFI, IP, 5G
- NTP and PTP for timing
- Driven by cost



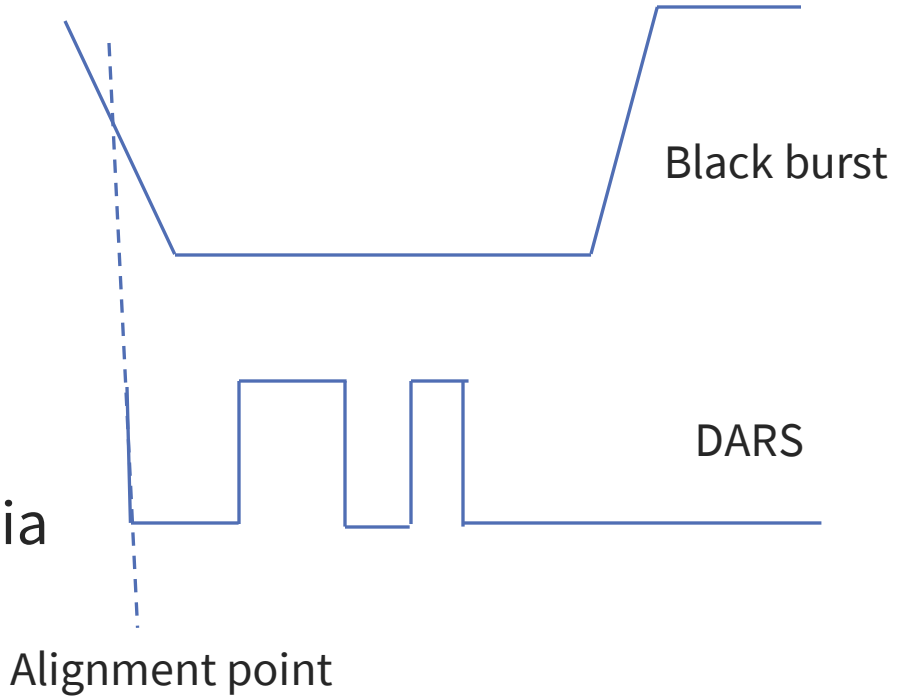
Why time is essential in Broadcast and Media

- Multiple audio and video files captured on separate equipment
  - Must be recombined for broadcast or steaming based on audio/visual file timestamps
  - Need smooth transitions among cameras, playback devices and other audio-visual sources
  - Color accuracy
  - Prevent jitter and artifacts
- Timing requirements
  - For video and mono audio: ~10 ms
  - For stereo audio: ~10 μs
  - Error budgeted to network time distribution is typically 1 μs.

