



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

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Outline



- 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



- 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





Outline

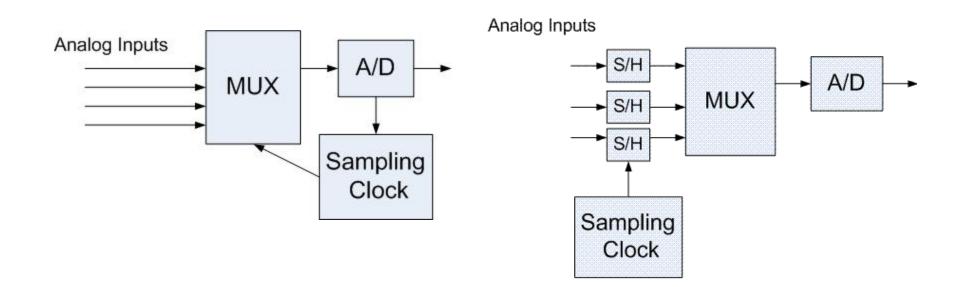
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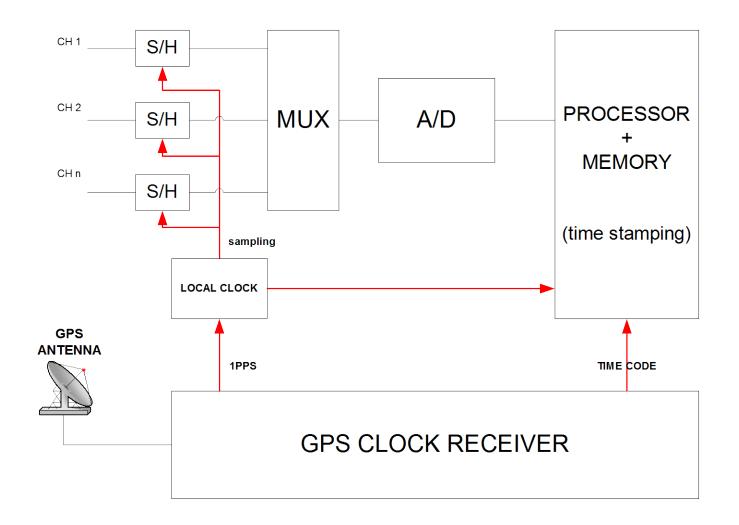
Scanning vs Synchronous sampling







Synchronous sampling vs time tagging







Background

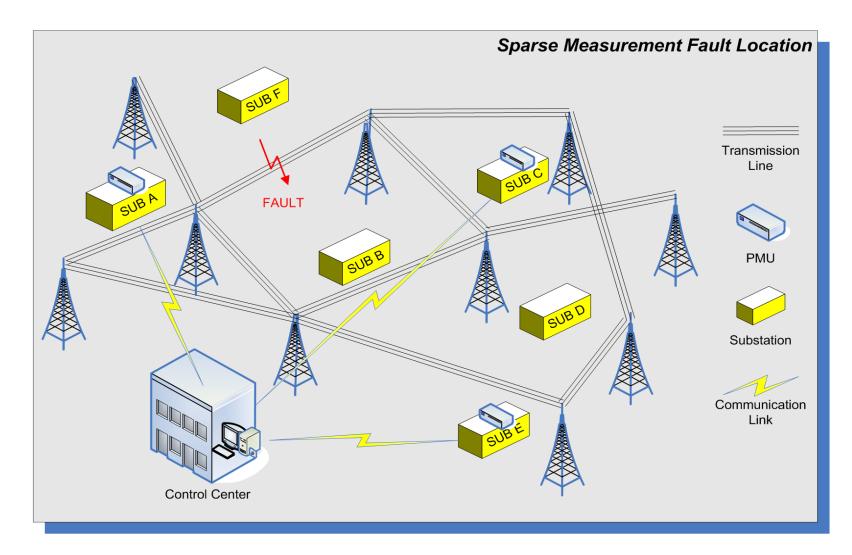
Time-synchronized Information:

- Synchronized Phasors
- Synchronized Samplings
- Synchronized Circuit Breaker States





