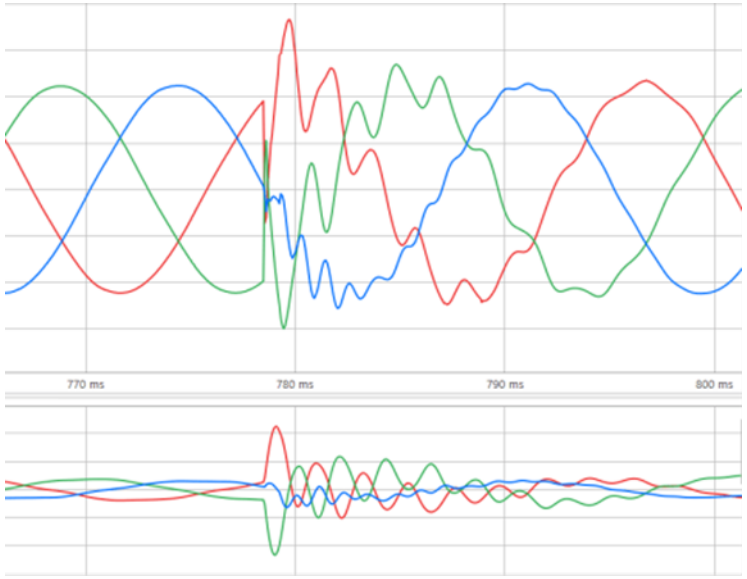
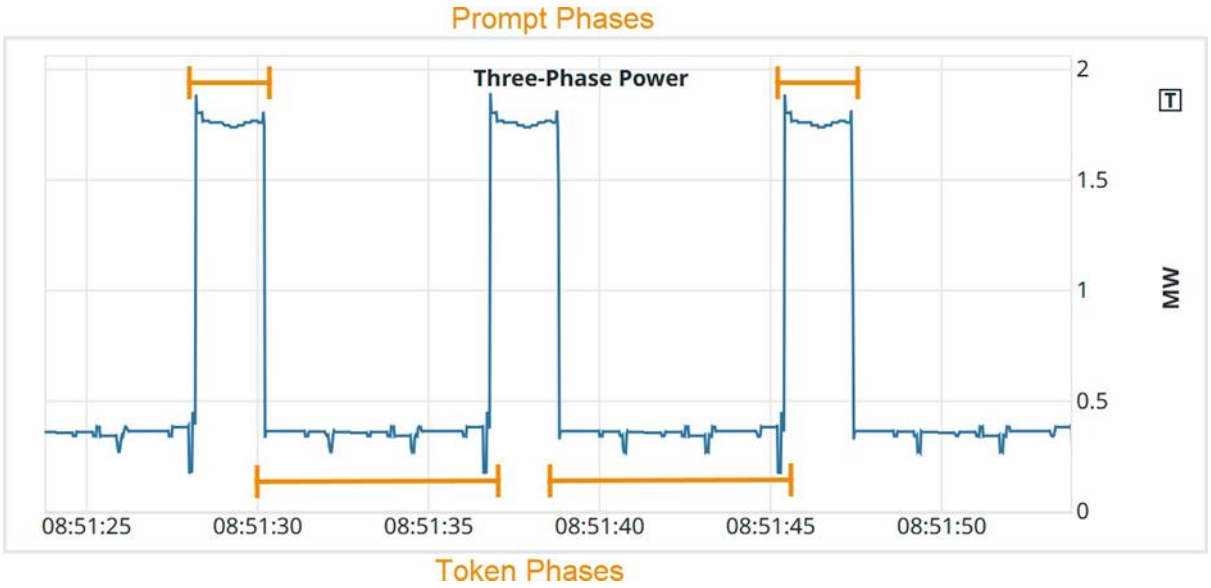
Exploring approaches to time-series streaming and event triggers

