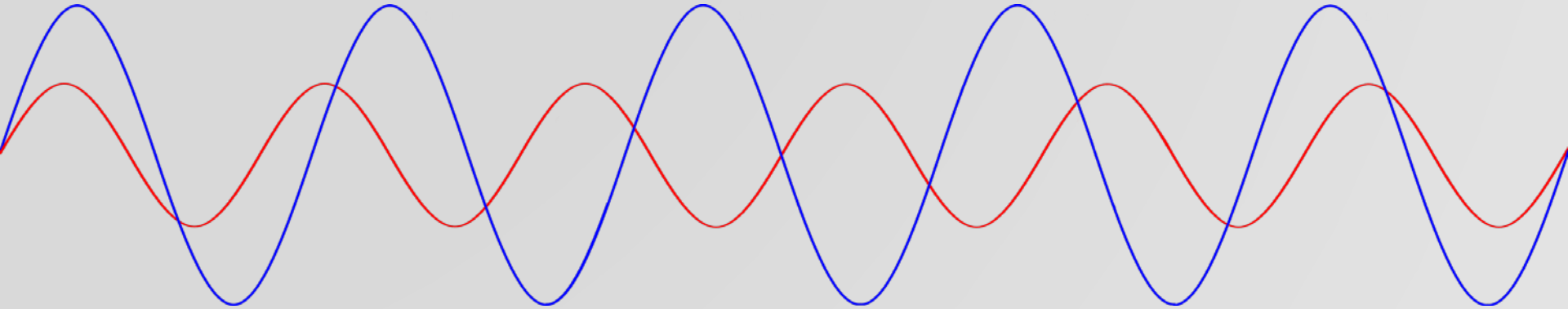
PJM-MISO-TVA Coordination

Phasor Reference Bus and Naming Conventions



NASPI Working Group Meeting
Toronto
June 8-9, 2011

Topics

Signal Naming Convention

- Background
- Station Name
- Channel Name
- Challenges

Positive Sequence Angle Calculation

- Background
- Positive Sequence Calculation
- Process and Challenges

PJM-MISO Naming Convention - Background

- As more and more PMUs are networked into PDCs, and PMU data is exchanged between neighboring reliability entities, common naming standards will be necessary to:
  - Avoid confusion and misinterpretation of signals
  - Enforce uniqueness
  - Basic meta-data such as where the signal is coming from and what it measures
- MISO and PJM early collaboration to agree on common naming convention
  - Prior to initial data exchange was established
  - Ensure SGIG project goals and timelines can be met
  - Served as the basis for further NASPI development (DNMTT ongoing)
- Phasor names are constrained by the limits of C37.118, which only permits a certain number of characters to name a signal.

PJM-MISO Naming Convention – Station Name

- 16 bytes ASCII
  - 4 bytes: Company Identifier
    - PJM has adopted 2 byte company identifiers (leaving 2 bytes blank)
    - MISO will utilize its existing ICCP prefixes
  - 10 bytes: Station Name
    - PJM will use station names from the MMWG model(first 9 bytes, leaving last byte blank)
    - MISO will use station names from its real-time model
  - 2 bytes: Device ID within Station
    - Allows uniqueness when there is more than one PMU at a station
- Blank spaces used if there are not enough characters to fill a particular field

PJM-MISO Naming Convention – Channel Name

- 16 bytes ASCII
  - 1 byte: Measurement Identifier
    - B = Phasor on Bus Side
    - L = Phasor on Line Side
    - A = Digital
    - D = Non-Phasor Analog
  - 3 bytes: Nominal Voltage
  - 9 bytes: Channel Name
    - Line name for Phasor values
    - Free-form identifier for non-Phasor (digital or analog),
  - 1 byte: Circuit Number
    - In the case of parallel lines
    - Phasor values only
  - 2 bytes: Measurement Variable Identifier
    - Vx = Voltage (x = 1,0,A,B,C,N)
    - Ix = Current (x = 1,0,A,B,C,N)
    - DC = Digital Channel
    - AC = Analog Channel (non-Phasor)

Blank spaces will be used if there are not enough characters to fill a particular field.

