

# POWER GRID-RX INC

PRESCRIPTIONS FOR THE POWER GRID IN THE DIGITAL AGE

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## Adventures In Building An OpenDashboard Plug-in

Presentation on 2008-04-25

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# Presentation Outline

- Background
- When all else fails, RTFM!
- Building the plug-in in 6 steps
- Database hacks
- Using the module
- Conclusions



# Background

- TVA maintains a database called System Interruption Database or SIDA for short.
- This database contains the authoritative outage information for each interruption on the TVA system.
- Amongst other things the following information is stored:
  - Date / Time of event
  - Cause code for event (eg. Wind, Lightning, Hail, Tree, etc.)

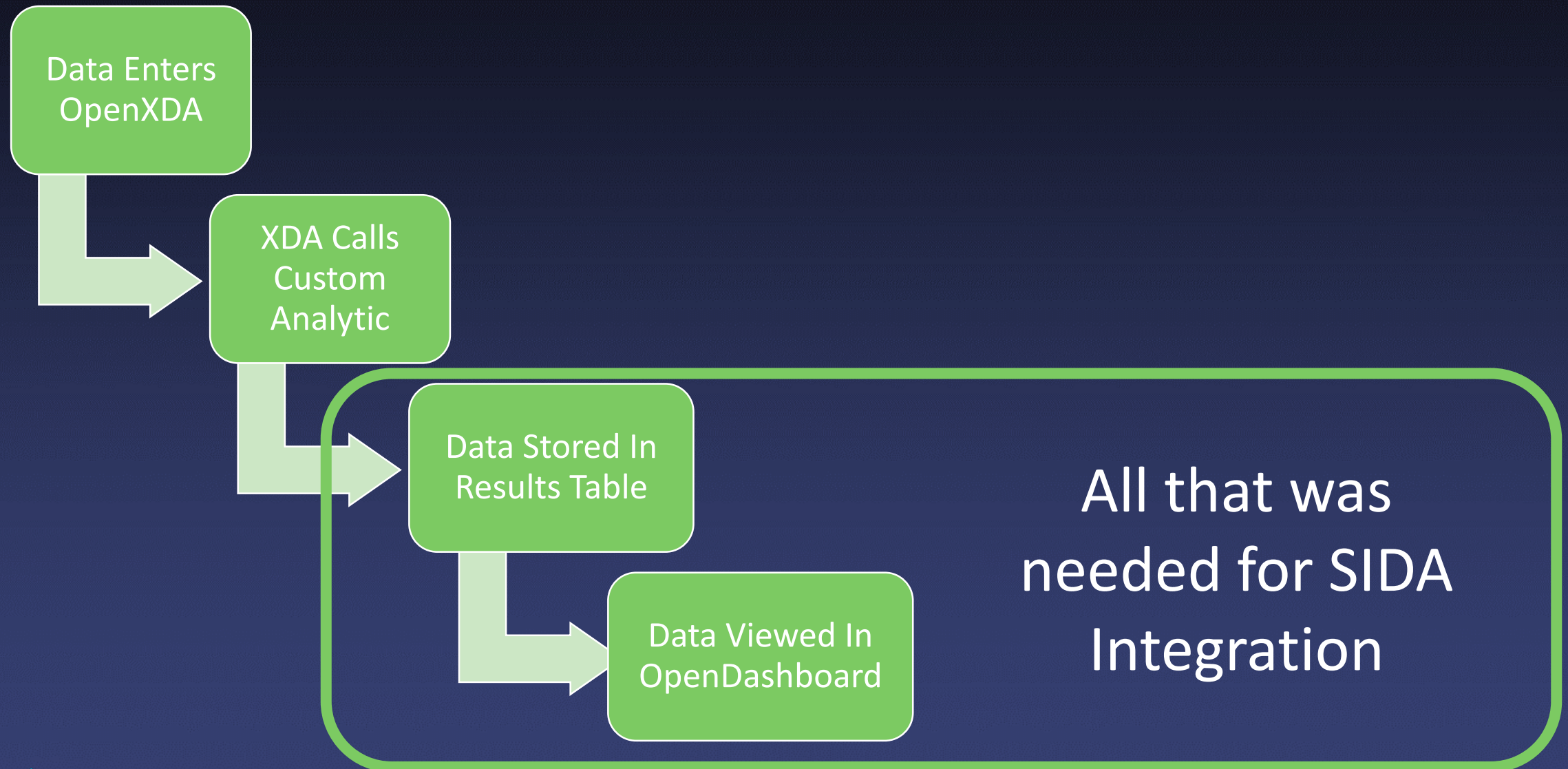
1	Event Date	Event Time	Event Num	LNS	KV	Duration	Duration	Cause	Subcaus	Event Ty	Exclude	Internal	External	Year
2	1/2/2006	51900	77316		500	10	43	LIGHTNING		TLP	N	INT		
3	3/13/2006	200200	77392		500	0	0	LIGHTNING		TLP	N	INT		2006
4	4/20/2006	80200	31348		500	0	0	LIGHTNING		TLP	N	INT		
5	4/21/2006	180400	77486		500	0	0	LIGHTNING		TLP	N	INT		2006
6	4/21/2006	180500	77485		500	0	0	LIGHTNING		TLP	N	INT		2006
7	4/21/2006	55800	31361		500	0	0	LIGHTNING		TLP	N	INT		
8	5/2/2006	220800	77501		500	14	49	LIGHTNING		TLP	N	INT		
9	5/2/2006	220800	77501		500	14	49	LIGHTNING		ICP	N	EXT		
10	5/3/2006	165000	31407		500	5	57	LIGHTNING	STATIC WII	TLP	N	INT		
11	5/21/2006	211200	68426		500	0	2	LIGHTNING		TLP	N	INT		

