

## Software

### MX4 SCADA and HMI Technical overview

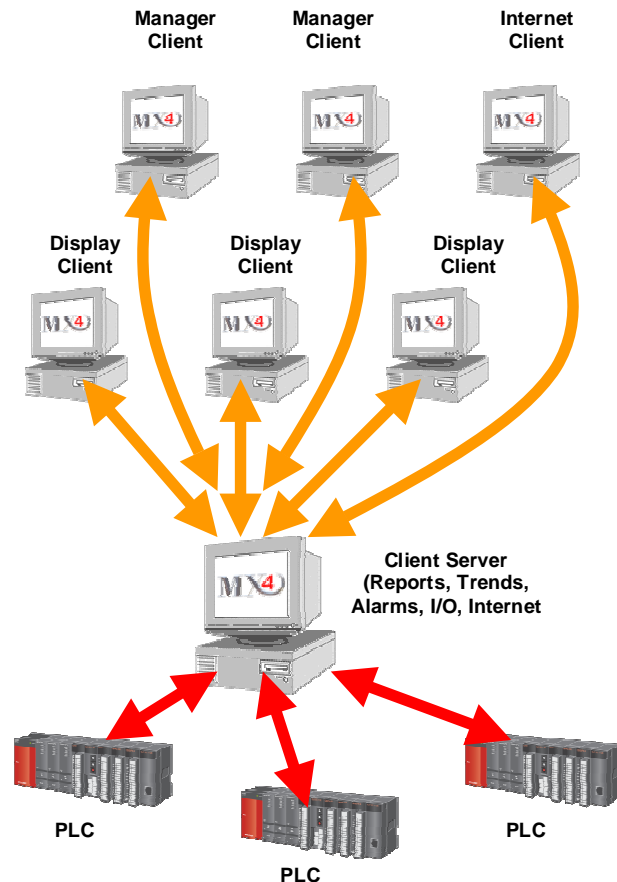
Date: 13<sup>th</sup> Dec 2004Contact: Martin Ginty  
+49/(0)2102/486-7920

## Technical Overview of MX4

MX4 is a HMI/SCADA solution that enables customers to increase return on assets by delivering a highly scalable, reliable control and monitoring system. Easy-to use configuration tools and powerful features enable you to quickly develop and deploy solutions for any size application. Unique features like true DCS style redundancy, scalability and unrivalled flexibility differentiate MX4 from its competitors. MX4 systems are sold complete and ready to go. All the features, protocols and drivers needed for Mitsubishi connection are included, and because it's sold as one comprehensive package, it is tightly integrated and built to perform. MX4 is designed to handle all the needs of large and complex enterprises in a single, integrated system while maintaining high performance and reliability.

### Scalable architecture

Scalability is the power to resize your system — up or down — without having to modify any of the existing system hardware or software. MX4's innovative scalable architecture allows your system's architecture to grow with your requirements, while preserving your initial investment. MX4 makes the most of its task oriented client-server design, allowing you to re-allocate tasks as you add more MX4 computers. For example, if you require a second operator interface, add a LAN and a new computer, and set it as a Display Client. The new computer can share the same configuration, and will receive I/O from the first MX4 computer. A secondary benefit of doing this is that you can also distribute the processing load. For example, if you think your first MX4 computer is too busy, you can simply nominate the second to take care of the alarms by becoming the Alarms Server. Put simply, some users want simple HMI, while others want a complete SCADA system. With MX4, you can do both. Start small... ..and grow bigger — without changing the configuration. To add new stations, just install the new computer, and nominate the task (or tasks) it should perform.

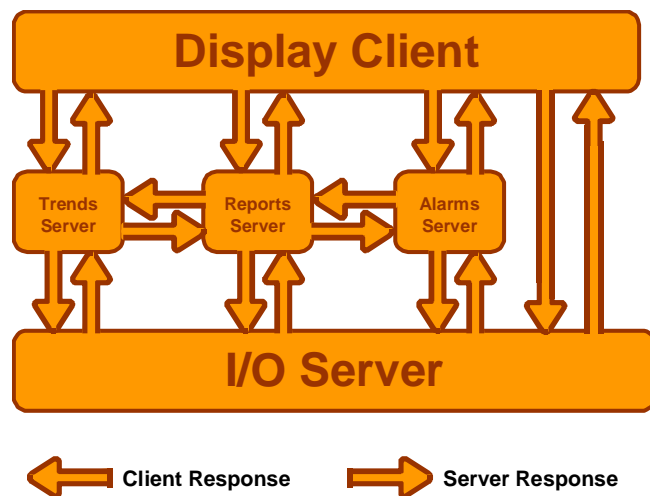


### Large systems

MX4 applications can scale easily from very small applications of a few points to very large ones that monitor and control over half a million points. This is achieved by providing the option of using centralized or distributed processing. Centralized processing has the benefit of keeping all the data and processing in one PC, which is a cheaper solution. However, for very large applications, distributed processing allows you to share the processing over multiple computers.

### Flexible Architecture

Designed from the start for true client-server architecture, MX4 is the real-time system that ensures high performance response and integrity of data. To take full advantage of a client-server architecture, it must be utilized at the task level. Each task works as a distinct client and/or server module, performing its own role, and interfacing with the other tasks through the client-server relationship. MX4 has five fundamental tasks which handle: communications with I/O Devices; monitoring of alarm conditions; report type output; trending; and user display. Each of these tasks is independent, performing its own processing. Due to this unique architecture, you have control over which computers in your system perform which tasks. For example, you can nominate one computer to perform the display, and report tasks, while your second computer performs display, I/O, and trends. MX4 encourages you to use a centralized database when using networked systems. Having one global database is obviously beneficial, since you only make changes at one location — which are then updated everywhere. Of course, if you want to use separate configurations on each computer, you can do that too. You can even have a mixture of both. While MX4 has a reputation for installations involving networks and large amounts of data, many users have single MX4 installations. Using MX4, your system can start out as simple as you like, and grow as large as required.



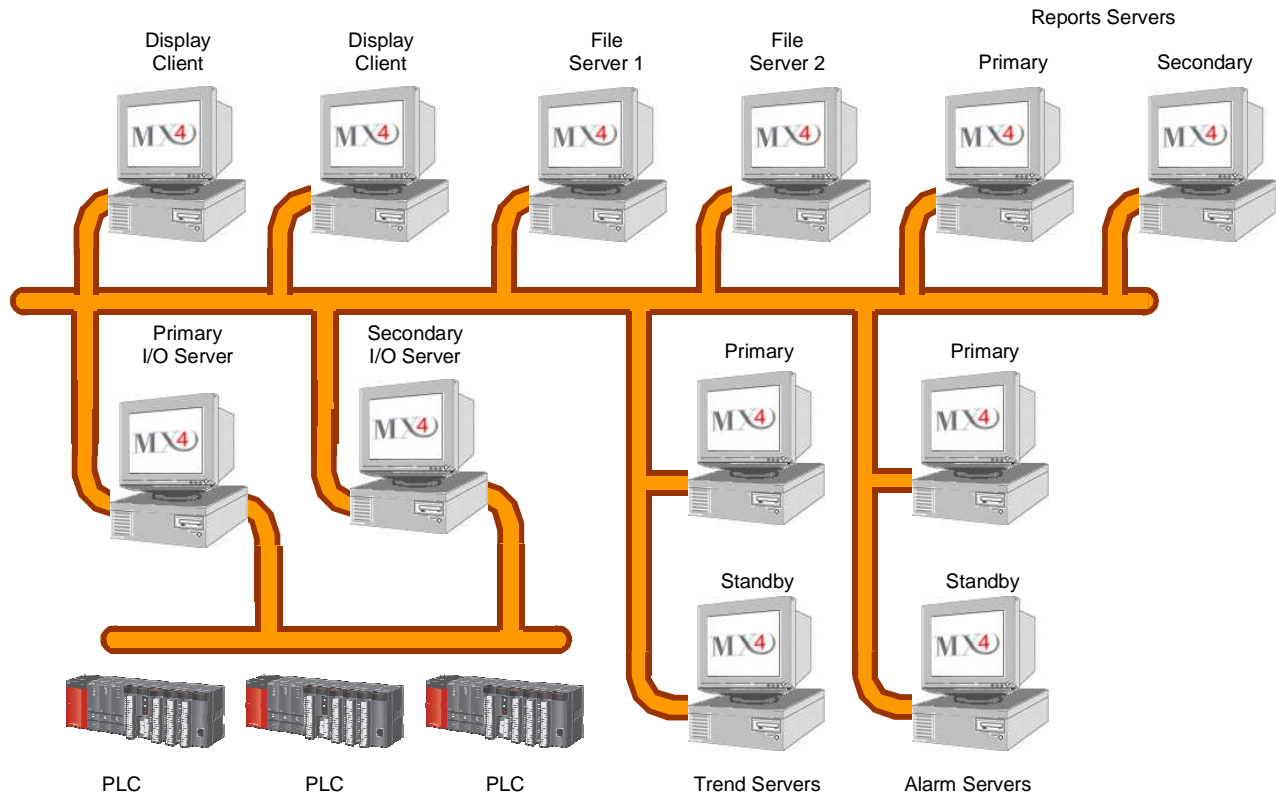
### Reliable Architecture

In factory automation and other mission critical applications, hardware failure leads to production loss, and can result in potentially hazardous situations. MX4's redundancy will tolerate failure anywhere in your system, with no loss of functionality, or performance. MX4 supports full hot standby configurations, providing complete I/O Device redundancy. By nominating one device as primary, and the other as standby, MX4 will automatically switch from one to the other in the event of failure. Using MX4's ability to write set point changes to both primary and standby I/O Devices, even I/O Devices that were not designed for redundancy can be used in a redundant configuration. A broken communication cable and unpredictable electrical noise are common communication problems. In response, MX4 allows the use of two separate communication cables (run separately) for each I/O Device. By using data path redundancy, you minimize the chance of communication loss affecting your operation. When communicating with an I/O Device, many systems demand redundant I/O Server configurations. To avoid conflict of data, and to maximize communication bandwidth, only the primary I/O Server communicates with the I/O Device. Many SCADA systems use LANs to connect the elements, but something as simple as a faulty network card can destroy communication. MX4's built-in multiple network support provides full LAN redundancy. All you have to do is install two networks (or more if you like). If the primary LAN fails, MX4 will automatically try to connect on the other available LANs — no configuration required. The fallibility of file servers is often forgotten. MX4

