Diagnostics and Troubleshooting Exam Study Guide

Version 7.20

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V7.20 Upgrade Exam Study Guide Training Manual

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Members of Educational Services' team of Instructional Designers have tertiary qualifications in Education, Educational Course Development and are also experienced instructors in their own right; some are also published authors. Currently, the team is supporting a range of over 70 courses in multiple languages and multiple software environments.

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Chapter 1: Introduction to the Examination System

Overview

Introduction

There are not many people who enjoy taking exams. In fact most people view impending exams with some degree of trepidation. There are, however, three things that help alleviate anxiety – preparation, preparation and preparation.

This Study Guide is designed to help prepare you for the exams in the **CitectSCADA Certified Engineer** stream. In this study guide you will see a list of suggested exercises, and a list of references for suggested reading.

The CSCE exams cover a very broad range of topics, so to enhance your chances of passing the exams it is advisable to take enough time to study the topics with which you are not yet familiar.

The best resource is the **Educational Services Training courseware**. Each of the exams is designed around the content in the Educational Services curriculum.

Of course you also need to be familiar with searching the CitectSCADA Help files and searching the CitectSCADA Knowledge base.

This Chapter Covers These Topics:

Examination and Certification

Authorised Examination Centres

There are a number of Authorised Examination Centres throughout the world. These centres are most likely to be your local Citect Office or Partner. A list of Examination Centres is located on the Educational Services website. Any Authorised Examination Centre must have been approved by Educational Services.

We are currently in the process of authorising our Citect offices so many of the Citect offices are in provisional status. If you do not find your local office listed on this page contact them directly as they may be a Provisional Examination Centre.

All examinations must be held under the supervision of an approved Examination Supervisor.

Registration

Registering for an Exam

Before anyone may sit for any of the Exams in the Certified Engineer program they must register via the Citect website.

To register for an exam through the website, this page needs to be filled out with the candidate's details. When the request is submitted an email will be sent to the Exam Coordinator in the Examination Centre that has been specified. The Exam Coordinator will contact the candidate regarding the details of the examination.

Go to the page http://www.citect.com/education and select the **Exam Registration** option from the left-side menu.

Complete the Exam Registration page with the appropriate information.

Why Register?

The registration process not only allows your local office to coordinate exams but is the first step in the exam process. When you register for the first time the Exam Coordinator in your region will arrange for your unique **Student Login** and **Student Password**. This Student Login and Password will be used in all of your Exams. We will also need an email address so that your exam results may be sent to you.

The **Student Login** follows this format

```
es_firstname_lastname
```

The **Student Password** is a computer generated random selection of characters.

The password will generally not be revealed to you, instead the Examination Supervisor will log in on your behalf at the examination centre

Exam Enrolment

The exam enrolment is created prior to the day of the exam. When the Exam coordinator registers the candidate to sit for a particular exam their Username is entered into the Enrolled User Group for that exam. The enrolment is disabled until the day of the exam.

The Day of the Exam

The Exams are supervised by Examination Supervisors. The exam may be held at the end of a training course or independently of any courses. When the candidate arrives at the Examination Centre they will need to identify themselves to the Exam Supervisor. If this is the candidate's first exam the Exam Supervisor will need to supply them with their Exam Username and Password. They will then be escorted to the Examination Room. The location of the testing room is most likely to be a Citect Training Room.

The Examination System

Open Book Exams

All exams are open book. The computers in the Examination room are loaded with an appropriate version of CitectSCADA for the exam being undertaken, the Knowledge Base and all PDF documents available on the distribution CD-ROM or DVD-ROM. However, no other material will be permitted in the Examination Room, for example, the Educational Services Training Manuals or the Study Guides.

The exams are supervised by the Exam Supervisor. Whilst candidates are allowed to refer to the online documentation and to create test projects on the installed CitectSCADA system, no speaking is allowed and no looking at another computer.

The examination procedure does not allow:

- Notes to be taken in or out of the examination room
- Screen shots or copies of examination questions to be taken from the examination room
- USB keys or any other removable media to be taken in or out of the examination room
- Photographs of any type
- Talking
- Collaboration with anyone

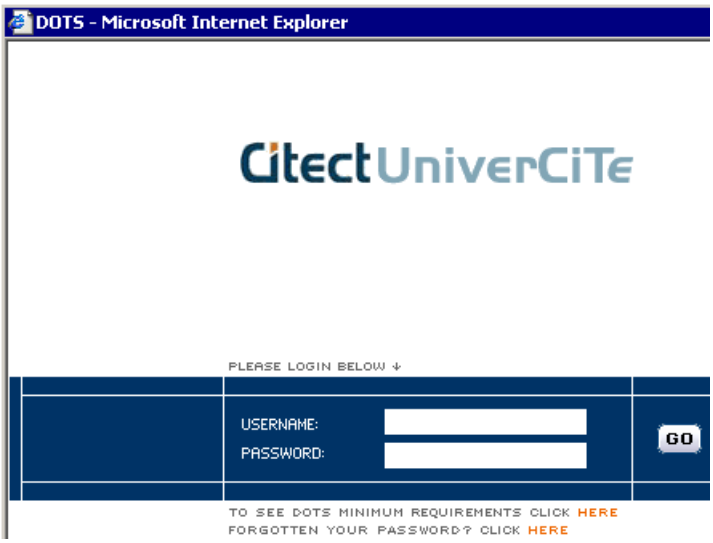
The Examination System (cont.)

Logging In to the Exam System

The Examination system is hosted on the Citect UniverCITe website and can be accessed from a web browser. The Examination Supervisor will have the page loaded prior to your arrival.

1 Login to the Examination System.

i. Enter the student name and password at the login page.



The name and password follows this format.

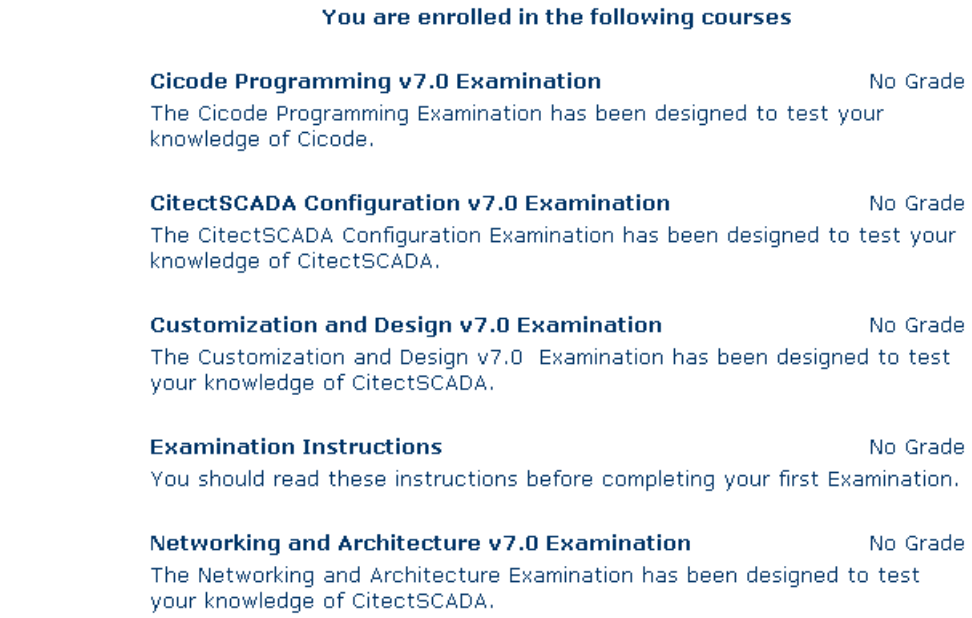
`es_firstname_lastname`

`password`

ii. Click **GO**.

Logging In to the Exam System (cont.)

iii. The Citect UniverCite will open at the Welcome page. All examinations and courses in which the candidate is currently enrolled will be listed.



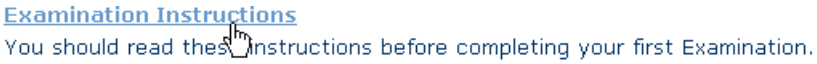
Examination Instructions Course

Course for New Candidates

A course has been provided to introduce new candidates to the examination system. If this is a new candidate they should complete this course before proceeding.

1 Complete the Examination Instructions course.

i. Once the candidate has logged into the examination system all courses and examinations in which they are enrolled are listed. If this is a first time candidate they should complete the **Examination Instructions** course. Click the **Examination Instructions** title to enter the course.



ii. Click the **Start -->** link to open the course.

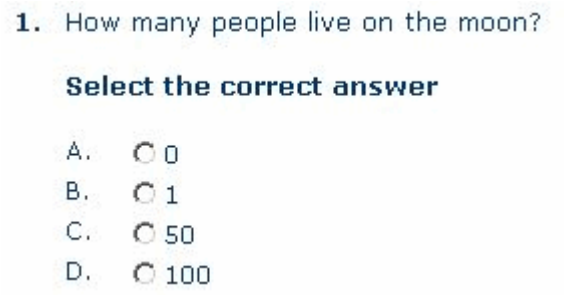
iii. The title page of the Course will open. Click the **Next -->** link to begin the course.

iv. Follow the links through the pages to view examples of all the question types that are used throughout the examination system.

Exam Questions

Single Answer

Read the question and select your response from the list of options. Select the radio button beside your choice.



Multiple Answers

These questions are expecting at least one response, possibly as many as four. Tick boxes are provided for you to select as many or as few responses as you think appropriate.

In order to score the marks for these questions, you much select **exactly** the correct set of responses; there are no partial marks for partially correct responses.

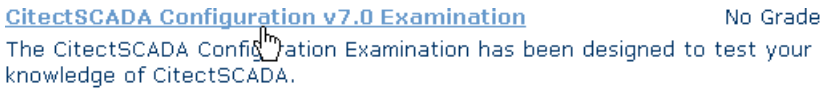
The Examination

Starting the Examination

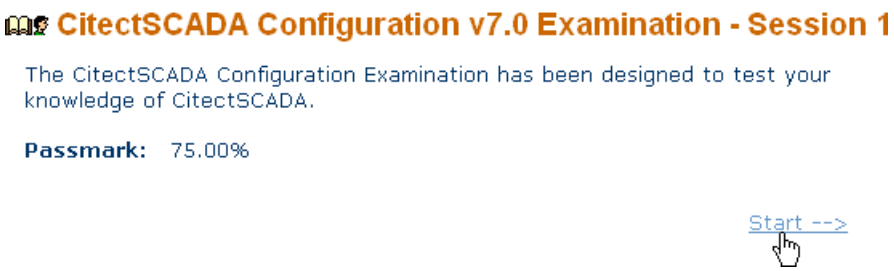
Once a candidate has completed the Examination Instructions course they are ready to begin their first examination.