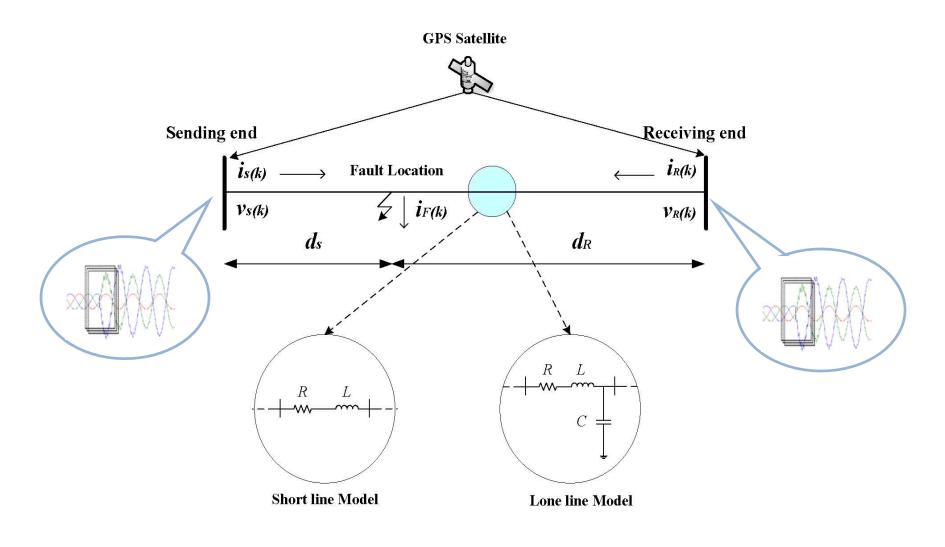
Synchronized phasors







Synchronized samples







👙 Sequence Analyzer		Maintenance Report
Import one-line diagram Save one-line diagram M		M SAP ID : 1234567
CB7 CB4 CB2 CB1?		Comment : opening Creation date : 15 Aug 2006 Creation time : 19:02:50.727 Station ID : OBR Device ID : F280 Company name : HLP Brkr manufacturer: WH
13 13:13:25	:0.900667 14 :0.854945	Brkr type : R3 File name : 060815,190250727,-5D,OBR,F280,HLP,WH,R3,1234567,
13:13:26 13:13:26	:0.456824 :0.468216	Expert System Log
BUSA		The record indicates an opening operation!
CB1	СВ4 СВ7	R11: Yard voltage unstable!
Line1 CB2 Line2	CB5 Line3 CB8 Line7 CB5 Line4 CB8 Line6 CB6 CB8	Excesive dip unrelated to close/trip coil activity!
		R26: 'B' contact flat!
CB3		R42: Phase A Current did not drop!
		R46: Phase B Current transition delayed!
BUSB Sequence Report		R49: Phase C Current transition delayed!
CB1 behaves unexpected. Oper	ation still unknown 0n 2\4\2002	at 13:13:2 R64: Slow breaker opening!
CB2 opening 0n 2\4\2002 at 13:13:25 .854945 CB4 opening 0n 2\4\2002 at 13:13:26 .456824		Maintenance & Repair Information
CB7 opening 0n 2\4\2002 at 13:13	3:26 .468216	Check substation battery, charging system, and control cables.
> Fault present on Line 1. Breaker Failure Logic fired. CB1 failed to disconnect Line 1.		Check auxiliary assembly, contacts, and linkage.
CB2,CB4 and CB7 disconected L	ine1 succesfully	Check Phase currents connections. There may be a bad interrupter.
		Check interupting medium and buffer.