supports redundant file locations, so that even if your file server fails, your SCADA system will continue unaffected. The redundancy features of MX4 are integrated and easy to configure — in fact, LAN redundancy requires no set-up, and task redundancy set-up is configured in a few seconds using a simple wizard. And, of course, all the redundancy features of MX4 can be used together, providing you with maximum protection. Because of MX4's task based architecture, you get an unrivalled level of SCADA redundancy. Each of the tasks in MX4 (I/O, Trends, Alarms, Reports, Display) can be shared by other computers in your system. This allows you to allocate a server task to two computers at one time — one as the primary and the other as the standby. If a primary server fails, the standby will automatically assume its role — without loss of data. When the primary is absent, the clients will automatically access the standby server. When the primary server is brought back online, it will be resynchronised automatically, ensuring no gaps in your history files. Since all tasks are different in nature, MX4 allows you a separate redundancy strategy for each. If you need to upgrade or make configuration changes, you can load a new project onto the standby server. Once loaded, switch from the primary server and run the new project on the standby server. Should it not work as expected you can switch back to the primary server without disturbing production.

### Clients

All Citect Display and Web Clients will automatically switch over to the standby server in the event of the primary server failing or becoming overloaded.



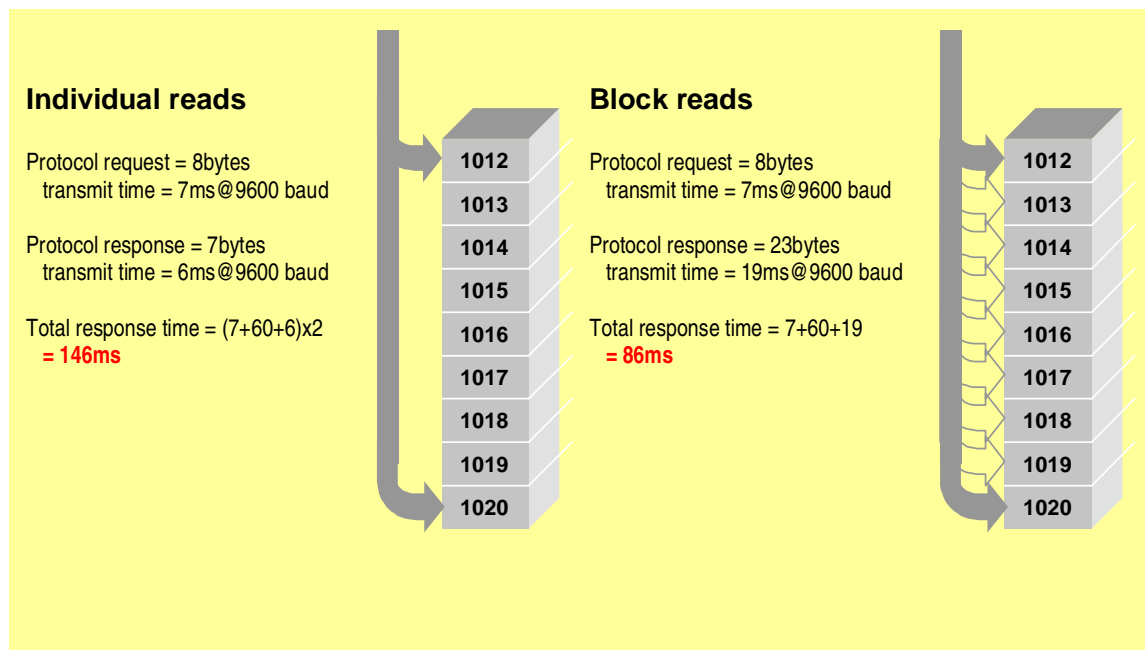
Each MX4 Server can also be a Display Client. File Servers do not require a MX4 license unless you are running a MX4 Server or Display Client on that PC.

## PLC Connection

MX4 comes with Device drivers included for all current Mitsubishi PLCs.

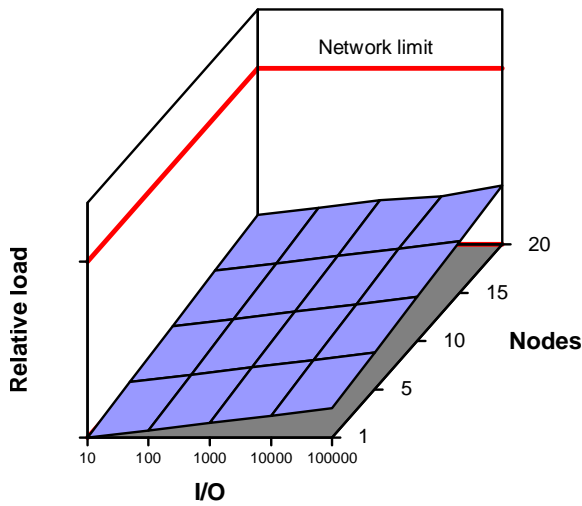
MX4 also gives you 100% data integrity. If the data represented on the screen isn't valid, MX4 will mark it with a user definable hash or text message. Rather than display operator entered data immediately on screen, MX4 can also be set to write to the PLC first, then display the read back value.

The speed with which data can be transferred depends on, and is limited by, the I/O Device and the protocol design. The limitation comes from the fact that I/O Devices do not respond immediately to requests for data, and many protocols are inefficient. The following strategies allow MX4 to maximize data transfer. MX4's communication is demand based — reading only those points which are requested by the clients. More importantly, the I/O Server rationalizes requests from clients, for example, combining them into one request where possible. This reduces needless communication, giving screen update times up to eight times faster (than without). Only a restricted volume of data can be returned in one request. If all requested data is grouped together, then fewer requests are required, and the response is faster. But what happens when two required registers are separated? MX4 uses a blocking constant to calculate whether it is quicker to read them separately, or in the same 'block'. By compiling a list of the registers that must be read in one scan, MX4 automatically calculates the most efficient way of reading the data.

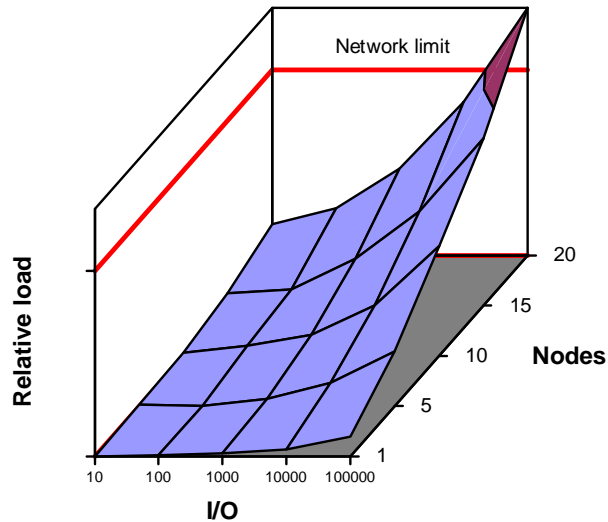


The client-server processing of MX4 allows further performance increases, through the use of a cache on the I/O Server. When an I/O Server reads registers, their values are retained in its memory for a user defined period (typically 300ms). If a client requests data that is stored in the cache, the data is provided without the register being re-read. In a typical two-client system, this will occur 30% of the time. The potential performance increase is therefore 30%. MX4 also uses read ahead caching, updating the cache if it gets accessed — predicting that the same information will be requested again! MX4 has an in-built performance monitor, allowing you to analyse your drivers. If required, each driver has a number of parameters that you can adjust, to perfectly tune your driver — under the guidance of the online help. MX4's distributed processing and network optimisation give you excellent network performance, even when you have over 450,000 I/O and 60 MX4. Without MX4's network optimisation you can expect network load to increase dramatically, 'choking' as you add more I/O and computer stations:

MX4: Network load vs system size

**IDEAL**

Other SCADA: Network load vs system size

**UNACCEPTABLE****Communication with Modems and RTUs**

MX4 can schedule connections to RTUs (for example, via modems or microwave links). To minimize data communication costs, MX4 can call up the I/O Device as per the user defined schedule, or when needed to exchange data, and automatically disconnect. By working with most serial protocols provided with MX4, Remote I/O Device Monitoring provides the user with flexibility in selecting a wide range of PLCs or RTUs.