1 Open the Examination.

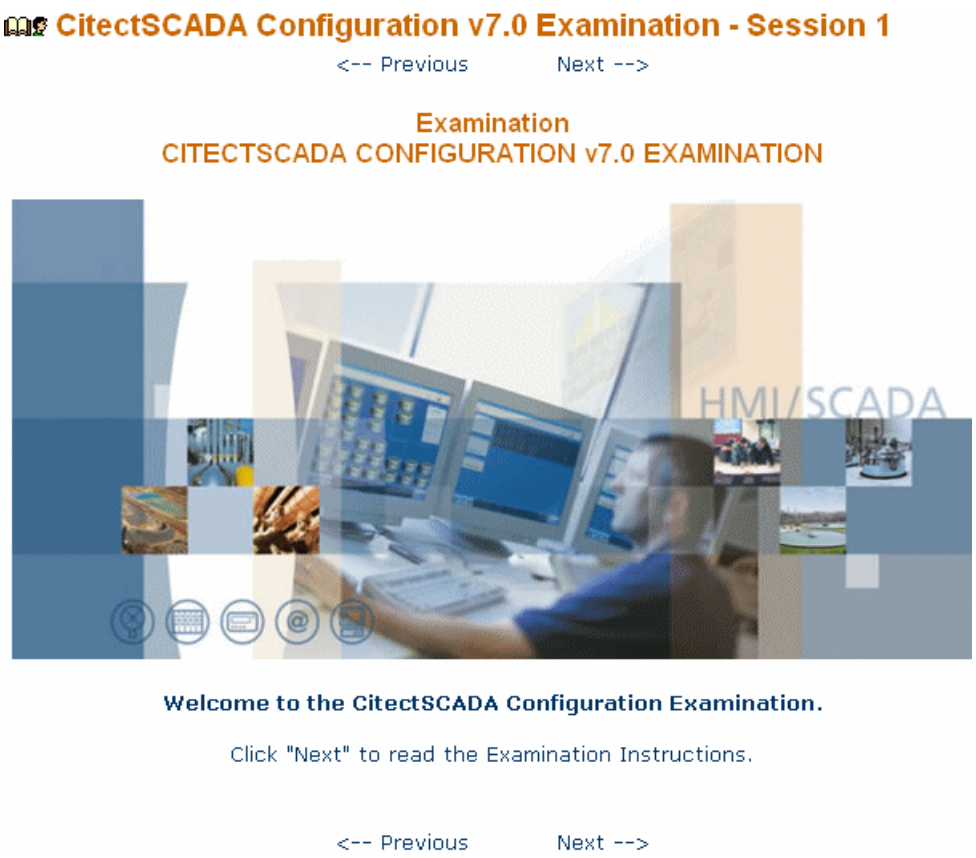
i. Return to the Welcome page and open the examination by clicking the link.



ii. The introduction page will give the title of the examination and the passmark. Click the **Start -->** link to open the **Title Page**.

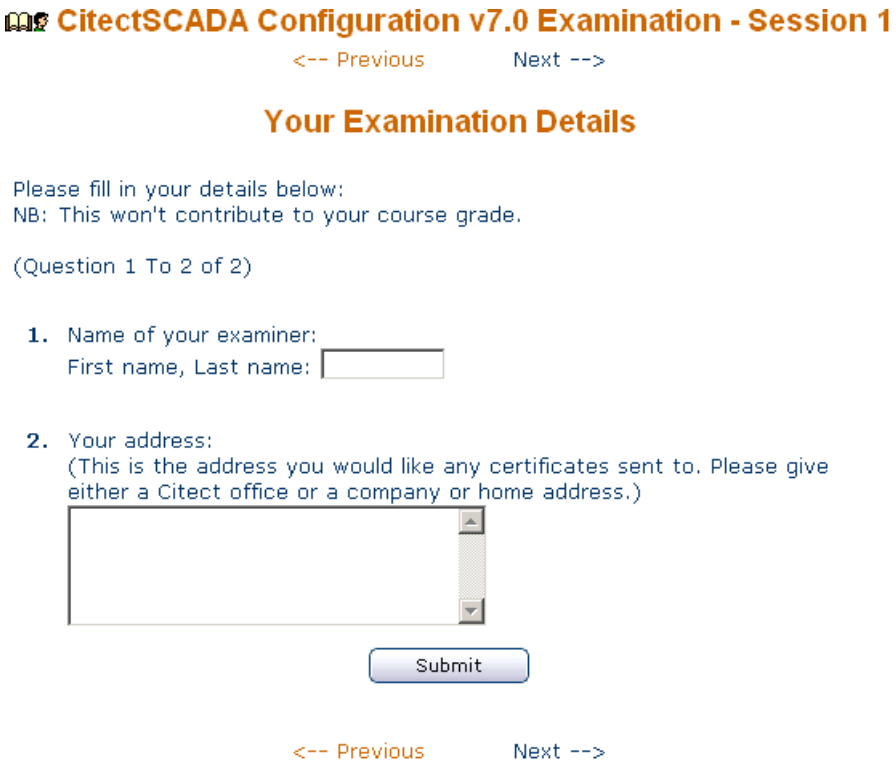


iii. The next page is the title page of the examination. Click the **Next -->** link to continue.



The Examination (cont.)

iv. This page is for the candidate to enter the information that is needed to print and send their certificate. The certificate will be created using the exact spelling of the candidate name entered on this page. Click the **Next -->** link to continue.

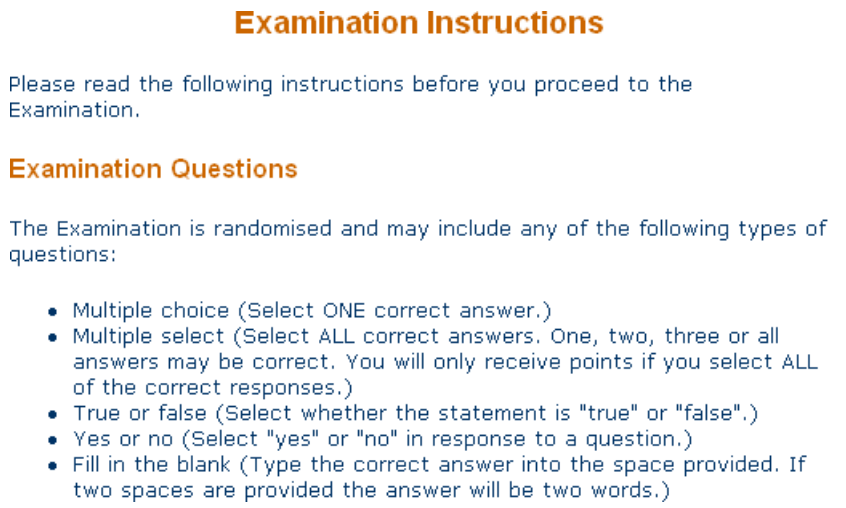


It is critically important that this page is correctly completed and properly submitted as it is the only cross-check we have to ensure the examination was conducted under suitable conditions.

Those exams received by the Chief Examiner without this information may be declared null and the candidate required to re-sit the exam.

The Examination (cont.)

v. The **Examination Instructions** provide the candidate with important information regarding the type of questions that they will see.



Examination Instructions

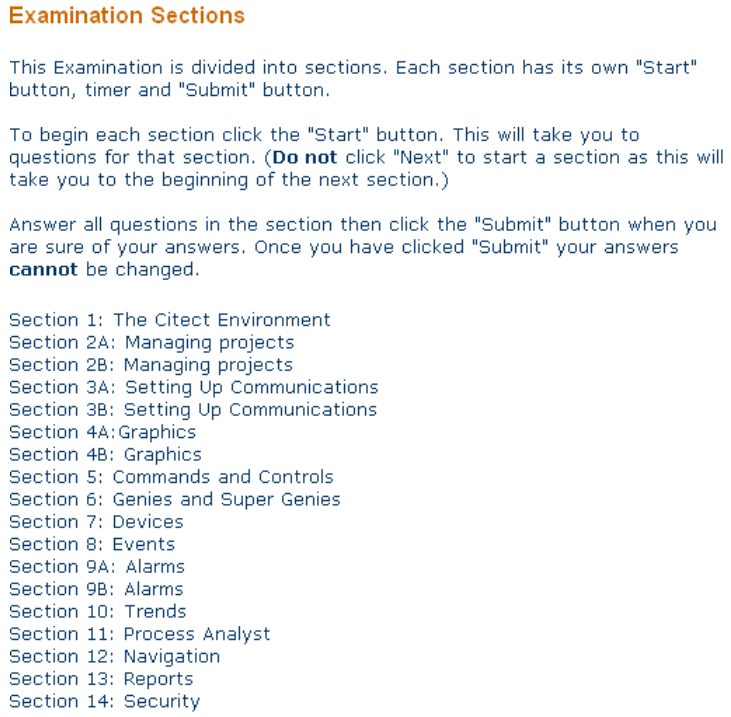
Please read the following instructions before you proceed to the Examination.

Examination Questions

The Examination is randomised and may include any of the following types of questions:

- Multiple choice (Select ONE correct answer.)
- Multiple select (Select ALL correct answers. One, two, three or all answers may be correct. You will only receive points if you select ALL of the correct responses.)
- True or false (Select whether the statement is "true" or "false".)
- Yes or no (Select "yes" or "no" in response to a question.)
- Fill in the blank (Type the correct answer into the space provided. If two spaces are provided the answer will be two words.)

vi. The Examination Sections provides information on the content of each section and the controls that are contained within each section. It is important that the candidate is familiar with these controls.



Examination Sections

This Examination is divided into sections. Each section has its own "Start" button, timer and "Submit" button.

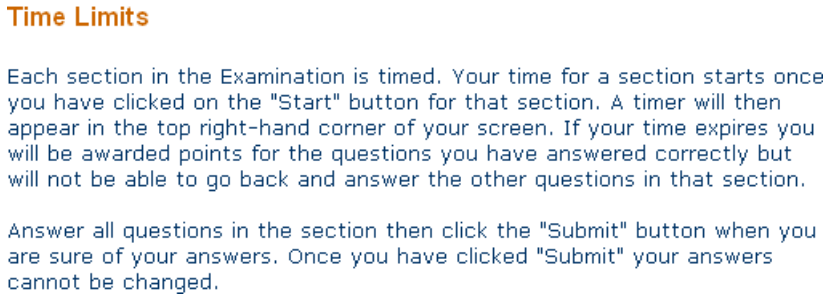
To begin each section click the "Start" button. This will take you to questions for that section. (**Do not** click "Next" to start a section as this will take you to the beginning of the next section.)

