



Merging PMU, operational and non-operational data for interpreting alarms, locating faults and preventing cascades

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June 3-4, 2009
Sacramento, California



Outline

- Goal
- Background
- Why merging data matters?
- What is involved in data merging?
- How to implement data merging?





Goal

Objective:

- *Improve cause-effect event analysis by merging situational (PMU), operational (SCADA) and non-operational (IED) data*

Expected product:

- *A set of integrated visualization tools for helping operators to deal effectively with event analysis*



Merge seemingly disjoint analysis processes



- *Improve alarm processing by explaining automatically cause-effect relationship*
- *If the alarms relate to fault, give full information needed to restore the line*
- *If the alarms indicate a cascade, confirm whether the lines that are healthy are being tripped*

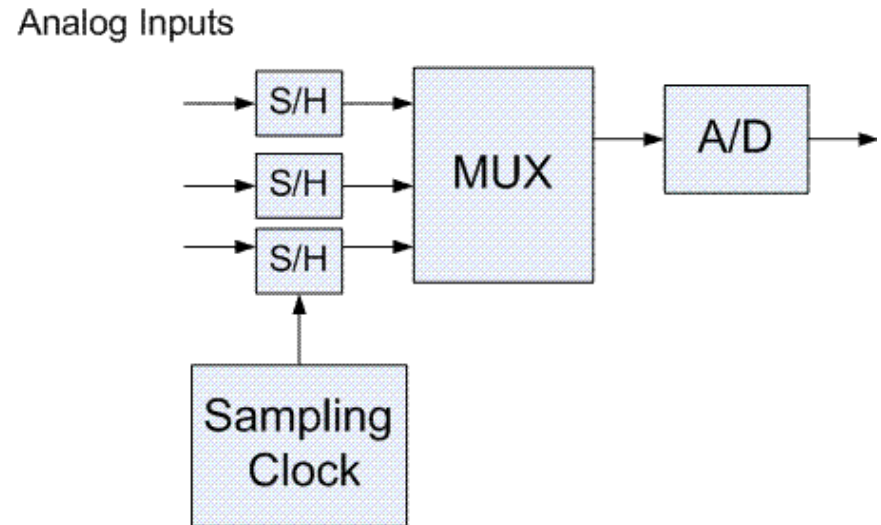
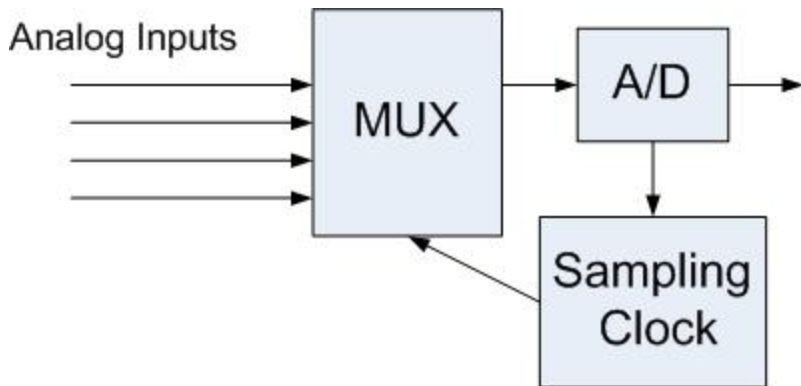


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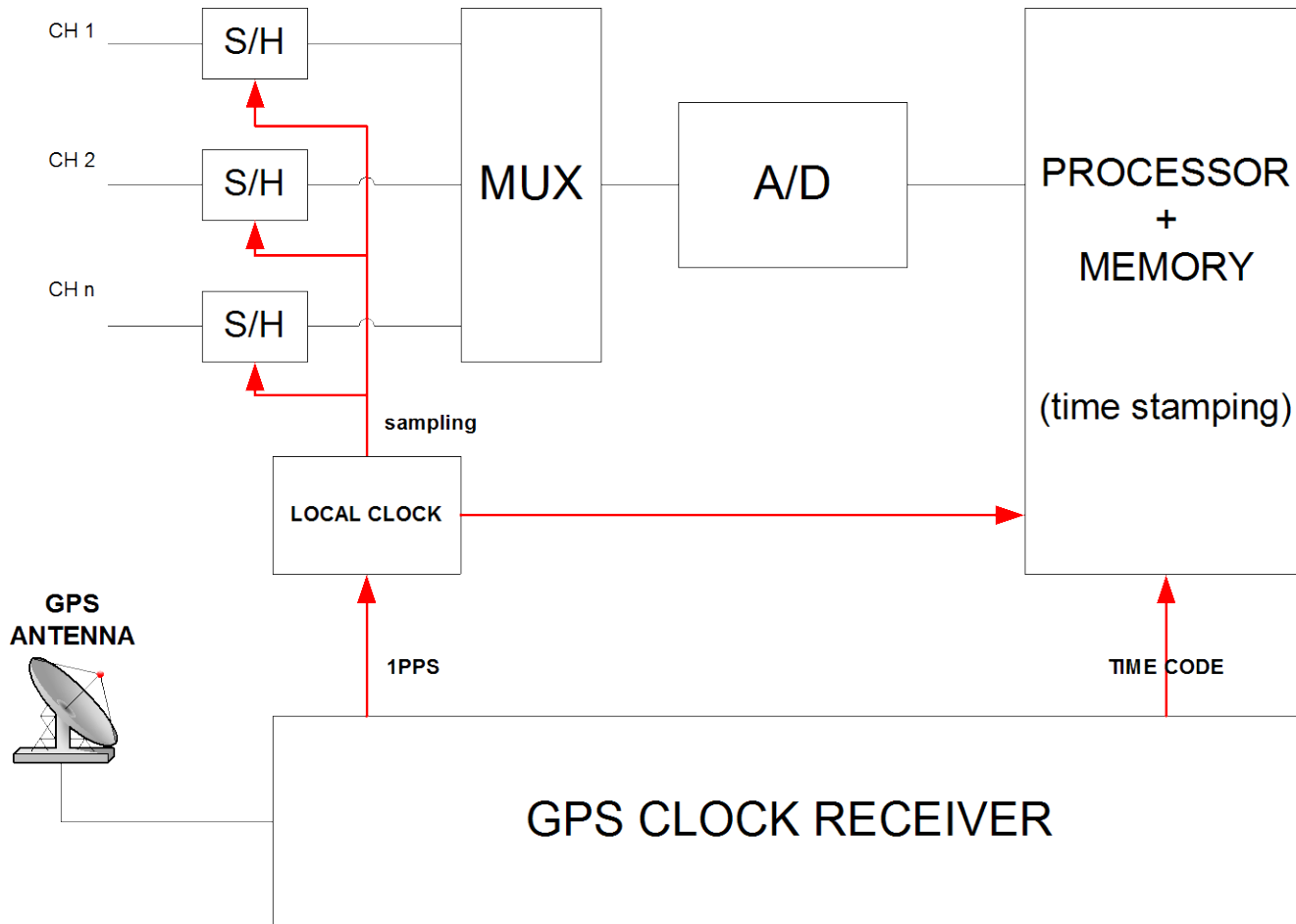