**Built-in Management**

MX4's comprehensive features for managing remote devices are built-in:

- Easy-to-use Express Communications Wizard.
- A single modem can be used to communicate with multiple I/O Devices.
- MX4 can use a modem pool to simultaneously connect to multiple devices.
- Dial-In feature for remote devices. If remote alarms occur outside of scheduled dial-out times, the devices can dial-in to MX4 and transfer the alarm information.
- Dial-Out I/O has full redundancy support. If the primary server fails, the standby server will dial the remote devices. The non-volatile data cache is replicated automatically between servers, so the latest data is always maintained on the standby and is available to the primary on restart. MX4 keeps a local record of the last values read from each device.
- If MX4 cannot connect to the remote device after user defined number of retries, that I/O Device will be flagged as off-line and the values marked accordingly.
- Each modem can be configured to define its purpose Dial-Out, Dial- In, or both, and it can be dedicated for MX4 only if desired.
- MX4 supports connection to devices which communicate using different data frames.

**Easy to configure and use**

Based on a user-selected schedule, MX4's Remote I/O Device Monitoring feature can automatically connect to remote devices to retrieve data. Conversely it can accept unsolicited connections and data uploads from remote devices. Remote I/O is more than a remote monitoring feature, it can also be used to implement Cicode functions on connection or disconnection. The Express Communications Wizard includes telephone number and call schedule fields. Set it up and let MX4 look after the call schedules, data transfers and disconnections. It's automatic! Implementing the Dial-In feature requires a remote device or modem that is capable of sending an identification string (ID String). MX4

uses the ID String to identify the remote caller along with the appropriate communications protocol. If the device cannot support ID string (for example, the serial port may be limited to a native protocol), Mitsubishi industrial modems can provide a suitable interface.

### Further benefits

- Economical solution for monitoring remote trend, alarm, and tag information
- Easy to configure
- Dial-in for alarms
- Full redundancy support
- Time stamped data from RTU event logs uploaded and back-filled into historical records.
- Any alarms for this data trigger new alarms based on the original time-stamp.

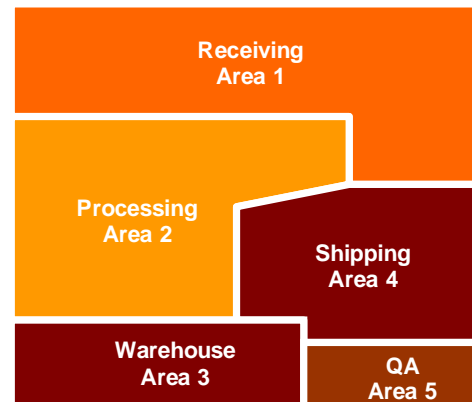
### Security

Most applications have special operations that only qualified personnel should perform. Your system must provide some form of security, to prevent accidental or deliberate tampering, and to protect personnel and your investment. MX4's comprehensive security features are integrated into all interface elements, ensuring a secure runtime system.

MX4's security system is user based, allowing you to define individual or group security details for the runtime system. Any user can be assigned a security login, forcing them to enter their user name and password to gain access to parts of the runtime system. There is no limit to the number of users (or groups) that you can have configured in your system — you can even add and delete new ones during runtime. Access is controlled by granting users the ability to view different areas of your system. If able to view an area, the user may also need to have the correct privilege level to perform actions, or view objects. For each graphical object, page, trend, report, etc., you can define the area to which it belongs, and what privilege levels are required to make it visible or usable. Since users can use any MX4 computer, access is granted/denied by the server, not by the client — giving added security for WAN applications. In most applications, the operator should not be allowed to exit MX4. You can secure the MX4 runtime environment itself, by stopping users from swapping to the Windows operating system or other Windows programs. MX4 Manager Clients are a cost effective way to provide view only access, with the additional protection of a hardware security lock that can reside on the MX4 Server. Manager Clients can be shared amongst many users anywhere on the network, simply allow enough Manager Client Licenses to satisfy the maximum number of users logged in at any one time.

### Security without thinking

To stop unknown people tampering with your plant when the operator station is unmanned, you can have MX4 automatically log people out of the system (for example, if the mouse is idle for 5 minutes). Without an appropriate password, operators can do no harm.



John Smith

Viewable Areas: 1, 3, 5

Global Privileges: 3, 5

Additional Privileges in Areas: 1, 2, 4

Operator 2

Viewable Areas: 1, 3

Global Privileges: 3, 5,

Additional Privileges in Areas: 1, 4

Supervisor

Viewable Areas: Plantwide

Global Privileges: 1, 2, 3, 4, 5

Additional Privileges in Area: 1

## PLC Tag Synchronization

Linking tags directly with PLC programming software makes system configuration and maintenance easy.

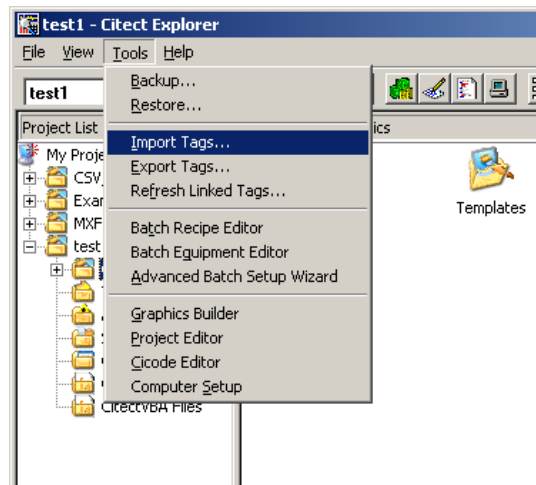
MX4 FastLinX links your database in MX4 and GX IEC Developer giving you a single database solution. This reduces the development time significantly and eliminates the chance of configuration errors occurring during project maintenance and development. The bi-directional linking feature ensures that changes made in any development environment are updated automatically when projects are worked on simultaneously. When MX4 and GX IEC Developer projects are worked on separately, the Import and Export feature is an invaluable tool ensuring that both environments are maintained and kept up-to-date. Regardless of whether you develop your MX4 and GX IEC Developer project simultaneously or separately, MX4 FastLinX ensures that all variable tags are maintained and updated automatically.

### **Tag Import/Export**

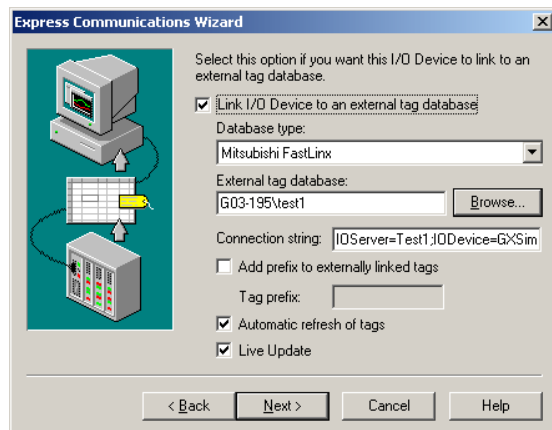
The tag import/export feature saves valuable configuration time because a group of tag definitions can be imported in one simple operation. Equally important is the elimination of typographical errors associated with transferring tag definitions. It is quick, convenient and accurate!

### **Automatic Synchronization**

The automatic tag synchronization feature ensures that changes made to controller tag definitions at the PLC level are automatically updated in MX4. By permanently linking MX4 tags to GX IEC Developer, changes made at the controller are automatically updated in MX4. To protect data integrity, the synchronization process is triggered on actions in MX4 — such as “Insert Tag”. These triggers cause MX4 to check the controllers to see if changes have been made, and if needed, will update MX4’s tag database. To prevent changes being made in MX4 and then overwritten on the next update, tags that are automatically refreshed have several fields set to read-only. For example, data fields are set to read only while other fields, such as engineering units and display formats are defined in MX4. By modifying the ASCII format file for each tag import driver, users can define which fields are read-only.



The import tags utility is accessed from the Tools menu in the MX4 Explorer



## **Internet Clients**

MX4 gives flexible access to remote plants, mobile laptop users and suppliers via the Internet.

MX4's Internet Clients allow all users throughout an enterprise to take advantage of real-time information by providing easy access to the SCADA system. These clients provide full system functionality via Internet and are a powerful, easy way to access MX4 from remote locations either as a Display Client or a Manager Client. With full functionality, you can display real-time data, change set points or even acknowledge alarms off-site. The Internet Clients have been designed for real-time operation. Screen update times vary between 1-5 seconds depending on connection speed. The small footprint downloads over the Internet, updates quickly, and caches pages intelligently. Using a standard browser, remote users simply point at the MX4 Server, click, and the program self-installs. Full remote functionality is never more than a few mouse clicks away. Choose between using the Web Client or Internet Display Client.

## **Web Client**

The MX4 Web Client is a zero maintenance, fully functional client that is viewed using Internet Explorer. MX4 provides one-click deployment to either a local or enterprise Internet Server.

## **Internet Display Client (IDC)**

The IDC is a fully functional interface that runs as a separate application using web technologies to transfer data from the SCADA system.

## **Security**

The Internet Server uses advanced firewall and encrypted password protection technology to ensure secure Internet operation. Access will be denied to Internet Clients without password authorization or when the number of Internet Clients using the server exceeds the MX4 Server license.

## **Operation**

Connect to the Internet, start up the Internet Client, and connect to your MX4 Server with your security password. You are now live on the system. The Internet Client will download and cache pages as they are requested. Unlike HTML applications, MX4 Internet Clients cache real project graphics from the server and deliver full functionality. Depending on your application, it may take a little longer to cache your graphic, but neither your functionality nor graphic quality are compromised. Once the page is cached, the client uses TCP/IP and the Internet/Intranet to update information.