-CB is ON

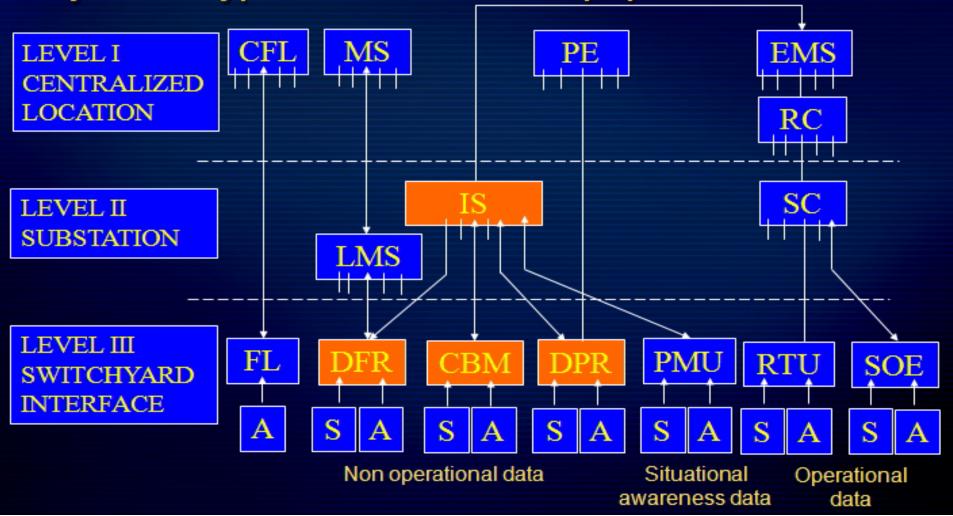


Detailed Maintenance & Repair Information





Layout of typical substation equipment

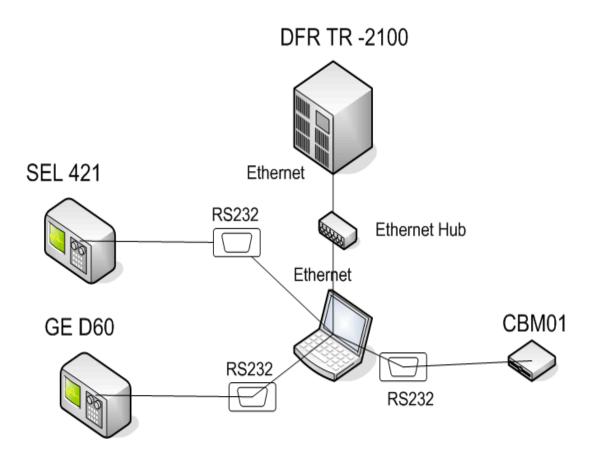






Example of time synchronization

IED GPS and data exchange wiring







Outline

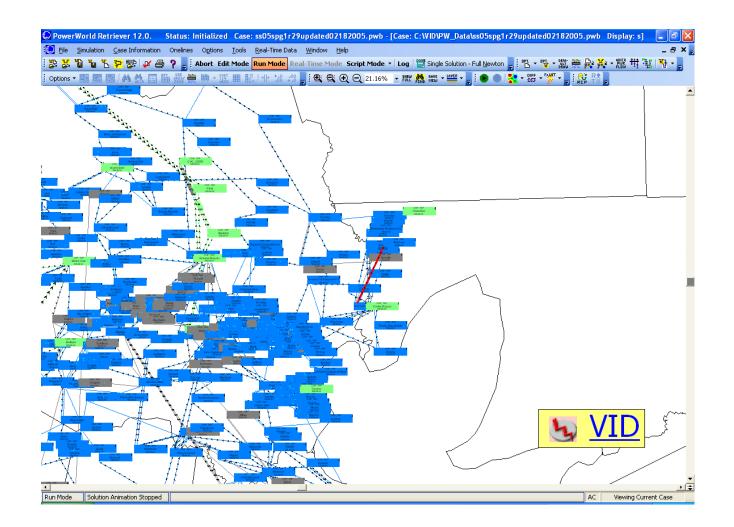
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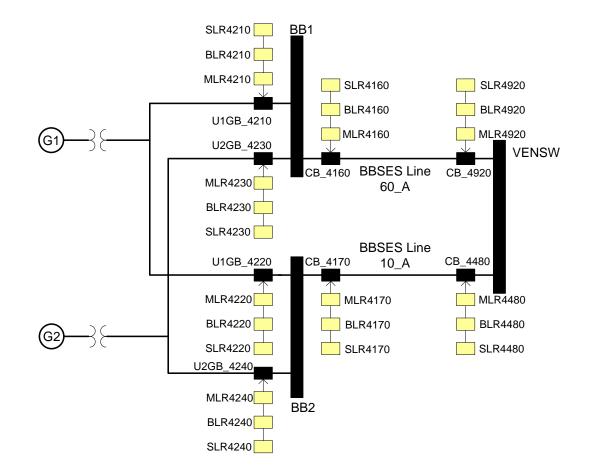




