DATAFORTH

ReDAQ

Remote Data Acquisition and Control System

for isoLynx

User Guide

Rev 1.004

ReDAQ®

Redefining Data Acquisition

Table of Contents

List of Figures

1. Getting started quickly

In order to gain a comprehensive understanding of the functionality of ReDAQ, users should read through this manual. However, the manual has been organized so that the product may be quickly installed and the built-in demonstration web-sites explored. To get started quickly in this way, please read the following sections and follow the procedures provided:

Section 2. Overview of ReDAQ

Section 3. Hardware requirements

Section 4. Installing the software and making the connections

Section 5. Exploring the demo

2. Overview of ReDAQ

ReDAQ is a Remote Data Monitoring and Control System for use with Dataforth isoLynx Data Acquisition Systems. ReDAQ operates as a service running under Windows XP Professional. One of the key advantages of ReDAQ is that users do not require any application software in order to access fully-featured real-time graphical displays. All that is required by each user is a Java-enabled browser. (Dataforth recommends Firefox for the browser).

2.1 Architecture

A typical ReDAQ system is illustrated in Figure 1. The ReDAQ software is installed on the server PC. The server connects to one or more networks of isoLynx systems on the one hand, and an intranet and/or the Internet on the other.

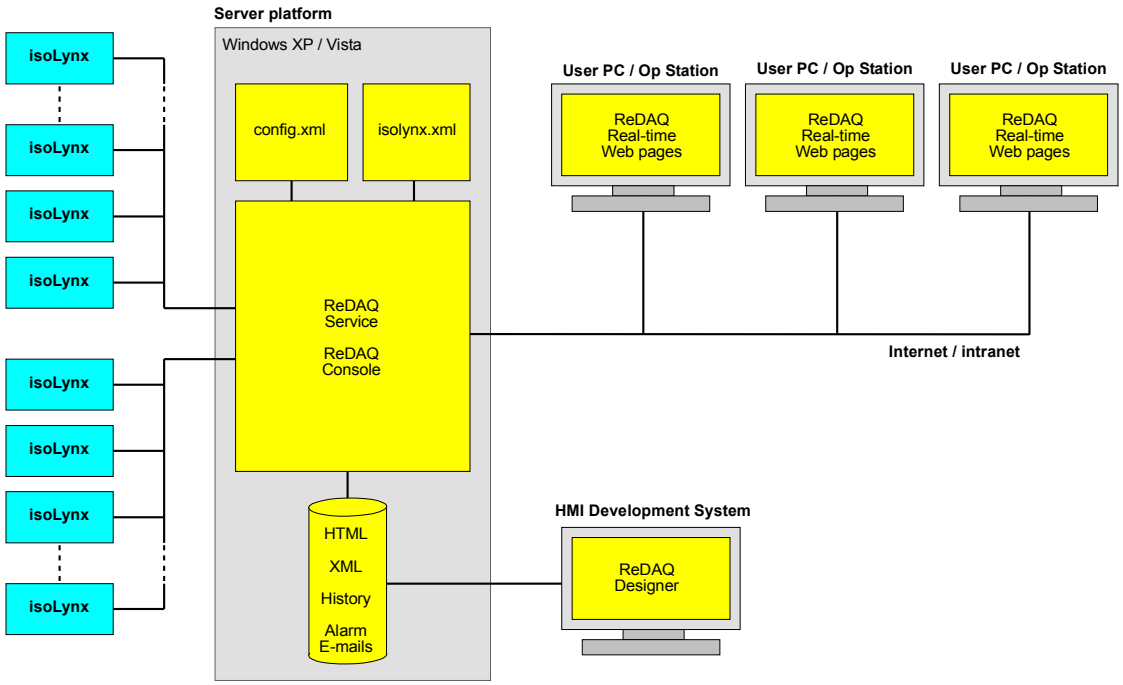


Figure 1 - System Architecture

ReDAQ essentially creates a web-server which delivers a flexible set of mimics and graphics within HTML pages. Unlike a conventional web-server, however, ReDAQ pages change in real-time, reflecting the signals connected to the isoLynx systems.

A lossless historian allows signals from the isoLynx systems to be automatically recorded. The data thereby created can be used to plot graphs and perform reruns of mimic displays.

Additionally, an alarm monitor will trigger an alarm condition for each signal. These alarms can then be shown in tables and mimics. Also, ReDAQ can transmit e-mails when alarms are triggered.

An example of a ReDAQ display is given in Figure 2.

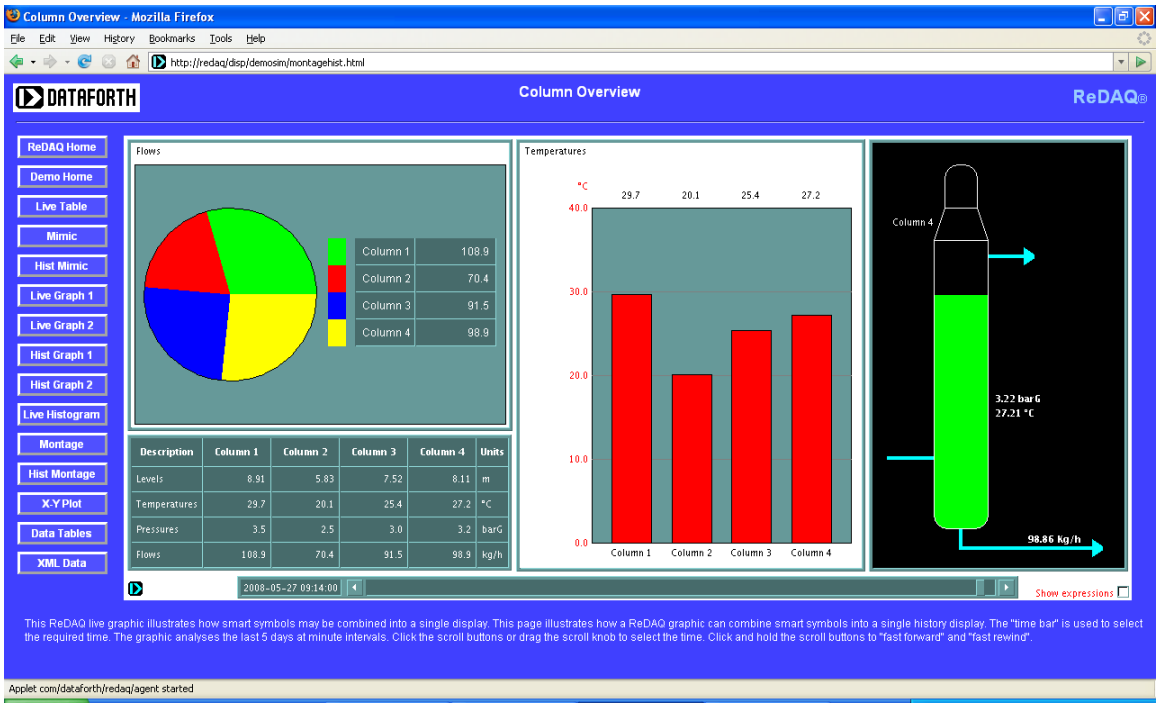


Figure 2 - Example of ReDAQ Display

2.2 isoLynx networks

The server connects to one or more networks of isoLynx systems. isoLynx networks can use EIA-232/485, or Ethernet TP for the physical layer protocol. ReDAQ can support up to eight EIA-485 networks or EIA-232 point-to-point links, plus up to eight Ethernet networks.

2.3 Intranet / Internet connections

The ReDAQ server communicates with users via an intranet, or the Internet, or both.

To test or try out the ReDAQ server, a single user PC can be connected directly by a crossover Ethernet TP RJ45 cable. Alternatively, a browser (e.g. FireFox, Internet Explorer or Chrome) can be run on the server PC itself.

2.4 ReDAQ Console

ReDAQ Console is a Windows program for the ReDAQ server machine. It serves two purposes. Firstly, it is an installer/remover of the ReDAQ service and associated files. Secondly, it serves as a console from which to manage the ReDAQ service.

The Console window is illustrated in Figure 3. The window is divided into 5 areas:

Install ReDAQ

Creates the ReDAQ directory containing the files representing the user web site.
Installs ReDAQ as a Windows service.
Starts the ReDAQ service.

Maintenance

A button to open the home page of the user web site.
A button to open the User Guide.
A button to start ReDAQ Designer in order to create graphical pages.

Remove ReDAQ

Stops the ReDAQ service.
Deletes the ReDAQ service.
Removes the ReDAQ directory.

Miscellaneous

A button to create a desktop shortcut to ReDAQ Console.
An “About ReDAQ” button.

Status

Shows the install status of the ReDAQ directory.
Shows the install status of the ReDAQ service.
Indicates whether the ReDAQ service is running, stopping, stopped, or starting.
Shows the server machine screen resolution indicating if non-optimal.
Shows the install status of Java on the server machine.
Shows the version number of Java, indicating if an update is required.
Shows the version number of Windows, indicating if an update is required.
Shows the Windows system name.

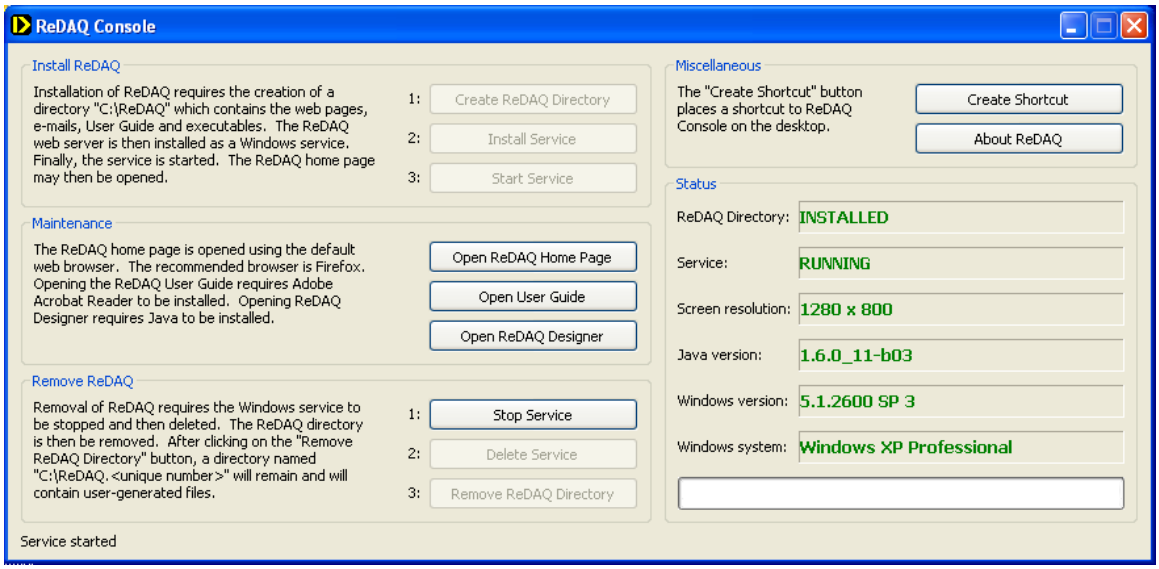


Figure 3 - ReDAQ Console

2.5 ReDAQ Designer

ReDAQ is delivered with ReDAQ Designer, a drawing system which is used to create the real-time graphics.

When used to design mimics, ReDAQ Designer is similar to a CAD drawing system, except that the symbols drawn can be specified to change according to the value of isoLynx signals. For example, a vessel can change its fill level, or a motor can change color. Numeric values can be the result of calculations involving signal values.

ReDAQ Designer can also be used to create graphs, histograms, and pie charts for inclusion in the graphic displays. An example of a Designer window is illustrated in Figure 4.

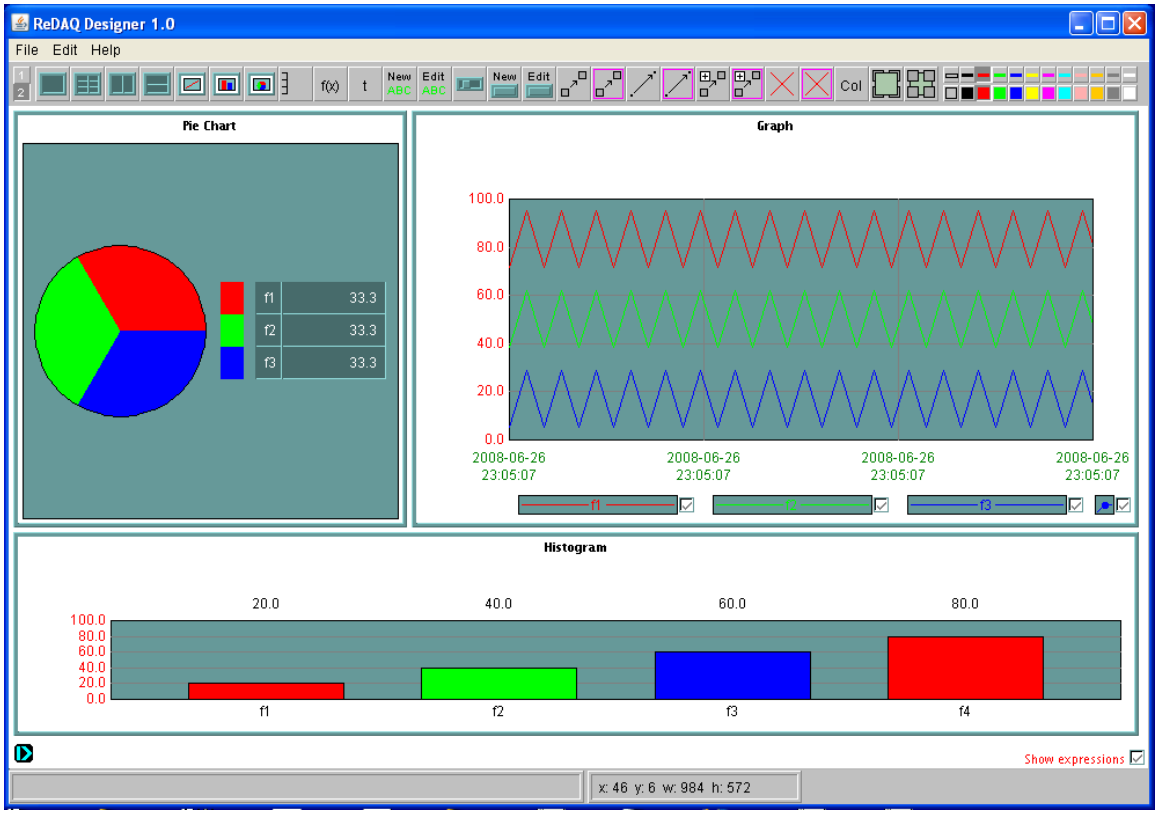


Figure 4 - ReDAQ Designer

3. Hardware requirements

3.1 isoLynx systems

ReDAQ communicates to one or more isoLynx systems. Each isoLynx system is comprised of one SLX200 analog I/O base unit, plus up to three optional SCMPB02 16-channel analog expansion backpanels, and/or up to six SCMPB06 8-channel analog expansion backpanels, and/or up to eight optional SLX101 digital expansion backpanels.

