

A Case for Multi-Function PMU

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PMU Definition

- **PMU is generally defined as:**
 - IEEE C37.118 compliant device
 - Time synchronized measurements
 - Voltages and currents
 - Frequency and rate of change of frequency
 - Real-time streaming of phasor values

IEEE C37.118 Requirements

- **Functional Requirements**
 - Measurements synchronized to UTC
 - Calculations of phasor values in real-time
 - Phasor value streaming at high rate
- **Measurement Accuracy and Response Requirements**
 - Accurate time stamp for measurements
 - 1% TVE (Total Vector Error) under specific conditions
 - Frequency accuracy 4 to 6 mHz over a specific range*
 - Steady state and dynamic response as defined in the standard*
- Members of IEEE PES PSRC H-11 WG are revising C37.118 to include these parameters for frequency accuracy and dynamic response testing for phasors.

PMU Requirements Not Recognized in C37.118

- **Configurability**
 - Selection of inputs, calculations and applications . . .
- **Overall performance parameters**
 - Filters, latency, application priorities . . .
- **Data handling**
 - Handling of data types with different attributes, time delays . . .
 - Access to and management of locally stored data
- **Interoperability for Smart Grid infrastructure**
 - PMU integration in a networked environment
 - Use of synchrophasors in substation applications

PMU Design Options

- Dedicated (stand-alone) device for phasor streaming
- Phasor streaming as an add-on function in a substation device such as a relay, recorder, meter, etc.
- Multifunction PMU as
 - A data acquisition device with generalized software that delivers synchronized measurements and various types of results (data) in real-time to serve the widest set of T&D automation applications

Multi-Function PMU Measurements

- Measurement Data Types in T&D Automation . .
 - Time
 - Point on the wave data
 - Phasors
 - Calculated results
 - Virtual channels such as V, I, P, Q, F, dF/dt
 - Events
 - Trigger markers

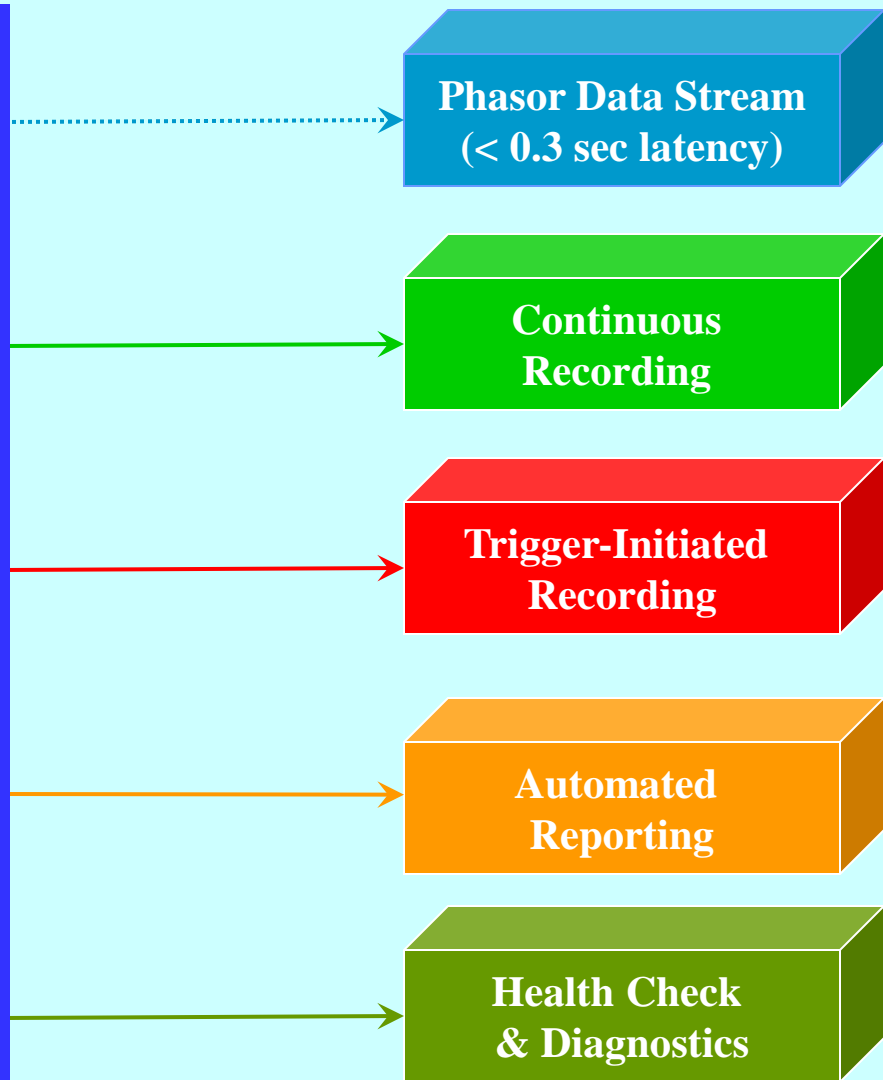
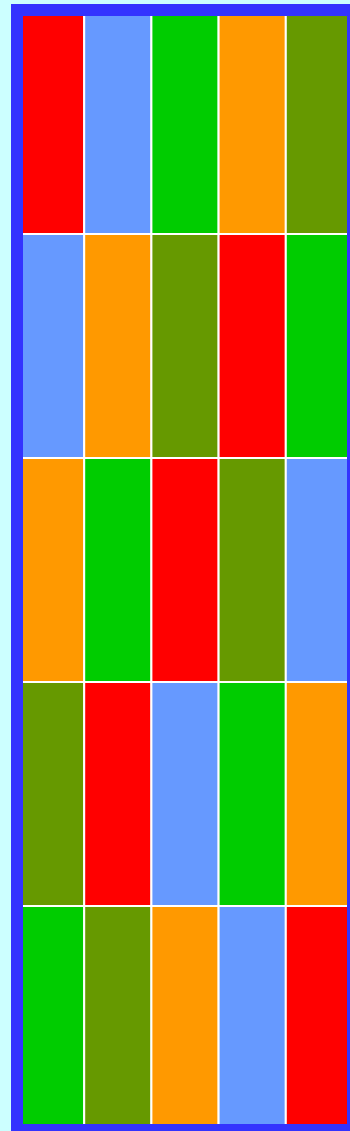
Multi-Function PMU Data Streams and Applications