Jared Bestebreur, Senior Engineering Manager

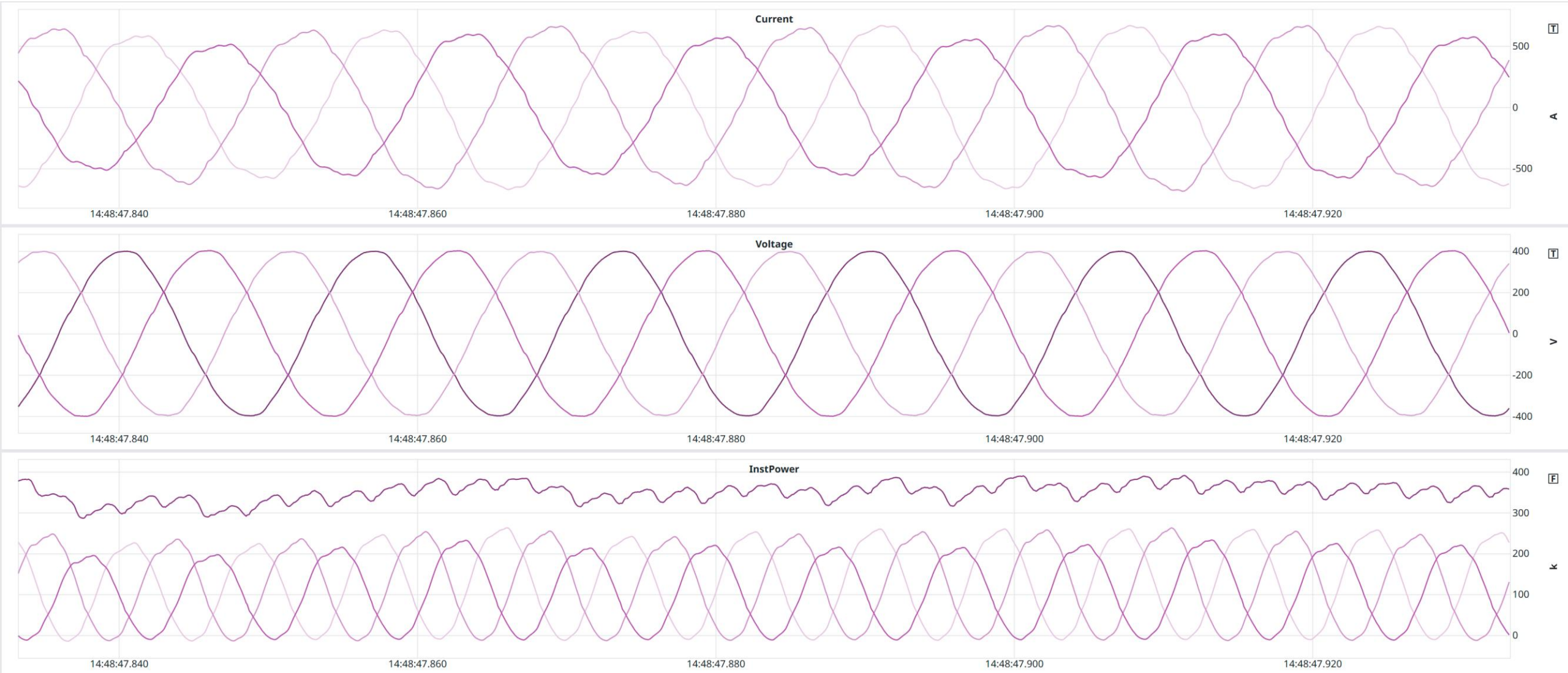
New Era of Loads

- AI Training Algorithms
- Arc Furnaces
- EV Charging
- Crypto-currency Mining

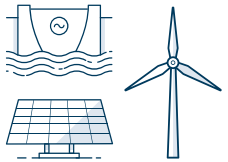




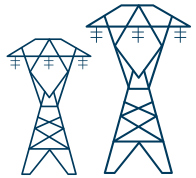
Continuous Waveform Data



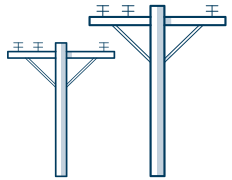
Power Systems



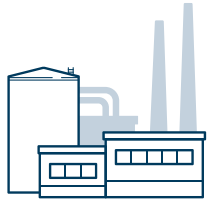
Generation



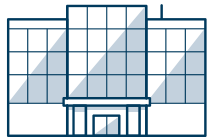
Transmission



Distribution



Industrial



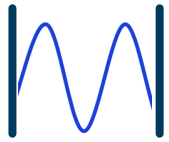
Commercial

Devices

- Relays
- DFRs
- Reclosers
- Meters
- Merging Units
- Virtual (Software)

Event Data

Hardware
Triggered Events



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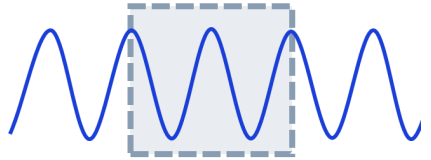
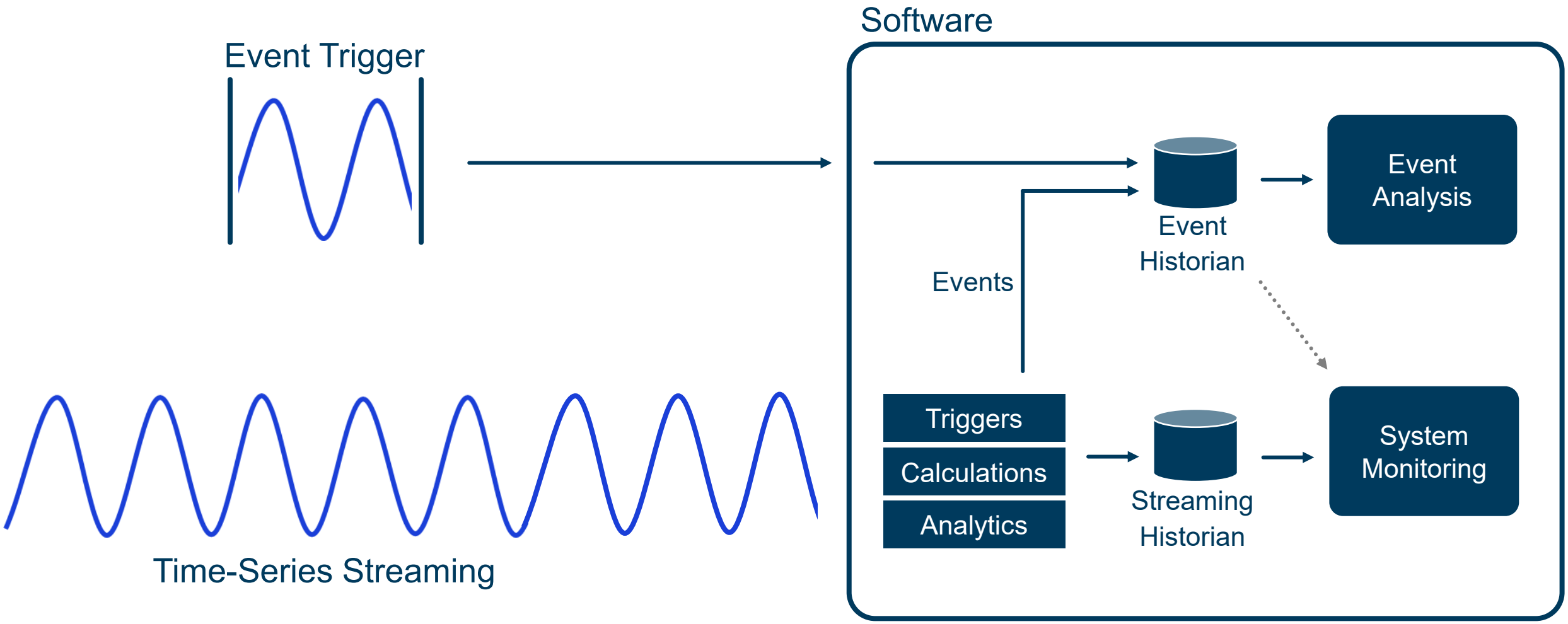
Software
Triggered Events



