

EPICS



# Operator Interface

**The Australian Synchrotron**

Lighting the path to innovation

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## Overview

- Borland Delphi – Brief Overview
- Why we used Delphi
- Home Grown Components
- Talking Channel Access
- Channel Access Aware Components
- Standard Forms
- Channel Access Archiver Interface
- EPICS Alarm Handler Interface
- Statistics
- Run Time Environment
- Example Screen Captures



## Delphi is a Windows Integrated Development Environment

- Graphical form design capability
- Components selected from the IDE menu and 'dropped' onto form
- Component properties set at design time - can be modified at run time
- Can declare component event handlers - this is where we write code
- Can create own components
- Has a run time debugger

## Many standard components both visible and non-visible

- Labels, buttons, paint boxes, edit boxes, memo boxes, dialogs, timers, image lists, radio buttons, popup menus

## Language is Object Pascal - fully OO

- Inheritance allows for the creation of components inheriting from standard components



## **Mature Stable Product**

- Based on Turbo Pascal – around since 1988

## **Enabled the quick development of a Channel Access API**

- Has been very stable
  - Performance stability
  - Code stability
- Details later

## **Enables us to customise behaviour where needs be**

- Avoided putting functionality into the IOC just for the OPI
- Allowed us to do what the Physicists wanted for the OPI



## Histogram

- Graphical histogram with axes.
- Used for Storage Ring Vacuum Profile and RGA Output

## XY Plane

- Wrapper around standard Canvas
  - Real coordinates of arbitrary scale (as opposed to integer)
  - Used for the Strip Chart and other graphical displays

## Analogue Slider Bar

- Has real (float) value (as opposed to discrete integer values)

## Label Grid

- Spread sheet like display, scrollable.
- Allows font & background colour selection on a cell basis
- Inherited from standard TCustomGrid component.

## Analogue Meter

- Graphical meter – depreciated





## Application Programming Interface

- Created a number of thin bindings to ca.dll
- Essentially one Pascal unit per “.h” file
  - Channel\_Accesss\_API.pas maps to cdef.h
  - DB\_Access\_API.pas maps to db\_Access.h
  - Epics\_Types\_API.pas maps to epicTypes.h (and epicsTime.h)
  - CA\_Error\_API.pas maps to caerr.h
  - Alarm\_API.pas maps to alarm.h
  - Interfaces\_C.pas defines C types in Pascal.
- Used same names where ever possible
  - Notable exception: “type” became “kind”



## Example

interface

```
function ca_Message (Status : c_int) : String; stdcall;
```

implementation

```
const Library_Name = 'ca.dll';
```

```
function Native_ca_Message (Status : c_int) : PChar; stdcall  
  external Library_Name name '_ca_message@4';
```

```
function ca_Message (Status : c_int) : String;  
begin  
  Result := String (Native_ca_Message (Status));  
end {ca_Message};
```



## Available at design time

### We have defined a number of CA aware components

- Labels, buttons, analogue slider bars, analogue meters, status indicators.
- Non visible Client component

### Each CA aware component contains a CA\_Client object

- Provides design time properties such as PV Name, PV Template Name, Include EGU indicator, Use Database Precision indicator
- Provides run time methods to Open Channel, Close Channel, Get EGU, Get Precision, Get Control Limits, Get Display Limits, Get Alarm States, Get Value as Real, Get Value as Integer, Get Value as String
- Defines common events that the user can optional provide a code handler
  - OnConnect – called whenever a channel connects or disconnects
  - OnUpdate – called whenever new PV value available.





## Abstract Form

- Is the base class of all Operator Interface Forms
- Ensures all forms have a common look and feel.
- Provides standard functionality, namely:
  - Open/Close channels when the form is opened/closed.
  - Associates a popup menu with each CA aware components
    - Properties – opens the PV Properties form
    - Add To Strip Chart – opens/adds the PV to the Strip Chart Form

## Strip Chart Form

- Tracks up to 10 Process Variables
- Can 'back fill' values from the Channel Access archiver
- Variable time scale from 1 minute to 24 hours

## Process Variable Properties Form

- Shows the values of all displayable fields associated with a record

## Error Log Form

- Textual display of all detected errors



**Used 3<sup>rd</sup> party software to implement xml-rpc**

**Provided API unit for the standard functions**

- archiver.info
- archiver.archives
- archiver.names
- archiver.values

**Accessable from**

- Strip Chart Form
- Beam Current Lifetime Form



## Example:

```
CHANNEL Sector_03 SR03CCG02:PRESSURE_MONITOR
$COMMAND alh_ack TVacuum_Control_Form 03
```

## alh\_ack

- Acknowledges the alarm
- Launches the Operator Interface (if required)
- Sends the OPI a TCP/IP message: "TVacuum\_Control\_Form 03"

## OPI Action

- Opens the nominated form
- Used the parameter 03 to select the required sector.