Multi-Function PMU



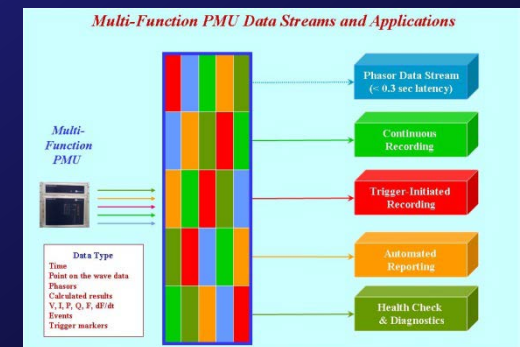
Data Types

Time
Point on the wave data
Phasors
Calculated results
 V, I, P, Q, F, dF/dt
Events
Trigger markers



Multi-Function PMU Data Acquisition

- Data streams are generated by measurements controlled by system firmware (collection rate, sequence, etc.)
- Data Streams
 - Logical grouping of data with common attributes
- Data Stream Sorting & Handling
 - Continuous (real-time pass through)
 - Trigger-initiated (initially recorded then transmitted)
 - Events (either or both of above)
- Data Output Options
 - As continuous stream
 - As file transfer of locally stored data
 - Data with selective delivery/retrieval



Mehta Tech's PMU Data Streams

- **Data stream management**
 - Multiple data streams
 - Multiple types, multiple streams of same type
 - Data stream configuration
 - Content and data rate
 - Storage of raw and processed data
 - Continuous and trigger initiated storage
 - Simultaneous communications
 - Streaming, file transfer, web interface

