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Webinar Questions and Answers

"Demystifying Distributions Synchrophasors: Use Cases, Requirements, and Integration from Field Experience"

with Dr. Paolo Romano

Question: Could you please give a brief description of what a synchrophasor is and what they do...? e.g. 101 level.

Answer: *Phasor Measurement Units (PMUs) estimate voltage and current phasors (magnitude and angle extracted from an AC waveform). The measurements from different devices are synchronized to a common clock, often using GPS. The measurements are typically reported 30, 60, or 120 times per second in a 60 Hz grid. The high speed and synchronization of the measurements enable a variety of applications.*

Question: What is the status of WG C41 / Part 118-3?

Answer: *The WG C41 is active with the objective to assess the need of a Distribution-PMU standard. You can contact WG Chair Ken Martin to know more or be included in the periodic meeting invitations.*

Question: Where does Dominion Energy stand on this?

Answer: *We are not aware of Dominion Energy's position for distribution synchrophasors. They did however make several efforts concerning data analytics using synchrophasors deployed in transmission grids. More info can be found here and here.*

Question: Regarding your question about Dominion, are you wondering specifically about private LTE?

Answer: *Unfortunately, we do not follow Dominion Energy closely. However, recent articles show that efforts are being made to test private LTE in Virginia. More info can be found here and here.*

Question: Is it possible D-PMUs in rural areas? what is necessary? fiber optic communications...

Answer: *It is absolutely feasible to deploy PMU in rural areas. Typically, in such areas fiber optic is not available, therefore time synchronization will be achieved via a dedicated GPS/GNSS receiver and data communication with wireless solutions such as public/private LTE networks.*

Question: Will the PTP timing error be large with a larger distance?

Answer: PTP timing error will increase with each transparent clock or boundary clock that the packets traverse. However, careful design and choice of appropriate devices and architecture can minimize the timing error within PMU tolerances. More info can be found in this [webinar](#).

Question: Have you studied locating D-PMU at preplanned substations to allow for measurements on a sampling basis to proactively sectionalize the distribution network? Sectionalize and sync with local generation?

Answer: The placement of D-PMUs is done optimally to: (i) minimize the number of needed field devices while covering the largest area and, (ii) satisfy the end application performance requirements.

Question: What is the basic difference between IEEE C37.118. and its versions to that of IEC? IEEE 60255-118-1

Answer: In terms of contents, there are no major differences between the IEEE C37.188.1-2011 Std and the latest IEC/60255-118-1 Std. Indeed, the IEC/IEEE 60255-118-1 was developed to add valuable upgrades to testing and definitions of synchrophasors, however, only the IEEE C37.118.2 provides details of packet encapsulation and communication protocols for synchrophasors.

Question: Do you anticipate a migration to vPRTC (virtual Primary Reference Time Clock) architecture?

Answer: We believe that vPRTC architecture can be very interesting for highly performing and secure D-PMU rollouts.

Question: What kind of software used for PMU for simulation?

Answer: We have developed our own software environment for PMU data simulation. Online there are numerous PMU simulators available, that still require access to PMU measurement time series. A freeware example of a PMU simulator can be found [here](#).

Question: Can the installation of D-PMU at a few locations give situational analysis to inform operator action? A small number of E-PMU - 10% to give, say 75% situational awareness and justify disconnection and load shedding to prevent system collapse?

Answer: Yes, we have demonstrated that with only 10-20% D-PMU coverage Distribution System State Estimation (DSSE) can provide sufficiently accurate estimations of nodal voltages and branch/nodal current/power flows in every grid node. Once the full-grid state is known, control schemes (e.g. load shedding, DER control, load management, peak shaving, etc.) can be applied to guarantee the distribution grid's static operational constraints, and, as a result, keep the system safe and avoid blackouts.

Question: Do you recommend any digital twin based open PMU? can we access?

Answer: I am not aware of any open source full PMU digital twin. SEL is offering a "virtual Phasor Measurement Unit" model in their SEL-3378 Synchrophasor Vector Processor (SVP). More details can be found here. However, we never tested it and cannot guarantee the accuracy levels of the model.

Question: Virtual PMU available?

Answer: See above.

Question: What level of voltage is considered distribution system? (slide 24)

Answer: We typically define Medium Voltage (MV) distribution whatever power system operated between 36 and 1 kV. Below 1 kV we call it Low Voltage (LV) distribution.

Question: Do you anticipate an evolution of vPRTC to cnPRTC (coherent network Primary Reference Time Clock) technology deployment?

