



# RTAP USERS GROUP

CONFERENCE 2007

**Berkana Resources Corporation**

## **Automated Conversion of a Legacy SCADA System to RTAP**

### **IDEAS AND CONCEPTS**

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for BP Olympic Pipeline**

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# Lifecycle of a SCADA System

- The Mad Scramble Project Period:
  - Armies of Personnel
  - Bags of Money
  - Delicate Balance between Non-Stop Operation of the Old and Replacement with the New

# Lifecycle of a SCADA System

- The Pax Romana Period:
  - Creative Additions of “Now Possible” Functionality
  - Excellent Vendor Support
  - Quite Often – Nice New Hardware

# Lifecycle of a SCADA System

- The Rumors of War Period:
  - First Discussions to Start the Process Anew
  - Diminished, Non-Existent or Expensive Vendor Support
  - Aging Hardware
  - “Indiana Jones” Spare Parts Situation

# SCADA System Replacement

- Choose New Vendor
- Choose New Hardware *(if necessary)*
- Convert all Databases
- Convert all Displays
- Convert all Custom Functionality

# Which Steps Can Benefit from Automation?

- Convert all Databases
- Convert all Custom Functionality

# Convert all the Databases

- Use the Legacy Database Access Utility:
  - List What Data is Needed for RTAP
  - List the Analogous Data in the Legacy System
  - Use the Legacy Utility to Extract the Analogous Items
  - Import that Output into a Spreadsheet

# Spreadsheet with Imported Data (Far Left)

Vector RecID	Description	Data Type	Data Sub-Type	Vector Byte	Vector Start Bit	Rtap # of Bits	Vector Alarm Type	Vector Alarm Priority	Vector State Decode	Control?	Rtap Label (11 characters max)
M16IVM161	BLOCK VALVE(VM16)	DISCRETE	CADISCRE	4	0	2	4	4	VALVE	Y	M16
M16IVM161S	BLOCK VALVE(VM16)	DISCRETE	CADISCRE	4	2	1	3	4	REMOTE.AUTO	N	M16
M16IHPSI1	16 HIGH PRESSURE	DISCRETE	CADISCRE	4	7	1	0	7	WARNING	N	M16
M16ISECA	FACILITY SECURITY	DISCRETE	CADISCRE	9	1	1	1	1	ALARM.NORMAL	N	M16
M16ISECS	FACILITY SECURITY STATUS	DISCRETE	CADISCRE	9	0	1	4	7	SECURITY	N	M16
M16ISRF	STN RESETABLE FAULT	DISCRETE	CADISCRE	8	2	1	1	3	FAULT	Y	M16
M16ISUAIF	STN UPS AC INPUT	DISCRETE	CADISCRE	8	0	1	1	3	FAILURE	N	M16
M16IVM161A	VM16 ARM/DISARM	DISCRETE	CADISCRE	5	2	1	0	7	DISARM.ARM	Y	M16
M16IVM161FC	BLOCK VALVE(VM16) CLOSE	DISCRETE	CADISCRE	4	6	1	0	7	FAILURE	N	M16
M16IVM161FO	BLOCK VALVE(VM16) OPEN	DISCRETE	CADISCRE	4	5	1	0	7	FAILURE	N	M16
M12IVM161I	BLOCK VALVE(VM16)	DISCRETE	CADISCRE	5	3	1	0	7	INVALID	N	M16
M16IVM161SA	BLOCK VALVE(VM16)STILL	DISCRETE	CADISCRE	5	1	1	1	4	AUTO.REMOTE	N	M16
M16ADWNPSI1	DOWNSTREAM PRESSURE	ANALOG	CAANALOG	10	0	0	0	6	CAANSTATES	N	M16
M16AUPPSI1	UPSTREAM PRESSURE	ANALOG	CAANALOG	12	0	0	0	6	CAANSTATES	N	M16

