Synchronization Redundancy Management for IEEE 802.1ASbt

IEEE 802 Plenary, Beijing, China, Mar/2014

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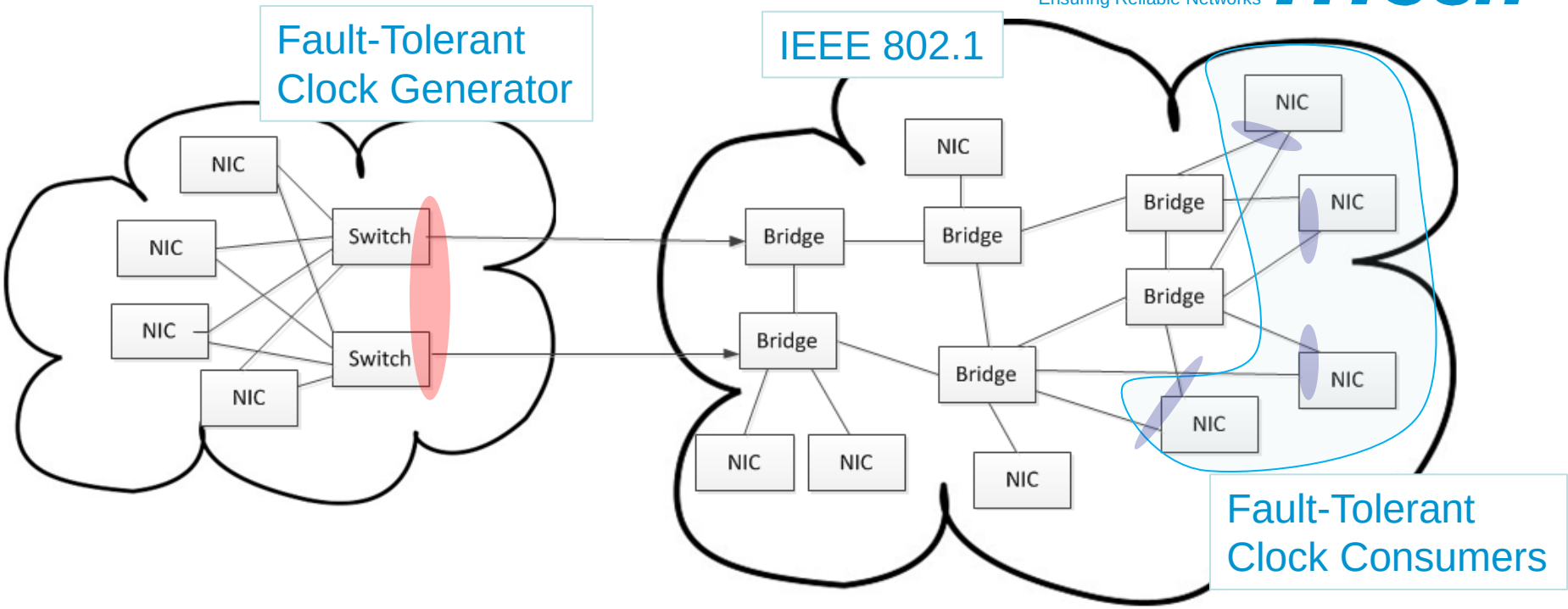
Interface Design



"Architecture Design is Interface Design" [Kopetz]

Red Interface specifies the behavior of the FT Clock Generator *as observed by the connecting bridges of the IEEE 802.1 network*.

Internal behavior of the FT Clock Generator may (and most likely will) *be much more complex* than as observed at the interface.