# When all else fails... Read the manual!

- <https://github.com/GridProtectionAlliance/openEAS>
- <https://github.com/GridProtectionAlliance/openEAS/wiki>



# EAS Full Implementation Overview



# 1. Create Table To Store The Results.

## OpenEAS Install Manual

```
4 -- Example:
5 IF NOT EXISTS (SELECT * FROM INFORMATION_SCHEMA TABLES WHERE TABLE_NAME = 'MAServiceResult')
6 BEGIN
7     CREATE TABLE MAServiceResult
8     (
9         ID INT IDENTITY(1, 1) NOT NULL PRIMARY KEY,
10        EventID INT NOT NULL REFERENCES Event(ID),
11        MyResult FLOAT NOT NULL
12    )
13
14 CREATE NONCLUSTERED INDEX IX_MAServiceResult_EventID
15 ON MAServiceResult(EventID ASC)
16 END
17 GO
18
```

## SIDA SQL

```
CREATE TABLE [dbo].[sidaResult](
    [ID] [int] IDENTITY(1,1) NOT NULL,
    [sidaeventnumber] [int] NOT NULL,
    [equipmentname] [nvarchar](255) NULL,
    [lms] [nvarchar](255) NULL,
    [kv] [int] NULL,
    [durationhr] [int] NULL,
    [durationmin] [int] NULL,
    [omoffice] [nvarchar](10) NULL,
    [causedescription] [nvarchar](50) NULL,
    [subcausedescription] [nvarchar](50) NULL,
    [eventtype] [nvarchar](10) NULL,
    [excludedrecord] [nvarchar](2) NULL,
    [internalexternal] [nvarchar](4) NULL,
    [eventtime] [datetime2](7) NULL,
    CONSTRAINT [PK_sidaResu_3214EC27DBC7C001] PRIMARY KEY CLUSTERED
(
    [ID] ASC
)WITH (PAD_INDEX = OFF, STATISTICS_NORECOMPUTE = OFF, IGNORE_DUP_KEY = OFF, ALLOW_ROW_LOCKS = ON, ALLOW_PAGE_LOCKS = ON) ON [PRIMARY]
) ON [PRIMARY]

GO
```

## 2. Create Function For Dashboard Integration.

The SIDA SQL is more complicated because we only have time correlation. Normally, EAS modules would have the eventID from the original event to correlate. Instead, we use a 2 minute window around the time from the original event to search for SIDA events.

