

## Optical Sensor Deployment & Signature Library

NASPI Work Group Virtual Meeting  
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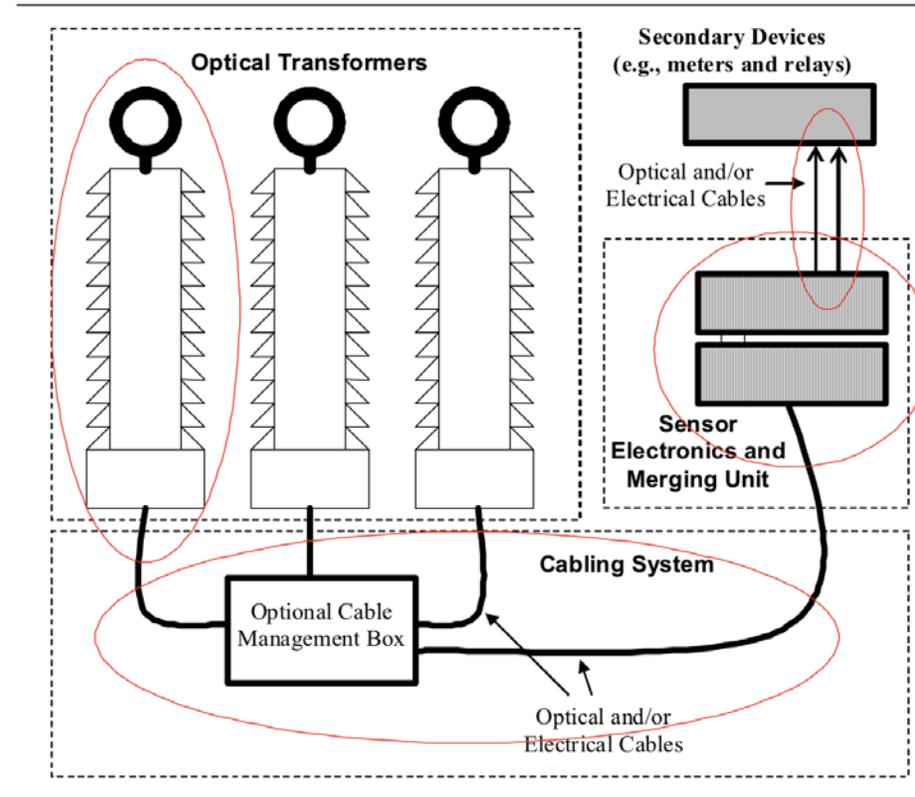


# Agenda

- Project Objective
- Optical Sensor Description & Deployment Requirements
- Sensor Data Requirements
- Description of Signature Library Database
- Summary