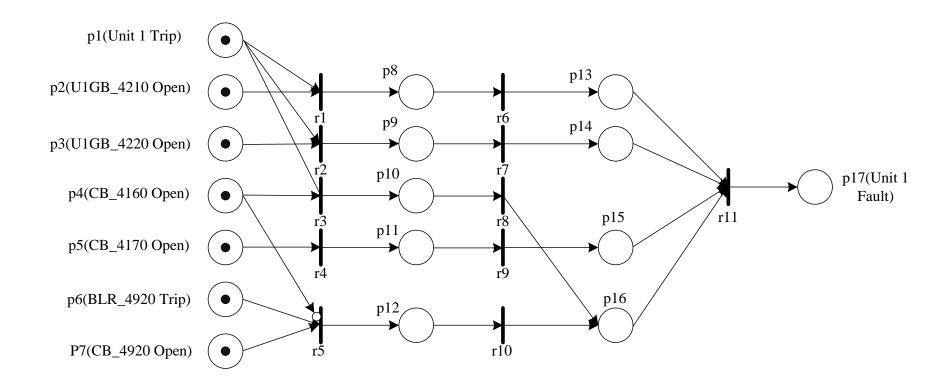
Event Analysis



Alarms



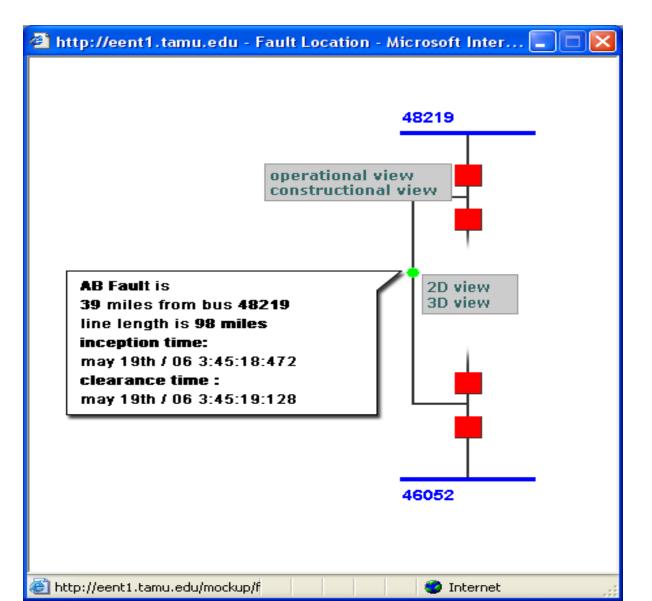
Cause-effect Analysis







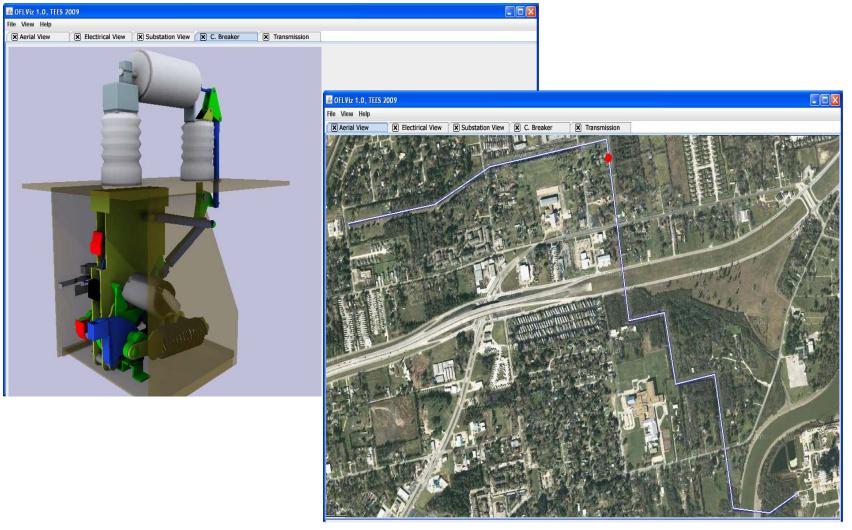
Control center visualization tools







Control center visualization tools





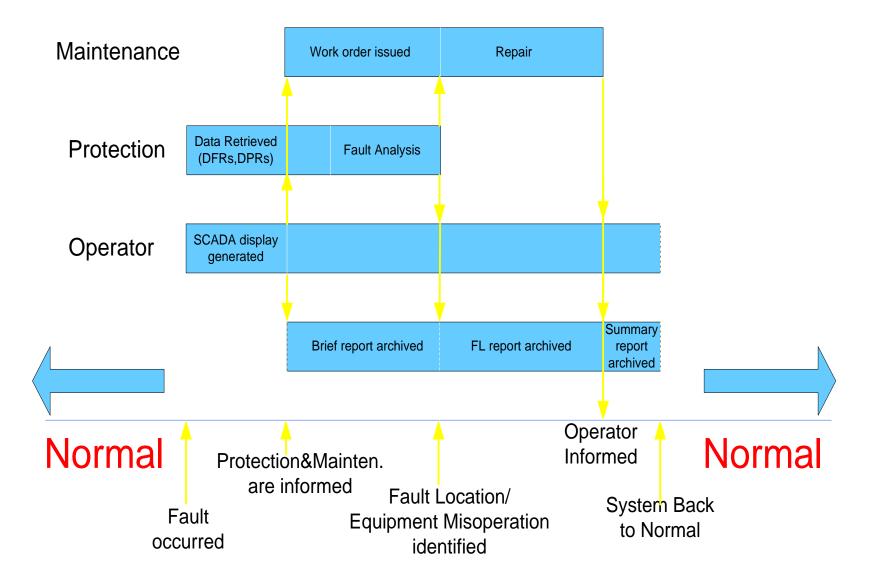


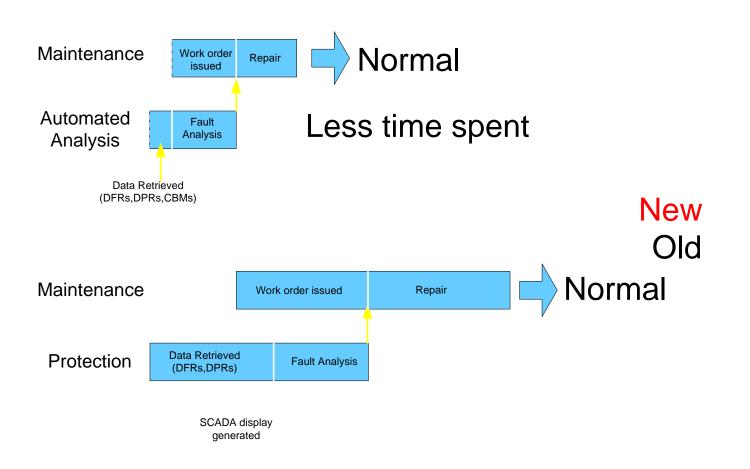
Enterprise Data Integration

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Event Chart Get or Delete Event Data	Filter Results Client: CenterPoint 0 Navigation Cor	Substation: Crosby ntrols	0		itcome: LL	0	
Waveforms	I< << Processed Date/Time	< Page 5 of 6 0 > Event Date/Time	>> > Substation Branch	Event Type Outcome	Location	Get Data	
TT. VVVV	2008-08-20 16:30:31.046	2007-10-30 05:59:38.343	Crosby CS-PSA-08	EXTERNAL_DISTURBANC NO_CLEARANCE	E 0.0	戰 陀	
JI AAAA	2008-08-20 16:14:36:437	2007-10-29 05:55:44.052	Crasby CS-PSA-08	EXTERNAL_DISTURBANC NO_CLEARANCE	E 0.0	1	
	2008-08-20 15:36:12.765	2007-10-26 06:06:01.906	Crosby CS-PSA-08	EXTERNAL_DISTURBANG NO_CLEARANCE	CE 0.0		
