

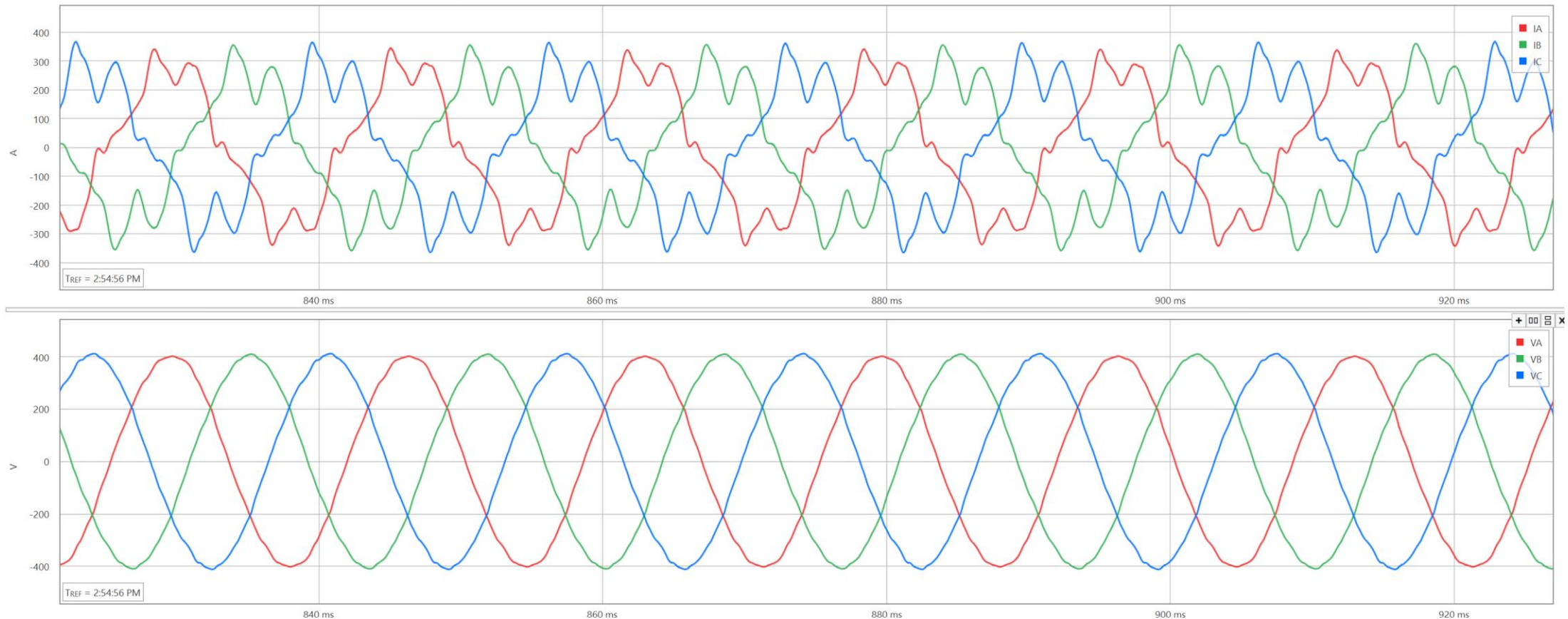
Exploring approaches to time-series streaming and event triggers