Answer all questions in the section then click the "Submit" button when you are sure of your answers. Once you have clicked "Submit" your answers **cannot** be changed.

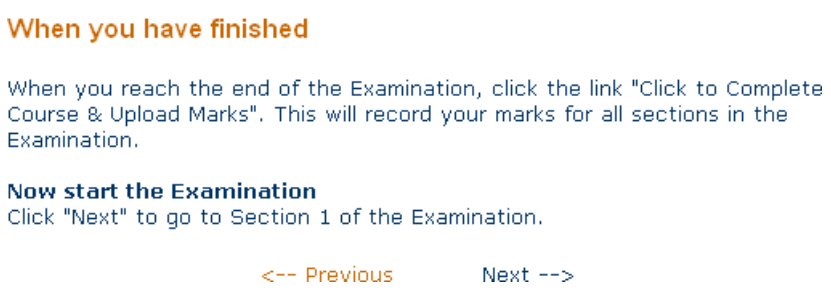
Section 1: The Citect Environment
Section 2A: Managing projects
Section 2B: Managing projects
Section 3A: Setting Up Communications
Section 3B: Setting Up Communications
Section 4A:Graphics
Section 4B: Graphics
Section 5: Commands and Controls
Section 6: Genies and Super Genies
Section 7: Devices
Section 8: Events
Section 9A: Alarms
Section 9B: Alarms
Section 10: Trends
Section 11: Process Analyst
Section 12: Navigation
Section 13: Reports
Section 14: Security

Starting the Examination (cont.)

vii. The instructions page provides information regarding the time limits and how to submit each section. Once the section has been submitted they may not re-enter that section. The time allocated increases with the difficulty of the questions. Regardless of the difficulty or the number of the questions each section is given a minimum of 5 minutes. Extra time has been provided in this system due to the needs of candidates who do not not speak English as their primary language.



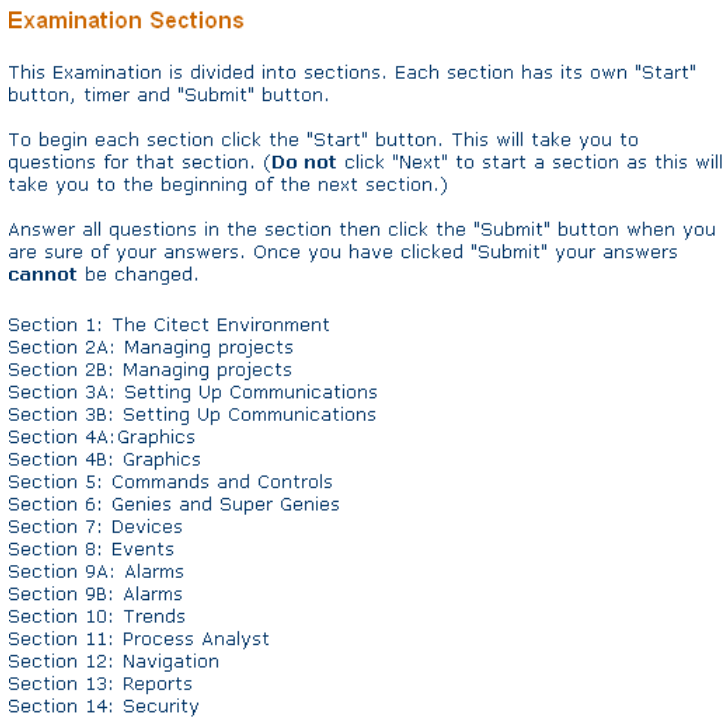
viii. The instructions page also provides information regarding how to finalise the examination and upload their marks. When the candidate has finished reading this page click the **Next -->** link to continue.



Exam Sections

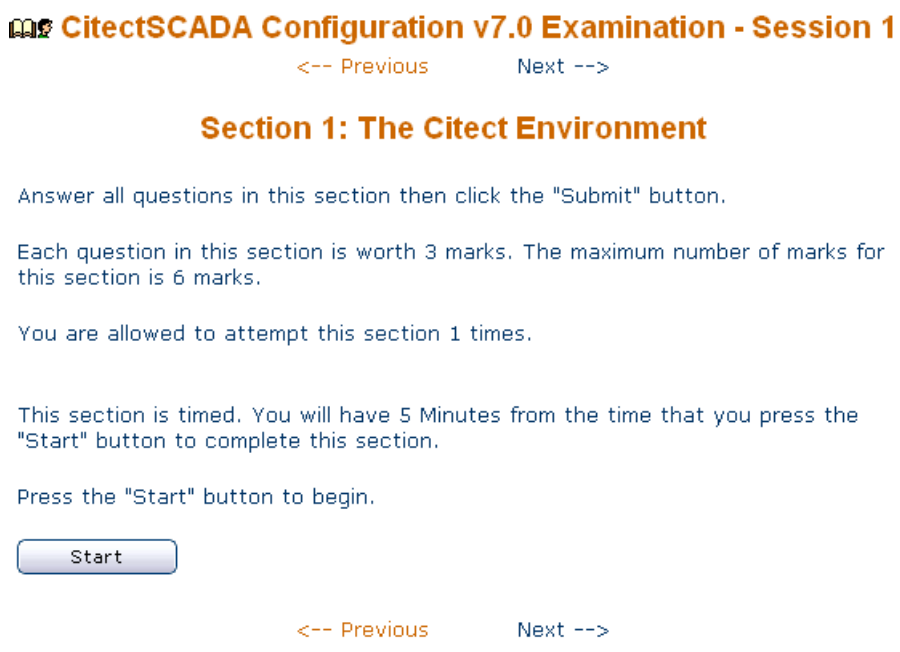
Topics

Each **Exam Section** covers a specific **Topic**. These topics are listed when the exam is entered but before the exam starts.



Value

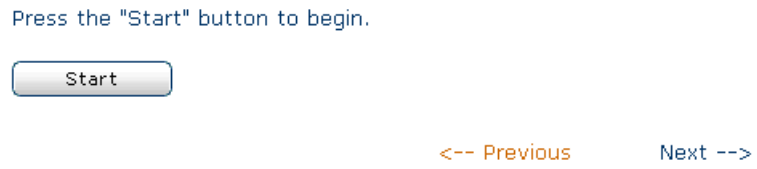
Each section contains a pool of questions. The candidate is given a random selection from this pool. Not all questions are of the same difficulty. Therefore different sections have different values assigned to the questions. However, all questions in each section have the same value. The Section information at the beginning of each section indicates the value of the questions.



Exam Sections (cont.)

Entering the Section

The Section Information page has a Start button that must be clicked to enter the section. The candidate should **NOT** press the **Next -->** link as this will not enter the section. Instead it will take them to the beginning of the following section.

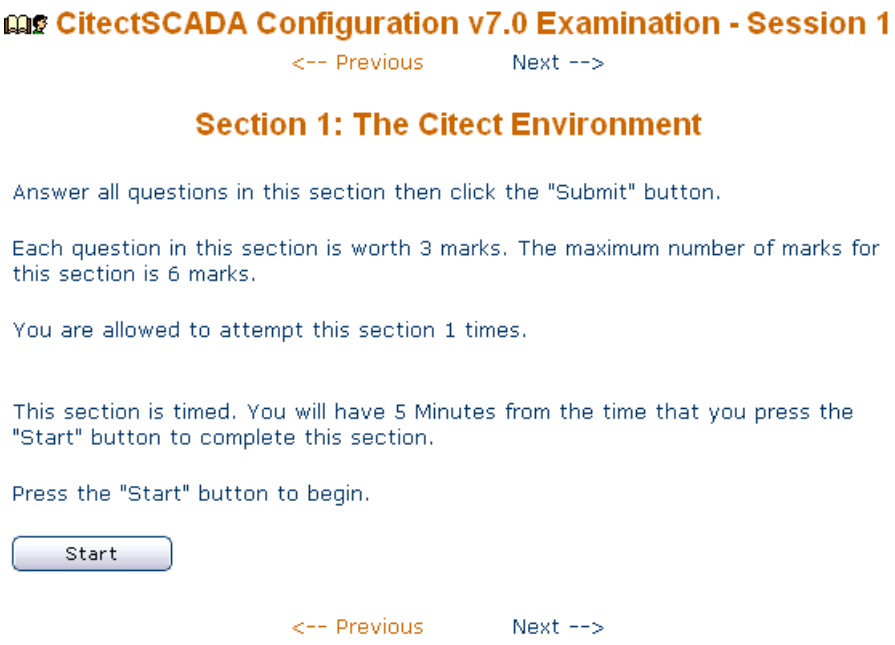


Section Time

All Sections allow a certain maximum amount of time in which to complete your work. Each section of the examination corresponds to chapters in the courses and is timed independently.

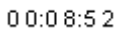
The available time is fixed for each exam and is also subdivided into allotments for each section of the exam. The system will not "bank" time - at the end of a section, any spare time is lost.

The Introduction page of each section provides the candidate with the time available for that section.



The candidate is able to control when they start each section. The section timer starts when the candidate clicks the Start button

This time is indicated by an onscreen counter/clock in the top right hand corner of the screen.



Exam Sections (cont.)

Completing a Section

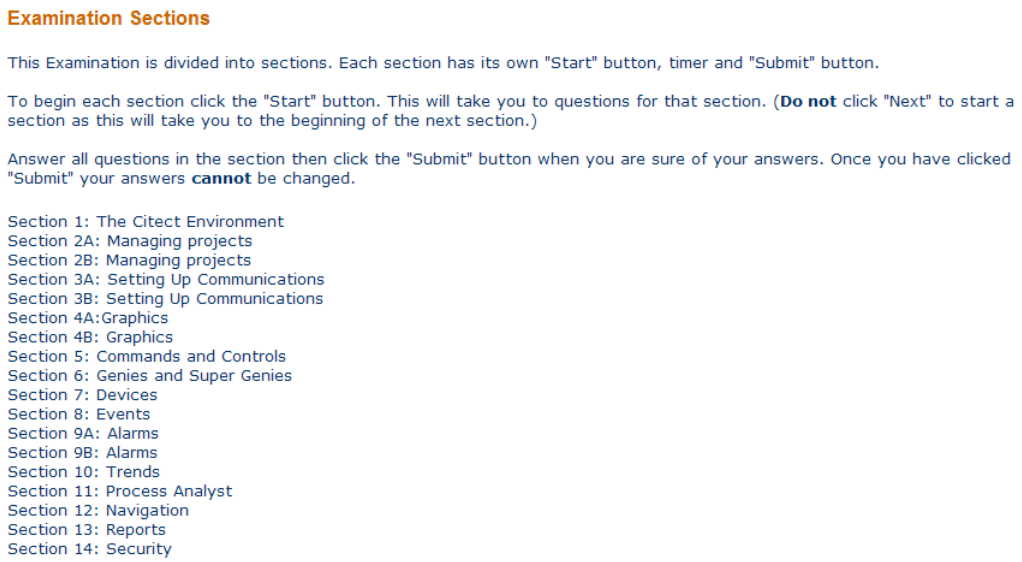
When the candidate clicks **Submit,** the section is graded and the section results are displayed. This is the reason why it is not possible to return to a section.

