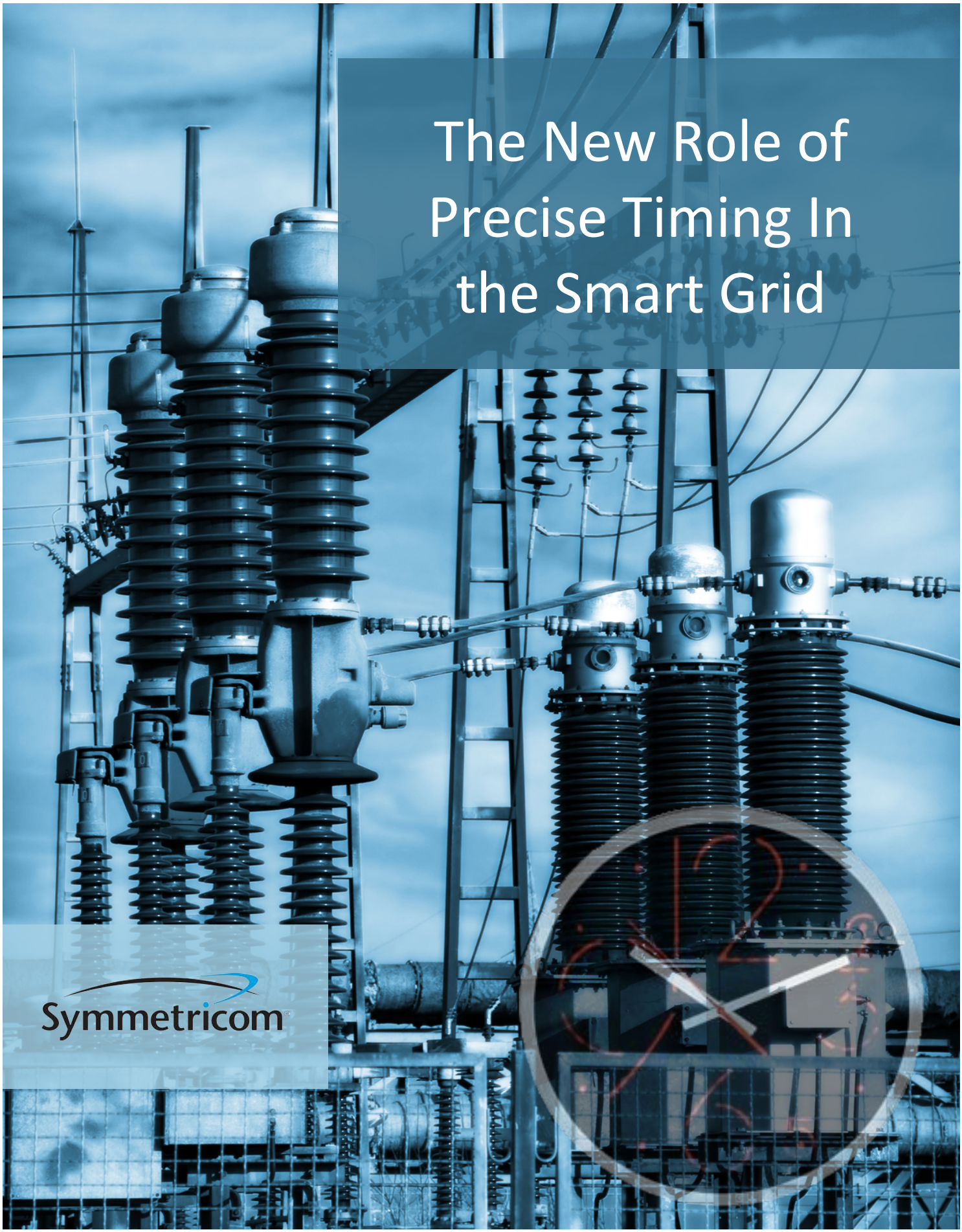
