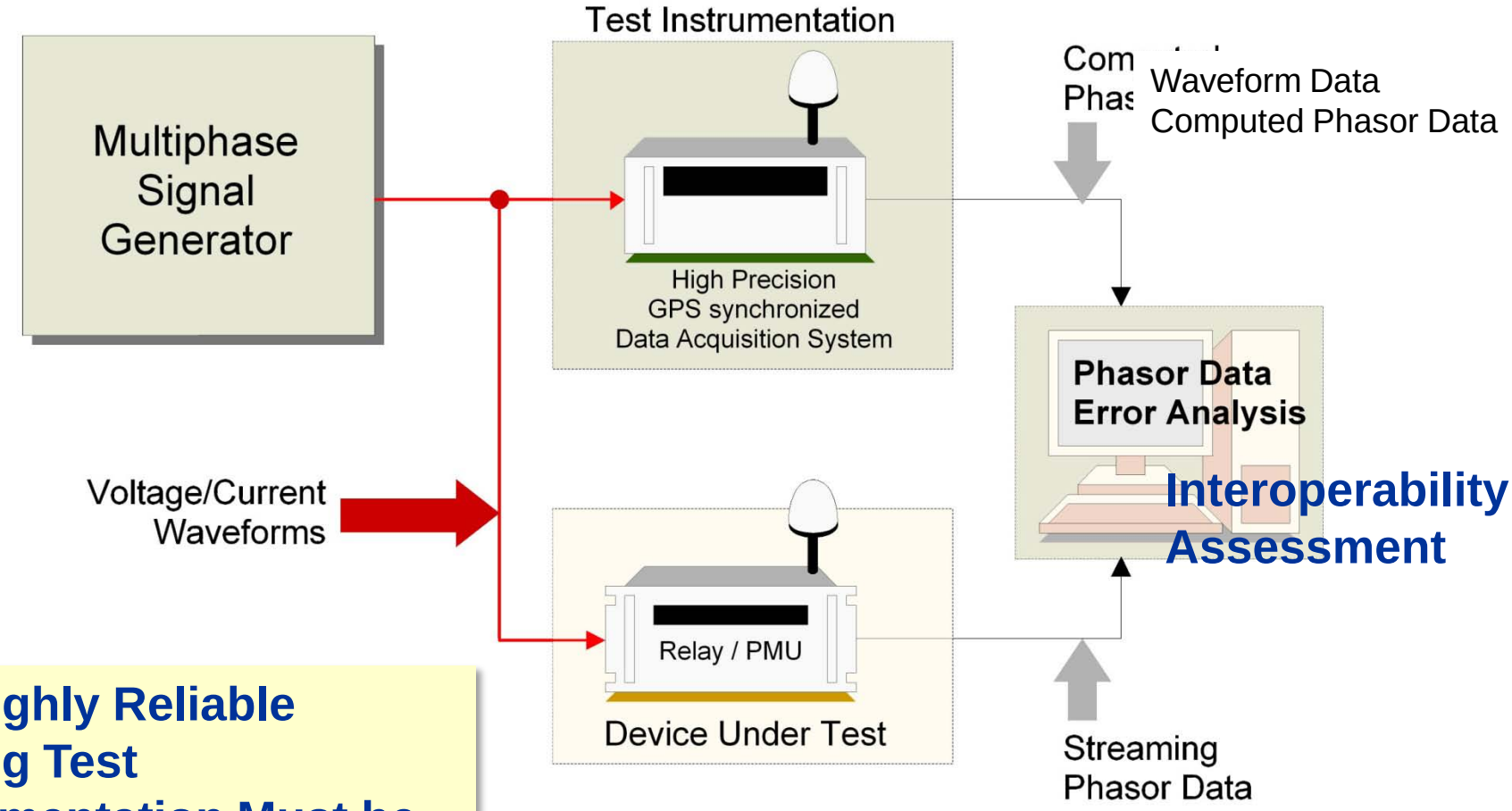
Few Comments on Relay, PDC and GPS-Synchronized Equipment Testing

Relaying and Automation Lab

A. P. Sakis Meliopoulos
Georgia Power Distinguished Professor
School of Electrical and Computer Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