from streaming data

Designing Systems for Streaming and Triggers

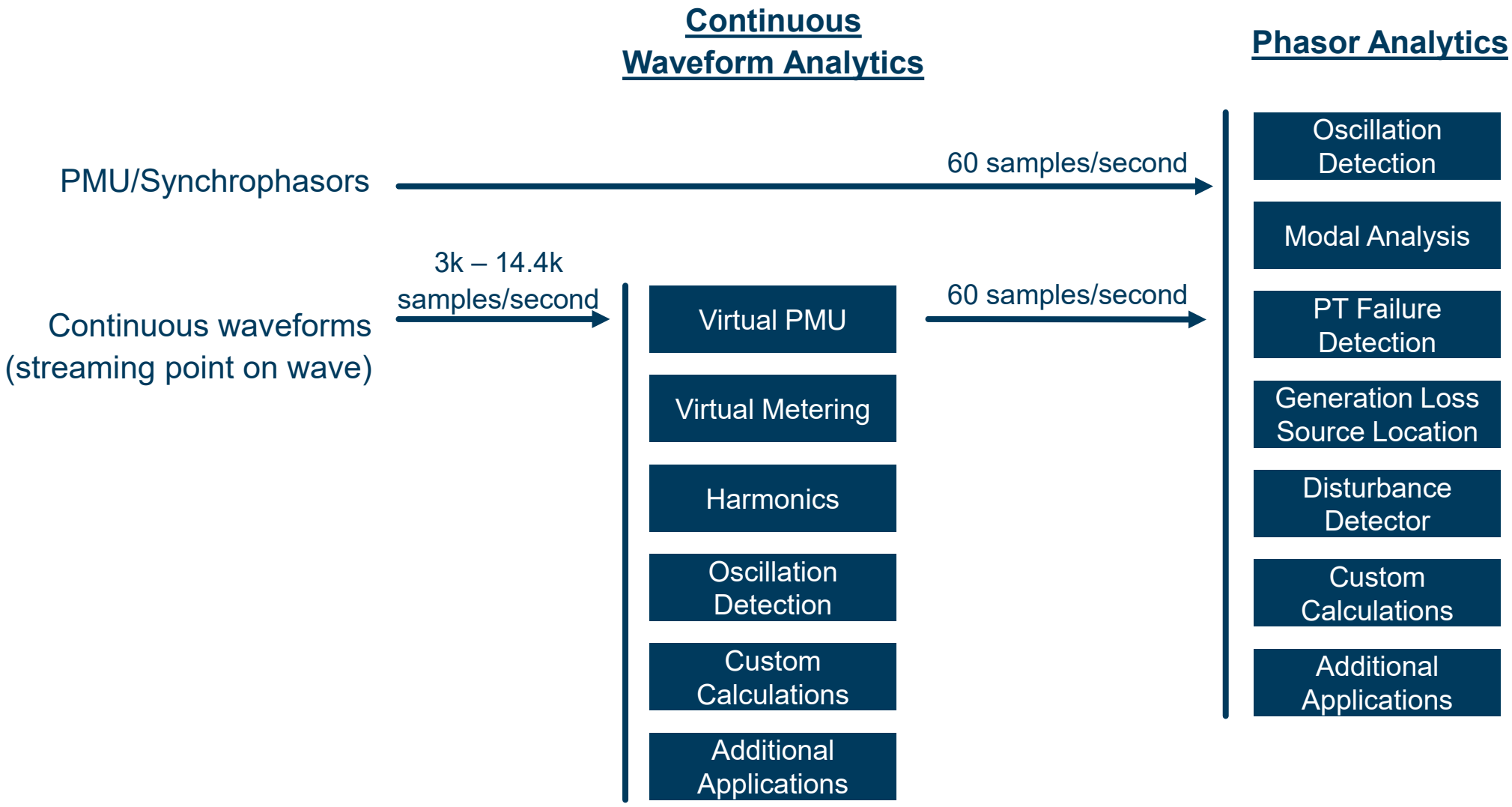


Streaming protocol examples

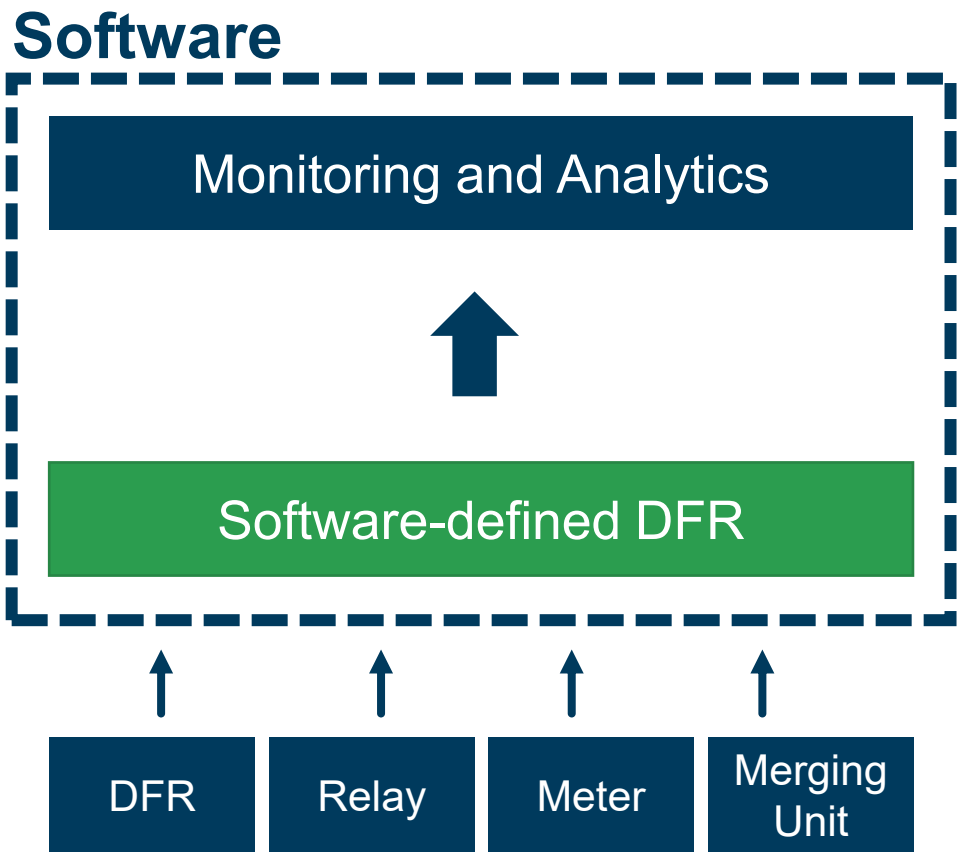
Synchrophasor Protocols	Device	Streaming Rate (sps)
IEEE C37.118	PMUs, PDCs	30, 60, 240
STTP	PDCs	30, 60, 240

Waveform Streaming Protocols	Device	Streaming Rate (ksps)
Wave Server (modified C37.118)	SEL-Axion, SEL-T35	3, 14.4
Continuous Waveform Stream (CWS)	SEL-735	3
Livestream	SEL-651R, SEL-351A	1.92
IEC 61850-9-2LE (Sample Values)	SEL-4XX, SEL-851, Others	4, 4.8
IEC 61869-9 (Sample Values)	SEL-4XX, Others	4, 4.8
STTP	OpePDC/WaveField	Variable