MWWWWWWW	2008-08-20 15:19:00.109	2007-10-21 08:34:53.615	Crosby CS-PSA-08	EXTERNAL_DISTURBANC NO_CLEARANCE	E 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	u 🔁	
	2008-08-20 15:18:49,000	2007-10-20 09:05:46.658	Crosby CS-BIL-86	EXTERNAL_DISTURBANC NO_CLEARANCE	.e 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	W	
	2008-08-20 14159106.562	2007-10-17 11:32:04.134	Crosby CS-PSA-08	GND_FAULT NO_CLEARANCE	0.0	4	
	2008-08-20 14:59:00.687	2007-10-17 11:32:02.920	Crosby CS-HB-66	BGND_FAULT CLEARANCE_LOCAL	22.2	.	
System Events Help	2008-08-20 14:53:26:437	2007-10-16 06:57:19.295	Crosby CS-HB-66	LINE_FAULT NO_CLEARANCE	0.0		
Click on event time stamp to select an event. Click on magnifying glass to inspect	2008-08-20 14:44:51.390	2007-10-15 10:11:32.407	Crosby CS-BIL-86	GND_FAULT NO_CLEARANCE	0.0		
Comtrade file for the selected event.	2008-08-20 14:28:13:093	2007-10-11 11:56:12.260	Crosby CS-HB-66	LINE_FAULT NO CLEARANCE	0.0		>
Done							0.