Working through the Exam

Exam Sections

Having confirmed your details, you are then presented with the exam sections you will encounter. Each of these sections is separately timed and questions in each section, although having equal value, may have different value to questions in other sections.

Typically, there are easy questions worth few marks and hard questions worth more marks. This is your last opportunity to decide you're attempting the wrong exam!

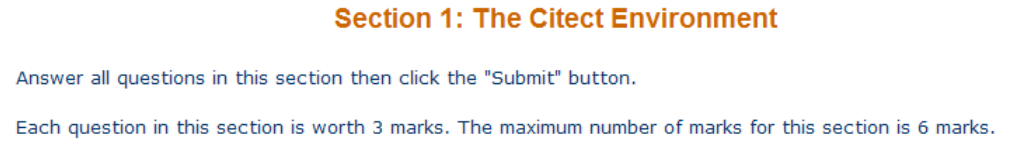


Once you click the **Start** button (not shown in the graphic) timing commences for the first section.

Inside a section

You will be given the name of the section and advised the value of each section and the total number of marks available in the section. The timer in the top-right corner of the screen commences a count-down.

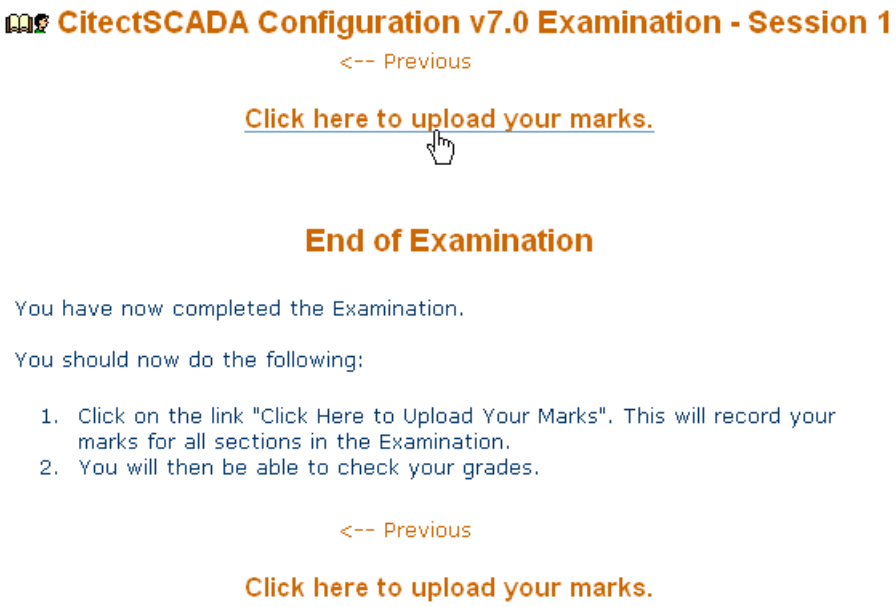
Click submit at the bottom of the screen to complete the section. You will be warned if there are un-completed questions and the section will not close.



Submitting an Exam

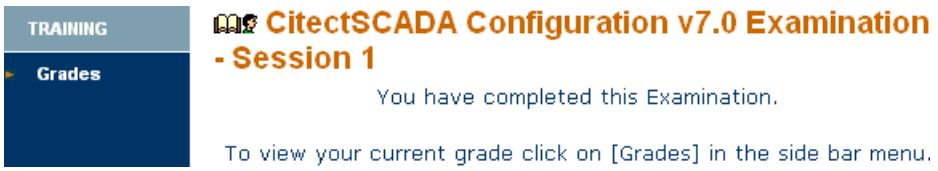
Last Exam Section

Once the examination has been completed the candidate needs to submit their examination. This is done by clicking the **Click to Complete Course & upload Marks** link.

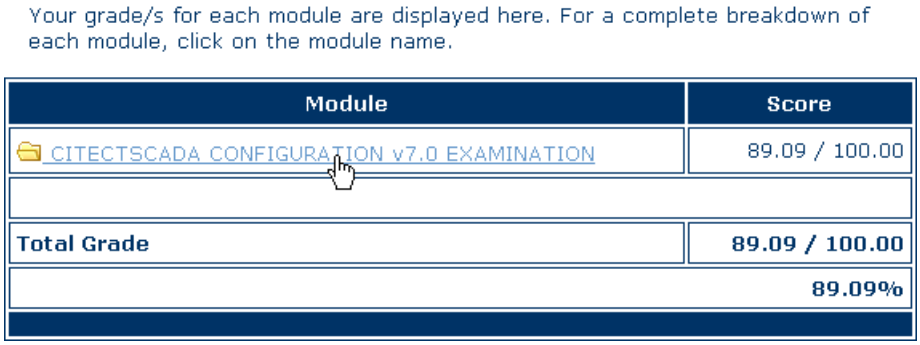


Confirmation and Results

The examination completion is confirmed and the candidate may view their results by clicking the **Grades** link on the left side menu.



The page will display their overall result. The full section detail may be viewed by clicking the module name.



Submitting an Exam (cont.)

Detailed Results

The full section detail allows the candidate to view the results for each section so that they can see which sections they may need to review.

Section 1: Introduction	
Section 1: Introduction	6.00 / 6.00
Topic Total	**6.00 / 6.00**
Section 2A: Variables	
Section 2A: Variables Drag and Drop	7.00 / 7.00
Topic Total	**7.00 / 7.00**
Section 2B: Variables	
Section 2B: Variables	16.00 / 18.00
Topic Total	**16.00 / 18.00**
Section 3A: Simple Functions	
Section 3A: Simple Functions drag and drop	4.97 / 7.00
Topic Total	**4.97 / 7.00**

Passing Grade

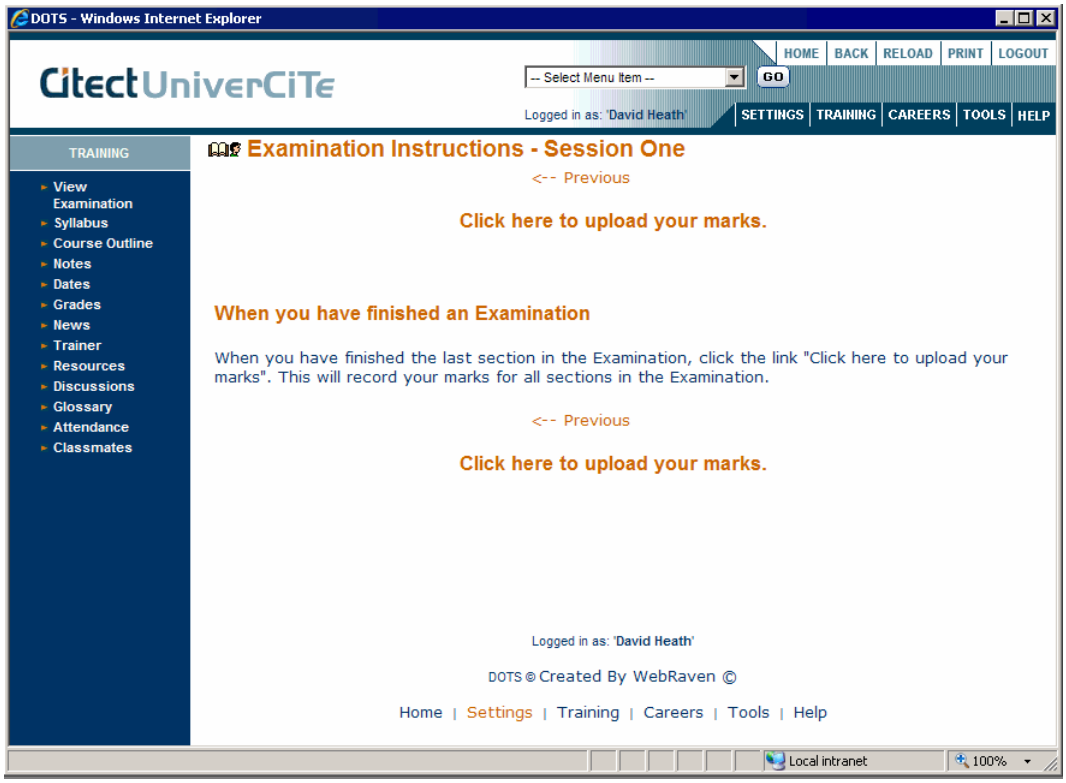
The pass mark for all exams is 75%.

Once all of the exams have been passed (or the upgrade exam for an existing CSCE), the Examination Administrator will be advised automatically. The certificate will be mailed within a few days.

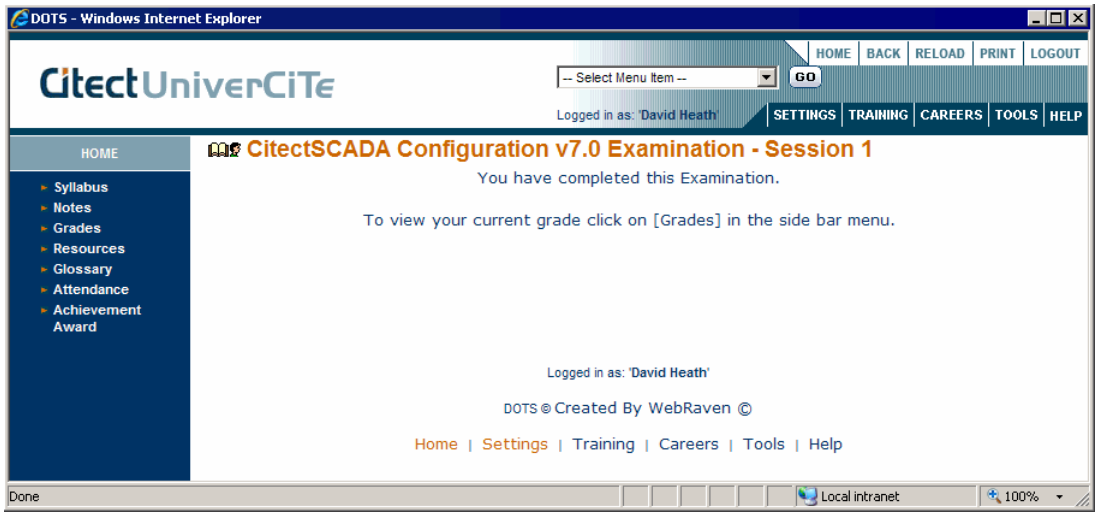
Completing the Exam

Uploading Your Marks

After submitting the final exam section, a screen will be presented inviting you to upload your marks.