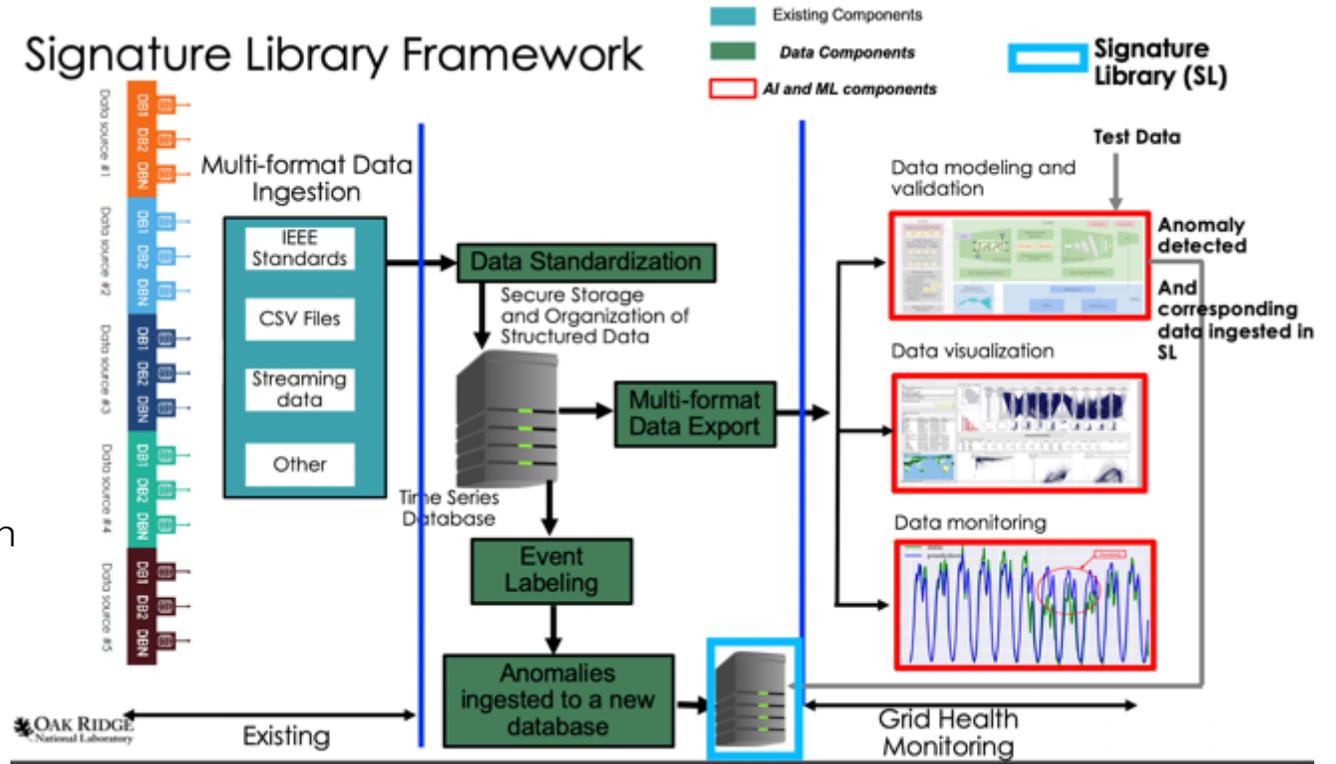
# Technology Deployment

## Optical Voltage and Current Sensor Systems



**Schematic of a typical optical sensor system**

- The objective of this proposed activity is to develop and implement a framework for an electric grid signature library.
  - Data fusion: populate the Library with information resources available to the project team.
  - incorporation of existing grid signature databases (static measurements), it is envisioned that the Signature Library may be further populated with real-time dynamic measurements provided by in-field deployed high-fidelity sensors from existing and new test beds.
  - key feature of the signature library is to have its design allow for easy accessibility to support, for example, artificial intelligence (AI)-based computational methods that may be used to analyze the Library's information
  - the Library will also serve as a resource for that may be used for algorithm validation.



Data Collection & Formatting

Ingestion in Grid Signature Library

Event Classification and Validation

Data Visualization

New Algorithms Testing & Validation

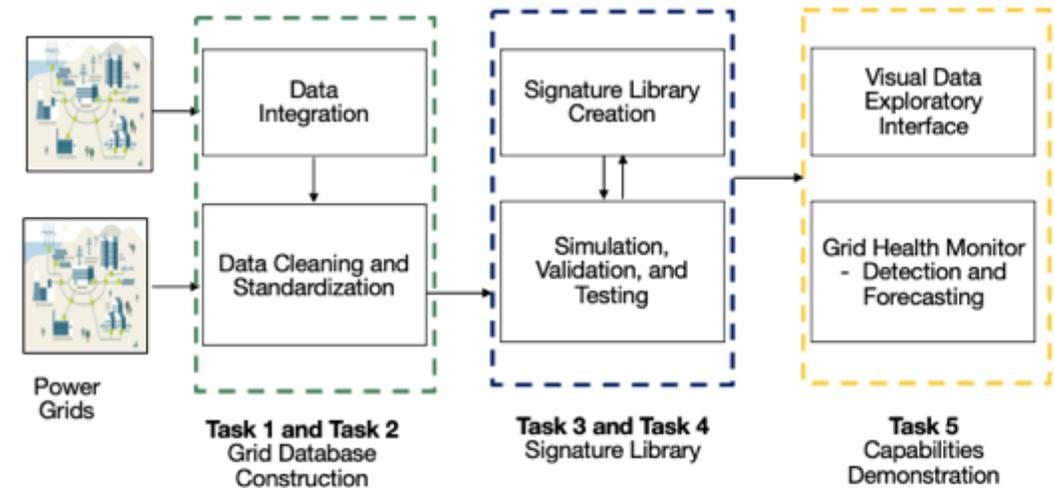
# Evaluation of Existing Grid Data

Existing grid event datasets are inadequate for AI/ML applications

- *Non-existent or unlabeled events*
- *Non-standardized sampling rates limits integration of datasets*
- *Low sampling rates cannot detect transient events*
- *Precursor events are not tracked and stored*