### Open EAS Manual

```
CREATE FUNCTION HasMAServiceResult
(
    @eventID INT
)
RETURNS INT
AS BEGIN
    DECLARE @hasResult INT

    SELECT @hasResult = COUNT(*)
    FROM MAServiceResult
    WHERE
        EventID = @eventID AND
        MyResult <> -1E308 -- error code

    RETURN @hasResult
END
GO

INSERT INTO EASExtension VALUES('MAService', 'HasMAServiceResult')
GO
```

### SIDA SQL

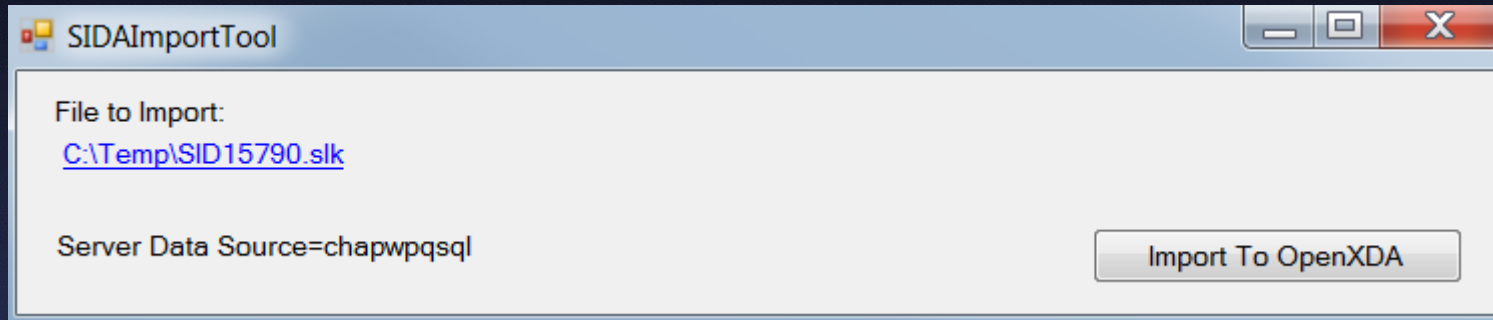
```
CREATE FUNCTION [dbo].[HassidaResult]
(
    @eventID INT
)
RETURNS INT
AS BEGIN
    DECLARE @HassidaResult INT
    DECLARE @starttime datetime2(7)
    DECLARE @endtime datetime2(7)

    select @starttime = dateadd(mi,-2,starttime),
           @endtime = dateadd(mi,2,starttime)
    from event
    where id=@eventID

    SELECT @HassidaResult = COUNT(*)
    FROM sidaResult
    WHERE
        eventtime between @starttime and @endtime
    RETURN @HassidaResult
END
GO
```



### 3. Develop Your Custom Analytic...



The SIDAImportTool is run manually. The SIDA results are locked down at the end of each month for reporting purposes. This tool can import the spreadsheet that is generated by the SIDA website at the end of each month.

Data is stored in the SIDAResult table created on step 1.



# 4. Insert Your Service Into The EASExtension Table.

## From EAS Manual

```
INSERT INTO EASExtension VALUES('MAService', 'HasMAServiceResult')  
GO
```

## SIDA Install

```
INSERT INTO EASExtension values ('SIDA','HasSIDAResult')  
GO
```

# 5. Copy EASServiceTemplate.aspx Web Page.

Modify these 2 lines with the name of your table and service.

```
<%@ Page Language="C#" AutoEventWireup="true" CodeFile="SIDA.aspx.cs" Inherits="EASDetails" %>
<%@ Import Namespace="System.Activities.Statements" %>
<%@ Import Namespace="FaultData.DataAnalysis" %>
<% ServiceName = "SIDA";
   TableName = "SIDAResult"; %>
<!DOCTYPE html>

<html xmlns="http://www.w3.org/1999/xhtml" style="height: 100%;">
<head id="Head1" runat="server">
  <% DoStuff(); %>
  <title><%=ServiceName%></title>

  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <link rel="shortcut icon" type="image/ico" href="~/favicon.ico" />
  <link rel="stylesheet" href="~/Content/FaultSpecifics.css" type="text/css" />

</head>

<body style="height: 100%;">
<table border="1px" width="100%" height="100%" cellpadding="0" cellspacing="0">
  <tr><td nowrap colspan="2" align="center"><%=ServiceName%></td></tr>

  <% foreach (Tuple<string, string> entry in thedata) { %>

  <tr><td nowrap align="right"><%= entry.Item1 %>:</td><td nowrap><%= entry.Item2 %></td></tr>

  <% } %>
</table>

</body>
</html>
```



## 6. Create Icon For Your Results.

- An image file is needed in the `..\pqrdashboard\images` folder. The name of the icon file needs to match your service name.
- Since our service is called SIDA, we placed a SIDA.png file in the images folder.
- I used paint to doctor one of the existing images.



