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(TEST Inc.)**

A Weatherford Enterra Company

SCADAWARE™

RTU / SCADA SYSTEMS

NETWORK OPERATIONS

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INTRODUCTION

This document provides detailed information on operating TEST's SCADAWARE program on a PC network.

This document focuses on the SCADAWARE functions only. Refer to the appropriate network documentation for information relative to operation of the particular network on each system.

DEFINITIONS

Client	Networked PC obtaining data from the SCADA Server
Host	Primary control computer in the SCADA system
Image	Data file which holds system setup data for network access
IPX	Novell messaging system
NetBios	PC-Lan compatible network messaging system
Network	Any PC compatible network with NetBios support
Server	Main computer on the network which holds system-wide data
ViewNode	Secondary computer (client) which accesses data from server

PC NETWORK CONFIGURATION

SCADAWARE requires that the PC network be configured with at least one system acting as a "server." It may be that more one system, or all systems, have server functions, and this may be an advantage in certain circumstances.

The basic concept is for the server to act as a data concentrator and polling unit for the entire SCADA system. The server handles communications to remote units as well as network communications to local units.

Network communications occurs via file transfers and network messages. The file transfers are used to let client systems access information in the TSP Image file as well as in any SCADA database files. Network messaging allows SCADAWARE computers to communicate over the network in much the same way they talk over a multidrop path. A combination of file and message passing is normally required to implement all the functions desired in a complete system.

The disk on the server unit must be accessed from the client stations. The method of establishing this access varies for each network, but the end result is that the client views the server's disk with a letter such as "D:" or "F:." The drive letter should point to a path into the SCADA directory on the server which looks like this:

```
\SCADA-----+
      + \HOST
      + \SCREENS
      + \SOUNDS
```

The complete network link path into the Server would look like C:\SCADA. Note that the SCREENS and SOUNDS directories are necessary only if the view node will use graphics and sound playback. They are not required in basic SCADA systems.

The reason for this structure is so that the Client computer can execute the following during its start.bat file (assume D: is the server path):

```
CD D:\HOST
D:RTUMON3.EXE /f=D:VIEWNODE.DAT
```

This setup assumes that D: points to the parent directory of the SCADA system on the server. Moving the client to D:\HOST would actually be moving it to C:\SCADA\HOST on the server, but that appears to be D:\HOST on the client.

With this setup, TSP procedures can reference the D: drive without concern for the actual network or server directory being used. They can also set the sound and graphics directories in a generic manner by referencing the parent with double-dot notation (..), as in:

```
SET DIR PCX D:..\SCREENS\
```

This tells the client computer where to find its graphics files on the server.

COMM PORT EMULATION

SCADAWARE provides a method of defining a network link such that it can be referenced as a normal PC serial port. Once the definition is made, in the system's DAT file, the port can be assigned to a task, and used to send and receive messages. The assigned port numbers can be any number not used by a "real" port, and numbers between 10 and 16 are recommended. The setup is a variation of the normal COMM line used in the DAT file, and looks like this:

```
COM Num, NET, NET_NAME
```

When this line is processed during system startup, SCADAWARE will establish this port with the number provided in NUM. The keyword NET defines this as a NetBios link, with the NetBios Address provided in NET_NAME. Other units will use this name in much the same way a callsign is used in multidrop systems. This name can be overridden at a later time if desired with the NET_NAME command, explained later. For example:

```
COMM 10, NET, VN1
```

This would set up comm port 10 as a NetBios link with the name VN1 (View Node 1). Now that the port is available, one of the RTU tasks can use it with a SET PORT 10 command in their startup file.

Note that it is possible to have more than one network task on the same system. This is done by defining multiple ports, each with a unique Com Port Number and Network name. Each network task operates independently. It is even possible for one network task to communicate with another on the

same machine. This would be similar to looping two serial ports on the same computer. This does not have much practical value, but can be useful for testing.

NETWORK NAMES AND MULTIDROP ID's

Each Network "port" has a name with which it is defined in the NetBios system. This name has a relationship to the task's multidrop ID, although that relationship depends on the mode of the NetBios message system, as explained below.

All TSP messages on the net are in multidrop mode, with a sender and receiver ID embedded in the TSP multidrop message packet. The network addressing of the NetBios datagrams themselves will depend on the mode of the system. The NetBios name and TSP Multidrop ID are not necessarily the same, although they often will be. It is important to understand the difference between Network Node Name and TSP Multidrop ID. The NetBios name determines where datagrams are delivered. The TSP Multidrop ID determines which SCADAWARE computer will process a message. Keeping these names consistent will reduce the overall complexity of the network communications system.

NetBios names can be either unique, or "group" names. The difference between unique and group determines whether the system operates in NetBios point-to-point mode, or NetBios Broadcast mode. The mode determines how networked SCADAWARE computers talk and listen to one another. Point-to-point means that only one computer physically receives a network packet. Group mode means that all units receive the datagram, although only one will usually process it.