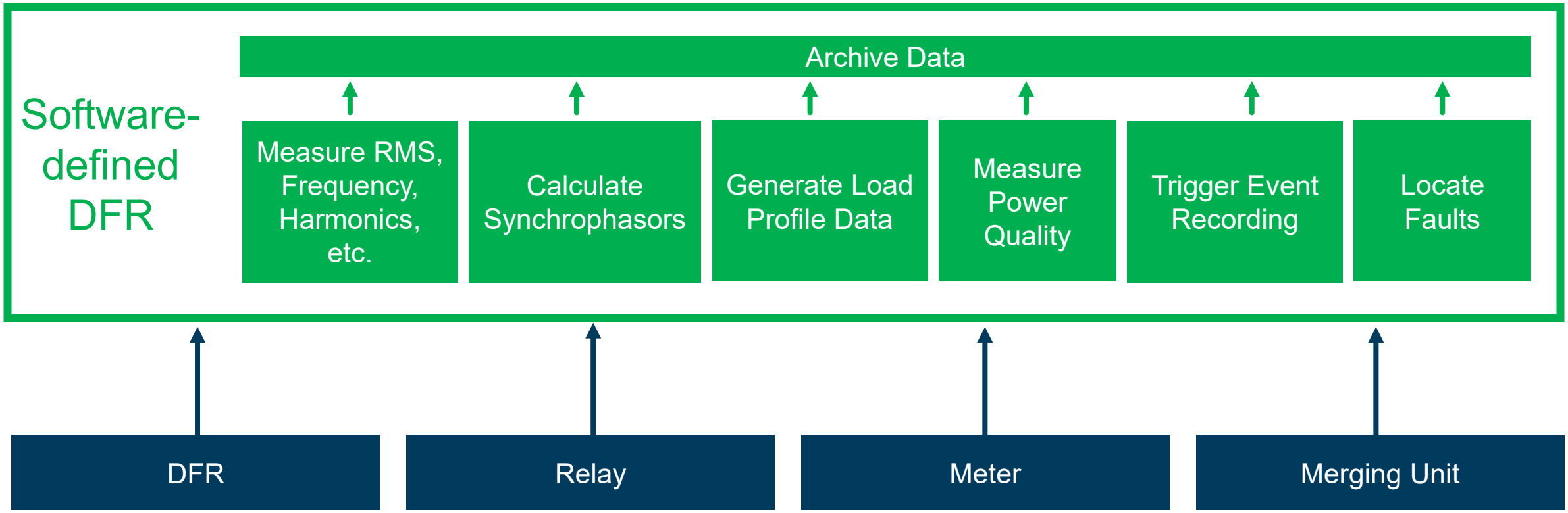
Streaming calculations and analytics



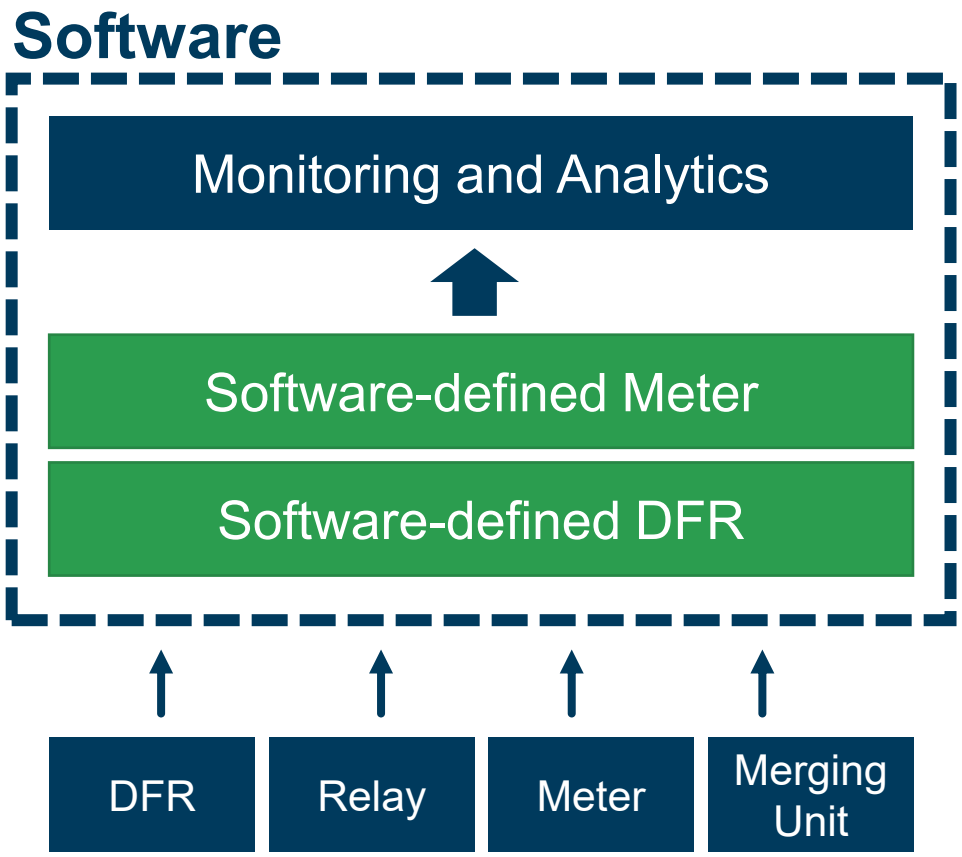
Use case 1: Software-defined DFR



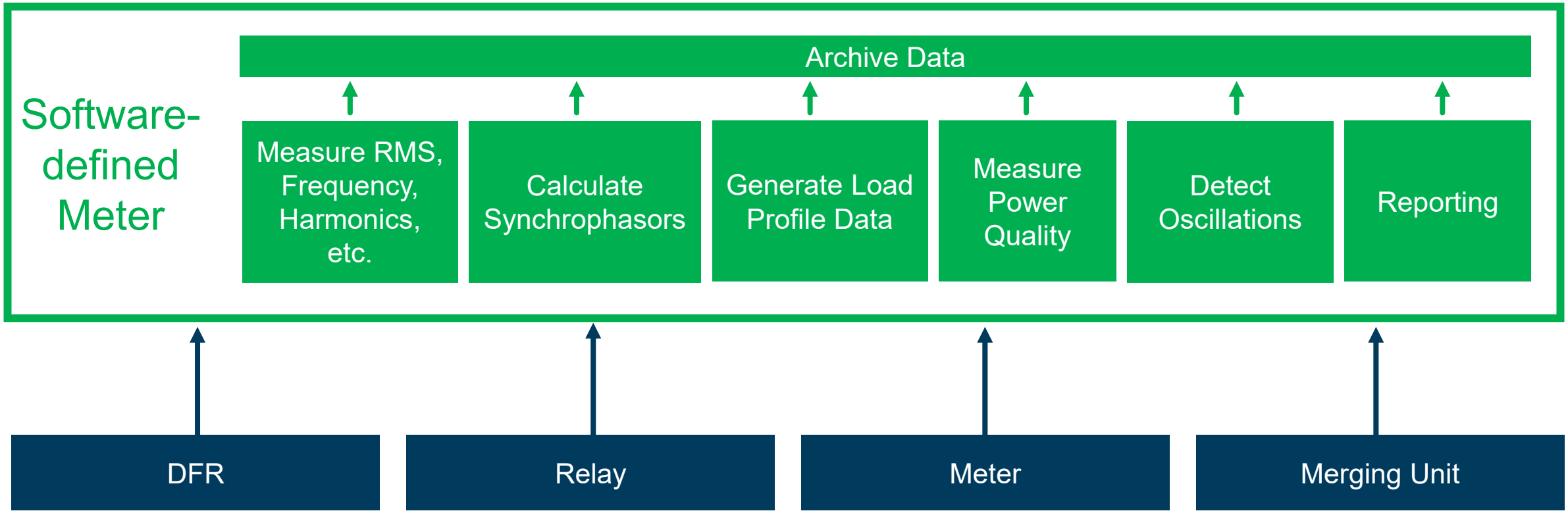
Software-defined DFR capability with continuous waveform streaming