Figure 5 - isoLynx System

The SLX200 analog I/O base units may be EIA-232/485 versions (SLX200-1X) or Ethernet versions (SLX200-2X).

3.2 Server PC

The only hardware required by ReDAQ in addition to the isoLynx systems is a server PC with Windows XP Professional installed. The PC must have Java installed so that web pages can be displayed in a browser running on the server.

The PC should have at least one Ethernet port to connect to the intranet/Internet. A dedicated intranet can easily be realized by installing an Ethernet switch. The up-link port should connect to the server, and the down-link ports to each user station. Alternatively, the ReDAQ server can easily be connected to an existing intranet via an unused port on an Ethernet switch. The switch should be configured to allow HTTP (web) access on port 80.

The ReDAQ server can be connected to the Internet via a DSL modem or ISDN connection. Note that a static IP address should be used and the modem/router should be configured to pass port 80 accesses directly to the ReDAQ server PC. This is often referred to as “port forwarding” in router documentation.

If any Ethernet-based isoLynx networks are in the system, then the PC should have at least one additional Ethernet port to connect to these networks. Hubs and/or switches can also be used to construct the isoLynx Ethernet networks.

If any EIA-485-based isoLynx networks are in the system, then the PC should have at least one EIA-485 port to connect to these networks. Ideally, these should be built-in ports. However, EIA-232 ports can be used with external 232-485 converters. Another option is to use USB serial converters.

The SLX200-1X can also connect directly to the server using a point-to-point EIA-232 link. If this mode is deployed, an EIA-232 port will be required for each such isoLynx.

4. Installing the software and making the connections

4.1 Overview

ReDAQ is a web-server which also communicates with isoLynx systems, thereby providing a graphical control/monitoring system, accessed via browsers. The system usually runs on a server machine which connects to one or more isoLynx networks on the one hand, and to an intranet and/or the Internet on the other.

For evaluation purposes, however, a single PC can be used for both server and client. Also, the supplied demonstration includes a simulated hypothetical plant which does not require any actual isoLynx systems to be connected.

To commence installation, commission the server PC with Windows XP Professional. Then follow the ReDAQ software installation procedure outlined in Section 4.2. After these procedures are complete, it is possible to run the simulation demonstration from a browser running on the server machine.

The supplied demonstration also includes some web pages designed to work with a "suitcase" isoLynx evaluation system (Ethernet version). In order to run this isoLynx demonstration, please follow the procedure outlined in Section 4.3 to connect to the isoLynx.

To connect to other isoLynx networks please follow the procedure outlined in Section 4.3, 4.4, or 4.5 as appropriate.

In order to access ReDAQ from a remote workstation, the server machine must be connected to an intranet or the Internet. Please follow the procedure outlined in Section 4.6 to achieve this.

4.2 Software installation

ReDAQ runs as a service under Windows. ReDAQ is supplied in the form of a file called "ReDAQ Console.exe". This program serves two purposes. Firstly, it is an installer of the ReDAQ system for the server machine. Secondly, it serves as a console from which to manage the ReDAQ service.

Obtain "ReDAQ Console.exe" via download or otherwise and place it somewhere convenient on the server disk. It may be placed on the desktop if desired. Start ReDAQ Console by double-clicking on the file. If the program was received over the Internet, a pop-up window may appear entitled "Open File – Security Warning". If this happens, please un-check the box "Always ask before running this program", and then click "Run". The Console window is illustrated in Figure 3.

Installation of the software requires three steps. Refer to the upper-left section of the Console:

1. Press button 1 to install the ReDAQ directory on the C drive. The status area will then show that the directory is installed.

2. Press button 2 to install the ReDAQ server ("redaq.exe") as a Windows service. The status area will then show that the service is installed.

3. Press button 3 to start the ReDAQ service. The status area will then show that the service is running.

At this point ReDAQ is installed and running. It is now possible to view ReDAQ web pages on the server machine itself, providing the machine has a Java-enabled browser. Most modern PC's supplied with Windows-XP systems have Microsoft Internet Explorer and Java pre-installed. Although ReDAQ will function well with Internet Explorer, the recommended browser is Firefox. This can be downloaded and installed in a couple of minutes from http://www.firefoxdownload.com. If Java is not installed, it may also be downloaded and installed a couple of minutes from http://java.com. The status area of ReDAQ Console will indicate if Java is not installed or is out of date.

Once it has been established that the desired browser and Java have been installed, the next step is to open the ReDAQ home page:

1. Press the "Open ReDAQ Home Page" button in the Console "Maintenance" section to open the home page.

2. When the browser attempts to open the first page from ReDAQ, it will be challenged to provide authentication information. Enter "demo" for both the user name and password. (Note that "demo" is the default in the software distribution; the system administrator may change this after installation).

3. Select "Simulation Demonstration Home".

At this stage, the supplied simulation demonstration can be fully explored. However, so far no isoLynx systems have been installed, and so the isoLynx "suitcase" demonstration will not display any data. Please refer to Section 4.3 to install the "suitcase" evaluation hardware.

4.3 Procedure for connecting the server to a single isoLynx via Ethernet

This is the configuration usually deployed for the isoLynx "suitcase" evaluation hardware, and is the easiest to set up. This procedure assumes that the IP address of the isoLynx is set to the factory default of 192.168.0.215. The isoLynx demonstration attempts to bind to the server Ethernet port with an IP address of 192.168.0.1. Note that this Ethernet port must be additional to any port used to connect to an intranet or the Internet.

1. Stop the ReDAQ service, if it is running, using ReDAQ Console.

2. Configure the server Ethernet port to be used to connect to the isoLynx network to a fixed IP address of 192.168.0.1 and subnet mask 255.255.255.0. This requires opening the "Internet (TCP/IP) Properties" window provided as part of the Windows operating system:

   Select: Start → Settings → Network Connections

   Double-click on the name of the Ethernet port which will connect to the isoLynx.

   Select "Internet Protocol (TCP/IP)".

   Click on "Properties".

   Set the address to 192.168.0.1 and the subnet mask to 255.255.255.0 as shown in Figure 6.

3. Ensure that all other Ethernet ports on the server, both wired and wireless, are set to use different IP segments from that used by the isoLynx Ethernet port. If necessary, disable any conflicting ports.

4. Connect the isoLynx to the server Ethernet port using a crossover RJ-45 cable.

5. Start the ReDAQ service using the Console.

6. Check that the host communication LEDs on the isoLynx are flashing. If they are not, check the previous procedures.

7. Obtain an unlock code for the required isoLynx. Enter this via the ReDAQ "System configuration" section, under "Maintain unlock codes". Then select "Save configuration" and "Save" in order to write the unlock code permanently to the configuration file. The configuration menu page is shown in Figure 7.

The ReDAQ isoLynx demonstration should now allow data from the isoLynx to be displayed.

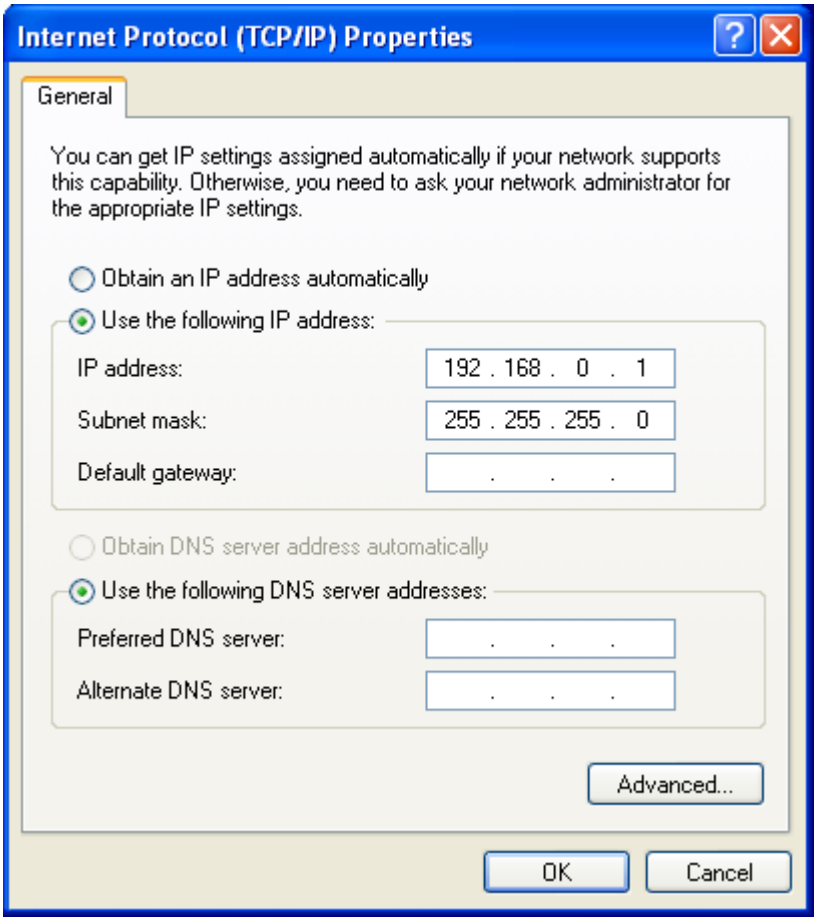


Figure 6 - Internet Protocol (TCP/IP) Properties window

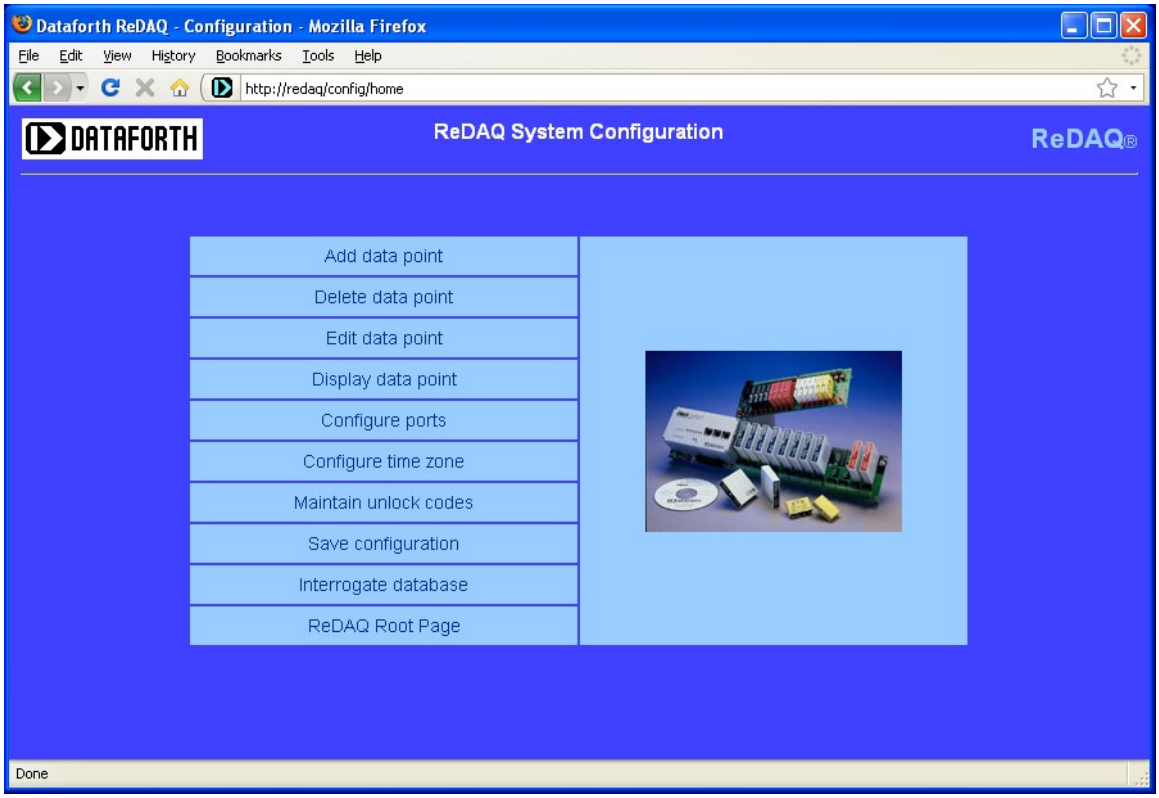


Figure 7 - ReDAQ System Configuration Menu

4.4 Procedure for connecting the server to an isoLynx Ethernet network

An isoLynx network can be set up using an Ethernet switch. Each isoLynx system should be configured with a unique IP address. Connect each isoLynx system to one of the down-link ports of the switch; connect the up-link port of the switch to the ReDAQ server. Please follow the procedures as described in the "isoLynx SLX200 Hardware User Manual" to set up the network.

