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Pre-Reading

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1 Introduction to SCADA System Solutions

Citect is the largest independent supplier of industrial automation software and services in the world with a 6% market share. Citect focuses on a number of key markets including Food and Beverage; Mining, Metals and Minerals Processing; Manufacturing and Facilities Monitoring.

This document is about the technical basics required by sales personal and engineers to be able to advise customers on the most appropriate solution for their application.

You will learn about all the components required to create a SCADA solution and how they fit together. The following subjects form the basis of this module:

- IO Devices
- Drivers
- Vijeo Citect Project Design
- Citect Client/Server
- Networking
- Redundancy
- Security
- Software Licensing

2 I/O Devices

An I/O Device is item of equipment that communicates with plant-floor control or monitoring equipment (sensors, controllers, etc).

The most common I/O Devices are PLC's (Programmable Logic Controllers), however Vijeo Citect supports a wide range of I/O Devices, including loop controllers, bar code readers, scientific analysers, remote terminal units (RTU's), and distributed control systems (DCS). Vijeo Citect can communicate with any I/O Device that has a standard communications channel or data highway.

2.1 Communicating with I/O Devices

I/O Devices can be classified into two distinct categories for their communication connection method with Vijeo Citect: - Local or Remote.

- Local I/O Devices are directly connected to a Vijeo Citect I/O Server.
- Remote I/O Devices are connected to Vijeo Citect via an intermediate communications means (radio link, modem and phone line, etc).

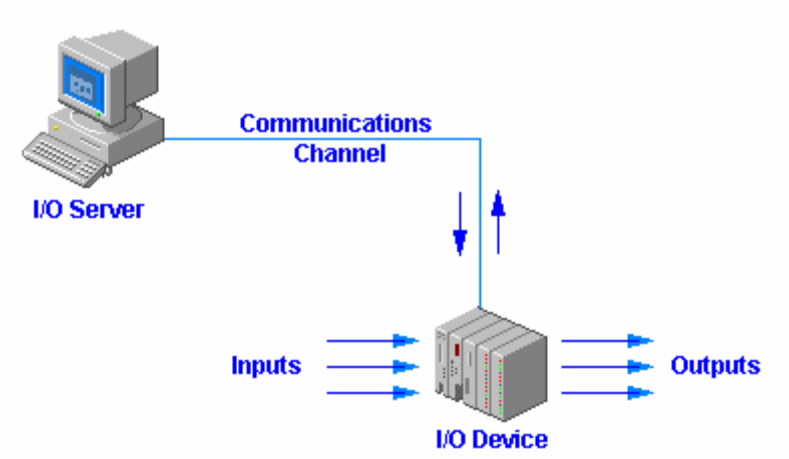
Both of these types can be configured to be permanent, periodic, or on request.

2.1.1 Local

Vijeo Citect communicates directly with the I/O Device(s) in your plant or factory. There are three major components in this system:

- The Vijeo Citect computer (I/O Server)
- The Communications channel
- The I/O Device

To enable Vijeo Citect to communicate with an I/O Device you need a device driver. This is the interface between Vijeo Citect and the I/O Device, which implements the communication protocol(s) of the I/O Device.



Inputs to the I/O Device provide information about your plant, such as the location of a product, speed of a machine, status of a drive, or temperature of an oven. Outputs from the I/O Device usually perform the tasks required to operate your plant, such as starting electric motors or varying their speed, or switching valves and indication lamps. In some I/O Devices (such as PLC's), a program stored in the I/O Device controls the

outputs. The logic (control strategy) of this stored program and the status of the inputs determine the value of each output.

The value of each input and output is stored in a separate memory register in the I/O Device. Each memory register is referenced by its address.

By reading and writing to memory registers in all your I/O Devices, Vijeo Citect collects data from your plant or factory for monitoring and analysis, and provides high level (supervisory) control of your equipment and processes.

You do not usually need to read (or write to) all registers in the I/O Device, and Vijeo Citect provides a project editor for you to specify the inputs and outputs that you want to monitor or control. Once you have defined these register addresses, you can use them for system control, operator displays, trend analysis, data logging and alarm indication.

2.1.2 Remote

Vijeo Citect allows you to schedule communications with your I/O Devices (regardless of the type of connection - modem, radio link, etc.). For example, if you have multiple I/O Devices on a single network or line, you can schedule reads so that critical I/O Devices are read more often than non-critical I/O Devices. Alternatively, a water supplier with radio link connections to dam level monitors might schedule hourly level reads from Vijeo Citect in order to conserve bandwidth.

Scheduled communications will only work for drivers that are designed to handle Report-By-Exception protocols.

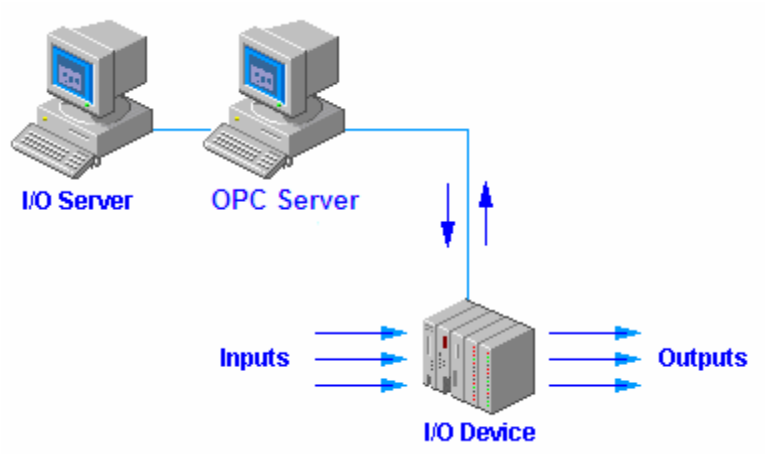
Whenever an I/O Device is actively communicating (as per its schedule), you can write to it directly. However, if you try to write to it when it is not communicating, your write request will be queued. Your display will not be updated with the change until the write has actually been performed at the I/O Device. For example, you might decide to schedule one write per hour. If someone at a Display Client changes a tag's value during that hour, that change will not be written to the I/O Device until the hour has expired. It is possible to set up your I/O Devices so that communication is initiated whenever the I/O Server receives a write request. To do this, you must use the IODeviceControl() function.

It is not advisable to control hardware using a scheduled I/O Device, as the exact state of the hardware may not be known. Although you can read the state from the cache, it may have changed since the cache was created.

2.1.3 OPC

Vijeo Citect allows you communicate with your I/O Devices using the OPC standard. With OPC, rather than Citect communicating directly to the I/O device it communicates with an OPC Server using the standard. The OPC Server communicates to the I/O

Device using a protocol. The OPC Server can reside on the same PC as Vijeo Citect (recommended) or a network connected computer.



2.2 Memory or Disk I/O Devices

Besides supporting the actual I/O Devices installed in your plant, Vijeo Citect supports memory based and disk based I/O Devices. These I/O Devices are "virtual" or pseudo I/O devices - they only exist within your computer. After pseudo I/O devices are configured, they appear exactly as any other I/O Device in your Vijeo Citect system - but they are not connected to any of the field equipment in the plant. Pseudo I/O Devices can contain any type of variable supported by Vijeo Citect, and you can configure them to emulate any I/O Device that Vijeo Citect supports. You can also specify a generic protocol for a Memory or Disk I/O Device.

Pseudo I/O Devices have several uses:

- When you are configuring a system for the first time, you can configure a pseudo I/O Device. You can then design your system, and test it thoroughly without affecting the operation of your plant. When you are satisfied with the design and testing, you can replace your pseudo I/O Device in the configuration with the actual I/O Device(s).
- You can use pseudo I/O Devices together with actual I/O Devices - for temporary and permanent (disk) data storage.

2.2.1 Disk I/O Device

A Disk I/O Device provides permanent storage. The value of each variable in the disk I/O Device is stored on your computer's hard disk.

Use a disk I/O Device when the status of your plant needs to be restored after shutdown or system failure. You can configure your Citect system to continually update a disk I/O Device with critical variables that define the status of your plant. When you restart your system after a shutdown or system failure, Citect can restore this status immediately.

You can also use disk I/O Devices for storing data that must be recalled immediately when a process is required (for example, in a simple recipe system).

See Redundancy chapter.

2.2.2 Memory IO Device

A Memory I/O Device is created in the memory of your computer when you start your runtime system. The value of each variable in the memory I/O Device is stored in your computer's memory.