# Spreadsheet with Imported Data (Center Section)

Rtap Comm Port	Rtap Scan Device	Rtap Register	Rtap # of Registers	Rtap DE Type	Rtap Start Bit	Rtap Output Function Code	Rtap Output Coil or Register #1	Rtap Output Final State #1	Rtap Output Coil or Register #2	Rtap Output Final State #2	Rtap Scan Output Device	Rtap Alarm Type	Rtap Alarm Priority
3	21	300	1	5	8	5	300	1	301	2	21	DEVICE CONTROL CHANGE	WARNING
3	21	300	1	5	10	0	0	0	0	0	0	TWO WAY UNCOMMANDED	WARNING
3	21	300	1	5	15	0	0	0	0	0	0	EVENT ONLY	WARNING
3	21	302	1	5	1	0	0	0	0	0	0	ONE-WAY 0->1	HAZARD
3	21	302	1	5	0	0	0	0	0	0	0	DEVICE CONTROL CHANGE	WARNING
3	21	302	1	5	10	5	308	0	0	0	21	ONE-WAY 0->1	RESET
3	21	302	1	5	8	0	0	0	0	0	0	ONE-WAY 0->1	RESET
3	21	300	1	5	2	5	302	1	303	0	21	EVENT ONLY	WARNING
3	21	300	1	5	14	0	0	0	0	0	0	EVENT ONLY	WARNING
3	21	300	1	5	13	0	0	0	0	0	0	EVENT ONLY	WARNING
3	21	300	1	5	3	0	0	0	0	0	0	EVENT ONLY	WARNING
3	21	300	1	5	1	0	0	0	0	0	0	ONE-WAY 0->1	WARNING
3	21	303	1	5		0	0	0	0	0	0	HI,HIHI,LO,LOLO,TRANSDUC	WARNING
3	21	304	1	5		0	0	0	0	0	0	HI,HIHI,LO,LOLO,TRANSDUC	WARNING

# Spreadsheet with Imported Data (Right Side)

Point Type or Group	Point Type/Group Name	Sub-Group (Group)/Org. Point (Type)	{1}	{2}	{3}	{4}	Point Name
GROUP	Single Block Valve			16			Valve
GROUP	Single Block Valve			16			Valve
GROUP	Single Block Valve			16			Psi Inhibit
GROUP	Single Block Valve			16			Facility Alarm
GROUP	Single Block Valve			16			Facility Status
GROUP	Single Block Valve	Controls		16			Resetable Fault
GROUP	Single Block Valve			16			AC Input Fail
GROUP	Single Block Valve	Controls		16			Arm Disarm
GROUP	Single Block Valve	Alarms		16			Valve Close Fail
GROUP	Single Block Valve	Alarms		16			Valve Open Fail
GROUP	Single Block Valve	Alarms		16			Valve Invalid
GROUP	Single Block Valve	Alarms		16			Still Off Auto
GROUP	Single Block Valve	Analogs		16			Downstream PSI
GROUP	Single Block Valve	Analogs		16			Upstream PSI