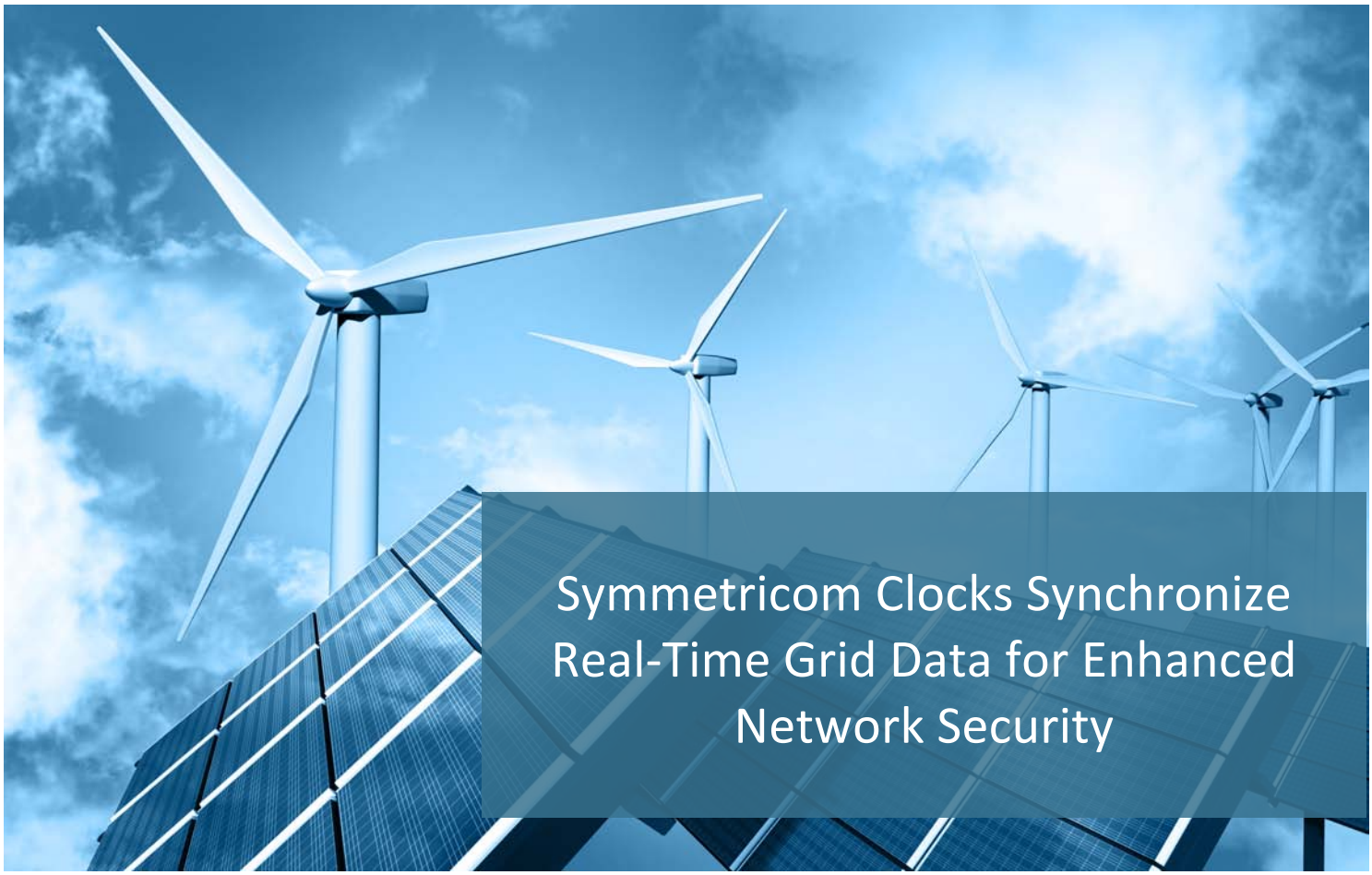