This procedure assumes that the IP address of the server port connecting to the switch is 192.168.0.1. If this is not the case, please modify the following instructions accordingly.

1. Start the ReDAQ service, if it is not already running, using ReDAQ Console.

2. Select "Configure ports" under "System Configuration". The ports specification table is shown in Figure 8.

3. Choose an Ethernet logical port name for the port which will connect to the switch. Set the IP address to 192.168.0.1.

4. Ensure that each data point associated with isoLynx systems on the network specifies or inherits the port specification with the name chosen above.

5. Stop the ReDAQ service, using the Console.

6. Configure the server Ethernet port to be used to connect to the switch to a specific IP address of 192.168.0.1 and subnet mask 255.255.255.0. This requires opening the "Internet (TCP/IP) Properties" window provided as part of the Windows operating system:

   Start → Settings → Network Connections

   Double-click on the name of the Ethernet port which will connect to the switch.

   Select "Internet Protocol (TCP/IP)".

   Click on "Properties".

   Enter the address and subnet mask as shown in Figure 6.

7. Ensure that all other Ethernet ports on the server, both wired and wireless, are set to use different IP segments from that used by the isoLynx network Ethernet port. If necessary, disable any conflicting ports.

8. Connect the switch to the server Ethernet port.

9. Start the ReDAQ service using the Console.

10. Check that the communication LEDs on the isoLynx systems are flashing. If they are not, check the previous procedures.

11. Obtain unlock codes for each isoLynx system on the network. Enter these via the ReDAQ "System Configuration" section, under "Maintain unlock codes". Then select "Save configuration" and "Save" in order to write the unlock codes permanently to the configuration file.

Enter parameters

isoLynx interface serial ports

Port	Current speed	Current parity	New speed	New parity
COM1	Not defined	Not defined		
COM2	Not defined	Not defined		
COM3	Not defined	Not defined		
COM4	Not defined	Not defined		
COM5	19200	even	19200	even
COM6	Not defined	Not defined		
COM7	Not defined	Not defined		
COM8	Not defined	Not defined		

isoLynx interface Ethernet ports

Port	Current IP address	New IP address
ETHERNET1	192.168.0.1	192.168.0.1
ETHERNET2	Not defined	
ETHERNET3	Not defined	
ETHERNET4	Not defined	
ETHERNET5	Not defined	
ETHERNET6	Not defined	
ETHERNET7	Not defined	
ETHERNET8	Not defined	

Internet interface Ethernet port

Port	Current IP address	New IP address
INTERNET	127.0.0.1	127.0.0.1

OK Apply Cancel

Figure 8 - Port specification table

4.5 Procedure for connecting the server to an isoLynx serial network

Please follow the procedures as described in the "isoLynx SLX200 Hardware User Manual" to set up the isoLynx network.

1. Start the ReDAQ service, if it is not already running, using the Console.

2. Select "System Configuration" and then "Configure ports". The ports specification table is shown in Figure 8.

3. Choose the COM port which will connect to the serial network. Set the transmission speed and parity parameters as required. The supplied configuration already includes an entry for COM5 and set at 19200 bps with even parity.

4. Ensure that each data point associated with isoLynx systems on the network specifies or inherits the port specification with the name chosen in the previous step.

5. Obtain unlock codes for each isoLynx system on the network. Enter these via the "System Configuration" section, under "Maintain unlock codes".

6. Select "Save configuration" and then "Save" in order to write the parameters entered above permanently to the configuration file.

7. Stop the ReDAQ service, using the Console.

8. Connect the isoLynx serial network to the server COM port.

9. Start the ReDAQ service using the Console.

10. Check that the communication LEDs on the isoLynx systems are flashing. If they are not, check the previous procedures.

4.6 Procedure for connecting to an intranet

A small private intranet can be set up using an Ethernet hub or switch. Connect the up-link port of the hub/switch to the server, using a straight RJ-45 cable. Connect the down-link ports of the hub/switch to the client machines using straight RJ-45 cables. Alternatively, a single user-station can be connected directly using a crossover RJ-45 cable.

If connecting to an existing corporate Ethernet switch, please request the network administrator to provide a static IP address for use by the server, and request port 80 to be opened. The network administrator will also arrange to connect the server to the switch. For the purpose of illustration, this procedure assumes the server Internet port IP address to be 192.168.1.1:

1. Start the ReDAQ service, if it is not already running, using the Console.

2. From the ReDAQ root page select "System Configuration" and then "Configure ports".

3. Set the Internet Interface IP address to 192.168.1.1. The supplied ReDAQ configuration has this address set to 127.0.0.1 (localhost) to provide for the browser being run on the server machine.

4. Stop the ReDAQ service, using the Console.

5. Configure the server Ethernet port to be used to connect to the intranet to a specific IP address of 192.168.1.1 and subnet mask 255.255.255.0. This requires opening the "Internet (TCP/IP) Properties" window provided as part of the Windows operating system:

   Select: Start → Settings → Network Connections

   Double-click on the name of the Ethernet port which will connect to the switch.

   Select "Internet Protocol (TCP/IP)".

   Click on "Properties".

   Enter the address and subnet mask as shown in Figure 9.

6. Ensure that all other Ethernet ports on the server, both wired and wireless, are set to use different IP segments from that used by the isoLynx network Ethernet port. If necessary, disable any conflicting ports.

7. Connect the intranet to the server Ethernet port.
8. Start the ReDAQ service using the Console.
9. Refer to Section 4.7 to set up the ReDAQ server IP address mapping on the client machines.

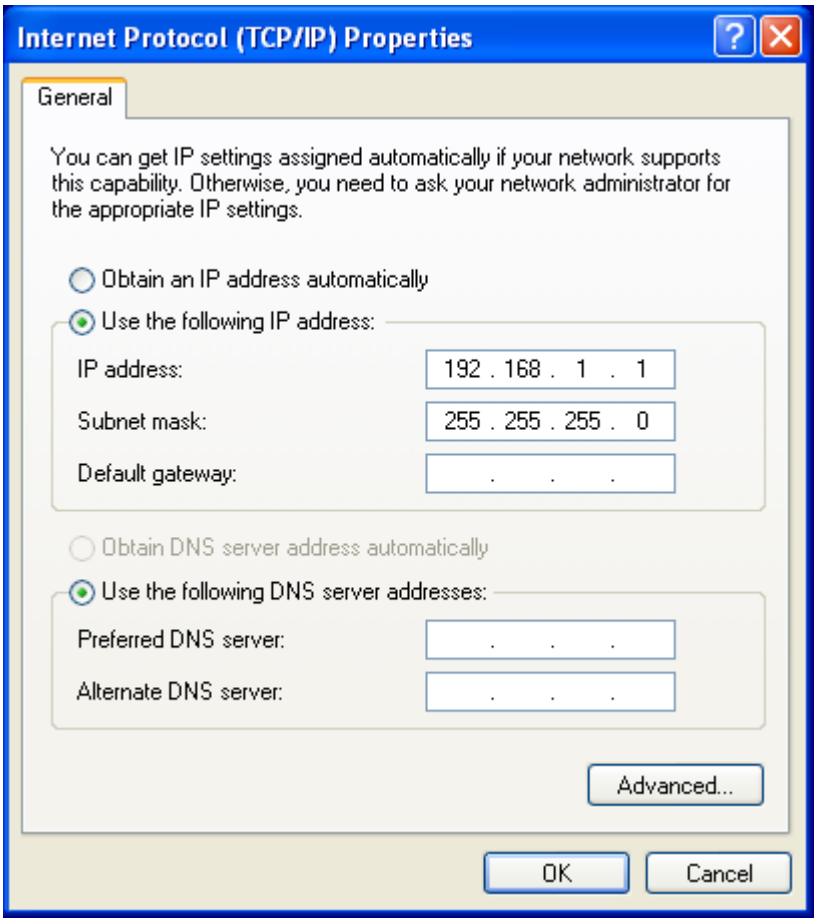


Figure 9 - Internet Protocol (TCP/IP) Properties window

4.7 Mapping the ReDAQ server host name

If it is intended to set up a small private client network, it may be the case that no domain name server is available. In this case, it is helpful to insert an entry in the Windows "hosts" file of each client machine for ReDAQ. The "hosts" file is found in the "C:\WINDOWS\system32\drivers\etc" directory. Open the file with a text editor such as “Notepad”. As the file does not have a type suffix, it is necessary to direct Windows towards the correct the program with which to open the file. To create a mapping to the ReDAQ server, add the following line at the end of the file:

<ip address> redaq

where <ip address> is the IP address, in dotted-quad format, of the ReDAQ server machine.

This allows the URI of the ReDAQ home page to be "http://redaq".

The ReDAQ console automatically makes such an entry in the hosts file of the server machine, when the “Install ReDAQ directory” button is pressed. Accordingly, the same URI may be used when running a browser on the server machine.

4.8 ReDAQ client machine screen resolution and aspect ratio

The demonstration pages in ReDAQ are optimized for monitors with an aspect ration of 16:10 and a screen resolution of 1280 x 800 pixels. Please use monitors with at least this screen resolution and maximize the browser window when accessing ReDAQ. Scrollbars will appear in the browser if the screen resolution is less than the optimal.

4.9 Running ReDAQ Designer

ReDAQ Console has a button which will start ReDAQ Designer directly. ReDAQ Designer is supplied as a Java archive, “redaq.jar”. This file will be found in the ReDAQ directory after installation.

The “redaq.jar” file may also be copied to another machine in order to allow graphical applets to be designed. The target machine must have Java installed. ReDAQ Designer may then be started by clicking on the “redaq.jar” file. Alternatively a shortcut be may set up.

4.10 Unlock code installation

Each SLX200 analog I/O base unit requires an unlock code to be entered into the ReDAQ configuration. If an appropriate unlock code for the isoLynx processor is not installed, numerical values associated with that processor will show “locked”, and graphical symbols will show two colors separated by a diagonal. Exceptions to this rule are the “device info” parameters which will be displayed even if there is no valid unlock code.

Unlock codes may be obtained by contacting Dataforth Corporation. To enter an unlock code into the ReDAQ configuration, perform the following procedure:

1. Go to the ReDAQ root page.
2. Select “System configuration”.
3. Select “Maintain unlock codes”.
4. Cut and paste the new unlock code into the text box and click on “Add”.
5. Click on “Return”.
6. Click on “Save configuration”.
7. Click on “Save”.
8. Click on “Return”.

Unlock codes may also be entered directly into the "config.xml" file. Please refer to Section 11 for details.

4.11 User names and passwords

The ReDAQ distribution is configured with a user name of “demo” and a password of “demo”. If the installation is expanded to include real data, these should be changed by the system administrator to more secure values. User names and passwords are specified in the "config.xml" file. Please refer to Section 11 for details.

5. Exploring the demo

To start exploring the demo, simply go to the ReDAQ root page. The procedure to do this depends on whether the browser it be run on the server machine or a client machine.

If working on the server machine, enter the following into the browser address line:

http://redaq

Alternatively, ReDAQ Console has a button which can be used to instantiate the default browser and open the root page directly.

If working on a client machine, enter the following into the browser address line:

http://<uri>

<uri> is the URI or IP address of the server on which ReDAQ is installed. An entry may have been made in the “hosts” file to map the server URI to a familiar name such as “redaq”. Please see the installation instructions in Section 4.6 for further details.

The browser will present an authentication window. Please enter the user name and password. The default user name and password are both "demo". ReDAQ will then return the root page which is illustrated in Figure 10.

Once the ReDAQ root page has been accessed, one of two demonstrations may be selected; a simulation demonstration, and an isoLynx demonstration. Each demonstration illustrates a “web site” constructed from HTML pages.

5.1 Simulation demonstration

The simulation demonstration does not require any isoLynx system to be connected. The simulation is based on a hypothetical plant consisting of four distillation columns.

The site illustrates the use of mimics, history graphs, live graphs, X-Y graphs, tables, histograms, and pie charts. These are all real-time graphical displays. The site also demonstrates the ability to generate data tables in both HTML and Excel formats.

The buttons at the left side of the display allow the various demonstration pages to be accessed, as well as providing direct links to both the ReDAQ home page and the simulation demonstration home page.