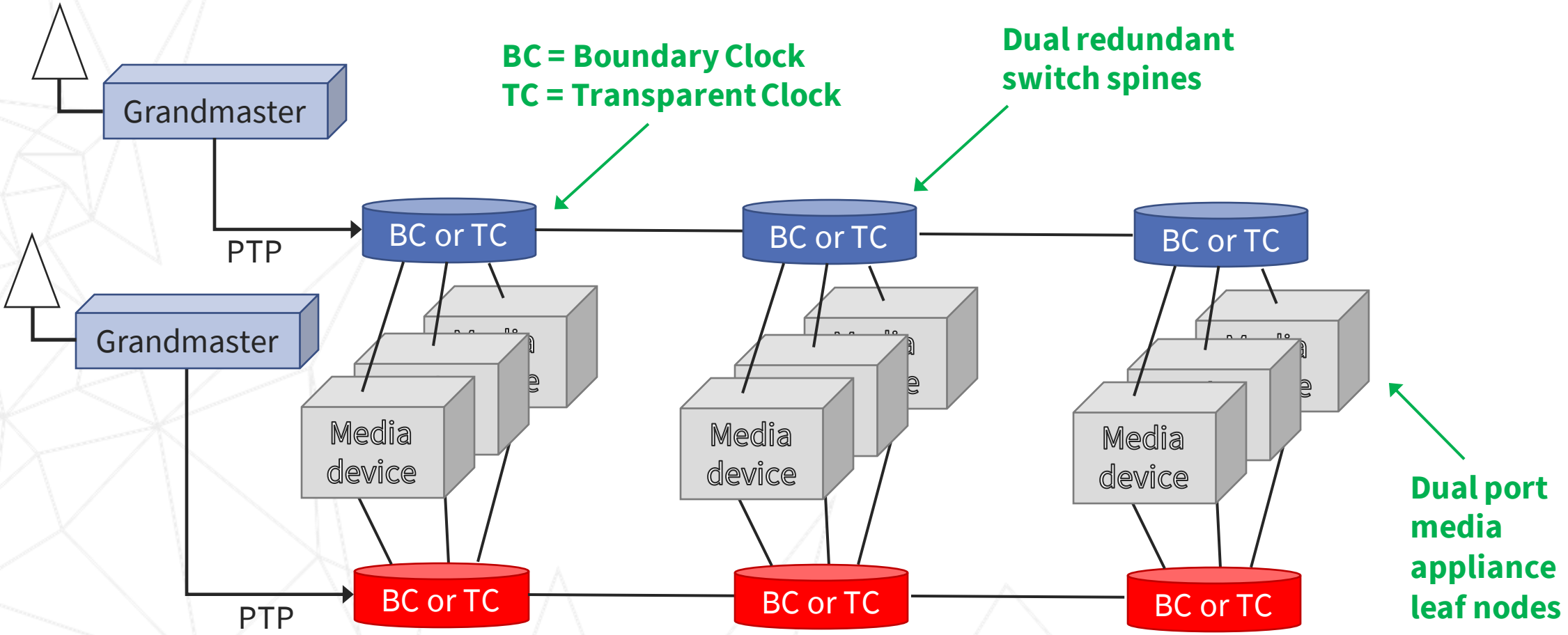
NBC Nightly News. Photo by Jeff Maurone

Legacy Broadcast timing signals

- Video signals
  - Black burst
  - Tri-level sync
- Audio signals
  - Word clock
  - Digital Audio Reference Signal (DARS)
- Linear time code
  - Used to insert timestamps in captured media



Redundant IP Networks



PTP for Broadcast and Media

PTP profiles for broadcast and media:

- SMPTE 2059-2
- Audio Engineering Society AES67
- L3, E2E, Multicast

Management message sent by ports in the Leader state

- Master locking status
- Default video frame rate
- Local time zone info
- Previous and next jam sync

Flags

- Drop frame enabled
- Color frame in use
- Daylight savings time in effect
- Leap second pending

IT in Finance Industry

- Enterprise IT technical viewpoint
  - IETF is where standards come from
  - Comfortable with non-standard approaches (Especially HFT firms)
- Regulatory compliance is mission critical
- Need time at software layer in standard hardware
  - PCIe cards
  - Software slaves/clients

Timing Requirements in Finance

- To trade in the United States (Consolidated Audit Trail)
  - Financial transactions need to be timestamped to 50 ms by traders
  - 100 µs by exchanges
  - To UTC:NIST
- To trade in the Europe (MiFID II)
  - Financial transactions need to be timestamped to 100 µs
  - To UTC
  - Most trading firms do business all over the world, so they will need to meet the strictest time accuracy for
- HFT
  - 50 ns – 500 ns
  - To measure network performance, not for regulation

Image from QuoteInspector.com

MiFID II

- Timestamp accuracy (100 µs)
  - Allows government regulators to identify illegal trading activity
  - Standard NTP software can barely meet this with a local timeserver
  - PTP or Specialized NTP preferred
- Archive data
  - Need to prove compliance on past dates
  - Government audits
- Measurements
  - Desire to prove timing accuracy of slaves/clients

Timing Protocols in Finance

- Default Profile PTP
- Enterprise Profile PTP
  - Draft RFC in IETF
  - Mixed multicast/unicast operation (hybrid mode)
- Specialized NTP
  - High message rates
  - Lucky packet filters
  - Hardware timestamping

Thank you for your attention

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