## Features

- Only one instance of the OPI Activated
- Can have up to 20 parameters
- Maximum used 2.



## Source Lines of Code

- xml-rpc (3rd party) 3357
- archiver interface 601
- own components 2670
- API bindings 960
- framework 4721
- ASP specific 7653  
(many lines of code created/maintained by IDE 90% down to 10%)
- main program 37
  
- **Total 20K**



## WINE: Wine Is Not an Emulator

- Provides a Windows environment on Linux
- Allows us to run a common executable file on Linux as well as Windows
- Solved Problems
  - iconisation - loss of size info - need to explicitly save Width and Height
  - geometry on re-sizable forms - need to adjust some Component sizes
  - text i/o <cr><lf> verses <lf> - created own Readln/Writeln procedures
- Outstanding Problem
  - some form will not remain iconised.



Vacuum Control - 1
[Min] [Max] [Close]

## Vacuum Control - Sector 2

[Lock]

**Select by Sector**

01 02 03 04 05 06 07 08 09 10 11 12 13 14

---

**Valve Control**

	Valve 1	Valve 2
Open/Close Status	<span style="background-color: yellow; padding: 2px;">Moving</span>	<span style="background-color: lightgreen; padding: 2px;">Opened</span>
Inhibit Open Status	<span style="background-color: lightgreen; padding: 2px;">Enabled</span>	<span style="background-color: red; color: white; padding: 2px;">Inhibited</span>
Open/Close Setpoint	<span style="background-color: lightgreen; padding: 2px;">Open</span>	<span style="background-color: lightgreen; padding: 2px;">Open</span>
Open/Close Control	<input type="button" value="Open"/> <input type="button" value="Close"/>	<input type="button" value="Open"/> <input type="button" value="Close"/>
Move Failure Status	<span style="background-color: red; color: white; padding: 2px;">FAILURE</span>	<span style="background-color: lightgreen; padding: 2px;">Okay</span>
Move Failure Reset	<input type="button" value="Reset"/>	<input type="button" value="Reset"/>

**Pumps/Gauges**

	Status	Pressure
Priani Arc	<span style="background-color: lightgreen; padding: 2px;">Ok</span>	<span style="background-color: lightgreen; padding: 2px;">6.88E-09 mbar</span>
Priani Strght 1	<span style="background-color: lightgreen; padding: 2px;">Ok</span>	<span style="background-color: lightgreen; padding: 2px;">5.88E-07 mbar</span>
Cold Cathode Arc 1	<span style="background-color: red; color: white; padding: 2px;">HV Off</span>	<span style="background-color: lightgreen; padding: 2px;">3.43E-09 mbar</span>
Cold Cathode Arc 2	<span style="background-color: lightgreen; padding: 2px;">Ok</span>	<span style="background-color: lightgreen; padding: 2px;">1.88E-09 mbar</span>
Cold Cathode Strght 1	<span style="background-color: lightgreen; padding: 2px;">Ok</span>	<span style="background-color: lightgreen; padding: 2px;">6.43E-08 mbar</span>
Arc Ion Pump 1	<span style="background-color: yellow; padding: 2px;">Running</span>	<span style="background-color: yellow; padding: 2px;">3.88E-07 mbar</span>
Arc Ion Pump 2	<span style="background-color: yellow; padding: 2px;">Safe</span>	<span style="background-color: lightgreen; padding: 2px;">1.22E-08 mbar</span>
Strght Ion Pump 1	<span style="background-color: yellow; padding: 2px;">Running</span>	<span style="background-color: lightgreen; padding: 2px;">6.44E-08 mbar</span>