Memory I/O Devices can contain any type of variable supported by Vijeo Citect. However, because the memory I/O Device is created each time your runtime system starts, these variables are also created at run time - they do not retain their values when you shut down your system.

When a temporary variable is created, it is set to a default value. The default value for numeric and digital variables is 0 (zero) and for strings is " " (empty string). If your system requires initial values other than these defaults, you must set them when you start your system.

Because a memory I/O Device is local to an individual computer, you cannot use a memory I/O Device across a Vijeo Citect network. Therefore Memory I/O Devices do not support redundancy.

2.3 Driver Classification

Currently there are 150+ drivers available to use with Vijeo Citect. To be able to prioritize development and enhancement work, the drivers have been classified into five groups. The driver classifications are decided on an annual basis by the Geographic Managers and will change depending on market requirements in the different geographies.

The Class I & II list of drivers consists of a maximum of 10 drivers in each group and is not prioritized in any order. Drivers in these lists are seen as more important in our markets than other drivers and will be given higher priorities in regards to development and defect resolution.

2.3.1 Class I Drivers

The Class I list consists of a compilation of up to 10 drivers selected as the most important drivers by the Geographic Managers and PMM-Drivers, this is decided on an annual basis. The majority of these drivers are used for communication with hardware provided by the market leaders in the PLC market. To ensure that our Class I drivers are up-to-date with the latest hardware from the manufacturers, regular discussions are held between the PMM and the manufacturers.

Defects logged with Class I drivers, that affect the majority of the users, are given Priority 1 status when assessed by the defect assessment committee; customer specific defects are given Priority 3 status.

ABCLX	Allen Bradley
ABTCP	Allen Bradley
ABRSLINX	Allen Bradley
MELSCNET	Mitsubishi
MODBUS	Generic

MODNET	Schneider/Modicon
OPC	Generic
S7	Siemens

2.3.2 Class II Drivers

The Class II list consists of a compilation of up to 10 drivers selected as the second most important drivers by the Geographic Managers and PMM-Drivers, this is decided on an annual basis. Some of these drivers are selected due to heavy usage in specific geographies and others due to the hardware provided by the market leaders in the PLC market.

Defects logged with Class II drivers that affect the majority of the users, are given Priority 2 status when assessed by the defect assessment committee; customer specific defects are given Priority 3 status.

FINS	Omron
KE	Allen Bradley
MICREXSX	Fuji
SINEC	Siemens
SNMPII	Generic
SXDIRECT	Sixnet I/O
TONS	Toshiba
UNITE	Schneider

2.3.3 Class III Drivers

The list of Class III drivers consists of the remaining drivers not classified as Class I or Class II drivers and will change as market requirements change.

Defects logged with Class III drivers that affect the majority of the users are given Priority 3 status when assessed by the defect assessment committee.

3 Vijeo Citect Project Design

The first and most important step in any system development is design. Good design ensures that your system:

- Performs the control and monitoring tasks that are required
- Is implemented with minimal interruption to the application
- Achieves the best possible performance

Poor design often results in substantial rework, major disruption to the organisation, poor performance, or all three. With Vijeo Citect you can easily configure a system to do whatever you want; there are no restrictions on how your system will operate, or how your operators will interact with it.

3.1 Vijeo Citect projects

A project contains the elements of a Vijeo Citect monitoring and control system, such as graphics pages, objects, etc. These elements are stored in files of various types, for example, graphics files for graphics pages, databases for configuration records.

3.1.1 Graphics Pages

Graphics pages display on your computer screen(s), and usually display the status or condition of the plant. Graphics pages can also contain controls and command buttons that enable an operator to control the processes in the plant.

3.1.2 Configuration Databases

Databases store configuration information (about the plant) that is used in the runtime system to control and monitor the plant. Some databases are linked to specific graphics pages.

3.1.3 Cicode Files

Cicode files store your custom Cicode functions. Cicode is used to perform commands and actions and extend the functionality of your system.

3.2 Project design considerations:

3.2.1 How the plant is graphically represented to the operator.

A Vijeo Citect runtime system is usually comprised of a series of graphics pages that display on your computer screen(s). Graphics pages provide a "window into the process". You can design your pages to provide your operators with control of an area (or all) of your plant. Your graphics pages can also display the status of your plant - using a variety of graphical items, known as objects.

3.2.2 How the operator navigates the system.

The operator needs an efficient navigation system to be able to quickly access the graphical page displaying the data that he requires.

- You can link related pages together with a browse sequence. A browse sequence creates a linear navigation sequence for the pages in your system.
- Projects based on the CSV_Include have an easy to configure drop down menu system.
- Special design considerations are needed for touch screens.

3.2.3 What plant-floor data will be displayed on the screen?

The operator needs enough information on each graphics page to be able to make quality decisions about the operation of his plant. Too much information and the operator will be overwhelmed, not enough information they will have to move from page to page to see the whole picture.

Objects are the basic drawing entities that you add to your graphics pages. Objects are drawn using the tools in the drawing toolbox, and they can be moved, reshaped, and copied after they are drawn. Objects are defined by a set of properties, which are assigned when the object is drawn, or afterwards, by double-clicking.

3.2.4 What operator controls are required and where they are presented on the page.

Commands allow your operators to interact with the Vijeo Citect runtime system. You can define three types of direct command controls:

- Touch commands that your operators issue by clicking on specific graphics object (displayed on a graphics page).
- Keyboard commands that your operators issue by typing instructions on the keyboard.
- Slider controls that your operators use to change the values of analog variables.

3.2.5 What plant conditions need to be monitored for alarm conditions?

Protection of valuable plant equipment is a central feature of your Vijeo Citect system. The Vijeo Citect alarm facility constantly monitors equipment data and alerts operators of any equipment fault or alarm condition.

3.2.6 What data logging is required for maintenance and performance monitoring purposes?

The trend system can provide a better understanding of the performance of your plant and equipment. It can be used for dynamic visual analysis (trend and SPC graphs), production records, or for regularly recording the status of equipment for efficiency and preventive maintenance.

3.2.7 What reports management will require.

You can request regular reports on the status of your plant, and reports that provide information about special conditions in your plant. Reports can be run on a request basis, at specified times, or when certain events occur (such as a change of state in a bit address).

Vijeo Citect Reports provides more advanced, multi-system reporting capabilities.

3.2.8 What level of security (if any) is required in the runtime system?

For large applications, or applications where access to certain processes or machinery must be restricted, you can build security into your system. You can then restrict access to commands that should not be available to all your operators, for example, commands that operate specialised machinery, acknowledge critical alarms, or print sensitive reports.

3.3 Project Design Standards

Project design standards should be documented in a project functional specification. A well-documented functional specification facilitates more than one developer working on the initial configuration of the project with consistent results. This document would initially be used to configure the project and later to ensure consistency when modifications are carried out on the project in the future.

Design standards promote consistency and clarity. Consistency and clarity will reduce your development time, and reduce the time that your operators will need to learn your system.

You should, for instance, choose a common screen location for all control buttons of a certain type, keyboard keys that always perform the same operation, and standard colours for displaying similar types of information (e.g. alarms).

Naming standards are recommended throughout your configuration - use a naming convention for pages, alarms, commands (and all database records). A standard naming convention will:

- Reduce database search time.
- Reduce data entry.
- Reduce time and effort when configuring future changes and enhancements.

A standard naming convention should be designed and documented to define all the database records. The most common method is to include as much (abbreviated) information as possible in the name (up to 16 characters, 32 for variable tag names). For instance, you can include the area and the process, or the machine and the device with which the record is associated.

3.3.1 Using Structured Tag Names

A Variable Tag is a unit of information used in a Vijeo Citect system. Variables are stored in memory registers in an I/O Device. Vijeo Citect exchanges information with an I/O Device by reading and writing variables. Vijeo Citect refers to I/O Device variables by their register addresses. I/O Devices usually support several types of variables, however the most common are digital variables and integer variables.

Citect puts no restrictions on the names of variable tags, but you will benefit from using a tag naming convention. By using a tag naming convention, your project will be easier and faster to design, configure, and commission, and will require less time for future maintenance.

Using a number as the first digit of a tag, is not good engineering practice. Tags starting with numbers are not supported by modern programming languages and they are not allowed in the industrial control systems standard IEC 1131-3.