Jared Bestebreur, Senior Engineering Manager

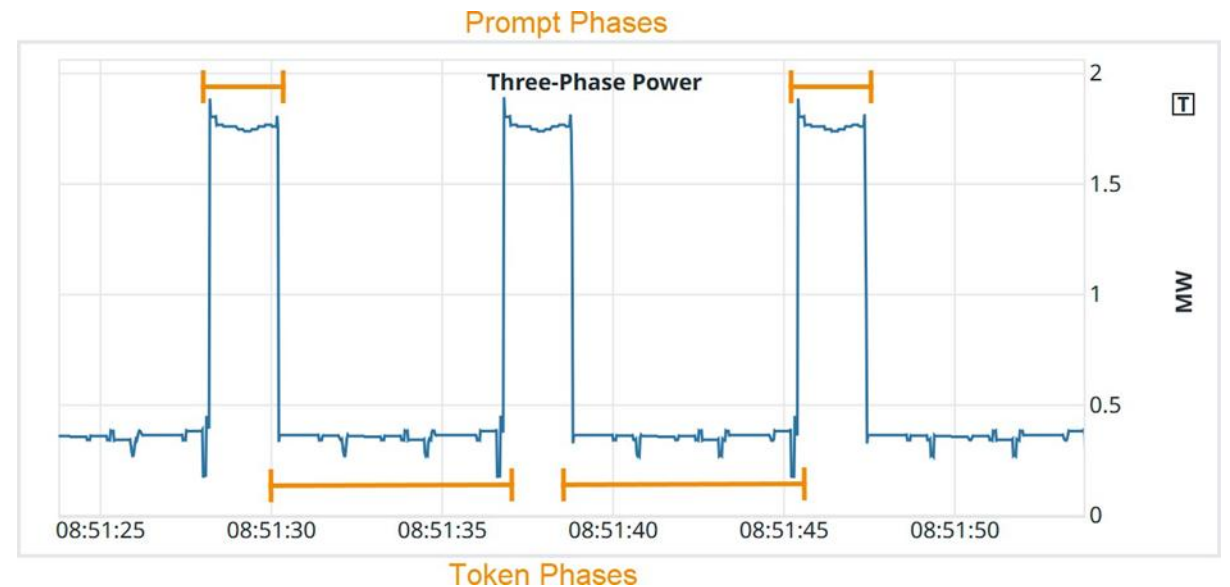
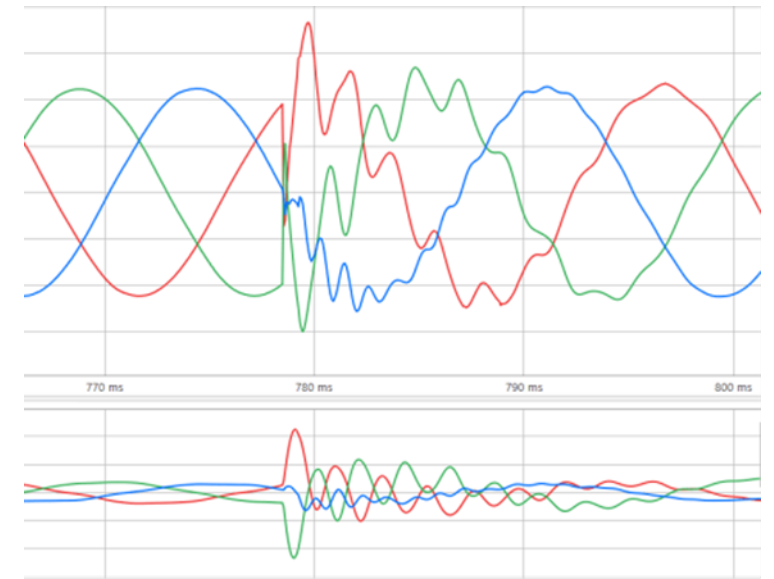
Power Quality

The consistency, reliability, and stability of the power system ensures proper function and longevity of electrical equipment.



New Era of Loads

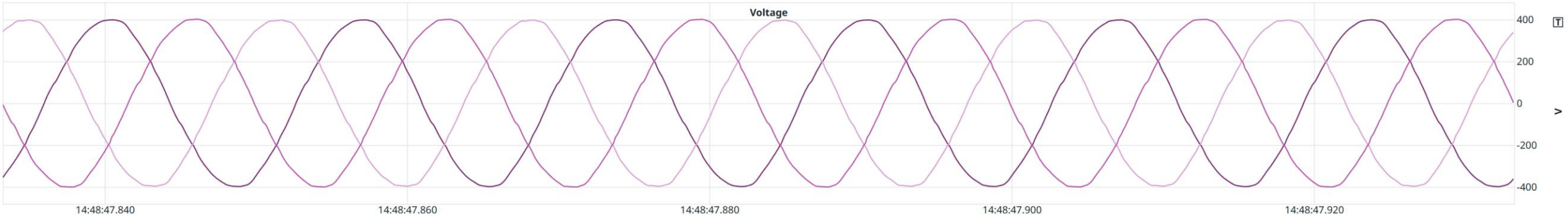
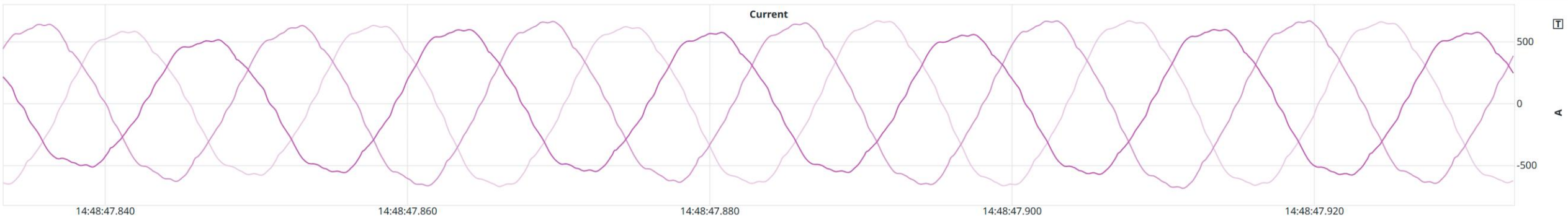
- AI Training Algorithms
- Arc Furnaces
- EV Charging
- Crypto-currency Mining