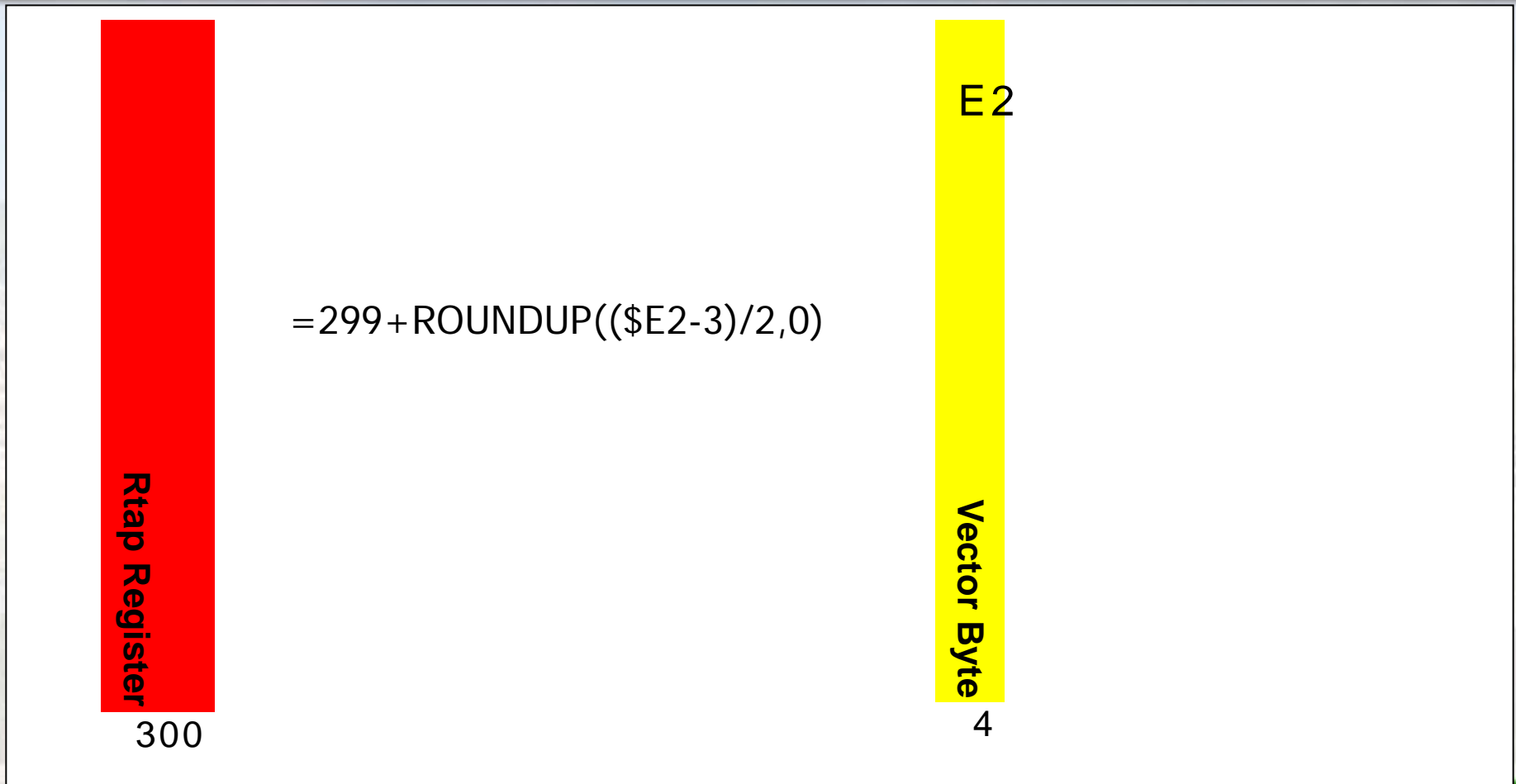
# Details on One Row

Vector RecID	Description	Data Type	Data Sub-Type	Vector Byte	Vector Start Bit	Rtap # of Bits	Vector Alarm Type	Vector Alarm Priority	Vector State Decode	Control?
M16IVM161	BLOCK VALVE(VM16)	DISCRETE	CADISCRE	4	0	2	4	4	VALVE	Y

# Scan Input and Output Section

Rtap Scan Output Device	21
Rtap Output Final State #2	2
Rtap Output Coil or Register #2	301
Rtap Output Final State #1	1
Rtap Output Coil or Register #1	300
Rtap Output Function Code	5
Rtap Start Bit	8
Rtap DE Type	5
Rtap # of Registers	1
Rtap Register	300
Rtap Scan Device	21
Rtap Comm Port	3

# Vector Byte $\leftrightarrow$ RTAP Register



# Vector Byte $\Leftrightarrow$ RTAP Register

- Vector Scan Response:
  - 3 Bytes of Overhead
  - 2 Bytes Per Same Register Number
  - Byte 4 – 3 = 1       $\frac{1}{2}$  Rounds to 1
  - Byte 5 – 3 = 2       $\frac{2}{2}$  Rounds to 1
  - Thus Bytes 4 and 5 = Register 1
  - Since the “First Register” = 1 (not 0), the Coefficient to be Added Must be N-1
  - N = The Starting Register in Vector

