Why IEEE C37 Does Not Work Well for Distribution-level Synchrophasors

2017-3-22 NASPI Meeting
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All errors attributed to Alex, all good ideas attributed to Harold, due to Alex's scheduling problems making it impossible for Harold to review.

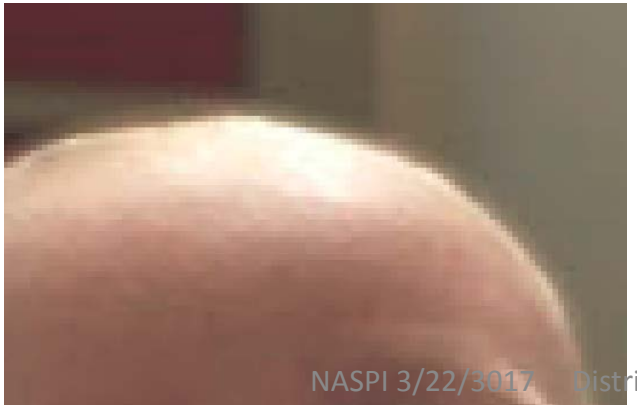
Hidden assumptions in C37 (1)

- Synchrophasors are a compression algorithm
  - Compress synchronized time-domain waveform samples to far less frequent magnitude/angle pairs
  - Compression ratio is >3:1, typically 100:1
  - It's a lossy compression, i.e. it isn't reversible

Hidden assumptions in C37 (1)

- Key point: in lossy compression algorithms, we make assumptions about the underlying data.
  - What information losses are we willing to tolerate? Answer is based on our expectations of data…






Distribution microsynchrophasors and C37 filters

- Require better resolution on magnitude and phase (2 orders of magnitude) than transmission
- Digital filters are tradeoffs between sharpness, damping, and resolution…
- C37 filters are optimized for typical transmission applications
  - Problems with rapid changes during distribution events
  - Problems with resolving distribution-level differences

Distribution microsynchrophasors and C37 definition of frequency

- There is no single definition of frequency!
  - *Harold*: only defensible definition is the LSE estimate of the value of the parameter in the equation, for the window-time defined.
  - *Alex*: The optimal definition depends on your purpose or application.
- The C37 definition is useful for transmission grids (large numbers of generators with rotating mass)
- The C37 definition doesn't work so well for microgrids, inverters, distribution generally
  - Depends on the application…
  - Microgrid control, coordination with distribution protection devices, inverter loop control, etc.

Distribution microsynchrophasors and C37 data communication

- C37 protocol is optimized for quasi-real-time control, with low latency, highly reliable data channels, and relatively low data rates.
- Distribution microsynchrophasors
  - Failure-prone data channels, especially during interesting events
  - Higher data rates: per individual sensor location, and multiple sensor locations (500MB per day per sensor)
  - Research, mostly, rather than control…

Conclusions

- There's not much wrong with IEEE C37 when used for its intended application: transmission-level synchrophasors
- Distribution microsynchrophasors have a different set of requirements.
- Micro PMU's have IEEE C37 built in, but it's not optimal for most microsynchrophasor applications.
- Other filters, and other comm channels, work better for microsynchrophasors.

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