Categorizing Phasor Measurement Units by Application Data Requirements

Note that yellow filled (light gray) cells are cells with best/initial guesses by the author and are unsubstantiated. Unfilled/white-filled cells have received some feedback/guidance, but more is always welcomed. Excel comments on the individual cells denote contributors beyond the primary author.

Phasor Measurement Unit Application Data Requirements

	PMU Measurement Parameters					Delay/Quality Parameters				Other Information		
Application	*Amplitude, Angle, or Frequency Precision (p.u., degrees, mHz)*	*Amplitude, Angle, or Frequency Accuracy (%, absolute values)*	*ROCOF (Hz/s)*	*Frequency Range (Hz)*	*Time Accuracy (μs)*	*Measurement Transfer Time (ms)*	*Message Rate (Reports/sec)*	*Time Window (sec)*	*Data Loss Sensitivity (Reports or ms)*	*Performance Class (M/P/X/N)*	*Tools /Platforms*	*Comments*
Small-Signal Stability Monitoring	0.5 degrees 0.01 Hz	TVE	STD	0.1 - 1.0 Hz	STD	50 ms	60 Reports/sec	600 seconds	10000 ms	M	EPG RTDMS, Allstom eTerra Vision	Even in real-time applications, small-signal stability often requires a long analysis window (unless event-based). Data drop outs can be tolerated and "burst data" packets can be handled by many algorithms.
Voltage Stability Monitoring/Assessment	0.01 p.u. mag 0.5 degrees	TVE	STD	0.1 - 10.0 Hz	STD	500 ms	30 Reports/sec	300 seconds	10000 ms	X	EPG RTDMS, Allstom eTerra Vision	Even in real-time applications,voltage stability often requires a long analysis window. Data drop outs can be tolerated and "burst data" packets can be handled by many algorithms.
Thermal Monitoring (Overload)	0.5 degrees 0.1 p.u. mag	TVE	STD	0 - 0.2 Hz	STD	1000 ms	1 Report/sec	300 seconds	30 Reports	X		Significant data drop outs can be tolerated and "burst data" packets can be handled by many algorithms. Thermal Monitoring (Overload) is primarily a function of fundamental frequency current and voltages.
Frequency Stability/Islanding	0.5 degrees 0.01 Hz	TVE	STD	1.0 - 30.0 Hz	STD	50 ms	60 Reports/sec	5 seconds	1 Report	P		
Remedial Action Schemes: Automatic Arming	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0.02 - 30.0 Hz	STD	20 ms or 50-70 ms	1 Report/sec	300 seconds	1 Report	P		RAS Arming is a low latency, steady state phenomina. The response is based on the overal required timing of the RAS to protect the system from instablity.
Remedial Action Schemes: Event Detection	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0.02 - 30.0 Hz	STD	20 ms	60-120 Reports/sec	300 seconds	1 Report	P		RAS Event Detection is a low latency, low delay event. Typically it would use a report by exception rather than a polling mechanism. This is only included as a reference NOT a recommended method. RAS event action would be a command action.
Out of step protection	0.5 degrees 0.01 Hz	TVE	STD	5.0 - 30.0 Hz	STD	10 ms	60 Reports/sec	5 seconds	0 Reports	P		
Short-term stability control	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0.5 - 30.0 Hz	STD	16 ms	60 Reports/sec	60 seconds	10 ms	P		
Long-term stability control	0.01 p.u. mag 0.5 degrees	TVE	STD	0 - 10.0 Hz	STD	1000 ms	30 Reports/sec	600 seconds	1000 ms	X		
FACTS feedback control, Smart switch-able networks	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	1.0 - 30.0 Hz	STD	16 ms	60 Reports/sec	300 seconds	50 ms	X		This is very dependent on the control application. Different objectives would lead to different data reauirements. Voltage Stability would be diffeent the Subsychronus Resonance control.
State Estimation	0.5 degrees 0.01 Hz	TVE	STD	0 - 1.0 Hz	STD	1000 ms	5 Reports/sec	300 seconds	1000 ms	M		Assumes traditional static state estimation. Dynamic state estimation would obviously have more stringingent requirements
Disturbance Analysis Compliance	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0 - 30.0 Hz	STD	1000 ms	60 Reports/sec	Length of event	100 ms	M		
Frequency Response Analysis	0.5 degrees 0.01 Hz	TVE	STD	0 - 1.0 Hz	STD	1000 ms	5 Reports/sec	300 seconds	25 Reports	M		
Model Validation	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0 - 30.0 Hz	STD	1000 ms	60 Reports/sec	Time frame of model	1000 ms	M		
Phasor Network performance monitoring & data quality	N/A	TVE	STD	0 - 30.0 Hz	STD	Measured	60 Reports/sec	86400 seconds	60 Reports	X		General evaluation of the phasor communication network, including delays and drop out sensitivities. This application itself is insensitive to drop outs and delays (it is evaluating them), but the results may tie directly into other application requirements.
Baseline Normal Phase Angle Trends	0.5 degrees	TVE	STD	0 - 10.0 Hz	STD	1000 ms	15 Reports/sec	86400 seconds	150 Reports	M		

Pattern Recognition/Correlation Analysis	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0 - 0.2 Hz	STD	1000 ms	1 Report/sec	3600 seconds	20 Reports	M		
Situational Awareness Dashboard	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0 - 1.0 Hz	STD	100 ms	30 Reports/sec	300 seconds	10 Reports	M		The data displayed on a trend or visualization may only be updated at 5 times a second or so, but if it is a trend the data should be displayed at scan rate updated at the slower rate.
Real Time Compliance Monitoring with Reliability Standards	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0 - 1.0 Hz	STD	1000 ms	5 Reports/sec	1800 seconds	10 Reports	M		Reports/Second could vary dependent upon the Reliablity standard in question
Real Time Performance Monitoring and Trending	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	0 - 0.2 Hz	STD	1000 ms	1 Report/sec	3600 seconds	30 Reports	X		Not sure what this one means. Are you refering to the Electrical system or the data collection system. Different information would be needed for the different systems.
Anomaly Characterization and Alarming	0.01 p.u. mag 0.5 degrees 0.01 Hz	TVE	STD	1.0 - 30.0 Hz	STD	100 ms	60 Reports/sec	3600 seconds	120 Reports	M		

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Unless otherwise noted, values are purely arbitrary and just based on initial guesses