Blue Interface specifies the behavior of the FT Clock Generator *as observed by the FT Clock Consumers.*

There is also a red interface in the 802.1ASbt Backup Master concept

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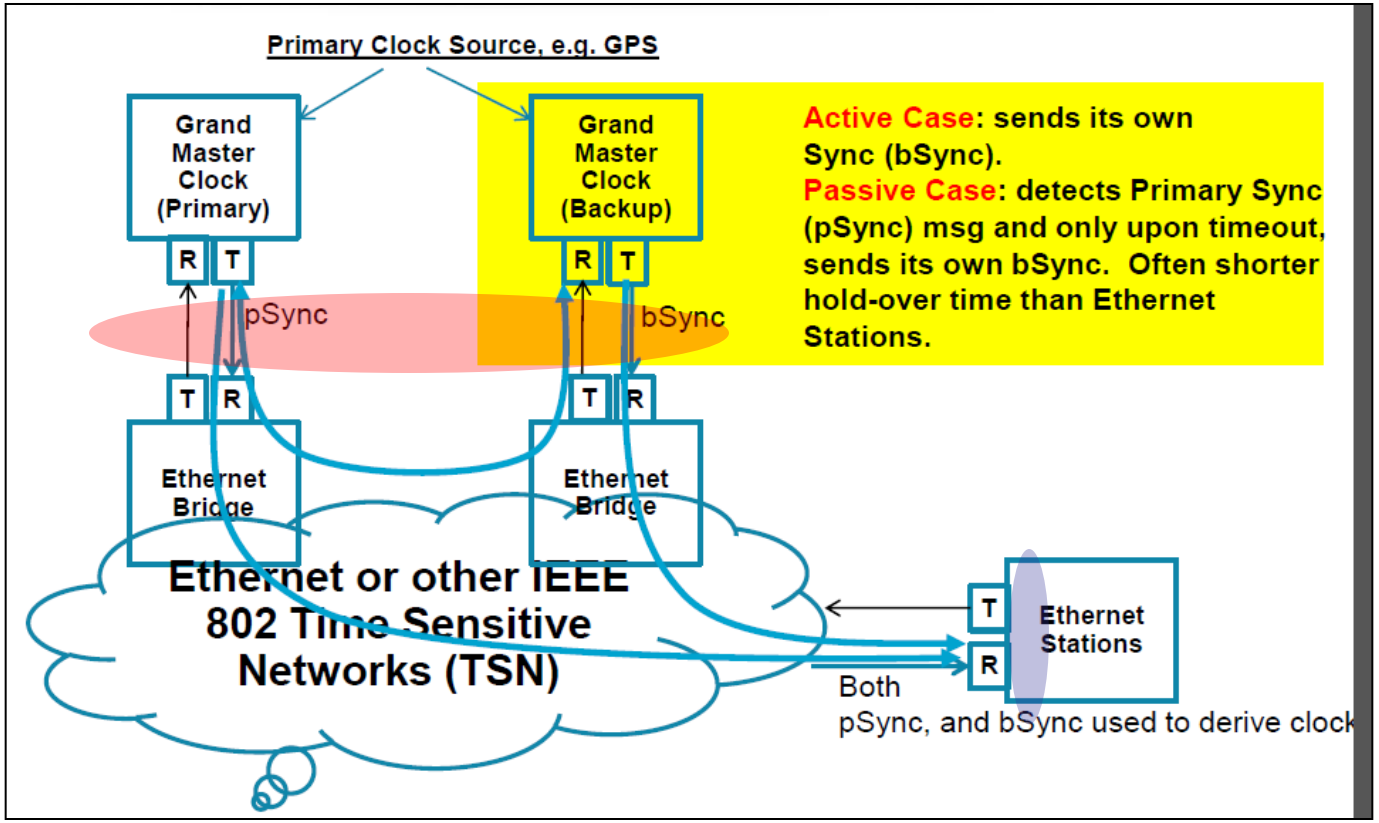
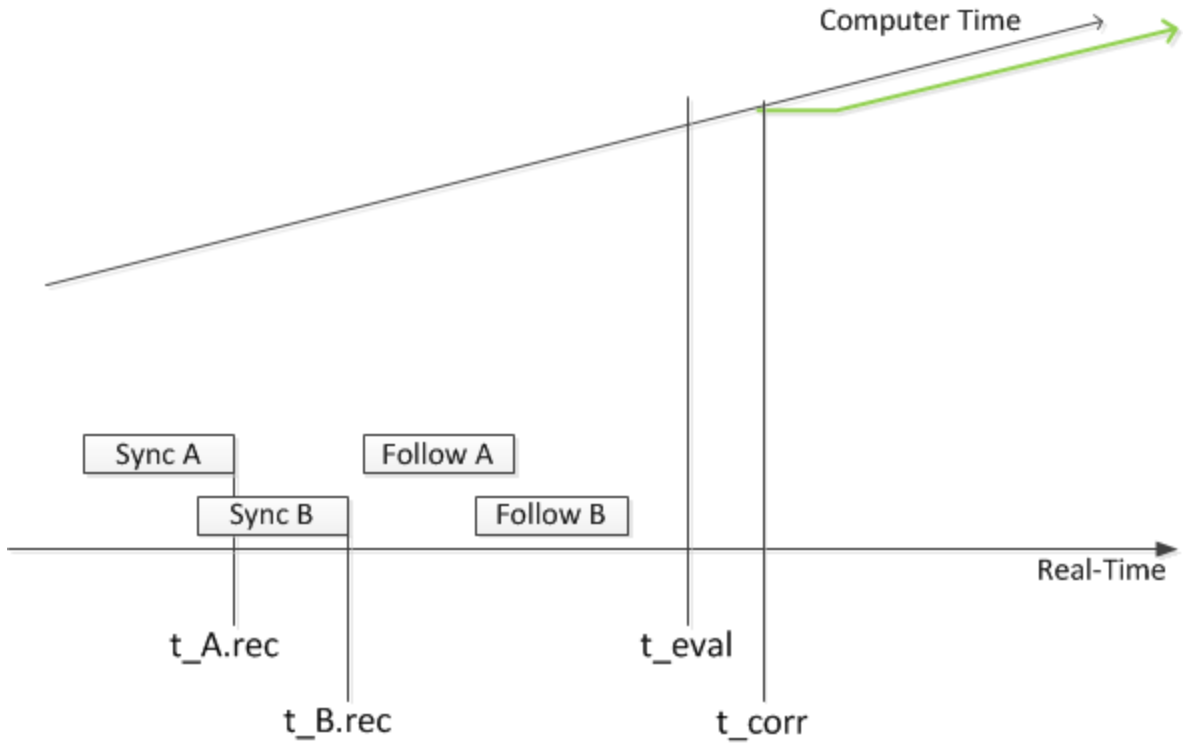


