

TVA Implementation of openXDA

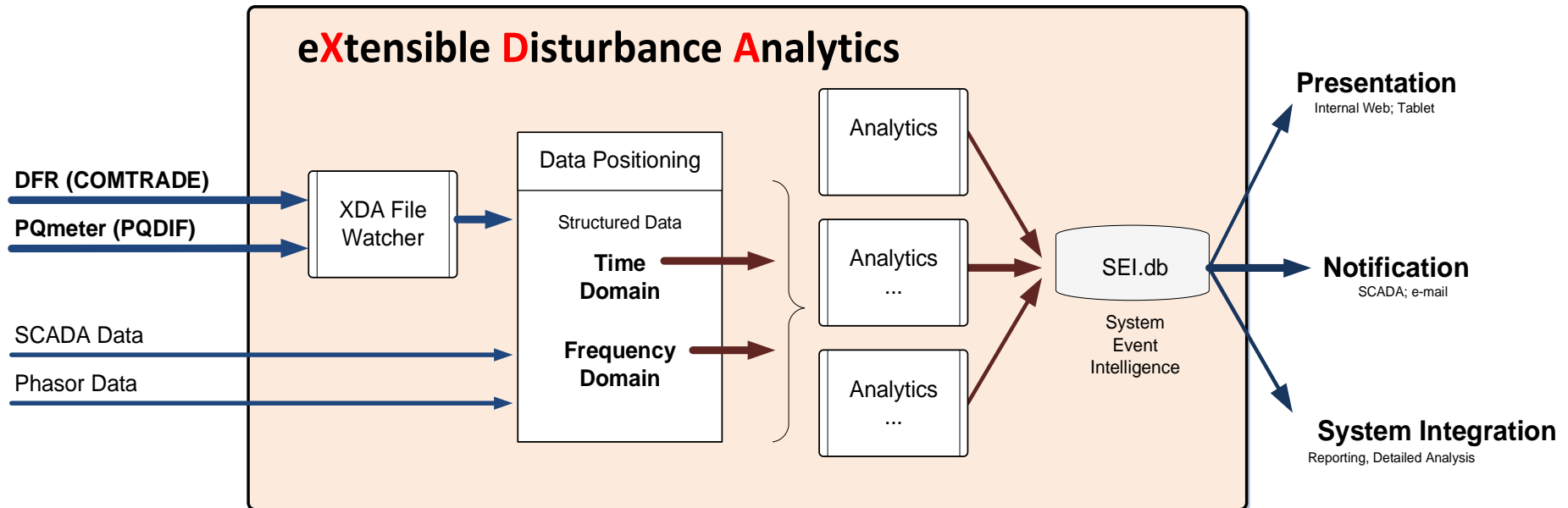
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GPA Users Forum

Background

- **TVA has a large population of disturbance meters**
 - 400 DFRs from 3 vendors
 - 400 PQ meters (200 ION Revenue meters by EOY)
 - 200 Relays that could potentially be used
- **TVA worked with EPRI and GPA in 2012 to develop and bench test automated fault location [openFLE]**
- **This work was extended to a pre-production pilot by TVA in 2013 with the business objectives to:**
 - Improve intelligence available to Transmission Operators
 - For line reclosing
 - For dispatch of line crews
 - Improve quality and reduce cost of disturbance analysis
- **GPA generalized openFLE and renamed it openXDA**

