DataNXT

Data Validation, Data Quality Reporting, and Data Conditioning

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NASPI – Synchrophasor Data Quality Workshop

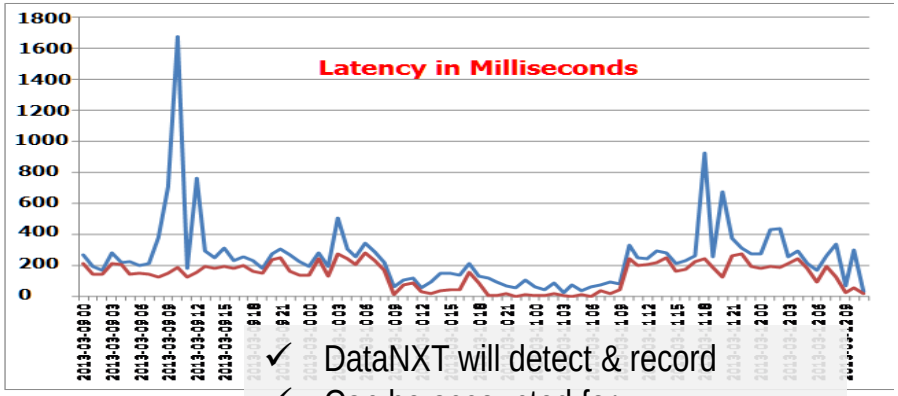
Data Quality Problems

- Dropouts & corrupt data
- Timing errors
- Measurement errors
- Lack of precision
- Incorrect measurement identification
- Excessive latency

Noisy signals cannot be used with confidence

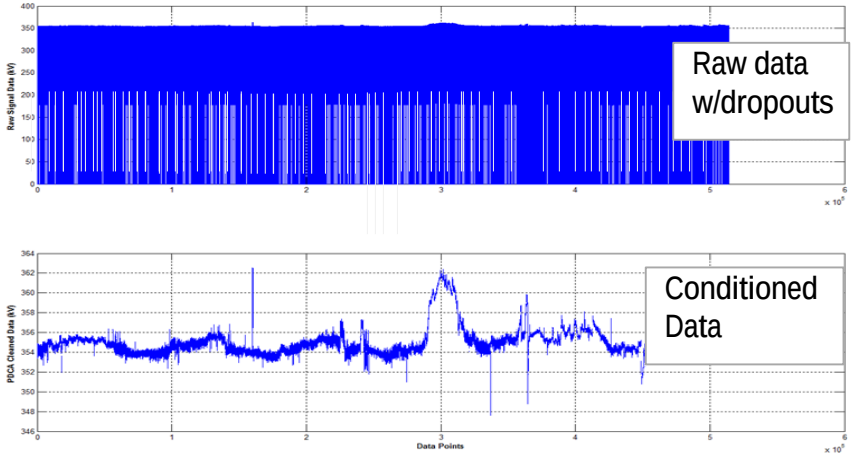
✓ DataNXT will detect problem & set warning flag
✓ Can be conditioned to improve data usability