# Vector Subtype $\leftrightarrow$ RTAP DE Type

=LOOKUP(D2,\$CA\$1020:\$CA\$1027,\$CC\$1020:\$CC\$1027)

Rtap # of Registers

Rtap DE Type

1

5

CAACCUMU	7	2
CAANALOG	5	1
CADISCRE	5	1
CATANK	5	1
DPAPIANA	5	1
FPANALOG	8	2
IEEEANLG	8	2
INT4ANAQ	7	2

Data Sub-Type

CADISCRE

# Vector Control DB ↔ Scan Output

=LOOKUP(IF(\$K2 = "Y", \$A2, "N/A"),\$CA\$1130:\$CA\$1200,\$CB\$1130:\$CB\$1200)

**Rtap Output Function Code**  
**Rtap Output Coil or Register #1**

5

300

M16IVM161	5	300	1	301	2	21
M16IVM161A	5	302	1	303	0	21

# Start of Manual Entries

Point Type or Group	Point Type/Group Name	Sub-Group (Group)/Org. Point (Type)	Parent
GROUP	Single Block Valve		

- Enter Point Type or Group, and Sub Group Position

# Column Data ↔ Point Group

{1}

OLYM16

{2}

16

{3}

Milepost 16

{4}

Alias: \${1}  
Point Name: \${3}  
Point Type: Block Valve

# Sample Point Group Diagram

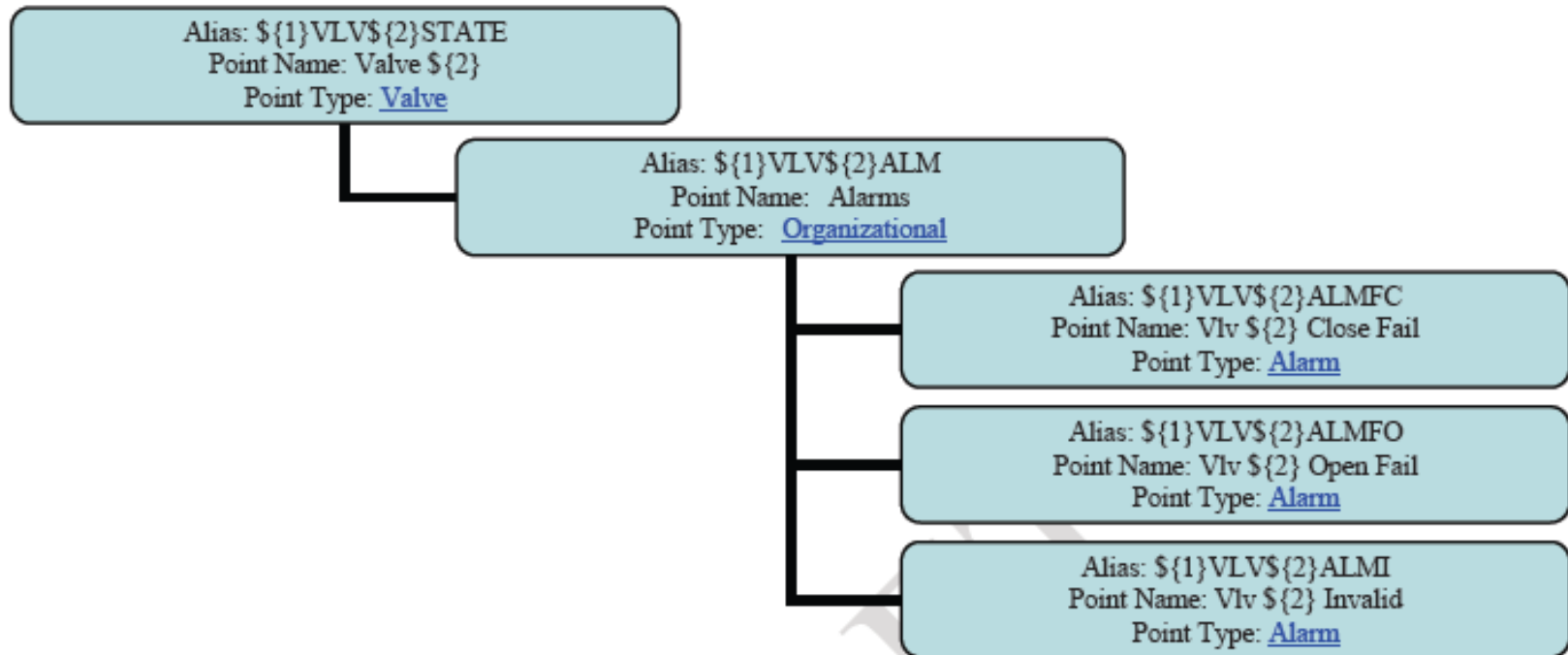
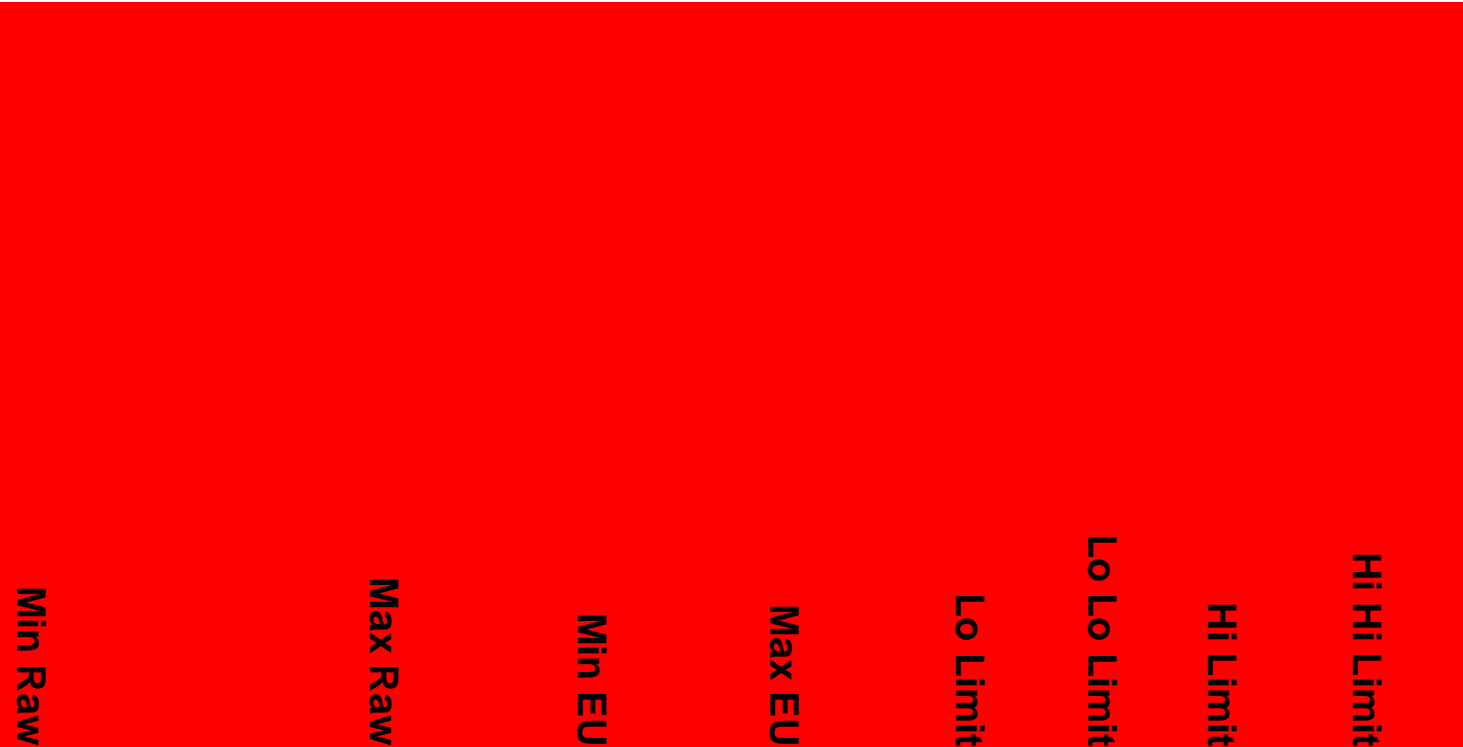