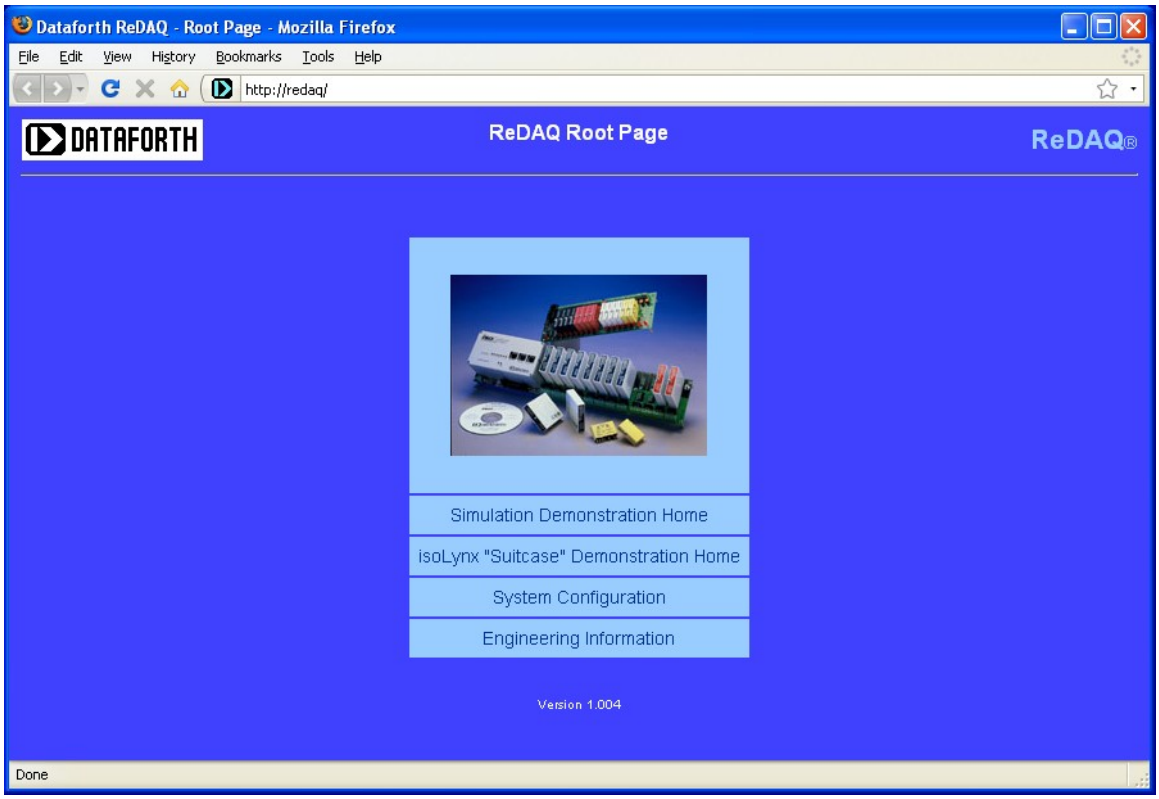


Figure 10 - The ReDAQ Root Page

5.2 isoLynx demonstration

The isoLynx demonstration is based on the standard "suitcase" hardware evaluation kit (Ethernet version). The site illustrates accessing real data via a mimic and a history graph. These are all real-time graphical displays.

The demonstration assumes that the hardware is configured with the default settings and has the modules installed as detailed in Figure 11.

If the isoLynx is not connected or not installed correctly, all numerical values will show “comms fail”, and graphical symbols will show two colors separated by a diagonal. If an appropriate unlock code for the isoLynx processor is not installed, all numerical values will show “locked”, and graphical symbols will again show two colors separated by a diagonal.

Analog Panel		
Channel 0:	SCM5B49-07	-10V to +10V Voltage output module
Channel 1:	SCM5B36-03	1000Ω Potentiometer module
Channel 2:	SCM5B47J-03	0ºC to 500ºC Linearized thermocouple input module
Digital Panel		
Channel 0:	1781-SW5S	Switch module
Channel 1:	SCMD-MOAC5	Digital output module

Figure 11 - Module configuration for isoLynx demonstration

The demonstration is a useful vehicle for learning about ReDAQ. Try checking the "Show expressions" box and then pointing at smart components. This will show how data points are accessed and how they can be incorporated into mathematical expressions. Also, try viewing the HTML source by selecting “view page source” in the browser. Note that the HTML source tends to be very similar from page to page, and, therefore, it is very easy to create new pages by copying existing ones and undertaking minor editing.

5.3 Demonstration data points

For reference, a schedule of the data points used by the demonstrations is provided in the appendix.

6. The Historian

ReDAQ has a built-in lossless historian. The historian is said to be lossless because the data is recorded without any loss of accuracy. Figure 12 shows an example of a graph and a table using history data.

Each data point may be specified to be historized. It is only necessary to provide two parameters for the historian.

The first is the duration in days for which history will be recorded. History is recorded in a circular storage mode. So, for example, if the duration is set at 90 days, data recorded on the 91st day after starting will overwrite the data recorded on the first day.

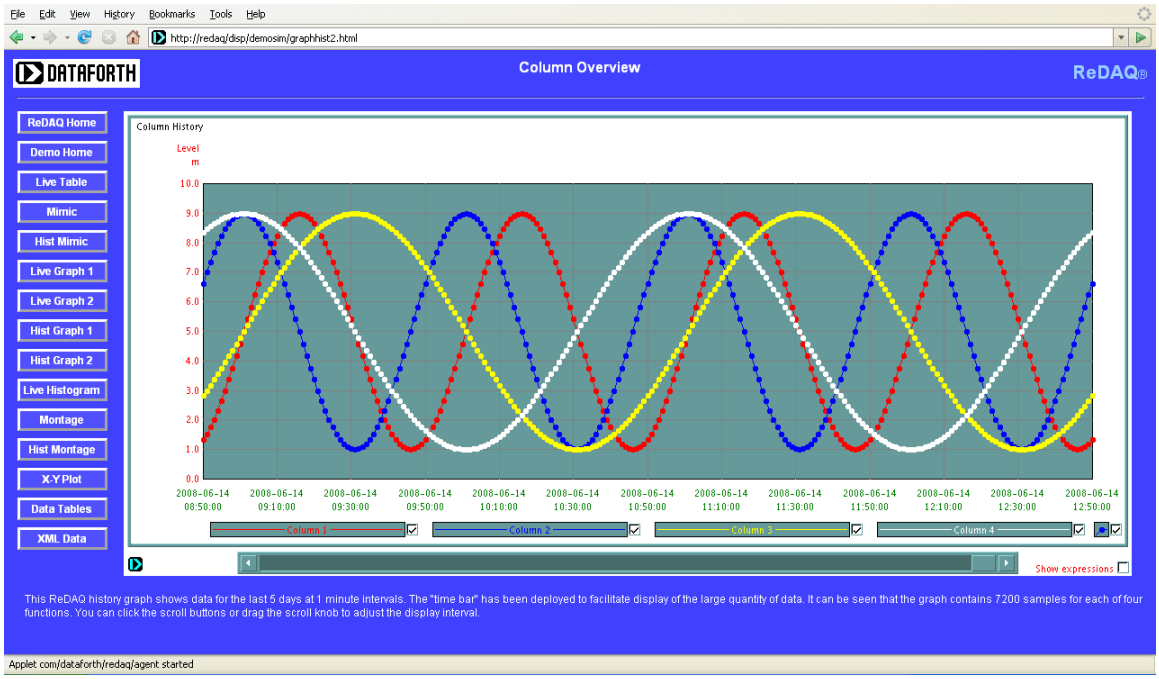
The second parameter required is the sampling interval in seconds. For a typical process plant, the sampling interval might be 60 seconds.

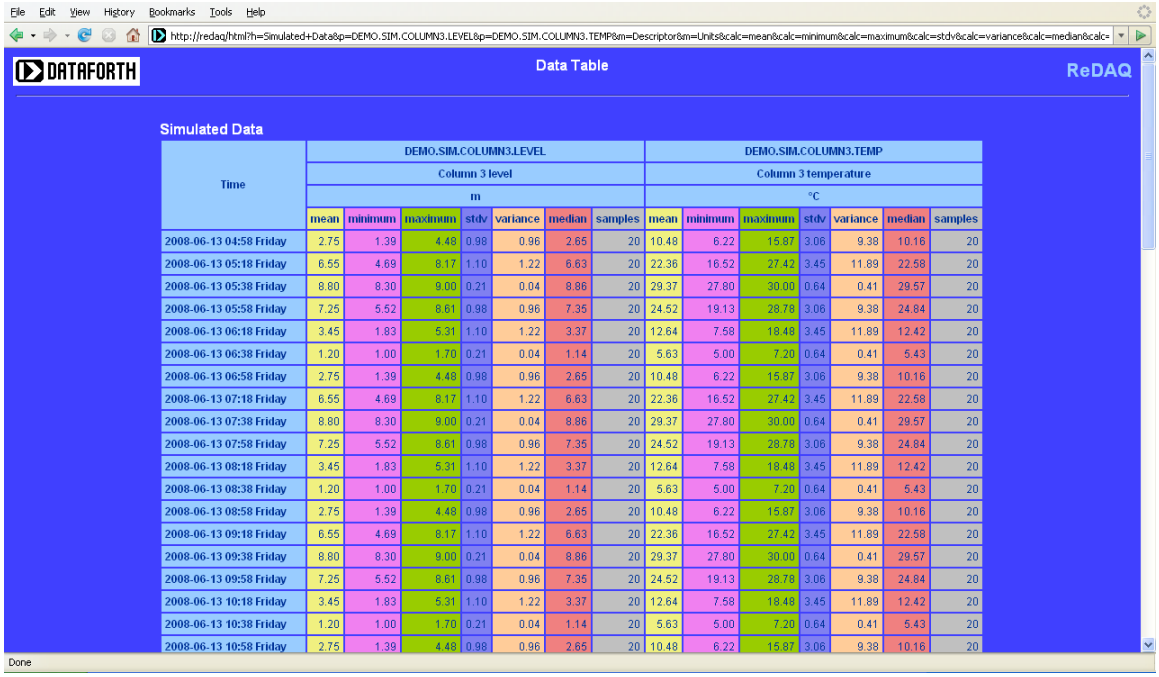
To give an idea of how much disk space is used, sampling at 60 second intervals for a duration of 90 days creates a file of size just under half a megabyte per data point.

As with other data point parameters, the history specifiers may be set either by accessing the “System Configuration” section via a browser, or by directly manipulating the "config.xml" file. Section 11 provides further details.

History files are located in the directory C:\redaq\history. It is generally unnecessary to access this directory directly. ReDAQ will create and access the history files automatically in accordance with the configuration parameters.

The sections "ReDAQ URIs" and "Graphical Displays" describe how to use history data.





Time	DEMO.SIM.COLUMN3.LEVEL							DEMO.SIM.COLUMN3.TEMP						
	Column 3 level							Column 3 temperature						
	m							°C						
	mean	minimum	maximum	stdv	variance	median	samples	mean	minimum	maximum	stdv	variance	median	samples
2008-06-13 04:58 Friday	2.75	1.39	4.48	0.98	0.96	2.65	20	10.48	6.22	15.87	3.06	9.38	10.16	20
2008-06-13 05:18 Friday	6.55	4.69	8.17	1.10	1.22	6.63	20	22.36	16.52	27.42	3.45	11.89	22.58	20
2008-06-13 05:38 Friday	8.80	8.30	9.00	0.21	0.04	8.86	20	29.37	27.80	30.00	0.64	0.41	29.57	20
2008-06-13 05:58 Friday	7.25	5.52	8.61	0.98	0.96	7.35	20	24.52	19.13	28.78	3.06	9.38	24.84	20
2008-06-13 06:18 Friday	3.45	1.83	5.31	1.10	1.22	3.37	20	12.64	7.58	18.48	3.45	11.89	12.42	20
2008-06-13 06:38 Friday	1.20	1.00	1.70	0.21	0.04	1.14	20	5.63	5.00	7.20	0.64	0.41	5.43	20
2008-06-13 06:58 Friday	2.75	1.39	4.48	0.98	0.96	2.65	20	10.48	6.22	15.87	3.06	9.38	10.16	20
2008-06-13 07:18 Friday	6.55	4.69	8.17	1.10	1.22	6.63	20	22.36	16.52	27.42	3.45	11.89	22.58	20
2008-06-13 07:38 Friday	8.80	8.30	9.00	0.21	0.04	8.86	20	29.37	27.80	30.00	0.64	0.41	29.57	20
2008-06-13 07:58 Friday	7.25	5.52	8.61	0.98	0.96	7.35	20	24.52	19.13	28.78	3.06	9.38	24.84	20
2008-06-13 08:18 Friday	3.45	1.83	5.31	1.10	1.22	3.37	20	12.64	7.58	18.48	3.45	11.89	12.42	20
2008-06-13 08:38 Friday	1.20	1.00	1.70	0.21	0.04	1.14	20	5.63	5.00	7.20	0.64	0.41	5.43	20
2008-06-13 08:58 Friday	2.75	1.39	4.48	0.98	0.96	2.65	20	10.48	6.22	15.87	3.06	9.38	10.16	20
2008-06-13 09:18 Friday	6.55	4.69	8.17	1.10	1.22	6.63	20	22.36	16.52	27.42	3.45	11.89	22.58	20
2008-06-13 09:38 Friday	8.80	8.30	9.00	0.21	0.04	8.86	20	29.37	27.80	30.00	0.64	0.41	29.57	20
2008-06-13 09:58 Friday	7.25	5.52	8.61	0.98	0.96	7.35	20	24.52	19.13	28.78	3.06	9.38	24.84	20
2008-06-13 10:18 Friday	3.45	1.83	5.31	1.10	1.22	3.37	20	12.64	7.58	18.48	3.45	11.89	12.42	20
2008-06-13 10:38 Friday	1.20	1.00	1.70	0.21	0.04	1.14	20	5.63	5.00	7.20	0.64	0.41	5.43	20
2008-06-13 10:58 Friday	2.75	1.39	4.48	0.98	0.96	2.65	20	10.48	6.22	15.87	3.06	9.38	10.16	20

Figure 12 - Example of graph and table using history data

7. The Alarm Processor

ReDAQ has a built-in alarm processor which continuously monitors data-point values and sets alarm conditions accordingly.

Each data point may be specified to be alarmed with an unlimited number of alarm conditions. An alarm condition typically is set when the data point value is greater than or less than the alarm condition value. A dead-band may be applied in determining the alarm condition. At any time, the data point is then either in one of the alarm conditions or none.

The alarm value of a data-point may be referenced by appending the modifier ":alarm" to the data point name. Alarmed data points can also be configured to send e-mails when the set alarm condition changes.

7.1 Alarm conditions

An unlimited number of alarm conditions may be associated with each data point. Alarm conditions are of type "high", "normal", or "low". High type alarms are set when the data point value becomes greater than or equal to the alarm condition limit value. They are reset when the data point value falls below the limit value minus the dead-band. Low type alarms are set when the data point value becomes less than or equal to the alarm condition limit value. They are reset when the data point value climbs above the limit value plus the dead-band. The normal type alarm does not contain limit or dead-band values; it is set when none of the other alarm conditions is satisfied. Only one normal type alarm is permitted.