The following naming convention is recommended for a Vijeo Citect system - to obtain maximum benefit when using features such as Genies and Super Genies. Each tag name can contain up to 79 characters. To establish a convention, you must divide the characters in the tag name into sections that describe characteristics of the tag, for example, the area where the tag is located, the type of variable, and any specific attributes. Four basic sections are suggested for a Vijeo Citect naming convention:

Area_Type_Occurrence_Attribute

3.3.2 Area

The Area section identifies a plant area or name. If you use a prefix that identifies tags within a particular area, you can easily duplicate all Vijeo Citect tags in all three areas. For example:

Variable Tag	Meaning
B1_bbb_ccc_dd	Boiler 1
B2_bbb_ccc_dd	Boiler 2
B3_bbb_ccc_dd	Boiler 3

3.3.3 Type

The Type section identifies the Type of parameter, process equipment, or control hardware. The ISA standard naming system is recommended.

Variable Tag	Meaning
aa_TIC_ccc_dd	Temperature Indicating controller
aa_FIC_ccc_dd	Flow Indicating controller
aa_PUMP_ccc_dd	Pump
aa_VALVE_ccc_dd	Valve

3.3.4 Occurrence

The Occurrence section identifies the loop or equipment number.

Variable Tag	Meaning
aa_TIC_101_dd	Temperature Indicating Controller 101
aa_TIC_102_dd	Temperature Indicating Controller 102
aa_PUMP_101_dd	Pump 101
aa_PUMP_102_dd	Pump 102

3.3.5 Attribute

The Attribute section identifies the attribute or particular parameter that is associated with the loop.

Variable Tag	Meaning
aa_bbb_ccc_PV	Process Variable
aa_bbb_ccc_SP	Setpoint
aa_bbb_ccc_OP	Output
aa_bbb_ccc_P	Gain or proportional band

aa_bbb_ccc_I	Integral
aa_bbb_ccc_CMD	Command signal to start pump
aa_bbb_ccc_M	Auto/Manual mode
aa_bbb_ccc_V	Value (running/stopped)

For complete list of suggested attributes, see Vijeo Citect help - “Using Structured Tag Names”.

3.4 Linked Projects

Vijeo Citect installations on different computers over the same network can share the same project. After a project has been created on one computer, other computers on the same network can link to the same project - but only if the project location is on a shared or network drive. Once linked, the remote project will be visible in the local Citect Explorer, and can be edited, compiled and run over the network. By linking the projects in this way, only one version of a project ever exists. Centralised file storage allows many developers to work on the project at the same time.

With a small system it is usually possible to get away with a separate copy of the project on each node, the modified project needs to be compiled and Citect restarted on each node. This way the node is immune from problems on the file server.

Maintaining a large and complex system can get extremely confusing and tedious. Storing the projects on a file server obviates the need to compile and restart Citect on each node.

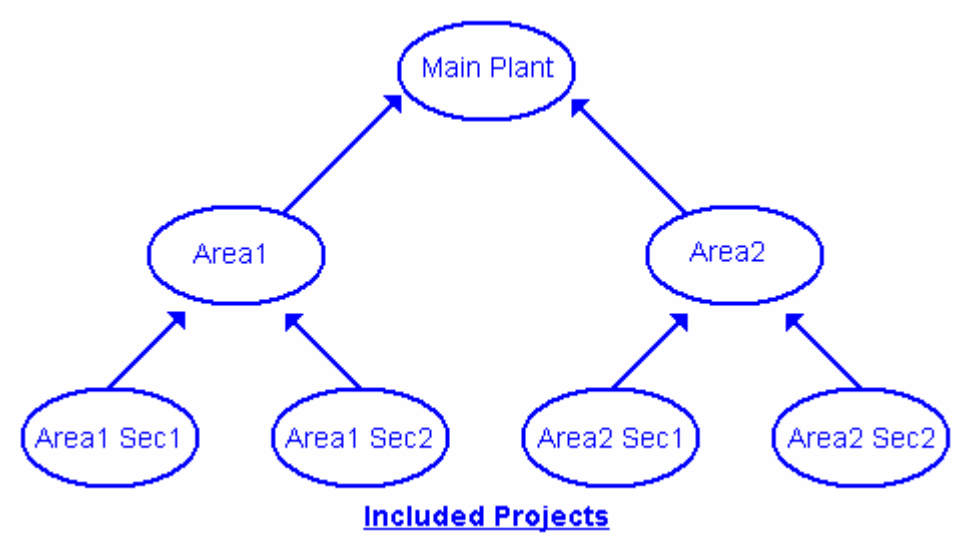
When considering these file management methods the following network architecture questions should be taken into account:

- What will happen if the network fails?
- What will happen if the file server goes down?
- How will we back up or development?
- What sort of performance can be expected?

3.5 Included Projects

Included Projects are separate Vijeo Citect Projects that can be included in another Vijeo Citect Project. All records in each project are globally accessible (i.e. a record defined in one project can be used in another) and are compiled as one Project.

With large systems, it might be more convenient to develop the application using a series of smaller Projects, instead of one large Project. For example, you could use a separate Project for each section of the plant, or for each main process. This way, you can develop and test each of the smaller Projects before including them in the main Project.



3.5.1 Vijeo Citect Predefined Include Projects

3.5.1.1 CSV_Include Project

The CSV_Include Project is a pre-configured project that is installed with Vijeo Citect Version 5.5 or later. Designed to reduce the amount of time required to configure a new project, it includes a set of templates and pages styled for the Windows XP environment. Note, WindowsXP is note required for this project to be used.

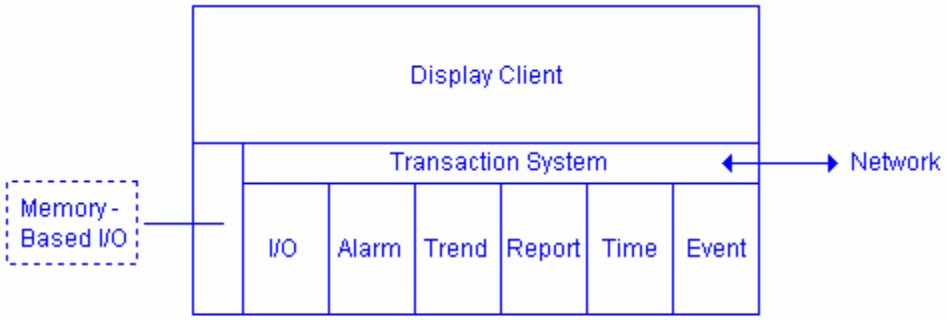
When a new Vijeo Citect project is created, the CSV_Include project is automatically incorporated as an included project. This means all the project's templates and associated content are available for implementation when creating your graphics pages in Graphics Builder.

Alongside a standard graphics page template for the creation of plant mimics, the project includes predefined trend and alarm display pages, an administration tools page, a file page for displaying text and Rich Text Format files, and a selection of popup windows. All feature common navigation and alarm menus for consistent functionality and appearance across an entire project. The project even supports multi monitor display, allowing a number of graphics pages to be simultaneously displayed across several computer screens.

4 Vijeo Citect Client/Server

Every Citect computer is a display client, even if they are configured as a server. In other words, all Citect computers are users of the system data. All requests for data originate from the client and the client is the ultimate destination for system data. Citect clients don't exchange data directly with any I/O Devices they exchange data with the servers.

Each Citect node can be viewed as a client and a potential server of information (alarms/trends/reports). In addition to this each Citect node is capable of being and I/O server, executing events (event server) and maintaining system time (time server).



Citect Client/Server Structure

4.1 What is a client?

A computer that accesses shared network resources provided by another computer called a server. In the case of Vijeo Citect, the purpose of having a client/server architecture is to distribute the processing tasks and gain the best performance.

4.2 Types of Vijeo Citect clients

4.2.1 Display Client

A Display Client is a computer running a Vijeo Citect system. A Display Client is the interface between the runtime system and an operator. If you are using Vijeo Citect on a network, all Vijeo Citect computers (on the network) are Display Clients.

4.2.2 Manager Client

A Vijeo Citect computer configured with manager-only access to the runtime system. No control of the system is possible, however full access to data monitoring is permitted. Special licensing arrangements are available for a system using Manager Clients.

4.2.3 Internet Clients

An Web Client allows you to run your project over the Internet from a remote location. It is a "runtime-only" version of Vijeo Citect; you can run your project from that computer, just as you would from any normal Display Client. A Web Client can only connect to an Internet Server. Any computer with an Internet connection (and the necessary hardware) can be used as an Internet Client. Two type of Internet Clients are available, the Web Client (V6 and above) and the Internet Display Client (IDC).

