Redundancy experience used

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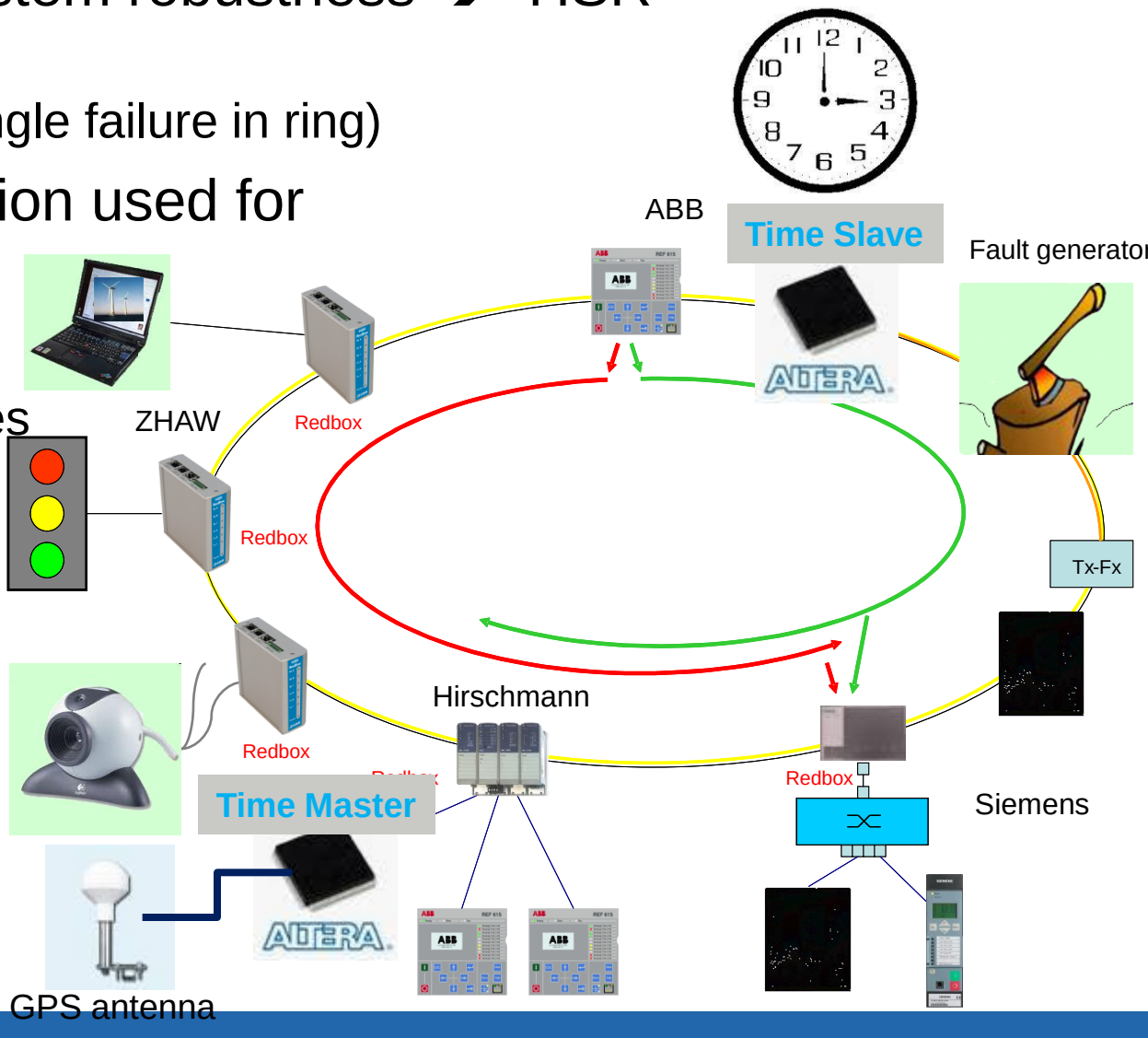
- Improvement of system robustness ➔ HSR
  - seamless redundancy
    (No stop in case of single failure in ring)
- Time synchronization used for
  - phase adjustment
  - protection functions
  - measurement variables

in Energy automation Demonstrated at Cigre 2010



Status Redundancy

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- Protocols defined in1588 & related Standards (e.g. C37.238)
  - Critical issue: follow up must be taken from same path
- But what is the impact on accuracy in case of an error?
  ➔control loops are designed for constant delivery of time
- Negative impact in case of an error
  - Longer period of time without sync
  - Significant Offset error
  - Frequency change in case of local Sync
  - Migration problems if time domains are merged