## **Add flexibility**

Internet Clients add flexibility and convenience to managing plant operations. Current MX4 users can monitor the operation from any Internet/Intranet supported location. It is economical to add access for all users (maintenance, QA, etc.) because server based licensing means you only pay for concurrent users. Applications are numerous: Mobile users Remote users Suppliers Remote plants Special users Regardless of network limitations, MX4 can be extended to users over the Internet.

## **Automatic Synchronization**

MX4 automatically compares file dates in the cache with those on the server. If the server's files have changed, the new files are automatically downloaded to the Client.

## **Licenses**

Internet Clients are available as Manager and Display Clients. The Display Client provides full functionality. The Manager Client is granted "view only" access. The MX4 Internet Server monitors license usage and, depending on the number of purchased licenses, allocates licenses to Clients as requested. There is no technical restriction on the number of Internet Clients. MX4's licensing is calculated on the number of MX4 clients connected to the server, not on the number of computers with MX4 software installed. The server based licensing makes Internet Clients an easy and convenient way to extend access to a wide range of remote users.



## Graphics

The graphics capabilities of your SCADA system are a critical factor in the overall usability. The graphics of MX4 allow you to quickly develop true colour, easy to use graphics that provide the operator with an intuitive, consistent user interface.

MX4's graphics are based on a simple set of objects, namely rectangles, ellipses, bitmaps, straight lines, freelines, polylines, text, symbols, and pipes. Associated with all these objects is a common set of object properties. These properties allow an object's behaviour to be directly linked to your plant variables. The movement, rotation, size, colour, fill, visibility, etc. of any object can be used to realistically mimic plant floor conditions, and commands and touch properties can be assigned so that the object can accept a variety of operator inputs. This approach quickly delivers impressive results — for even the most demanding applications. All objects are interactive, so your operator interface will be simple, intuitive, and flexible, and because graphics were developed with optimisation in mind, you can expect excellent runtime performance.



MX4 utilizes screen resolutions up to 4096x4096, which you can choose to suit the application. With these resolution capabilities, you can even use high quality images (scanned photos, etc.) to provide instant recognition of plant equipment.

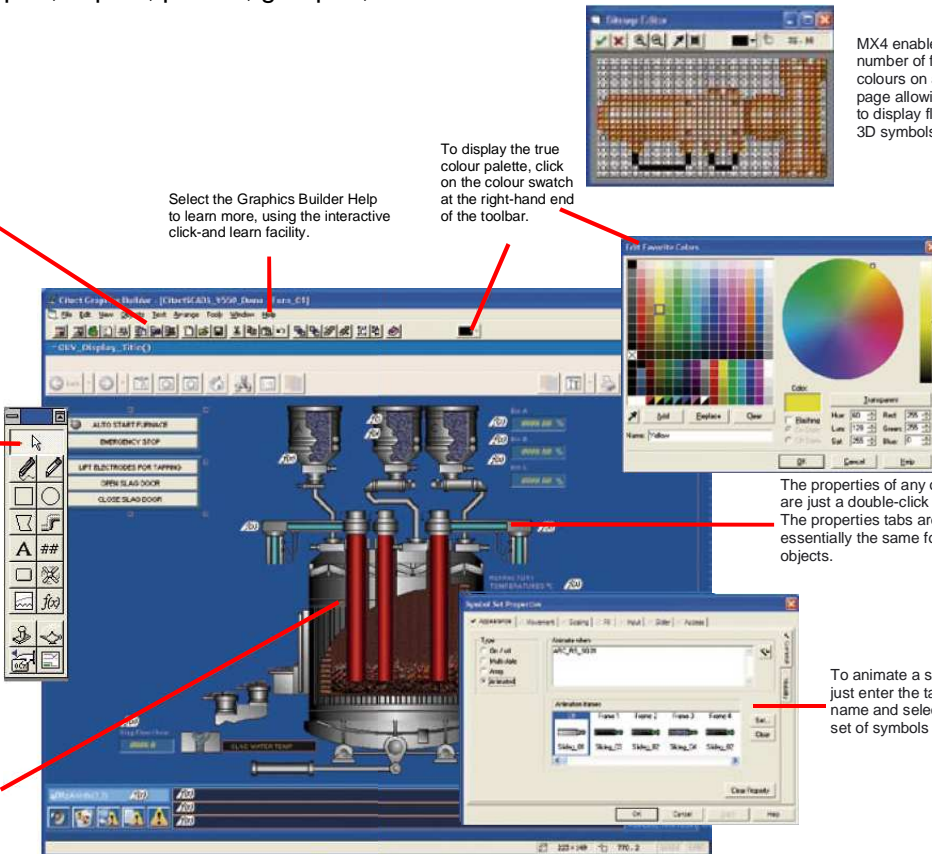
Symbol Libraries are also provided, loaded with commonly used graphics — like pumps, tanks, valves, and motors. These graphics will instantly add consistency and functionality to your screens.

## Benefits at a glance

- ❑ Complete flexibility
- ❑ Intuitive graphics reduce operator error
- ❑ Minimum operator keystrokes
- ❑ Increase learnability through clarity
- ❑ Blend control and display functionality into one object
- ❑ Efficient use of screen space

## Graphics Builder

The graphics builder allows you to quickly and easily design an intuitive operator interface for your MX4 system. Drawing operations are simple – select a tool then click and drag. Once drawn, objects can be moved, reshaped, copied, pasted, grouped, etc.



Because objects can be placed precisely using guidelines or the grid, your graphics pages will look professional and precise.

Objects can be locked onto a page so they cannot be accidentally moved or deleted.

Objects can also be rotated, mirrored, grouped, ungrouped, aligned, etc.

The Toolbox has the drawing tools that you use to draw your graphics objects.

All the graphics tools have their own tool tips and each is fully explained in the Online Help.

The Toolbox can be moved to any part of your screen, allowing you to take full advantage of the entire drawing area. If the Toolbox is to go unused for a short period of time, you can "roll" it up (so that only its title bar displays), or hide it altogether.

Nodes of lines, polylines and pipes can be moved, added or deleted

Select the Graphics Builder Help to learn more, using the interactive click-and-learn facility.

To display the true colour palette, click on the colour swatch at the right-hand end of the toolbar.

MX4 enables any number of flashing colours on a single page allowing users to display flashing 3D symbols.

The properties of any object are just a double-click away. The properties tabs are essentially the same for all objects.

To animate a symbol, just enter the tag name and select the set of symbols

## Graphics import

Import any of the following formats: Windows Bitmap (BMP, RLE, DIB) AutoCAD (DXF) — both 2D and binary Window Meta File (WMF) Tagged Image Format (TIF) JPEG (JPG, JIF, JFF, JGE) Encapsulated Postscript (EPS) Fax Image (FAX) Ventura (IMG) Photo CD (PCD) Paintbrush (PCX) Portable Network Graphic (PNG) Targa (TGA) WordPerfect (WPG) ActiveX objects

If the picture you want is already drawn, just import it. Simply import using click on the file and drag and drop it onto a page in the Graphics Builder if the source application supports this. Once imported, MX4 sees it as a Graphics object, with all of the associated configuration features and flexibility.

## Colour swapping

The colours in a graphics object can be changed automatically. This is particularly useful for 3D object manipulation. For example, a 3D green ball can be made blue at the press of a button, and the quality and illusion of depth remain the same.

## Bitmap Editor

Any graphics object (or group of objects) can be converted into a bitmap in one simple step. Bitmaps are edited using the Bitmap Editor. The Bitmap Editor is a tool that allows you to edit your bitmap pixel by pixel. Because you can zoom in and out, even the smallest details can be edited precisely. You can even change the size of the bitmap.

## OLE Automation

Graphics can be automatically generated from a database using the OLE Automation interface for the Graphics Editor.

## Page templates

MX4 provides templates for all common page types, so graphics pages are easy to create. Templates are tried and tested page designs that you can adapt to your own environment.

MX4 provides a comprehensive selection of templates. Alarm, Trend, and SPC display pages, come pre-built — all you have to do is add the relevant tag names, etc. More unique pages can be based on generic templates, such as the Normal template. No matter what template you use, the basic elements (borders, status bars, navigation tools, etc.) are already configured.

Page templates save time and effort because you don't have to draw each page from scratch. When you base a new page on a template, the page design is already complete, just enter the information that is unique to the new page. Templates are also useful when you need to make the same modification to a group of pages. If all the pages are based on the same template, just change the template. The pages will be updated automatically. If you take advantage of MX4's page templates, you will notice your project developing a consistent look and feel. Consistency reduces both operator learning times and operator error.

## Symbols

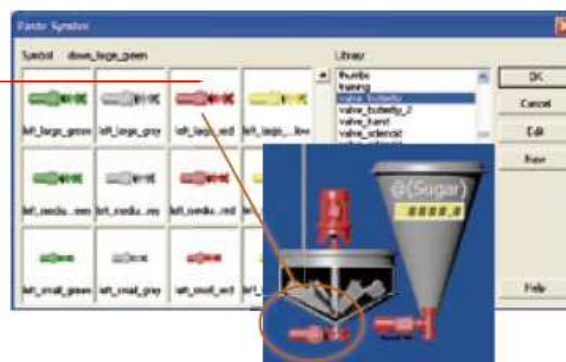
If you use a particular graphic regularly, you can store it in a library as a symbol. Rather than constantly redrawing the graphic, you can just paste the symbol from the library

You only need to draw an object once. You can then save it to a library (as a symbol), and use the symbol many times on any of your graphics pages. When you change a symbol, all occurrences of the symbol are updated automatically on all pages. A symbol remains linked to its library unless you deliberately cut the link. By storing common objects in a library, you reduce the amount of disk space required to store your project, and reduce the amount of memory required by the runtime system. MX4 comes with several pre-defined symbol libraries and a range of pre-defined symbol sets which can be used as real animations. When the individual symbols in the set are displayed in quick succession, a simple animation is formed. Animations can be used at runtime to indicate moving equipment, active processes, etc.