PMU-PDC Testing Method Approach

GPS-Synchronized Relays, PMUs, PDCs and Recorders

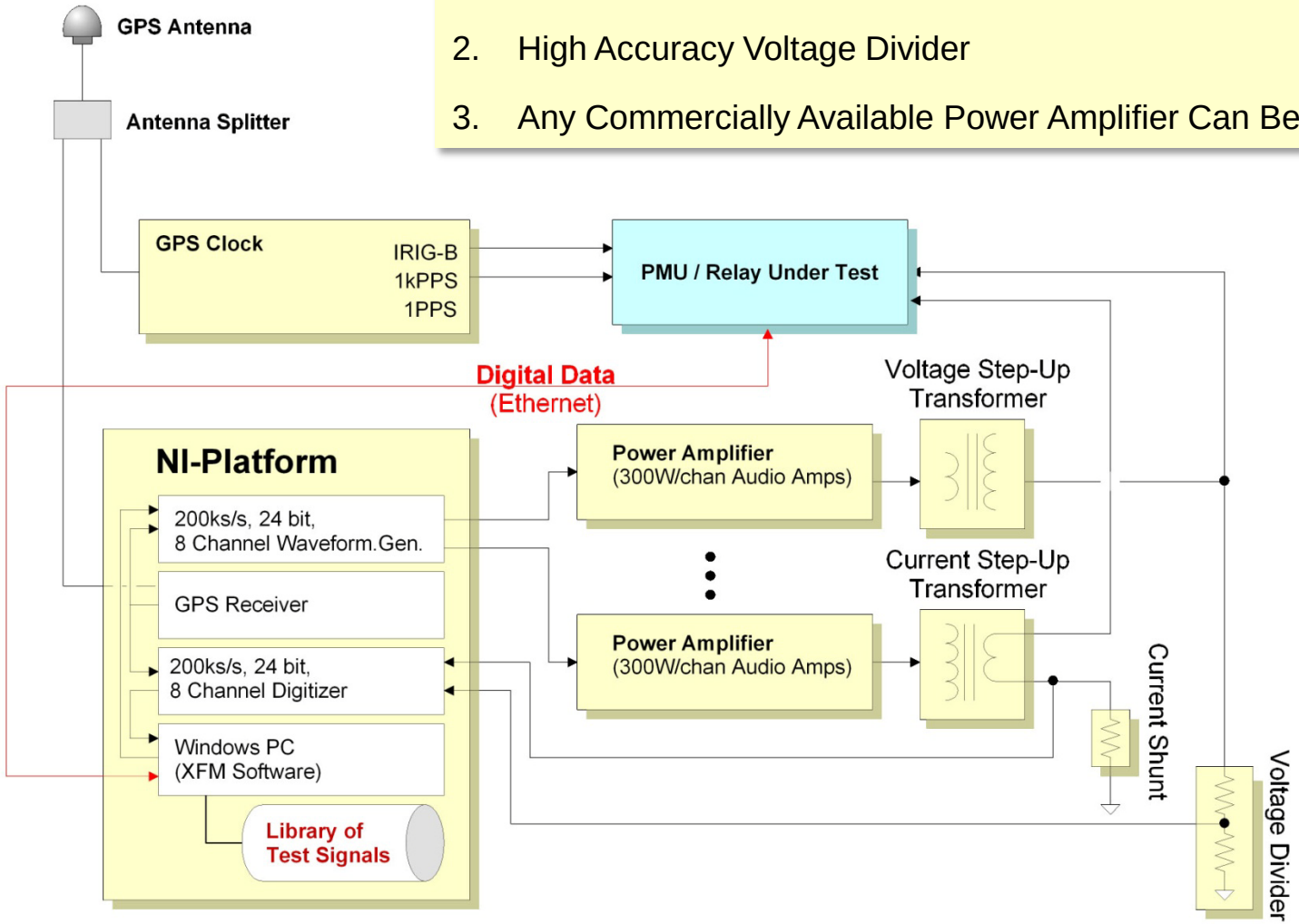


For Highly Reliable Testing Test Instrumentation Must be Accurate (0.01%, 0.5usec)

PMU-PDC Testing Method Approach

GPS-Synchronized Relays, PMUs, PDCs and Recorders (Implementation)

1. High Accuracy Current Shunt
2. High Accuracy Voltage Divider
3. Any Commercially Available Power Amplifier Can Be Used



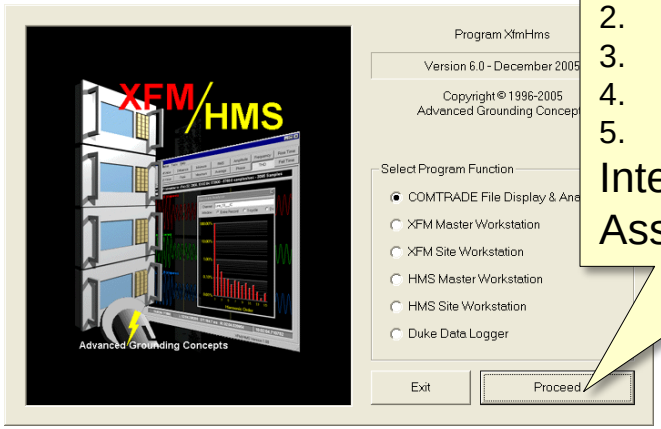
PMU-PDC Testing Method Approach

GPS-Synchronized Relays, PMUs, PDCs and Recorders

(Instrumentation Software & Hardware)