Timeline: Fault is permanent









Outline

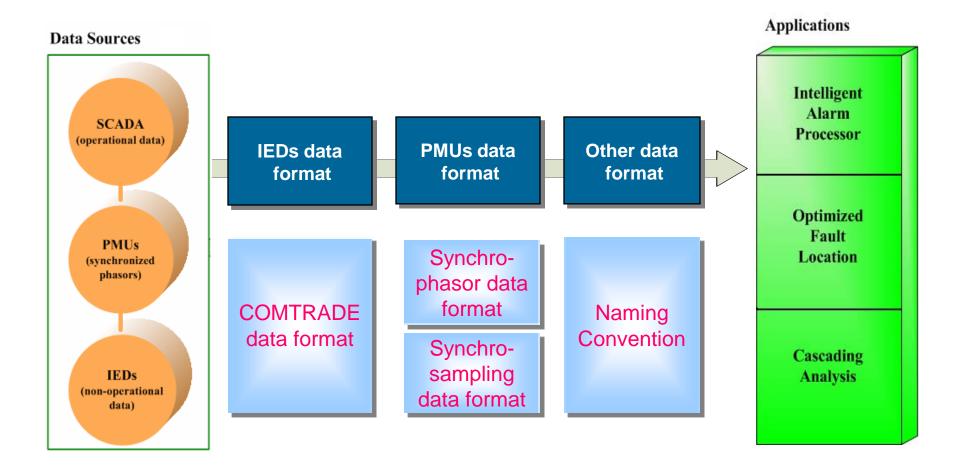


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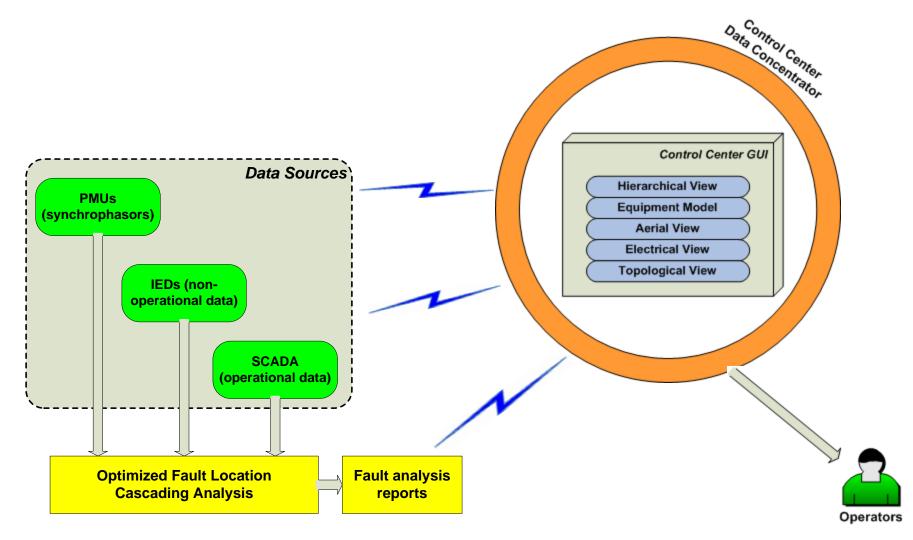