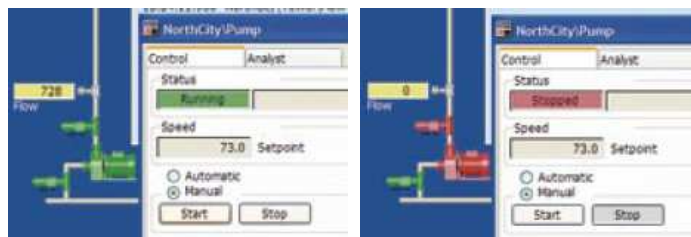
For example, if you need the same valve graphic on multiple pages as a static background picture, draw the valve, and copy it to the symbol library — it is now a symbol.



First check the standard symbol library shipped with MX4. If the symbol exists then simply paste it onto the page. If not, draw the required symbol directly into the symbol library.



Symbols can change dynamically based on the state of a device. For example, you could assign two pump symbols to a device, a green one for running and a red for stopped.



## **Object-based Configuration**

SCADA systems comprise objects or devices, ranging from simple pushbuttons, pumps, valves, loop controllers, PLCs or motor control centres. MX4 enables you to quickly and easily develop your control system by providing object-based configuration tools for development. In addition the use of object-based configuration reduces maintenance and ensures a consistent operator interaction. MX4 provides libraries that can be extended and customized or enhanced to suit the requirements for your project, or you can build your own. These tools are optimised by the use of a tagging standard within the device tags. A good tag naming convention reduces the amount of configuration entry and so lowers the risk of errors. Both internal and user defined libraries can be easily transferred between projects to leverage development or maintain a consistent corporate standard. Any modifications made to enhance these libraries can be seamlessly retrofitted within previous MX4 systems.

### **Genies**

Genies act as a macro within project development. The Genie is built to combine any number of individual graphics objects together. A pump may consist of the pump display plus an auto/manual indication and an alarm indication. All of these configurations are grouped together in a Genie. The configuration is made by combining fixed text with parameters. The parameters can represent a whole field alone or be combined with other parameters or fixed text to represent the contents of a field. Optional parameters can be provided to enable a reduction in the number of Genies resulting in reduced maintenance and testing costs. The optional parameters enable pumps without auto/manual control to hide this indication based on the fact that the auto/manual tag has not been defined. Each parameter is exposed when the Genie is added to the graphics page. The form used to display the parameters can be tailored to include additional help information for the user or to provide a drop down list from the devices within the database.

### **Super Genies**

Super Genies are most often used for device control pop-ups. Super Genies are a combination of any number of individual graphics objects grouped together on a page or pop-up. A loop control popup may have trend sliders, buttons, values, etc. These are defined as a single Super Genie and can be reused throughout the project. To enable reuse, the configuration is made in terms of assignments (or parameters) passed to the Super Genie when it is displayed. Each parameter represents a tag, value or string. The configuration can access both the values and the attributes of the tags passed to the Super Genies. A Super Genie can be provided a fixed set of assignments from a Genie or use a tagging convention to turn a single device name into a set of assignments. Code can also enable these parameters to be read from other sources (databases, files). To reduce the number of Super Genies within a project, non-existing tags can be replaced by default values. Users can also pass text strings into the Super Genie for use as titles, display information or within logging.

### **Benefits of Genies and Super Genies**

You only need to draw and configure an object once, then save it to a library and use it over and over again. When you change a Genie or Super Genie from the library, it will be automatically changed wherever you have used it throughout your project. (A Genie remains linked to its library unless you deliberately cut the link). Like Symbols, Genies and Super Genies save runtime memory and disk space, because you only save one copy of the actual configured object. MX4 has a library of pre-configured Genies and Super Genies that you can use.

#### **Examples of Genies**

- Pumps
- Valves
- Values (with input)
- Tanks
- Conveyors
- Faceplates (on graphics screens)
- Any repeated configuration

#### **Examples of Super Genies**

- Device Pop-ups
- Loop Control
- Sequence Control
- Duty/Standby
- PLC/RTW Status
- Identical Machine Control
- Any repeated popup or page

## Operations

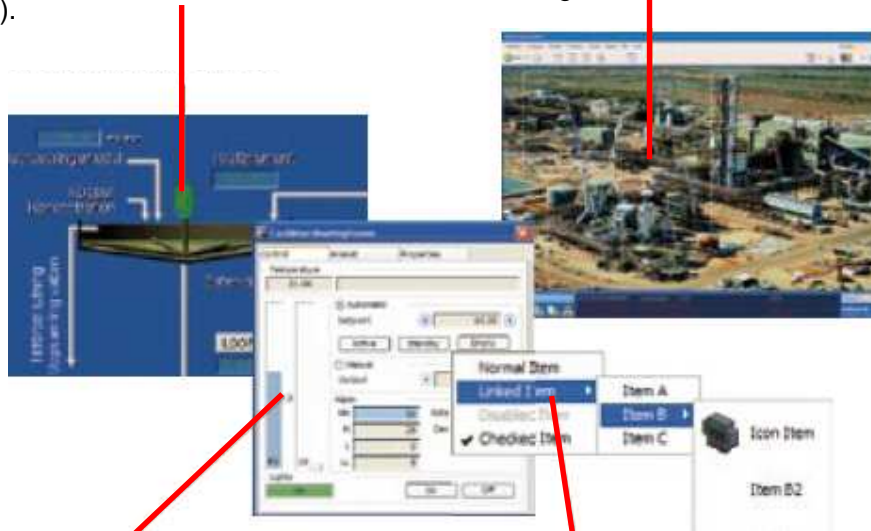
MX4 provides users with a range of pre-defined system pages and templates to get you up and running fast. System pages are included for trends, alarms, administration tools and the Process Analyst, which are available in a variety of templates. Both system pages and custom graphics utilize a variety of user-friendly commands and controls for operators to interact with the MX4 runtime. You can assign privileges to the different commands and controls as well as send a message to the command log each time an operator issues a command.

### **Touch Commands**

Touch Commands can be assigned to any graphics object, including button objects. They are activated when the operator clicks on the object. Separate commands can be activated when the mouse button is pressed (down), released (up), and held (repeat).

### **Screen Targets**

Screen targets are a hot-spot region on the background screen which the operator can click on (like a button). These invisible buttons allow for greater flexibility in operator interface design.



### **Sliders**

All graphics objects (rectangles, ellipses, etc.) can be defined as sliders. Sliders allow operators to change the value of analog variables by changing the position of the slider object. For instance, a set-point value might increase as you move a slider up, and decrease as you move it down. Sliders can move left to right, up and down, and they can even rotate. If runtime conditions change the value of the variable, the slider will automatically move to reflect the new

### **Popup Menus**

Popup menus simplify navigation and can also be used to trigger Cicode or CitectVBA functions. Popup menus can be disabled, checked or linked to other menu items.

### **Keyboard Commands**

Global (or system) keyboard commands can be issued from anywhere in the runtime system. Page keyboard commands can be issued only from the page for which they are configured. Object keyboard commands can only be issued when the mouse pointer is positioned over the object.

## **Process Analyst**

This allows operators and process engineers to analyse the cause of process disturbances by bringing together trend and alarm data, which are traditionally stored separately. With the Process Analyst, users can view them all on a single integrated display. Pens can be displayed with complete flexibility, for example they can be overlaid or stacked and any pen can be placed in different panes to reduce clutter and improve readability. The Process Analyst includes many unique features including true Daylight Savings Time support, accuracy to millisecond resolution, individual time axis per pen, customisable toolbars, rich printing and saving of all display settings for easy recall.

### **Examples of use**

#### **Root Cause Analysis**

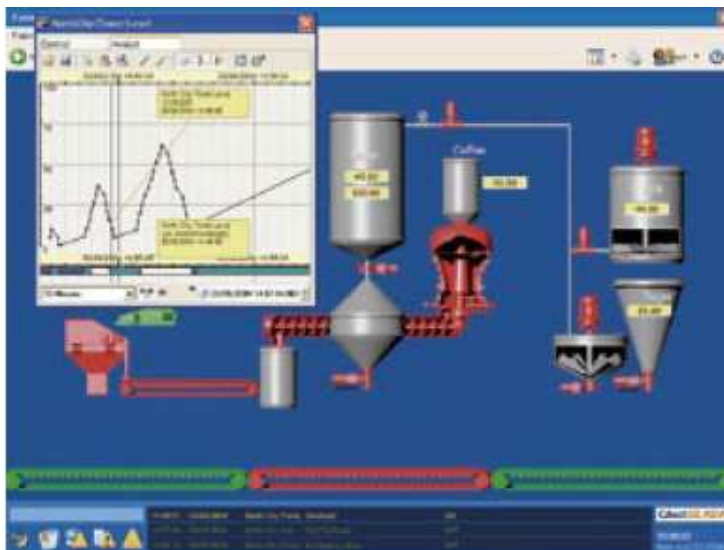
When a process upset or disturbance occurs it is always time consuming to have to find the root cause. In the past the process engineer had to compare trend data from the screen with alarm logs. With Process Analyst, all the engineer has to do is simply add any pen (analog, digital, alarm) that could have contributed to the process upset to the display. Each process change can then easily be compared as alarms occur, enabling sophisticated analysis of the process upset.