Scanning vs Synchronous sampling





Synchronous sampling vs time tagging



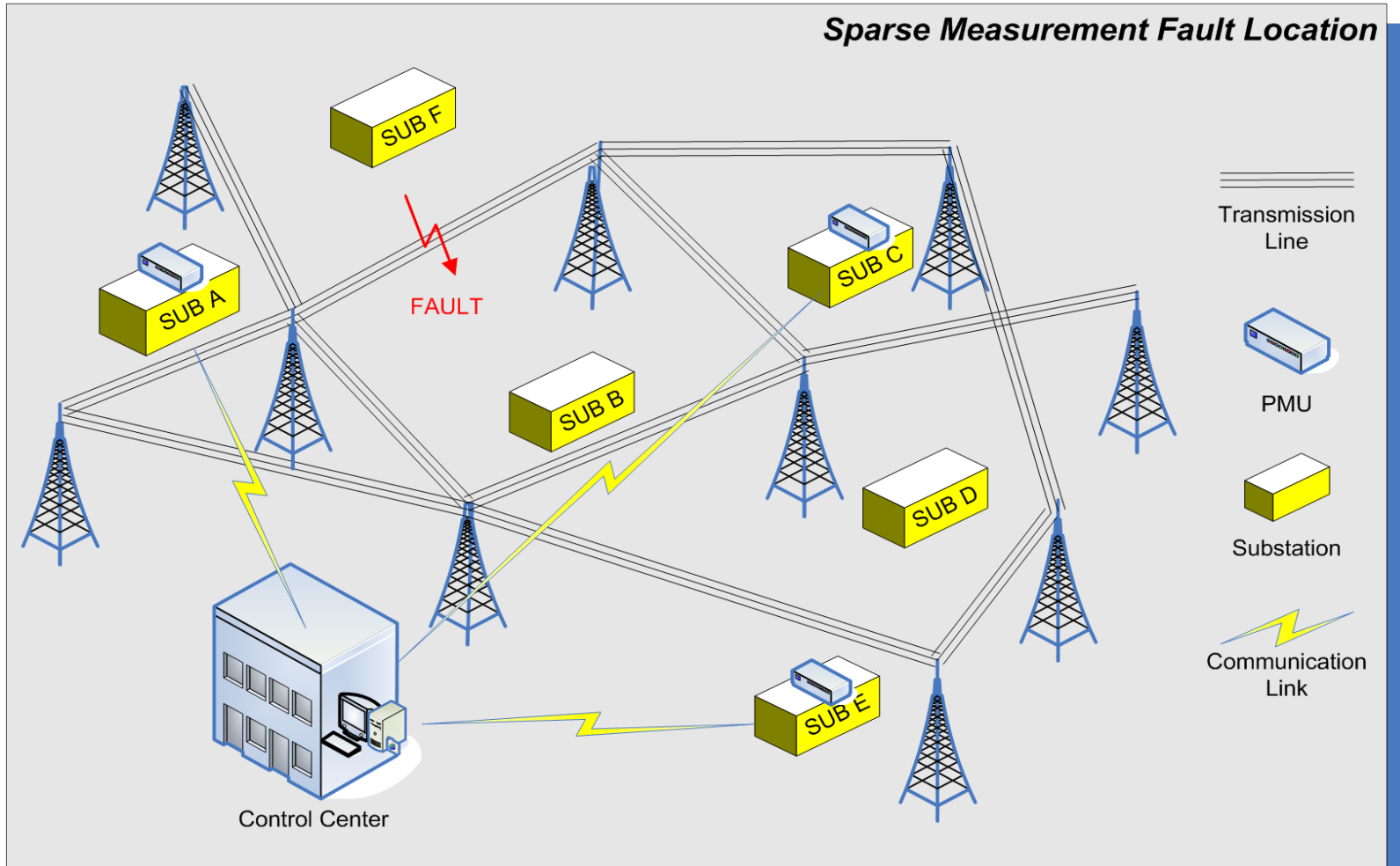


Background

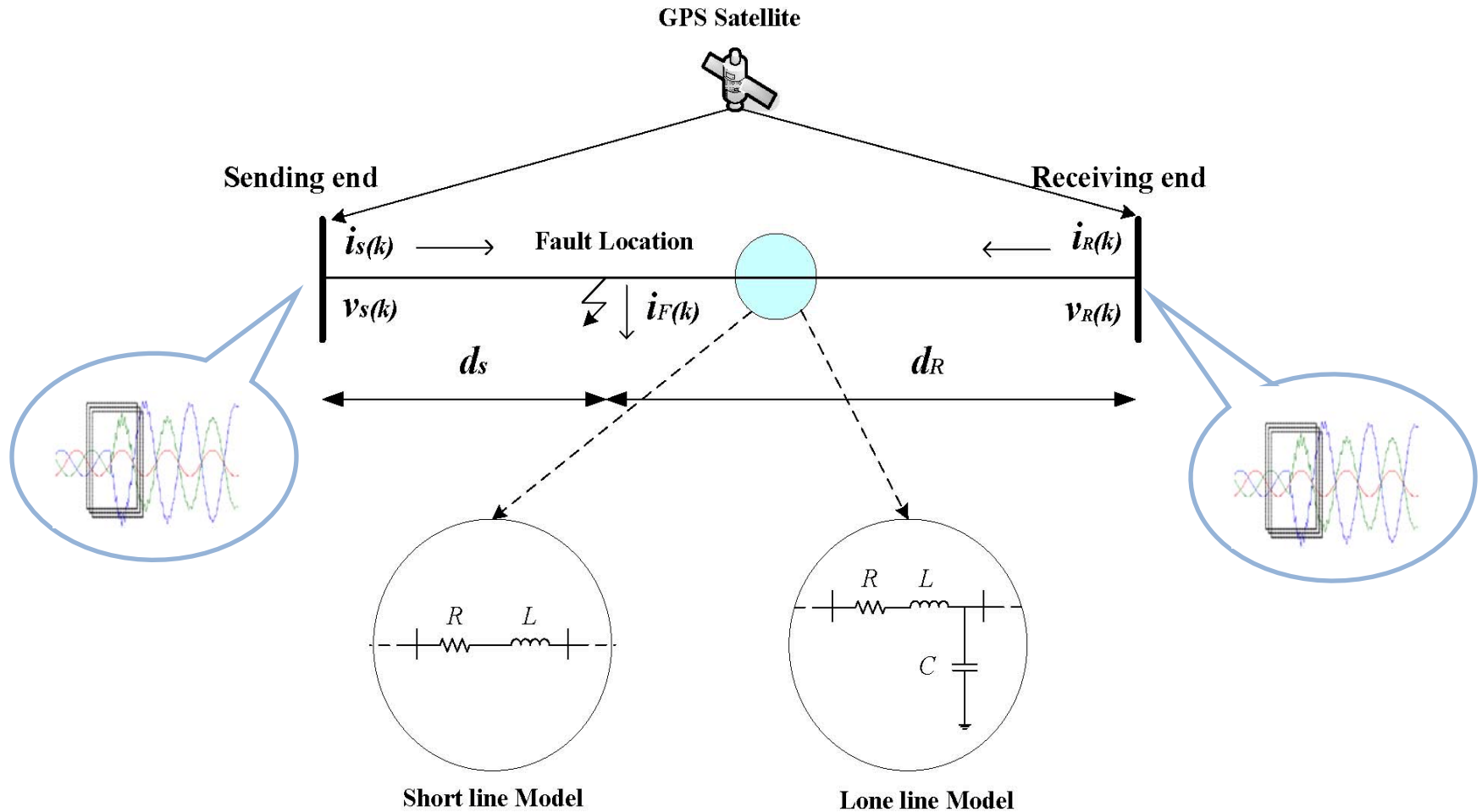
Time-synchronized Information:

- *Synchronized Phasors*
- *Synchronized Samplings*
- *Synchronized Circuit Breaker States*