Each alarm condition also has a user-defined name string. This is usually set to an expression meaningful of the condition. For example, a data point associated with a tank level might have two high-type alarm conditions called "high level" and "overflow". For compatibility with many process control systems, a data-point could be configured with two high-type alarm conditions named "high-high", and "high", and two low-type alarm conditions named "low" and "low-low". The alarm value returned when the data point is referenced with the ":alarm" modifier is the name of the alarm condition set.

7.2 SMTP server

ReDAQ has a built-in SMTP (Simple Mail Transfer Protocol) server. The SMTP Server allows e-mails to be transmitted on entering or leaving alarm conditions. Each alarm condition may have a number of parameters specified for controlling the transmitted e-mail. These include the name of the ISP's SMTP server to which ReDAQ will connect, the recipient e-mail addresses, the subject line of the e-mail, and the name of a file containing the content of the e-mail.

The content of each e-mail is provided in a .txt file located in the “C:\redaq\mail” directory. The file may contain references to data points so that values may be dynamically embedded in the e-mails. This is achieved by specifying the data point name in braces as shown in the following example:

The ambient temperature is {DEMO.ANALOGS.TEMP} {DEMO.ANALOGS.TEMP:units}.

This might produce the following text in the transmitted e-mail:

The ambient temperature is 67.55 ºF.

By using data point references, the e-mail can present data from any data point in addition to that causing the alarm condition.

The ReDAQ SMTP server will connect to ISP servers which require authentication in accordance with the RFC 4954 specification. The PLAIN, LOGIN, and CRAM-MD5 authentications methods are supported. CRAM-MD5 is the most secure. ReDAQ authenticates using CRAM-MD5 if the ISP server supports it, otherwise it will use PLAIN or LOGIN.

7.3 Configuring alarms

As with other data point parameters, the alarm parameters may be set either by accessing the “System Configuration” section via a browser, or by directly manipulating the “config.xml” file. Section 11 provides further details.

8. ReDAQ URIs

The Uniform Resource Identifier (URI) is the key to communicating with isoLynx systems using ReDAQ. The most basic URI is the one used to access the ReDAQ root HTML page:

http://<hostname>

<hostname> is the name of the server on which ReDAQ is installed. For example, the Dataforth demonstration of ReDAQ is installed on the host “dataforth.net”. Please refer to Section 4.7 for details on how to create IP address mappings to the server by placing entries in the “hosts” file. Note that ReDAQ Console automatically places an entry in the server machine “hosts” file so that the root page URI can be “http://redaq”.

Having arrived at the root page, data can be accessed by simply navigating around the web site. ReDAQ is distributed with a built-in simulation demonstration which can be accessed by clicking on the appropriate entry in the root page. The actual URI of the simulation home page is:

http://<hostname>/disp/demosim/home.html

Similarly, the URI of the demonstration home page for a connected isoLynx is:

http://<hostname>/disp/demolynx/home.html

Note that all of the names of the html pages used for the demonstration begin with /disp. Indeed, all user generated pages must begin with “/disp”, and the corresponding html files are located in the directory “C:\redaq\disp”. It can be seen that in addition to providing communications to isoLynx systems, ReDAQ also acts as a web server for HTML files located in this directory.

However, not all pages delivered by ReDAQ actually exist as files on the disk drive. Some pages are built-in and are actually generated programmatically. For example, the URI of the configuration home page is:

http://<hostname>/config/home

All URIs of the form “http://<hostname>/config/....” are generated programmatically. These are HTML pages which are used for management of the data point configuration. The really powerful URIs, however, are those used to generate tabular data in both HTML and XML format. The use of these URIs is described in the following sections.

8.1 Generating tabular data in HTML format

This section provides a tutorial on generating HTML data tables. Some basic knowledge of HTML is assumed. However, readers unfamiliar with HTML will find the subject matter informative.

Suppose we wish to display, in a browser, the current value of the data point DEMO.SIM.COLUMN1.LEVEL. We need to do two things. First we have to form a URI which specifies that we require ReDAQ to return an HTML page. Secondly, we append to this a query string which specifies the data point of interest. A query string is a sequence of one or more fields where each field is of the format, "<name>=<value>". In this case, the name is 'p' for "point". The query string is preceded by the character '?'. The full URI is:

http://<hostname>/html?p=DEMO.SIM.COLUMN1.LEVEL

Figure 13 shows the response to this request. The returned table shows the date and time at the instant the request was processed, with the current value and alarm status of the data point.

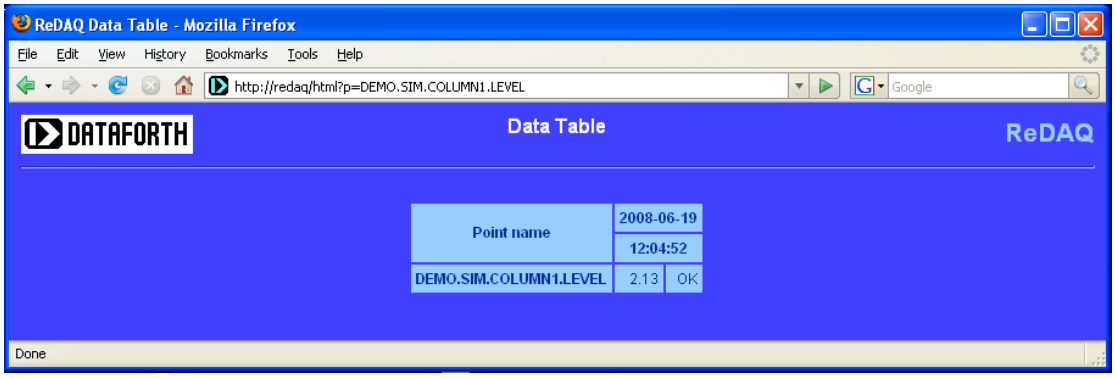


Figure 13 - HTML tabular data

However, the idea of a table is to be able to show several entities. So a URI which also returns temperature as well as the level, and also the data point descriptors and units is formed as follows:

http://<hostname>/html?
p=DEMO.SIM.COLUMN1.LEVEL&p=DEMO.SIM.COLUMN1.TEMP&m=Descriptor&m=Units

Note that that this URI has several query string fields, which are separated by the '&' character. The benefit of using a query string for HTML requests is that several data points and several parameters may be specified in the one URI, thereby allowing tables to be generated. The HTML page returned is shown in Figure 14.

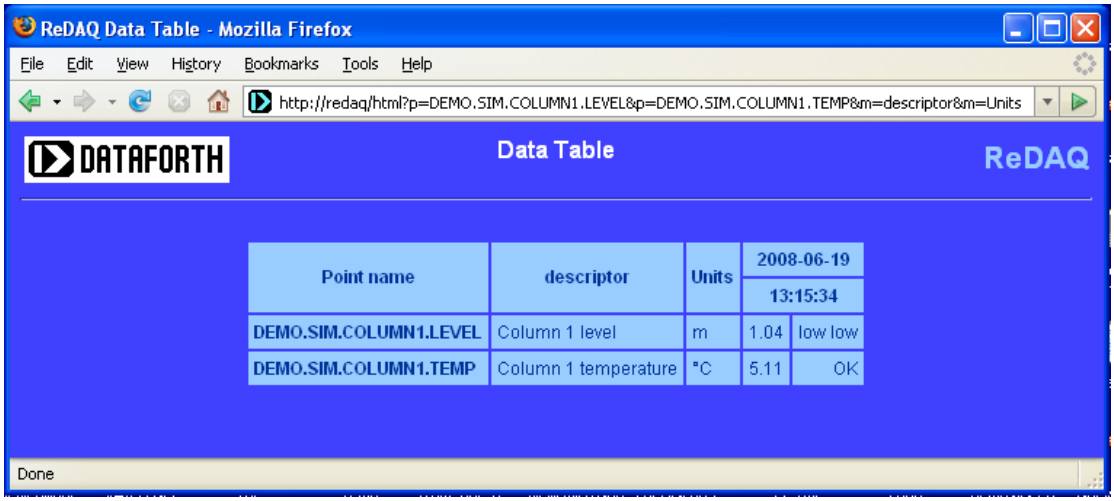


Figure 14 - HTML tabular data

The purpose of detailing these URIs is to illustrate how ReDAQ works "under the hood". We do not, of course, wish to manually formulate URIs of this kind to obtain data. Therefore, we will use the HTML "form" tag to generate the URI for us. Figure 15 provides an example of a rather unembellished HTML page which will submit the previous URI. The HTML page appears in the browser as shown in Figure 12.

So far, the examples have returned only current data. The process to obtain history data will now be considered. To do this, some additional fields need to be included in the query string. Firstly, to specify history data, a calculation type is required. Usually, just the mean calculation is used, although ReDAQ can also calculate any combination of mean, maximum, minimum, standard deviation, variance, and number of samples. To specify the mean calculation, the field “calc=mean” is included in the query string. The calculations apply to the data samples recorded by the historian in each interval. To specify an interval of 300 seconds, the field is “it=300”. The start time must be specified in either relative or absolute format. In this example, we will request data for the last hour and so the field will be “st=-3600”. The end time for the table can also be specified, but in this example we will omit it, so that the end time will default to the current time. The URI required is, therefore:

http://<hostname>/html?p=DEMO.SIM.COLUMN1.LEVEL&p=DEMO.SIM.
COLUMN1.TEMP&m=Descriptor&m=Units&calc=mean&st=-3600&it=300

The table returned is shown in Figure 16.

```
<?xml version='1.0' encoding='UTF-8'?>

<!DOCTYPE html PUBLIC '-//W3C//DTD HTML 1.0 Transitional//EN' 'http://
www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd'>

<html>
  <head>
    <title>Simple Table</title>
    <link rel="stylesheet" type="text/css" href="demo.css" />
  </head>
  <body>
    <img class='top' src='/image/dflogo' />
    <div class='redaq'>ReDAQ</div>
    <div class='head'>HTML simple data table request example</div>
    <div class='main'>
      <hr />
      <p>Pressing the button submits a form to query the Column 1
         Level and Temperature</p>
      <form name="form1" method="get" action="/html">
        <input type="hidden" name="p" value="DEMO.SIM.COLUMN1.LEVEL">
        <input type="hidden" name="p" value="DEMO.SIM.COLUMN1.TEMP">
        <input type="hidden" name="m" value="Descriptor">
        <input type="hidden" name="m" value="Units">
        <input type="Submit" value="Get Data">
      </form>
    </div>
  </body>
</html>
```

Figure 15 - HTML page source using <form> to request tabular data

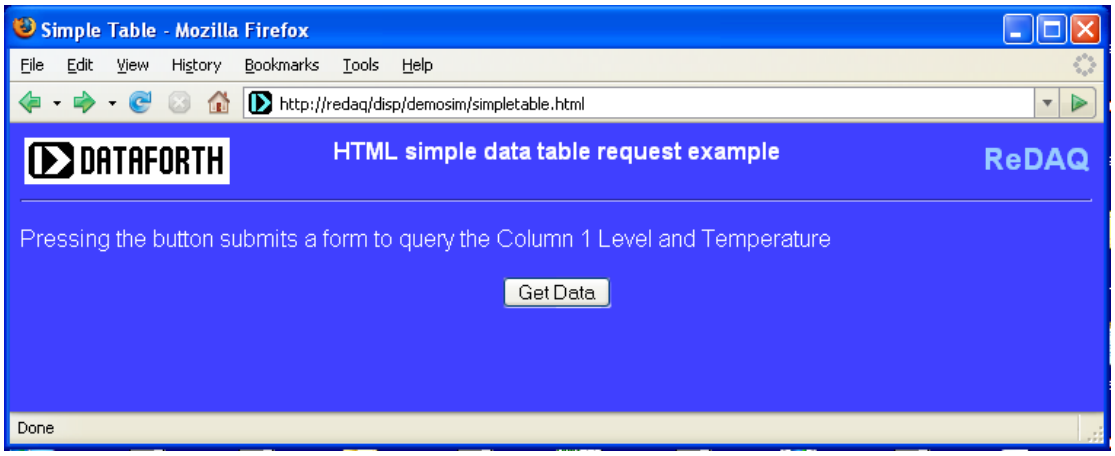
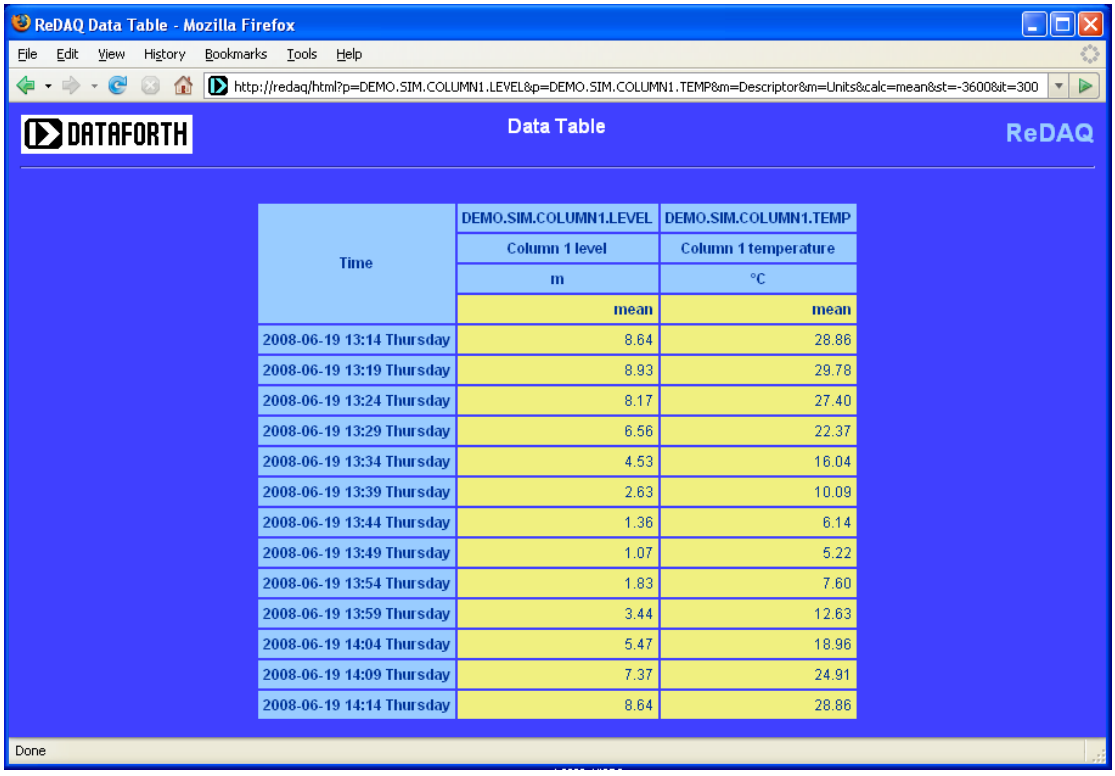