4.3 What is a server?

A server is a local area network (LAN) computer that performs processing tasks or makes resources available to other computers, which are then known as clients. In the

case of Vijeo Citect, the purpose of having a client-server architecture is to distribute the processing tasks and gain the best performance.

4.3.1 Vijeo Citect Server

Each computer you connect to an I/O Device (or number of I/O Devices) is called a Vijeo Citect I/O Server. When the Vijeo Citect system is running, the Server exchanges data with the I/O Device(s) and distributes information to the other Display Clients as required. Vijeo Citect also has Servers that are dedicated to handling specific functions, such as alarms, reports, trending etc. For a small application, you would only use a single server. On larger installations, you can distribute communications across several servers to provide redundancy, or split the processing task (and increase efficiency). A Vijeo Citect server also acts as a Display Client.

Vijeo Citect V6.10 and later also support multi-cpu PCs to load share these tasks across multiple processors within a single computer.

4.4 Types of Vijeo Citect Servers

4.4.1 I/O Server

The I/O Server is a totally dedicated communications server. Its function is to exchange data between I/O Devices and Vijeo Citect Display Clients. No data processing is performed by the I/O Server (except for its local display). Data is collected and passed to the Display Clients for display, or to another server for further processing. All data sent to an I/O Device from any Vijeo Citect computer is also channelled through the I/O Server. If data traffic is heavy, you can use several I/O Servers to balance the load.

4.4.2 Alarms Server

The Alarms Server constantly monitors all alarms, and instantly displays an alarm on the appropriate Display Client(s) when an alarm condition becomes active.

4.4.3 Trends Server

The Trends Server controls the accumulation and logging of trend information. This information provides a current and historical view of the plant, and can be processed for display on a graphics page or printed in a report.

4.4.4 Reports Server

The Reports Server controls the processing of reports. You can request reports at any time or when specific events occur.

4.4.5 Event Server

The Event Server must be enabled on each Citect computer for events to work that particular machine.

An event is something that occurs in the plant, such as when a container fills or when a process is complete. An Event when related to Vijeo Citect may be enabled or disabled on a Vijeo Citect computer.

4.4.6 Time Server

The Time Server periodically synchronises the time clock on all Display Clients (and other Vijeo Citect Servers) to the time and date of the computer configured as the Time Server. (You can only configure the Time Server on the same computer as an I/O Server.) You can set the time and date on the computer (configured as the Time Server) with the Windows Control Panel or with the TimeSet() Cicode function.

4.4.7 The Vijeo Citect Internet Server

For the Web Client, any computer can be configured to run either the Microsoft Internet Information Service (IIS) or Apache Tomcat WebServer to serve the data to web clients.

For the IDC, any I/O Server can be used as a Vijeo Citect Internet Server - you just need to set it up using the Computer Setup Wizard (and your protection key must allow you to do so).

5 Networking

Using Vijeo Citect on a LAN adds more flexibility to the system, and coordination within large plants can be more easily achieved. You can control and monitor autonomous areas within the plant separately, and interrogate the whole plant using any Vijeo Citect computer on the network if you wish.

A LAN can also be used to:

- Distributing processing load for large systems
- Redundancy

5.1 Types of network protocols supported by Vijeo Citect

You can use multiple protocols at the same time including NetBEUI, IPX/SPX, TCP/IP, and other network protocols.

5.2 Scalable Architecture

Control system designers today face a major challenge – they must not only maximise performance and minimise costs, but must also cater for future requirements of the plant. Because manufacturing processes and methodologies are constantly changing, the successful plant control and monitoring system is one that adapts easily to these changes. The successful system must be easily modifiable as the task changes and expandable as the task grows – this system must use scalable architecture.

A client/server processing allows you to distribute sub-tasks, ensuring that you are not restricted by conventional hardware configurations. The result is a scalable architecture that can be moulded to the size of the application – a solution that resolves many limitations of conventional systems and provides features that have never before been possible in plant control and monitoring systems.

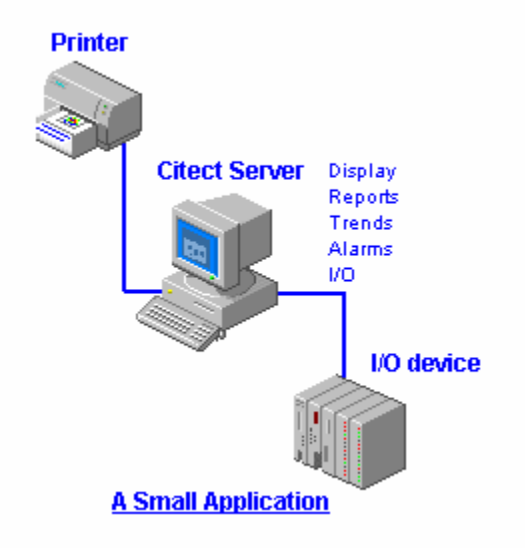
Vijeo Citect supports 'Scalable Architecture', permitting you to initially implement Vijeo Citect on a single computer, or over a small network, and then expand the system at a later stage (to suit budget, development path, etc), without the need to replace existing hardware, software, or system configuration.

5.3 Examples of network architecture

The best way to highlight the tremendous potential of scalable architecture is through a series of actual applications.

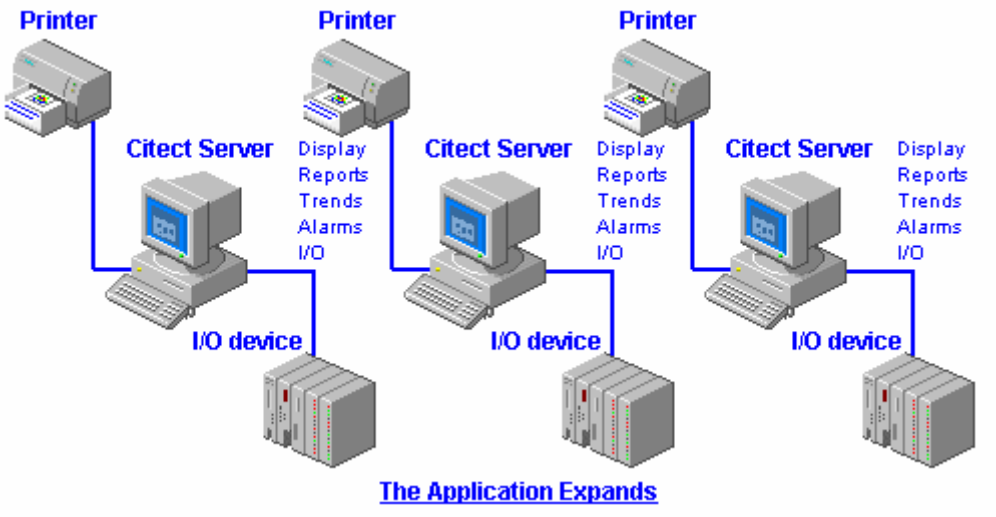
5.3.1 A Small Application

For a small application, a single computer can manage all the Display, Alarms, Trends, Reports and I/O tasks.



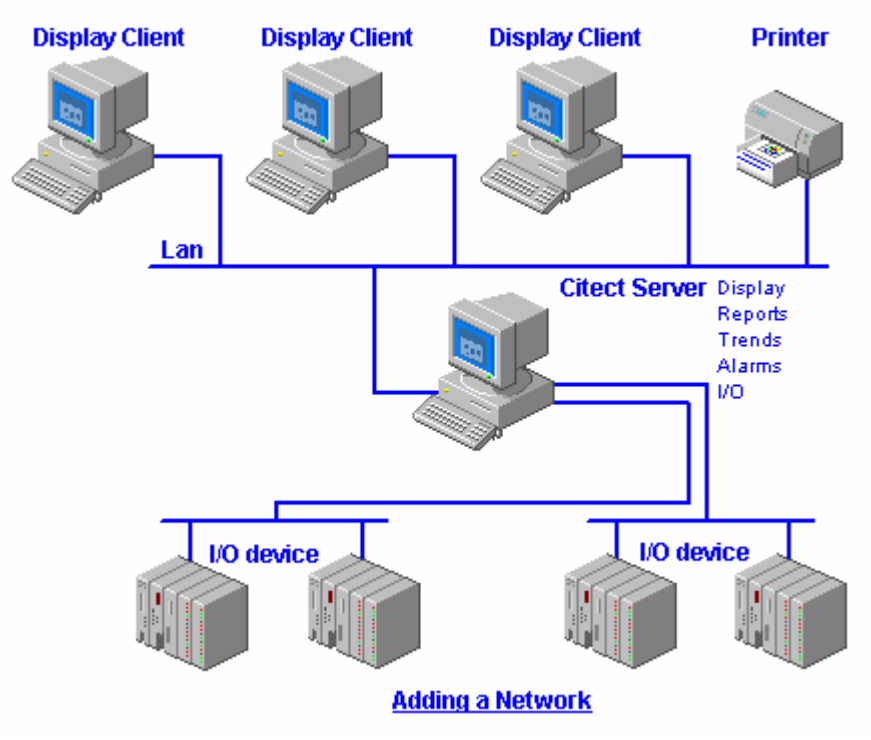
5.3.2 The Application Expands

As the application expands (for example, two new cells are added), an additional computer can be used for each cell – each running Vijeo Citect. This layout is fine – but it could be better. The lack of communication between computers makes it impossible to get the big picture.