Latency variations impact applications



✓ DataNXT will detect & record
✓ Can be accounted for

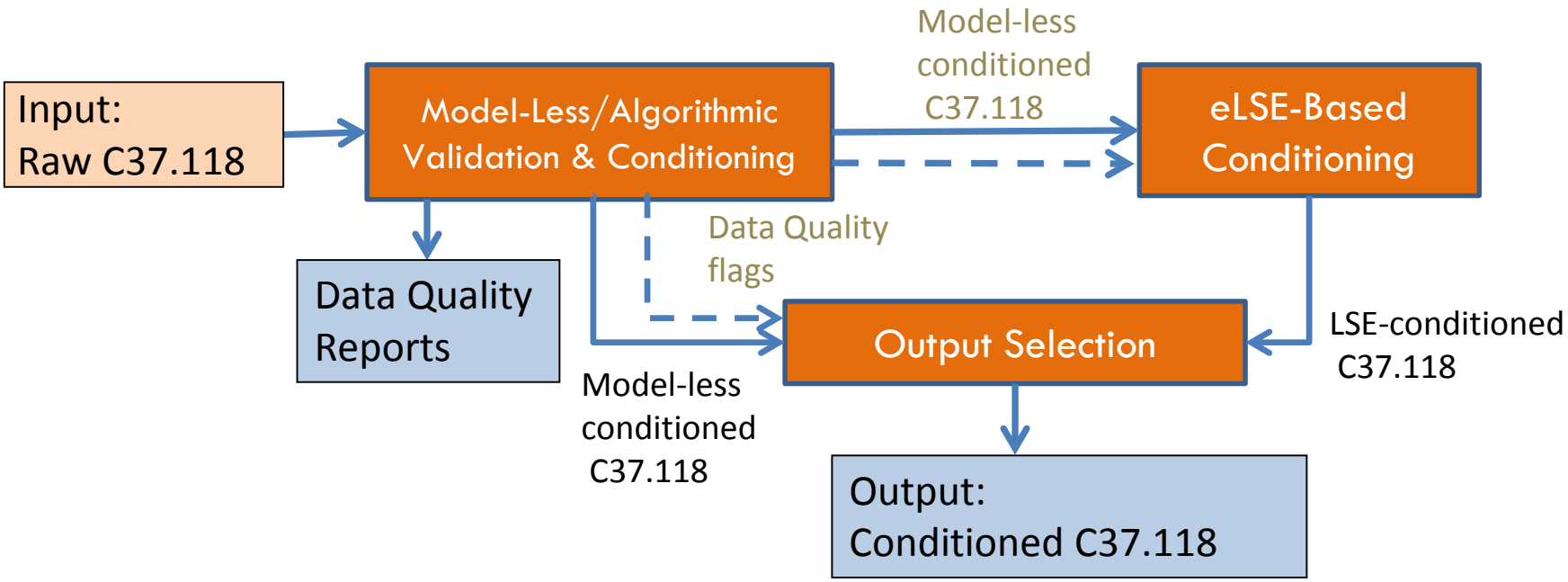
Dropouts make data unusable



DataNXT – the Solution

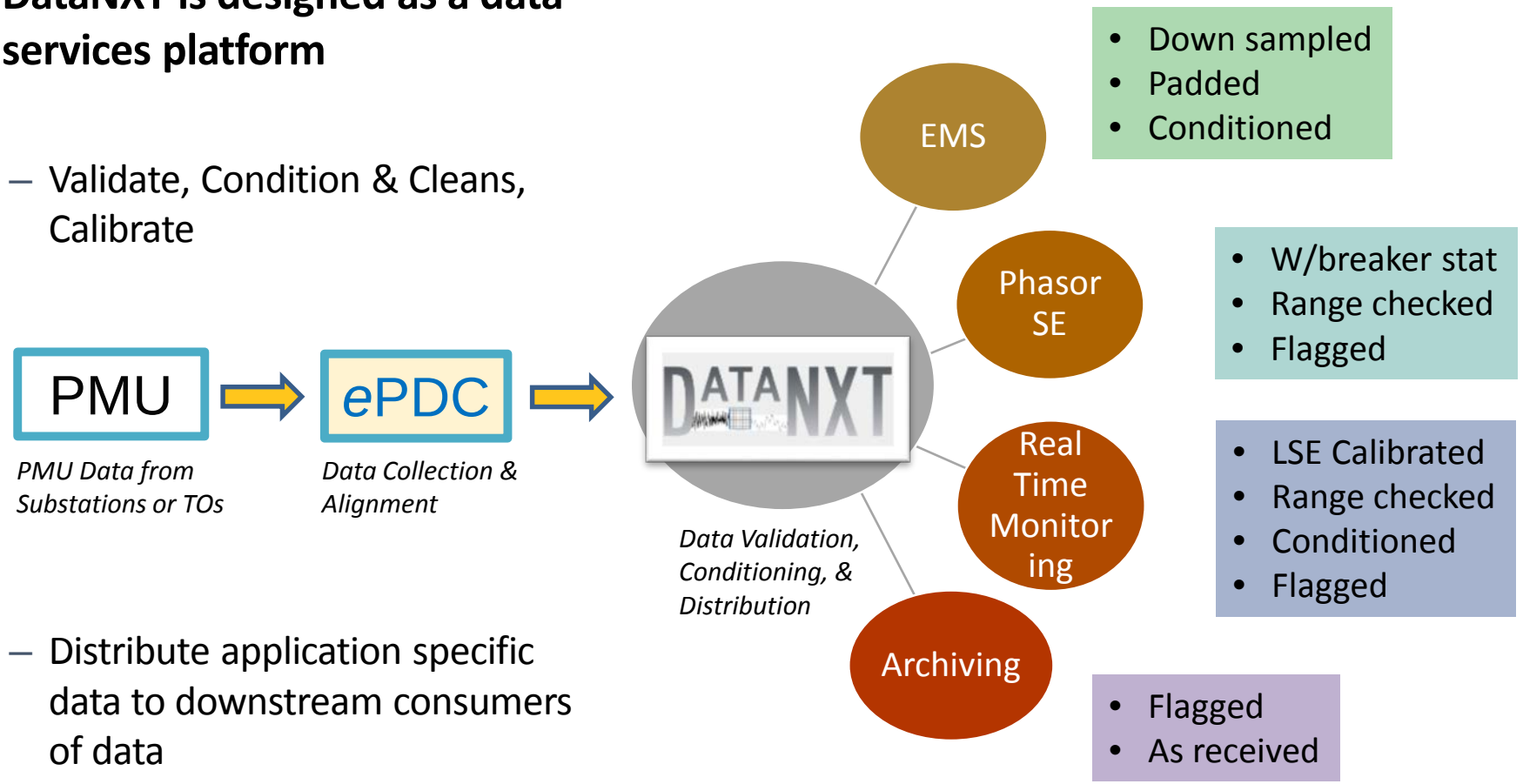
Algorithms = Detect and Flag Bad Data

Linear State Estimator = Replace Bad Data with Validated Model Based Values

