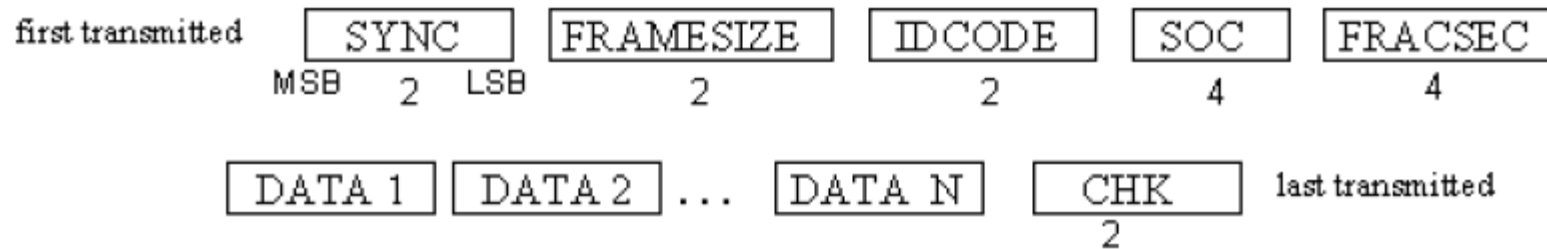


Phasor Data Quality Flags

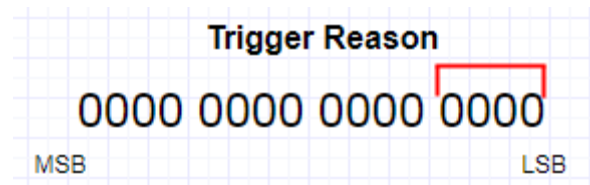
Erkan Tuna
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- What are C37.118 flags (also referred to as Status Word)?
 - A protocol specific mapping of quality flags
 - Equivalent to a SCADA quality code
 - Every PMU contains a Status Word that is sent within the C37.118 frame
 - Sent as a binary value
 - Often converted to hexadecimal in many applications