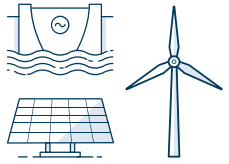
Complex Power Quality Concerns

- Visualizing Long Duration Faults
- Identifying Sub-Cycle Transients
- Detecting Oscillations
- Tracking Rapid Power Fluctuations

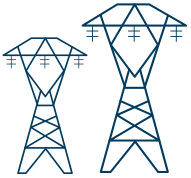
Continuous Waveform Data



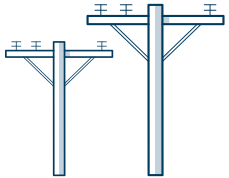
Power Systems



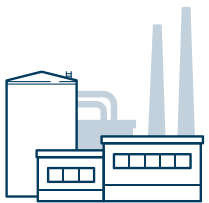
Generation



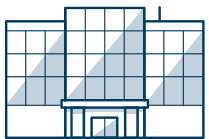
Transmission



Distribution



Industrial



Commercial



Devices



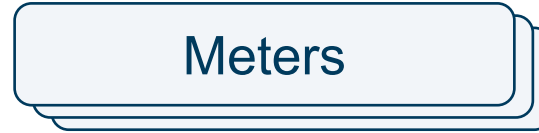
Relays



DFRs



Reclosers



Meters



Merging Units

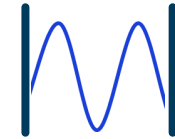


Virtual (Software)