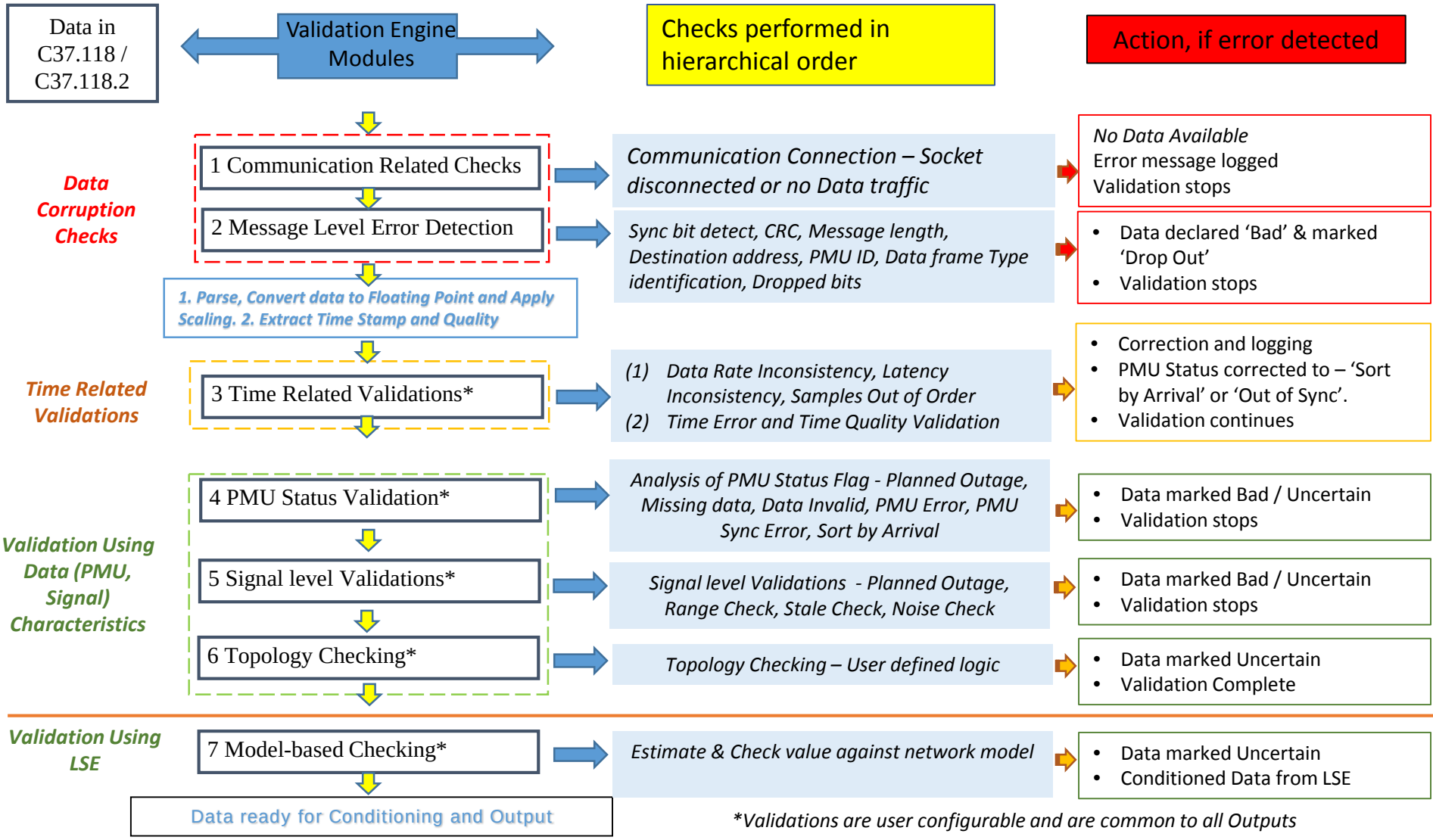


DataNXT in a phasor system

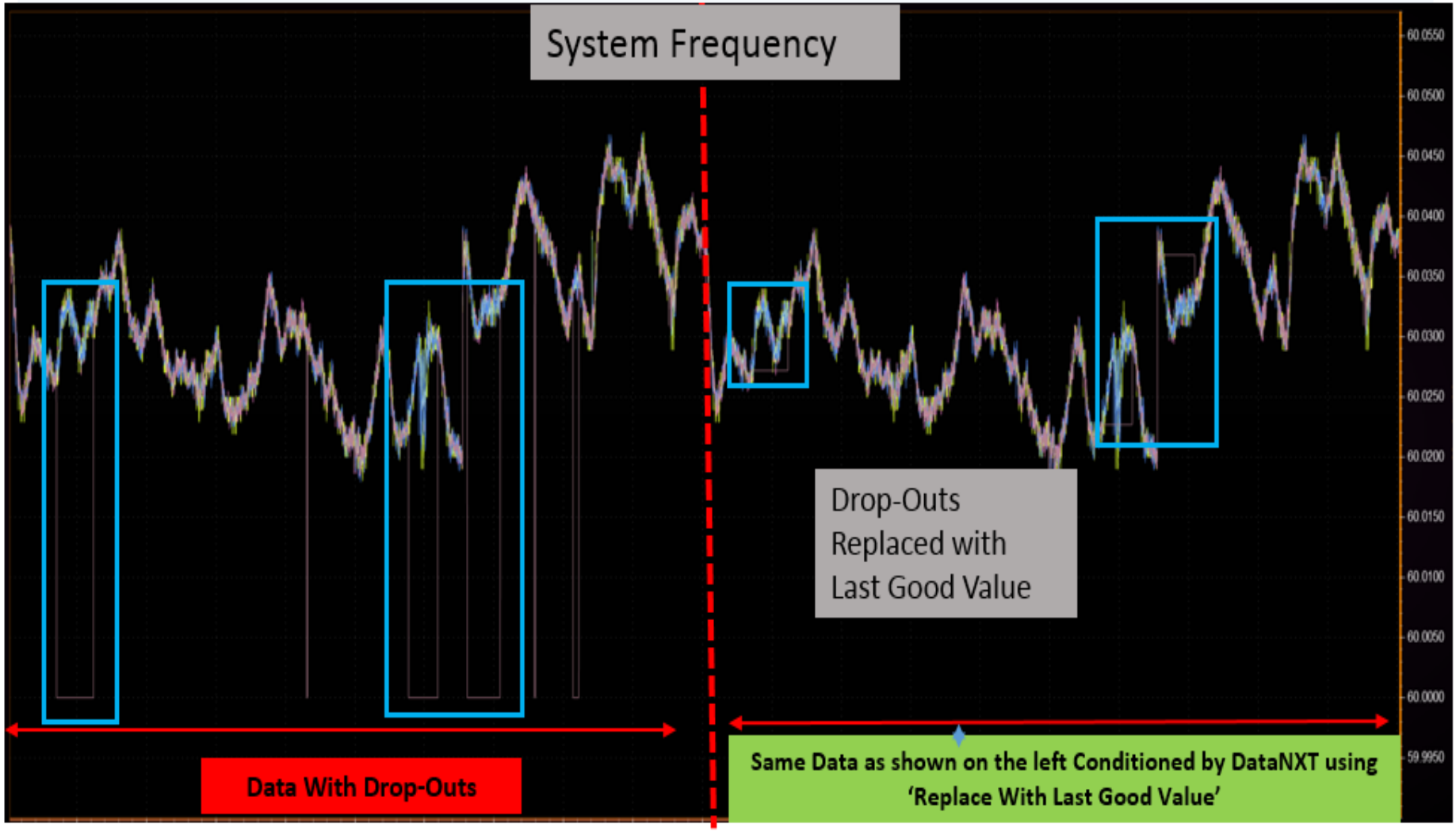
- **DataNXT is designed as a data services platform**
  - Validate, Condition & Cleans, Calibrate
  - Distribute application specific data to downstream consumers of data



