

In-Field RAS Testing

Overview and Problem Statement

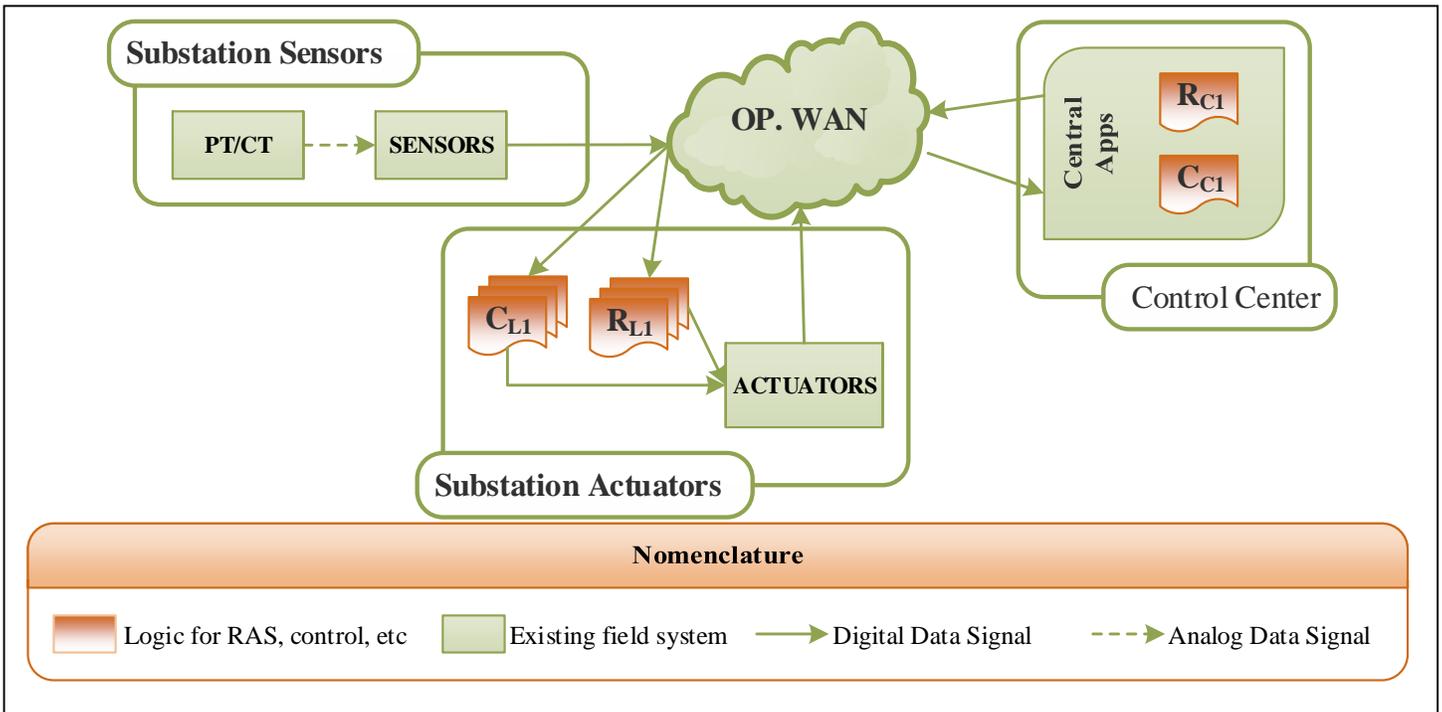
Power grids are increasingly stressed and are increasingly relying on Remedial Action Schemes (RAS), which are last-resort tripwire scheme that are a generalization of traditional protection schemes. RAS schemes involve 3 or more substations. RAS schemes are calibrated when first fielded. The question is, will they still work 10 or more years later when they are needed to prevent a large blackout? Sensor values drift and other things can change. We note that misconfiguration of protection schemes (including RAS) is the #1 cause of major blackouts, including the recent one in San Diego.