Software XFM

- Signal Generation/COMTRADE
- Accepts Streaming Phasor Data
- Performs Error Analysis
- PC Based



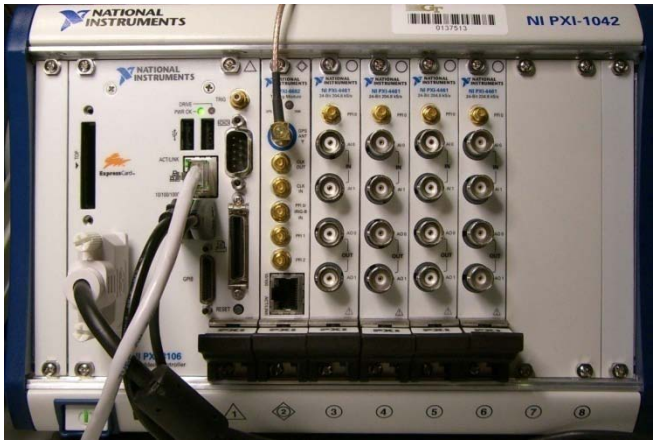
Error Analysis

1. Max Error
2. RMS Error
3. Max Phase Error
4. RMS Phase Error
5. Etc.

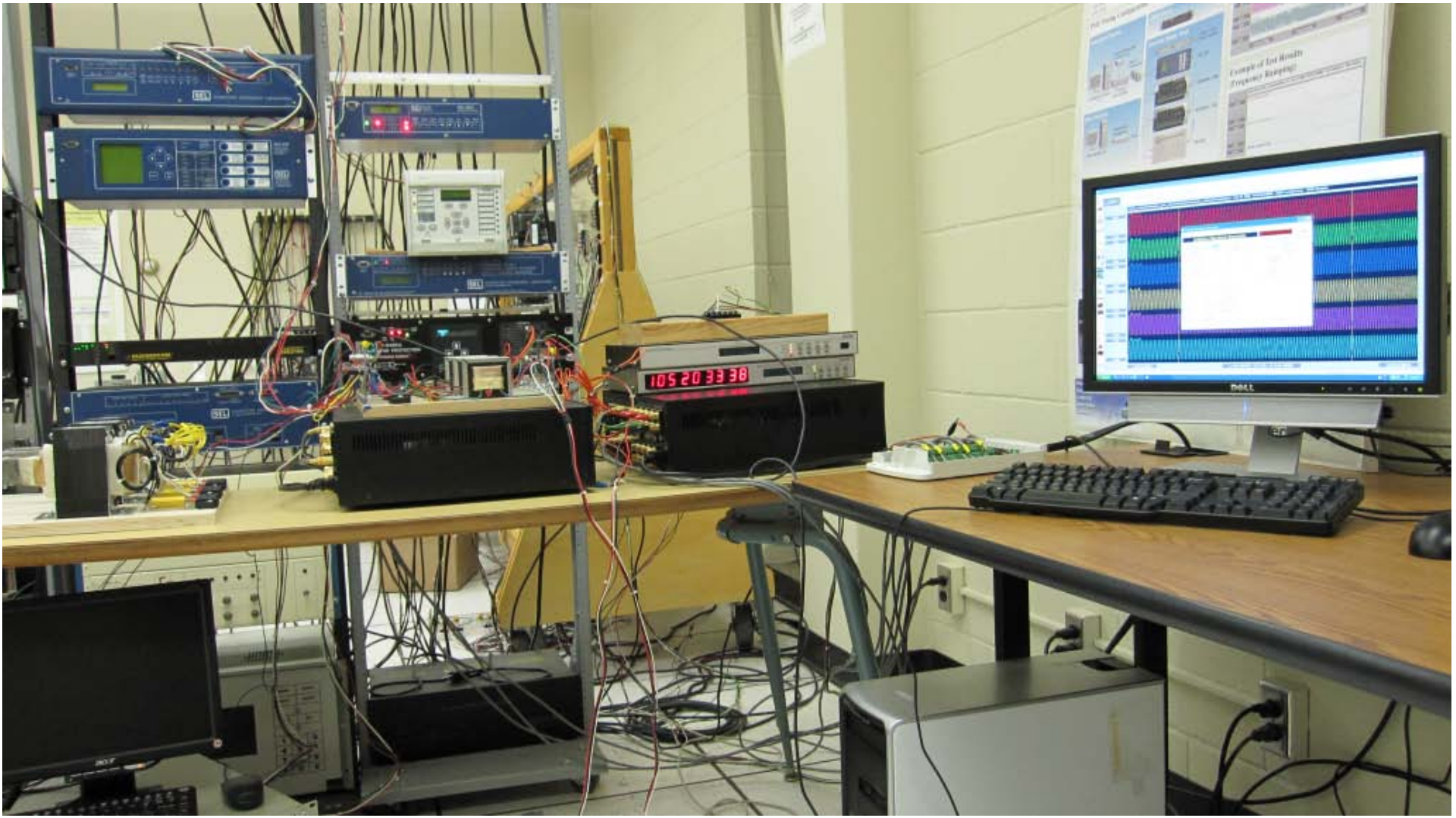
Interoperability Assessment

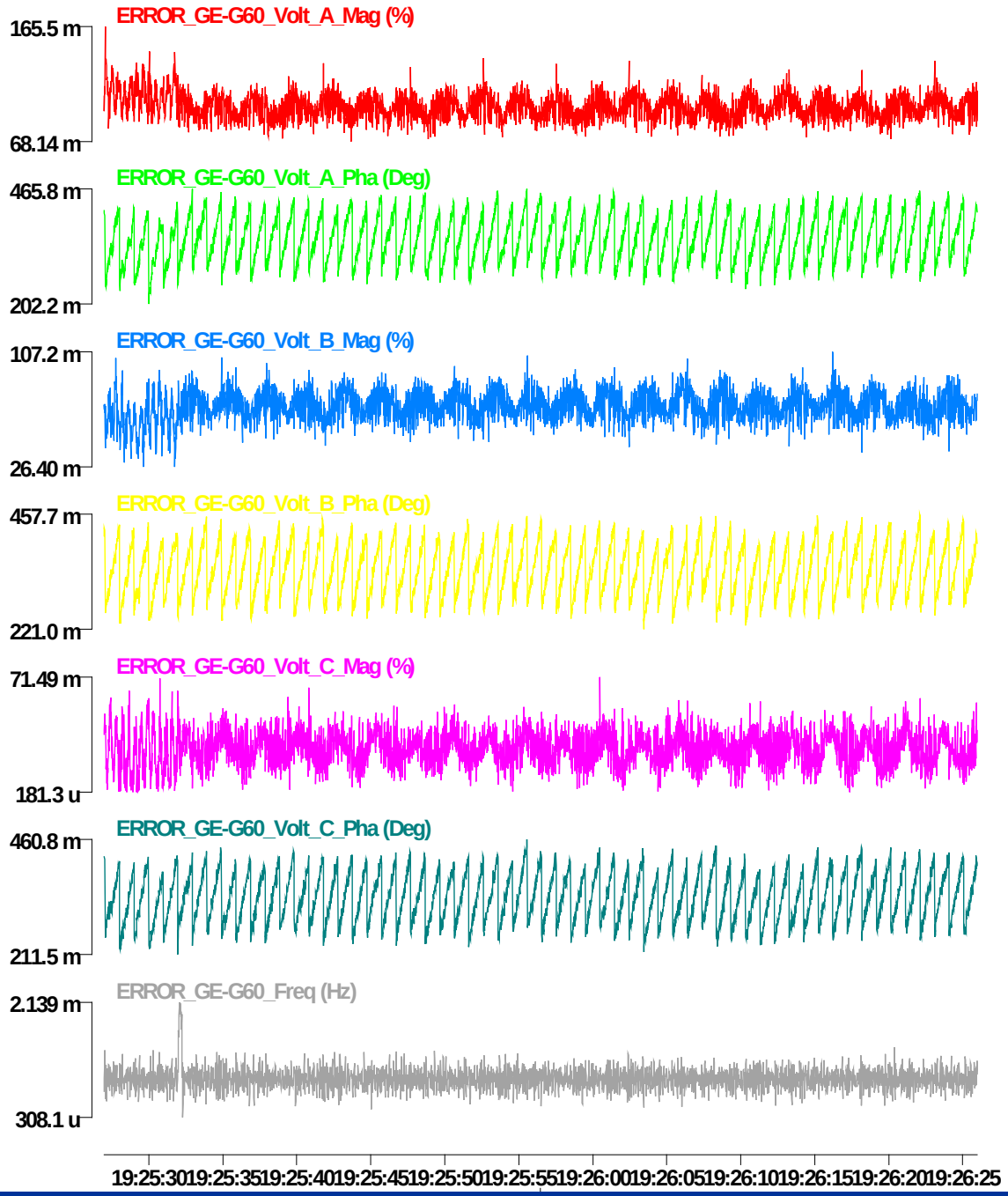
Hardware - National Instruments PXI

- 8 channel D-A 200 ksps, 24 bits
- 8 channel A-D 200 ksps, 24 bits
- Integrated GPS Clock
- Integrated Windows PC