DataNXT Validation Process

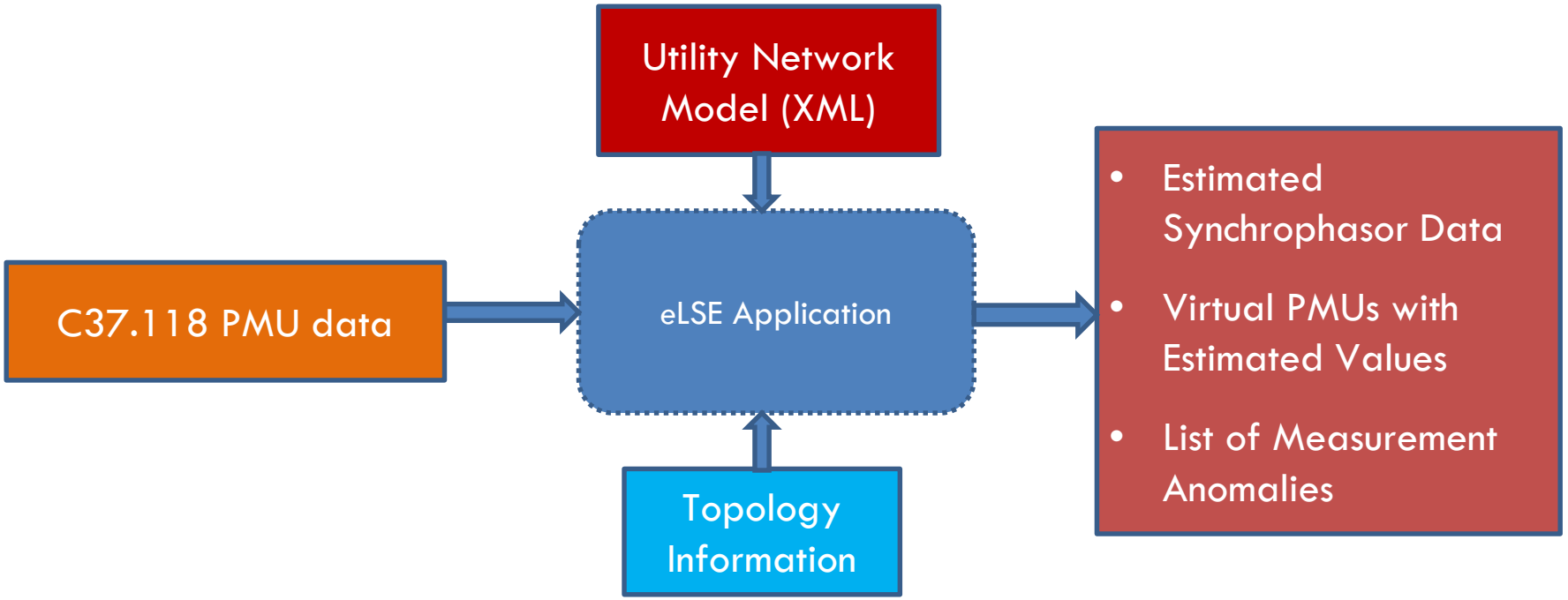


Data Conditioning Example:
Replace Dropout with Last Good Value



Model-based Validation and Conditioning Using Linear State Estimator (LSE)

- Network Model (CIM format)
- PMU Data (Real-time or Recorded)
- Topology/Breaker Status Info (From EMS or Recorded)
- Tested with BPA System, ERCOT System, and Duke Energy System

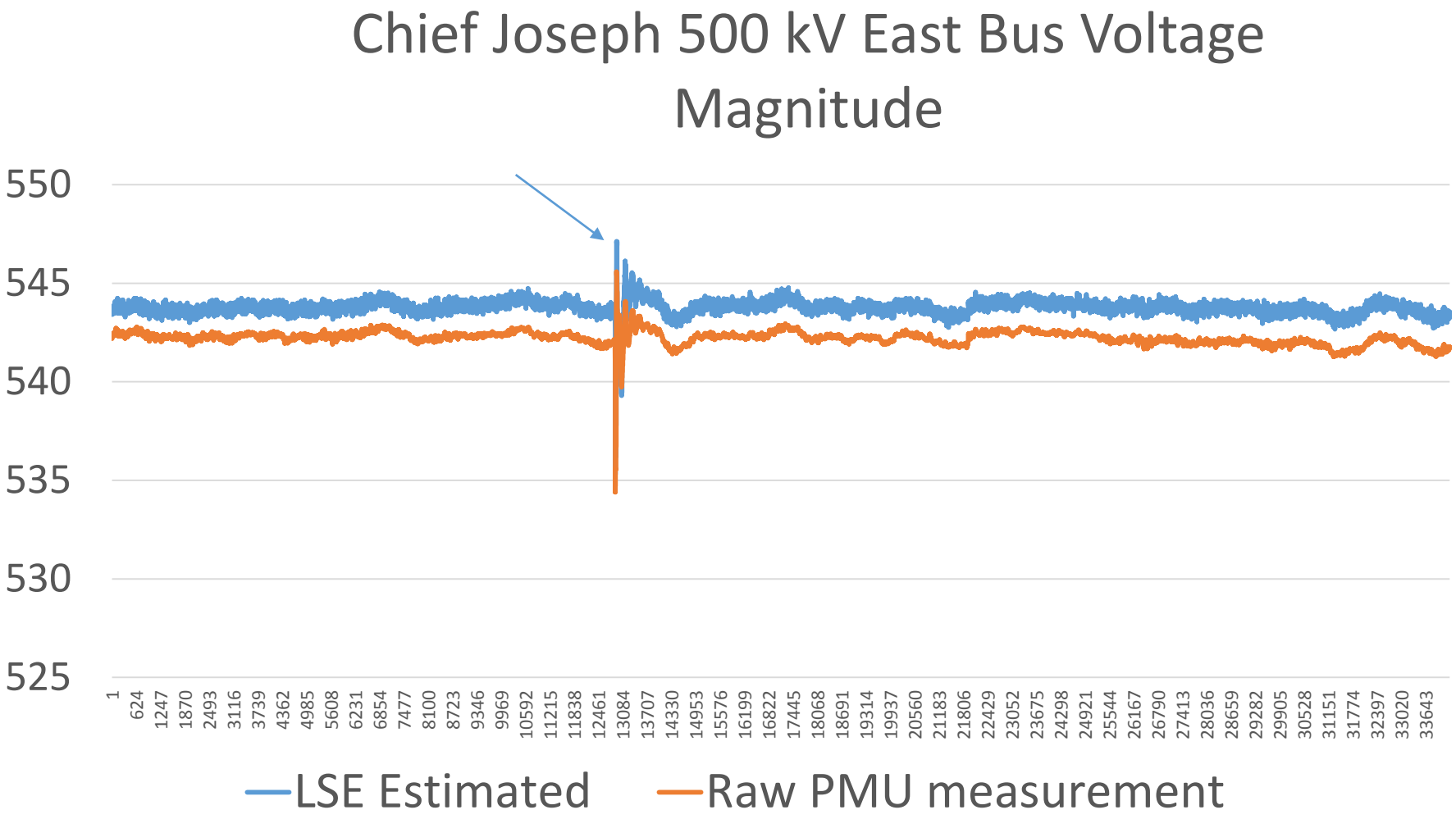


LSE Use Example: BPA System

- Validated for BPA's 500 kV and portion of 230 kV system
- System reduced to PMU visible area
  - 37 Substations with PMU installed
  - 220 phasor measurements
  - 65 observable substations
- Runs properly at 60 frames per second
- Testing with historical and live PMU data