Answer: As previously explained, these concepts are quite new with little field tests in distribution grid applications. Theoretically speaking, the technology looks promising, and we invite the interested reader to check this presentation for a comparison in terms of "projected" performance.

Question: What cyber security solutions should be considered while deploying PMU on virtualized servers or clouds?

Answer: PMU software platforms that are integrated in control room solutions should adopt the same cybersecurity principles and practices used for SCADA/DMS systems. On the other hand, if the PMU platform is deployed as a standalone system not connected with any control room nor closed-loop control solution, then such cybersecurity requirements can be typically soften up.

Question: Do you also consider the fault detectability issue while installing D-PMUs across the system?

Answer: Yes, optimal PMU placement must consider (i) the envisaged PMU applications and (ii) their expected performance

Question: Do hardware in loop (HIL) and software In Loop (SIL) based PMUs can be altered according to the requirements?

Answer: The question is unclear. However, as any applications, if the device requirements are tightened then either minor change in the firmware could lead to performances that are compatible with the standards, or a complete firmware redesign should be done.

Question: As regional based Satellite systems are available why don't we make use of them for time synchronization rather than depending on GPS alone?

Answer: *Modern digital substation clocks are typically fitted with 184 channel multi-constellation, multi-band GNSS receivers. Most utilities are looking to augment them with highly accurate secondary synchronization sources like PTP through Fiber communication networks.*

Question: Is PMU deployed through the SCADA system?

Answer: *Usually synchrophasors originating from PMUs are not directly integrated into already deployed SCADA systems due to interoperability. As a result, to enable the integration of PMU data/information into existing SCADA, the use of software middleware and gateways is typically required.*

Question: How can the D-PMU Platform be used to identify congestion points on distribution networks and manage remedial actions?

Answer: *The D-PMU software platform can identify congestions either via direct measurements of current/power flows or via PMU-based Distribution System State Estimation. Once the congestion is identified, the platform can either generate an alarm to the SCADA/DMS system so that the grid operator identifies a remedial action or automatically calculate optimal control set-points for controllable resources that can resolve the congestion.*

Question: Which DSP algorithm you have applied?

Answer: *Zaphiro phasor-extraction patented algorithm is based on the discrete Fourier transform.*

Question: What is the sensor class recommended for D-PMU? As you mentioned, the P and M classes are not suitable for D PMU.

Answer: *In our humble view P and M class are not suitable for D-PMU applications as they were originally designed for their application in transmission systems.*

Question: What's the difference between a D-PMU and a micro PMU that can also be installed on a MV/LV network?

Answer: *D-PMUs and micro-PMUs are synonyms.*

Question: Cost of a D-PMU compared to a standard PMU? Also, if D-PMU is better than a standard PMU, can it be used in transmission system?

Answer: *Compared to a standard PMU a D-PMU should be normally characterized by a higher resiliency to harmonic interferences and other disturbances and adopt shorter window lengths to guarantee better response times during grid dynamics. Also, with respect to costs, D-PMUs are from a deployment and total cost of ownership perspective closer to existing IED solutions than transmission level PMUs. Depending on the target applications and installation requirements, a D-PMU could be also used in transmission systems.*

Question: If PTP requires fibre network, then the same network can be used to report data instead of LTE?

Answer: Absolutely, if a fiber network is available, it can be used both for data communication and measurement time synchronization.

Question: What are the commercial D PMUs available in the market, what are their price range as you suggested there are need of low-cost D PMUs

Answer: Today there are not many D-PMU vendors and the price ranges of their devices are typically not publicly available. The interested reader is advised to contact the specific vendor and inquire.

Question: How to do PMU data Analysis?

Answer: PMU data analysis requires a complex infrastructure in place, including Phasor Data Concentrators, long-term data storage systems and sophisticated grid analytic solutions developed around the assumption of having access to synchronized measurement of voltage and current phasors.

Question: Time synchronisation error requirement for D-PMU same as standard PMU?

Answer: Time synchronization error requirements depend both for standard and distribution (D-) PMUs on the final application that will be using such data. In general, the most relevant error source in synchrophasor measurements is not coming from time-synchronization but from the voltage/current transducers.

Question: Do we need to perform noise analysis for D-PMU?

Answer: Measurement noise can be a relevant source of error, particularly if the D-PMU has been designed for monitoring power grids during both normal and fault conditions. To avoid having excess measurement noise, high-resolution A/D converters must be adopted. In the case measurement noise is present, algorithmic processes can alleviate that by performing bad-data detection and noise smoothing (e.g. Distribution System State Estimation).