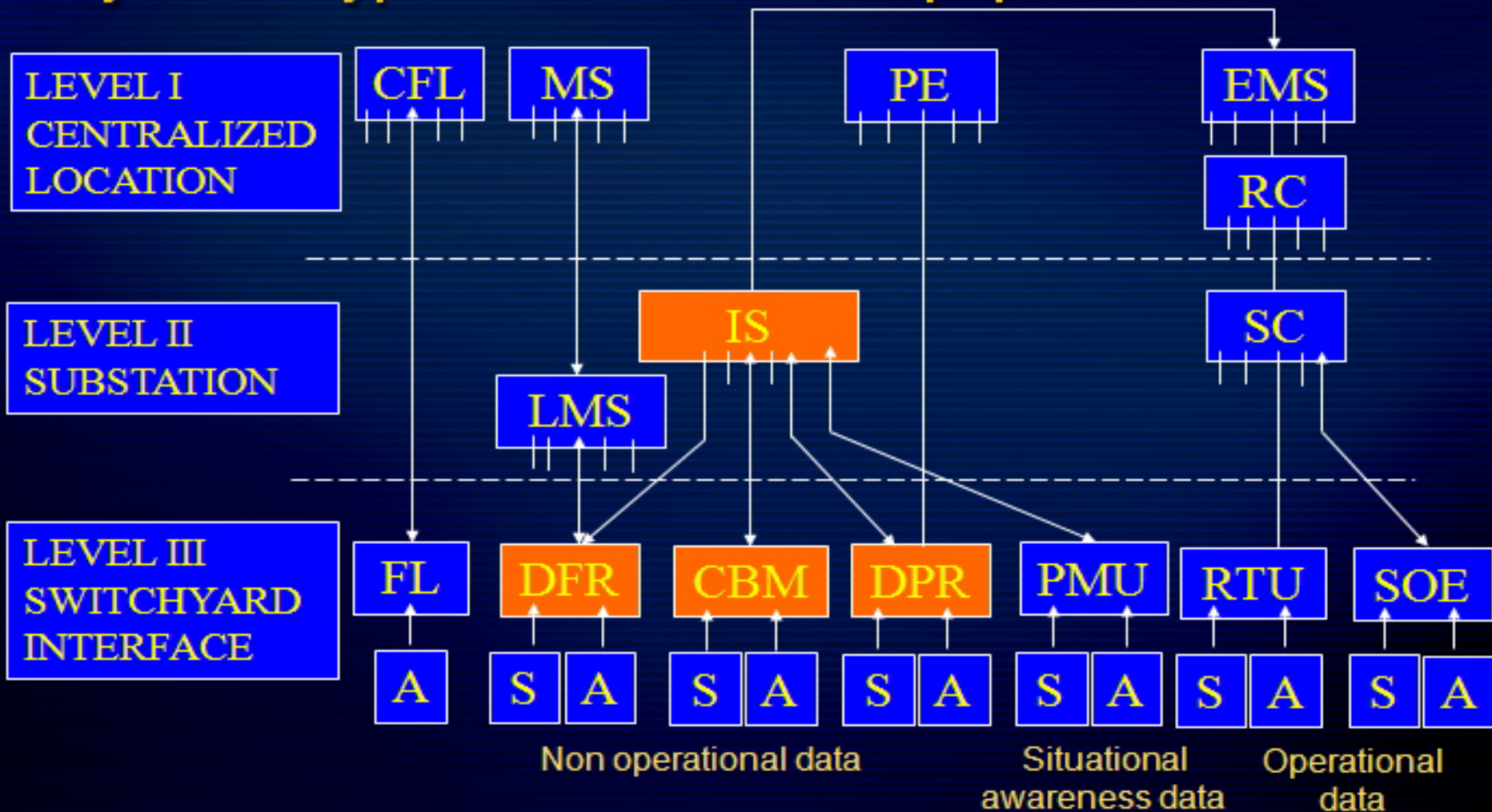
Synchronized phasors



Synchronized samples

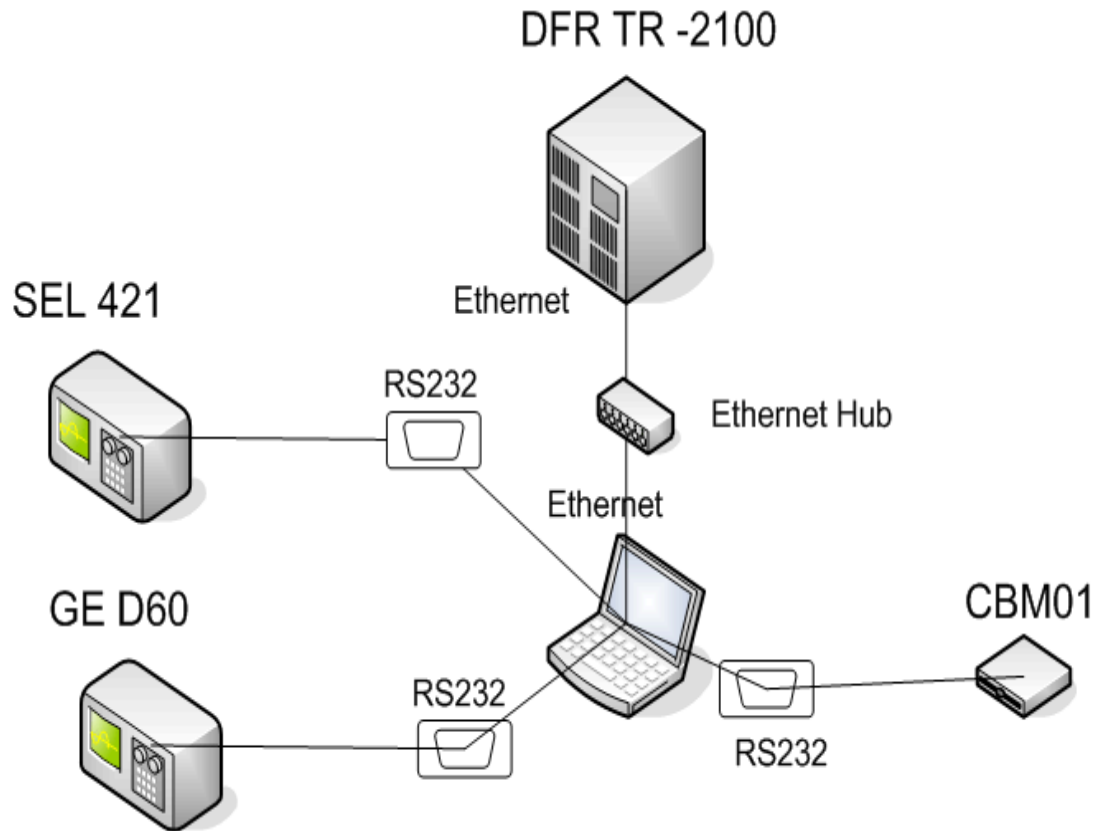


Layout of typical substation equipment



Example of time synchronization

IED GPS and data exchange wiring



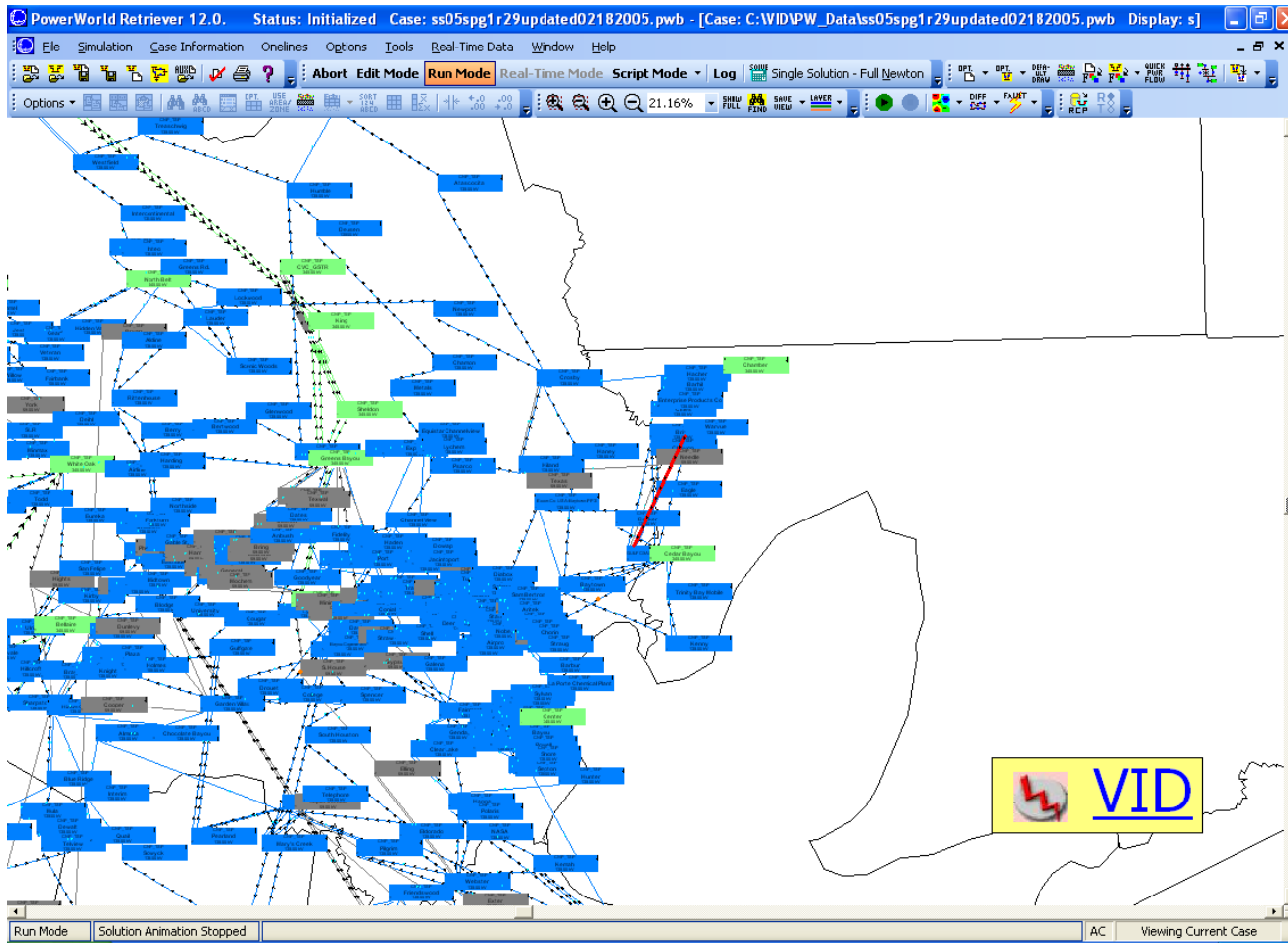


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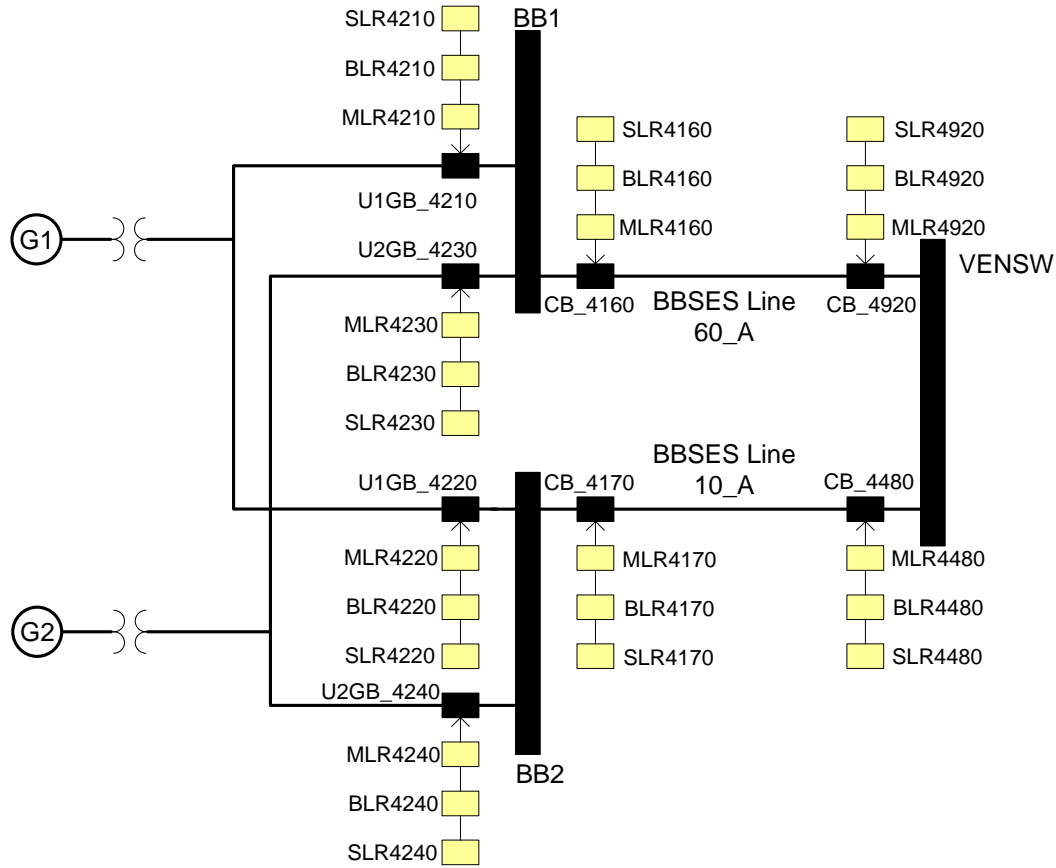
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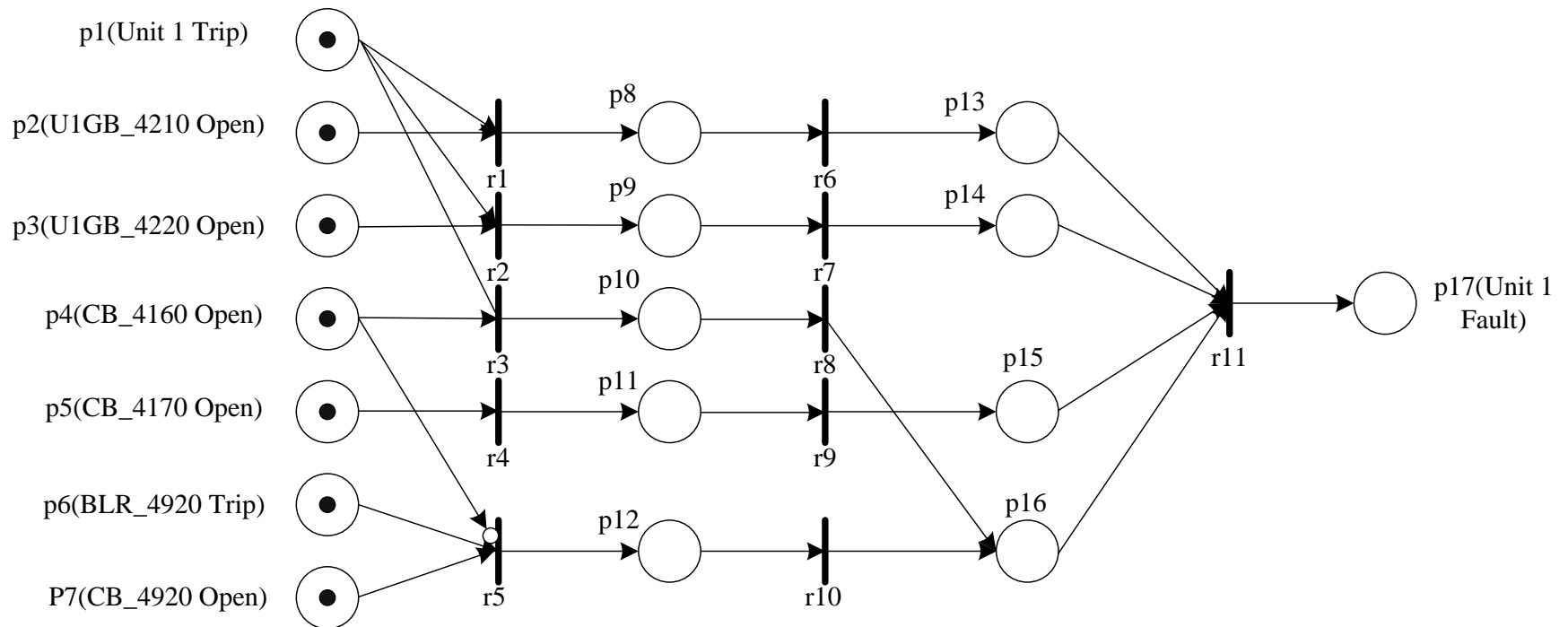
Event Analysis