Elements	Number
Substations	65
Lines	96
Line Segments	126
Transformers	129
Nodes	3,091
Breakers	849
Switches	2,357
Series Capacitors	18
Shunt Capacitors	112
Observable buses	78

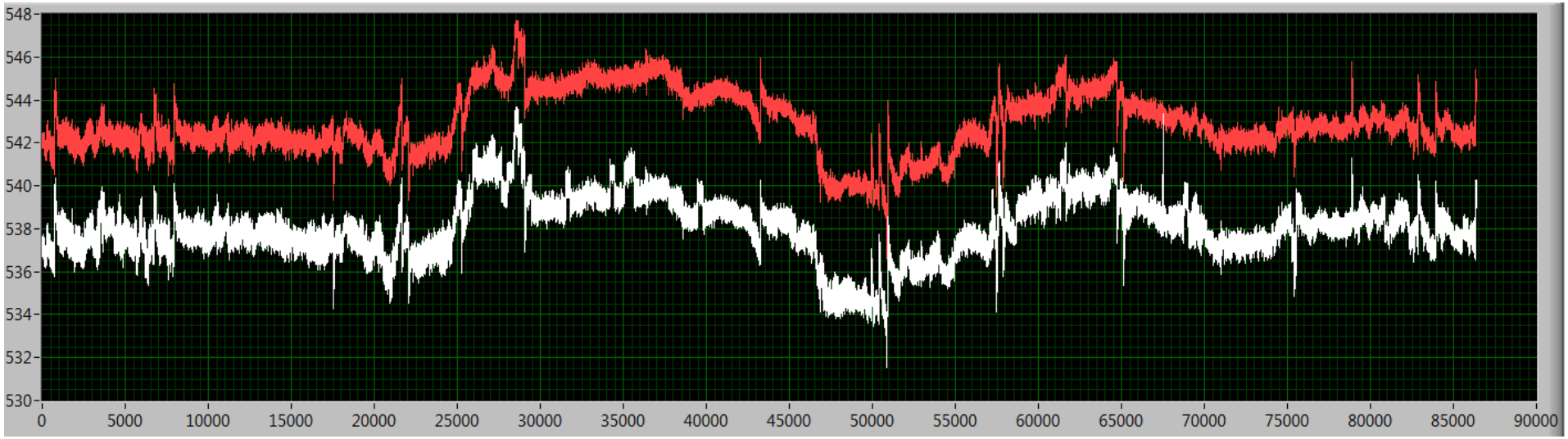
BPA System Data Conditioning
-- Off-line LSE estimation (recorded event)