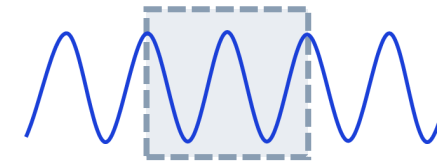
Event Data

Hardware
Triggered Events



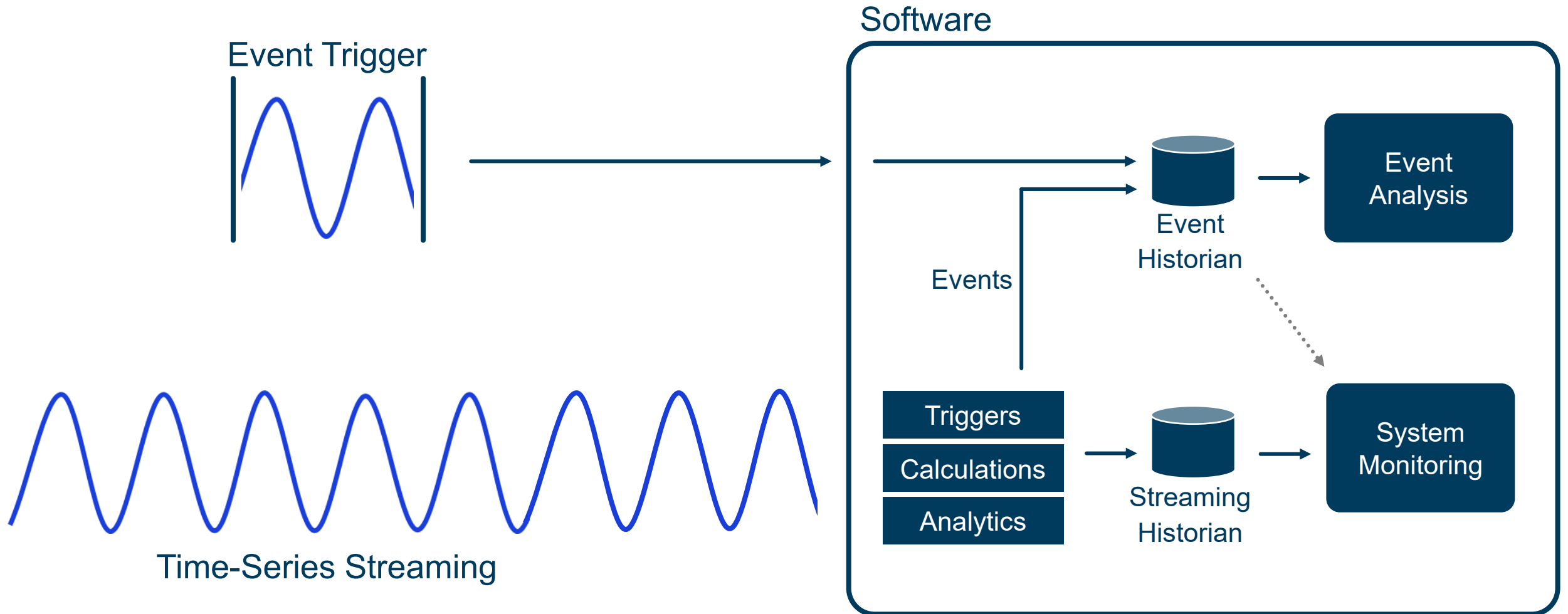
+

Software
Triggered Events



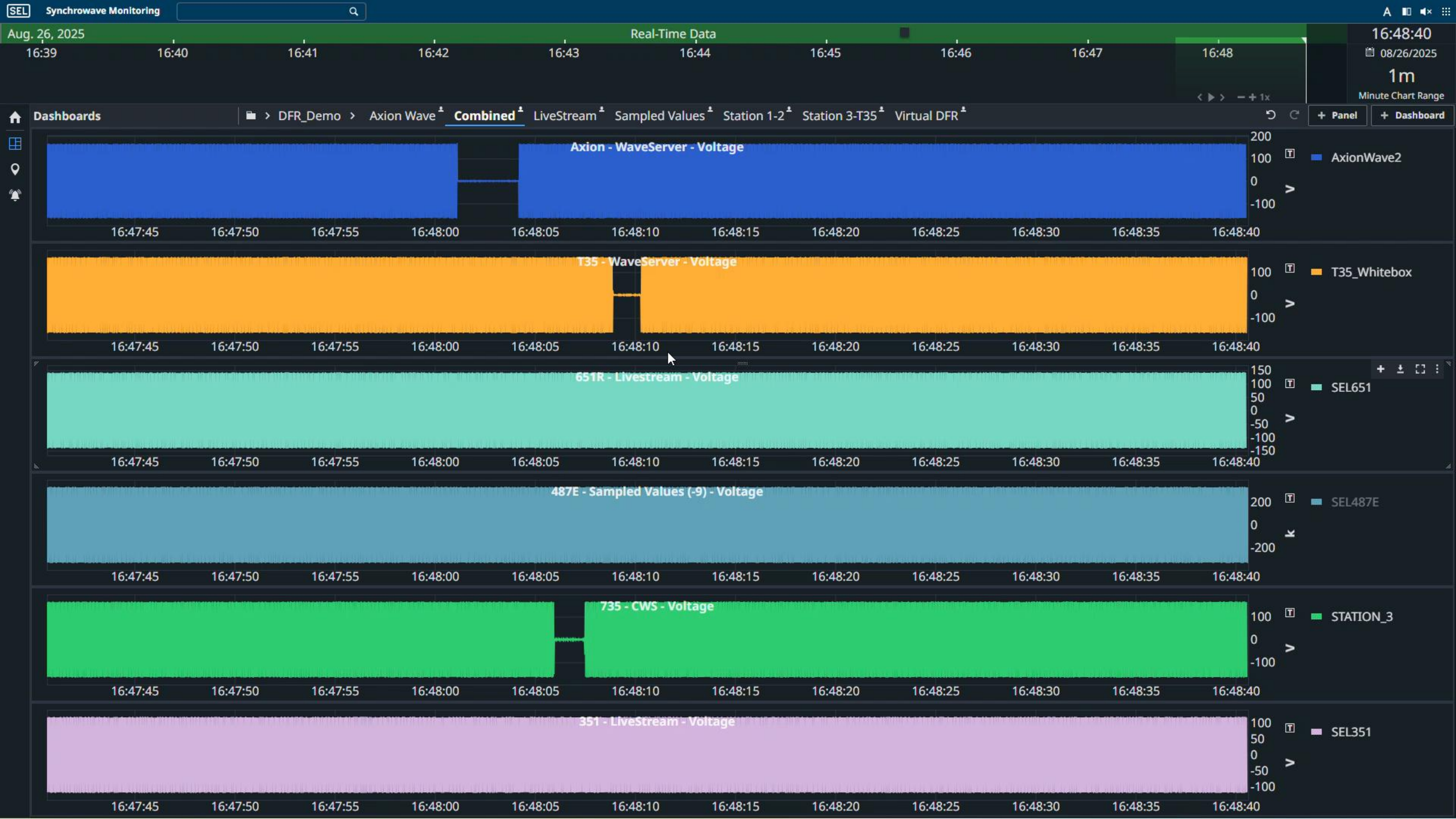
from streaming data

Designing Systems for Streaming and Triggers