openXDA Overview

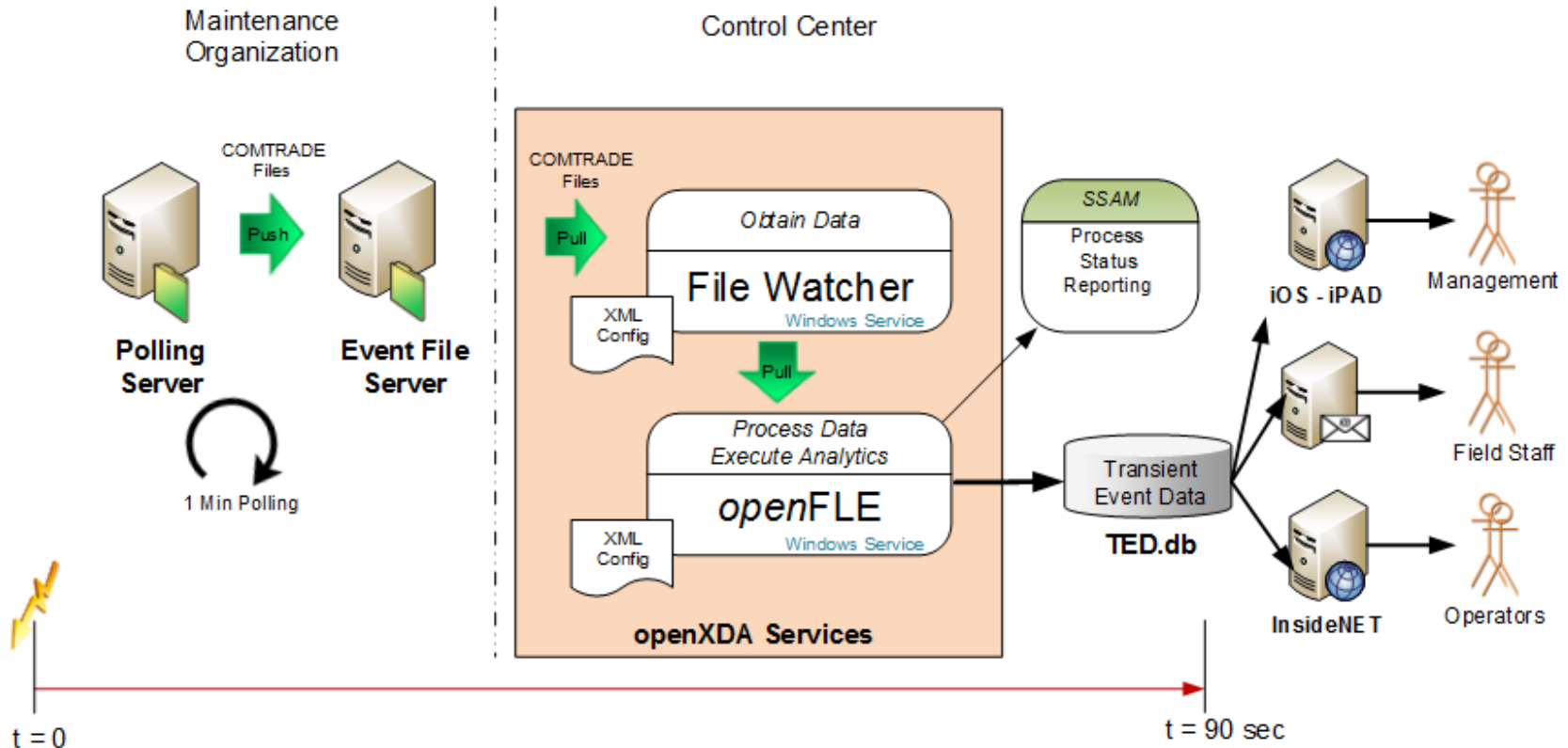


The Pilot - 10 Subs; 30 lines

- **Colbert #1**
- **Colbert #2**
- **Douglas**
- **Pickwick**
- **Charleston**
- **Franklin #2**
- **Fort Loudoun**
- **Oakwood**
- **Springfield**
- **Bull Run #1**

Approach: *Simple low-cost implementation without full integration with other TVA systems to allow benefits to be showcased to key users – Transmission Operators and Power System Engineers*

Pilot System Architecture



System Health Monitoring

SYSTEM STATUS AND ALARM MONITOR
Last Event Time: 08/12/2013

ASL 1 (Yellow bar) | **ASL 2** (Purple bar) | **ASL 3** (Blue bar)