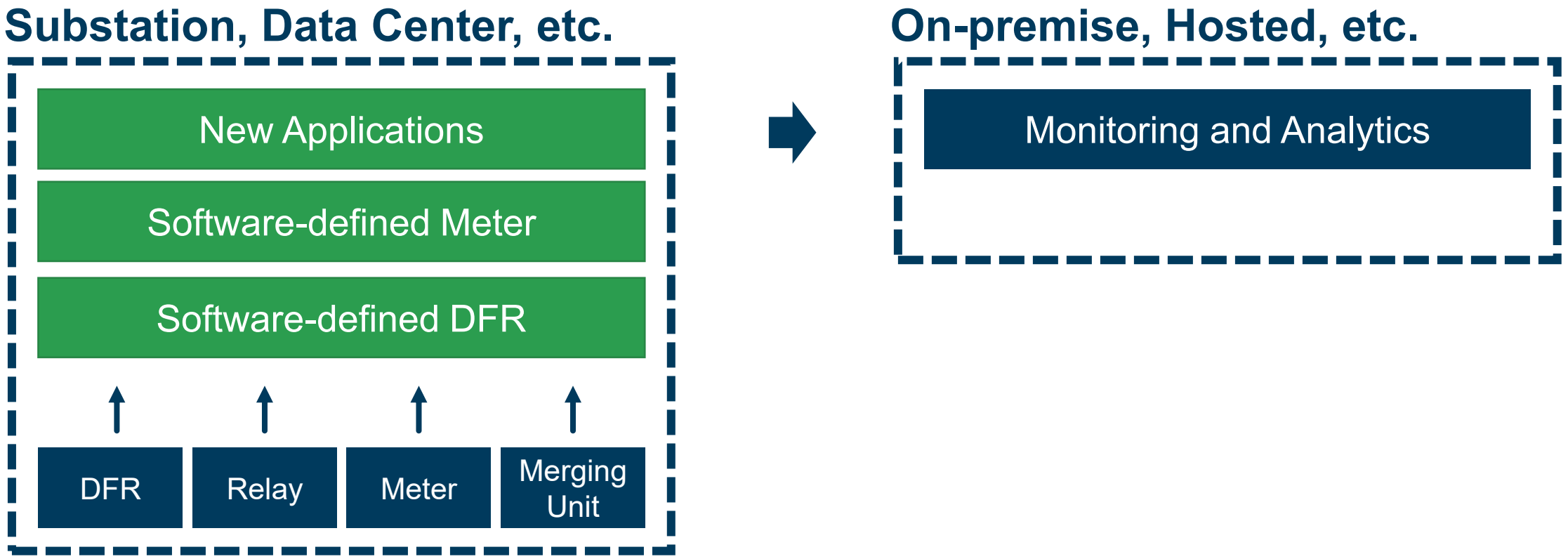
Use Case 2: Software-defined Meter



Software-defined Meter capability with continuous waveform streaming

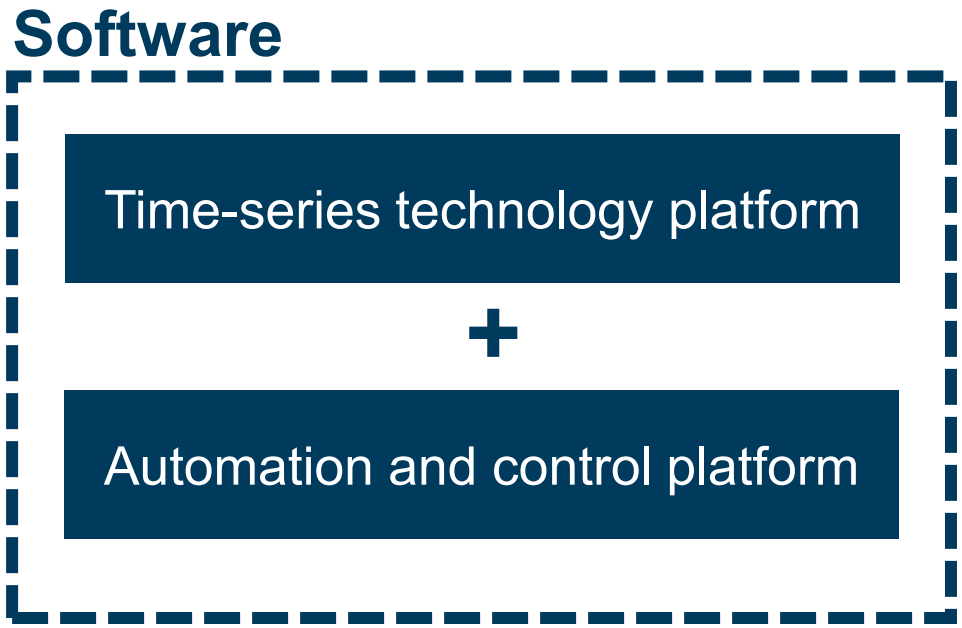


Join us in exploring new use cases and deployment architectures

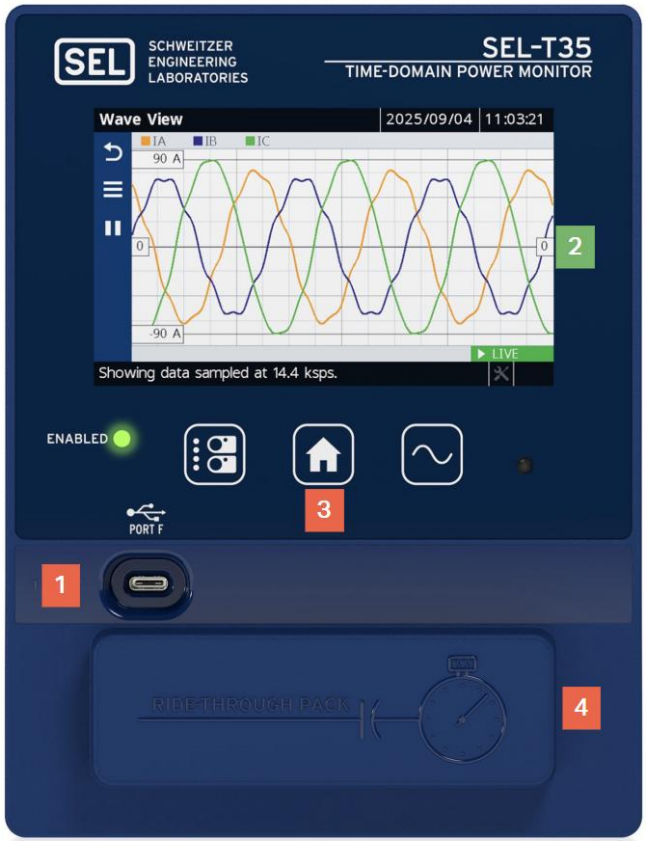


What’s happened since last NASPI?