**Temperature Sensors**

Name	Temperature
Chamber Temp 1	<span style="background-color: red; color: white; padding: 2px;">122.2 Deg C</span>
Chamber Temp 2	<span style="background-color: red; color: white; padding: 2px;">223.4 Deg C</span>
Chamber Temp 3	<span style="background-color: red; color: white; padding: 2px;">399.8 Deg C</span>
Chamber Temp 4	<span style="background-color: red; color: white; padding: 2px;">360.0 Deg C</span>

---

**Vacuum Pressure Status**

Arc	<span style="background-color: lightgreen; padding: 2px;">OK</span>
Straight	<span style="background-color: lightgreen; padding: 2px;">OK</span>

---

**Compressed Air**

Status	<span style="background-color: orange; padding: 2px;">Not OK</span>
Pressure	<span style="background-color: orange; padding: 2px;">0.00 bar</span>

The diagram shows a horizontal blue pipe with several components:

- Four red diamond-shaped temperature sensors at the top, labeled 122.2 Deg C, 223.4 Deg C, 399.8 Deg C, and 360.0 Deg C.
- A yellow valve in the middle of the pipe, currently closed.
- A green valve on the right side of the pipe, currently open.
- Five green square gauges below the pipe with the following values: 6.44E-8 mbar, 6.43E-8 mbar, 5.88E-7 mbar, 3.88E-7 mbar, and 1.22E-8 mbar.
- Five green circular gauges below the pipe with the following values: 6.43E-8 mbar, 5.88E-7 mbar, 3.43E-9 mbar, 6.88E-9 mbar, and 1.88E-9 mbar.

ASP  
CONTROLS

13 Sep 05 10:20:29





LCW Monitor - 1

### LCW Monitor - Sector 1

Select by Sector

01 02 03 04 05 06 07 08 09 10 11 12 13 14

Name	Status	Flow Rate	Temperature
Photon Stop 1 & 2	OK	2.90 l/min	26.1 Deg C
Slot Absorber 1	OK	3.10 l/min	25.2 Deg C
Photon Stop 3	Not OK	0.20 l/min	28.3 Deg C
Photon Stop 4	OK	0.00 l/min	29.4 Deg C
Photon Stop 5	OK	4.20 l/min	34.5 Deg C
Slot Absorber 2	OK	3.50 l/min	37.6 Deg C
Photon Stop 6	OK	2.20 l/min	25.7 Deg C
Photon Stop 7	OK	2.40 l/min	18.8 Deg C
Fixed Mask	Not OK	0.00 l/min	
Something Else	Not OK	0.00 l/min	
Fixed Mask	Not OK	0.00 l/min	
Something Else	Not OK	0.00 l/min	
Equipment Rack Status	Not OK		

ASP CONTROLS SR01TES03:TEMPERATURE\_MONITOR 13 Sep 05 10:55:30



### Magnet Control - 1

## Magnet Control - Sector 01 - Dipole 1

Select by Sector

01 02 03 04 05 06 07 08 09 10 11 12 13 14

Select by Magnet

D1 D2 Q1 Q2 Q3 Q4 Q5 Q6 S1 S2 S3 S4 S5 S6 S7 C1 C2 C3 C4 C5 C6 C7 C8 C9 K1 K2

Status

On/Off	EPS Inhibit	Temp Status	LCW Status	LCW Flow Rate	Strength	Current	Voltage
On						400.4 Amps	18.5 Volts
Ripple Current 1	Ripple Current 2	Ripple Current 3	Ground Current	Circuit Breaker	Local / Remote	Inlet Water Temp	
17.96 Amps	5.08 Amps	104.37 Amps	0.093 mA	Closed	Remote	40.5 C	

- Phase
- DC Fuse
- SCR Fuse
- SCR Temp
- XFMR Temp
- Choke Temp
- Water
- Water Temp
- DCCT
- Outlet Temp
- EPS
- PSS
- Ground
- Door
- XFMR Fuse
- Water Leak
- DC Voltage
- Filter Cap Ripple Current
- Breaker Trip
- Breaker Open
- Emergency Off Pressed

Control

Set Point	Readback	Sync	
400.0 Amps	400.4 Amps		<input checked="" type="radio"/> Adjust Current
			<input type="radio"/> Adjust Strength