# Database Hacks...

- Since we are only performing temporal correlation on the related table, some additional queries were needed.
- They are provided in this section for inspiration.
- They also allow additional integration which will be seen in the next section.



# Getting a list of OpenXDA Events within two minutes of an SIDA Event.

```
create PROCEDURE [dbo].[GetSIDAEvents]
(
    @sidaeventID INT
)
AS BEGIN
    DECLARE @starttime datetime2(7)
    DECLARE @endtime datetime2(7)

    select @starttime = dateadd(mi,-2,eventtime) ,
           @endtime = dateadd(mi,2,eventtime)
    from sidaResult
    where sidaeventnumber=@sidaeventID

    SELECT *
    FROM web_report_events_valid
    WHERE
           faulttime between @starttime and @endtime
END
GO
```

# Getting a list of SIDA Events within two minutes of an OpenXDA event.

```
CREATE PROCEDURE [dbo].[GetSIDAResult]
(
    @eventID INT
)
AS BEGIN
    DECLARE @starttime datetime2(7)
    DECLARE @endtime datetime2(7)

    select @starttime = dateadd(mi,-2,starttime),
           @endtime = dateadd(mi,2,starttime)
    from event
    where id=@eventID

    SELECT *
    FROM sidaResult
    WHERE
        eventtime between @starttime and @endtime
END
GO
```



# Results!

# Site Details

Events for [REDACTED] for 03/19/2018						
Start Time ↕	Type ↕	Line Name ↕	Line KV ↕	Confidence ↕	SEE	SEARCH
2018-03-19T18:07:13.4907996	SIDA	[REDACTED] 161	161	1	SEE	SEARCH
2018-03-19T18:07:13.4907996	SIDA	[REDACTED] 161	161	1	SEE	SEARCH
2018-03-19T18:07:13.4907996	SIDA		161	1	SEE	SEARCH
2018-03-19T18:07:13.4907996	ID: [REDACTED]		161	1	SEE	SEARCH
2018-03-19T18:07:13.4907996	sidaeventnumber: 456731		161	1	SEE	SEARCH
2018-03-19T18:07:13.4907996	equipmentname: [REDACTED]		161	1	SEE	SEARCH
	Ins:					
	kv: 161					
	durationhr: 0					
	durationmin: 0					
	omoffice: [REDACTED]					
	causedescription: LIGHTNING					
	subcausedescription:					
	eventtype: TLP					
	excludedrecord: N					
	internalexternal: INT					
	eventtime: 3/19/2018 6:07:13 PM					



# Custom Fault Location Details Page

**Fault Location Reports**

**Fault Inception Time:** 2018-03-19 18:07:13.7352430  
**Fault Duration:** 3.69 cycles / 61.21 ms  
**Fault Type:** AN  
**Location:** 20.61 miles from [redacted] on [redacted] 161kV Line  
**Double Ended Location:** 24.44 miles from [redacted]  
**Tree Probability:** Low (RF=3.75)  
**View:** Miles TeleGyr Quick BSL Search

1 structures found matching distance criteria!  
**Solution 1 Nearest Structure:** 125 @ [redacted]

Time Extent: 3/19/2018 6:07:11 PM - 3/19/2018 6:07:15 PM Line No: L5171 Vaisala Lat: 35.8367413 Lon: -86.0664545 Get Details Reset

DISPLAYTIME	LATITUDE	LONGITUDE	AMPLITUDE
03/19/2018 18:07:13.735002804			-8.4175

- TVA incorporated a custom fault location page in the dashboard.
- This page incorporates links to lightning data and the SIDA correlation that was produced through this effort.
- There are a number of events that have positive correlation!

Corresponding SIDA Reports	SIDA Event Number	Event Time	Equipment Name	kV	Duration (HH:MM)	OM Office	Cause	Subcause	Type	Excluded	Internal/External
	<a href="#">456731</a>	2018-03-19 18:07:13.0000000	[redacted]	161	0:0	[redacted]	LIGHTNING		TLP	N	INT

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