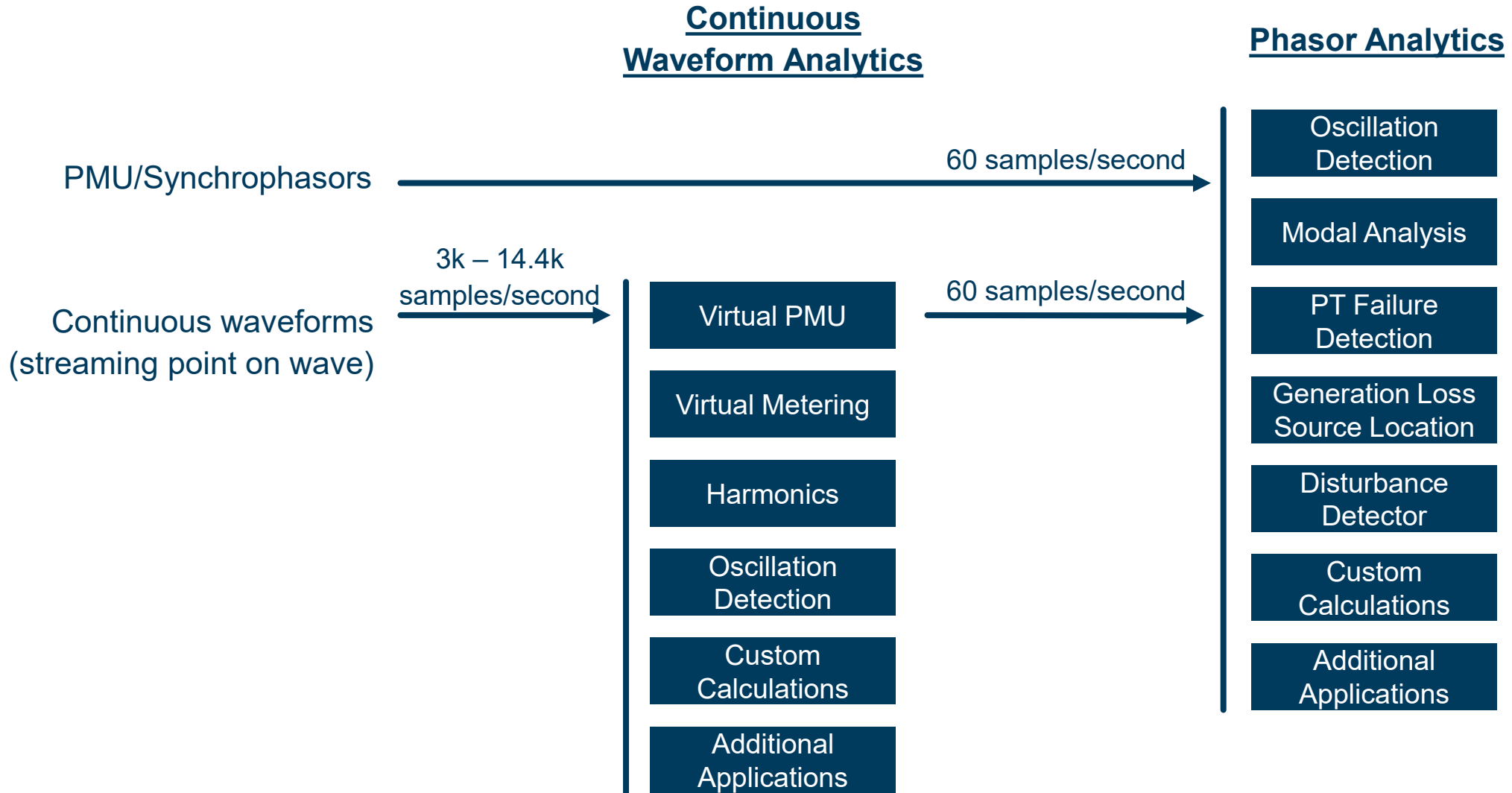


Streaming protocol examples

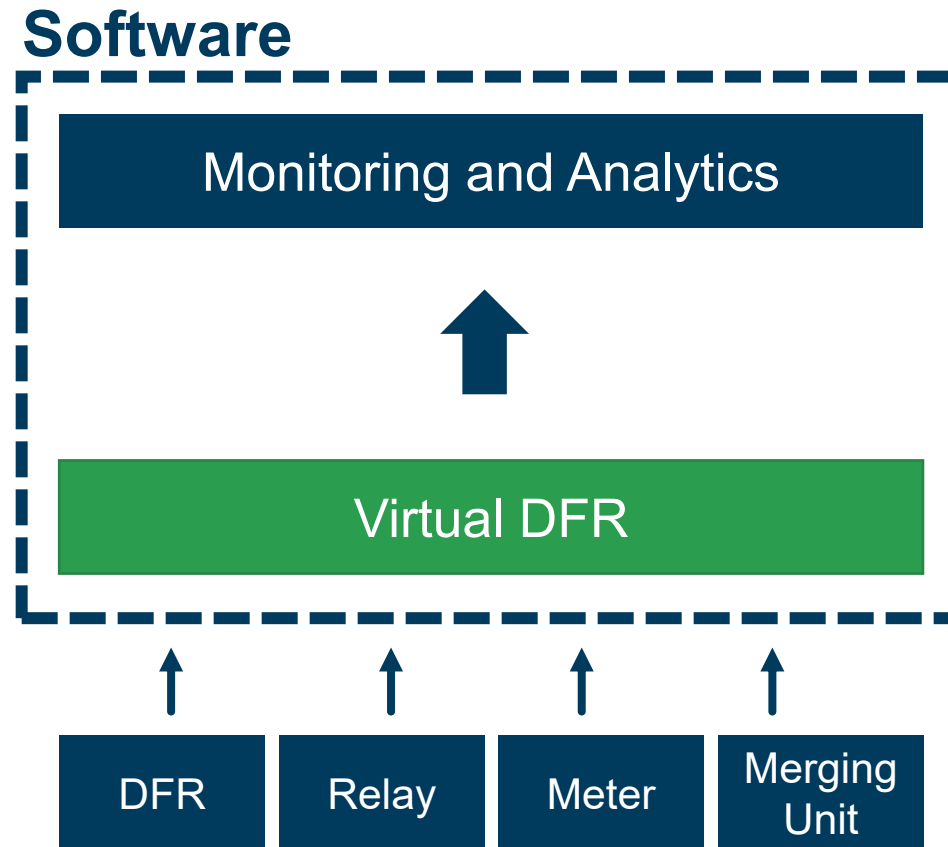
Synchrophasor Protocols	Device	Streaming Rate (sps)
IEEE C37.118	PMUs, PDCs	30, 60, 240
STTP	PDCs	30, 60, 240
Waveform Streaming Protocols	Device	Streaming Rate (ksps)
Wave Server (modified C37.118)	SEL-Axion, SEL-T35	3, 14.4
Continuous Waveform Stream (CWS)	SEL-735	3
Livestream	SEL-651R, SEL-351A	1.92
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