Figure 13: Valve Point Group Diagram

# Assign Point Names and Path

Point Name	Rtap Path (to the parent of this point)
Milepost 16 Valve	Olympic
Resetable Fault	Olympic:Milepost 16:Valve:Controls

# Analog Parameters from Vector – Another Lookup



Min Raw	Max Raw	Min EU	Max EU	Lo Limit	Lo Lo Limit	Hi Limit	Hi Hi Limit
0	1600	0	1600	0	0	0	0
0	1600	0	1600	0	0	0	0

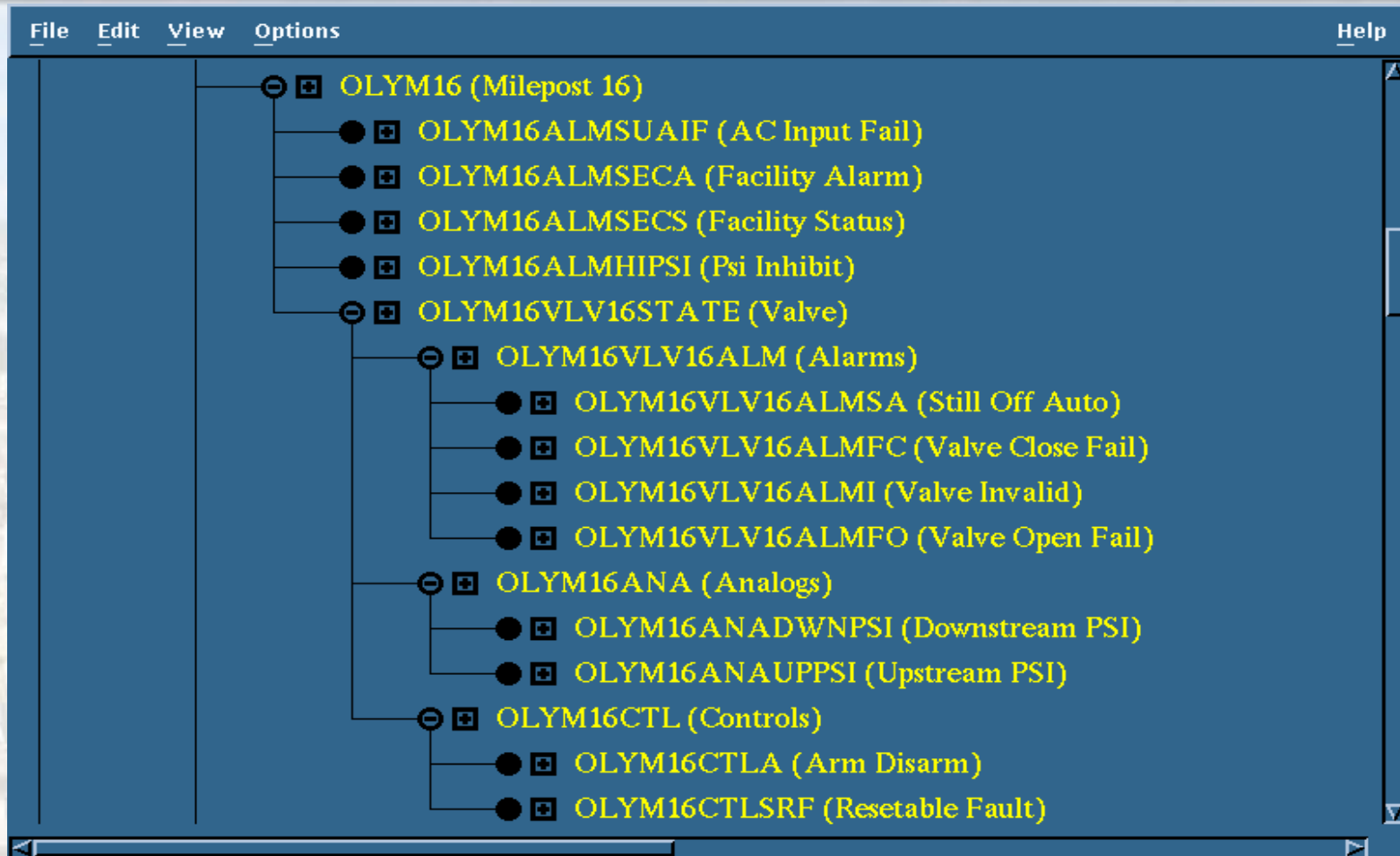
# extractSIO.pl

- Registering with RTAP environment gp5oly... done.
- Opening and parsing file '/opt/olympic/env/buildDB/Milepost\_16\_P3.xls'... done.
- Working on worksheet Milepost\_16.
  - ... row 17: BLANK, stopped processing this sheet.
- Working on worksheet Scan Input.
  - ... row 16: BLANK, stopped processing this sheet.
    - ... Scan Input for "r003\_021":
      - 300,5,1,packed register
      - 302,5,1,packed register
      - 303,5,1,
      - 304,5,1,
      - packed registers = 300,302
    - ... Scan Input for "r000\_000":
      - '''
    - ... Scan Output for "r003\_021":
      - 5,300
      - 5,301
      - 5,302
      - 5,303
      - 5,308
- Finished parsing "/opt/olympic/env/buildDB/Milepost\_16\_P3.xls".





# Run buildDB.pl Against the Sheet



# Base Requirements

- To Automate a SCADA Replacement
  - Must Have:
    - Design Document Specifying:
      - Alias Naming Convention
      - Standard Point Names
      - All Point Type Definitions
      - All Point Group Definitions

# Convert Custom Functionality

- One Example:
  - Automated Creation of PI Tags:
    - PI will be the Data Historian
    - Need a Tag for Every Attribute of Every Point that will be Historized
    - All Tags Must be Unique

# extractPIData.pl

- Rtap Enabled Perl Script that produces a CSV File Containing:
  - Rtap Alias
  - Attribute to be Archived
  - The PI Tag Manufactured from the Alias
  - The Contents of the PI Extended Description (Alias.Attribute)
  - The Current Description Attrib from RTAP
  - Space for a Larger Descriptor in PI (if desired)

# Import the CSV File into Excel

Alias	Attribute Name	PI Tag	PI Extended Description
OLYAL1DRAACCDRAINJ	current value	AL1_DRA_ACCDRAINJ_CUR_VAL	OLYAL1DRAACCDRAINJ.current value
OLYAL2DRAACCDRAINJ	current value	AL2_DRA_ACCDRAINJ_CUR_VAL	OLYAL2DRAACCDRAINJ.current value
OLYALDACCGROSS	current value	ALD_ACCGROSS_CUR_VAL	OLYALDACCGROSS.current value
OLYANAACCGROSS	current value	ANA_ACCGROSS_CUR_VAL	OLYANAACCGROSS.current value
OLYANAACCNET	current value	ANA_ACCNET_CUR_VAL	OLYANAACCNET.current value
OLYBV1ACCGROSSFB	current value	BV1_ACCGROSSFB_CUR_VAL	OLYBV1ACCGROSSFB.current value
OLYBV1ACCGROSS1	current value	BV1_ACCGROSS1_CUR_VAL	OLYBV1ACCGROSS1.current value
OLYBV2ACCGROSSAB	current value	BV2_ACCGROSSAB_CUR_VAL	OLYBV2ACCGROSSAB.current value
OLYBV2ACCGROSS2	current value	BV2_ACCGROSS2_CUR_VAL	OLYBV2ACCGROSS2.current value
OLYBVAACCGROSSA	current value	BVA_ACCGROSSA_CUR_VAL	OLYBVAACCGROSSA.current value
OLYBVFACCGROSSF	current value	BVF_ACCGROSSF_CUR_VAL	OLYBVFACCGROSSF.current value