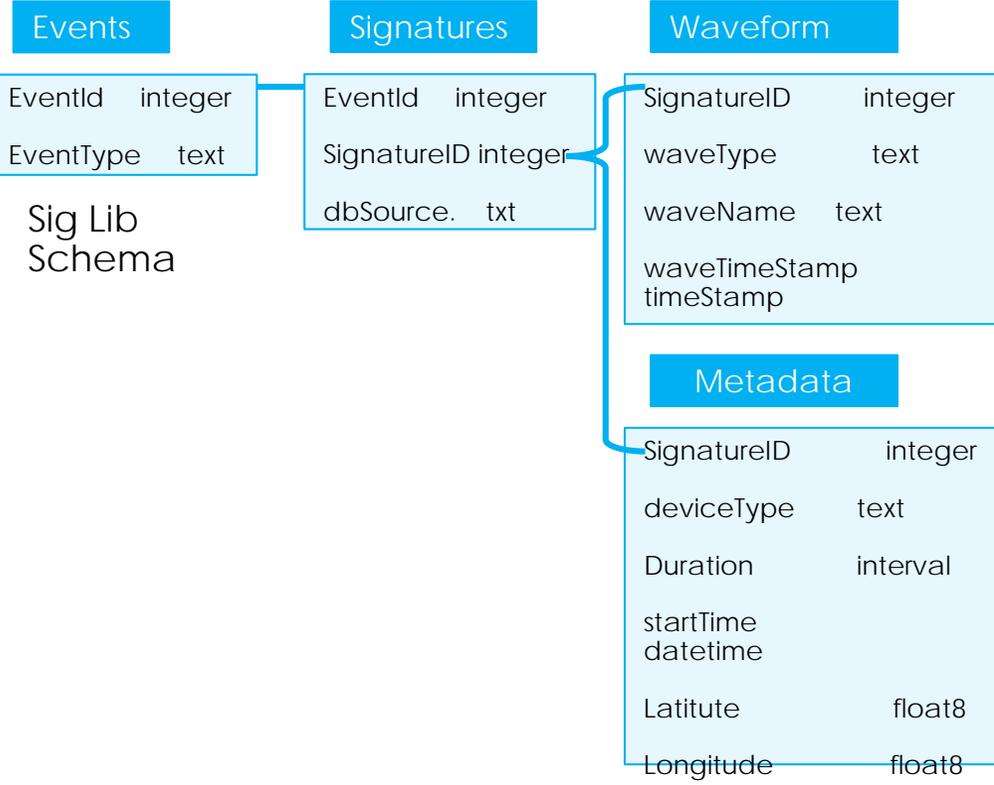
## Proposed Research Workflow

### Steps to achieve the signature library framework



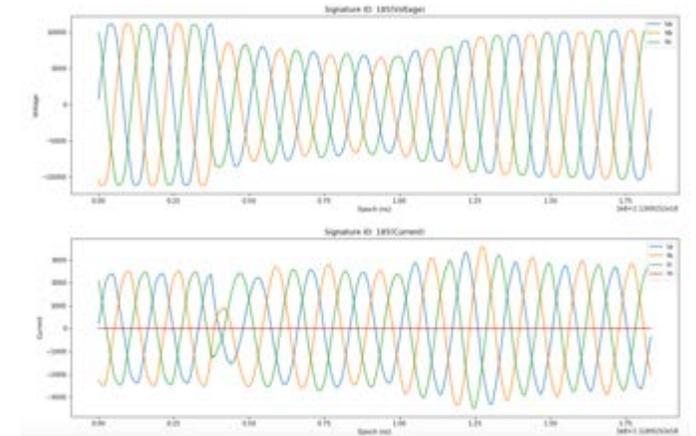
# Signature Library Backend – Postgres + Timescale DB

## Real Time Monitoring



Signatures by Event Type:

No.	Event Type	Num of Signatures
1	breaker	97
2	co15	14
3	co15lb	13
4	fault	35
5	fuse	20
6	generation trip	207
7	line capacitor switching off normally	5
8	line capacitor switching off unbalanced	5
9	line capacitor switching on normally	5
10	line capacitor switching on unbalanced	5
11	line switching	9
12	load shedding	330
13	multi-phase faults that trip/close circuit breaker	6
14	multi-phase faults that trip/close non-substation recloser	5
15	multi-phase low-amplitude series arcing	5
16	multi-phase low-amplitude shunt arcing	5
17	none	66
18	ocb	1
19	r-ovr-1pt	6
20	r100-4e	13
21	r100e	1
22	recloser	17
23	sect200nlb	4
24	sectionalizer	24
25	service restorer	3
26	single-phase fault that blows fuse or trips recloser with reclosing blocked	5
27	single-phase faults that trip/close circuit breaker	5
28	single-phase low-amplitude series arcing	6
29	single-phase low-amplitude shunt arcing	5
30	single-phase motor starts	6
31	switch	4
32	three-phase motor starts	5
33	unknown	12
<b>Total</b>		<b>858</b>