5.3.3 Adding a Network

It can be improved by adding a Local Area Network (LAN) and one dedicated I/O Server. As the Alarms, Trends and Reports tasks are centralised, they can be combined with the I/O Server. The Display task is still distributed, and yet any operator can access common data from anywhere in the plant.

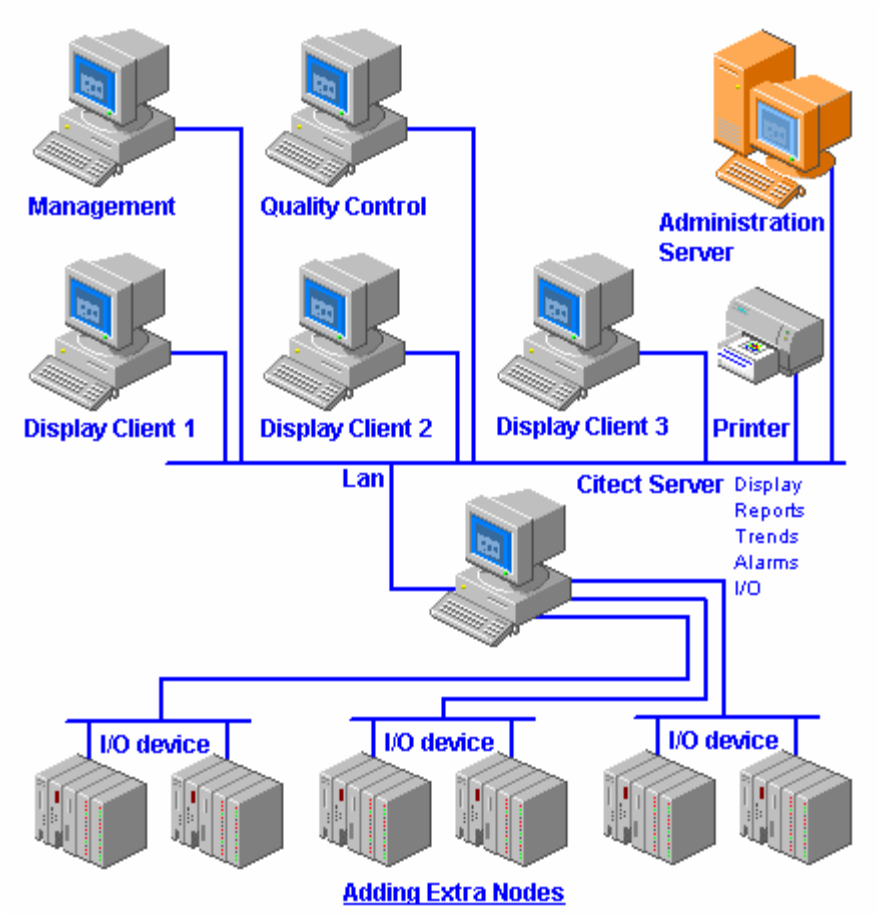


5.3.4 Adding Extra Nodes

Extra operators can be added easily to the system. Management and Quality Control can be given access to plant data. A tiered password structure restricts access to data and protects plant equipment. For example, each operator can be given access to only their particular part of the plant, Quality Control can have read-only access to the whole plant, while shift supervisors can have total access.

Adhoc system users such as maintenance, quality and management can take advantage of the Internet Clients available with Vijeo Citect.

A link with the Administration Server would allow the downloading of recipes and production schedules, and production reports could be passed up to the Administration Server and on to the accounts department.

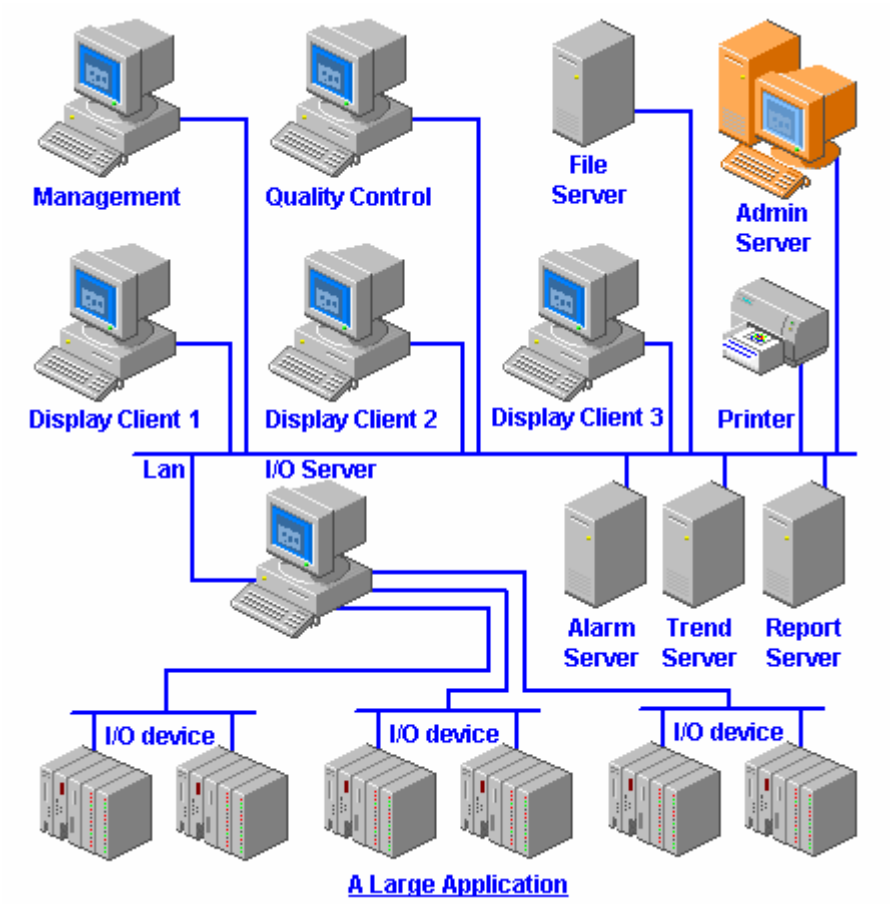


5.3.5 A large Application

Consider an application that monitors 40,000 points and has 40 users.

The size of the processing task would usually warrant a separate server for Alarms, Trends and Reports tasks. In addition, a separate file server can be included to store the configuration database and all the common system software.

In addition, Vijeo Citect Reports can be added in these types of applications for reporting and or transferring data to business systems.