#### **Compare Different Batches**

With Process Analyst it is easy to compare different batches in a single integrated view. Simply place all the variable tags, alarms and state changes for a batch unit on one pane, and the same set on a separate pane. Then the operator simply has to scroll one of the panes through time. Any differences in the batch execution will immediately be visible.

#### **Sequence of Events**

With SCADA systems, the data is distributed around a wide area and typically the RTUs collect the data at millisecond resolution and send it to MX4 every polling cycle. Process Analyst displays historical alarms and trends to millisecond accuracy, for easy determination of the event sequence.

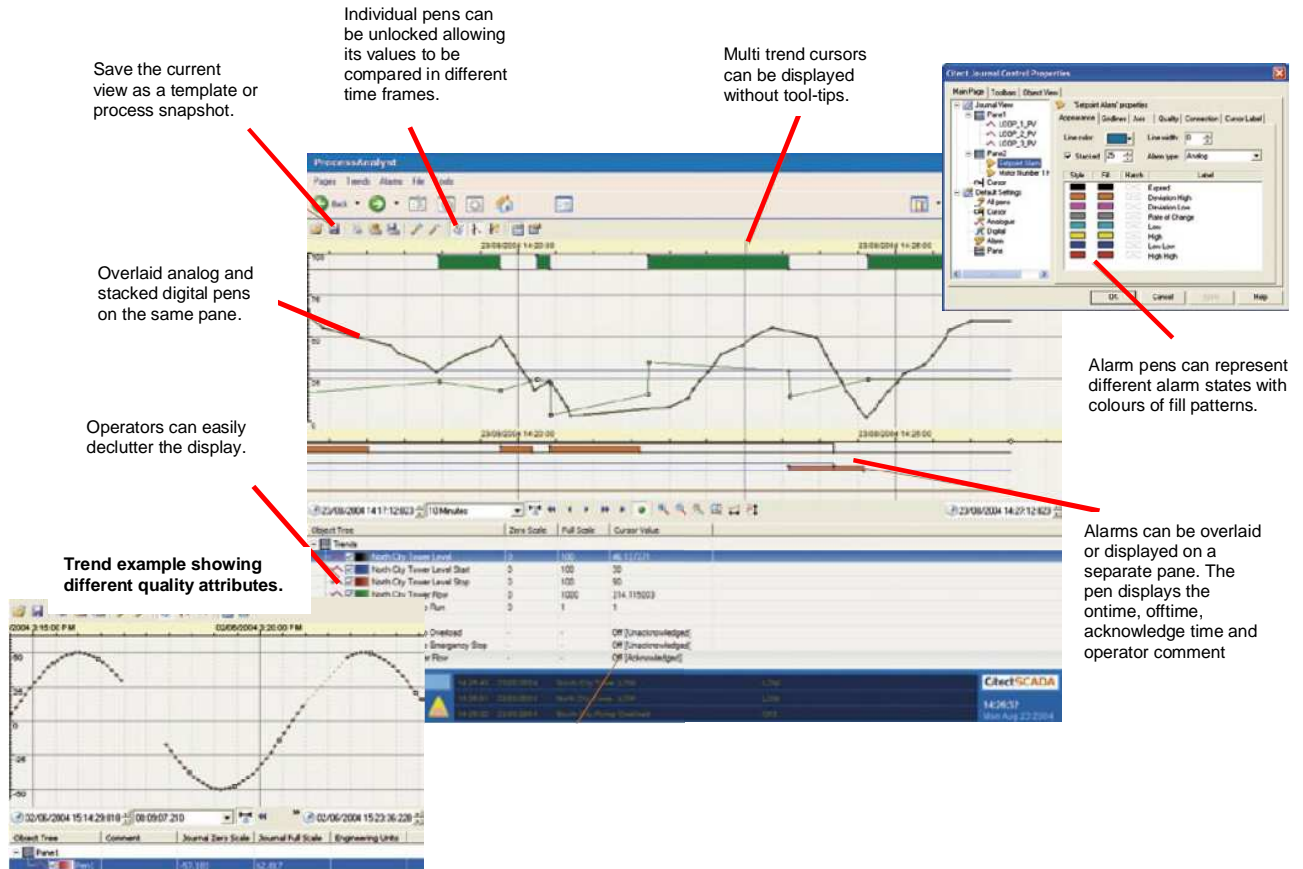


### **Easy to use**

Process Analyst's capability to display such rich information requires it to have an easy to use, yet powerful navigation system. Every pen added to the Process Analyst has a number of properties including: Pen Colour and Name Tag properties such as Engineering Units, Scales, etc. Cursor Values (multiple cursors are available) Data average / minimum / maximum. The information available is customisable, allowing you to add or remove any of the standard column types (e.g. Engineering Units), and also add custom columns.

**Customisable**

Users can select which buttons to appear on each instance of the Process Analyst. The security access required can also be defined and users can add custom buttons for additional functionality.



Individual pens can be unlocked allowing its values to be compared in different time frames.

Multi trend cursors can be displayed without tool-tips.

Save the current view as a template or process snapshot.

Overlaid analog and stacked digital pens on the same pane.

Operators can easily declutter the display.

Trend example showing different quality attributes.

Alarm pens can represent different alarm states with colours of fill patterns.

Alarms can be overlaid or displayed on a separate pane. The pen displays the ontime, offtime, acknowledge time and operator comment

**Chart Journal Control Properties**

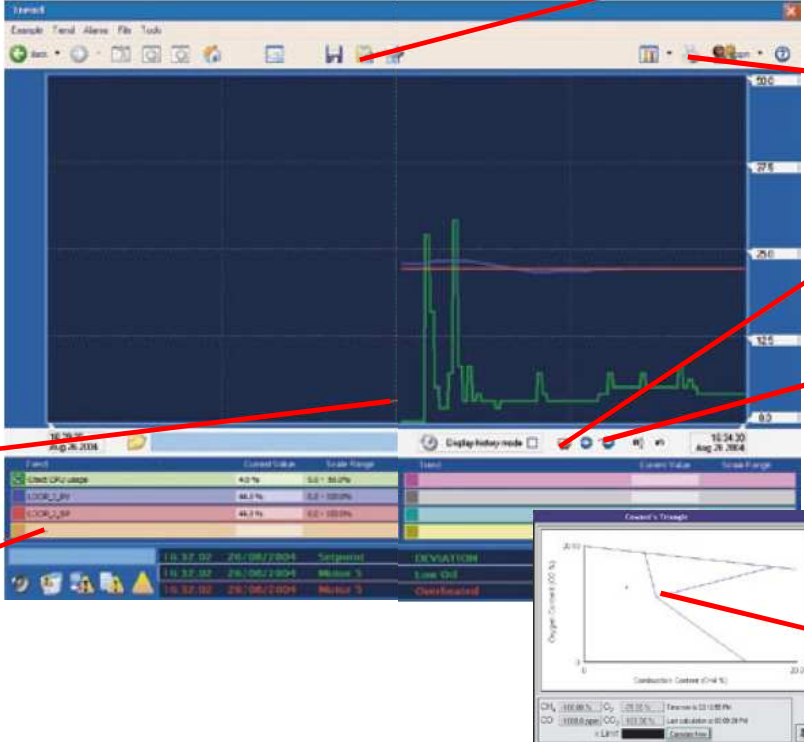
Journal View

- Journal View
- Annotations
- Default Settings
- Color
- Line Color
- Line Width
- Line Style
- Annotation
- Line Color
- Line Width
- Line Style
- Annotation
- Line Color
- Line Width
- Line Style
- Annotation

Style	Fill	Mark	Label
...	...	...	Event
...	...	...	Deviation High
...	...	...	Deviation Low
...	...	...	Rate of Change
...	...	...	Low
...	...	...	High
...	...	...	Low Low
...	...	...	High High

## Trend Pages

Any plant floor variable can be logged and trended. A trend builds a picture over time of how the variable (product output, level, temperature, etc.) is changing or how a device or process is performing. Trends are created from a selection of sample values. The sample values are plotted against time, and the resultant graph gives you an indication of process behaviour. Trend samples can be taken periodically, or when specific events occur in your system. Sampling rates can be as low as 10 milliseconds, and as high as 24 hours. MX4 comes with a host of readymade trend templates, allowing you to quickly create trend graphs complete with navigation tools and dynamic readouts from the plant floor. You can display trends in single, double, or popup windows, but if you feel that you want something specific to your system, you can easily configure it yourself, with your own functions and trend pens.



Copy trend data to the clipboard, ready for pasting into third party applications (in table format), such as Excel, Word, etc.

Print the trend data in intuitive color or black and white plots. You can also integrate trend plots into reports.

Change the resolution and span time of the graph while it is running.

Select an area of the graph, and press the Zoom button to magnify it.

As the values of variables change over time (or as events occur), the graph moves across the page — the latest values are always displayed.

CitectSCADA trends give you the flexibility to define your trend pens while the project is running.

The X,Y plot feature is very flexible, allowing you a high level of customization. You can display your plots on screen or as a printout — using the full color palette.

MX4 trends are a seamless combination of real-time and historical data. When you display a MX4 trend page, you can monitor the current activity as it happens, and simply scroll back through time to view the trend history. MX4's trend task is client-server based. The Primary Trend Server collects and records the trend data, sending updates to a Standby Trend Server (if one exists) as requested. When a trend is displayed on a client computer, the client has only to request the necessary trend data from the Primary Trend Server. You can choose to have redundancy by allocating a Standby Trend Server (using a wizard). If the Primary Trend Server fails, the Standby will instantly assume its role, obtaining data directly through the I/O Server and responding to all client requests. Because the Standby Trend Server tracks all trend data, even when the Primary is operating, no data is lost if the



Primary fails. When restarted, the failed computer receives updates from the new Primary Server, and becomes the Standby Trend Server.

