Resilient Information Architecture Platform for Smart Grid (RIAPS)

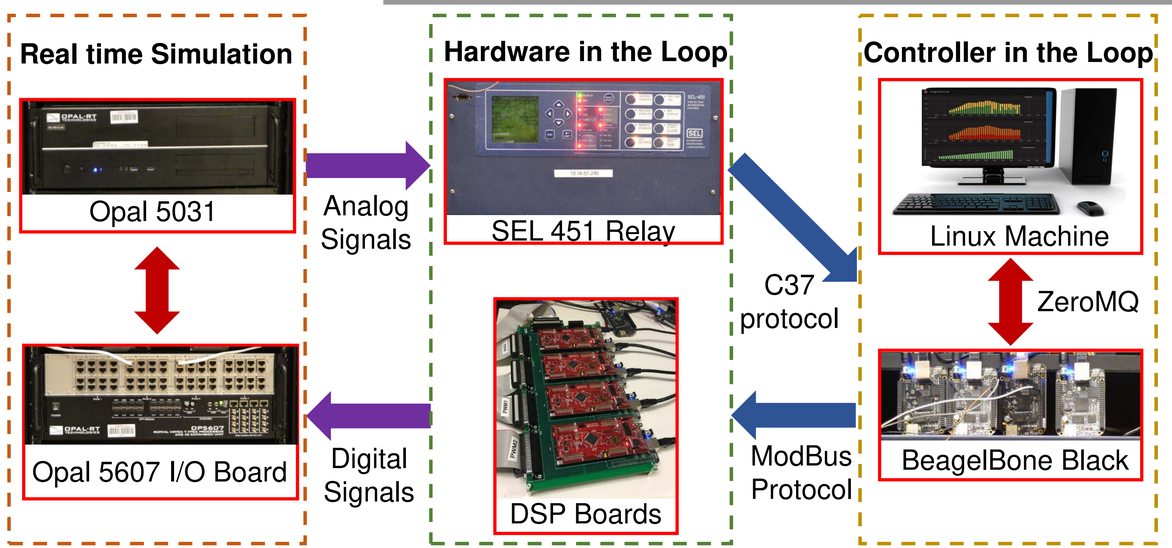
Yuhua Du, Hao Tu, Srdjan Lukic, David Lubkeman FREEDM Systems Center, North Carolina State University

Overview

Microgrids are ideally suited for distributed control solutions. However, challenges exist when realizing the developed distributed controller under hardware level:

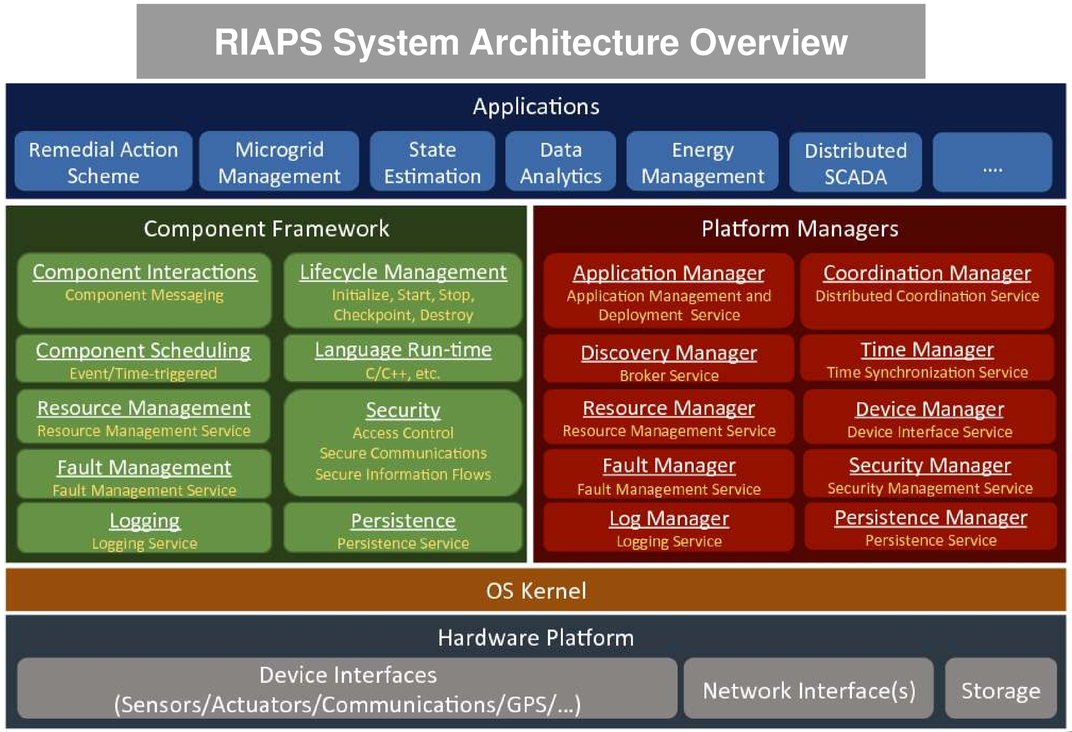
- ✓ Sufficient computational capability to support small iterative time step;
- ✓ Time synchronization management of concurrency among all the nodes
- ✓ Exchange information in a fast and accurate manner;
- ✓ Scalable controller and hardware implementation;
- ✓ Device interaction codes development VS Core control codes development;
- ✓ Communication failure tolerance

Microgrid Testbed in FREEDM Systems Center



1. **Opal-RT real time simulator**
   - Inverter switching model in FPGA solver
   - Power system model in CPU solver
2. **Texas Instruments F28377S MCU**
   - Inverter control using PWM signal
   - Modbus communication with Beaglebone Black
3. **SEL 451 Relay**
   - Providing real-world protection device response
   - Communication with Beaglebone Black using C37 protocol
4. **Beaglebone Black**
   - RIAPS node hardware carrier
   - Distributed control algorithm implementation
   - Communication with DSP via Modbus
5. **Linux machine**
   - Grafana Display

RIAPS System Architecture Overview



Infrastructure

RIAPS runs on a three-layer structure:

- An ***Application*** is a distributed control algorithm that is designed for a specific control goal and it is consist of ***Actors***;
- An ***Actor*** realizes an abstract function that is part of the designed algorithm like individual controller in each agent, it is consist of ***Components***;
- A ***Component*** is the building block of RIAPS and realizes the physical functions like measurement sensing or calculation.

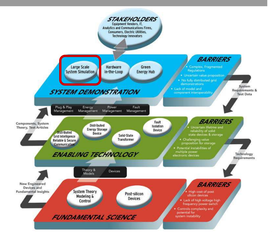
References

- https://riaps.isis.vanderbilt.edu/

Partners

VANDERBILT UNIVERSITY

arpa·e CHANGING WHAT'S POSSIBLE



Application Developments

- Improved energy/power management with adaptive distributed control;
- Stable control for islanded mode, grid synchronization, (un)intentional islanding;
- Voltage/frequency restoration upon re-synchronization;
- Virtual Impedance control for improved dynamic reactive power sharing;
- Utilizes distributed computation and decision making platform.