6 Redundancy

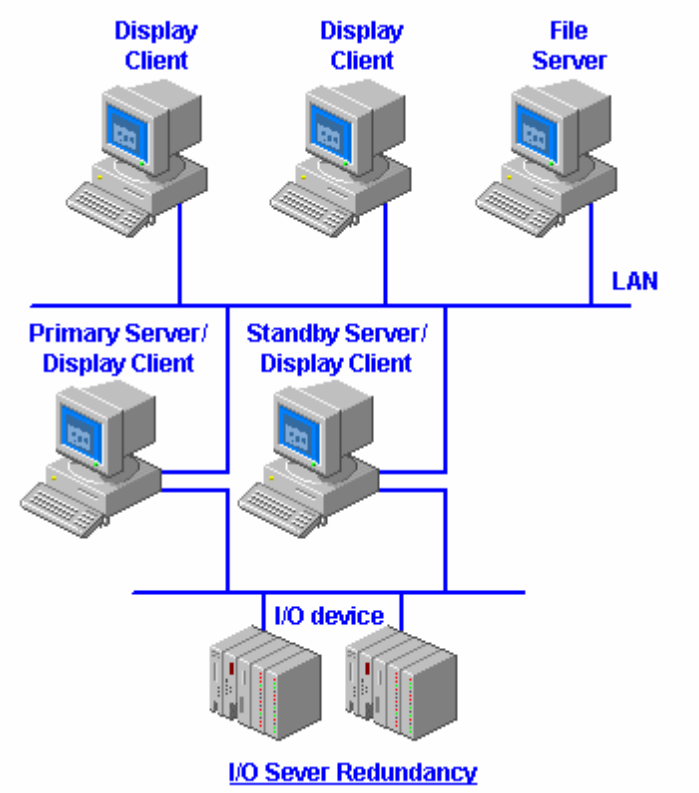
Redundancy is designed into Vijeo Citect and can be implemented without changing the project configuration. (Vijeo Citect was designed for total redundancy support. Almost everything in Vijeo Citect can be made redundant: system display, alarms, trends, reports, I/O Servers, external I/O Devices, Disk I/O Devices, Network cables, Network File Servers, FTP Servers, etc.)

6.1 Why have redundancy?

While reliability is a key feature of most current computer hardware, breakdowns can still occur. If some (or all) of the processes in your plant are critical, or if the potential down time through failure could be excessive, you should design a level of redundancy into your Vijeo Citect system. A system with in-built redundancy minimises interruptions due to equipment failure. You can choose a level of redundancy to suit the application.

6.2 I/O Server Redundancy

Systems with a single I/O Server have a single point of failure. If the Server fails, control and monitoring of the system is lost. The single point of failure can be eliminated with a redundant I/O Server that is connected to the same I/O Devices. These Vijeo Citect Servers are called the primary and Standby Servers.



I/O Sever Redundancy

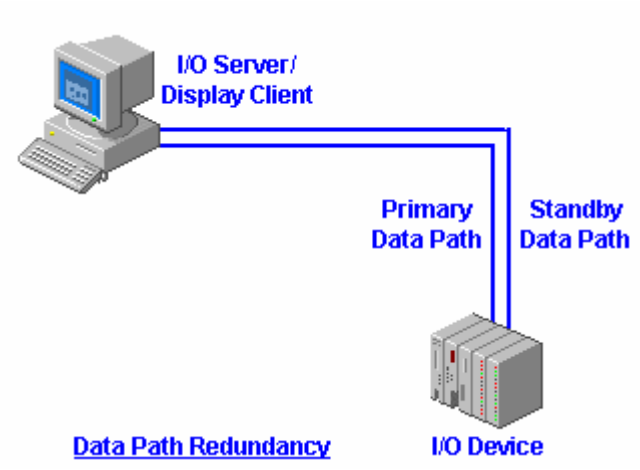
When the system is in operation, Vijeo Citect maintains both servers identically. If the primary server fails, the standby server assumes total control without any interruption to the system. When the primary server is returned to service, Vijeo Citect automatically returns control to the primary server. Vijeo Citect also ensures that no data is lost.

I/O Server redundancy stabilises the system by removing the single point of failure (the Vijeo Citect I/O Server). However, in the event of failure by the LAN, control and

monitoring by the Display Clients is lost (although control and monitoring by the servers is maintained).

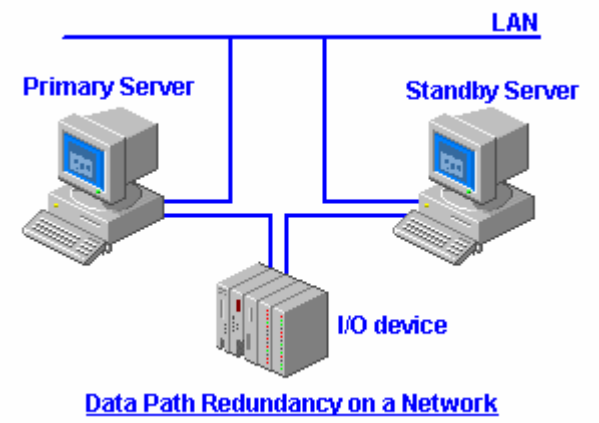
6.3 Data Path Redundancy

With most brands of PLC's, you can install a parallel data path from the I/O Server to the I/O Device. A parallel data path ensures that if one data path fails, your system can continue without interruption.



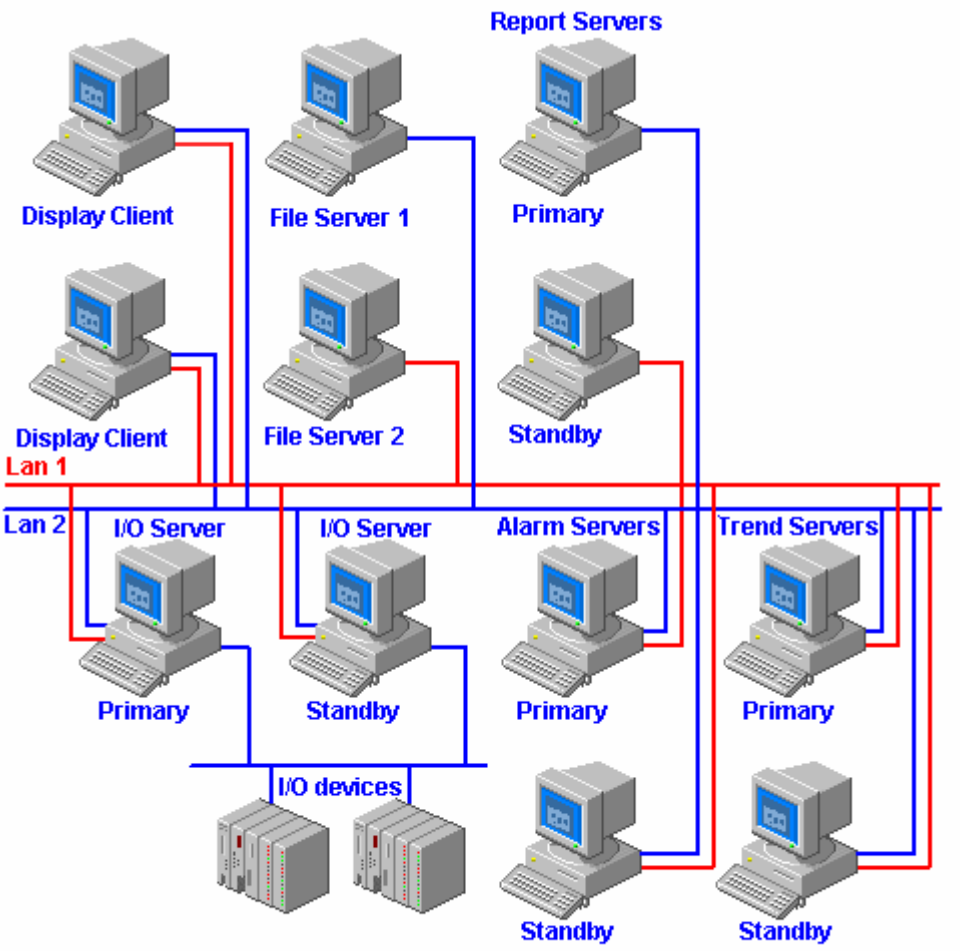
When you start your runtime system, Vijeo Citect connects to the I/O Device using the primary data path. If communication with the I/O Device fails at any time (e.g. if the communications cable is cut), Vijeo Citect switches to the standby data path. Vijeo Citect reconnects through the primary data path when it is returned to service.

You can also use data path redundancy on a network, as in the following diagram:



6.4 Alarms, Reports, and Trends Server Redundancy

On large systems with multiple servers, you can parallel the Alarms, Reports, and Trends Servers. To achieve this level of redundancy, you configure three other computers (or Display Clients) as standby servers. Then if a primary server fails, its operation is immediately transferred to its standby server.