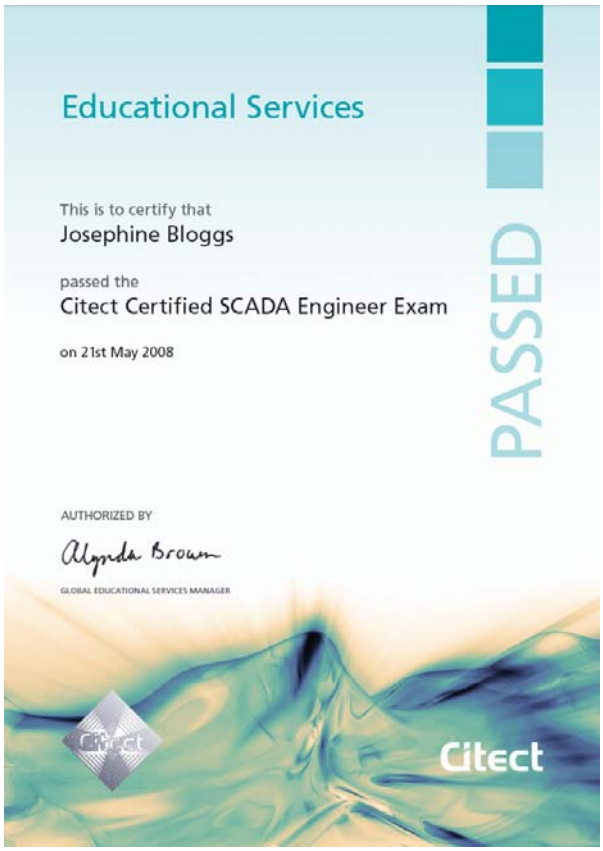
Once done, you are advised that your final grade may be seen via the Grades link on the left-side menu. The exam is completed.



Successful Completion

Certificates

If the candidate has been successful in all the required examinations they will be given CitectSCADA Certified Professional (CSCP) or CitectSCADA Certified Engineer (CSCE) status. Unlike the course certificates, a CSCP or CSCE qualification is one that implies attainment of a level of expertise. In order to separate the two types of certificate given by Citect, any accreditation that implies the attainment of expertise is represented by the word **PASSED** on the certificate. The certificates may be sent either directly to the candidate or to the Examination Centre.



Chapter 2: V7.20 Diagnostics and Troubleshooting Exam Topics

Overview

Introduction

At any time, a fully configured and properly operating system may experience problems. These may be related to issues on the network, on the computers or simply a side-effect of growth in the system.

In order to be able to isolate and deal with such issues, the ability to intelligently troubleshoot is an important skill.

This Chapter Covers These Topics:

Tag Extensions

Access to Plant Meta-data

A tag name by itself (for instance TIC_P1_PV) carries the current value as its only attribute. In order to access additional information, a series of sub-fields, referred to as **Tag Extensions** has been defined.

In addition to the actual plant data, Tag Extensions provide access to:

- Tag value Quality and Timestamp information
- Extended data associated with a variable tag

In addition, it is now possible to perform the following actions:

- Override the tag variable value
- Prohibit writing to the tag variable value
- Display and trend the tag values even if quality is not “Good”

Access to this extra information allows operators to gain a deeper understanding of the actual state of their plant.

Quality information was available in CitectSCADA v7.0 and v7.10 via a suite of Cicode functions, however the information has now been made more visible with this new structure.

See Also:

For further information about **Tag Extensions in previous versions,** see *CitectSCADA KnowledgeBase - "Q5741 - PSI Quality values."*

Project developers should also be aware that Tag Extensions can be used inside SuperGenies and Popup pages, but not in their associations.

If a tag with an extension is passed to an association then Runtime doesn't parse it and split to Tag, Element and Item, but interprets entire string with dots as a tag name. This will almost certainly lead to a ‘tag not found’ compile error.

Note:

The use of tag Extensions will have an effect on network traffic as the distribution of Quality and Value timestamps will increase the amount of data being sent between servers and clients.

Tag Extensions (cont.)

Quality Attributes

The primary extension fields are as follows;

tagname.**v**	The current tag **value** (this is the same as referencing the tagname without any extension).
tagname.**vt**	The **value timestamp.** This is the timestamp of when the value last changed.
tagname.**q**	The **quality** of the tag value. This will represent the quality of the value and is expressed as either GOOD, UNCERTAIN or BAD
tagname.**qt**	The **quality timestamp.** This is the timestamp of when the quality last changed
tagname.**t**	The timestamp of when the tag or element was last updated.

Tags may now be referenced according to this syntax:

[Cluster.]Tag[.Element][.Item]

The tag data may be accessed via a Cicode function, or a Text element on a graphics page by using either a qualified or an unqualified tag reference.

A qualified tag reference includes the tag element name and provides access to the specified tag element or the element item, for example. “Tag1.Field”, “Tag1.Field.Q” where "Field" is the element name and "Q" is the item name. An unqualified tag reference is one that does not include a tag element name or item name, and is resolved at runtime, for example “Tag1”, “Tag1.Q”.

Tag Extensions (cont.)

Ensure Operators are Aware

To provide a visual indication to the operator that a tag is in the **Control inhibit** mode the following can be done:

Set any of the following Citect.ini parameters in such a way that Control inhibit mode will be indicated by changing the background colour or overlaying the numeric or text graphics objects and symbol set objects with a dithered pattern:

[Page]ControlInhibitDitheringColor [Page]ControlInhibitDitheringDensity [Page]ControlInhibitTextBackgroundColor In addition, set [Page]IgnoreValueQuality parameter to a value of 0 or 2.
or Use the Control Mode element value (0 if the tag is not in the control inhibit mode or 1 otherwise)
or Use the Field element quality Tag Status ControlInhibit bit (1 if the tag is in the control inhibit mode or 0 otherwise)

Caution!

Dithering values are not implemented when values are delivered to a graphic page using the tagname.V format. If the .V format is used, project designers must find some other way to identify that Override of Control Inhibit modes are set. This may be confirmed with a close inspection of the popup page in Exercise - Control Inhibit and Override Modes .

Tag Extensions (cont.)

Quality and Timestamp Cicode Functions

There are a number of Cicode functions provided to deal with the **Quality** and **Timestamp** attributes of the Tag Extension fields.

Quality Functions	
QualityCreate	Creates a quality value based on the quality fields provided.
QualityIsBad	Returns a value indicating whether the quality is bad.
QualityIsGood	Returns a value indicating whether the quality is good.
QualityIsUncertain	Returns a value indicating whether the quality is uncertain.
QualityIsOverride	Returns a value indicating whether the tag is in Override Mode.
QualityIsControlInhibit	Returns a value indicating whether the tag is in Control inhibit mode.
QualityGetPart	Extracts a requested part of the Quality value from the QUALITY variable.
QualitySetPart	Sets a Quality part's value to the QUALITY variable.
QualityToStr	Returns a textual representation of the CitectSCADA quality.
VariableQuality	Extracts the quality from a given variable.

Timestamp Functions	
TimestampAdd	Adds time (in part of) to a TIMESTAMP variable.
TimestampCreate	Returns a timestamp variable created from the parts.
TimestampToStr	Converts a TIMESTAMP variable into a string.
TimestampDifference	Returns a difference between two TIMESTAMP variables as a number of milliseconds.
TimestampCurrent	Returns the current system date and time as a TIMESTAMP variable.
TimestampFormat	Format a TIMESTAMP variable into a string.
TimestampGetPart	Returns one part (year, month, day, etc) of the timestamp variable.
TimeIntToTimestamp	Converts a time INTEGER which is represented as a number of seconds since 01/01/1970 to a TIMESTAMP
TimestampSub	Subtracts time (in part of) from a TIMESTAMP variable.
TimestampToTimeInt	Converts a TIMESTAMP variable into a time INTEGER which is represented as a number of seconds since 01/01/1970.
VariableTimestamp	Extracts the timestamp from a given variable.

Tag Extensions (cont.)

Suggested Exercises

Use these suggested exercises to increase your understanding of the topic.

- Access the Tag Extensions popup page in the Example project and manipulate the various properties available.
- Work with the available citect.ini parameters and cicode functions to control the display of quality and other Tag Extension attributes.

Further Reading

Use the following references to assist your understanding of the topic.

- CitectSCADA Help Topic - *Tag Extensions*.
- CitectSCADA Help Topic - *Tag data Types*.
- CitectSCADA Help Topic - *Controlling and OverridingTag Values*.
- CitectSCADA Help Topic - *Page Parameters*.

The Cicode Kernel

How to Open the Kernel

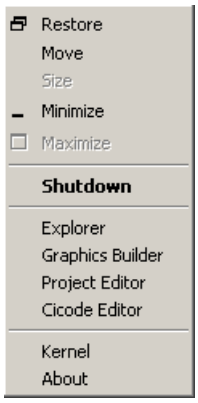
There are several ways to gain access to the Kernel.

- **To open the Citect Kernel using the Computer Setup Editor:**

Open the Computer Setup Editor and add this parameter:

```
[DEBUG]
Menu=1
```

This will place an entry for the Kernel on the Control Menu that is displayed when the icon to the left of the title bar is single clicked or by pressing Alt-Space on the keyboard.



or

Add this parameter:

```
[Debug]
Kernel=1
```

This will show the Kernel as the project is compiling and also when CitectSCADA starts runtime. As most problems with CitectSCADA are to do with something not communicating or not connecting properly, the only way to see exactly what happens and when is to be viewing the Kernel as CitectSCADA starts up.

The Citect Kernel (cont.)

How to Open the Kernel (cont.)

➢ **To open the Kernel using the Runtime Manager:**

Another way to gain access to the kernel is to single click the **Runtime Manager** icon in the system tray then right click one of the processes and select **Kernel** from the menu.