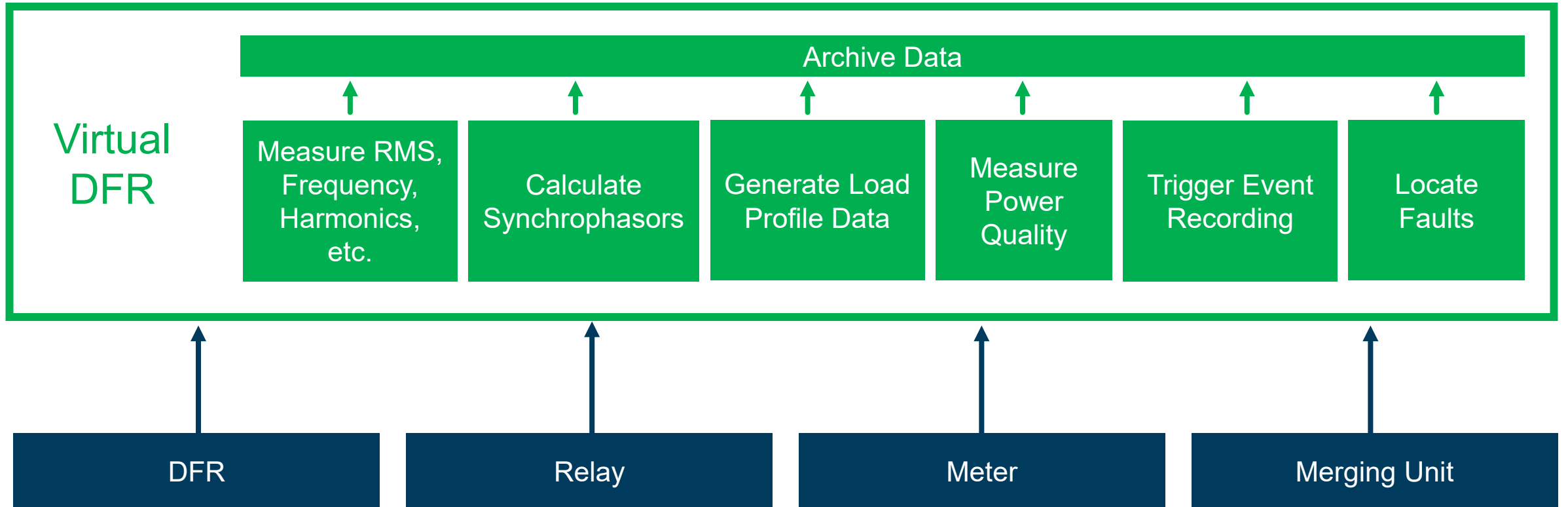
Streaming calculations and analytics



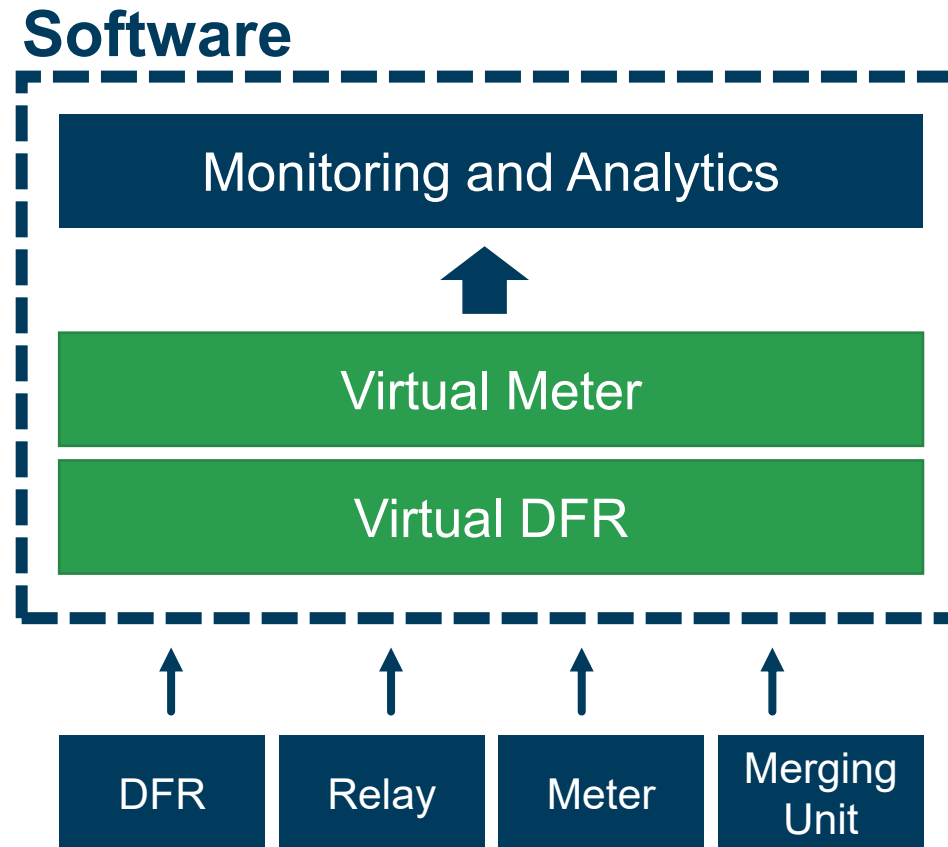
Use case 1: Virtual DFR



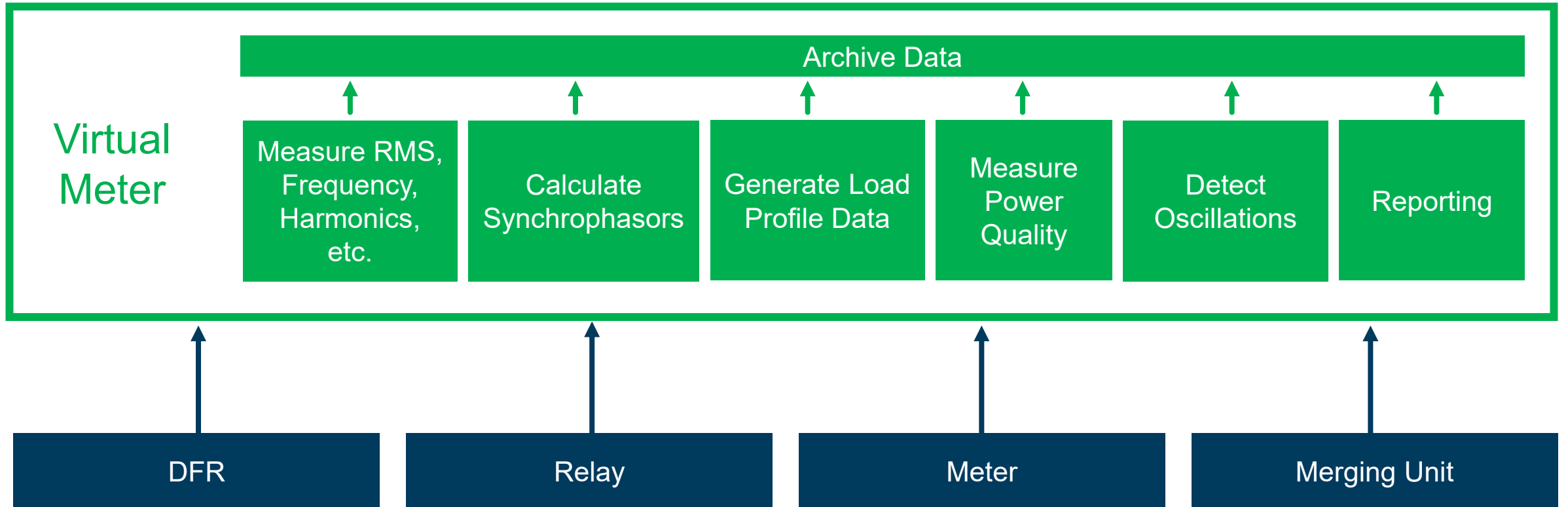
Virtualize DFR capability with continuous waveform streaming