Test Set-up

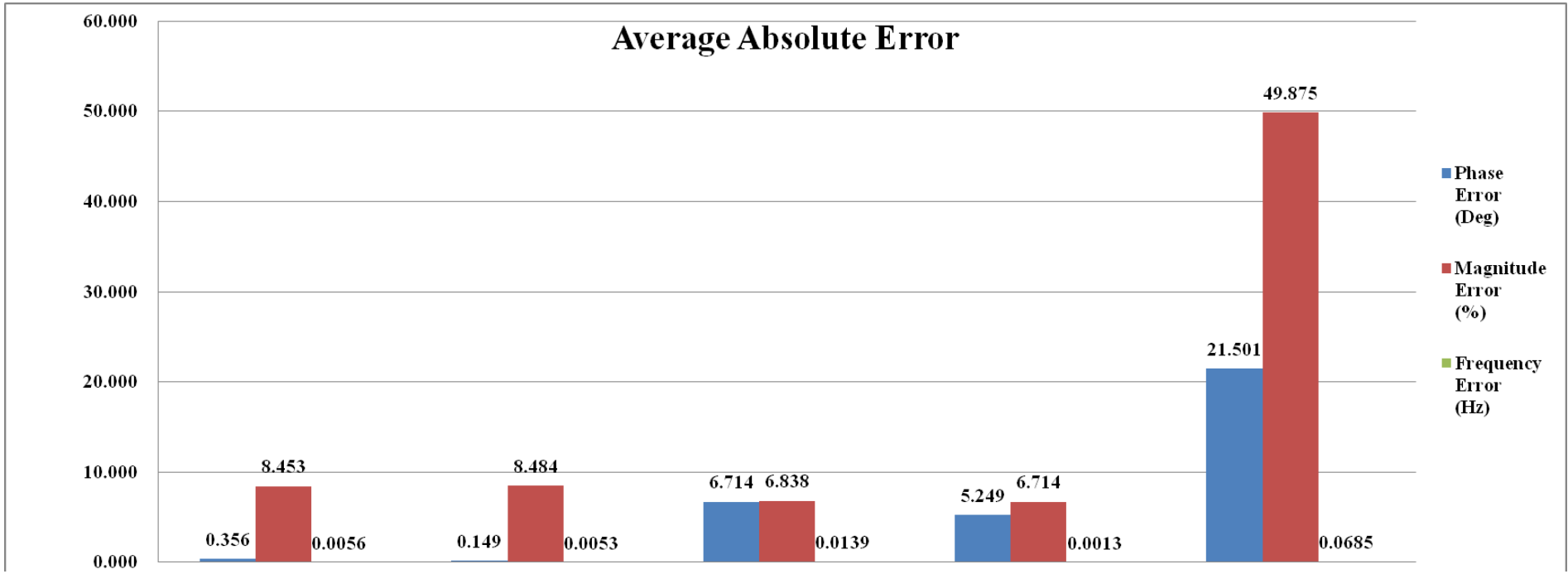




Error Tracking

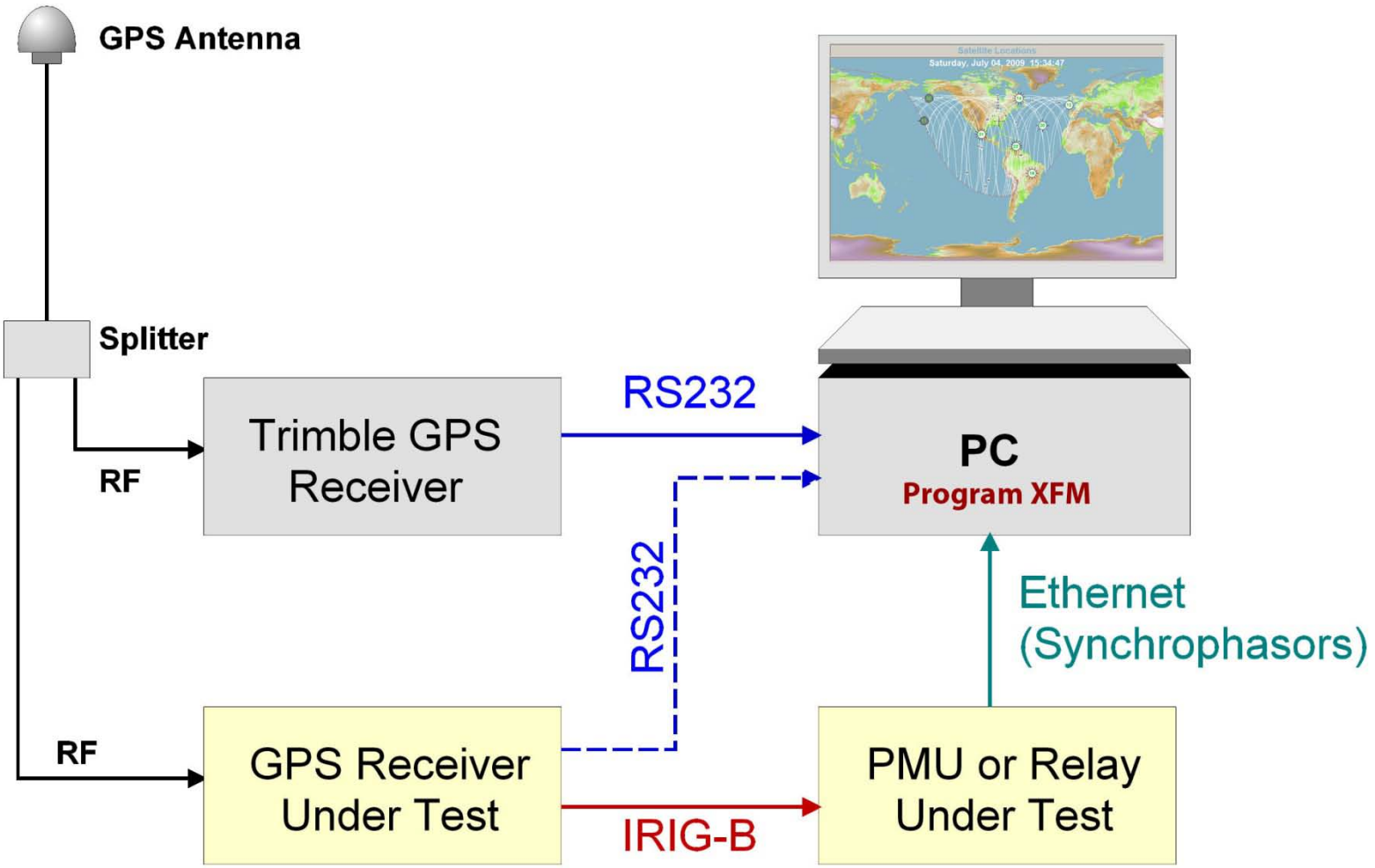
Example

Test-B: Voltage Step & Frequency Ramp



Real Time PMU Performance Monitoring

Monitoring system based on a high precision GPS receiver and XMF software.
Records history of PMU performance