Recent Live Data Testing Result - 24 hrs

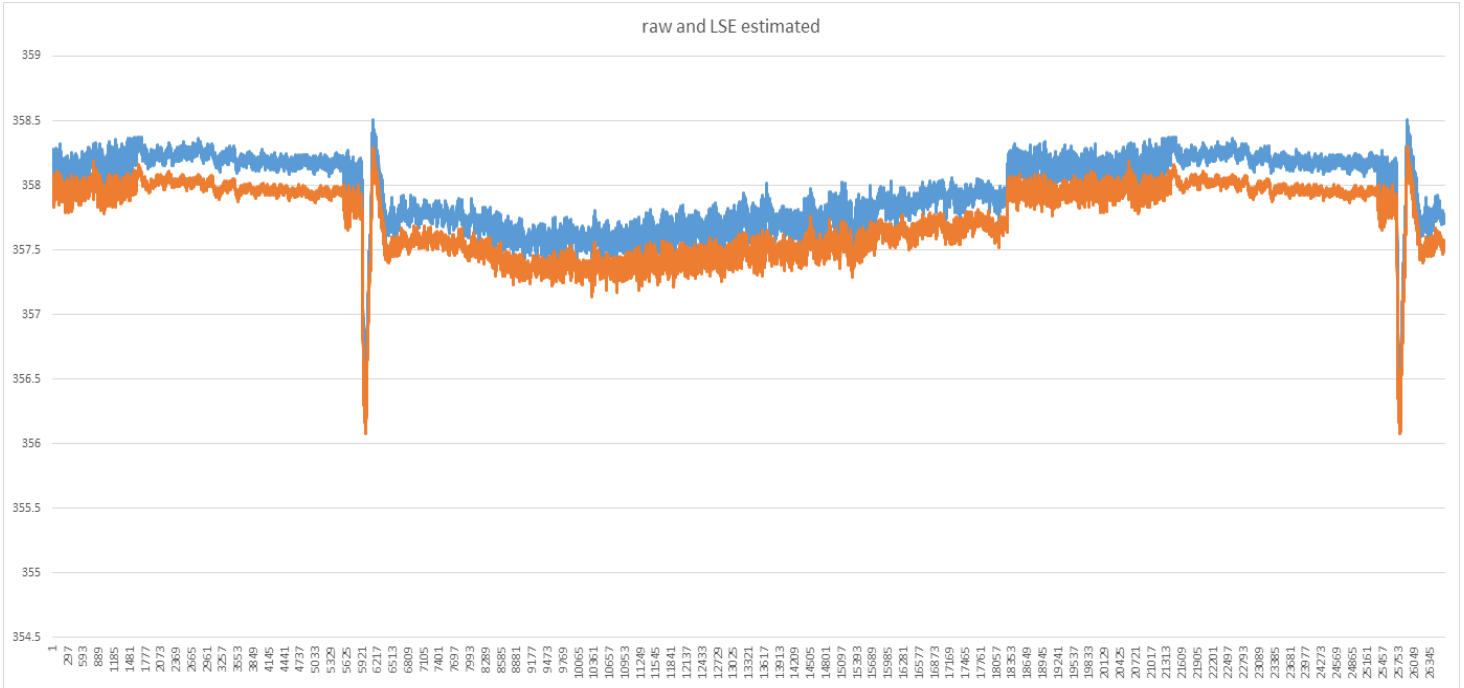
With Real-Time ICCP Update

White: SDVCA
Red: Raw



*e*LSE for ERCOT System

Orange: *e*LSE
Blue: Raw



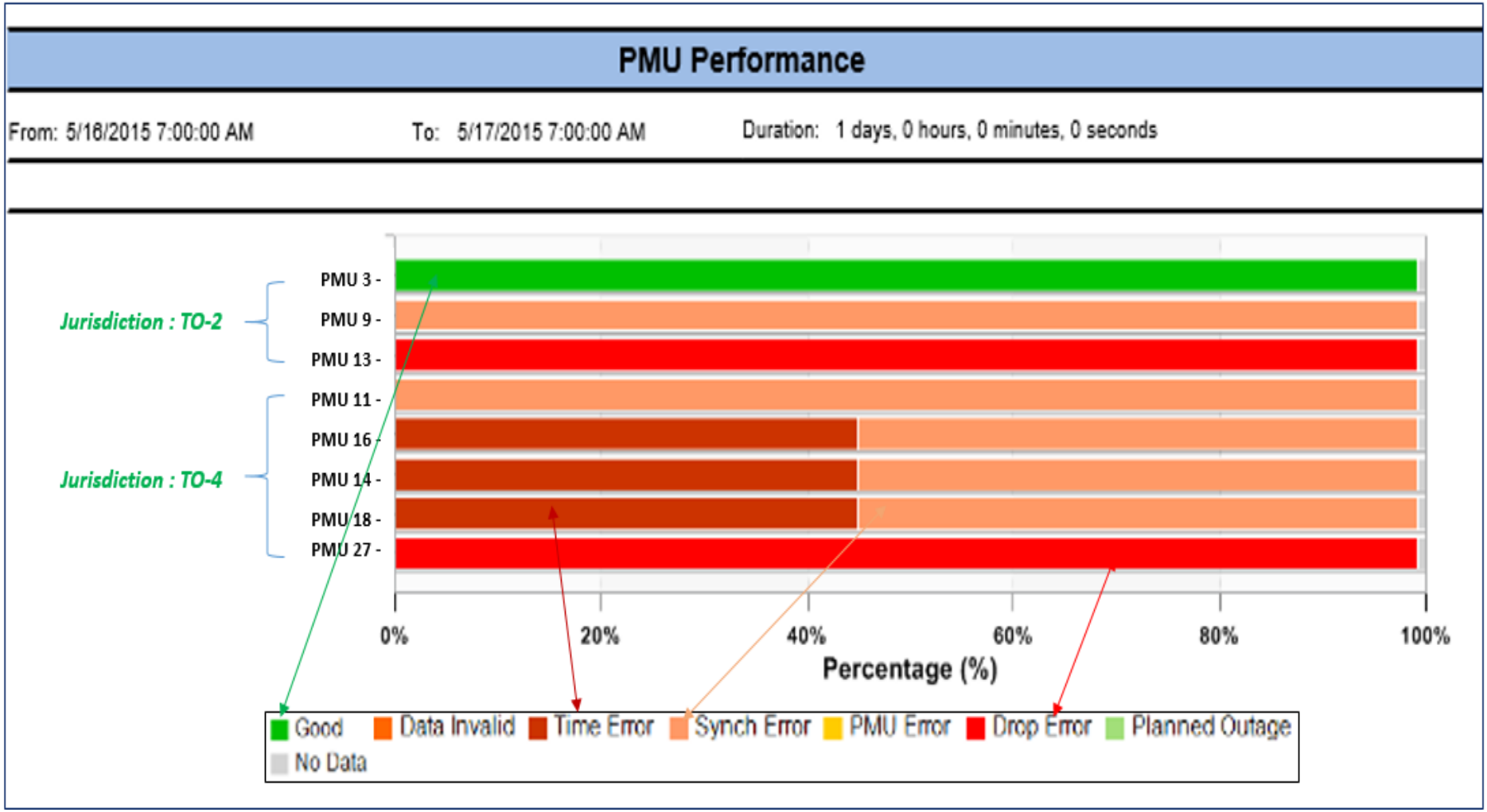
Elements	#
PMUs	92
Voltage and Current Phasors	141
Substations has PMU	30
LSE Observable Substations	54
Lines	57
Line Segments	57
Transformers	74
Nodes	1959
Breakers	555
Switches	1293
Series Capacitors	5
Shunt Capacitors	62