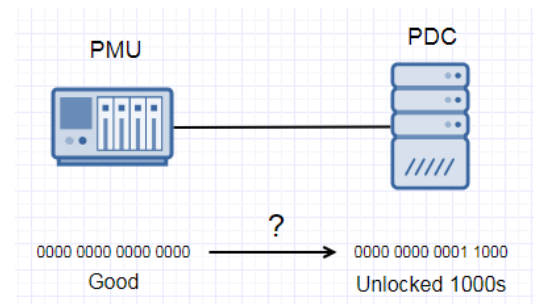


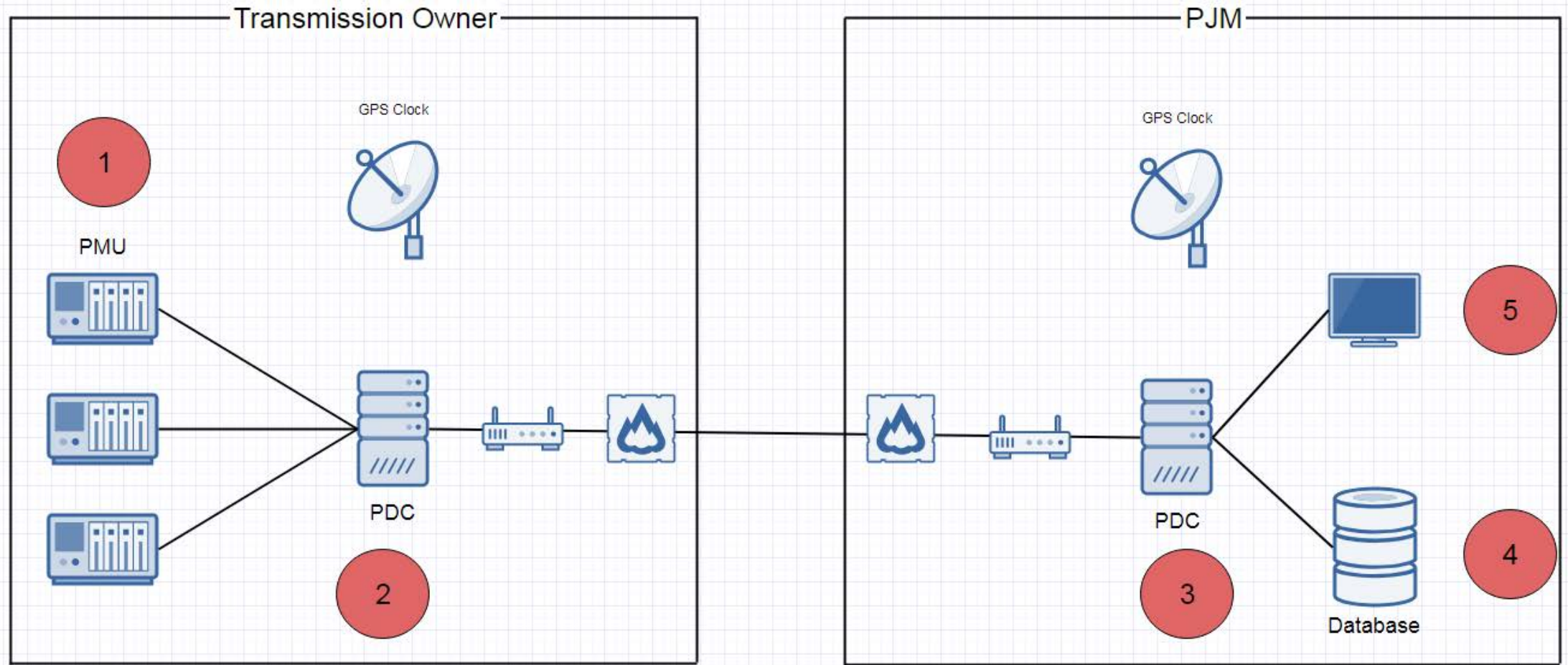
- The Status Word (or STAT) contains 16 bits
 - Each bit corresponds to a different flag, or status
 - Bit 15 – Valid indicator. 0 when valid, 1 when invalid or in test mode.
 - Bit 14 – PMU error or configuration error, 0 when no error
 - Bit 13 – PMU sync error, 0 when in sync
 - Bit 12 – Data sorting. 0 by time stamp, 1 by arrival
 - Bit 11 – PMU trigger detected, 0 when no trigger. (See bits 00-03 for triggers)
 - Bit 10 – Configuration changed, set to 1 when configuration changed for 1 minute
 - Bits 09-06 – Reserved (not used)
 - Bits 05-04 – Unlocked time
 - 00 = sync locked, best quality
 - 01 = unlocked for 10 seconds
 - 10 = unlocked for 100 seconds
 - 11 = unlocked over 1000 seconds

- The Status Word (or STAT) contains 16 bits
 - Each bit corresponds to a different flag, or status
 - Bits 03-00 – Trigger reason
 - 1111-1000 = Available for user definition
 - 0111 = Digital
 - 0101 = df/dt high
 - 0011 = Phase-angle Difference
 - 0001 = Magnitude Low
 - 0010 = Reserved
 - 0100 = Frequency high/low
 - 0010 = Magnitude High
 - 0000 = Manual



- C37.118 Flagging can be misleading, and often times confusing
 - Why?
 - The flags can be set on the **PMU and the PDC level**
 - PMU can generate and send one flag, but PDC might interpret it a different way
 - It is indistinguishable as to what level the flag was set
 - Makes troubleshooting efforts difficult
 - Error flags are not specific
 - Error flags are difficult to understand





- C37.118 flags are consumed and interpreted through the DataNXT Application
 - Looks at the C37.118 flag, and places signals into pre-defined categories
 - Good Sample
 - Data Invalid
 - Time Error
 - Synch Error
 - Drop Error
 - PMU Error
 - Planned Outage
 - Missing Samples
 - Error Samples
- DataNXT is the application that currently generates the weekly reports

- Data Invalid
 - Bit 15 flag in protocol
 - PMU is potentially in “Test Mode” and outputting test data
 - All the measurements may not be available
- Time Error
 - Bits 05-04 in protocol
 - Requires time quality accuracy check
 - A range of seconds may be lost
- Synch Error
 - Bit 13 flag in protocol
 - PMU detected a loss of external time synchronization (GPS Clock)

- Drop Error
 - Occurs when there are dropped bits in the frame
 - Potentially due to loss of communication
 - Message frame could have been sent incorrectly
 - Can be on the Transmission Owner, or PJM side
- PMU Error
 - Bit 14 flag in protocol
 - PMU may be out of calibration
 - Memory/processor error
 - Some measurements may not be usable
 - PMU telling protocol not to use the bad data
- Planned Outage
 - Reported outages that are compensated for the timeframe

- Missing samples
 - C37.118 Frame expects a certain number of samples
 - Expects 30 samples/second per sample
 - Inconsistent sample arrive times
 - Samples could be out of order
- Error samples (Drop error bucket)
 - C37.118 Frame could have a format error
 - I/O error of PDC/Database

Questions?

- For any phasor inquiries or questions about data quality:
 - PJMSynchroPhasorSupport@pjm.com