Figure 16 - HTML page as displayed in the browser



Time	DEMO.SIM.COLUMN1.LEVEL	DEMO.SIM.COLUMN1.TEMP
	Column 1 level	Column 1 temperature
	m	°C
	mean	mean
2008-06-19 13:14 Thursday	8.64	28.86
2008-06-19 13:19 Thursday	8.93	29.78
2008-06-19 13:24 Thursday	8.17	27.40
2008-06-19 13:29 Thursday	6.56	22.37
2008-06-19 13:34 Thursday	4.53	16.04
2008-06-19 13:39 Thursday	2.63	10.09
2008-06-19 13:44 Thursday	1.36	6.14
2008-06-19 13:49 Thursday	1.07	5.22
2008-06-19 13:54 Thursday	1.83	7.60
2008-06-19 13:59 Thursday	3.44	12.63
2008-06-19 14:04 Thursday	5.47	18.96
2008-06-19 14:09 Thursday	7.37	24.91
2008-06-19 14:14 Thursday	8.64	28.86

Figure 17 - HTML tabular data showing history

8.2 Generating tabular data in Excel format

Tabular data can also be downloaded in Excel format. Excel downloads may be saved as files or opened immediately in the browser.

An Excel download is achieved by a process very similar to that used for HTML downloads. The difference is that the base URI for Excel downloads is http://<hostname>/xl. Also, an additional field is included with Excel downloads to specify the file name. The following sections provide the details.

With Firefox, a pop-up window appears after submitting the request. Select the appropriate radio button. If "open with" is selected, ensure that the value in the select box is set to "excel.exe".

8.3 Query string field syntax for use with HTML and Excel downloads

The following sections detail the syntax for query string fields for use with HTML and Excel downloads. The base URI for HTML downloads is http://<hostname>/html. The base URI for Excel downloads is http://<hostname>/xl. The query string begins with the '?' character and the fields must be separated by the '&' character. Note that each field must be URL encoded.

8.3.1 Heading

Field format: **h=<heading text>**

Example: h=Summary
Example: h=Plant+Data

The heading field is optional.

8.3.2 Data point

Field format: **p=<name of data point>**

Example: p=DEMO.SIM.COLUMN1.LEVEL
Example: p=DEMO.SIM.COLUMN1.TEMP

One or more point fields may be included in the query.

8.3.3 Parameter

Field format version 1: **m=Descriptor**
Field format version 2: **m=Units**
Field format version 3: **m=Module**
Field format version 4: **m=Panel**
Field format version 5: **m=Channel**

Zero, one, or more parameter fields may be included in the query. As far as accessing data is concerned, the parameter value is case insensitive. However, the parameter value is reproduced in the same case in the table headings.

8.3.4 Calculation

Field format version 1: **calc=mean**
Field format version 2: **calc=minimum**
Field format version 3: **calc=maximum**
Field format version 4: **calc=median**
Field format version 5: **calc=variance**
Field format version 6: **calc=stdv**
Field format version 7: **calc=samples**
Field format version 8: **calc=current**

Zero, one, or more calculation fields may be included in the query. If no calculation field is included, current data is assumed. The calculation field is generally included to specify a history request. "calc=samples" returns the number of good values in each interval.

8.3.5 Start time

Field format version 1: **st=<unix time>**
Field format version 2: **st=-n**
Field format version 3: **st=YYYY-MM-DD-hh-mm-ss**

Example: st=-3600 [start one hour ago]
Example: st=2008-06-12-15-30-00 [start at 15:30 on June 12, 2008]

8.3.6 End time

Field format version 1: **et=<unix time>**
Field format version 2: **et=YYYY-MM-DD-hh-mm-ss**
Field format version 3: **et=0**

Example: et=0 [end now]
Example: et=2008-06-12-16-30-00 [end at 16:30 on June 12, 2008]

Omitting the end time field is equivalent to setting the end time to now.

8.3.7 Interval time

Field format: **it=<interval time in seconds>**

Example: it=600 [5-minute intervals]
Example: it=3600 [hourly intervals]

8.3.8 Rounding time

Field format: **rt=<rounding time in seconds>**

Example: rt=3600 [round to hours]
Example: rt=600 [round to 5-minute times]

Rounds down the absolute start time to the highest multiple of the value provided in seconds. This is useful when used in conjunction with relative start times. For example, setting the start time to -14400 and the interval time to 3600 will request history data for 4 hourly intervals starting 4 hours ago. Combining this with a rounding time of 3600 will request history data for 4 hourly intervals starting on the hour for the 4 previous complete hours.

8.3.9 File name for Excel download

Field format: **filename=<name of excel file>**

Example: filename=summary.xls

If the file name field is omitted, Excel files will be named “redaq.xls”.

8.3.10 Table orientation

Field format version 1: **or=down**
Field format version 2: **or=across**

This field allows the orientation of tables to be specified.

Version 1 means that the point names will be listed down the page and version 2 specifies that the point names will be listed across the page. If the field is omitted, current data tables default to point names down, and history data tables default to point names across.

8.3.11 Cascadable style sheet

Field format: **css=<file name>**

Example: css=summary.css

Specifies that the cascadable style sheet file will be used by the returned HTML page.

8.4 Requesting XML downloads

HTML and Excel downloads are mainly used for immediate viewing by human operators. A third format for downloading, XML, provides for user applications to import or automatically interrogate ReDAQ.

For XML downloads, ReDAQ makes use of a philosophy known as Representational State Transfer or REST.

The principle of REST is that a set of distributed resources may be accessed using Uniform Resource Identifiers (URIs). The HTTP protocol is used to deliver the request for the resource to the server and to return a representation of the resource to the client.

The World Wide Web is an example of a REST system. A typical web page, represented in HTML, is addressed by a URI, and returned to a browser using HTTP. When the browser receives the page, its state is changed. The received page may contain a hyperlink (another URI) which will cause, should the user select the link, another resource to be received and the state changed again.

ReDAQ returns representations of data point resources in the form of XML. For example, to obtain a list of data points configured in a ReDAQ server, a client application would issue an HTTP GET request with the following URI:

http://<hostname>/points

The ReDAQ server returns a schedule of data points in XML format. To request data concerning the data point “panel2.voltage1”, including the current value, client application would issue an HTTP GET request with the following URI:

http://<hostname>/point/panel2.voltage1

The ReDAQ server returns data specific to this particular data point in XML format. The URI required to access the data point was included in the response to the first request in the format of an xlink element. This means that a client application, for example a SQL database, can start by issuing the first simple GET request, determine from this details of the entire set of data points, and then drill down to obtain all required data.

It is possible to experiment with the procedure described here, by using a browser such as Internet Explorer or Firefox. Simply enter the URI in the address field. The browser will format the received XML file neatly. The browser is doing what a client application would usually do to obtain data from ReDAQ.

8.5 Query string field syntax for use with XML downloads

The following sections detail the syntax for query string fields for use with XML downloads. The base URI for XML downloads is described in the previous section. The query string begins with the ‘?’ character and the fields must be separated by the ‘&’ character. Note that each field must be URL encoded. For XML, the query string specifies just the history data. The following URI is an example of an XML request for the last 4 hours at 1-minute intervals with the mean calculation:

http://<hostname>/point/demo.sim.column1.level?calc=mean&st=-14400&it=60

8.5.1 Calculation

Field format version 1: **calc=mean**
Field format version 2: **calc=minimum**
Field format version 3: **calc=maximum**
Field format version 4: **calc=median**
Field format version 5: **calc=variance**
Field format version 6: **calc=stdv**
Field format version 7: **calc=samples**
Field format version 8: **calc=current**

Zero, one, or more calculation fields may be included in the query. If no calculation field is included, current data is assumed. The calculation field is generally included to specify a history request. "calc=samples" returns the number of good values in each interval.

8.5.2 Start time

Field format version 1: **st=<unix time>**
Field format version 2: **st=-n**
Field format version 3: **st=YYYY-MM-DD-hh-mm-ss**

Example: st=-3600 [start one hour ago]
Example: st=2008-06-12-15-30-00 [start at 15:30 on June 12, 2008]

8.5.3 End time

Field format version 1: **et=<unix time>**
Field format version 2: **et=YYYY-MM-DD-hh-mm-ss**
Field format version 3: **et=0**

Example: et=0 [end now]
Example: et=2008-06-12-16-30-00 [end at 16:30 on June 12, 2008]

Omitting the end time field is equivalent to setting the end time to now.

8.5.4 Interval time

Field format: **it=<interval time in seconds>**

Example: it=600 [5-minute intervals]
Example: it=3600 [hourly intervals]

8.5.5 Rounding time

Field format: **rt=<rounding time in seconds>**

Example: rt=3600 [round to hours]
Example: rt=600 [round to 5-minute times]

Rounds down the absolute start time to the highest multiple of the value provided in seconds. This is useful when used in conjunction with relative start times. For example, setting the start time to -14400 and the interval time to 3600 will request history data for 4 hourly intervals starting 4 hours ago. Combining this with a rounding time of 3600 will request history data for 4 hourly intervals starting on the hour for the 4 previous complete hours.

9. Designing custom pages

ReDAQ provides the functionality of a web-server which delivers a flexible set of mimics and graphics within HTML pages. Two demonstration web-sites are included with ReDAQ. This section explains how to add user-generated web pages.

9.1 File organization

All user pages are located in the directory “C:/ReDAQ/disp”. It will be seen that the ReDAQ distribution includes two sub-directories within “disp” entitled “demosim” and demolynx”. These directories contain the web pages for the two demonstration web-sites.

To add plant-specific pages, users should create a new directory under “disp”. For example, a directory entitled “plant” might be created. This would contain the new web pages to be associated with the user's plant. For example a file “summary.html” might be generated. This file would exist on the server disk at location “C:\redaq\disp\plant\summary.html”. It would be accessed from web browsers by using the URI: “http://<localhist>/disp/plant/summary.html”.

9.2 Creating pages to retrieve tabular data

Section 7 describes how to form URIs to obtain HTML and Excel snapshot tabular data. This technique makes use of HTML forms and an example of the HTML code required is provided. The user might like to experiment with creating similar pages for the plant data points. Other examples are provided in the demonstration web-sites.

The next section describes how to create HTML pages which return dynamic real-time data.

9.3 Real-time graphical displays - the ReDAQ agent

The most powerful direct user interface is achieved by creating real-time graphical displays. For this, the ReDAQ Java agent is deployed. The agent is a program which runs from within the user's browser, communicating with the ReDAQ server, and drawing dynamic mimics and graphs in the web page.

The ReDAQ agent is automatically loaded into a cache in the user's machine when the first page requiring it is displayed.

Figure 2 shows an example of a ReDAQ graphical display. The large white rectangle is the area generated by the ReDAQ agent; the remainder is regular HTML. It is possible for the entire display to be generated by the ReDAQ agent, or the user may choose to make use of HTML facilities.

Figure 18 shows the source of the example shown in Figure 2. It may be seen that the HTML code responsible for the graphic is just three lines as follows:

```
<applet code="com/dataforth/redaq/agent.class"archive="/image/redaq.jar" width="1120" height="516">
        <param name="file" value="/disp/demosim/montagehist.xml">
</applet>
```

The code invokes the ReDAQ Java applet which is called “agent.class”. In turn, the ReDAQ agent needs to access an XML file which contains the details of the graphical image to be included. In this example, the XML file is identified by its relative URL in the <param> tag.

The XML file is generated and edited by using the ReDAQ Designer. Please refer to Section 10 for details of how to use the Designer.

```
<?xml version='1.0' encoding='UTF-8'?>
<!DOCTYPE html PUBLIC '-//W3C//DTD XHTML 1.0 Transitional//EN'
'http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd'>

<html>
  <head>
    <title>Column Overview</title>
    <link rel="stylesheet" type="text/css" href="demo.css" />
  </head>
  <body>
    <img class='top' src='/image/dflogo' />
    <div class='redaq'>ReDAQ</div>
    <div class='head'>Column Overview</div>
    <div class='main'>
      <hr />
      <div class='navi'>
        <a class='navi' href="/">ReDAQ Home</a>
        <a class='navi' href="home.html">Demo Home</a>
        <a class='navi' href="table.html">Live Table</a>
        <a class='navi' href="mimic.html">Mimic</a>
        <a class='navi' href="mimichist.html">Hist Mimic</a>
        <a class='navi' href="graphlive1.html">Live Graph 1</a>
        <a class='navi' href="graphlive2.html">Live Graph 2</a>
        <a class='navi' href="graphhist1.html">Hist Graph 1</a>
        <a class='navi' href="graphhist2.html">Hist Graph 2</a>
        <a class='navi' href="histogramlive.html">Live Histogram</a>
        <a class='navi' href="montage.html">Montage</a>
        <a class='navi' href="montagehist.html">Hist Montage</a>
        <a class='navi' href="xyplot.html">X-Y Plot</a>
        <a class='navi' href="datatables.html">Data Tables</a>
        <a class='navi' href="xmldata.html">XML Data</a>
      </div>
      <div class='cent'>
        <applet code="com/dataforth/redaq/agent.class”
                archive="/image/redaq.jar" width="1120" height="516">
          <param name="file" value="/disp/demosim/montagehist.xml">
        </applet>
      </div>
      <div class='comm'>
        <p>This is a ReDAQ live graphic.</p>
      </div>
    </div>
  </body>
</html>
```

Figure 18 - HTML source of page containing ReDAQ graphic

10. ReDAQ Designer

10.1 Introduction

ReDAQ Designer is used to design dynamic operator and management screens for use with the ReDAQ server. Mimics can be constructed by drawing primitive graphical objects. Primitive objects can be multiple-lines, regular or rounded rectangles, polygons, text strings, or images (gif or jpg). Graphical symbols can be configured to change fill-color or have a fill-level according to system data. Text strings can include formatted system data values. Symbols can also be configured to be hyperlinks.