**Features**

- Seamlessly combines real-time and historical data
- Runtime variable (pen) selection
- Runtime time base (period) selection
- No limit on trend variables
- Millisecond resolution
- Instant trends allow the user to view trends of any variable tag even if trend tags are not defined
- Display Mode (stretch/condensed) selection
- Concise trend plotting
- Multiple pens per graph per page
- DBF, CSV and ASCII data formats
- Client-server architecture
- Data can be stored as Scaled (2 byte) or Floating Point (8 byte) format

## **Fast and Reliable Alarms**

All alarms are processed and managed by a MX4 Alarm Server. Any MX4 Display Client can display alarms and acknowledge alarms. This eliminates duplicated processing, ensures that alarms are acknowledged system wide, and provides for server based security checking. Configurable Alarms report fault conditions in your plant. Variables, groups of variables, expressions, calculation results, etc. can all be monitored by the MX4 alarm system. Working in conjunction with the I/O Device, MX4's alarms are time-stamped, with precision to 1 millisecond. This can be essential when differentiating between alarms that occur in rapid succession. Millisecond precision allows you to determine cause/effect relationships between alarms. Quick recognition and identification of alarms is important. MX4 displays alarms on dedicated alarm pages, but the most recent alarms are always visible on every page. Alarms can be organized by colour, font, and order, according to priority, category, or time of occurrence. For an account of all alarms that have occurred on your system, the alarm summary page provides a complete history. MX4 also continually runs diagnostic routines to check both its own operation and all peripheral equipment, such as I/O Devices. This facility is fully integrated within MX4, and no configuration is necessary.

There are often many alarms that trigger simultaneously. MX4 has been designed and tested to make sure that it will capture and log every single alarm — even in very large systems. You can specify the action to be taken when the alarms are triggered (e.g. activate an audible alarm such as a .WAV file). To assist operators in dealing with alarms, you can create graphic help pages that contain information about the alarms, such as the action an operator must perform to correct the situation. You can display these pages automatically when the alarm occurs, or only when an operator specifically requests help.

### **Alarm Properties**

Alarm properties can be used to change the appearance of your graphics objects — when a specific alarm occurs, you might change the colour of a symbol from green to red, or display a 'danger' icon.

- Alarm Tag, Alarm Name, Alarm Description
- Alarm Category, Help Page, Area, Privilege
- Disabled, Acknowledged, Unacknowledged
- On Time, Off Time, On Date, Off Date, Alarm Duration, Acknowledged Time/Date
- Operator Definable Comment
- Alarm State for High High, High, Low, Low Low, Rate, Deviation
- Value of the variable and the alarm deadband (hysteresis)
- Custom Filters

### **Alarm filters**

A good alarm system should not overwhelm operators with excessive alarm information. MX4 allows the operator to filter alarms based on any alarm property. Filters can be saved and automatically loaded based on the current user.

### **Features**

- Analog, digital, SPC, and custom alarms
- Integrated Hardware/ Diagnostic alarms
- No limit on configurable alarms
- Millisecond resolution
- Configurable display formats
- Summary/History logging
- Filter is customisable by any alarm property
- Acknowledge from any network computer
- ODBC, DBF, CSV and ASCII data formats
- Support for RTU based alarms

## Integrated Reports

A report is a statement or account of plant floor conditions that you can run periodically; on request, or only when an event occurs (such as a change of state in a bit address, when MX4 starts up, or at a specified time of day).

Reports can be generated in any format you want. They can include formatted text, current and historical data, and even the results of calculations. They can also contain operating instructions — to change operations or variables within your plant, download instructions, perform diagnostics, change recipes, etc. Reports can be displayed on a page at runtime, printed when the report runs, or saved on disk for printing or display at a later date. You can use a text editor or word processor to view, edit, or print these reports. Your reports can be saved in HTML format, so that they can be viewed over the Internet, using a standard web browser.

## Accumulators

Accumulators are an easy way to keep track of incremental runtime data such as motor run hours, power consumption, and downtime. You set a trigger (e.g. motor on) to increment three counters:

- The number of times the accumulator is triggered (e.g. start times for the motor)
- The run time in steps of 1 second
- The totalised value, by a value you define (e.g. the current)

## Events

Events can be set up so that they trigger actions when they occur. For instance, when a process is complete, an operator could be notified and a series of instructions could be executed. You can run an event:

- Automatically at a specified time and period
- Automatically when a trigger condition becomes TRUE
- Automatically when a trigger condition is TRUE at a specified time and period

## Shift Report

Wednesday, 23 November 2005

Total milk in:	336150	L
Total starter in:	3090	L
Total Milk and Starter in:	339230	L
Production Time Forward:	656	mins
Production Time in Divert:	10	mins
Total Production Time:	666	mins
Number of Diverts:	8	diverts
Number of Vats:	22	vats
Total Cheese Weight:	23441.92	Kg
Total Number of Blocks:	1272	blocks
<b>Yield:</b>	<b>0.069</b>	<b>Kg/L</b>

## Grower Status

Date: Friday, Nov 25, 2005

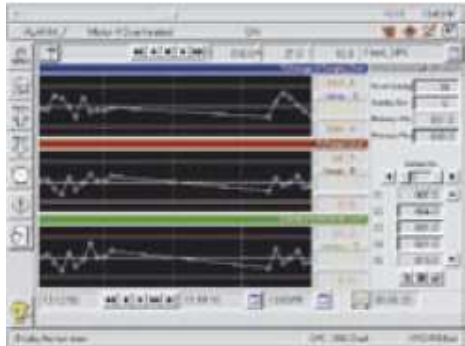
Run No.	Batch No.	Merchant	Processed Modules	A/V Turnout
66	13	ADF	8	36.52%
66	13	ADH	2	39.77%
67	14	ADF	6	37.28%
67	14	ADH	2	38.41%
68	15	BBF	10	39.60%
68	15	BBF	4	36.88%



## Statistical Process Control

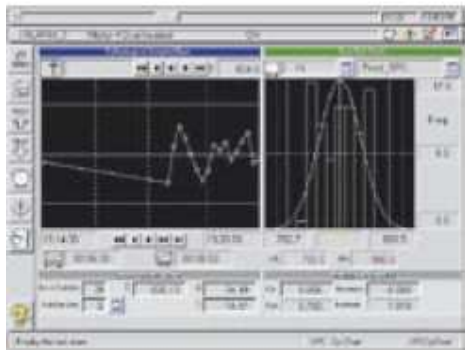
For an easy to understand graphical indication on product quality, you can use SPC charts. Prevent out of limit deviations before they happen with MX4's easy-to-understand SPC charts.

MX4 provides the three types of charts most commonly used for statistical analysis.



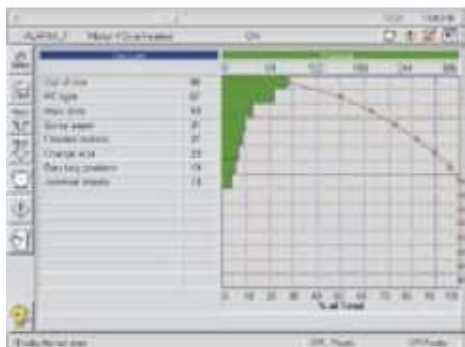
### **Control (XRS) Charts**

Control (XRS) charts allow you to analyse the variations in plant data. You can configure charts to individually display the mean, range, or standard deviation, or all of the above.



### **Capability Charts**

You can use capability charts to determine whether your process is meeting your specifications. MX4 is pre-configured to arrange the data and make all necessary calculations.



### **Pareto Charts**

If you would like to analyse the frequency of faults and problems, use a Pareto chart. After you specify which values to watch, MX4 will arrange the data and draw the graphs in runtime.

### **Features**

- ❑ Mean, Range, and Standard Deviation (XRS)
- ❑ Pre-configured calculation routines
- ❑ Template based pages (easy configuration)
- ❑ Capability charts
- ❑ Pareto charts

SPC Alarms are integrated into the alarming system

## **Multilanguage Projects**

A single MX4 project can be run in any number of languages. This means you can accommodate the languages of your customers without configuring multiple projects, so both your customers and your productivity will benefit.

No matter where your project is bound, or who is going to use it, you only need to configure it once. Speakers of all languages can just run the same project. This is particularly useful for anyone distributing or implementing control systems internationally (OEMs, etc.).

At the touch of a button, operators can view the project in their preferred language. You can even switch languages at runtime!

For instance, at any point in time, one Display Client could switch the running project from Chinese to English, while another is running it in French, another in German, and so on. The important thing to note is that each Display Client is running exactly the same project. A new language can be added while the system is still running, and you can switch to it immediately — without shutting down.

### **Features**

- ❑ One project, multiple languages
- ❑ Runtime switching
- ❑ No language limit
- ❑ Single and double byte characters
- ❑ Different languages on each Client

### **Online Help**

All MX4 dialogs have a Help button that invokes context sensitive help. For more general information, you can use the Help menu. It gives you direct access to the Help Contents and the Help Guide, as well as application specific information, such as the click-and-learn facilities. Of course, you can always just press the Help Topics button to the right of the toolbar, and display the Contents. Once the Help is open, you can perform index or keyword searches or browse the 'Help Direct' topics. No matter what kind of information you require, the MX4 Online Help provides the tools to find it. MX4's online Help Index operates using standard Windows functionality. To find the information you need, just type part of a key word — the keyword list scrolls automatically to the closest match. You can also do a full text search using the Find facility.