Note:

The availability of the Kernel option in the Runtime Manager is controlled by the `Menu = 1` parameter described earlier.

Access to the Runtime Manager may also be gained via the Cicode function `DisplayRuntimeManager()` which will display the Runtime Manager on the local computer. If the Runtime Manager is already running, it will be brought to the foreground.

Kernel Access

It is important to restrict access to the Kernel, because once a user has acces to the Kernel, any Cicode function can be executed with no privilege restrictions.

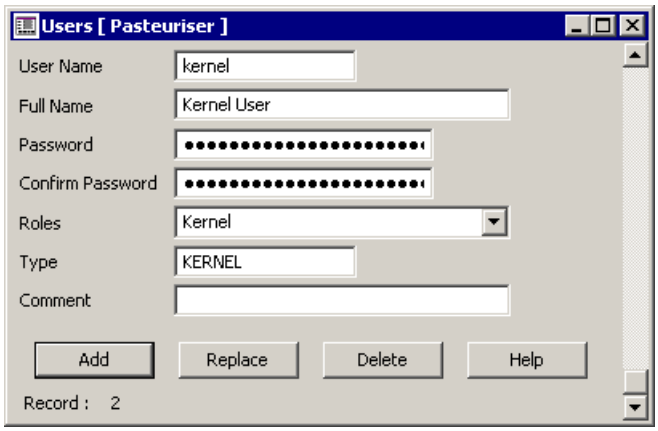
Anyone using the Kernel will have total control of CitectSCADA (and subsequently the plant and equipment). Therefore in a normal runtime environment it is not good practice to enable the Kernel menu command or configure the Kernel to start up automatically.

The function **DspKernel(1)** will open the Kernel from a button or system command.

The Cicode Kernel (cont.)

Password Protection

Cicode and **Cache** commands are password protected in the Kernel, preventing unauthorized access. A user named **kernel** must be defined in the **User database** of the CitectSCADA project in order to gain access to these windows.



The user **must** be called kernel and have a non-blank password. There is no requirement for the user to have any specific privileges or areas assigned.

See Also:

For further information about **The kernel user,** see *CitectSCADA Help - Using the Kernel*.

Debug Cicode Functions

This command is particularly useful for debugging Cicode functions and running functions directly from within the running system.

The Cicode command opens a child window that can be used to call Cicode functions. Any in-built or user-written function can be called from this window. When the Cicode command is entered a local Cicode window is created. The syntax is:

```
Cicode
```

Each Cicode command is executed with its own Cicode task, so tasks that take a long time to complete can be executed.

The Cicode prompt returns immediately after the Cicode task has started and the task continues to run in the background. If the function is completed immediately, the return result of the function is displayed. If the function continues to run, the result is not displayed and cannot be returned.

 **Note:**

As mentioned previously, Cicode and Cache commands are now password-protected in the Kernel, preventing unauthorised access.

The Cicode prompt 0:> shows the current window number with which any object is associated. To change the current window, use the WinGoto() function (or any other Cicode function that affects the current window).

The Cicode window does not recognise any variable names, so when a Cicode function is called, it is possible to pass constants only (e.g. numbers or strings).

When a function that expects a string is called, ya string constant should be passed, e.g. Prompt("Hello from the Kernel"). If the string is only a single word, delimiters need not be used, e.g. Prompt(Hello).

The Cicode window tries to convert whatever is entered (as arguments) into the correct data type. If it cannot convert the arguments, it passes either 0 (zero) or an empty string to the function.

 **Note:**

Some Cicode functions are implemented as label macros by the compiler. These macros allow backward compatibility when the number of arguments to a function has been changed.
These functions cannot be called directly because the Cicode window does not expand macros. In this case the macro expansion must be used. If the function cannot be found, try again by adding an underscore (_) to the front of the function name, e.g. _DevClose(1)

The Cicode Kernel (cont.)

Tasks and Pre-emption

Cicode tasks (or threads) can be executed in either **foreground** or **background** mode. A foreground task is one that displays and controls animations on the graphics pages. Any expression (not a command) entered in a **property** field (i.e. Text, Rectangle, Button, etc.) is executed as a foreground task. All other commands and expressions are executed in background mode.

The difference between a background and foreground task is that a background task can be **pre-empted**, that is, if system resources are limited, the task (e.g. the printing of a report) can pause to allow a more critical task to be executed. When the critical task is completed (or when system resources become available) the original task resumes. Foreground tasks are considered critical and can never be pre-empted.

Suggested Exercises

Use these suggested exercises to increase your understanding of the topic.

- Access the kernel using all available methods.
- Open a variety of Kernel windows and note their behaviour.
- Write a function that will increment the value of a variable indefinitely.
- Call the function from a command button.
- Call the function from a command button using TaskNew().
- Compare the two running threads using the Page Cicode in the kernel and the Thread Window in the Cicode Editor.

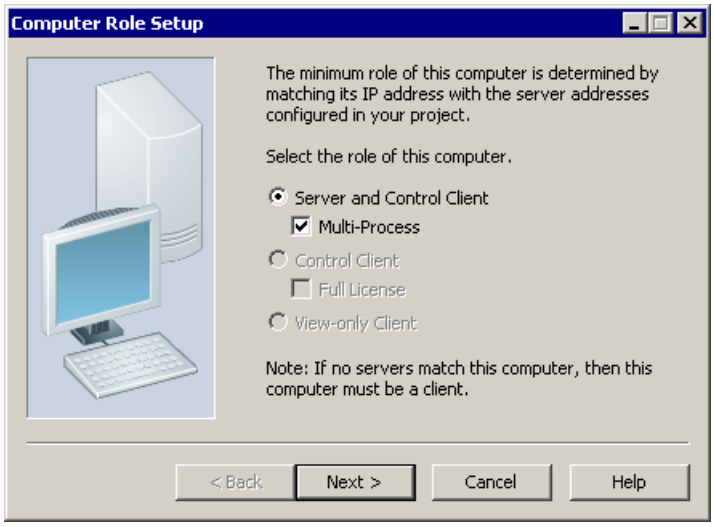
Further Reading

Use the following references to assist your understanding of the topic.

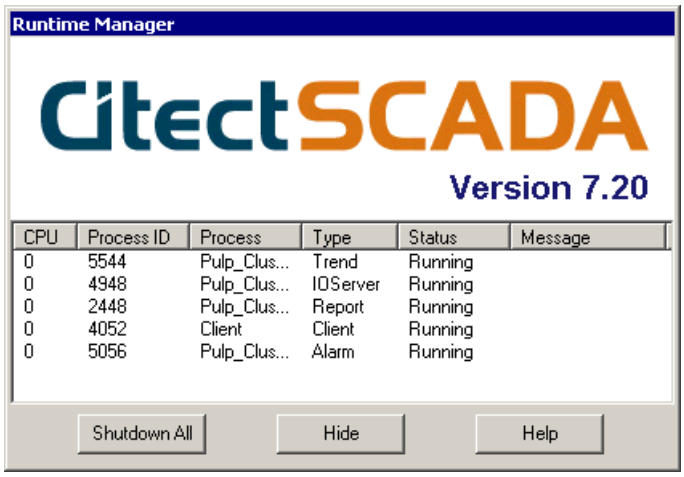
- CitectSCADA Help Topic - *Foreground and background tasks.*
- CitectSCADA Help Topic - *Using the Kernel.*
- CitectSCADA Help Topic - *taskNew.*

Multi-process Kernel Startup

Every instance of CitectSCADA on a given computer has a separate kernel view for each process when the **Multi-Process** option is selected in the Computer Role setup. Examples of processes include a Trend Server, an Alarm Server, a Report Server, and an I/O Server. In pre V7 versions of CitectSCADA, each of these Servers existed, but they were all contained within a single process. Even the Control Client is now a process.



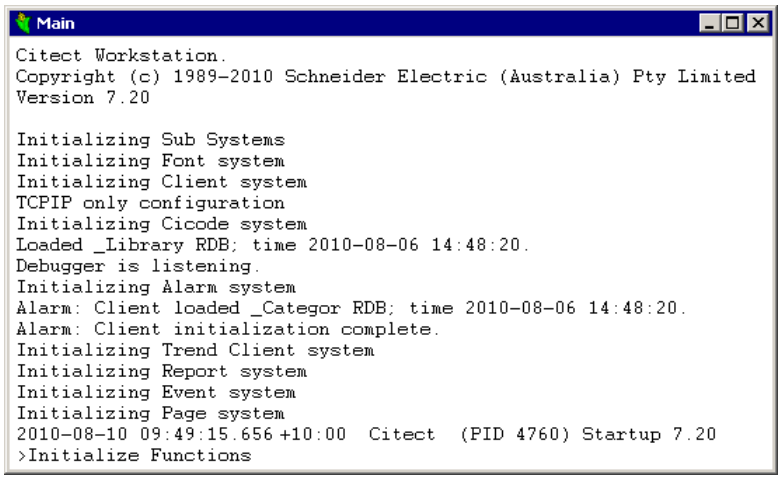
In this mode, when the project is run, the Runtime manager window will display separate tasks for each process.



Communication and the Kernel (cont.)

Kernel Startup Information

Once the Kernel is open a Line by Line description of the startup process is visible (this is identical whether the computer is a standalone or a networked Server).



These are some typical startup notifications and their meanings.

Version	The first line displays version of CitectSCADA.
Initializing Sub Systems	These internal sub systems provide services to the major components and must be started first so that the bigger components can be started. Once all these sub systems are loaded then the RDB system is initialised and CitectSCADA can start loading the RDB files.
Initializing Font System	This is now creating all fonts that have been defined within CitectSCADA. These are fonts for displaying items such as Alarms, and any pre V5.0 dynamic text.
Initializing Client System	This is determining what Servers the Client needs to talk to, as set in the INI file.
TCPIP only configuration	This is a relic. Prior to V7, CitectSCADA supported both TCP/IP and NetBIOS.
Initializing Cicode System	All the Cicode has been loaded into memory and is getting ready to run.

Status Messages when the Kernel Starts Up (cont.)

Kernel Startup Information (cont.)

