

Time Synchronized Phasor Measurements

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Lecture 21

- What is a “synchrophasor”?
 - » A synchrophasor is a phasor measurement with respect to an absolute time reference.
 - » Allows determination of absolute phase relationship between quantities at different locations in a power system



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First, how do we define a phasor?

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Reference Angle is not too Difficult in a Substation

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Benefits of External Reference

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- Phadke and Thorpe → GPS clock signals
- Slow adoption



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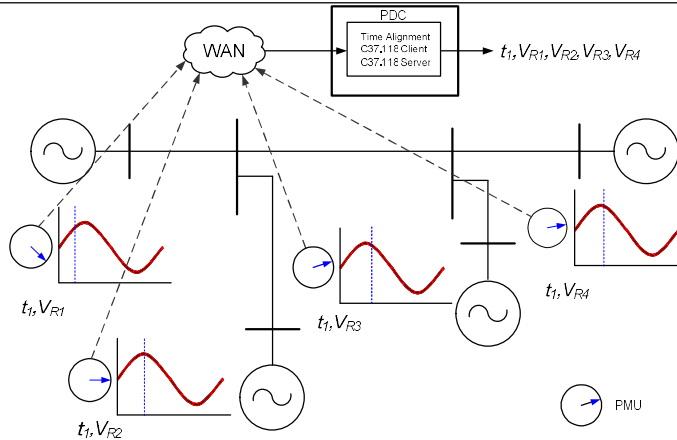
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Phasors With Common Timestamp Provide a "Snapshot" of the System

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System Needs

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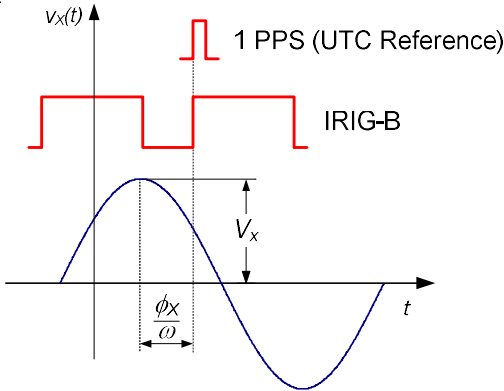
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Precision Time Protocol



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Phasor Representation With Respect to the 1 PPS UTC Reference



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Tolerances

- Total Vector Error (TVE) - Limit – ($\leq 1\%$)
- Frequency Error (FE) - Limit – ($\leq 0.005\text{Hz}$)
- Rate of Change Frequency error (ROCOF) - Limit ($\leq 0.01 \text{ Hz/s}$)

- P-Class (Protection—fast response)
- M-Class (High precision monitoring, slower needs)



Data Transmission