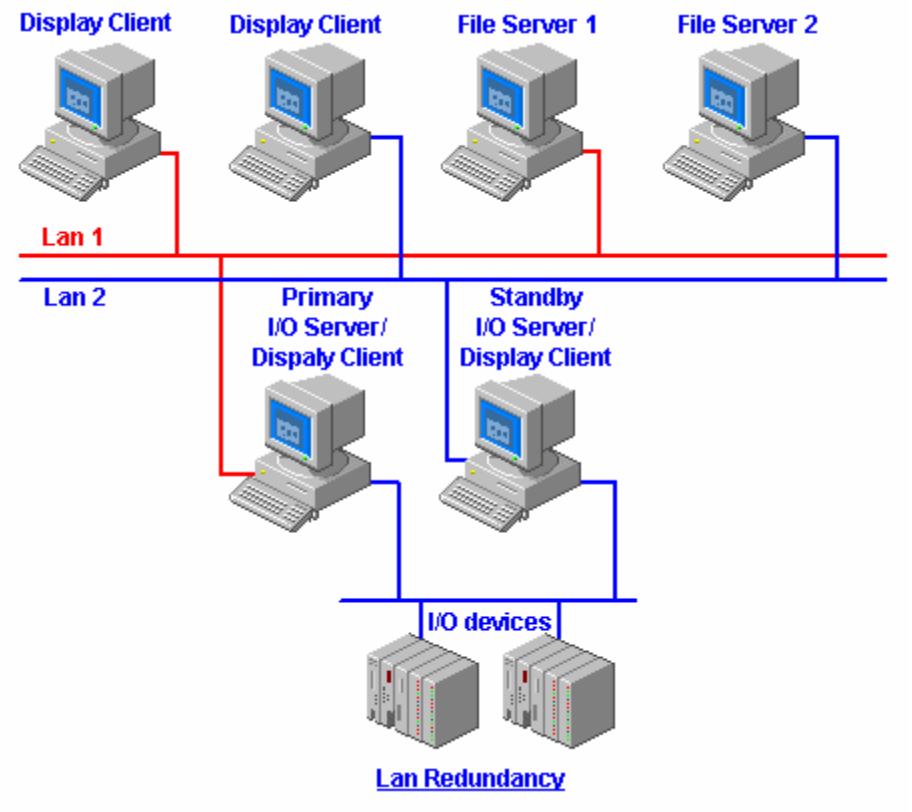


Alarm, Trend, Report Server Redundancy

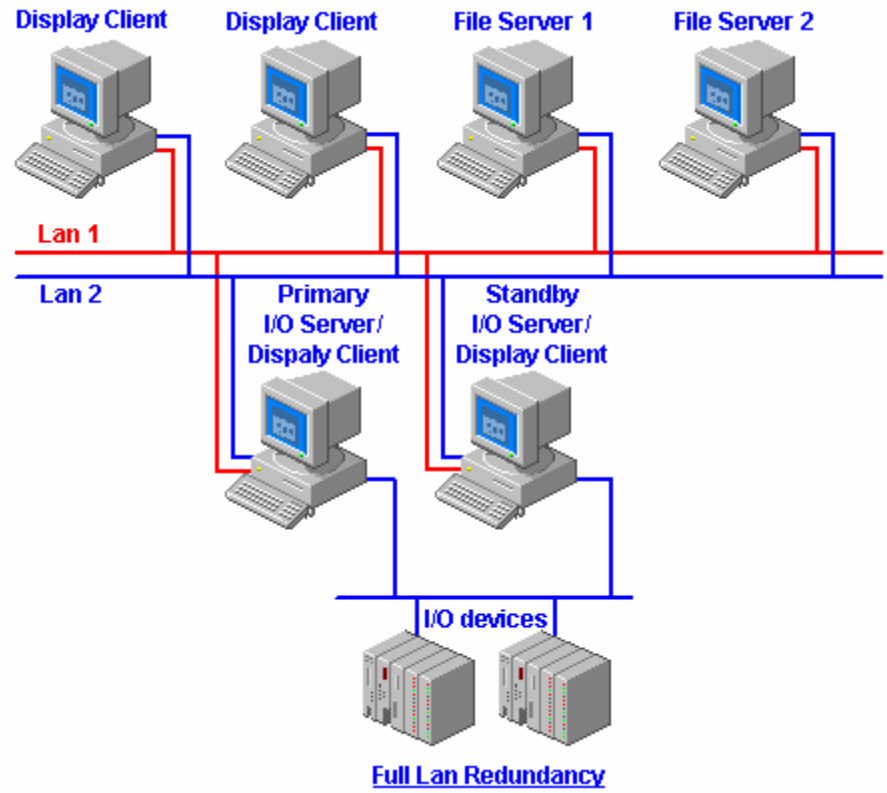
When the system is in operation, Vijeo Citect mirrors the primary and standby servers. If the primary Reports, Alarms, or Trend Server fails, all clients access the appropriate standby server for data. When the primary server restarts, the clients stay on the standby server unless the standby server fails, or the client is shutdown and restarted. (Because Vijeo Citect maintains identical data on both servers, it is not important whether a client receives data from the primary or standby server, and it is quite normal for some clients to be communicating with the primary and some with the standby server. This also saves the extra overhead of checking if a primary server has come back online.)

6.5 LAN Redundancy

A second Local Area Network (LAN) and file server would ensure system stability even in the event of network failure.

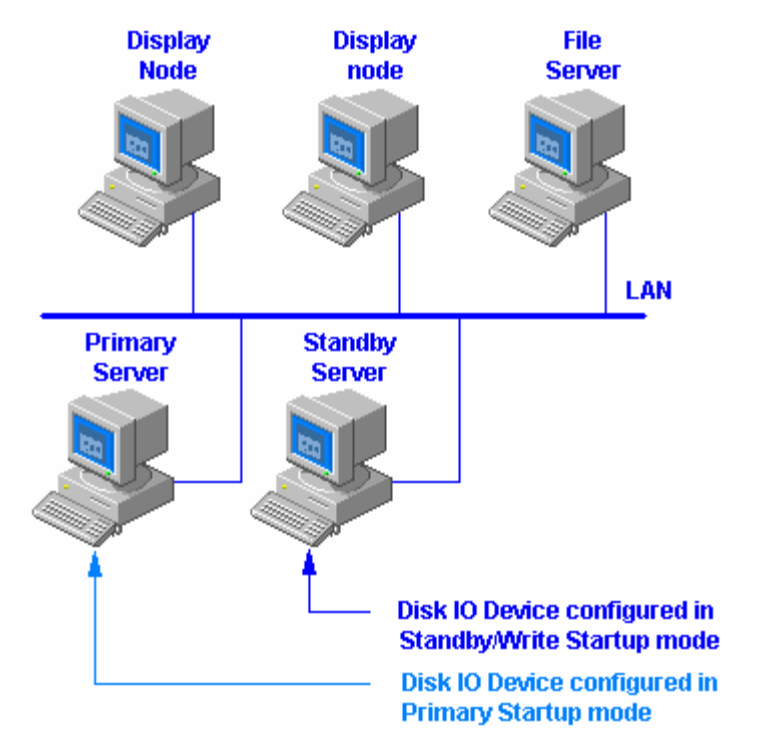


In the above illustration, half of the computers remain operable if one of the LANs or a server fails. With two network cards in each computer, full operation of all computers can be maintained in the event of a failure of one of the LANs (or a server).



6.6 Disk I/O Device Redundancy

If you are using a network, you can configure a redundant Disk I/O Device to eliminate data loss (in the event of a server failure). The following diagram illustrates the use of redundant Disk I/O Devices:



When the system is in operation, Vijeo Citect reads and writes runtime data to the Disk I/O Device configured in the primary server. Vijeo Citect also writes runtime data to the Disk I/O Device configured in the standby server. (Vijeo Citect maintains both Disk I/O Devices identically.)

If the primary server fails, the Disk I/O Device in the standby server is activated - without interruption to the system. When the primary server becomes active, Vijeo Citect automatically returns control to the primary server, and copies the Disk I/O Device from the standby server to the primary server. The Disk I/O Device in the standby server reverts to its standby role.

It is only possible to display information from one cluster at a time.

7 Security

7.1 Vijeo Citect project level (eg page, alarm, object etc)

For large applications, or applications where access to certain processes or machinery must be restricted, you can build security into your system. You can then restrict access to commands that should not be available to all your operators, for example, commands that operate specialised machinery, acknowledge critical alarms, or print sensitive reports.

You can assign a separate password to each of your operators (or class of operators), that must be entered before the operator can use the system.

7.1.1 Maintaining User Records

You can add login records for some (or all) users of your runtime system. User records enforce an orderly login and restrict access to your system. Operators for whom you add a user record must enter their user name and password to gain access to your runtime system.

You can add a user record for each of your users when you configure your project, or add a single record for each class (or type) of user (for example, Operators, Managers, Supervisors, etc.). When your system is running, you can add new users (based on a defined class) as required. Each class of users shares common attributes, such as privileges.