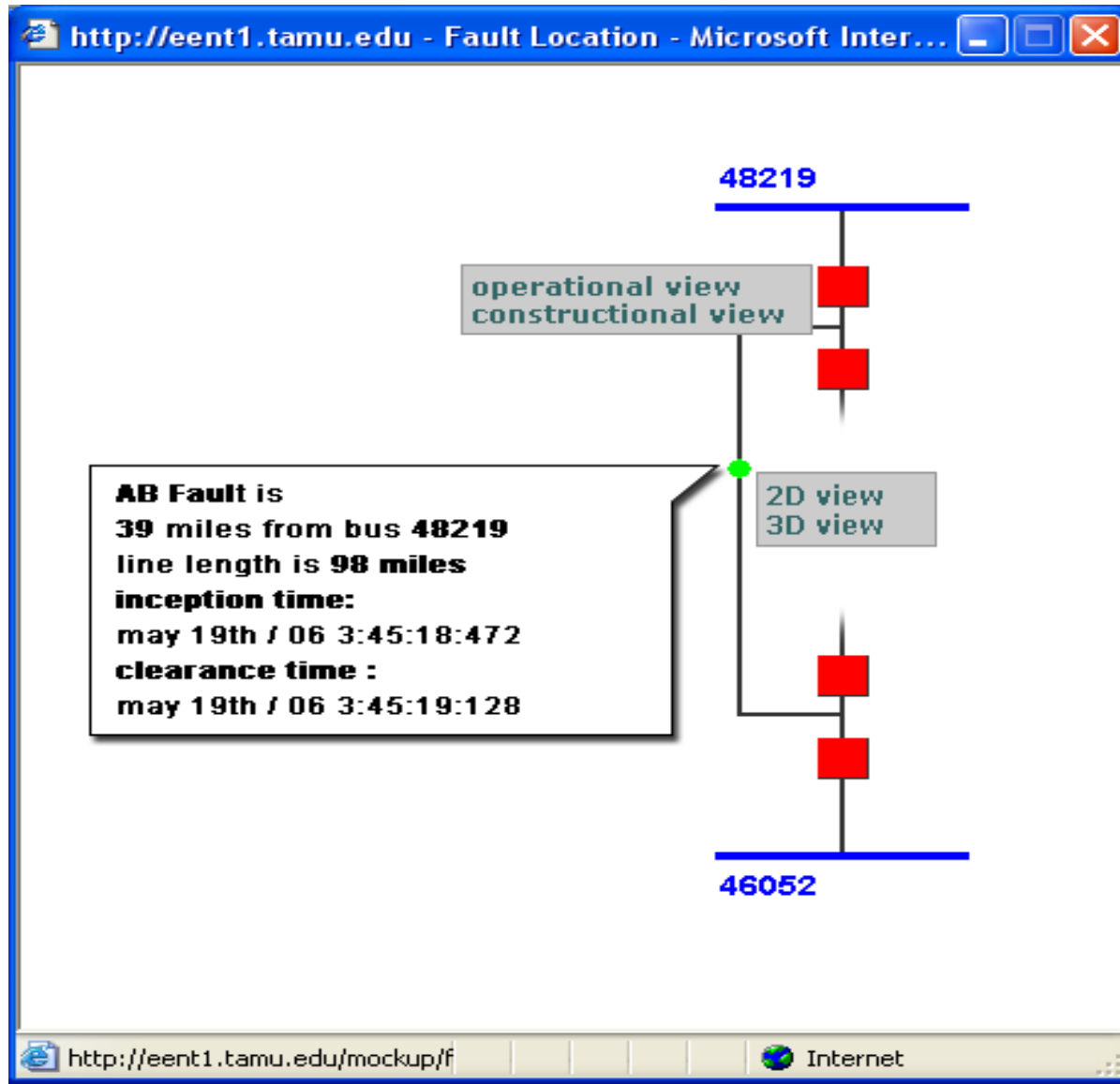
Alarms



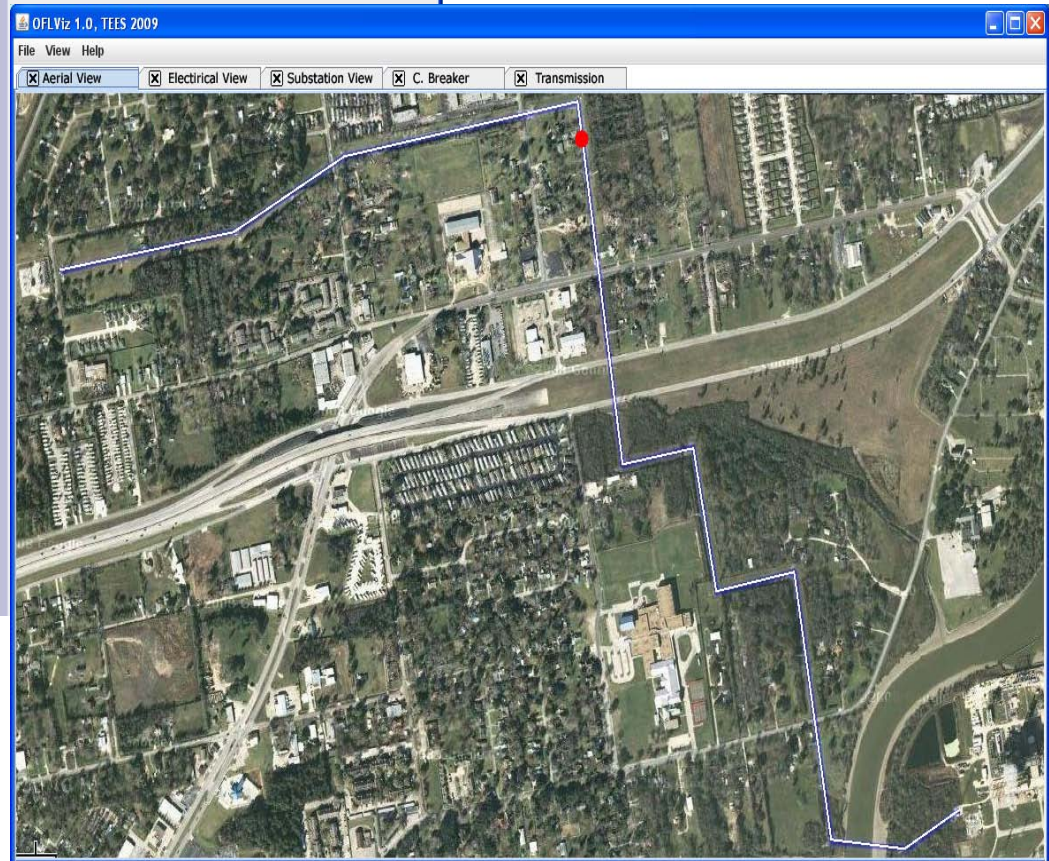
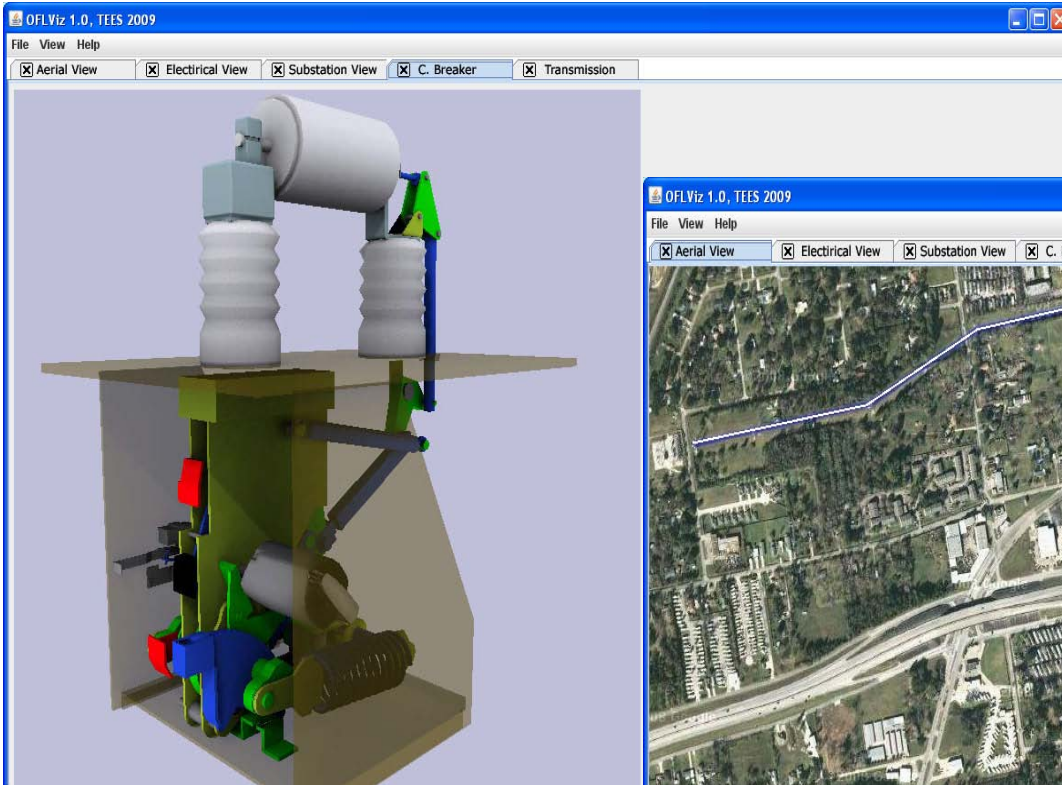
Cause-effect Analysis



Control center visualization tools



Control center visualization tools





Enterprise Data Integration

DFR Assistant Data Management: System Events - Mozilla Firefox

http://dfrassist3/DFRAWA/eventstable.jsp?event=17898

DFR Assistant Data Management
System Events

User Info
Welcome admin, today is: Thu Sep 04 14:03:30 CDT 2008. If you are not admin please [click here](#).