http://www.ieee802.org/1/files/public/docs2013/ASbt-Spada-Kim-Fault-tolerant-grand-master-proposal-0513-v1.pdf

Clock Correction in the Blue Interface



At t_eval the time information as represented by the two Grandmasters A and B is combined (e.g., by simple arithmetic average).

At t_corr the local “Computer Time” is corrected (or started to be corrected) for to bring the local time in agreement with the combined Grandmaster times.

Clock Synchronization Robustness Filters

SAE AS6802 – Protocol Control Frame Structure

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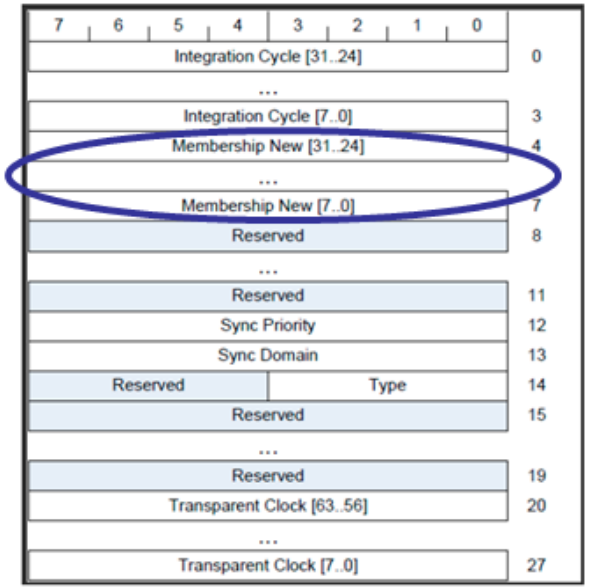
- "Membership New" field is filled by the Compression Master.
- One-to-one mapping between Synchronization Masters (the NICs) and bits in the field.
- Compression Master will set the bits from those NICs from which it received PCFs.