Data Quality Reporting

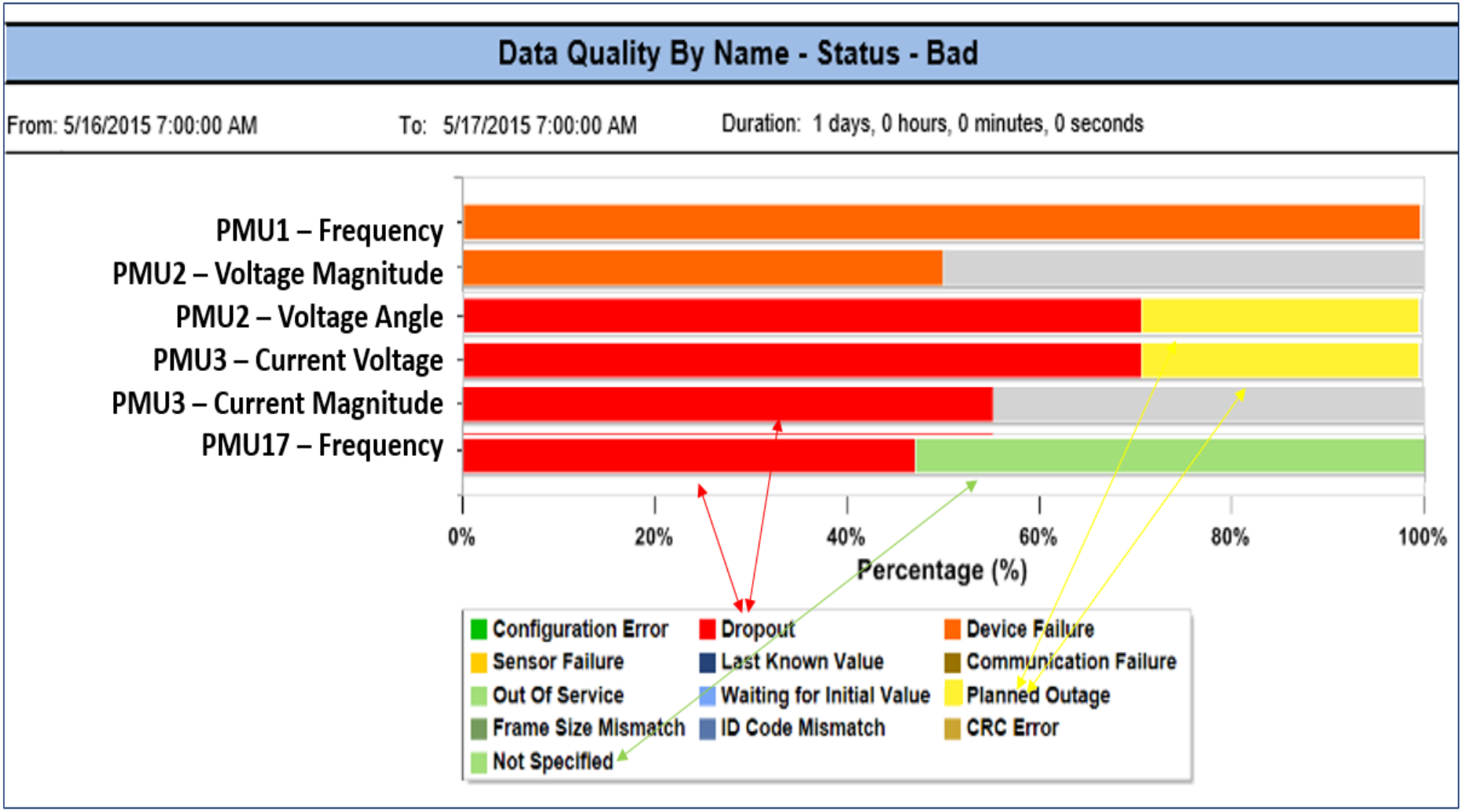
1. **Data Availability -** *How much data is missing? When? Where?*
2. **Data Quality -** *How much of the data is Good, Bad or Uncertain?*
3. **Problem Breakdown -** *What are the problems causing of Bad and Uncertain data?*
4. **Problem Sources -** *What are the problem root causes (both PMUs & Signals)? When and for how long?*
5. **Reports –** *Dashboard summary of data quality, diagnostics to pin point problems, root cause analysis, and comparison of conditioned data and raw data*

Data Quality Dashboard

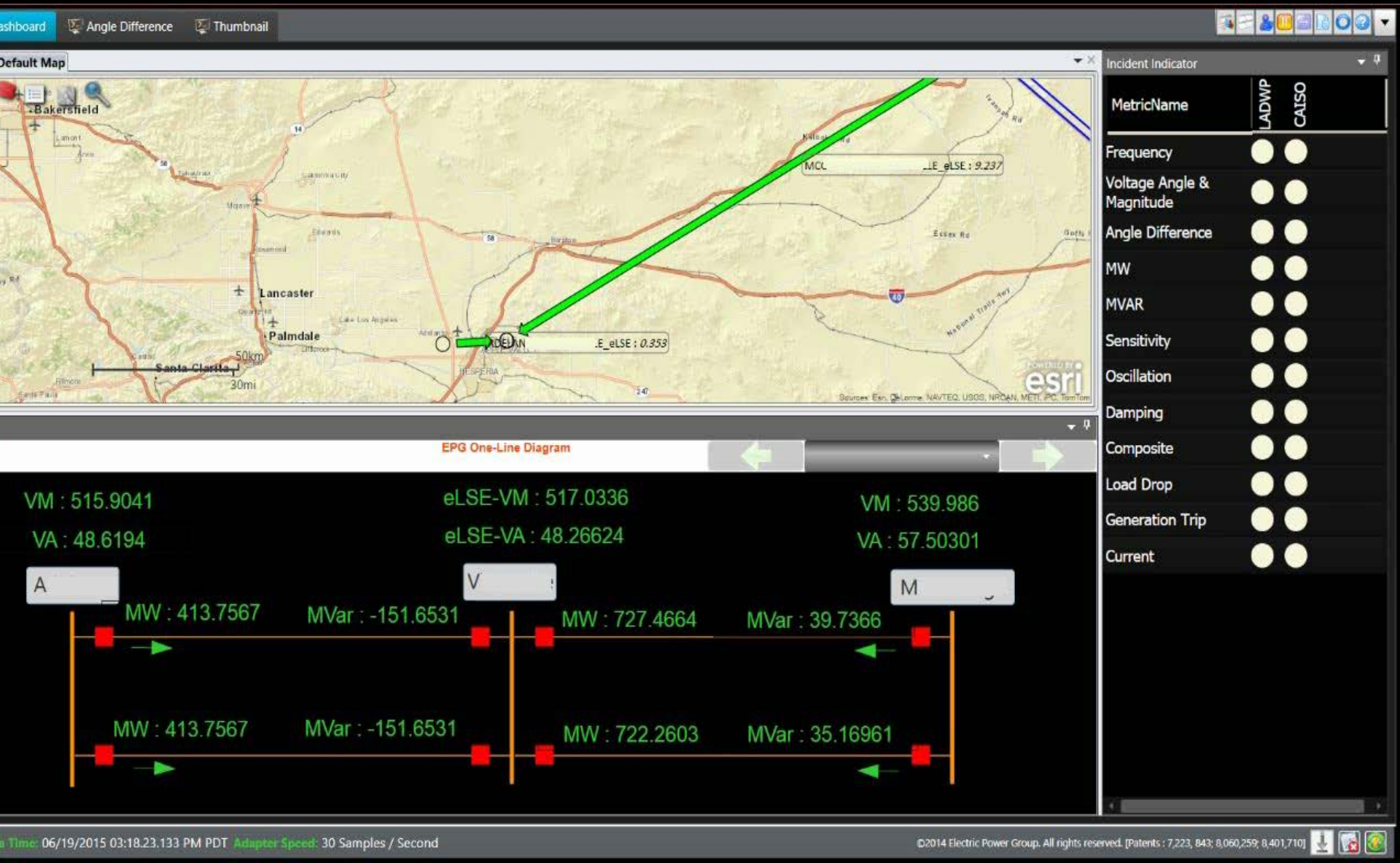
PMU Level Errors
Bad Data Determined Using PMU Status