Logout | **Events** | Configuration | Users

Event Chart | Search | Comtrade

Event Chart
Get or Delete Event Data

Waveforms

Filter Results
Client: CenterPoint | Substation: Crosby | Circuit: ALL | Outcome: ALL

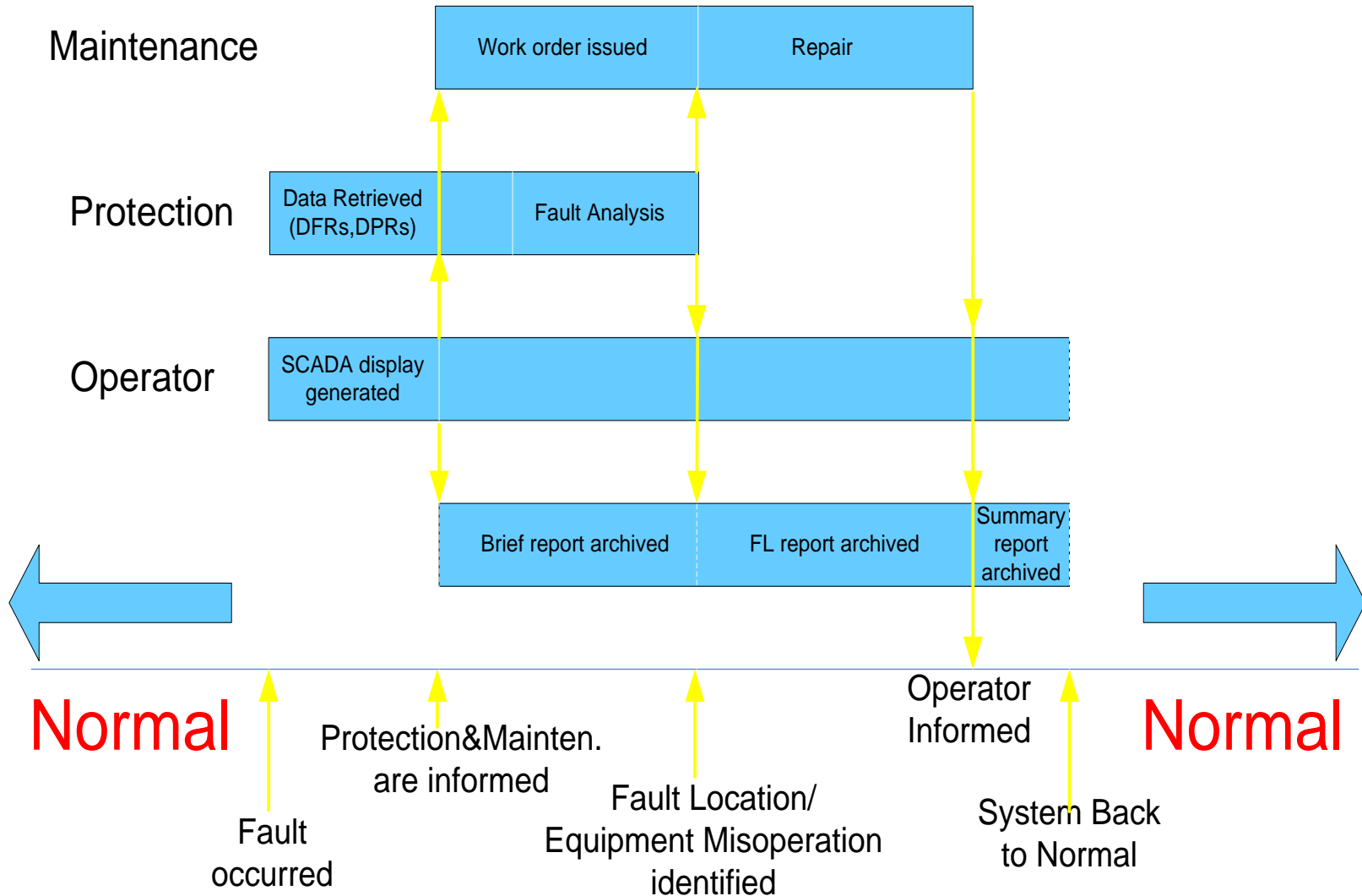
Navigation Controls
Page 5 of 6

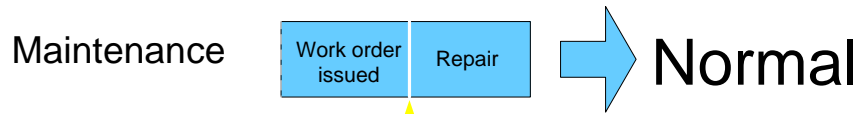
Processed Date/Time	Event Date/Time	Substation Branch	Event Type Outcome	Location	Get Data
2008-08-20 16:30:31.046	2007-10-30 05:59:38.343	Crosby CS-PSA-08	EXTERNAL_DISTURBANCE NO_CLEARANCE	0.0	
2008-08-20 16:14:36.437	2007-10-29 05:55:44.052	Crosby CS-PSA-08	EXTERNAL_DISTURBANCE NO_CLEARANCE	0.0	
2008-08-20 15:36:12.769	2007-10-26 06:06:01.986	Crosby CS-PSA-08	EXTERNAL_DISTURBANCE NO_CLEARANCE	0.0	
2008-08-20 15:19:00.109	2007-10-21 08:34:53.615	Crosby CS-PSA-08	EXTERNAL_DISTURBANCE NO_CLEARANCE	0.0	
2008-08-20 15:18:54.078	2007-10-20 19:09:19.406	Crosby CS-PSA-08	AGND_FAULT NO_CLEARANCE	274.2	
2008-08-20 15:18:49.000	2007-10-20 09:05:46.658	Crosby CS-BIL-86	EXTERNAL_DISTURBANCE NO_CLEARANCE	0.0	
2008-08-20 14:59:10.796	2007-10-17 11:41:47.462	Crosby CS-BIL-86	GND_FAULT NO_CLEARANCE	0.0	
2008-08-20 14:59:06.562	2007-10-17 11:32:04.134	Crosby CS-PSA-08	GND_FAULT NO_CLEARANCE	0.0	
2008-08-20 14:59:00.687	2007-10-17 11:32:02.920	Crosby CS-HB-66	BGND_FAULT CLEARANCE_LOCAL	22.2	
2008-08-20 14:53:26.437	2007-10-16 06:57:19.295	Crosby CS-HB-66	LINE_FAULT NO_CLEARANCE	0.0	
2008-08-20 14:44:51.390	2007-10-15 10:11:32.407	Crosby CS-BIL-86	GND_FAULT NO_CLEARANCE	0.0	
2008-08-20 14:28:13.093	2007-10-11 11:56:12.260	Crosby CS-HB-66	LINE_FAULT NO_CLEARANCE	0.0	

System Events Help
Click on event time stamp to select an event.
Click on magnifying glass to inspect Comtrade file for the selected event.

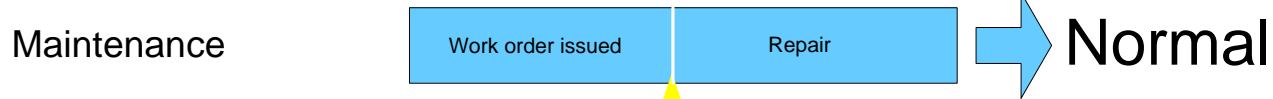


Timeline: Fault is permanent





Data Retrieved
(DFRs,DPRs,CBMs)