Complex objects such as tables, graphs, histograms, and pie charts can also be entered graphically and mixed with mimics.

Designer is used to edit or create the XML files which are accessed by the ReDAQ Java applet (agent.class).

An example of a Designer window is illustrated in Figure 2. The Designer is entirely intuitive to use. The buttons at the top of the screen are used to create or edit objects in the drawing area.

The two small buttons at the top-left of the window are used to select one of two banks of main object buttons. The small colored buttons at the top right of the window are used to set the current colors. The default line-color is set by the upper row, and the default fill-color is set by the lower row. Note the blank line-color and fill-color buttons.

The step-by-step instructions for each object are shown at the bottom-left of the window. To learn what a button does, just press it and the function appears.

10.2 Drawing Lines

Single or multiple lines can be drawn. Select the bank 1 set of tools. Then select the required line-color. Then press the line-draw button. Position the drawing cursor at the first point and left-click. Intermediate points are entered with further left-clicks, and the final point is entered with a right-click.

10.3 Drawing Rectangles

Standard or rounded rectangles may be drawn according to the button chosen. Select the bank 1 set of tools. Then select the required line-color and fill-color. Then press the appropriate "Rectangle" button. The first corner is entered with a left-click. The opposite corner is entered with another left-click.

10.4 Drawing Polygons

Select the bank 1 set of tools. Then select the required line-color and fill-color. Then press the "Polygon" button. Position the drawing cursor at the first vertex and left-click. Intermediate vertices are entered with further left-clicks, and the final vertex is entered with a right-click.

10.5 Drawing Circles

Select the bank 1 set of tools. Select the required line-color and fill-color, and then press the "Circle" button. Enter the center with a left-click and then a point on the circumference with another left-click.

10.6 Drawing Text Strings

Select the bank 1 set of tools. Select the required line-color, and then press the "ABC" button. Enter the text and expression (see below), and the required justification, weight, and point-size. Click on "OK" and then set the position with a left-click.

10.7 Editing Text Strings

Select the bank 1 set of tools. Press the "ABC edit" button, and select the required text string object with a left-click. Modify the text and expression (see Section 10.27), and the required justification, weight, and point-size. Click on "OK".

10.8 Inserting Images

Select the bank 1 set of tools. Press the "Img" button, select the required image path, and click "OK". Enter the URL. (This will be used by the applet to locate the image). Note that the filename is provided; add the first part of the URL. Click on "OK". Ensure that the URL is correct. Designer does not check the URL.

10.9 Adding an Hyperlink

Select the bank 1 set of tools. Press the "Link" button and select the object (see Section 10.26). Select whether the new page should open in the same window or a new window. Enter the URL of the page and click on "OK". Ensure that the URL is correct. Designer does not check the URL.

10.10 Adding a Smart Level

Select the bank 1 set of tools. Press the "Lvl" button and select the object (see Section 10.26). Select the required color and enter the expression. The value of the expression should be between 0.0 and 1.0 corresponding to zero and full fill respectively.

10.11 Adding a Smart Fill

Select the bank 1 set of tools. Press the "Fill" button and select the object (see Section 10.26). Select the required color and enter a boolean expression. The smart fill-color is applied if the value of the expression is true.

10.12 Moving an Object

Press the "Move" button and select the object (see Section 10.26). Position the drawing cursor at the new position and left-click.

10.13 Copying an Object

Press the "Copy" button and select the object (see Section 10.26). Position the drawing cursor at the new position and left-click.

10.14 Moving a Point

Press the "Move Point" button and select the vertex of the symbol (see Section 10.26). Position the drawing cursor at the new position and left-click.

10.15 Moving Multiple Points

Press the "Move Multiple Points" button and draw the selection rectangle; the first corner is entered with a left-click and the opposite corner is entered with another left-click. Left-click on a reference point, and then left-click again on the target location. Note that when moving multiple points, rectangular objects are constrained to remain rectangular.

10.16 Deleting Objects

Press the "Delete" button and select the object (see Section 10.26). If you delete something by mistake, select the "edit" menu and "undo".

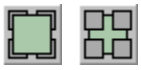
10.17 Deleting Multiple Objects

Press the "Multiple-delete" button and draw the selection rectangle; the first corner is entered with a left-click and the opposite corner is entered with another left-click. If you delete something by mistake, select the "edit" menu and "undo".

10.18 Changing the Default Line-color and Default Fill-color of Objects

Set the desired line-color and fill-color with the color buttons. Press the "Col" button, and then select the object (see Section 10.26).

10.19 Changing the Order of Objects



Press either the "Above" or "Below" order button as required. Then select the object (see Section 10.26).

10.20 Drawing Frames

Frames are used for mimic displays. To create a mimic display, draw a frame, and then draw the primitive symbols on top. To draw a frame, select the bank 2 set of tools, press the "Frame" button, enter the first corner with a left-click, and the opposite corner with another left-click. The standard frame is achieved when the fill-color button is set to blank and has a dark-green background. This coordinates with the standard ReDAQ style. A different background color can be achieved by setting the fill-color button otherwise.

10.21 Drawing Tables

Select the bank 2 set of tools. Press the "Table" button and enter the required number of rows and columns. Enter the first corner with a left-click, and the opposite corner with another left-click.

To enter data, press the "Edit ABC" button, left-click inside the desired table-cell, and proceed as for editing a text string. Note that the "ABC" button does not operate on tables.

To add a cell, press the "Divide table-cell" button, and left-click in the appropriate cell. A new cell is created to the right of the original cell. If there is insufficient space, the operation will be ignored. Use the "Move Multiple Points" button to adjust the cell sizes (see Section 10.15).

To add a row, press the "Divide table-row" button and left-click in the appropriate row. A new row is created to the bottom of the original row. If there is insufficient space, the operation will be ignored. Use the "Move Multiple Points" button to adjust the row sizes (see Section 10.15).

To delete a cell, press the "Delete" button, and left-click in the appropriate cell. Unless the cell is the left-most one, the cell to the left will be extended to fill the space.

To delete multiple cells, press the "Multiple-delete" button and draw the selection rectangle. Cells which are entirely contained by the selection rectangle are deleted.

To adjust the shape of a table, use the "Move Multiple Points" button. Table dividers and edges contained by the selection rectangle can be moved. Note that a row divider can only be moved if the selection rectangle spans the width of the table. Movement of dividers and edges will block if the action would result in a cell becoming too small.

10.22 Drawing Graphs

To draw a graph, select the bank 2 set of tools, press the "Draw graph" button, enter the first corner with a left-click, and the opposite corner with another left-click. Ensure that the graph is large enough for the text on the axes not to overlap. The graph is drawn initially with a left axis, a bottom axis, and three functions.

To edit the left scale, press the "Scale" button and left-click to the left of the graph paper but within the outer frame. Enter the required parameters and click on "OK".

To add a right scale, press the "Scale" button and left-click to the right of the graph paper but within the outer frame. Enter the required parameters and click on "OK".

To edit the functions, press the "f(x)" button and left-click on the function curve representation on the graph paper. Enter the required parameters and click on "OK". To add a new function, press the "f(x)" button and left-click outside the graph paper but within the outer frame.

To edit the title, press the "Edit ABC" button, left-click on the title, and proceed as for editing a text string.

The time axis is determined by the timespan parameters (see Section 10.25).

10.23 Drawing Histograms

To draw an histogram, select the bank 2 set of tools, press the "Draw histogram" button, enter the first corner with a left-click, and the opposite corner with another left-click. Ensure that the graph is large enough for the text on the axes not to overlap. The histogram is drawn initially with a left axis and three functions.

To edit the left scale, press the "Scale" button and left-click to the left of the graph paper but within the outer frame. Enter the required parameters and click on "OK".

To add a right scale, press the "Scale" button and left-click to the right of the graph paper but within the outer frame. Enter the required parameters and click on "OK".

To edit the functions, press the "f(x)" button and left-click on the function bar representation on the graph paper. Enter the required parameters and click on "OK". To add a new function, press the "f(x)" button and left-click outside the graph paper but within the outer frame.

To edit the title, press the "Edit ABC" button, left-click on the title, and proceed as for editing a text string.

The time axis is determined by the timespan parameters (see Section 10.25).

10.24 Drawing Pie Charts

To draw a pie chart, select the bank 2 set of tools, press the "Draw pie chart" button, enter the first corner with a left-click, and the opposite corner with another left-click. Ensure that the pie chart is large enough for the text to fit. The pie chart is drawn initially with three functions.

To edit the functions, press the "f(x)" button and left-click on the appropriate row in the table. Enter the required parameters and click on "OK". To add a new function, press the "f(x)" button and left-click outside the table rows.

To edit the title, press the "Edit ABC" button, left-click on the title, and proceed as for editing a text string.

The time axis is determined by the timespan parameters (see below).

10.25 Setting the Timespan

The timespan applies to all objects. To set the timespan, select the bank 2 set of tools, press the "timespan" button and enter the required parameters.

For live data, select the "live" mode. Specify the "interval" in milliseconds. If the design includes a live graph, enter a negative number for the "start" parameter where the magnitude of the number is the span of the time axis in milliseconds.

For history data, select the "history" mode. Specify the "interval" in milliseconds. Usually, history ends with the current time and so the end parameter can be left blank and the "start" parameter set to a negative number where the magnitude of the number is the span of the history data in milliseconds. For example, enter -3600 to display a trend over the last hour. The number in the "round" parameter, if entered, causes the start and end times to be rounded down to multiples of that number. This allows graphs to display, for example, daily or hourly data.

10.26 Selecting Objects

Lines, rectangles, polygons, frames, tables, and graphs are selected by left-clicking on one of the vertices. Note that the "vertices" of a rounded rectangle are where the corners would be on the equivalent non-rounded rectangle. Circles are selected by left-clicking on the North, South, East, or West compass points. Images are selected by clicking in the image.

10.27 Expressions

Expressions are entered using the following operators:

+, -, *, /, ^, %, cos, sin, tan, acos, asin, atan, sqrt, sqr, exp, log, min, max, ceil, floor, abs, neg, rand

Data point names should be enclosed in braces, e.g. {DEMO.COLUMN1.FLOW}.

An example of an expression would be:

sqrt (20 * {DEMO.COLUMN1.VOLTAGE}) + cos ({DEMO.COLUMN1.PRESSURE} / 100.0)

10.28 Saving files

When Designer is closed, a window will appear requesting the details for saving the XML file. Alternatively, the Designer XML file can be saved at any time by selecting File->save from the menu.

The saved file should subsequently be moved to the appropriate directory within C:\redaq\disp. It is usual to put the XML file in the same directory as the HTML file which will refer to it. Note that designer files have the filetype “xml”. Please refer to Section 8.3 for details.

10.29 Opening files

An existing Designer XML file can be opened at any time by selecting File->open from the menu.

11. System configuration

The system configuration is represented by an XML file, “config.xml”, located in the “redaq” directory. The configuration details include the parameters necessary for the server to be able to communicate with the isoLynx networks, the intranet/Internet interface, and the schedule of data points.

The “config.xml” file can be edited directly on the server PC. Alternatively, the “System Configuration” web-page can be used; it is essentially a user-friendly way of setting up the “config.xml” file. This section will, therefore, also be useful when working with the “System Configuration” page. This web-page may be accessed via the menu on the ReDAQ root page.

An example of the configuration file for a very simple system with just two data points is shown in Figure 19. Section 11.2 details the syntax for the configuration file.

For reference, a schedule of the data points defined in the demonstration configuration file is provided in the Appendix.

11.1 Note regarding Extensible Markup Language

Extensible Markup Language (XML) is a data exchange and storage mechanism which allows data to be shared between different types of computers and applications. XML has become the industry standard for exchanging data of any kind. ReDAQ makes extensive use of XML, both for storing the system configuration and for transmitting real-time and history data to other computers and applications in response to HTTP requests.

The basic syntax is as follows:

<element_name attribute1_name=”attribute1_value“ attribute2_name=”attribute2_value“>
Element content
</element_name>

where *Element content* may be other elements or text values.

The above example shows an element with two attributes. In fact, the number of attributes may be zero, one, or several. It can be seen that XML represents data in a tree structure because elements themselves contain other elements. Section 11.3 specifies the names of the elements and attributes which define the ReDAQ system configuration. Please see Figure 19 for an example of the configuration file, “config.xml”.

11.2 Data point naming

Data points in ReDAQ are hierarchical. They are of the following format:

<identifier>.<identifier>.<identifier>…

<identifier> is any sequence of alphanumeric characters or '-'. The identifiers are separated by periods, and the number of identifiers is unlimited.