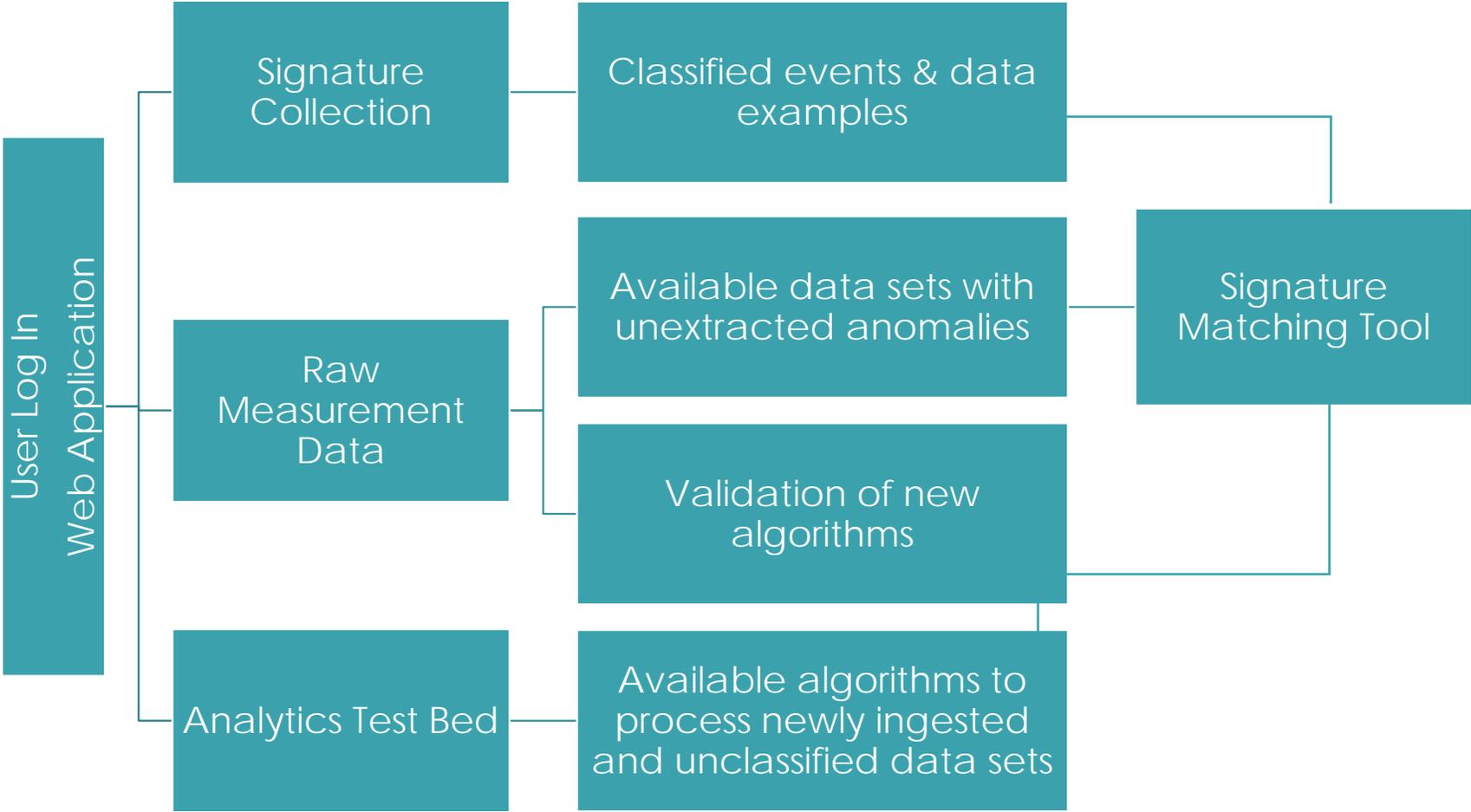


SCHEMA/Data Query

Data Sources/Event Type

Output

# Signature Library Database Functionalities



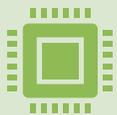
# Summary



ORNL has built an expandable grid “fingerprint” signatures database



High Fidelity data is needed to build predictive analytics and behavior models



ORNL is coordinating with multiple utilities the installation of a High-Fidelity sensor to build real-time analytics and capability of wide area predictive fault and location.