I am not advocating to add a field like this to the .1AS/1588 standards!

- This detailed information should be hidden by the red interface.
- A generic FT-quality field would make more sense (similar to a priority).



http://www.ieee802.org/1/files/public/docs2013/new-avb-wsteiner-8021ASbt-FT-QoS-1111-v01.pdf

Clock Synchronization Robustness Filters (cont.)

A generic field could be added to the Sync messages to describe the current Quality of Fault-Tolerance.

Such a field describes dynamically the current “health status” of the Fault-Tolerant Clock Generators.

In this respect it is similar to a priority (and could potentially be implemented as a dynamic priority).

Differences to .1CB

- Highly accurate reception time capturing ALL the redundant messages is essential.
- Typically the timing information of ALL redundant messages is used.
  - i.e., redundant copies are typically not dropped

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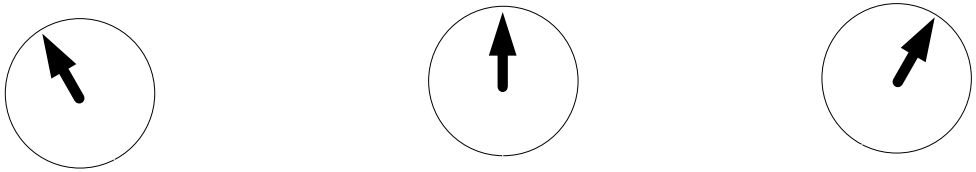
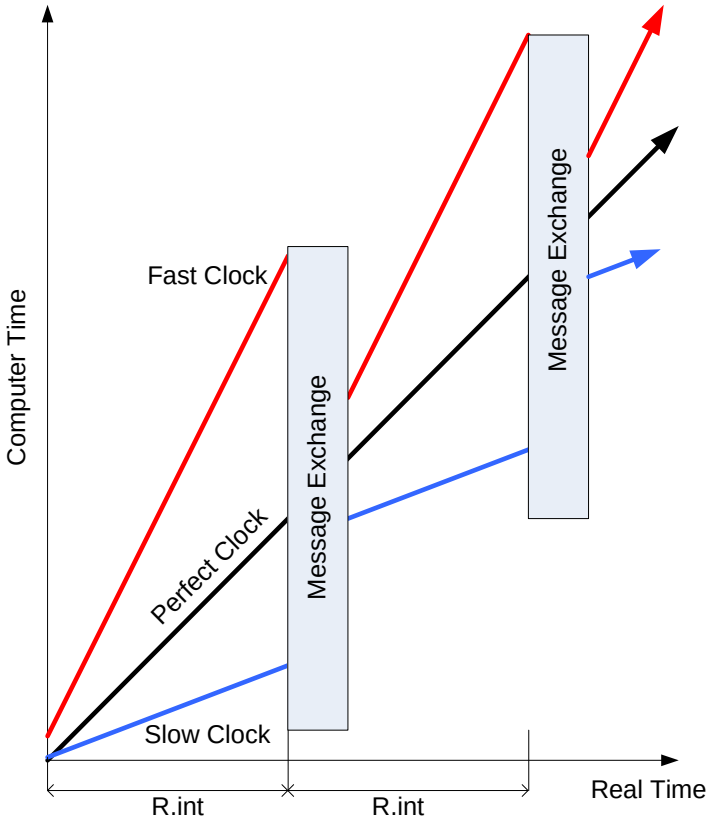
Quality of Clock Synchronization: Precision

In an ensemble of clocks, the [insert fancy name here] is defined as the maximum time difference between any two synchronized non-faulty clocks at any point in real time.



Late Clock Perfect Clock Early Clock

Synchronization Services



[Insert fancy name for Pi here]:

$$\forall t > t_0 : |C_p(t) - C_q(t)| < \Pi$$

Cp,q() … the computer time of the clocks p and q

t … any point in real time

"[Insert fancy name for Pi here] defines the maximum difference in computer time of any two clocks at any point in real time."