# Enable AutoFilter to Select One Site

- Select Column Desired and Boolean Needed:
  - For Example Filter the Alias Column
  - Filter = “Begins With OLYM16”

Alias	Attribute Name	PI Tag	PI Extended Description
OLYM16ALMSUAIF	current value	M16_SUAIF_CUR_VAL	OLYM16ALMSUAIF.current value
OLYM16ALMSECA	current value	M16_SECA_CUR_VAL	OLYM16ALMSECA.current value
OLYM16ALMSECS	current value	M16_SECS_CUR_VAL	OLYM16ALMSECS.current value
OLYM16ALMHIPSI	current value	M16_HIPSI_CUR_VAL	OLYM16ALMHIPSI.current value
OLYM16VLV16ALMSA	current value	M16_VLV16_SA_CUR_VAL	OLYM16VLV16ALMSA.current value
OLYM16VLV16ALMFC	current value	M16_VLV16_FC_CUR_VAL	OLYM16VLV16ALMFC.current value
OLYM16VLV16ALMI	current value	M16_VLV16_I_CUR_VAL	OLYM16VLV16ALMI.current value
OLYM16VLV16ALMFO	current value	M16_VLV16_FO_CUR_VAL	OLYM16VLV16ALMFO.current value
OLYM16ANADWNPSI	current value	M16_ANADWNPSI_CUR_VAL	OLYM16ANADWNPSI.current value
OLYM16ANAUPPSI	current value	M16_ANAUPPSI_CUR_VAL	OLYM16ANAUPPSI.current value
OLYM16CTLA	current value	M16_CTLA_CUR_VAL	OLYM16CTLA.current value
OLYM16CTLSRF	current value	M16_CTLSRF_CUR_VAL	OLYM16CTLSRF.current value
OLYM16VLV16STATE	local rem value	M16_VLV_16STATE_LOC_REM_VAL	OLYM16VLV16STATE.local rem value
OLYM16VLV16STATE	current value	M16_VLV_16STATE_CUR_VAL	OLYM16VLV16STATE.current value

# To Create or Delete PI Tags

- Must Have the PI Add-In for Excel
- Import Some Few Existing Tags to Create a Template Spreadsheet
- Example Below is a Small Excerpt!!

Select (x)	Tag	archiving	changedate	changer	compdev	compdevpercent	compmax
x	RTAP_HEARTBEAT	1	13-Dec-06 11:02:43	piadmin	0	0	28800
x	RTAP_LAST_UPDATE	1	13-Dec-06 11:02:44	piadmin	0	0	28800
x	RTAP_MODE	1	13-Dec-06 11:02:44	piadmin	0	0	28800
x	RTAP_MODE_GP2OLY	1	22-Feb-07 16:16:24	piadmin	0	0	28800
x	RTAP_MODE_GP5OLY	1	22-Feb-07 16:16:24	piadmin	0	0	28800
x	RTAP_MODE_GP6OLY	1	22-Feb-07 16:16:25	piadmin	0	0	28800

# Transfer Filtered Data from the Master Sheet to the Import/Export Sheet

- “Pull” the Filtered Tag Column from the Master Sheet, Copy, and Paste into the Tag Column on the Import/Export Sheet
- Same Procedure for the Extended Description Column on the Master Sheet
- Place an “X” in the Select Column on the Export Sheet for All Rows to be Created or Deleted

# Final Steps

- Set the PI Data Type (Column AI – pointtype) (This Could be Automated Based on the RTAP DE Type)
- Set Any Other PI Parameter Columns Desired
- Select PI-SMT from the Excel Toolbar
  - Select Export Tags
  - Mode = Create or Delete

# Conclusion

- Automating Portions of a SCADA Conversion Can Save:
  - Time
  - Typographical Errors
  - Money
- The User Must Evaluate:
  - The Time Required To Invent the Automation
  - Vs.
  - The Time Required to Perform the Operation Manually

# Berkana Resources Corporation

## RTAP Users Group Conference

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*SCADA Integration, Security & Compliance*



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