### **Example Project**

Two example projects are supplied with MX4 based on different templates. These are fully configured projects that are ready to run and can be used for ideas on how to configure your own project.

The Example Project is automatically installed when you install MX4. You can use the Example project when you want to experiment with something before including it in your own project. The test page is already set up to display directly from the menu page. The Example Project is provided complete with the ability to switch online between the following languages:

Afrikaans	English	German	French
Norwegian	Polish	Spanish	Swedish
Zulu	Russian	Chinese	Hungarian
Japanese	Korean	Dutch	

## **Software Licensing**

MX4's licensing is based on the number of computers that will be running MX4 at once, not the number of computers with MX4 installed. So, if MX4 is installed on 100 computers, but no more than 15 run it at any one time, you only need 15 licenses. The price of each license is determined by a number of factors:

### **Point count and Limit**

A point is an individual digital or integer variable, read from an I/O Device. MX4 only counts points from the I/O Device once, no matter how many times they are used in your project. You get memory, disk, and Cicode variables free of charge. The point limit is the maximum number of I/O Device addresses that can be read. MX4 caters for any point limit, from 75 to unlimited.

### **Computer role**

In networked applications, not all MX4 tasks are used on each computer. Since you should not have to pay for what you do not use, you have the option to purchase Display and Manager Client licenses instead of a full license. A computer with a Display Client license is able to perform all operator interface functions and exchange data with servers, but it cannot be a MX4 server. A computer with a Manager Client license provides read only displays — perfect for just monitoring a process.

### **Single vs. Multi User**

MX4 licenses can be supplied as single user or multi-user. Multi-user licenses allow anyone on the LAN or WAN to run a session of MX4. This means you can use any PC to run MX4 without having to install a software or hardware protection key on every PC. It also means you can access any information from any computer.

### **No risk trial**

Concurrent licensing Manager Clients Hardware or Software protection keys Internal Variable Tags – free If you want to try MX4 for yourself, you can obtain a fully functional evaluation pack from your distributor for a small fee, (to handle printing and shipping costs), or download it from our website at [www.mitsubishi-automation.com](http://www.mitsubishi-automation.com). The evaluation pack is exactly the same as a licensed pack, (including the software and manuals), but projects will run for a limited time only. The configuration environment, on the other hand, can be utilized for as long as you want. Feel free to use the evaluation pack to build a trial project — to test the runtime and communication capabilities of MX4 as introduced in this document.

## Quick Lookup of Key features

### ARCHITECTURE

#### Scalable

- Configuration free system growth
- Unlimited project size
- 255 simultaneous connected clients
- LAN / WAN Support
- Web ready without configuration
- Support for low bandwidth operation
- Support for clustered systems

#### Flexible

- True Client/Server Architecture
- Alarm, Trend and Report Servers scalable across arrays of servers
- Project files centralized for maintenance, distributed for remote sites or a mix of both
- Changes in a single location
- Support for low bandwidth operation
- Support for existing and emerging standards

#### Reliable

- Built-in Primary/Standby level
- File Server Redundancy
- LAN Redundancy
- Alarms Server Redundancy
- Trend Server Redundancy
- Report Server Redundancy
- Multi-level I/O Server Redundancy
- Automatic server swap
- Automatic trend history synchronization
- Automatic alarm table synchronization
- Automatic time synchronization
- Secure

#### Performance

- Maintain performance regardless of size
- Low CPU and Memory requirements
- Low network utilization

#### Security

- Based on individual users as well as groups of users
- 250 simultaneous logged in users
- Unlimited number of user names definable
- Definable area and privilege profile per user name

### I/O COMMUNICATIONS

#### Connectivity

- Support for open standards
- Multiple protocols per I/O server
- Drivers work on RS232, 422, 485, TCP/IP
- Driver set-up in 60s
- 255 simultaneous connected clients
- 4096 I/O devices per system
- Dial-In/Out support for remote devices
- Driver Development Kit for custom protocols
- Mitsubishi Drivers at no additional cost

#### Performance

- Dynamic optimisation of all drivers
- Data read on demand
- 100,000 integers per second update from an I/O device

#### TAGS

- Unlimited number of tags
- 80 Character Tag Name
- Support for Quality and time stamp

#### FastLinX

- Single database solution for PLC and SCADA
- Bi-direction synchronization with PLC development environment
- Static synchronization for offline development

#### Import

- Automatic importation and synchronization
- Import from multiple PLC types
- Add user defined importation schema

### GRAPHICS

#### Development

- Unlimited screens
- True Colour screens
- Easy pick colour selector with names colours
- Transparent colour support
- Advanced animations without coding
- Animation of symbols sets based on tag data
- 32,000 animations per page
- Unlimited Flashing Colours
- Support for multiple languages
- 3D pipe tool
- 3D effects (raise, lower, emboss)
- Import graphics
- Windows Bitmap (BMP, RLE, DIB), AutoCad (DXF), Encapsulated Postscript (EPS), Fax Image (FAX), Ventura (IMG), JPEG (JPG, JIF, JFF, JFE), Photo CD (PCD), PaintBrush (PCX), Portable Network Graphics (PNG), Targa (TGA), Tagged Image Format (TIFF), Windows Meta File (WMF), Word Perfect (WPG)
- Unlimited undo

#### Templates

- Over 70 templates in multiple styles and at multiple resolutions are provided
- Templates are extensible in the graphics builder
- Templates can contain animations
- Changes in templates are replicated to all pages

- Templates are transportable between projects

#### Symbols

- Over 800 symbols provided
- User defined symbols can be developed in the graphics builder
- Symbols can contain animations
- Changes in symbols are updated to all instances
- Symbols are transportable between projects

#### Object-based Configuration

- Unlimited number of objects defined as Genies and Super Genies
- User defined Genies enable user defined plant equipment to be placed on the screen
- User defined Super Genies enable a single user interface for multiple devices
- Genies and Super Genies can accommodate variations in the device tags without needing further development

#### Runtime

- 4096 x 4096 resolution
- Resizable screens (Isotropic and Anisotropic)
- Multi-monitor support
- Page selectable update times (min 10ms)
- Communication loss display
- Runtime language swapping
- Support for single and double byte character sets

#### Security

- Security level can control:
- Visibility of objects
- Access to graphic displays
- Acknowledge of alarms
- Running of reports
- System utilities

**OPERATIONS****Controls**

- Touch commands
- Mouse over detection
- Keyboard commands of system, page or animation level
- Sliders in one or two dimensions

**Process Analyst**

- Combine alarm & trend data
- 32+ pens
- 4+ panes
- 2+ cursors
- Stacked or Overlaid pens
- Display of data quality
- Analogue & Digital Pens
- Alarm Acknowledge displayed
- Alarm Description ( analog and multi-digital )
- Alarm Comment display
- True Daylight Savings support
- Save views at runtime
- Views stored in redundant locations
- Display different time periods
- on the same display
- Customizable and
- Extensible controls

**Alarms**

- Unlimited number of alarms
  - Centralized processing of alarms
- Alarms can be defined as:
- Digital
  - Analog
  - Time-stamped
  - High level expression
  - Multi-Digital
  - Time-stamped digital
  - Time-stamped analog
- On-line change of language for all alarms
  - Network acknowledge without configuration
  - Network disable without configuration
  - Category, area and priority of alarms
  - Alarm Delay
  - 1ms precision of time stamped alarms
  - Variable data in alarm messages
  - Acknowledge individually or in group
  - Acknowledge based on category or priority
  - Acknowledge graphically, in alarm list or through Cicode
  - Alarm sorting
  - Alarm filtering
  - Custom alarm fields

**Trending**

- Unlimited number of trends
- 16,000 trends per page
- Display any historical trend in less than 1 sec
- Control of trend file sizes
- View archived trends transparently in the running trend system
- Resolution user selectable from 1ms<sup>2</sup>
- Compare trends

- Instant trends on any tag
- Event or periodic storage

**SPC**

- Cp & CpK Charts
- X, R & S Charts
- Pareto Charts
- Adjustable subgroup size & limits
- Alarms on the following Above UCL, Below LCL, Outside CL, Down Trend, Up Trend, Erratic, Gradual Down, Gradual Up, Mixture, Outside WL, Freak, Stratification and High Level expression

**Reports**

- Native report editor, WYSIWYN reports, Rich Text reports
- Triggered by: Time Schedule, External Event, High Level Expression, Operator Input
- Output to: Printer, File, Email, Screen, HTML

**CONFIGURATION****Project Development**

- Any size project
- Divisible into include projects
- Easy standards definition
- Easy project maintenance

**Code**

- True pre-emptive and multitasking
- Up to 512 concurrent threads
- More than 600 SCADA functions provided
- Libraries for user-written functions
- Capable of more than 2,700 user functions
- Local, module & global variables
- No additional software required to write own functions
- Direct access to trend data, report values and alarm details
- Syntax colouring
- Quick help as 'tool tip'

**Editor with:**

- Runtime breakpoints
- Variable watch
- Thread monitoring
- Colourcoding
- Breakpoints window
- Single stepping
- Current line indication
- Remote debugging (NT only)
- Automatic debug on error

**Date Exchange**

- OPC Server and Client
- ODBC
- OLE-DB
- CTAPI
- DLL
- MAPI (MAIL)
- TCP/IP
- SERIAL