Research Objectives

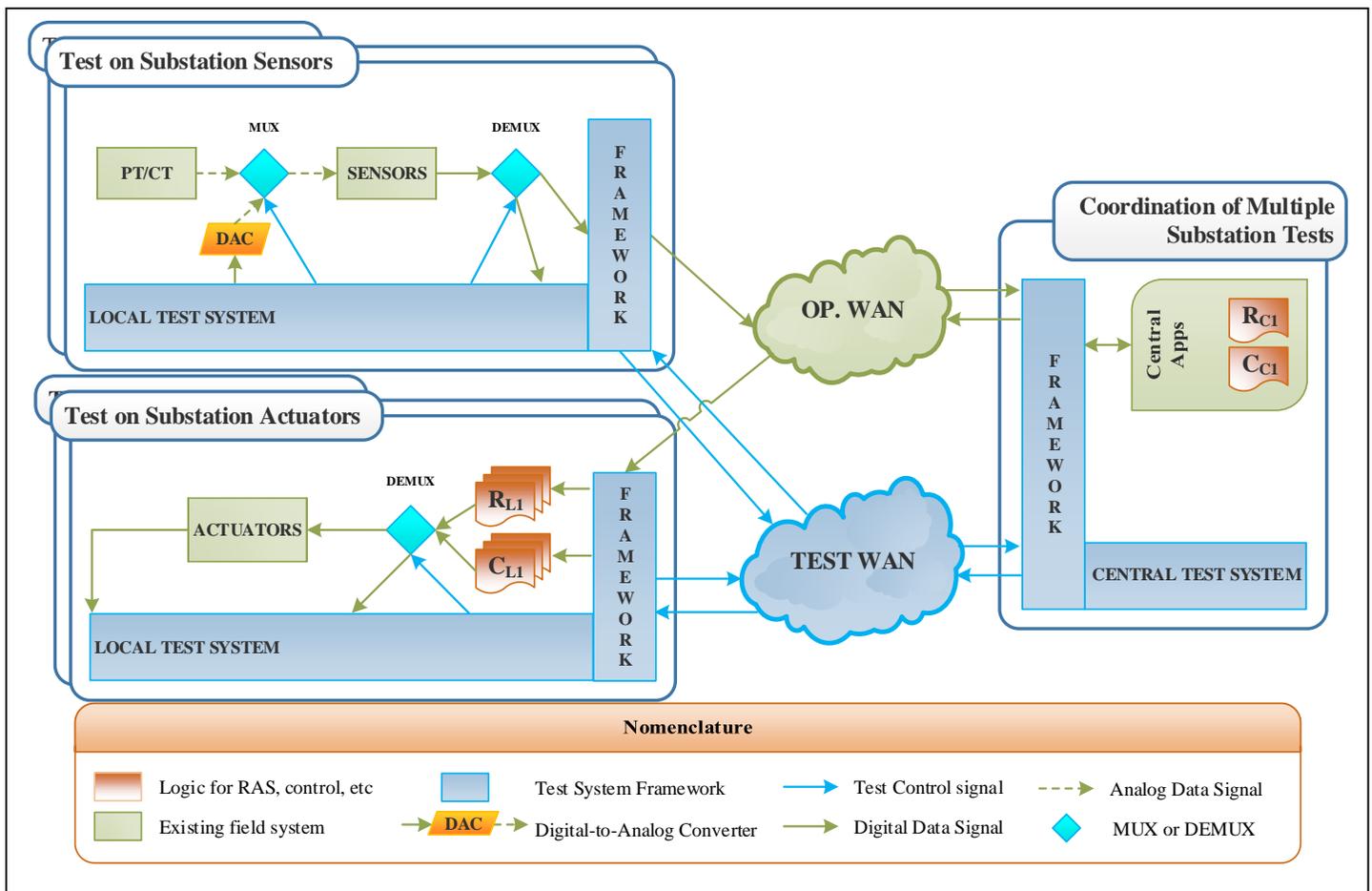
- Develop a middleware framework to test RAS schemes in the field.
- Extend the framework, Erkios, to have a more formal specification of the RAS scheme to analyze its temporal characteristics and eventually be able to find bugs in existing RAS schemes.
- Integrate actual relays into Erkios in a lab at Washington State University.
- Work with ARMOR PIs to investigate how Erkios' application-unaware testing mechanisms could be combined with ARMOR's application-aware software fault tolerance, and what benefits may accrue to the development and testing of future RAS schemes with such a system.
- Integrate Erkios into DETERLab to enable more control over timing and reliability of message delivery and node failures.

Technical Description and Solution Approach

A canonical RAS structure in the field:



The ErkiOS architecture. The MUX or DEMUX are there to enable signals to be injected rather than a PT/CT, for example:



Results and Benefits

- Higher grid reliability
- **Technology Readiness Level:** initial capability prototype

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