How Long to Propagate Synchronized Time Through a Network?
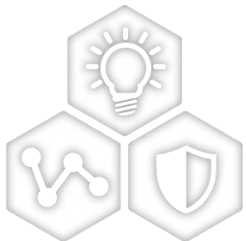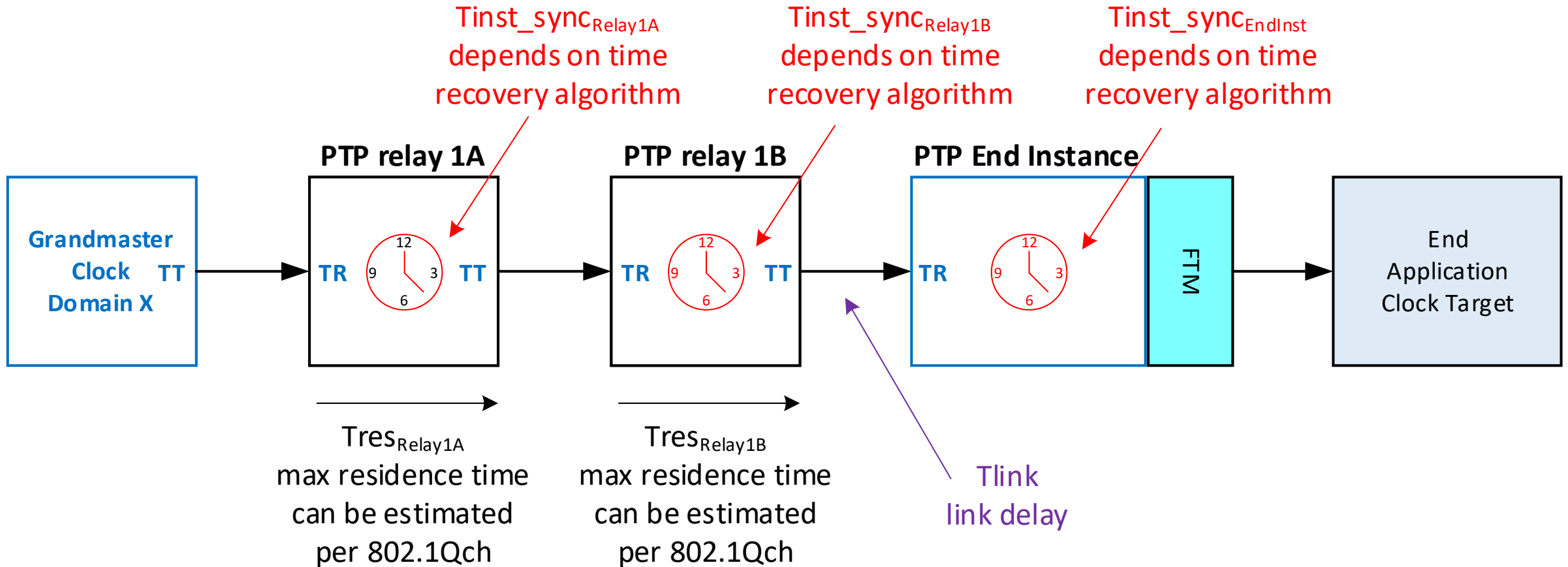
A Leading Provider of Smart, Connected and Secure Embedded Control Solutions

Richard Tse

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Propagation of Synchronized Time Through a Network

Tinst_sync$_{Relay1A}$ depends on time recovery algorithm

Tinst_sync$_{Relay1B}$ depends on time recovery algorithm

Tinst_sync$_{EndInst}$ depends on time recovery algorithm

PTP relay 1A

PTP relay 1B

PTP End Instance

Grandmaster Clock Domain X **TT**

TR **TT**

TR **TT**

TR

FTM

End Application Clock Target

Tres$_{Relay1A}$ max residence time can be estimated per 802.1Qch

Tres$_{Relay1B}$ max residence time can be estimated per 802.1Qch

Tlink link delay

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Propagation of Synchronized Time Through a Network

- **Components:**
  - Link delays (Tlink)
  - Time to send a Sync message through each Relay instance (Tres):
    - 802.1Qch cyclic-queuing and forwarding mechanism could be used to determine the maximum residence time per Relay Instance
  - Time for each PTP instance to synchronize (Tinst_sync):
    - If low-pass filtering is not used in time recovery algorithm:
      - Tinst_sync can be small (time for a few Sync messages and a few Pdelay message exchanges)
    - If low-pass filtering is used in time recovery algorithm:
      - Tinst_sync depends on the filter's time constant
    - What effect does the ppm offset of local oscillators have?
      - Affects initial magnitude of error in rateRatio value

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Propagation of Synchronized Time Through a Network

- **Result:**
  - Time to propagate Sync through a network of PTP Instances (Tsync):
    - Is the result a linear sum of the components?

$$Tsync = \sum Tlink + \sum Tres + \sum Tinst\_sync$$

    - Or would all PTP instances converge simultaneously?

$$Tsync = \sum Tlink + \sum Tres + MAX(Tinst\_sync)$$

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