SCADA display
generated

New
Old

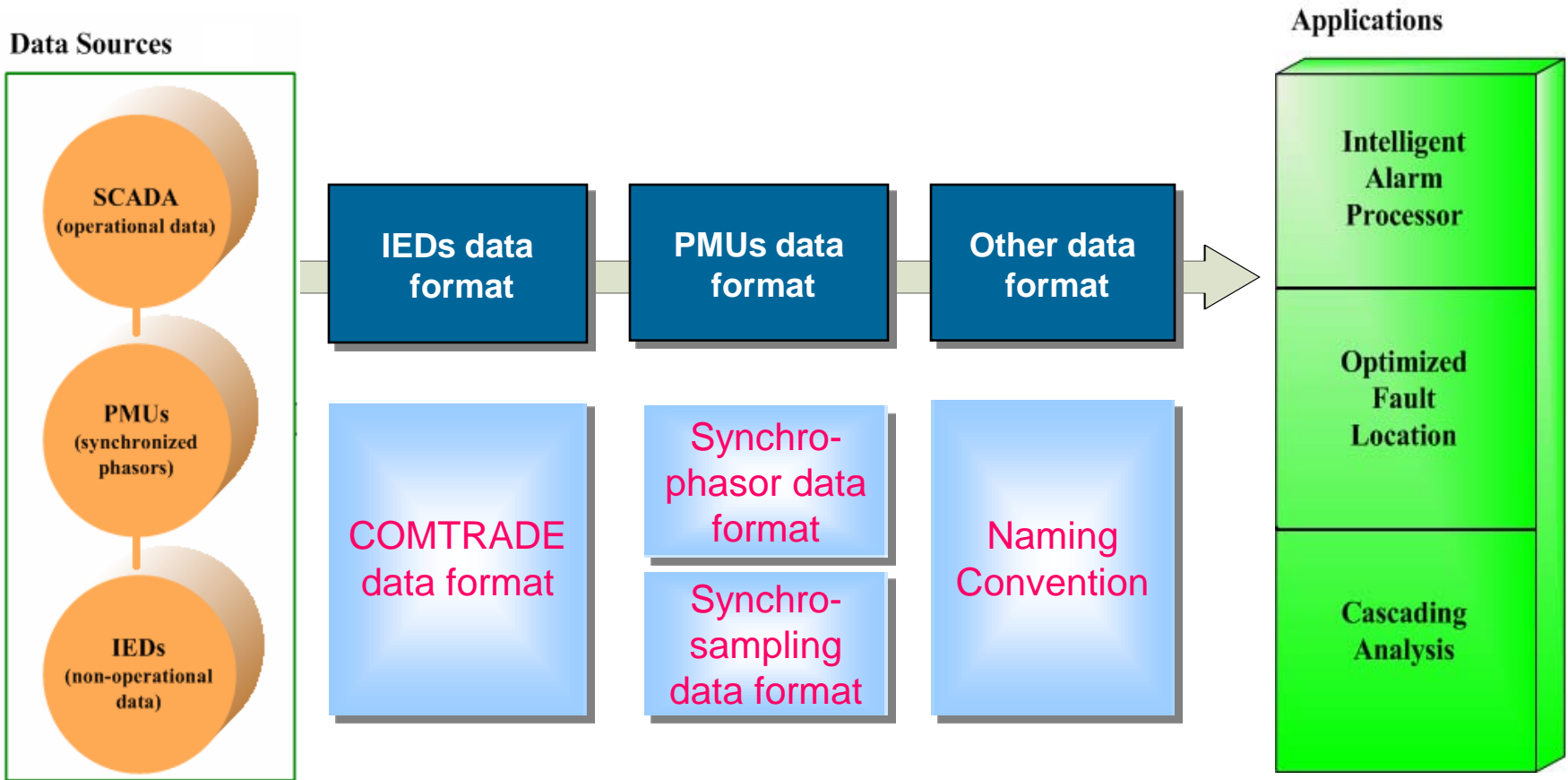


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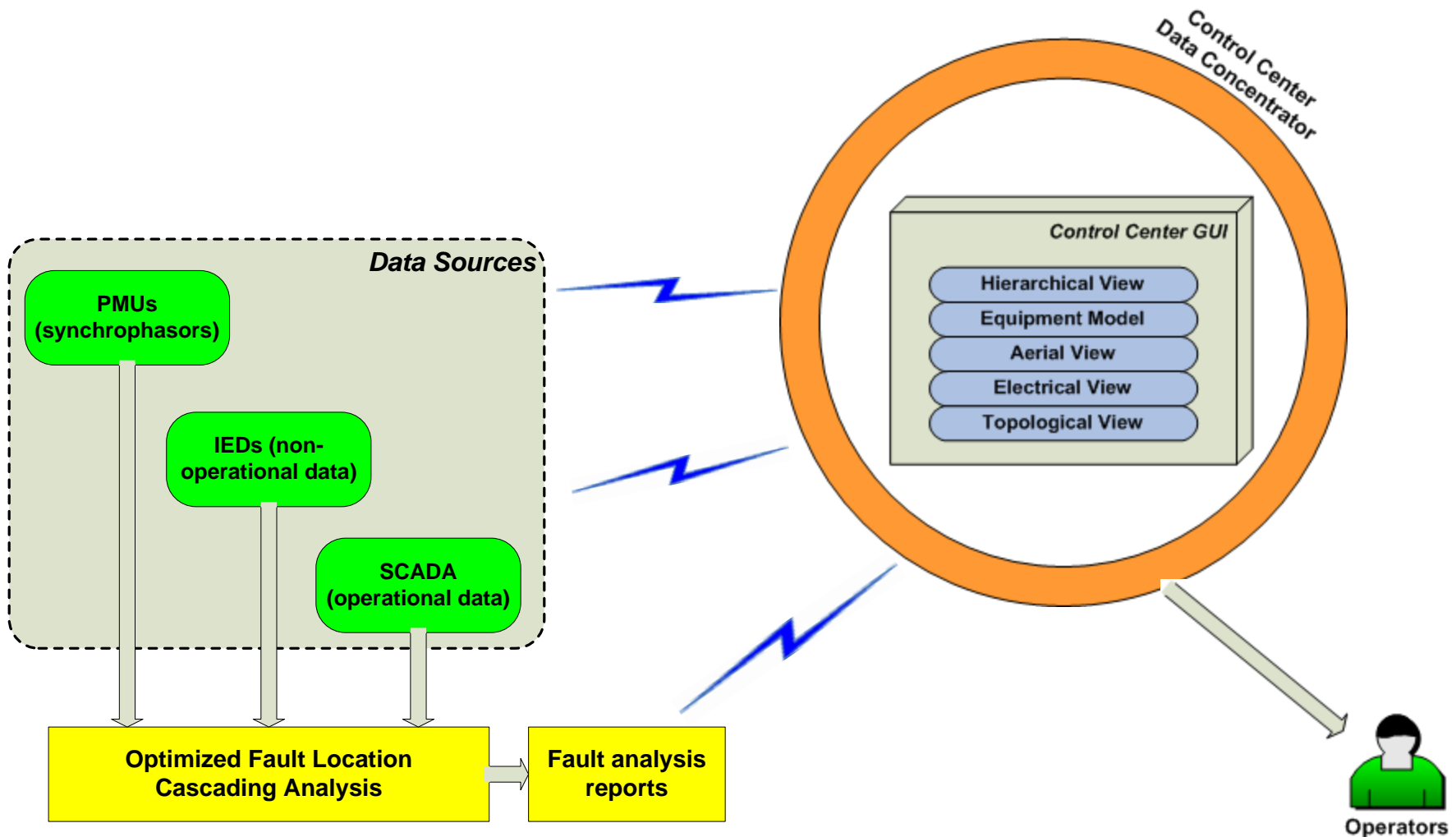
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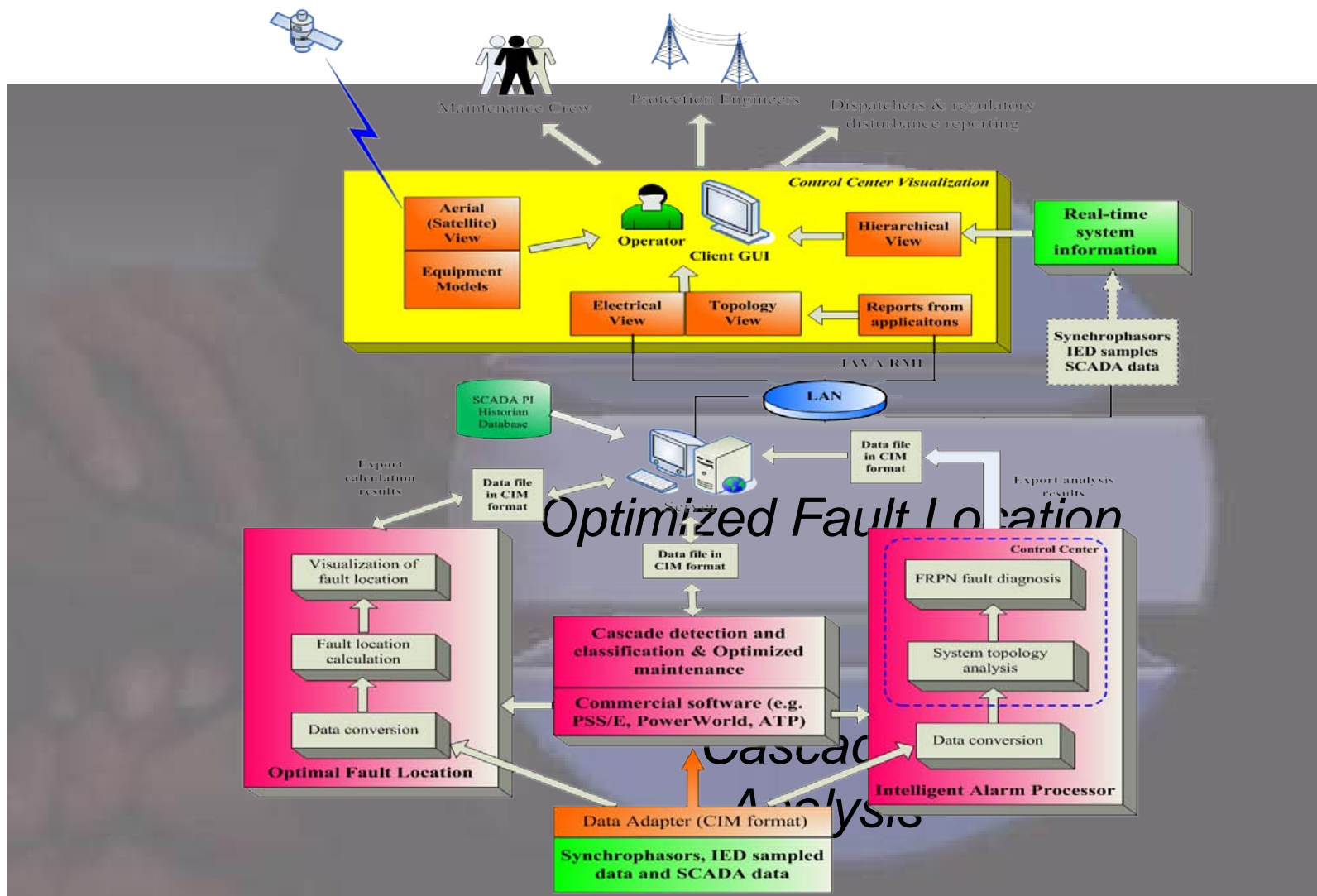
What is involved in data merging?