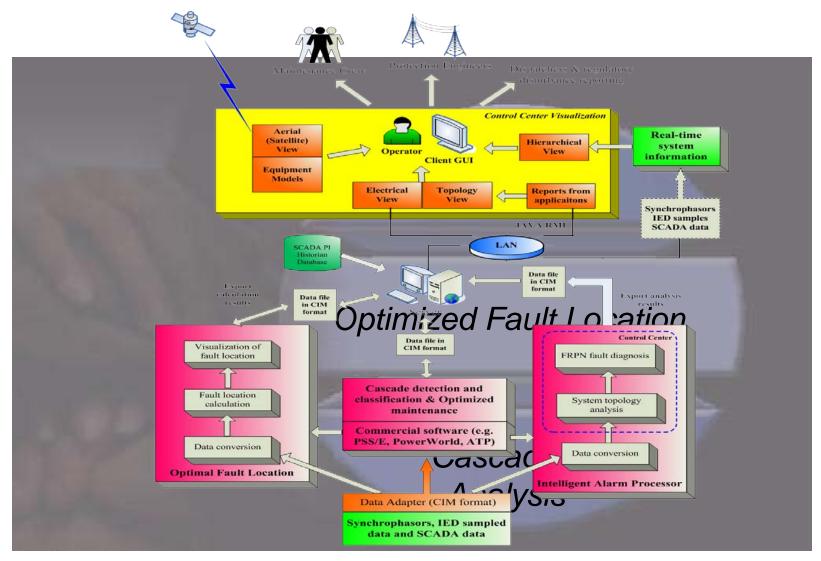
Control center visualization tools







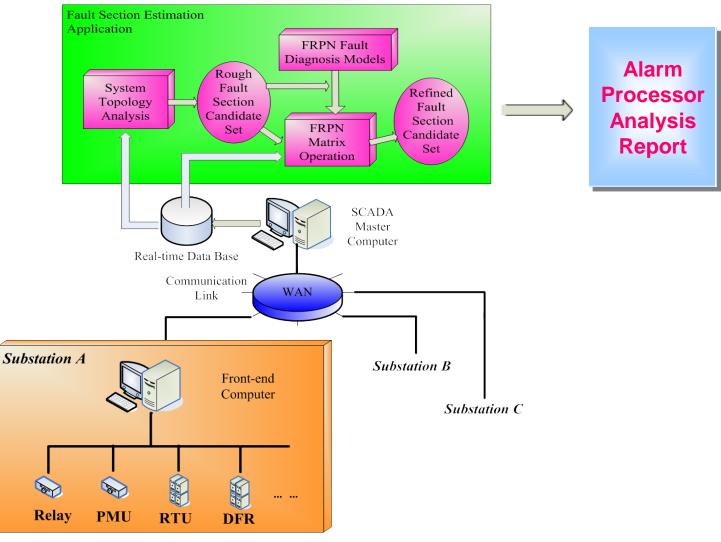
Applications using data merging





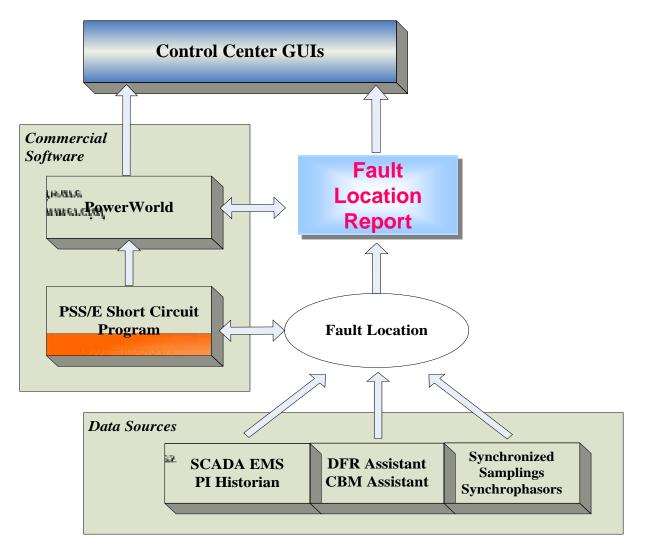


Application: Intelligent Alarm Processor





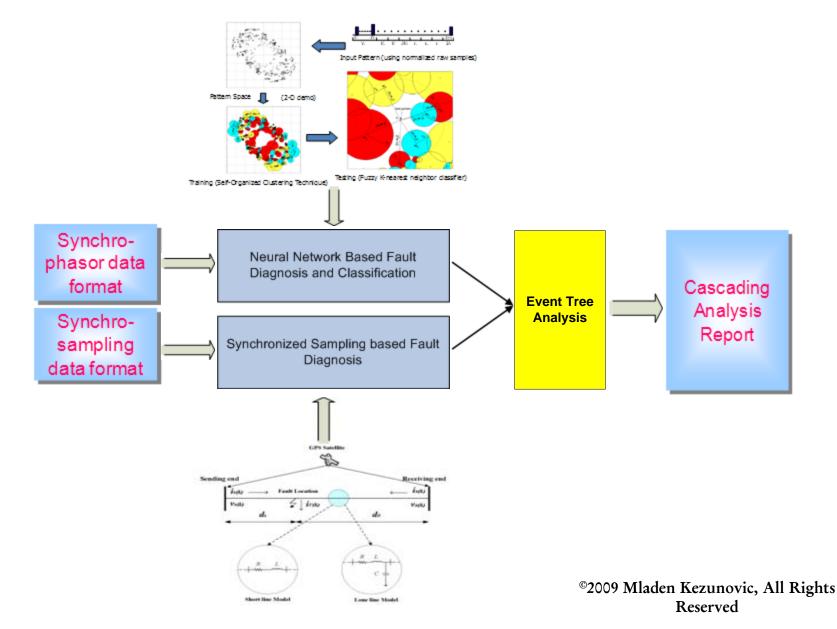
Application: Optimized Fault Location







Application: Cascading Analysis