Loaded _Library RDB	_Library.RDB contains all of the compiled custom Cicode functions developed as part of the project. these must be loaded separately.
Debugger is listening	The breakpoint debugger is always active, whether or not breakpoints have been placed in any Cicode functions. Breakpoints are discussed in Exercise - Thread Window .
Initializing Alarm System	Starting the Alarm Server.
Alarm: Client loaded _Categor RDB	Alarm Category information is separately stored in _Categor.RDB; this file is loaded into the Alarm Client separately.
Alarm: Client initialization complete	The Alarm Client is loaded and functional.
Initializing Trend Client System	The Trend Client is slightly different than the normal Client so it has its own method of doing things.
Initializing Report System	Starting the Report Server.
Initializing Event System	Starting the Event Server.
Initializing Page System	The system is ready to display the Startup Page. It is at this time that CitectSCADA will cover up the Kernel. Use the TaskBar or switch to the kernel with Alt-Tab or Alt-Esc to return to the Kernel screen.
Citect (PID 4760) Startup	This identifies the Windows Process ID Number of the client task and confirms that the Server has completed the startup teps successfully.

Status Messages when the Kernel Starts Up (cont.)

Kernel Startup Information (cont.)

Things to Watch	Areas to watch are that all the PLCs come online. First the ports must be initialised and be online, then the PLCs should all come online. Some PLCs may take 2 attempts from CitectSCADA to come online or may not be connected initially. In that case messages that are specific to every PLC type will be displayed. All these messages are basically similar and will identify something like PLC not responding, or, Unit Offline, or something similar. If the PLC is difficult to connect to, then wait 30 seconds (the standard period that CitectSCADA waits until it will try to connect again) and see what happens this time. If still nothing good happens then it is time to check EVERYTHING.

Hints & Tips

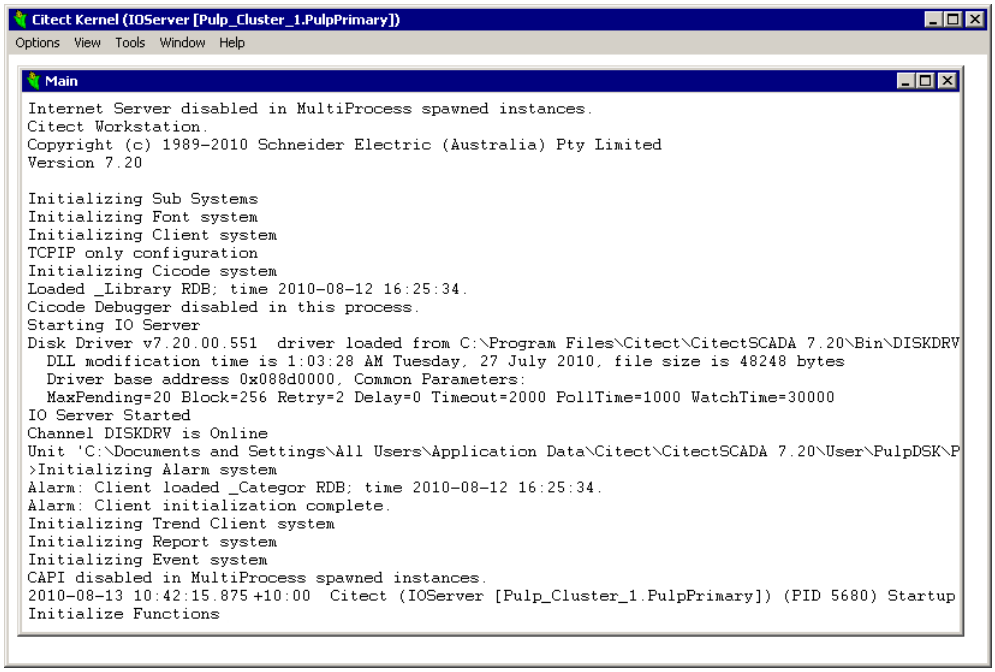
Use the Pulp or Paper project for the exercises to do with networking. It may be useful in the exercises that examine performance and code to use different projects such as the Example project and compare the differences.

Communication and the Kernel (cont.)

Server Startup

This screen displays the Kernel startup for the I/O process of a computer that is the I/O, Alarm, Trend and Report Servers. The screen displays all messages as the Servers are first initialised and then started.

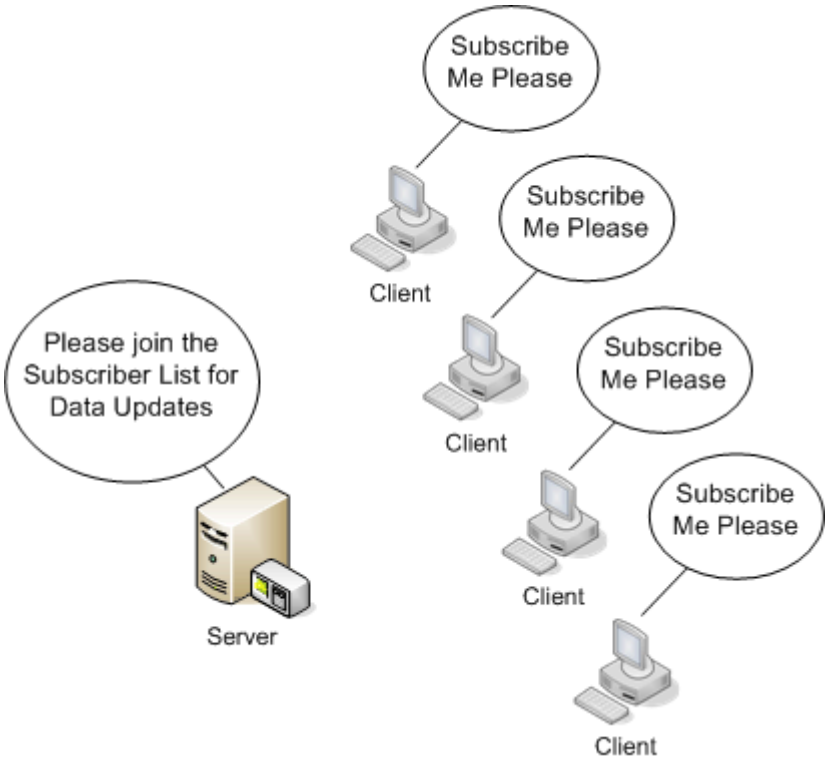
The previous exercises were based on a persisted Memory I/O Server which is relatively invisible to the kernel startup logs. The next few steps will be based on a Disk PLC I/O Device.



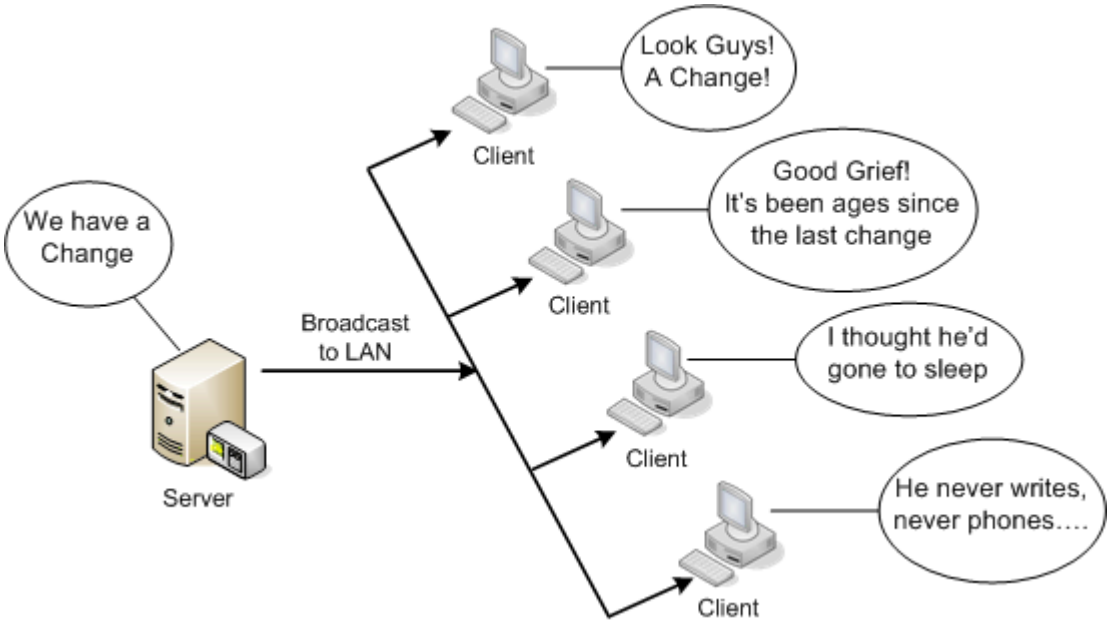
Communication and the Kernel (cont.)

Publish Subscribe Model

A more effective method of communication is for the **Clients** to join a list of users and identify the information they need. In other words the Clients **Subscribe** to the Server.

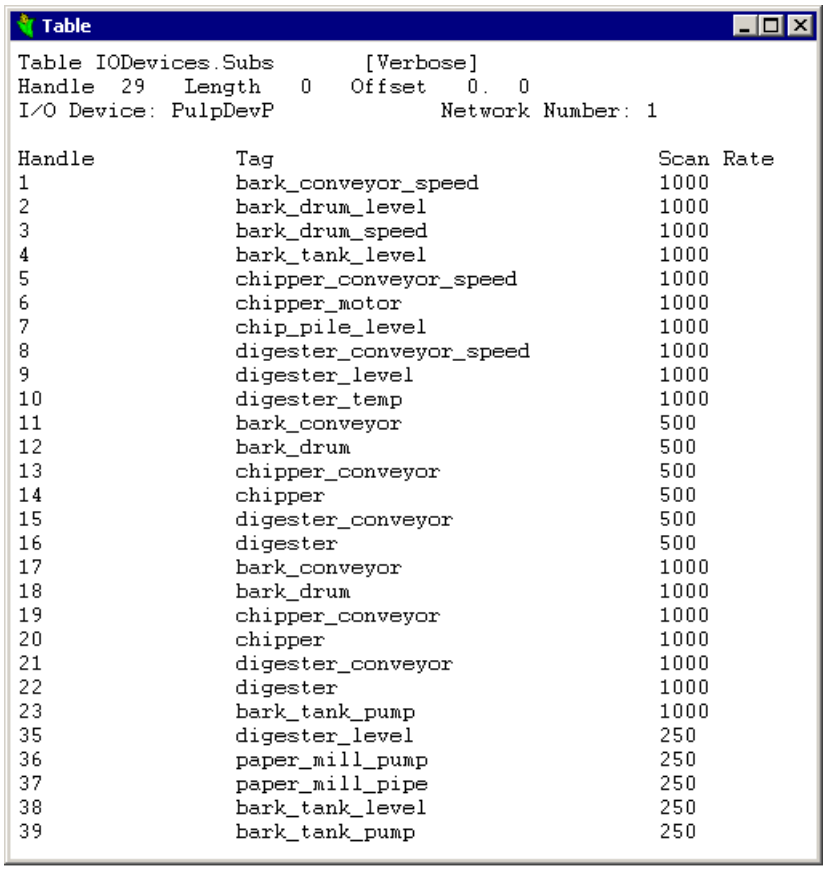


The Server will announce, or **Publish**, the new information to the subscribers when there is data that has changed. This reduces the amount of network traffic considerably.