Control center visualization tools

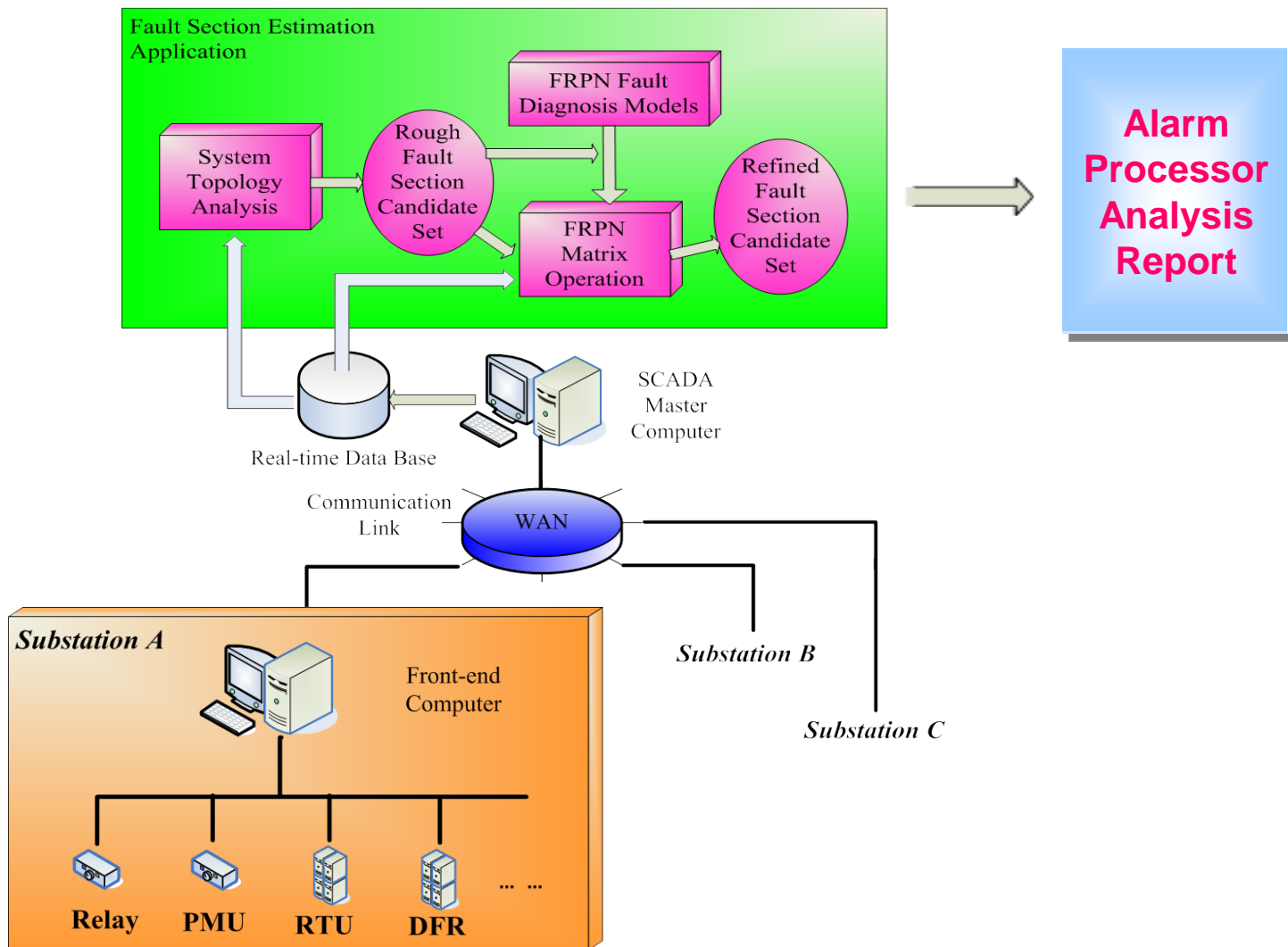


Applications using data merging



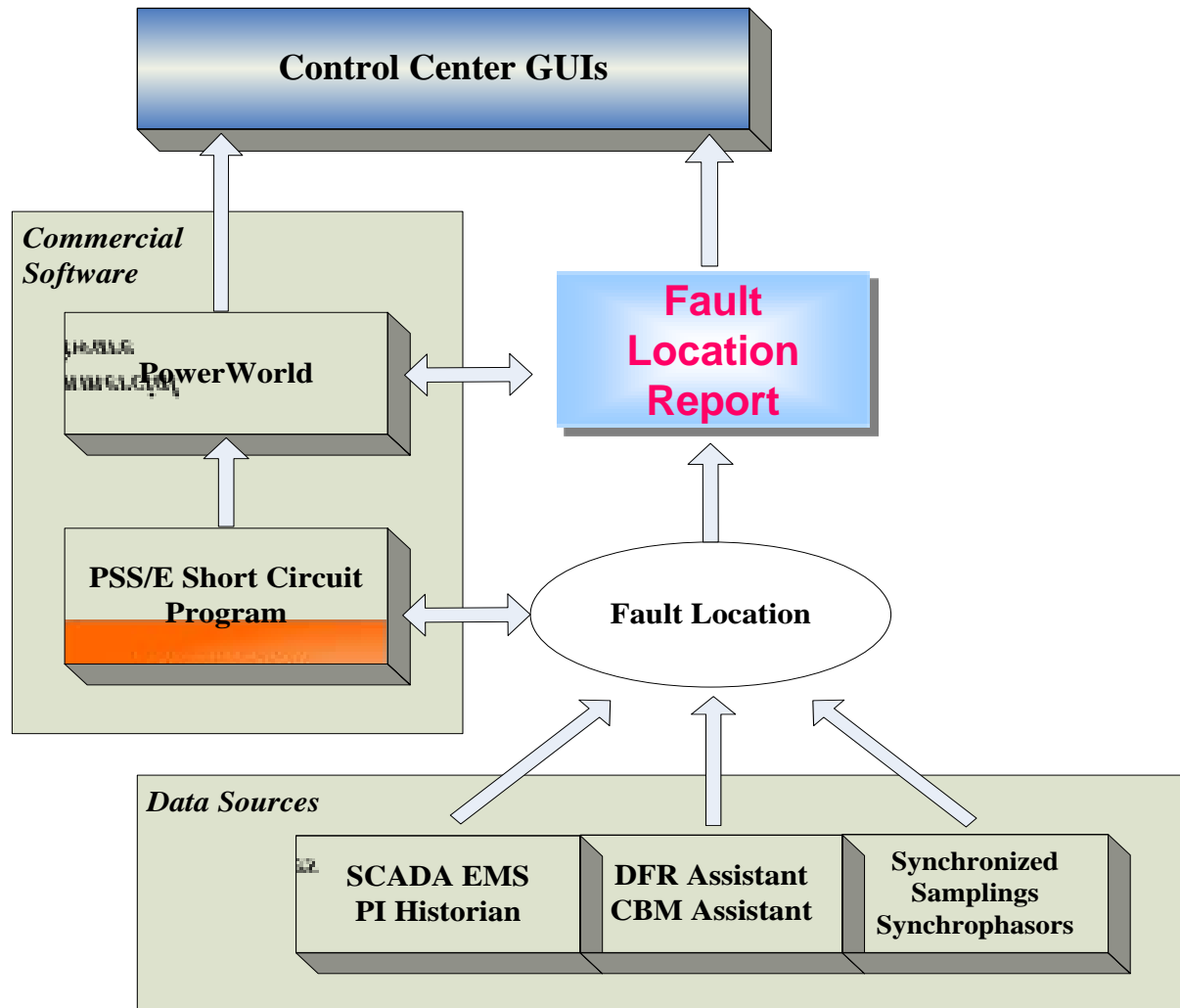


Application: *Intelligent Alarm Processor*

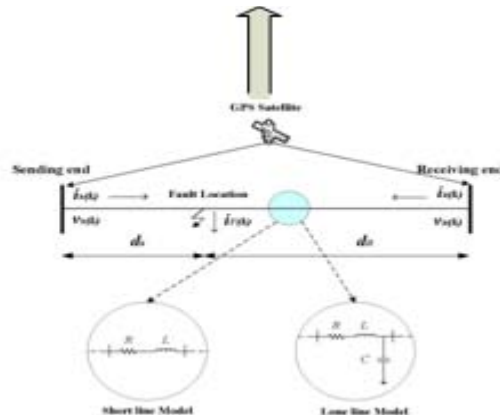
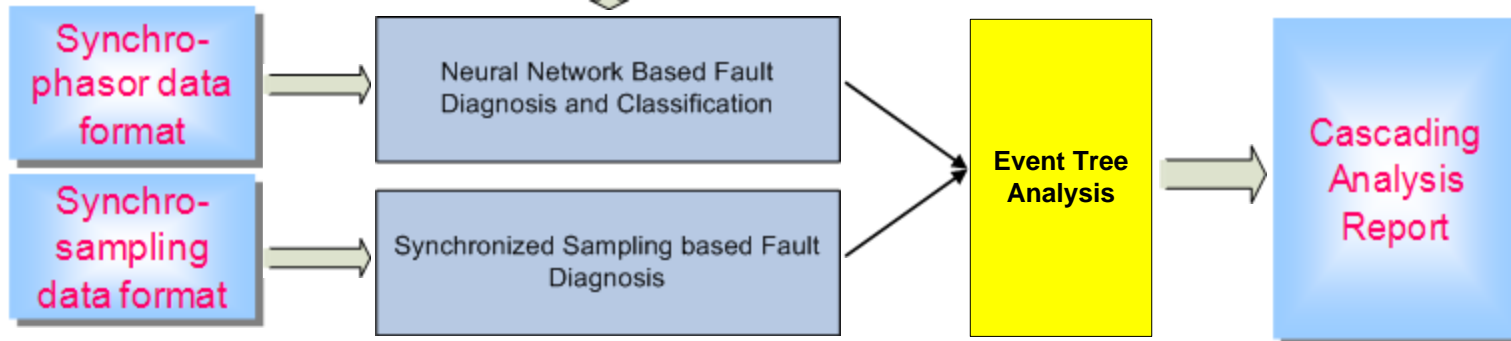
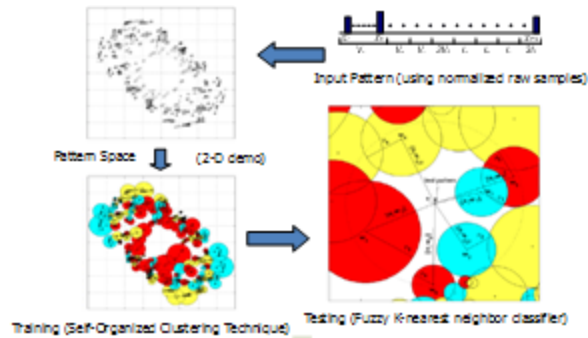