PJM-MISO Naming Convention – Challenges

- Biggest challenge was agreement on the source of the station and channel names
  - PJM choose to use the MMWG model
  - Best reference for consistency across interconnection
  - MISO internal processes required names from EMS model
- Develop meaningful convention within C37.118 space constraints
- Led both sides to consider the future of post-SGIG data exchange
  - Ensure support by each company's model propagation processes

Topics

Signal Naming Convention

- Background
- Station Name
- Channel Name
- Challenges

Positive Sequence Angle Calculation

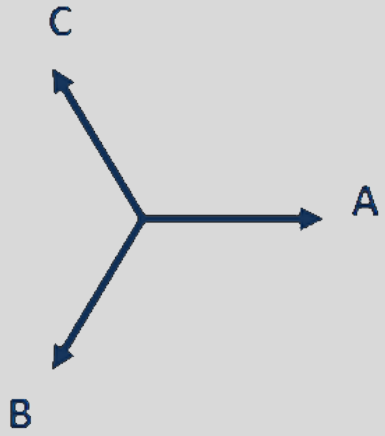
- Background
- Positive Sequence Calculation
- Process and Challenges

PJM-MISO-TVA Phase Orientation - Background

- What one company calls “A” Phase, another may call “C” Phase, and yet another may call “1” Phase, or another may call “Blue” Phase
- Results in a 120˚ shift of angle orientation between “common” phases
- Requires “decoding” the relative phase conventions, and “line-up” the angles
- PJM, MISO, and TVA have agreed to use a common reference bus
  - Correct 1 time near source of data (PMU/PDC) rather than multiple corrections at destination

Angle Orientation

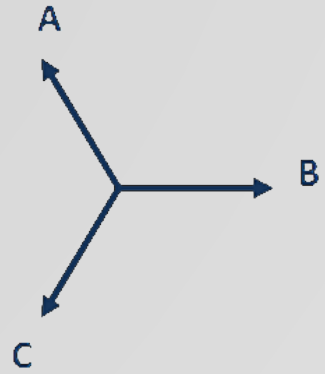
A-B-C



$V_{pos.} = (V_A + aV_B + a^2V_C)/3$

$I_{pos.} = (I_A + aI_B + a^2I_C)/3$

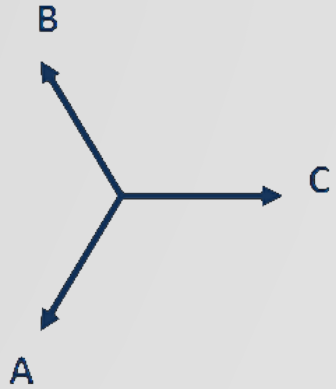
B-C-A



$V_{pos.} = (V_B + aV_C + a^2V_A)/3$

$I_{pos.} = (I_B + aI_C + a^2I_A)/3$

C-A-B



$V_{pos.} = (V_C + aV_A + a^2V_B)/3$

$I_{pos.} = (I_C + aI_A + a^2I_B)/3$

PJM-MISO-TVA Phase Orientation - Challenges

- PJM had already coordinated a standard angle orientation with its Transmission Owners
  - TVA and MISO had to decide whether or not to follow suit
- Both companies adopted PJM's standard
- Challenge propagating the correct "A" Phase throughout each region's Transmission Owners.
  - Phase diagrams were outdated due to company mergers, divisions, etc
  - To each individual company "the A Phase is the A Phase!"
  - Worked with each individual company
    - Determine correlation of angles throughout MISO footprint

Going Forward

- Data-exchange critical to realizing goals of enhanced Wide-Area Situational Awareness and reliability
  - Ideal to implement standards as early in the process as possible to facilitate widespread adoption
- Work with other SGIG projects
  - Establish data exchange as required pending development and implementation of common standards and communications
- Support ongoing DNMTT initiatives
- For more information contact
  - Mahendra Patel (patelm3@pjm.com)
  - Kevin Frankeny (kfrankeny@midwestiso.org)