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# Robust Synchronization with IEEE 802.1ASbt

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# Recap:
# Use Cases for Redundant GM (Cold- & Hot-Standby)

Reference:
( http://www.ieee802.org/1/files/public/docs2013/ASbt-Spada-Kim-Fault-tolerant-grand-master-proposal-0513-v1.pdf )

## Uses Cases

- **Backup GM is synchronized to primary GM**
  - Only primary GM is transmitting Sync messages  (one sync tree)
  - Primary and backup GM are transmitting Sync messages - second sync tree
  - $\Rightarrow$ **Method to synchronize working clock (local time) or universal time**

- **GM synchronized to common clock source e.g. GPS**
  - Only primary GM is transmitting Sync messages  (one sync tree)
  - Primary and backup GM are transmitting Sync messages simultaneously - second sync tree
  - $\Rightarrow$ **Method to synchronize universal time**

- **Redundant GM are synchronizing each other**
  - Redundant GM are synchronizing each other – *separate sync tree and sync message?*
  - Only one GM is transmitting Sync messages
  - Redundant GM are transmitting Sync messages simultaneously
  - **=> A method to synchronize working clock (local time)**

# Proposal to distribute GM Information and Selection of Redundant GM

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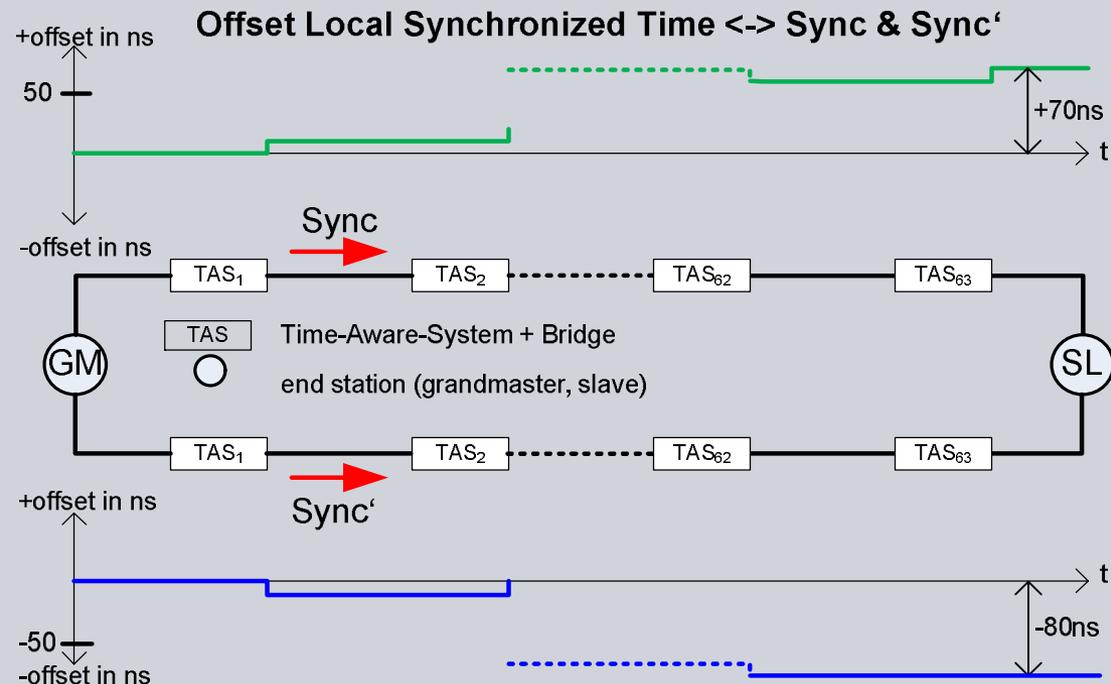## How to distribute GM information for GM selection (plug & play)?

**(1) ISIS is used to distribute form <u>all</u> grandmaster capable time aware systems the GM information in the network**

- Each time aware system can calculate with an <u>extended BMCA</u> the best GM's (e.g. primary & secondary)
( http://www.ieee802.org/1/files/public/docs2013/asbt-goetz-HighAvailableSync-0319-v02.pdf )

**(2) P2P Announce message is used to distribute aggregated GM information form the <u>best</u> grandmaster capable time aware system in the network**

- Each time aware system can calculate with an <u>extended BMCA</u> best GM's
- Announce messages carries the information of the best GM's (e.g. primary & secondary)
- The mechanism distributing aggregated GM information with the Announce messages is comparable to the mechanism described by ISIS

**Reasons for offset error when Sync message is forwarded over disjoint sync path simultaneously (network reconfiguration, grandmaster change):**

- Inaccurate path delay measurement

  - Asymmetry (PHY, cable)

  - Inaccurate response delay (frequency offset)

- Inaccurate sync residence time measurement (frequency offset)

⇒ Huge number of hop count amplifies these problem



Offset Local Synchronized Time <-> Sync & Sync'

+offset in ns

50

-offset in ns

Sync

TAS₁  TAS₂  TAS₆₂  TAS₆₃

GM

TAS

Time-Aware-System + Bridge

end station (grandmaster, slave)

SL

TAS₁  TAS₂  TAS₆₂  TAS₆₃

Sync'

+offset in ns

-50

-offset in ns

+70ns

-80ns

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## Redundant Sync Paths for Robust Synchronization

**Redundant Sync Paths for Sync messages**

**(1) Primary and backup GM are transmitting their Sync messages simultaneously over two independent sync trees**

- Redundant sync trees
    - Extended BMCA (primary and backup GM) is used to establish sync tree
    - Reconfiguration of each sync tree is independent
    - no guarantee for disjoint path
      => no guarantee to handle single point of link failure
    - Sync path change can cause unpredictable inaccuracy

**(2) GM is transmitting or GM's are transmitting redundant Sync messages simultaneously over most disjoint path**

Most disjoint redundant path for sync message

- **To handle single link failure**
    - **No reconfiguration time**
    - **Offset error between sync messages transmitted over redundant path becomes predictable (receiving redundant sync messages simultaneously over most disjoint path)**
- Topology information and routing algorithm are required to find most disjoint path
  **=> ISIS-SPB-PCR ?**

# THANK YOU for you attention!

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# Questions?