By way of example, the two data points defined in Figure 19 are named as follows:

DEMO.ANALOGS.POTENTIOMETER
DEMO.ANALOGS.TEMP

Data point references entered using ReDAQ Designer may also have modifiers. For example, the modifier ":alarm" when appended to the data point name, refers to the alarm value. Other modifiers are ":descriptor" and ":units". Examples of such references are:

DEMO.ANALOGS.TEMP:alarm
DEMO.ANALOGS.TEMP:descriptor
DEMO.ANALOGS.TEMP:units

Each <identifier> is defined by the value of the name attribute of a point element in the configuration file. A point may contain a child point. The value of the name attribute of such a child point provides the next <identifier> in the chain. In this way, the data points are organized into a tree architecture. This allows process plant data points to be organized into groups which map to the structure of the facility or process.

Child points inherit many parameters from their parent points. This makes the specification of many parameters very efficient. For example, all the data points associated which a particular isoLynx system will have the same unit ID. By arranging for all of these points to be children, grandchildren, or great grandchildren, of a higher point, the ID value only needs to be specified once. Section 11.3 provides the details.

11.3 Config XML parameters

This section details the syntax rules for the “config.xml” file. Please refer to Figure 19 for additional clarification.

11.3.1 The redaq element

redaq: The "config.xml" file must contain one and one only redaq element. This is the root element and serves as a holder for the other elements.

11.3.2 Elements within the redaq element

timezone: Sets the time zone of the server to the number of hours relative to GMT. For example, if located in Arizona, set the time zone to **-7**. If located in the UK, set the time zone to **0**. If located in Singapore, set the time zone to **8**. ReDAQ automatically adjusts for daylight savings. Only one timezone element should be present within the redaq element.

unlock: Installs an unlock code. One unlock element is required for each SLX200 in the system. If a valid unlock element for an isoLynx is not present, ReDAQ will still display the “device info” parameters. However, all other data values will be returned as “locked”.

authentication: Sets the name and password for a user. Zero, one, or more authentication elements may be present depending on how many user names are required.

ipaddress: Sets the IP address of the Internet/intranet Ethernet port. ReDAQ binds to this address and listens for TCP/IP connections from browsers on port 80. If the same machine is being used for both server and client, and there is no Ethernet port, the IP address should be set to **127.0.0.1** (localhost). Only one ipaddress element should be present within the redaq element.

portspec: Sets the parameters of an isoLynx network port. For serial ports the name attribute can be “**COM1**” through “**COM8**”, and for Ethernet ports the name attribute can be “**ETHERNET1**” through “**ETHERNET8**”. For serial ports, specify the transmission speed in the bps element to **1200**, **2400**, **4800**, **9600**, **19200**, **38400**, **57600**, or **115200**, and the parity element to **no**, **odd**, or **even**. For Ethernet ports, specify the IP address of the network port in the ipaddress element. ReDAQ binds to this address for communications with isoLynx systems. There should be one portspec element for each isoLynx network.

point: Specifies a data point. The name attribute sets the data point name identifier. The redaq element must contain one and one only point element.

11.3.3 Elements within the point element

point: Specifies a data point. The name attribute sets the data point name identifier. The point element may itself contain one or more point elements.

port: Links the data point to the corresponding portspec element. That is, the interface port connecting to the isoLynx containing the data to which the point corresponds. If the port element is absent, the point inherits the value from its parent.

ipaddress: Sets the IP address of the isoLynx containing the data to which the point corresponds. If the ipaddress element is absent, the point inherits the value from its parent. The ipaddress element is not required if the isoLynx is on a serial network.

id: Sets the device ID of the isoLynx containing the data to which the point corresponds. If the id element is absent, the point inherits the value from its parent.

descriptor: Sets the descriptor of the data point. If the descriptor element is absent, the point inherits the value from its parent.

units: Sets the units of the data point. If the units element is absent, the point inherits the value from its parent.

panel: Sets the panel of the isoLynx containing the data to which the point corresponds. Values of **A0** through **A3** refer to analog panels with **A0** meaning the SLX200 itself. Values of **D0** through **D7** refer to digital panels. The value of the panel element is not inherited and must be specified within a point element accessing data from a module.

channel: Sets the channel containing the module to which the point corresponds. Valid values are 0 through 15. The value of the channel element is not inherited and must be specified within a point element accessing data from a module.

item: Sets the item type in the module or the isoLynx to which the data point refers. If the data point corresponds to a module, valid values are **current**, **minimum**, **maximum**, or **average**. If the data point refers to "device info", valid values are **manufacturer**, **model**, **serial**, or **firmware**. If the item element is absent, the value defaults to **current**.

module: Sets the model number of the module to which the data point refers. Valid values are those model numbers as defined in isoLynx.xml.

history: Specifies that a data point should be historized. The history element, if present, must contain interval and duration elements. If the history element is absent, the data point is not historized.

alarms: Specifies that a data point should be alarmed. The alarms element, if present, must contain at least one high or low element. If the alarms element is absent, the data point is not alarmed.

11.3.4 Elements within the history element

duration: Specifies the duration, in days, for which history is maintained.

interval: Specifies the interval, in seconds, at which the data point will be sampled and the value stored in the history data set.

11.3.5 Elements within the alarms element

smtpserver: Specifies the URI of the ISP's SMTP server to which ReDAQ should connect when sending an e-mail. Preferably, the hostname attribute should be present. e.g. hostname='**www.mycompany.com**'. If it is omitted, the hello message in the e-mail will specify "ReDAQ" as the host name. If authentication is required, the username and password attributes should be present. When authenticating, ReDAQ will use CRAM-MD5, PLAIN, and LOGIN methods in descending order of preference as supported by the remote server.

from: Specifies the source e-mail address. If the from element is absent, "ReDAQ" will be used as the source address.

to: Specifies a recipient e-mail address. The alarms element may contain zero, one, or more to elements.

subject: Specifies the subject line of the e-mail. If the subject element is absent, ReDAQ will provide a default subject line.

high: Specifies a high-type alarm condition associated with the data point. (A high-type alarm condition is set with an increasing value of the data point). A high element must contain a name attribute and a limit element. It may, optionally, contain a deadband element. The value of the name attribute may be any alphanumeric character sequence, including the space character. The value of the name attribute is shown in HTML tables, and ReDAQ graphics when the alarm condition is set. Zero, one, or more high elements may be present.

low: Specifies a low-type alarm condition associated with the data point. (A low-type alarm condition is set with a decreasing value of the data point). A low element must contain a name attribute and a limit element. It may, optionally, contain a deadband element. The value of the name attribute may be any alphanumeric character sequence, including the space character. The value of the name attribute is shown in HTML tables, and ReDAQ graphics when the alarm condition is set. Zero, one, or more low elements may be present.

normal: Specifies a normal-type alarm condition. (A normal-type alarm condition is set by default if no high-type or low-type alarm conditions are set). The name attribute must be present. The value of the name attribute may be any alphanumeric character sequence, including the space character. The value of the name attribute is shown in HTML tables, and ReDAQ graphics when the alarm condition is set. Zero or one normal elements may be present. If a normal element is not present, HTML tables and ReDAQ graphics will show "OK" when no high-type or low-type alarm conditions are set.

11.3.6 Elements within the high and low elements

limit: Sets the value at which the alarm condition will be set.

deadband: Sets the dead-band value for this alarm condition. For high-type alarms, the alarm condition will not become reset until the value reduces to the limit minus the dead-band. For low-type alarms, the alarm will not become reset until the value increases to the limit plus the dead-band.

smtpserver: Specifies the URI of the ISP's SMTP server to which ReDAQ should connect when sending an e-mail associated with this alarm condition. This element overrides any smtpserver element present in the alarms element. Preferably, the hostname attribute should be present. e.g. hostname='**www.mycompany.com**'. If it is omitted, the hello message in the e-mail will specify "ReDAQ" as the host name. If authentication is required, the username and password attributes should be present. When authenticating, ReDAQ will use CRAM-MD5, PLAIN, and LOGIN methods in descending order of preference as supported by the remote server.

from: Specifies the source e-mail address. This element overrides any from element present in the alarms element. If the from element is absent from both this element and the alarms element, "ReDAQ" will be used as the source address.

to: Specifies a recipient e-mail address. The alarms element may contain zero, one, or more to elements. The list of recipients to which the email will be sent is the combination of those provided in the alarms element with those provided in this element.

subject: Specifies the subject line of the e-mail. This element overrides any subject element present in the alarms element. If the subject element is absent from both this element and the alarms element, ReDAQ will provide a default subject line.

```
<?xml version="1.0" encoding="us-ascii" ?>
<redaq>
 <timezone>-7</timezone>
 <ipaddress>192.168.1.1</ipaddress>
 <unlock>abcde-abcde-abcde-abcde-abcde-abcde-abcde-abcde</unlock>
 <authentication name="demo">
   <password>demo</password>
 </authentication>
 <portspec name="ETHERNET1">
   <ipaddress>192.168.0.1</ipaddress>
 </portspec>
 <point name="DEMO">
   <port>ETHERNET1</port>
   <ipaddress>192.168.0.215</ipaddress>
   <id>31</id>
   <point name="ANALOGS">
     <descriptor>Analog Panel</descriptor>
     <point name="POTENTIOMETER">
       <descriptor>Potentiometer</descriptor>
       <units>ohms</units>
       <panel>A0</panel>
       <channel>1</channel>
       <item>current</item>
       <module>SCM5B36-03</module>
       <history>
         <interval>60</interval>
         <duration>90</duration>
       </history>
     </point>
     <point name="TEMP">
       <descriptor>Temperature</descriptor>
       <units>&#176;C</units>
       <panel>A0</panel>
       <channel>2</channel>
       <item>current</item>
       <module>SCM5B47J-03</module>
       <history>
         <interval>60</interval>
         <duration>90</duration>
       </history>
     </point>
   </point>
 </point>
</redaq>
```

Figure 19 - Example of simple "config.xml" file

```
<point name="TEMPERATURE">
  <descriptor>Ambient temperature</descriptor>
  <units>&#176;C</units>
  <panel>A0</panel>
  <channel>1</channel>
  <item>current</item>
  <module>SCM5B47J-03</module>
  <alarms>
    <high name="hot">
      <limit>25.0</limit>
      <deadband>0.2</deadband>
    </high>
    <high name="warm">
      <limit>24.5</limit>
      <deadband>0.2</deadband>
    </high>
    <low name="cool">
      <limit>20.5</limit>
      <deadband>0.2</deadband>
    </low>
    <low name="cold">
      <limit>20.0</limit>
      <deadband>0.2</deadband>
    </low>
</point>
```

Figure 20 - Example of alarm elements

```
<point name="TEMPERATURE">
  <descriptor>Ambient temperature</descriptor>
  <units>&#176;C</units>
  <panel>A0</panel>
  <channel>1</channel>
  <item>current</item>
  <module>SCM5B47J-03</module>
  <history>
    <interval>60</interval>
    <duration>90</duration>
  </history>
</point>
```

Figure 21 - Example of history elements

Appendix - Demonstration data points

The data points defined for the two demonstration web-sites are as follows:.

DEMO
DEMO.ANALOGS
DEMO.ANALOGS.FIRMWARE
DEMO.ANALOGS.MANUFACTURER
DEMO.ANALOGS.MODEL
DEMO.ANALOGS.POTENTIOMETER
DEMO.ANALOGS.POTENTIOMETER.AVERAGE
DEMO.ANALOGS.POTENTIOMETER.MAX
DEMO.ANALOGS.POTENTIOMETER.MIN
DEMO.ANALOGS.SERIAL
DEMO.ANALOGS.TEMP
DEMO.ANALOGS.TEMP.AVERAGE
DEMO.ANALOGS.TEMP.MAX
DEMO.ANALOGS.TEMP.MIN
DEMO.ANALOGS.VOLTAGE
DEMO.ANALOGS.VOLTAGE.AVERAGE
DEMO.ANALOGS.VOLTAGE.MAX
DEMO.ANALOGS.VOLTAGE.MIN
DEMO.DIGITALS
DEMO.DIGITALS.DO1
DEMO.DIGITALS.FIRMWARE
DEMO.DIGITALS.MANUFACTURER
DEMO.DIGITALS.MODEL
DEMO.DIGITALS.SERIAL
DEMO.DIGITALS.SWITCH1
DEMO.SIM
DEMO.SIM.COLUMN1
DEMO.SIM.COLUMN1.FLOW
DEMO.SIM.COLUMN1.LEVEL
DEMO.SIM.COLUMN1.PRESSURE
DEMO.SIM.COLUMN1.PUMP
DEMO.SIM.COLUMN1.TEMP
DEMO.SIM.COLUMN1.VESSEL
DEMO.SIM.COLUMN2
DEMO.SIM.COLUMN2.FLOW
DEMO.SIM.COLUMN2.LEVEL
DEMO.SIM.COLUMN2.PRESSURE
DEMO.SIM.COLUMN2.PUMP
DEMO.SIM.COLUMN2.TEMP
DEMO.SIM.COLUMN2.VESSEL
DEMO.SIM.COLUMN3
DEMO.SIM.COLUMN3.FLOW

DEMO.SIM.COLUMN3.LEVEL
DEMO.SIM.COLUMN3.PRESSURE
DEMO.SIM.COLUMN3.PUMP
DEMO.SIM.COLUMN3.TEMP
DEMO.SIM.COLUMN3.VESSEL
DEMO.SIM.COLUMN4
DEMO.SIM.COLUMN4.FLOW
DEMO.SIM.COLUMN4.LEVEL
DEMO.SIM.COLUMN4.PRESSURE
DEMO.SIM.COLUMN4.PUMP
DEMO.SIM.COLUMN4.TEMP
DEMO.SIM.COLUMN4.VESSEL
DEMO.SIM.VALVE1
DEMO.SIM.VALVE2

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