The New Role of Precise Timing In the Smart Grid

Symmetricom



Symmetricom Clocks Synchronize Real-Time Grid Data for Enhanced Network Security

Without Time There Is Chaos !

Without time there is chaos, and nowhere will this be more true than in the new Smart Grid. In full operation, a typical Transmission substation will generate and process 100,000 data samples per second at the process bus level[1]. Add to that the estimated 50 TB of Smart Metering data generated and transmitted per day in North America and it becomes obvious that without the benefit of time, a utility just has data and the ensuing chaos of how to process it.

Timing has always had a role in the grid. Consider for a moment the Protection, Metering and Control substation functions. The by-product of protection is time-stamped data, and the direct output of control and metering is time stamped data.

Energy Accounting applications are the least demanding in terms of precision, and metering instruments are normally synchronized to within 1 second of an accepted time reference.

Forensics applications are slightly more demanding, and protection relays & disturbance recorders are typically synchronized within 1 ms of a grid wide standard. In the operational realm, SCADA applications are also met with data time stamped within 1ms of the same reference.

The need for synchronization is understood but until recently, time was considered optional by many, and this is reflected in the deployment practice evident at many utilities.

1 60Hz system, 20 bays with 5000 Sample Values per second

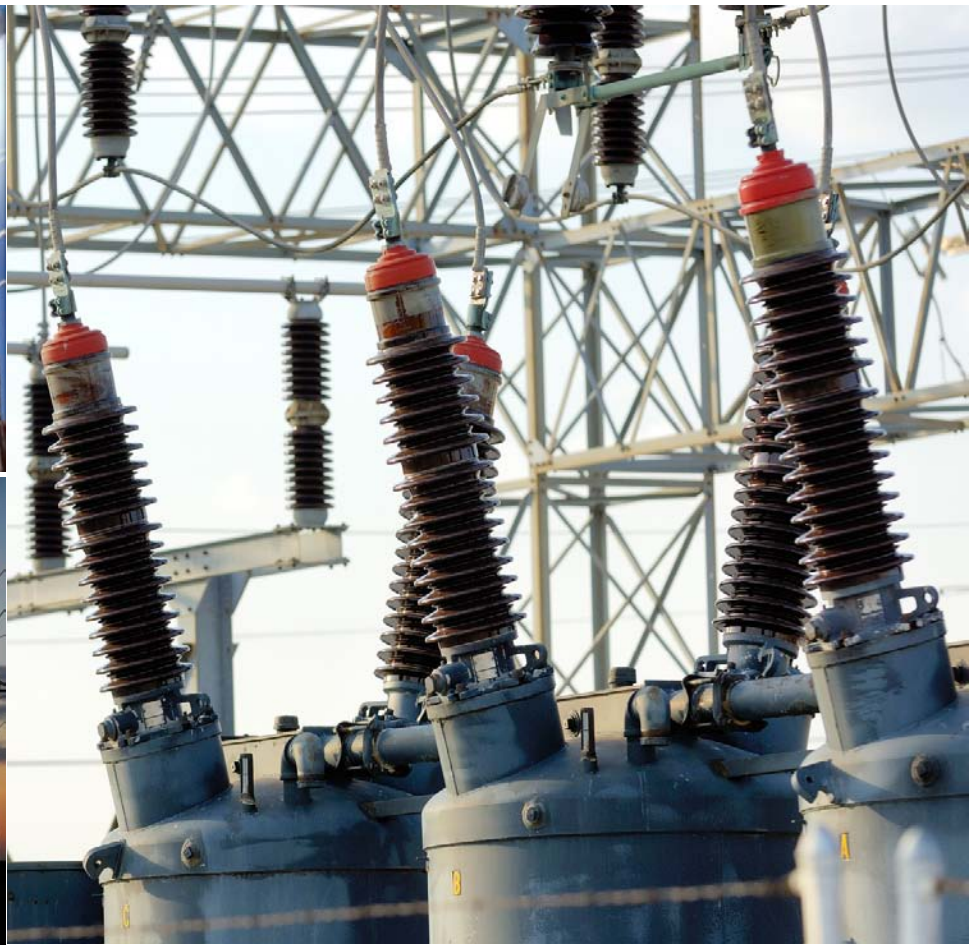
GPS clocks are often installed autonomously for an application, or project. GPS certainly meets the accuracy needs, but it is not uncommon to see multiple "project" based GPS systems in a single substation, with the resulting antenna array on the control room roof. More importantly, these GPS devices are rarely managed beyond the catastrophic failure of the clock.

As utilities strive to deliver more from their existing grid infrastructure, the control and protection functions have become more dependant on data that is synchronized with greater precision. Applications such as Wide Area Measurement Systems[2], Traveling wave fault locators, and Sample Values require microsecond accuracy. Synchronous sampling and time stamping of Sampled Values is critical, as failure to do so across the substation can result in incorrect tripping by protection relays. Timing is therefore no longer optional ... It is now an operation necessity and an ad-hoc approach to timing cannot be sustained.

With the need for more precision established, the challenge is how to distribute a 1us reference reliably and cost effectively? Engineering a parallel timing bus to every IED is not sustainable, and 1us is beyond the reach of the Network Time Protocol (selected by current release IEC 61850). An IEEE Power System Relaying Committee task group defined a profile of the IEEE 1588 protocol to deliver 1us in the substation, and this profile is defined in the IEEE C37.238 standard. This solution overcomes the limitations of previous technologies - high precision, in-band distribution over the LAN, and management of the clock quality.

When published, the power profile will also be referenced in the IEC 61850-9-2 standard to address the higher accuracy needs of Sampled Values.

2 Scheme of Phasor Measurement Units sampling phase data at synchronous moments and reporting of the synchrophasor data to a central location



The Substation Clock for Tomorrow

Not only has timing become more accurate in the Smart Grid - It is now a leading contributor to grid security. Bay-level clocks do not fit naturally into the smart substation architecture, and the centralized substation clock must now meet many new objectives.

- First, it must support the legacy equipment in the substation.
- The clock must deliver NTP for local consumption.
- Utilities will deploy IEEE 1588 compliant IED's at different speeds, but the clock installed today should have a natural path to C37.238. The clock must be future proof.
- The reliability and manageability of the clock is critical, particularly as the process bus becomes a reality.
- No one can ignore the importance of the NERC CIP requirements, and the clock cannot compromise the integrity of the cyber security system that has (or will be) established.
- And finally, the clock must be cost effective.

Symmetricom designs and manufactures the Grandmaster clock source and substation slave elements that meet the needs of the next generation telecom platforms as well as the Smart Grid timing infrastructure. To find out more about our next generation solutions, contact your local representative or e-mail us at expertadvice@symmetricom.com

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