Merged analytics and control platforms

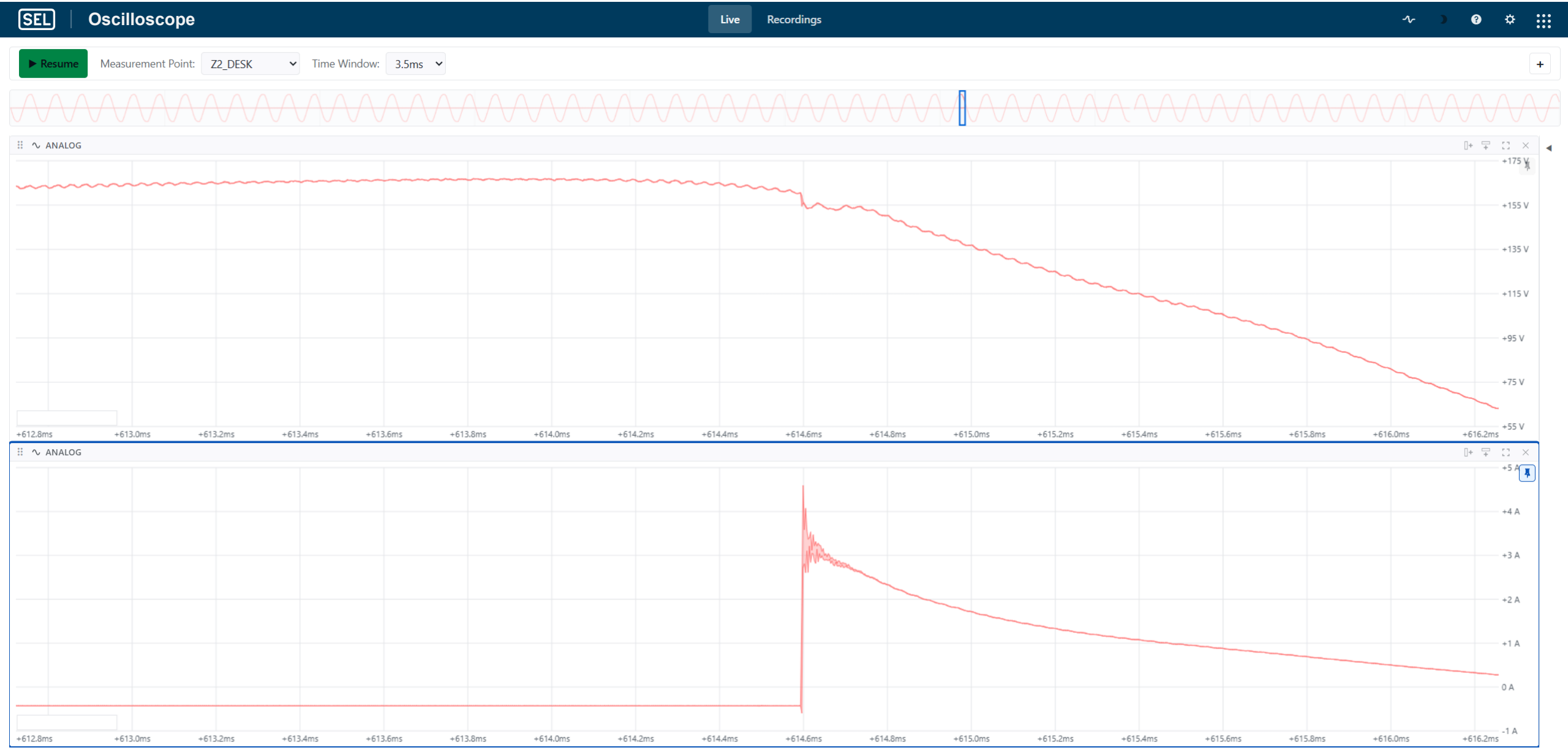


Improved edge architecture for 1 MHz



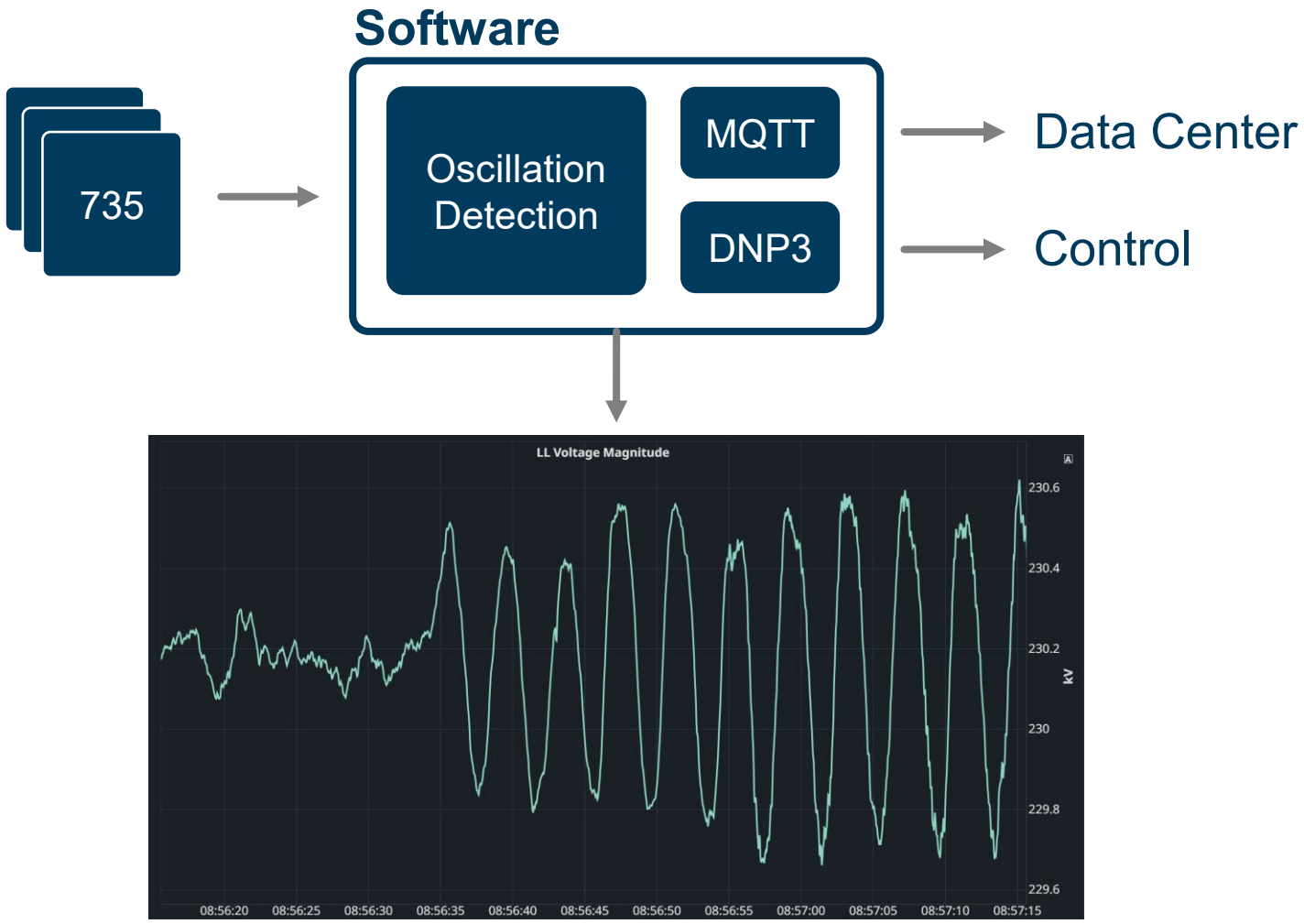
Oscilloscope


SEL Oscilloscope
Live
Recordings
Pause
Measurement Point: GRAPHITE_SOLAR
Time Window: 93.5ms
ANALOG
INSPECTOR
TRIGGER
CHANNELS
Show All
FREQ
PHASEA.CURRENT
PHASEA.VOLTAGE
PHASEB.CURRENT
PHASEB.VOLTAGE
PHASEC.CURRENT
PHASEC.VOLTAGE
+200 V
+150 V
+100 V
+50 V
0 V
-50 V
-100 V
-150 V
-200 V
T_REF = 16:43:44.15000
+470ms
+480ms
+490ms
+500ms
+510ms
+520ms
+530ms
+540ms
+550ms
+560ms
Connected
data: 22 fps
render: 12 fps
1 MHz
Viewing MPs: GRAPHITE_SOLAR
v0.0.0.195


SEL
Oscilloscope
Live
Recordings
▶ Resume
Measurement Point:
Z2_DESK
Time Window:
3.5ms
+
ANALOG
+175 V
+155 V
+135 V
+115 V
+95 V
+75 V
+55 V
+612.8ms
+613.0ms
+613.2ms
+613.4ms
+613.6ms
+613.8ms
+614.0ms
+614.2ms
+614.4ms
+614.6ms
+614.8ms
+615.0ms
+615.2ms
+615.4ms
+615.6ms
+615.8ms
+616.0ms
+616.2ms
ANALOG
+5 A
+4 A
+3 A
+2 A
+1 A
0 A
-1 A
+612.8ms
+613.0ms
+613.2ms
+613.4ms
+613.6ms
+613.8ms
+614.0ms
+614.2ms
+614.4ms
+614.6ms
+614.8ms
+615.0ms
+615.2ms
+615.4ms
+615.6ms
+615.8ms
+616.0ms
+616.2ms
Paused
data: 21 fps
render: 30 fps
1 MHz
Viewing MPs: Z2_DESK
v0.0.0.181