Knowledge Base

Systems
 PCS IS TEST

System Help
 Alarm Warning Success ASL 1 ASL 2 ASL 3 Sound On Group By Process

Flow Name	RI	Description	Event	Intv	LastEventTS	ExpectedTS	Org	History
FL_BPC_RAC_MTN_COST	?	Monitors Raccoon Mountain Costs from ODS	Success	1 min	08/12/2013 21:43	08/12/2013 21:44	PCS	
RTP_BC_CREATE_COST_CURVE	?	Monitors creation of Product Cost Curves	Success	-	08/12/2013 21:21	NA	PCS	
DJ_RITS	?	Monitors importing of Interchange data to BPC	Success	5 mins	08/12/2013 21:41	08/12/2013 21:46	PCS	
FL_BCGA_ARCHIVE	?	Monitors archiving of BCGA data	Success	-	08/12/2013 21:16	NA	PCS	
FL_BCGA_RUN	?	Monitors running of BCGA SSIS process	Success	1 hr	08/12/2013 21:16	08/12/2013 22:16	PCS	
FL_BCGA_DAP_ARCHIVE	?	Monitors marking of DAP ID for archive	Success	-	08/12/2013 21:16	NA	PCS	
RTP_BC_FACTOR_CONFUSION	?	Monitors user-entered configuration data	Success	-	08/12/2013 21:21	NA	PCS	
RTP_BC_SAVE_COSTS	?	Monitors saving of Product Costs for publishing	Success	-	08/12/2013 21:21	NA	PCS	
RTP_BC_UNEXPECTED_ERROR	?	Monitors RTP_BC_SERVER unexpected errors	Success	-	08/12/2013 21:21	NA	PCS	
PR_BPC_RTP_BC	?	Monitors the RTP_BC_SERVER process which runs every hour	Success	1 hr	08/12/2013 21:21	08/12/2013 22:21	PCS	
FL_BPC_UC	?	Monitors running of BPC UC SSIS process	Success	-	08/02/2013 14:21	NA	PCS	
FL_CTFuelCost_BPC	?	Monitors running of SSIS process for importing CT Fuel Cost to BPC	Success	1 hr	08/12/2013 21:05	08/12/2013 22:05	PCS	
FL_CTFuelCost_AssetChar	?	Monitors running of SSIS process for importing CT Fuel Cost to Asset Char	Success	1 hr	08/12/2013 21:05	08/12/2013 22:05	PCS	
FL_CTFuelCost_Heartbeat	?	Heartbeat: CT Fuel Cost SSIS package is running	Success	-	08/12/2013 21:05	NA	PCS	
FL_COAL_MINDEV COSTSERV	?	Heart beat for service that calculates the Fossil fleet Deviation cost	Success	-	08/15/2012 09:55	NA	PCS	
DR_RITS_HR	?	RITS HeartBeat	Success	-	08/12/2013	NA	PCS	

Monitored Flows
Total Flow Count: 23

PR_BPC

Primary Contact
 Apps ON-CALL
 Work: (423) 6...
 1st Call: (423) 7...
 2nd Call: (423) 7...
 3rd Call: (423) 5...

Secondary Contact
 L...
 Work: (4...
 1st Call: (4...
 2nd Call: (4...
 3rd Call: ...

Tertiary Contact
 J...
 Work: (423...
 1st Call: (423...
 2nd Call: (423...
 3rd Call: (423...)

Other Info
 App Name: BPC
 SystemName: BPC
 ServerName: 152.85.97.188
 Software: Power Builder
 Criticality: A
 Srcv Level: ASL 1
 ProcessName: ...

- Alarm Prioritization
- High Level Awareness

- 800 Data Flows
- Response Instructions
- Support contact

File Watcher XML

- Server/Root Path
- Folder(s)
- Meter attributes
(to allow use in file renaming)
- Include subfolders(Y/N)
- File types to watch
- Action – copy or move

```
<sourceRootPath>..\openFLE\Watch</sourceRootPath>

<watchActions>
  <folder name=".">
    <meterName> </meterName>
    <meterSN> </meterSN>
    <meterAssetID> </meterAssetID>
    <meterAlias> </meterAlias>
    <meterSubstationName> </meterSubstationName>
    <meterVendor> </meterVendor>
    <meterModel> </meterModel>
    <meterSubstationID> </meterSubstationID>
    <produceResultsXML>Yes</produceResultsXML>
    <includeSubFolders>Yes</includeSubFolders>
    <fileFilter>*.dat, *.cfg</fileFilter>
    <watchCreated action="copy"
      destinationFolder = "..\openFLE\Drop"
      destinationFileName = "{existingFilename}" >
      Yes
    </watchCreated>
    <description> </description>
  </folder>
</watchActions>
```