Application: *Optimized Fault Location*



Application: *Cascading Analysis*



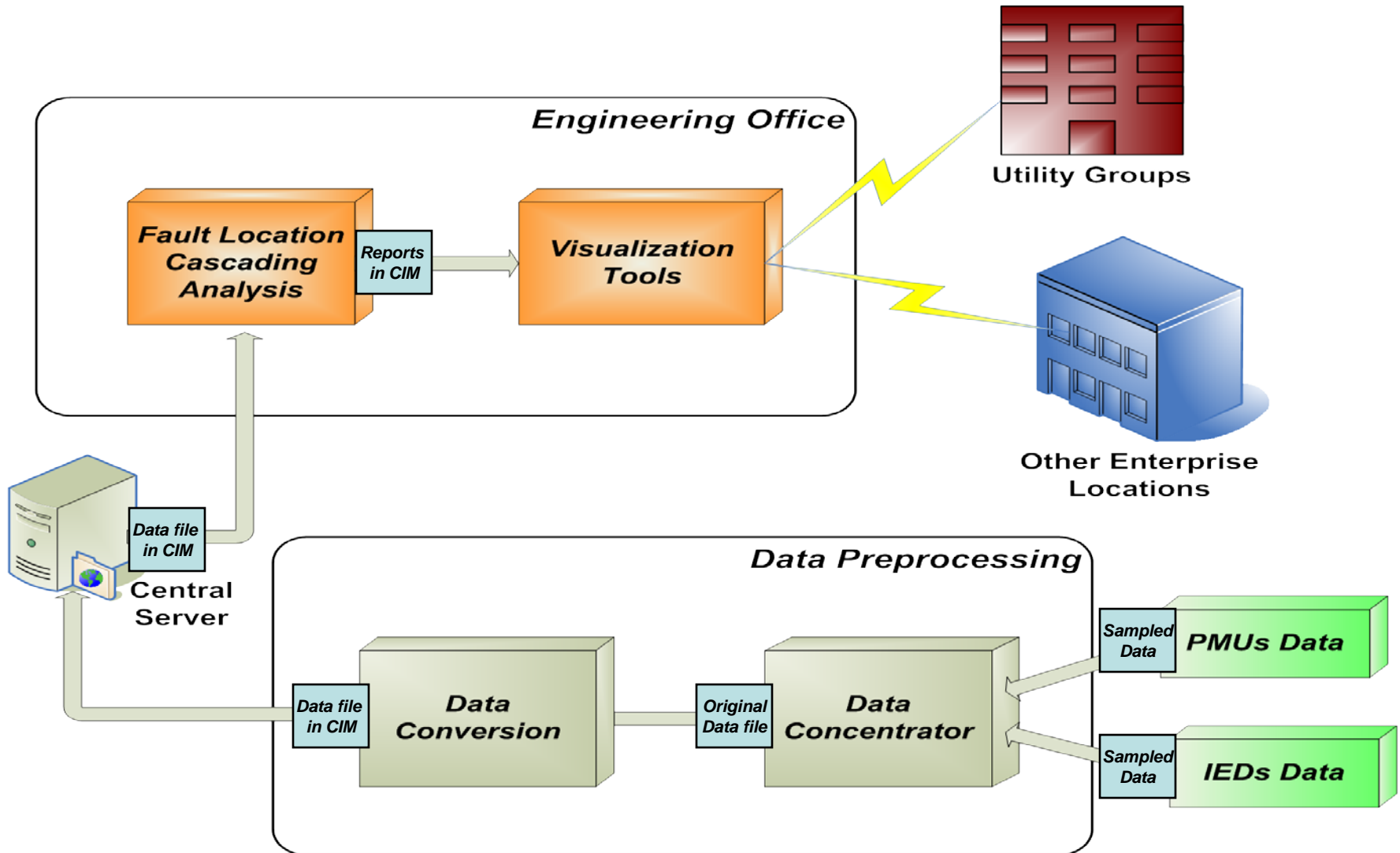


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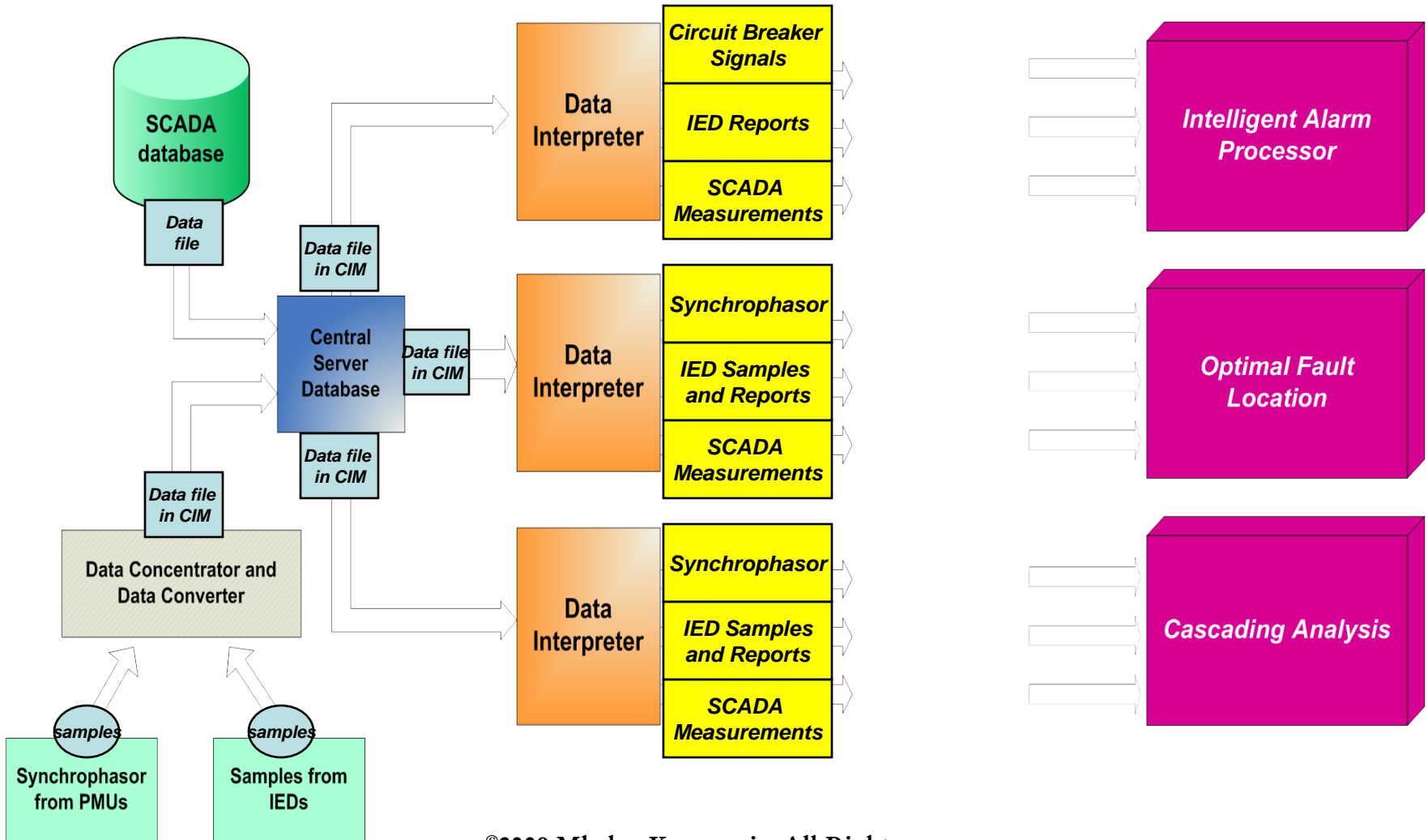
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Data Exchange Structure

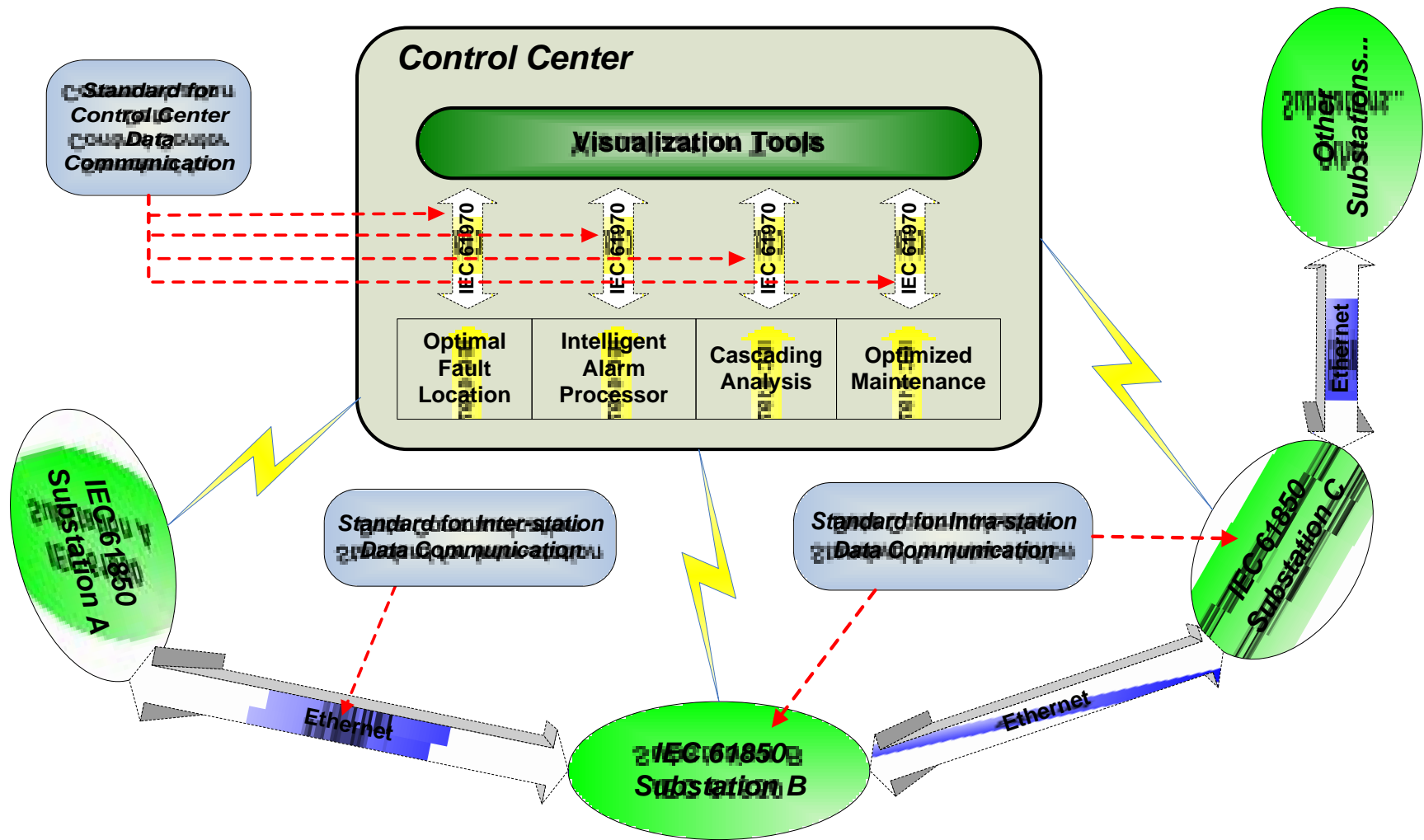


Data Interpretation





Data Communication: Network Interoperability





Thanks!

Questions?