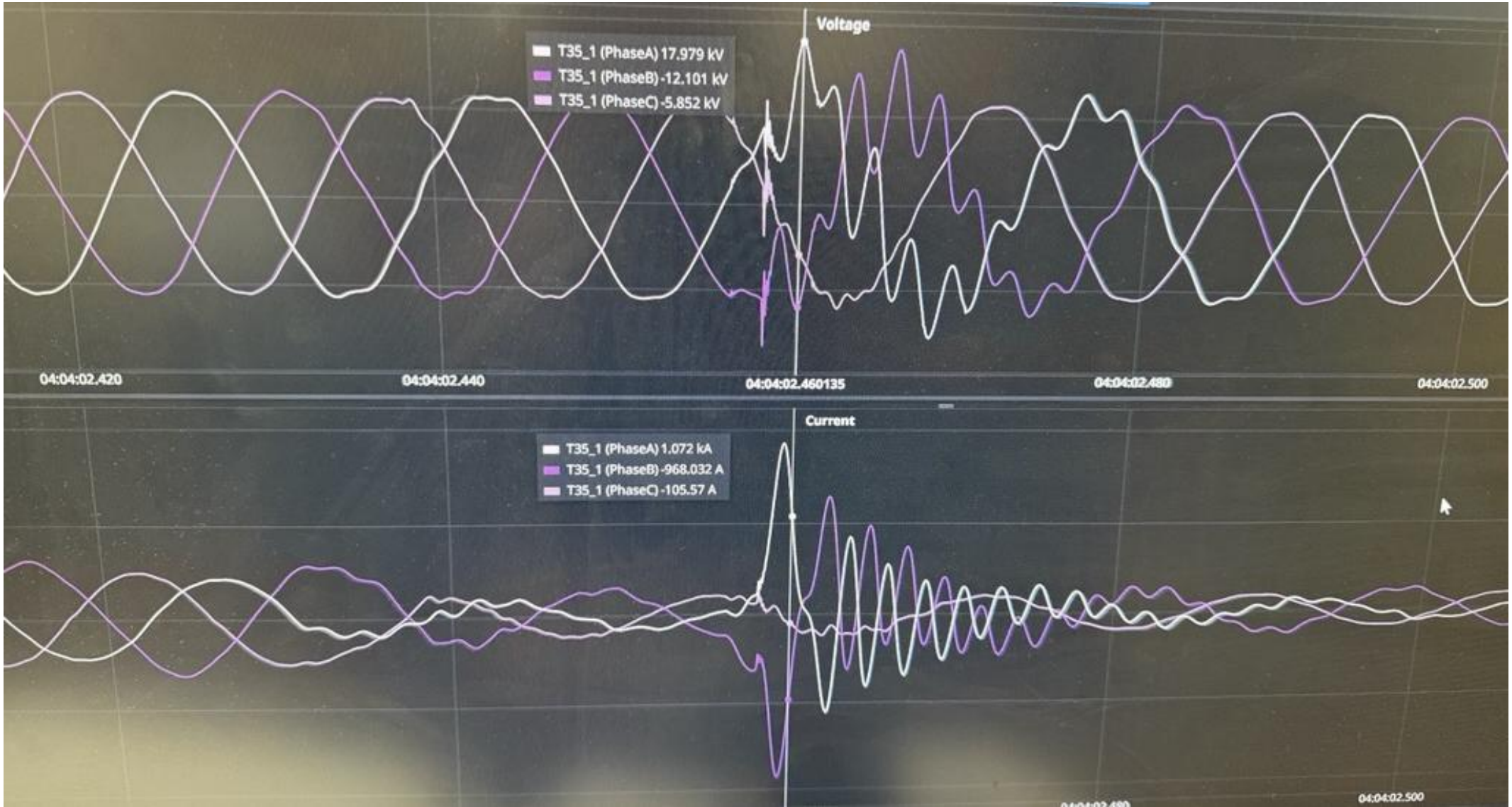

SEL
Oscilloscope
Live
Recordings
Pause
Measurement Point:
Z2_DESK
Time Window:
50ms
ANALOG
+300 V
+200 V
+100 V
0 V
-100 V
-200 V
-300 V
+950ms
+955ms
+960ms
+965ms
+970ms
+975ms
+980ms
+985ms
+990ms
+995ms
+1000ms
ANALOG
+1.5 A
+1.0 A
+0.5 A
0.0 A
-0.5 A
-1.0 A
-1.5 A
+950ms
+955ms
+960ms
+965ms
+970ms
+975ms
+980ms
+985ms
+990ms
+995ms
+1000ms
Connected
data: 20 fps
render: 19 fps
1 MHz
Viewing MPs: Z2_DESK
v0.0.0.181