Fault Location XML

- Line Name
- Nominal Voltage
- Rated Current
- Length
- Trigger Method
- End Station
- Impedances
- Channel Mapping

```
<line ID="xx2">
  <name> </name>
  <voltage> </voltage>
  <rating50F> </rating50F>
  <length> </length>
  <faultTrigger method="xx"> </faultTrigger>
  <endStationID> </endStationID>
  <endStationName> </endStationName>
  <impedances>
    <R1>3.1805</R1>
    <X1>16.67497</X1>
    <R0>15.21303</R0>
    <X0>52.45370</X0>
    <Rs>7.19134</Rs>
    <Xs>28/60121</Xs>
  </impedances>
  <channels>
    <VA>0</VA>
    <VB>1</VB>
    <VC>2</VC>
    <IA>28</IA>
    <IB>29</IB>
    <IC>30</IC>
    <IR>31</IR>
  </channels>
  ...
</line>
```


Example - Email Notification

Line fault detected: Paris-Rome 500 - Message (HTML)

This message was sent with High importance.

From: [Redacted] Sent: Tue 08/06/2013 4:19 PM

To: [Redacted]

Cc: [Redacted]

Subject: Line fault detected: Paris-Rome 500

This automated email has been triggered by the detection of a fault on the Paris-Rome 500 line. The details of analysis of this fault are provided below:

Fault Type	Fault Distance	Cycles of Data	Fault Cycles	Fault Calc Cycle	First Fault Cycle Time	IAFault	IBFault	ICFault	VAFault	VBFault	VCFault	IAMax	IBMax	ICMax	VAMin	VBMin	VCMin
ABC	47.138	12903	88	1805	2013-08-06 15:08:00	2803.32	3276.30	2402.08	88693.06	88010.87	87447.65	2858.83	3288.27	2422.61	88182.26	87498.19	87060.41

Web Based Reporting

Time	Name	Type	Location
08/06/2013 3:08:01 PM		ABC	47.138163
07/21/2013 5:32:52 PM		CA	11.478227
06/17/2013 6:59:00 PM		CN	22.26225
06/05/2013 6:41:19 AM		CA	10.886865
05/22/2013 5:09:36 PM		CN	0.09867
04/28/2013 9:24:22 AM		BC	27.538537
04/28/2013 9:24:22 AM		ABC	0.000895
04/27/2013 9:01:00 AM		CA	0.586955
03/19/2013 10:14:28 PM		CN	3.70334
03/18/2013 7:40:02 AM		CA	0.587289

Links to Details Page

Links to Map of Location

Line name removed by TVA

Fault Detail

Fault Location Reports

Event Details: 2013-08-06 15:08:00.567

Station: Bastille
Line: Paris-Rome 500

Line Parameters:

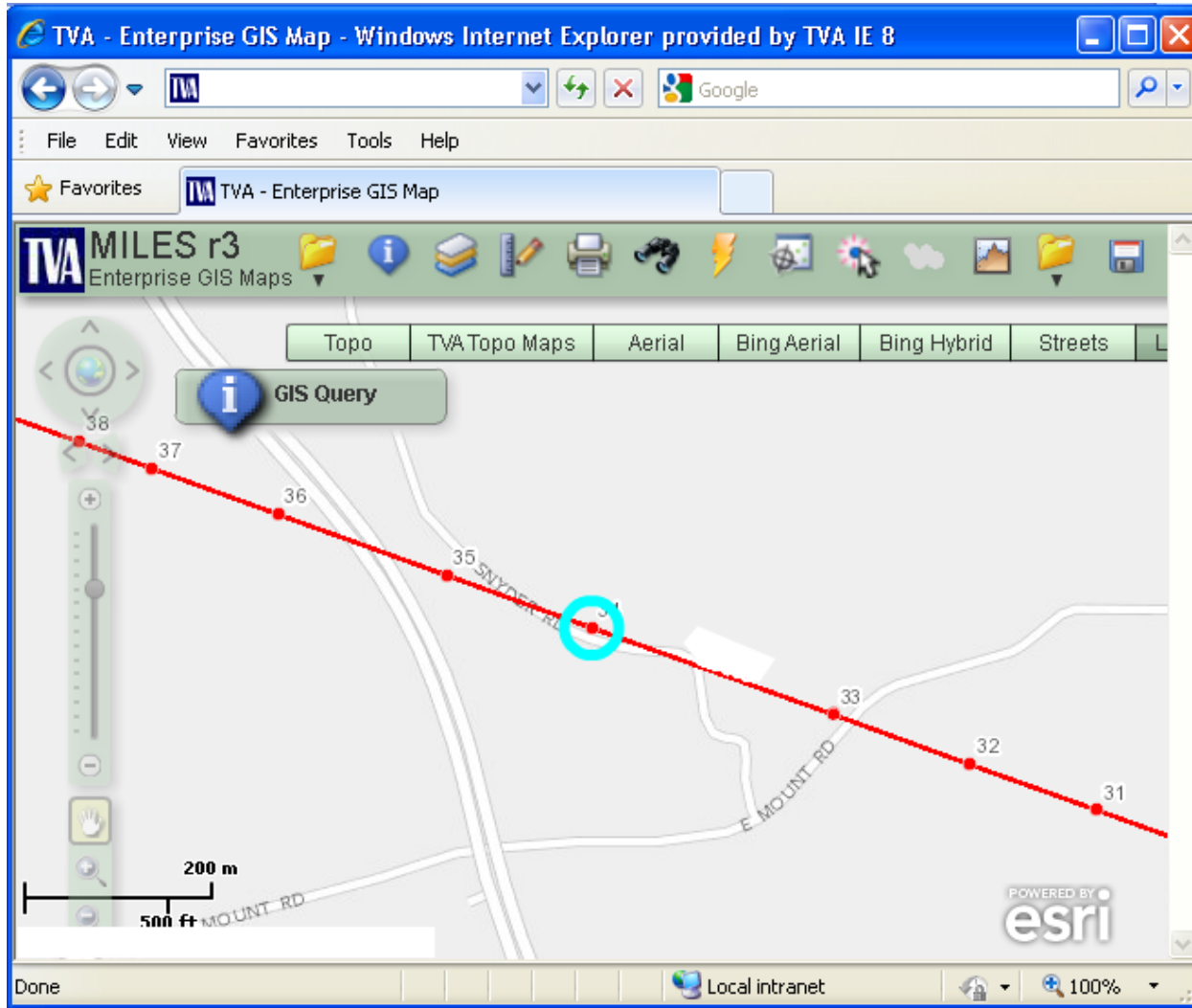
Length (Mi)	R1	X1	R0	X0
83.37	9.46117	63.6879	62.88435	200.34341
Impedance	Z1(3ph, LL, LLG)		ZS(LG)	
	64.387 < 81.553		112.592 < 75.986	

Fault Information: ABC - 47.14 Mi
Fault Links: [MILES](#) / [Structure Crawler](#)

V/I Info:

VA	VB	VC
88,693.06	88,010.87	87,447.65
IA	IB	IC
2,803.32	3,276.30	2,402.08

Map Detail



Plans after the Pilot

- **In FY 2014,**
 - Expansion of the system to include all meters that produce well-formed COMTRADE or PQDIF files and potentially DFR's
 - Simplification / Automation of openXDA configuration
 - Developing processes to improve DFR channel mapping configuration control
 - Acquiring line parameter data directly from primary source
 - Investments in software and hardware to enhance polling process
 - Increase confidence by adding multiple fault location algorithms
 - Look for other problems that could be solved with openXDA (e.g. equipment health)