Outline

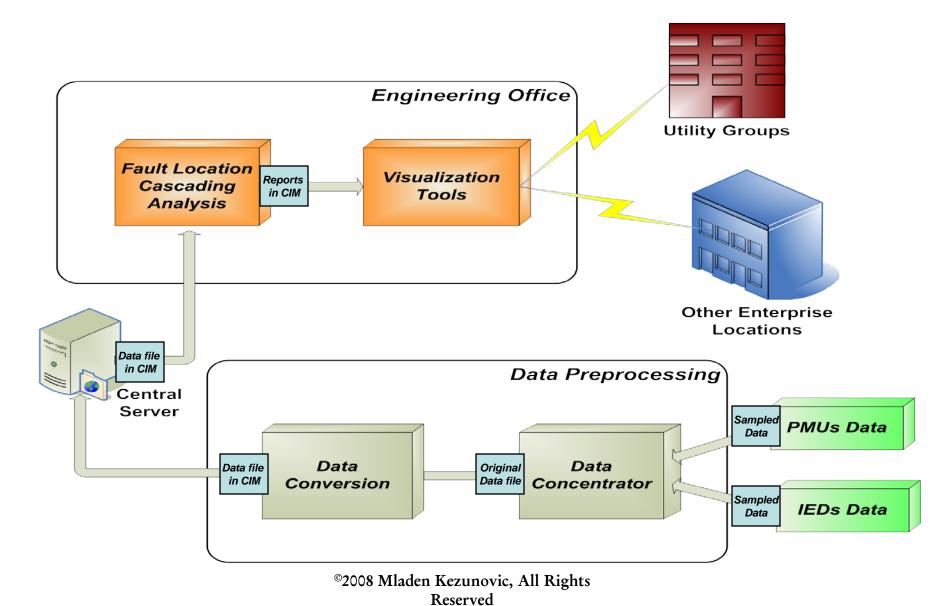
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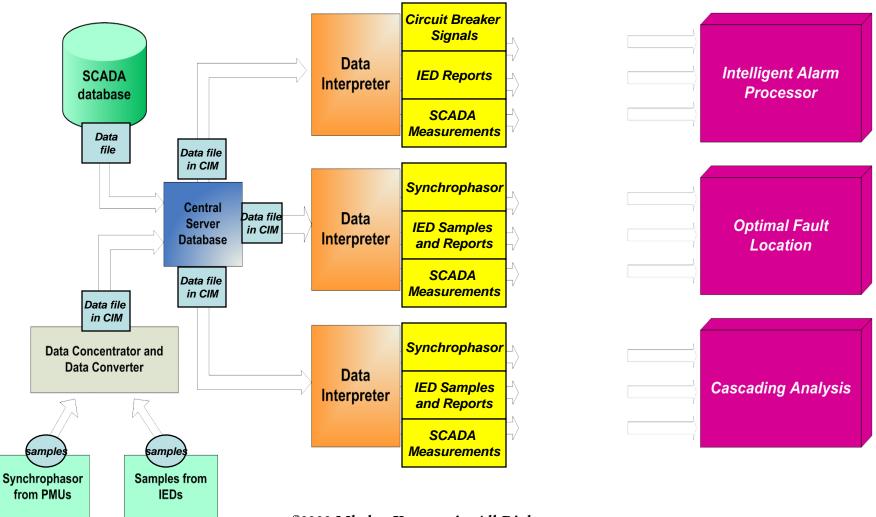
Data Exchange Structure







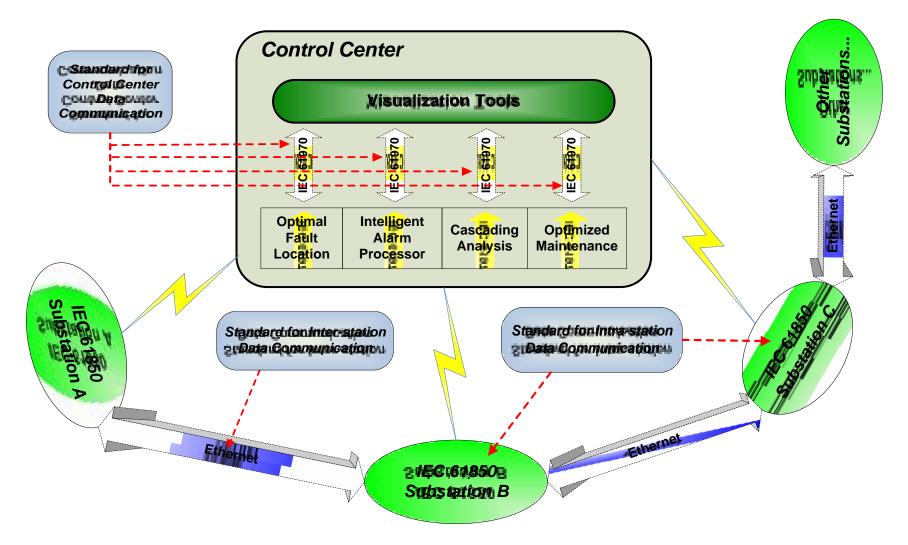
Data Interpretation







Data Communication: Network Interoperability



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Thanks!