New Use Case: Data Center Monitoring

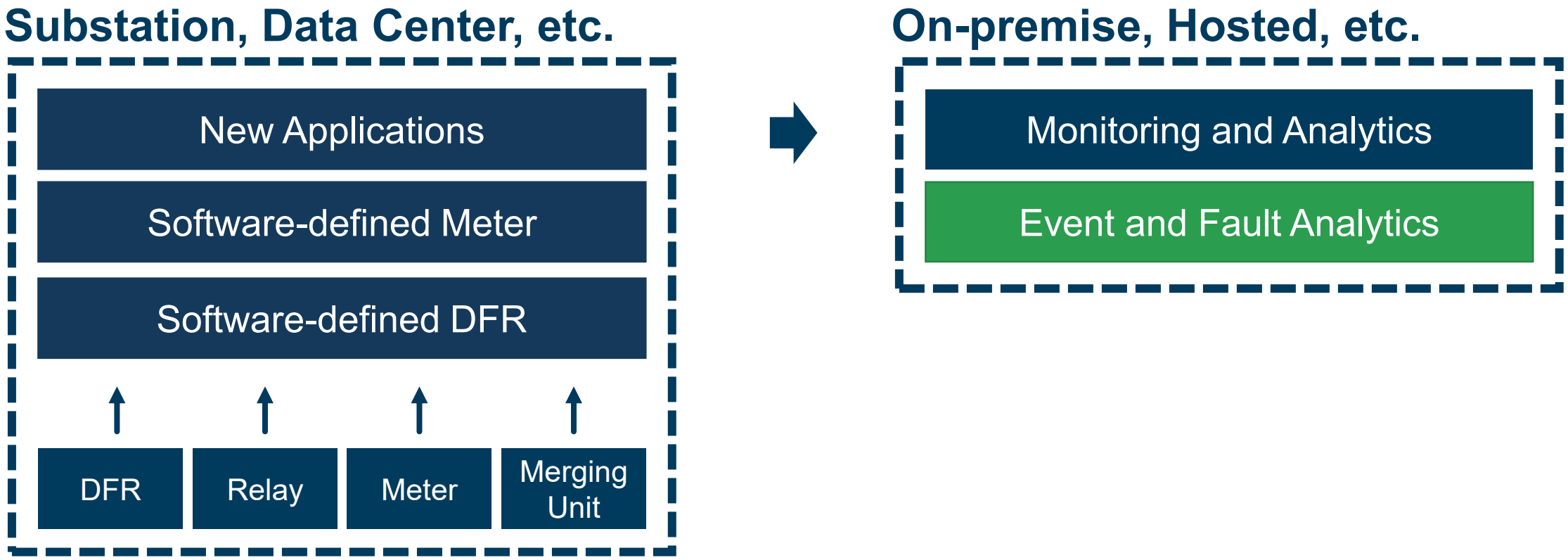


Utility Substation – Solar + BESS

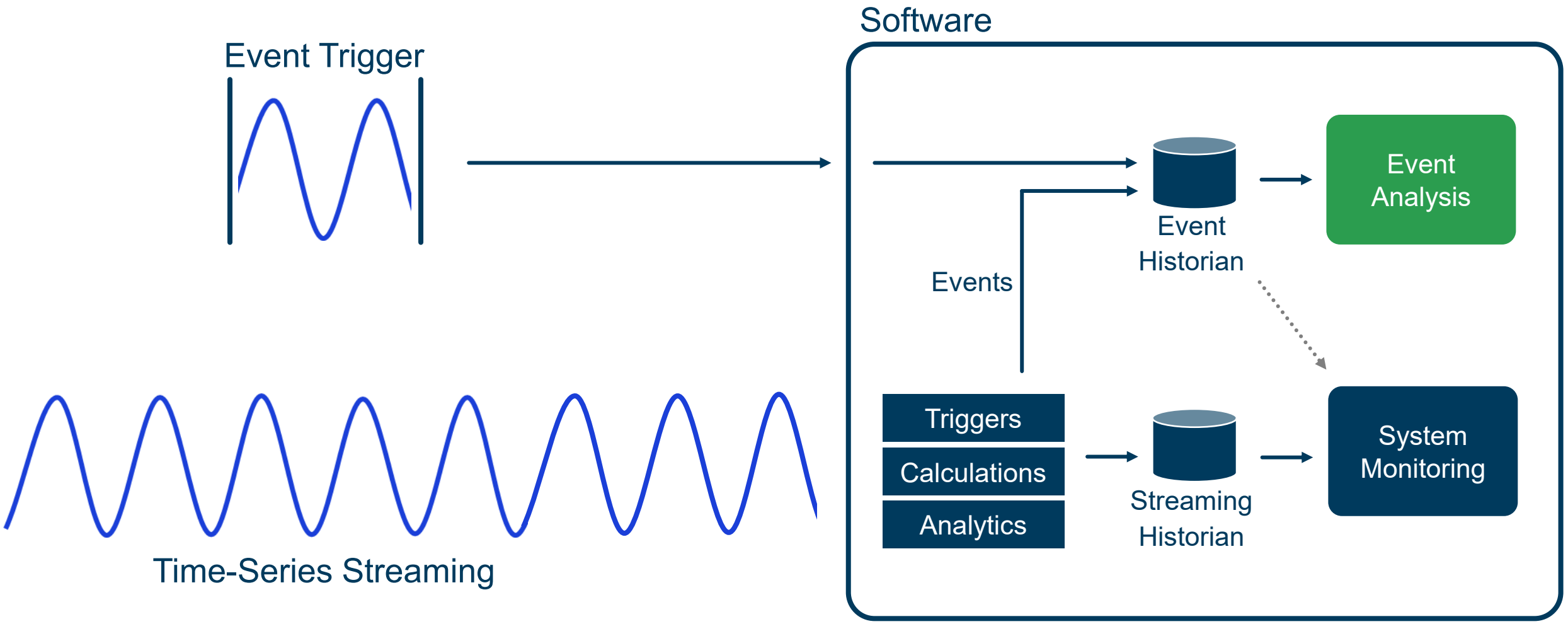
Industrial Facility – Transient impacts 3 VFDs

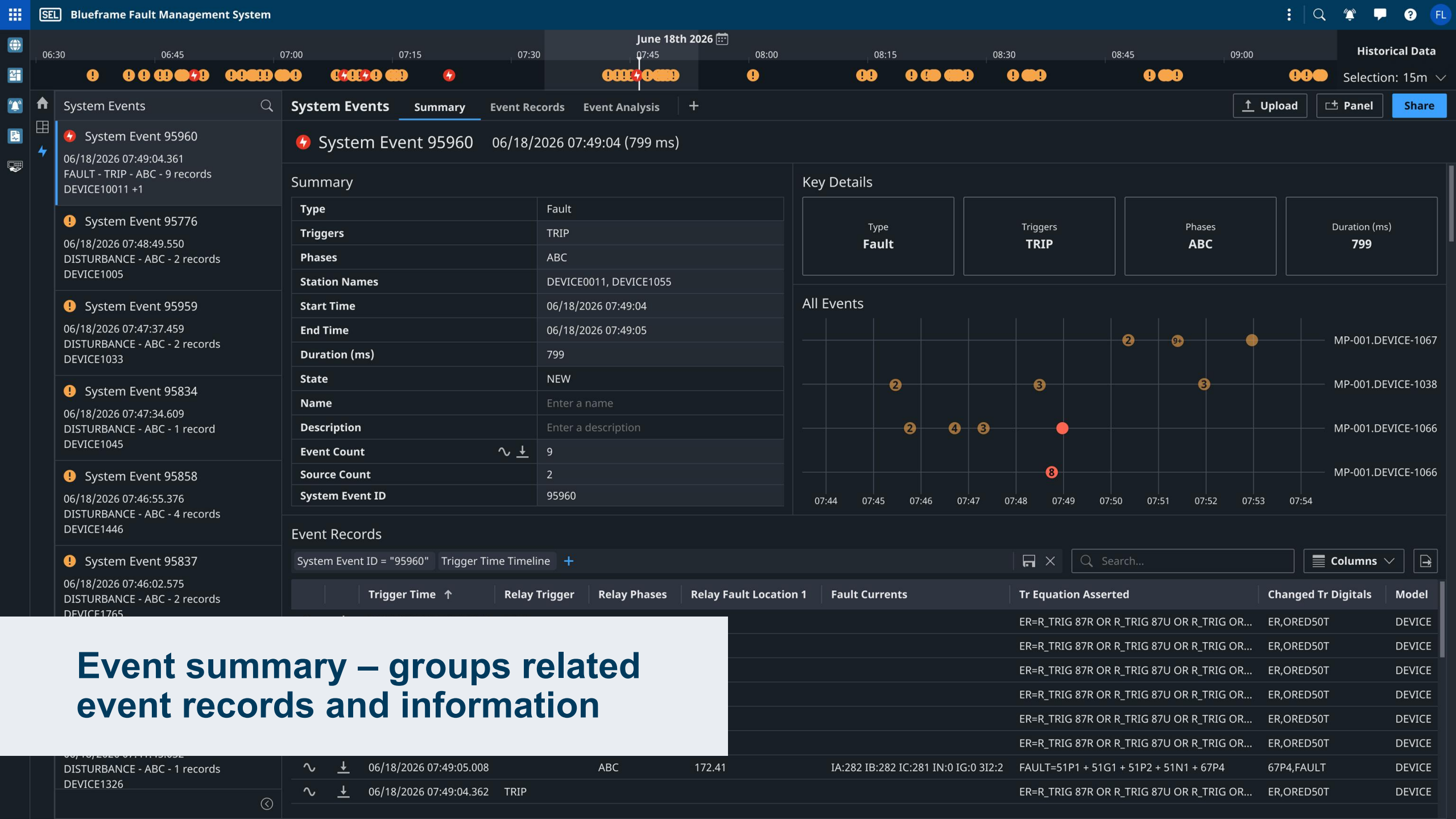


Expanding analytics capabilities



Designing Systems for Streaming and Triggers





Event summary – groups related event records and information

Join us in exploring new use cases and deployment architectures