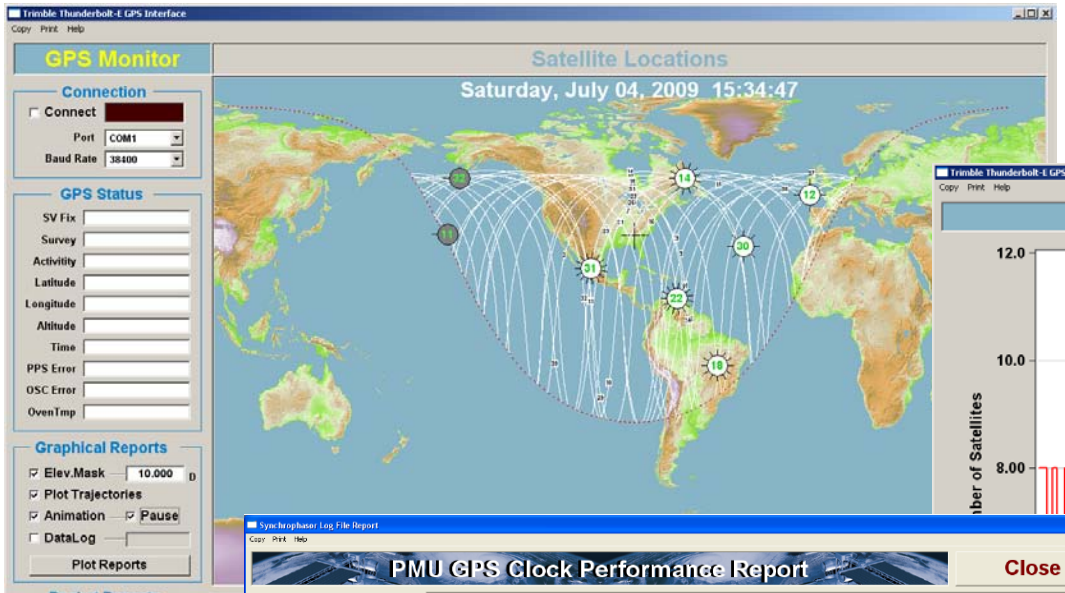
Real Time PMU Performance Monitoring

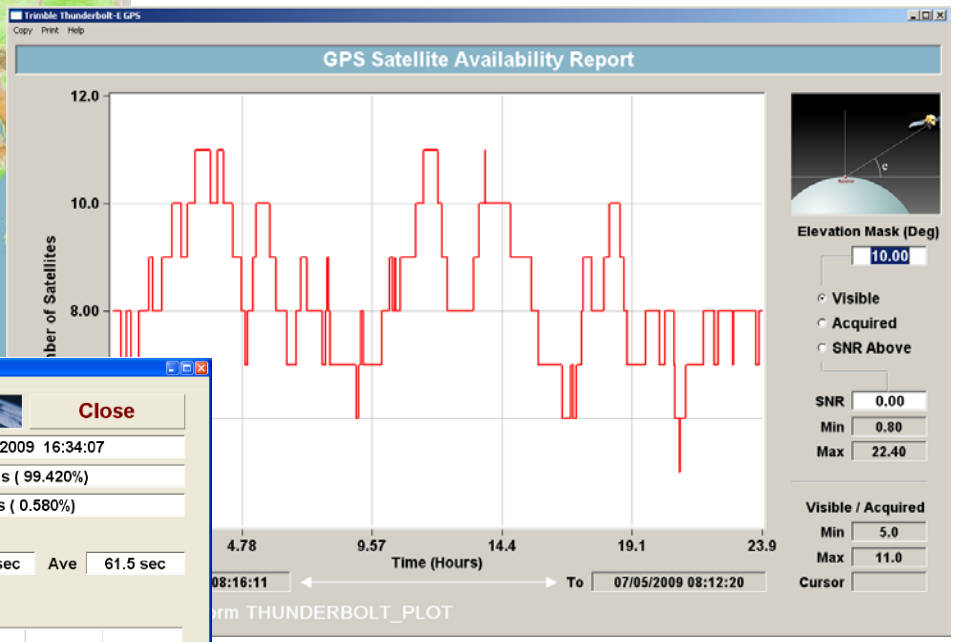
System based on Trimble Thunderbolt-E

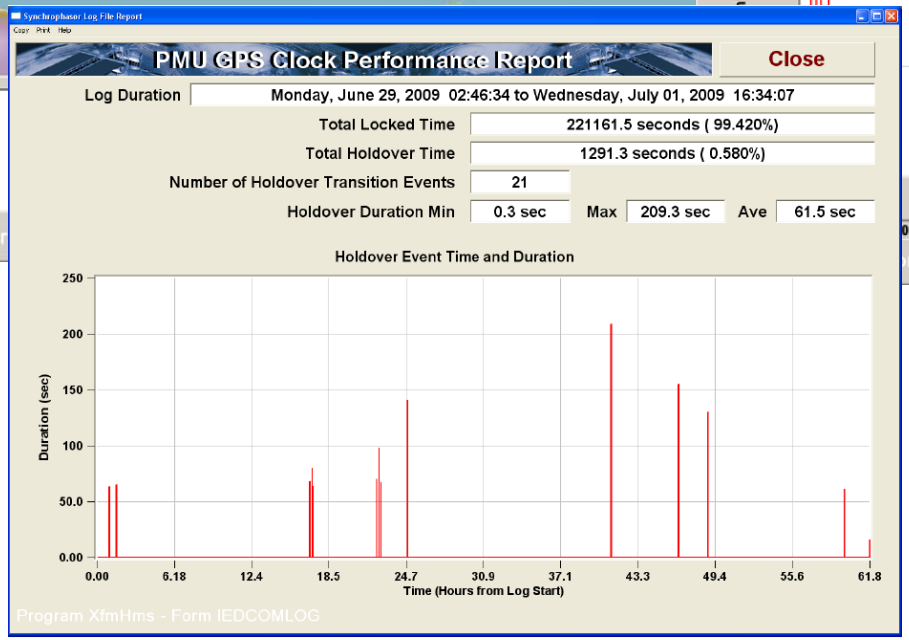
- **High precision GPS receiver**
- **Provides detailed GPS status reports:**
  - Satellite Locations
  - Satellite Signal Strength
  - Satellite Configuration Characteristics (GDOP)
- **High precision 1PPS and 10MHz Outputs**