➔ Need **Robust Sync** not Redundancy

Sample Error cases

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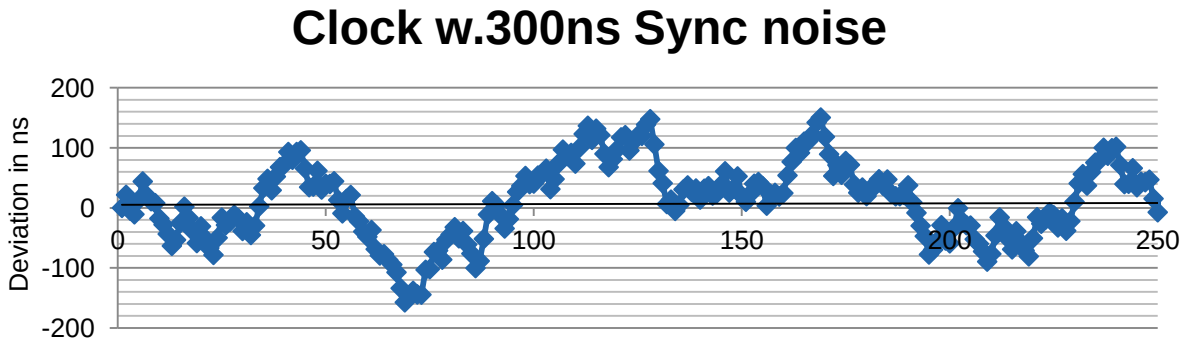
- Normal Flow

Error margin +/-150ns

50% of noise signal

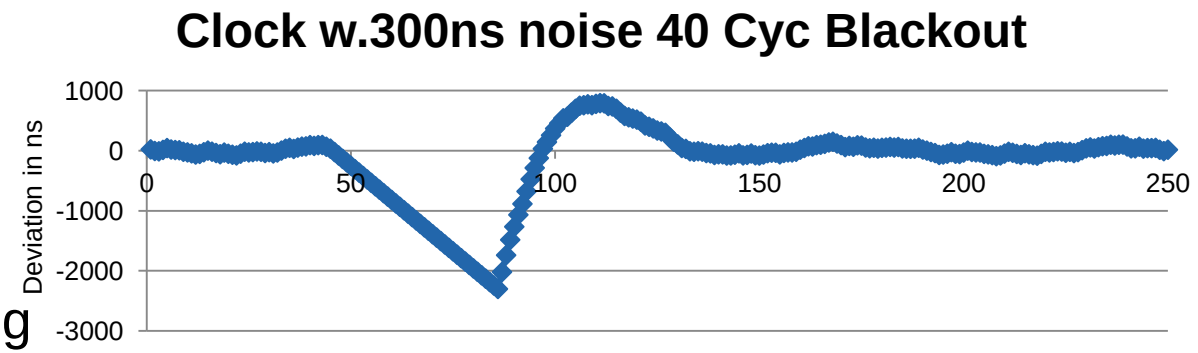


- Blackout 40sync

Error margin 2500ns

Disturbance for 70 cyc

Additional Correction required for Master xchg



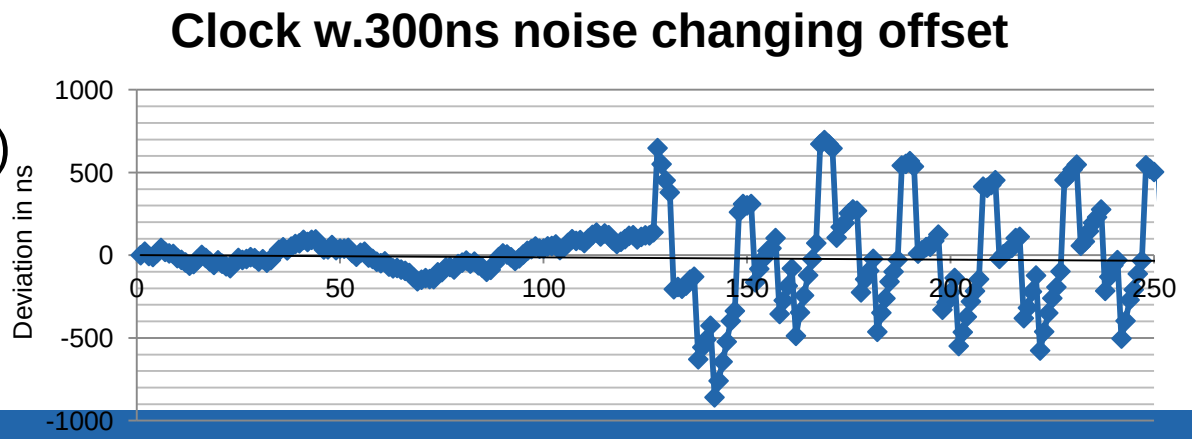
- Changing offset

500ns offset change(5 cyc)

Error margin 850ns

Disturbance for 70 cyc

4 times higher correction



Observation and further steps

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- Redundancy means less stability
- And more critical situations

- Improvements

➔ Seamless redundancy (shorter changeover)

➔ Adapted control loop in case of missing Sync

➔ Detection and handling of offset differences in redundant networks

Common setup for handling this errors needed