7.1.2 Defining User Privileges

To restrict access to a particular system element (command, object, report, alarm, etc.), you assign it a privilege requirement, then allocate that privilege to the users who will use it. Vijeo Citect provides eight privileges, numbered 1 to 8. For example, different privileges to different types of operation can be allocate, as in the following table:

Privilege	Command
1	Operate the conveyors
2	Operate the ovens
3	Operate the canners
4	Acknowledge alarms
5	Print reports

7.1.3 Defining Areas

When implementing Vijeo Citect for a large application, you would usually visualise the plant as a series of discrete sections or areas. You can define these areas geographically - especially where parts of the plant are separated by vast distances (or physical barriers) - or logically (as discrete processes or individual tasks).

After you have defined your areas, you can configure the commands, objects, alarms, reports, etc. your operators will use in those areas.

8 Licensing Options

Vijeo Citect's licensing is calculated on the number of instances of Vijeo Citect runtime that will be running at any one time, not the number of computers with Vijeo Citect installed. For example, if Vijeo Citect is installed on 100 computers with no more than 15 instances running at any one time, only 15 licenses are required.

Citect uses a hardware key to safeguard against license infringement that is a physical 'dongle' that plugs into the printer or USB port of the computer.

Vijeo Citect project development can be done on a computer without a license. Additionally, the development environment will allow up to 15 minutes of non-networked runtime to test your system without requiring a license. Development licenses for networked tests or longer runtimes are available to Citect System Integrators.

Vijeo Citect Licenses can be supplied as Single or Floating licenses.

The point count must be specified when ordering a key. The point limit is the maximum number of I/O Device addresses that can be read, and is specified by your Vijeo Citect license. Vijeo Citect counts static and dynamic points.

Static points are Variable Tags linked to physical I/O in an external device, that are picked up by the compiler when used on either Graphic pages, in Alarms or Trends and in Cicode.

Dynamic points are Variable Tags linked to physical I/O in an external device that are not picked up by the compiler as they are dynamically used in Super Genies, accessed through the CTAPI or the Vijeo Citect OPC Server and with the Tagxxx() Cicode functions.

The total amount of points used in your system is the number of static points found during project compilation, plus, the number of dynamic points accessed in runtime. For example, if the compiler finds 50 Variable tags during project compilation and you have an application that accesses 10 different Variable Tags through the CTAPI during Vijeo Citect runtime. The total point count for your system is 60.

8.1 Single License

Each computer that has an instance Vijeo Citect runtime running can have its own license on the hardware key attached the printer port (dongle) or USB key.

8.2 Floating Licenses (Multi User)

Floating Licenses allow Vijeo Citect workstations to share one or more Vijeo Citect licenses across the LAN, WAN, or Dial-in connections. Floating licenses are usually made available from one of the Vijeo Citect servers.

More than one Citect License may reside on the hardware key attached to a Citect Server, a Citect Client will search the network to find an available Floating License. There can be up to 254 floating licenses on each server.

8.3 Manager Licenses

Manager licenses are a cost effective way of displaying the CitectHMI/SACADA system to none operational staff members. Manager licenses permit view only, viewers cannot perform control tasks and the computer cannot perform server tasks. Manager licenses can be single or floating.

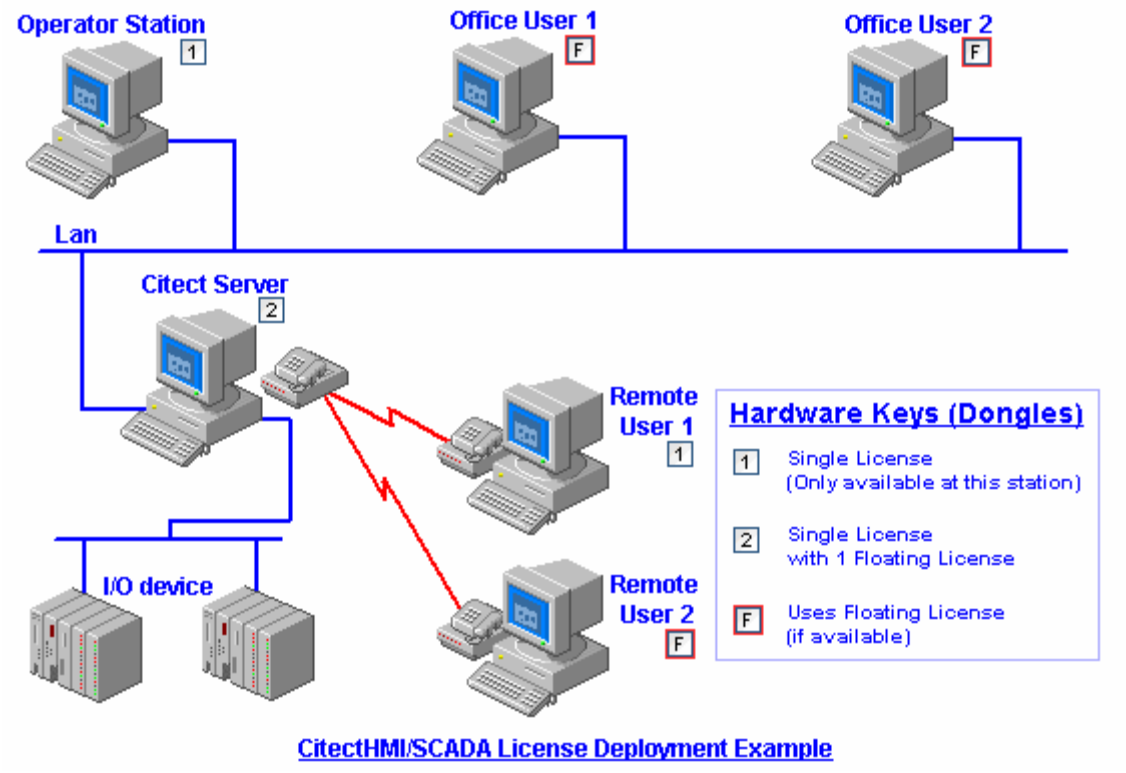
8.4 Web Client Licenses

If you have a computer with Internet access, you can use it to run your project over the Internet from a remote location. Your computer would then be called an Web Client. These are runtime-only versions of Vijeo Citect; you can run your project from that computer, just as you would from any normal Display Client. However, an Internet Display Client or a Web Client cannot be a server, and it cannot be used to make configuration changes - you can only run your project.

The IDC or Web Client License must reside on the server hardware key.

8.5 Vijeo Citect License Deployment Example

The following example shows some of the many ways Citect Licenses can be deployed.



CitectHMI/SCADA License Deployment Example

Operator Station:

This station is always running Citect and utilises one Citect license. In this example, this station has a Single License to guarantee that there is always a Citect license available to the operator.

Office Users and Remote User 2:

These stations only run Citect when necessary and share the Floating License that is made available by the server. In this example only, one of these stations can be running Citect at any one time.

Citect Server:

This station is always running Citect and utilises one Citect License. As it is a Citect Server, it is the point at which any Floating Licenses are placed. This example shows one Floating License however there can be 254 Floating Licenses on each Citect Server.

Remote User 1:

This station only runs Citect when necessary and utilises one Citect License. As maintenance staff uses this station and their access must be guaranteed the Citect License is not a Floating License.

8.6 Engineering Rules of Thumb

The estimation of the engineering effort required to implement the designed solution is also a complex art that is dependent on many factors. Citect's Project Managers and Engineering Managers have had years of training consolidated by years of experience that enables them to sort through the particular issues of the site to identify the resources required to implement the solution and to minimise the risks.

The Rules of Thumb given below should be used only as a guide to the effort required. Any requirement for anything more than budget pricing must be coordinated and approved by the Engineering Manager.

8.6.1 Budget Engineering Estimates

8.6.1.1 Ratios

- Including PLC - Total Effort distribution from project go ahead to the end of FAT for the Design, PLC Programming, Vijeo Citect Configuration and Integration Testing is approximately
    - High Level Design 20%
    - Functional Specification 30%
    - Implementation 35%
    - Integration Testing 15%
- Excluding PLC - Total Effort distribution from project go ahead to the end of FAT for the Design, Vijeo Citect Configuration and Integration Testing is approximately
    - High Level Design 20%
    - Functional Specification 30%
    - Implementation 30%
    - Integration Testing 20%