Real Time PMU Performance Monitoring

Program XFM Example Reports



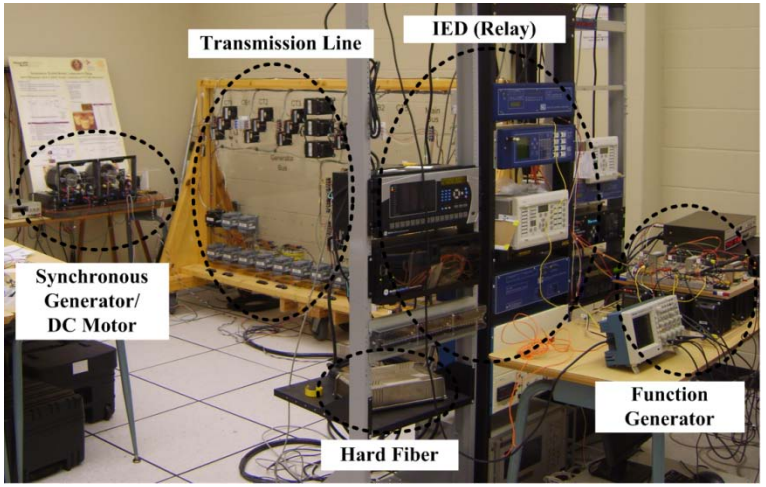


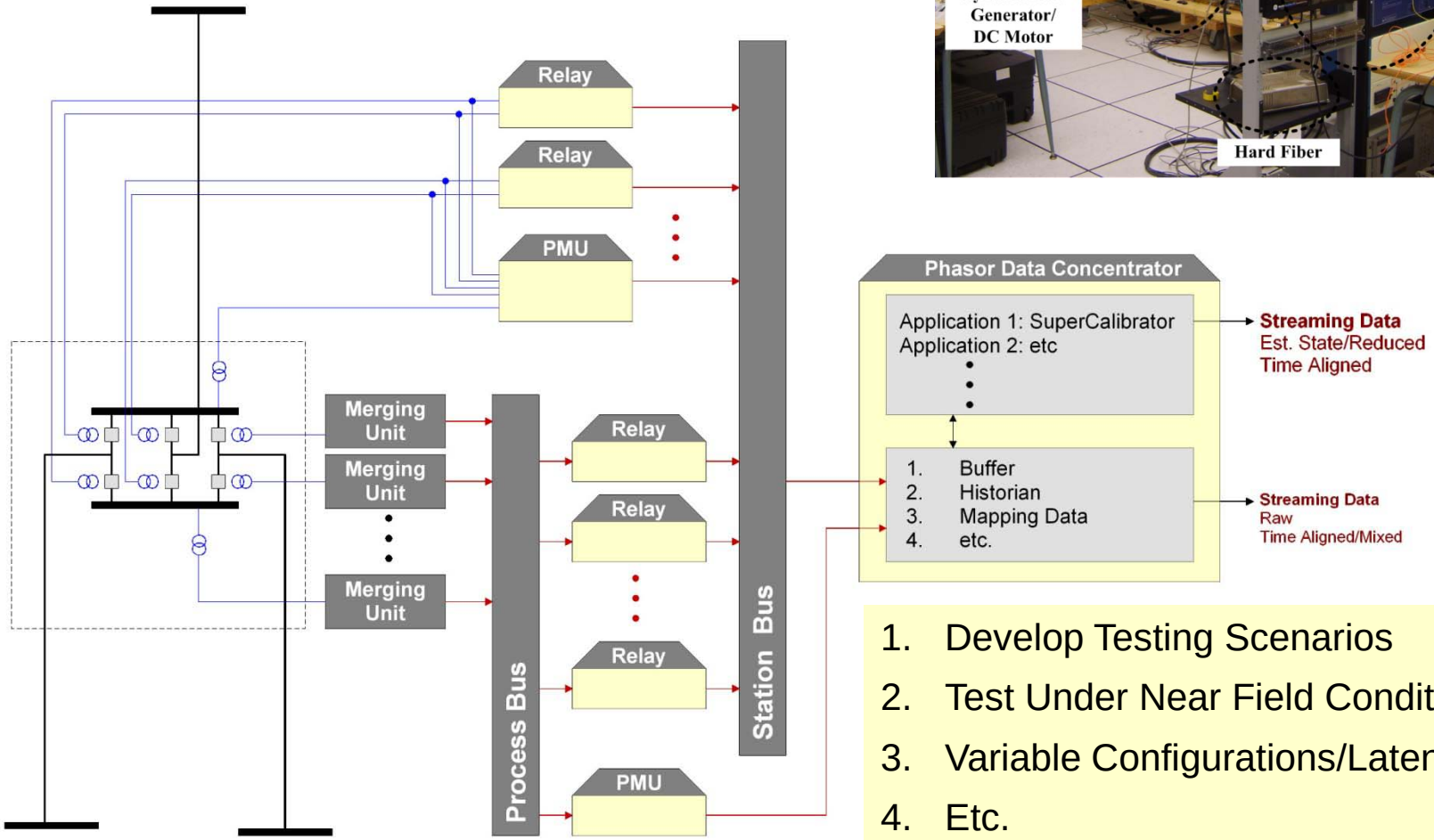


PDC Functions/Testing

A Major Issue is Lack of Standards on What the PDC Functions Should Be.

1. Data Concentration
2. Applications (need for interface standards)





1. Develop Testing Scenarios
2. Test Under Near Field Conditions
3. Variable Configurations/Latencies
4. Etc.