Mehta Tech's PMU

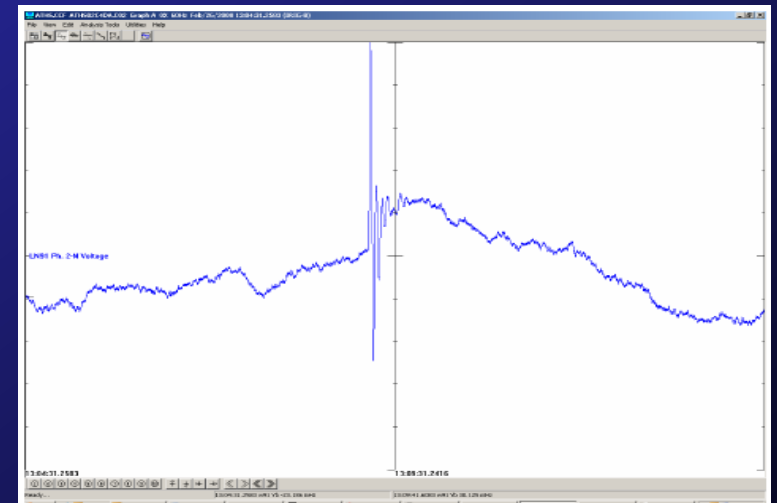
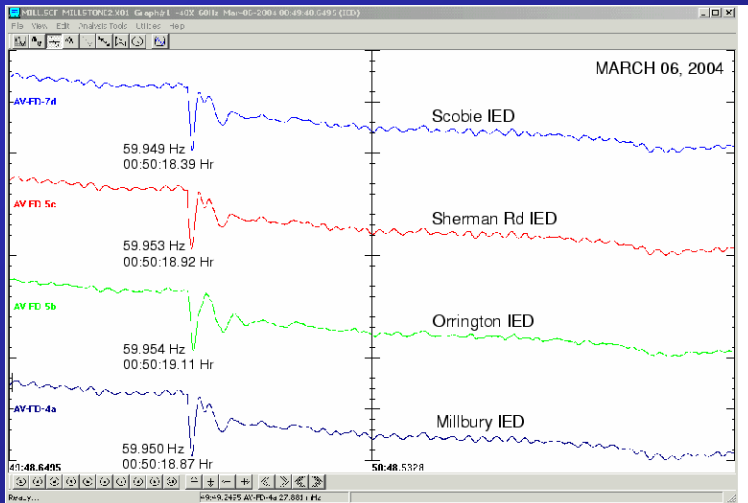
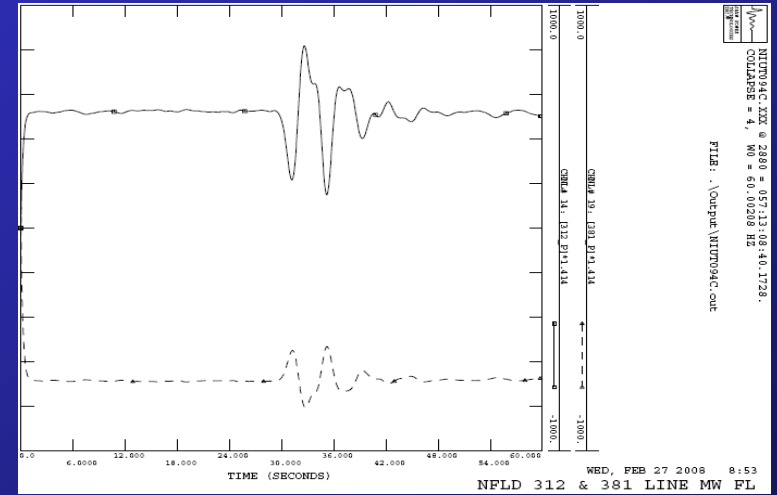
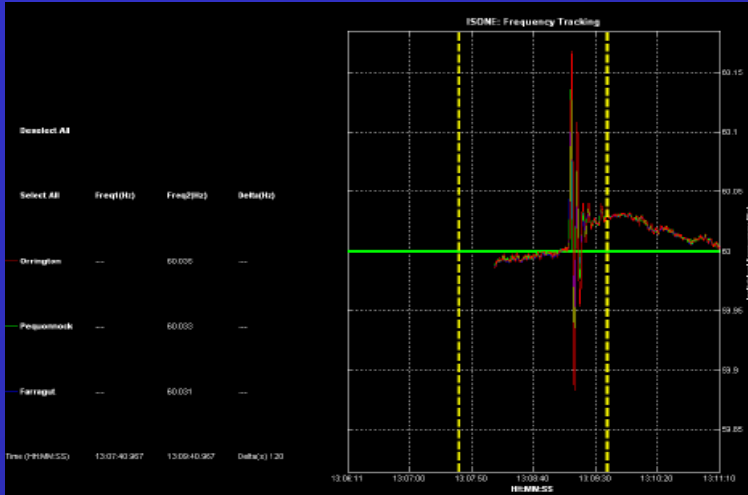
Resolves Issues Not Defined in C37.118

- **Architecture provides predictable response and versatile communication, enabling multiple independent applications**
 - Capability to extract the widest set of information
 - Application-driven successive phasor/data filters
 - Point on wave values for high resolution data
 - Sequence of events
 - Data streaming, file transfer as well as local storage
 - Industry standard protocols and web interface

Mehta Tech's PMU Benefits

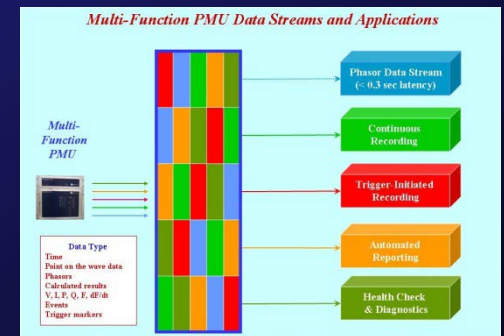
- **Comprehensive set information from a single source**
- **Applications Served**
 - **Situational awareness and forensic analysis**
 - Phasor measurement and streaming
 - Continuous Recording
 - Trigger-initiated fault, disturbance and sequence of events recording
 - **NERC and Regional requirements satisfied**
 - PRC-002 & PRC- 018 standards

PMU Measurement Examples



Summary

- Multi-Function PMU delivers the most comprehensive deployment of synchrophasor technology
- Mehta Tech's multi-function PMU
 - Meets C37.118 requirements while resolving many issues not addressed in C37.118
 - Offers interoperability for Smart Grid integration
 - Provides configurability, upgradability and responsiveness using patented product architecture for data stream management



Thank You!

Questions?