Use Case 2: Virtual Meter

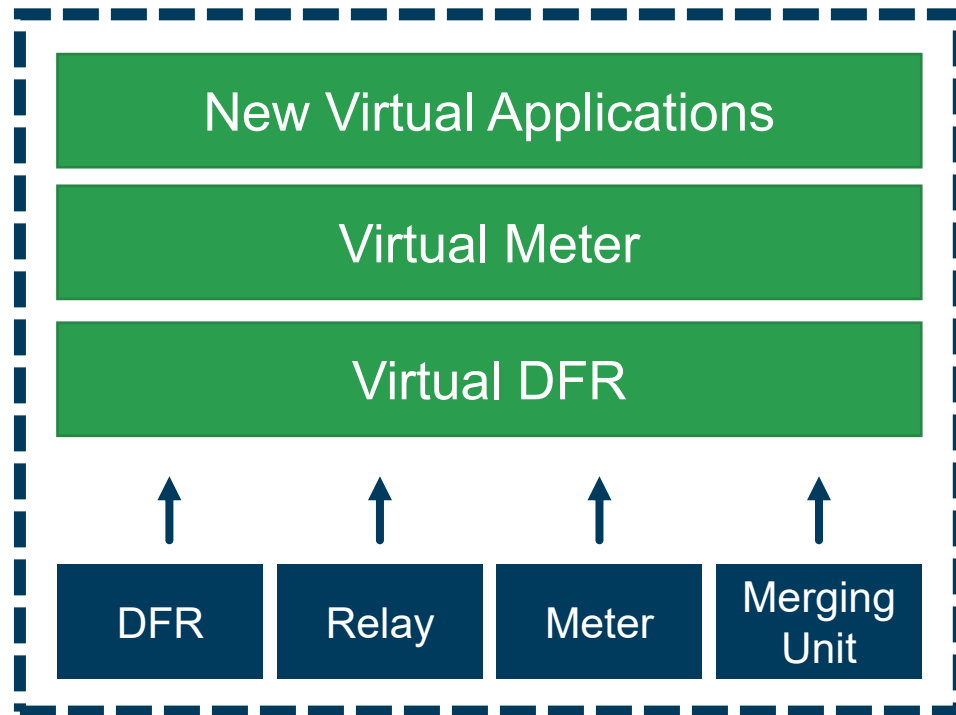


Virtualize Meter capability with continuous waveform streaming



Join us in exploring new use cases and deployment architectures

Substation, Data Center, etc.



On-premise, Hosted, etc.