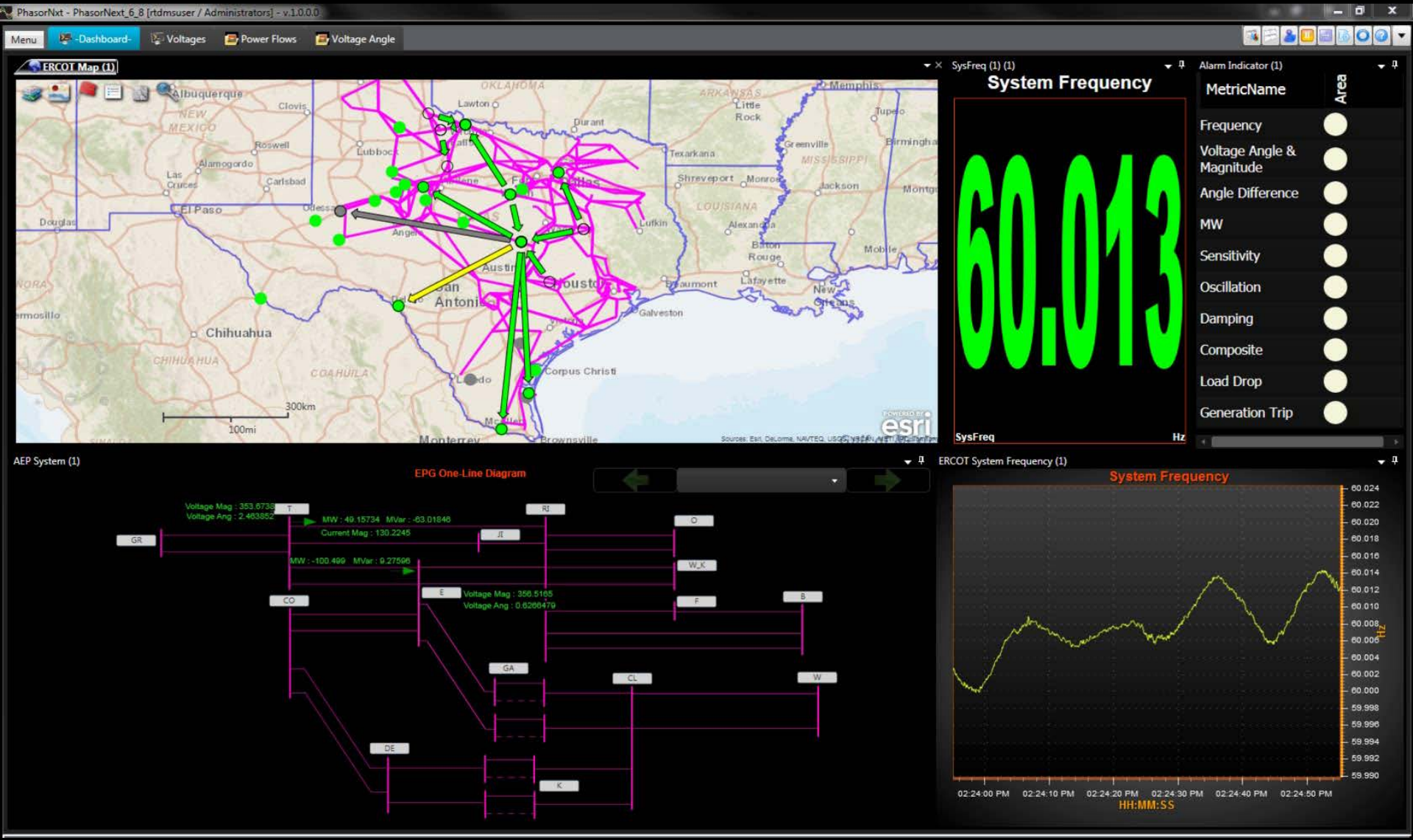
Where is Bad Data Coming From?



Use Case Example for Downstream Application: Extend PMU Observability for Line Switching



Use Case Example for Downstream Application: Monitor Critical Part of Grid as Alternate System



DataNXT Summary

Determine & Diagnose

- What are the errors?
- How serious? Impact?

Root Cause Assessment

- What are the causes?
- Where? PMU, Communication etc.

Fix

- Fix the source
  (GPS, PMU, Filter, Router…)

Develop & Establish Business Process

- Periodic/Scheduled Assessment
- Process for fix, test, certify, etc.

Validate/Assess Input Stream

- What are the errors?
- How serious?

Determine Usability

- Is the data useable by downstream application?
- What conditioning is appropriate for respective applications?

Configure Conditioning for Output Streams

- NAN
- Flag
- Correct (LSE based)

Distribute/Report

- Monitor Input Errors , Conditioned outputs

Links for More Info

- Synchro-Phasor Data Conditioning and Validation Project Phase 1 to Phase 3 Reports: https://www.naspi.org/documents
- Synchrophasor Data Validation and Conditioning: https://certs.lbl.gov/project/synchrophasor-data-validation-and
- WECC Synchrophasor Data Validation and Conditioning Application Project Reports: https://www.wecc.biz/Administrative
- Synchrophasor Data Validation and Conditioning Application Webinar: https://www.wecc.biz/Administrative/2015%2011%2012%20Synchrophasor%20Data%20Validation%20and%20Conditioning%20Application.pdf
- Synchrophasor Data Validation and Conditioning Application: https://www.electricpowergroup.net/researchApps/SDVCA/default.aspx

Thank You - Questions?

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