Tag Subscriptions to I/O Device

The IODevices.Subs table shows all the tag subscriptions that have been made to this I/O Device.



Table

```
Table IODevices.Subs        [Verbose]
Handle  29   Length   0   Offset   0.  0
I/O Device: PulpDevP              Network Number: 1

Handle          Tag                                Scan Rate
1               bark_conveyor_speed                1000
2               bark_drum_level                    1000
3               bark_drum_speed                    1000
4               bark_tank_level                    1000
5               chipper_conveyor_speed             1000
6               chipper_motor                      1000
7               chip_pile_level                    1000
8               digester_conveyor_speed            1000
9               digester_level                     1000
10              digester_temp                      1000
11              bark_conveyor                      500
12              bark_drum                          500
13              chipper_conveyor                   500
14              chipper                            500
15              digester_conveyor                  500
16              digester                           500
17              bark_conveyor                      1000
18              bark_drum                          1000
19              chipper_conveyor                   1000
20              chipper                            1000
21              digester_conveyor                  1000
22              digester                           1000
23              bark_tank_pump                     1000
35              digester_level                     250
36              paper_mill_pump                    250
37              paper_mill_pipe                    250
38              bark_tank_level                    250
39              bark_tank_pump                     250
```

The fields provide the following information:

Column	Description
Handle	An internal subscription handle (unique identifier)
Tag	The variable tag the subscription has been made for
Scan Rate	The scan rate of the subscription in milliseconds

Note:

There may well be multiple subscriptions to an individual tag and varying scan rates, depending on the project configuration and the number of I/O Clients active at any time.

Communication and the Kernel (cont.)

Variable Tag Deadband

A deadband is expressed as a percentage of the engineering range of the tag to which it is applied.

For example, if a variable tag has an engineering range of zero to 5,000 a deadband of 1 would mean a change of at least 50 would be required before the change was sent through the system. Thus if the current value was 3,230, a value lower than 3,180 or greater than 3,280 would be required in order for the new value to appear at the clients.

Clearly some tags are more amenable than others to being deadbanded.

Suggested Exercises

Use these suggested exercises to increase your understanding of the topic.

- Configure a multi-server CitectSCADA system and observe the start-up screens of all computers.
- Use a variety of kernel pages to track the creation and termination of tag subscriptions between the I/O Server and a variety of clients.

Further Reading

Use the following references to assist your understanding of the topic.

- CitectSCADA Help Topic - *Foreground and background tasks.*
- CitectSCADA Help Topic - *Using the Kernel.*
- CitectSCADA Help Topic - *TaskNew.*

The Minidump File

As part of the standard CitectSCADA installation, the Windows crash handler is automatically extended to enable Mini Dumps to be captured whenever a system crash occurs.

Mini Dumps, which were introduced with Windows XP, are an alternative to the full crash dump that is usually associated with Dr Watson (Microsoft's full crash analysis tool). The crash dump (sometimes also referred to as a user dump) dumps all running threads. Mini dumps give a smaller dump which just provides information on errors due to the faulted thread rather than other threads. They can be an asset to problem discovery.

By default, a crash will create a "light mini dump" which generally seems to contain less information than is required to properly understand the issues at play. Customers are generally recommended to ensure Heavy Mini Dumps are acquired instead. This is achieved with the Citect.ini file setting:

```
[Debug]MiniDumpType=3
```

The Mini Dump type may also be configured with a Registry entry; this is described in KnowledgeBase article Q4495 "*How do I Enable the Mini Dump Feature in the Event of a Crash.*"

The following table lists the available types of Mini Dump:

0	No Minidump.	
1	Light Minidump.	➢ MiniDumpWithIndirectlyReferencedMemory (Heap referenced by stack)
2	Medium Minidump.	➢ MiniDumpWithDataSegs (Global Variables, and heap referenced by stack) ➢ MiniDumpWithHandleData ➢ MiniDumpWithUnloadedModules (Details of recently unloaded modules) ➢ MiniDumpWithProcessThreadData (Complete process and thread data)
3	Heavy Minidump.	➢ Same as Medium but with MiniDumpWithFullMemory (All memory, same as a User.dmp but smarter)

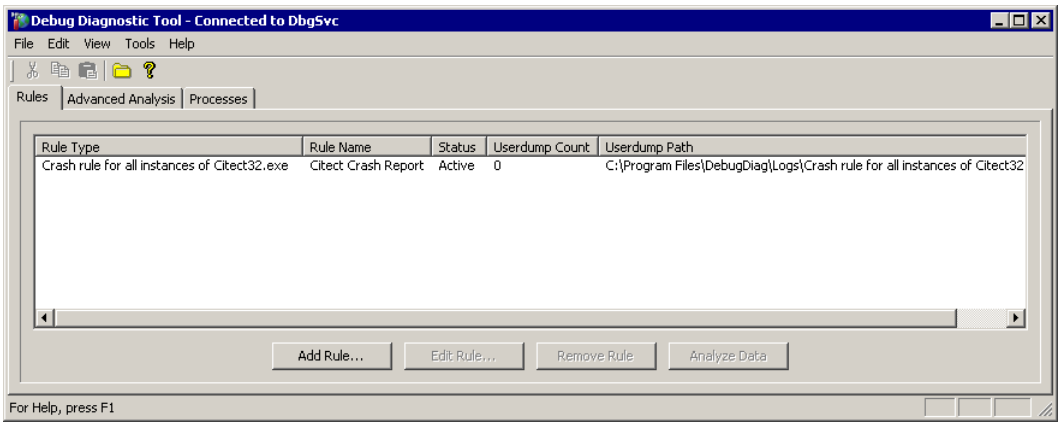
See Also:

For further information about **Crash Logs and related information,** see *CitectSCADA KnowledgeBase - Q4366 Crash Logs, Crash Dumps, User Dumps, Mini Dumps, Dr Watson Logs and Exception Reports.*

Logging Tools (cont.)

Debug Diagnostics Tool

On occasions, a Citect crash may not generate a usable Exception report. In this situation, it is advisable to use an active exception monitoring tool such as Microsoft's Debug Diagnostic Tool.



According to the Help contained within the Debug Diagnostics Tool, "*The Debug Diagnostics Tool is designed to assist in troubleshooting issues such as hangs, slow performance, memory leaks or fragmentation, and crashes in any Win32 user-mode process.*"

See Also:

For further information about **The Debug Diagnostics Tool,** see *CitectSCADA Knowledgebase - Q5387 "Monitor Process using Debug Diagnostics Tool"*.

Suggested Exercises

Use these suggested exercises to increase your understanding of the topic.

- Cause a system to crash (using the command debug("GPF") and experiment with the various tools , including the debug diagnostics tool, to investigate the crash and the various information it provides.
- Investigate the use of various citect.ini parameters for logging Alarm and other transactions.

Further Reading

Use the following references to assist your understanding of the topic.

- CitectSCADA KnowledgeBase - *Q4366 Crash Logs, Crash Dumps, User Dumps, Mini Dumps, Dr Watson Logs and Exception Reports.*
- CitectSCADA Knowledgebase - *Q5387 "Monitor Process using Debug Diagnostics Tool"*

Communications Analysis

Understand the Network

A variety of publicly-available tools may be used to determine the computers on the network and what processes or tasks they are running.

This information may be used to confirm that only the expected computers are present and that they are only running tasks intended for them.

The course investigates, as examples only, the following tools:

- NetStat
- Process Monitor
- Nmap
- Wireshark

Suggested Exercises

Use these suggested exercises to increase your understanding of the topic.

- Install and / or make use of the featured analysis tools (NetStat, Process Monitor, Nmap and Wireshark) on a running system to become familiar with their installation and use.

Further Reading

Use the following references to assist your understanding of the topic.

- CitectSCADA Help Topic - *Configure Servers.*
- CitectSCADA Knowledgebase Article - *Q3943 Implications for Citect and Microsoft Windows XP Service Pack 2*
- CitectSCADA Knowledgebase Article - *Q4813 Default TCP/IP Ports used by Citect*
- CitectSCADA Knowledgebase Article - *Q4946 WebClient across LAN / WAN - v7.0*

Performance Management

Monitor and Manage Performance

CitectSCADA has the ability to distribute its various server tasks across the multiple CPUs in a multi-core system. This permits some semblance of load-balancing to occur.

In addition, it is useful for system managers to undertake regular base-line performance measurements to get an accurate view of the long-term trends in the system's activity. This may give early warning of the need for upgrade or other remediation work.

Suggested Exercises

Use these suggested exercises to increase your understanding of the topic.

- Use the Computer Setup Wizard to allocate server tasks to CPUs on a multi-core computer.
- Use Performance Monitor to access the variety of dotNet counters provided by CitectSCADA.

Chapter 3: Navigating the Knowledge Base

Overview

Introduction

The Knowledge Base contains three navigational tools to help you quickly find relevant information:

- Contents - so you can always find the start and also lists the Latest Articles.
- Index - Lists all articles in numeric order
- Search - the quickest way to find relevant articles. It allows you to query all of the text in the entire Citect Knowledge Base.

This Chapter Covers These Topics:

Searching

Search Queries

Learning about effective queries will help you to locate relevant articles. The simplest query consists of just one word. For example, to find articles about alarm pages, you could enter the word alarm. This query would return a list of all articles that contain the word 'alarm'. If the query word is common, a large number of articles will be displayed, and you may need to further narrow your search.

Enter Multiple Words

To narrow your search, enter more than one word. For example, to find articles about alarm pages, you could enter the words alarm page. This query would return all articles that contain both the words 'alarm' and 'page'. Some search engines require the keyword AND to be used for this kind of search - it is not necessary here.

Operators

Customise your queries with the NEAR, NOT and OR keyword operators. For example, the query alarms page not hardware, would exclude an article about the "hardware alarms page".

Literal Phrases

Put quotation marks around keywords if you want to search for a literal expression. For example, searching for "alarm page" would find articles that contain that exact phrase. This can be quite useful if you need to use a keyword in your search. For example, "exclusive or" contains the keyword OR, and would cause an error without the quotes.

Wild Cards

Use wild cards (* and ?) where you are uncertain about the form of a word. For example, if you are uncertain about whether to search for "alarms", "alarm", or "alarming", search instead for alarm*. The ? is similar, but works only for one character.