0.0 100.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0

400.0 400.0

Current / Voltage / Strength Control

Power On Power Off Fault Reset Revert Apply

ASP CONTROLS Sextupole 6 Defocussing 03 Oct 05 16:48:29



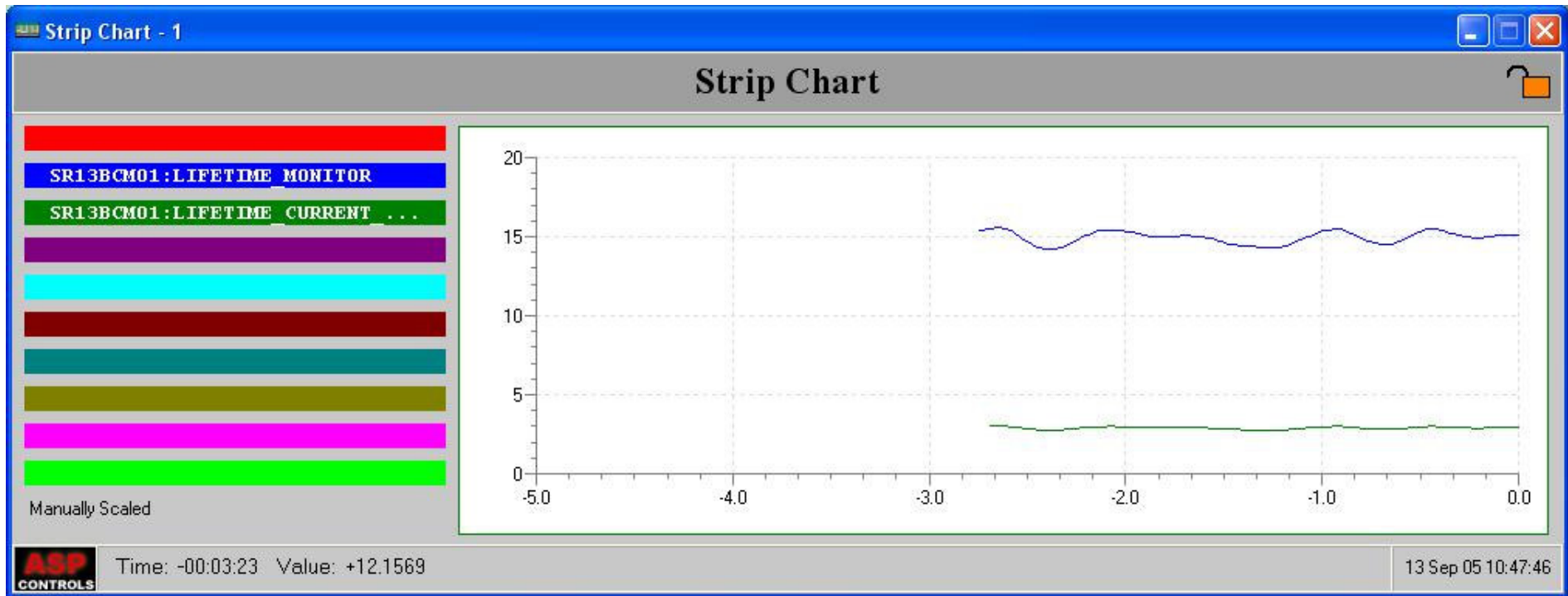
Process Variable Properties - 1

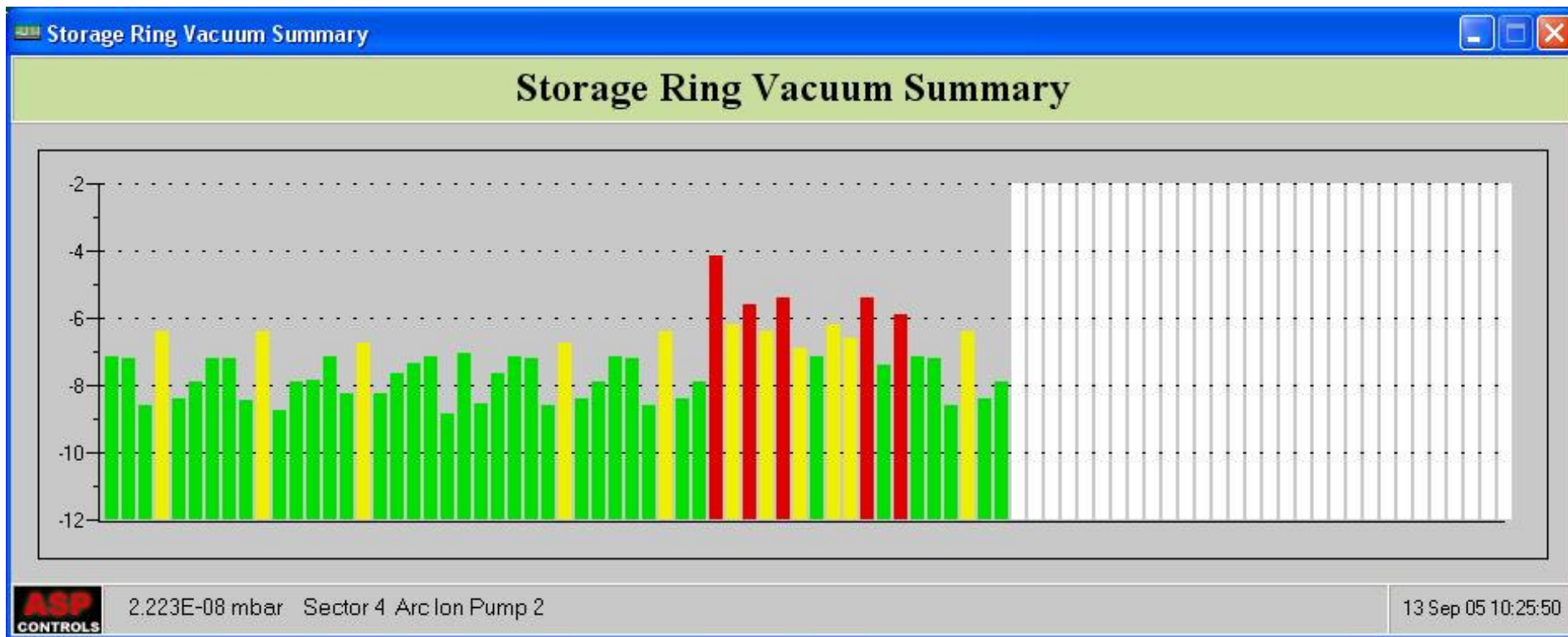
## Process Variable Properties

NAME: SR02IPC02:CHAN01\_STATUS  
 HOST: ASDEVL02:33399  
 DBF: ENUM  
 DBR: CTRL\_ENUM  
 TIME: 13 Sep 2005 10:28:27.936999

Field	Value
RTYP	mbbi
NAME	SR02IPC02:CHAN01_STATUS
DESC	Arc Ion Pump 2 Status
ASG	
SCAN	2 second
PINI	NO
PHAS	0
EVNT	0
TSE	0
TSEL	
DTYP	Soft Channel
DISV	1
DISA	0
SDIS	
DISP	0
PROC	0
STAT	STATE
SEVR	MINOR
NSTA	NO_ALARM
NSEV	NO_ALARM
ACKS	MINOR
ACKT	YES
DISS	NO_ALARM
LCNT	0
PACT	0
PUTF	0

ASP CONTROLS 13 Sep 05 10:28:54









**Error Reports**

Clear    Log Diagnostic    Log Information

```
-----  
Severity: Warning  
Archiver data retrieval failed  
Date Time: 13/09/2005 12:16:16 PM  
Supp Info: PV Name => SR13BCMO1:CURRENT_MONITOR  
          Status => Cannot access archives  
Call Tree:  
  Archiver_Uilities.VCL_Notify_User  
-----  
Severity: Warning  
Archiver data retrieval failed  
Date Time: 13/09/2005 12:16:18 PM  
Supp Info: PV Name => SR13BCMO1:LIFETIME_MONITOR  
          Status => Cannot access archives  
Call Tree:  
  Archiver_Uilities.VCL_Notify_User  
-----  
Severity: Warning  
Archiver data retrieval failed  
Date Time: 13/09/2005 12:16:20 PM  
Supp Info: PV Name => SR13BCMO1:LIFETIME_CURRENT_PRODUCT  
          Status => Cannot access archives  
Call Tree:  
  Archiver_Uilities.VCL_Notify_User  
-----
```

**ASP**  
CONTROLS

13 Sep 05 12:16:41