A unique NetBios name is one which does not contain the star (*) character. For example, a name like VN1 can be used to uniquely reference the machine called View Node 1. The name HOST1 could be one of the server names on a redundant CPU system. The actual name is not important, although it should reflect the machine on which is used, and should match the multidrop ID exactly to avoid confusion. The important thing as far as uniqueness is concerned is that it doesn't contain a star character. If unique names are used, then the task's multidrop ID should be set to the same name as the NetBios name.

A group name configures SCADAWARE to send all NetBios messages as "broadcasts" so that all units can receive it. SCADAWARE Group names must end with a star, as in the group name SCADA*. Group names are preferred on a SCADAWARE system because they allow the network to emulate a familiar multi-drop system. With this scheme, network transmissions from any computer to the group name will be processed by all systems having the same group name. Because SCADAWARE can handle multidrop links, it is permissible for all units to receive the message because only the correct system will process and respond.

A benefit of the group name system is that the TSP multidrop protocol allows for multiple systems to process a single DATA statement. This is done with the TAP feature (explained in the SCADAWARE system documentation). When NetBios group names are used, it becomes possible for a Host to simultaneously send data updates to all machines on the network. It is also possible for passive updates to occur on machines which are set to "tap" data destined for another multidrop address.

In practice, there is no penalty associated with group names in SCADAWARE, and they should be used whenever possible. The option to use unique names is provided only for special cases.

NETBIOS AND MULTIDROP ADDRESSING

In point-to-point networking, the packets are sent to specific NetBios names, and are received by only one computer. That computer is assumed to have a NetBios name which is the same as its TSP multidrop ID. The receiver would reply to the sender with the assumption that the multidrop ID for the sender is the same as its network name. In this scheme, the TSP multidrop packet header contains all

the information necessary to route the message and reply over the network.

In Group Name networking, all packets are sent to the same Group name. This name is specified with the NET NAME xxxxxx statement, which must be executed by the affected task. In this case, all machines using that group name will process the multidrop header to determine if the message was for that machine. If it is, the unit will respond to the same group name Network address on which it received the message. However, the TSP multidrop header will be reversed for the reply, so that the original sender will know the packet is destined for that machine. This is very similar to normal TSP multidrop communications, in which all machines hear all transmissions, perhaps including their own.

The selection of the NetBios names used in SCADAWARE communications is done automatically, based on the unique or group nature of the name provided to the virtual port. A group name is one which ends with a star (*). The relationship between NetBios name and Multidrop ID is listed in the table below.

For example, consider a two unit network consisting of a host and a view node. The Host computer has the TSP ID of BASE, while the view node is called VN1. If each system used a NetBios name which is the same as its ID, the system will be in point-to-point mode. In this case, network transmissions would have this address arrangement:

	<i>NETBIOS ADDRESSES</i>		<i>TSP MULTIDROP ID</i>	
	<u>SENDER</u>	<u>RECEIVER</u>	<u>SENDER</u>	<u>RECEIVER</u>
Host to View Node	BASE	VN1	BASE	VN1
View Node to Host	VN1	BASE	VN1	BASE

However, if both systems defined themselves with the NetBios name of SCADA*, then the addressing arrangement would be as follows:

	<i>NETBIOS ADDRESSES</i>		<i>TSP MULTIDROP ID</i>	
	<u>SENDER</u>	<u>RECEIVER</u>	<u>SENDER</u>	<u>RECEIVER</u>
Host to View Node	SCADA*	SCADA*	BASE	VN1
View Node to Host	SCADA*	SCADA*	VN1	BASE

Note that in both cases, the TSP addressing is the same. Each sender builds a multidrop header which specifies the exact SCADAWARE computer to receive the message. However, the network driver selects its NetBios destination name depending on the mode. In unique (point-to-point) mode, it uses a NetBios address which matches the receiver ID. In group mode, it uses a common NetBios address.

TASK ASSIGNMENT

The network task is almost exactly the same as a normal RTU type task. Instead of using a serial port, the task will use the simulated port on the network. During task startup, its port number is defined in the same way that a serial port is defined, with a SET PORT xx command.

Setting a task's ID to NET will make it the default Network task. This is required for some of the automated features of View Node systems. Therefore, it is always required that at least one network task be defined, and that it have the ID of NET. This name is set with the TASK x ID NET command during the system startup procedure.

LINK ASSIGNMENT

The view nodes do not have direct access to remote units. When a poll request is made at a view node, the desired action will be for the node to send a message to the server telling it to activate the link for the appropriate RTU. This process is automated at the view node by setting the default link for each RTU to be a NETWORK link, instead of a normal link number. This is done in the node's DAT file, or with a SET LINK NET line at any time.

The DAT file reference has the keyword NET in place of the link number on the line in which the RTU is defined. For example:

```
RTU, TFARM, Main Tank Farm, NET, remote
```

This tells SCADAWARE to define an RTU named TFARM, with a network link, not connected directly to this machine.

HOST LINK ACTIVATION OVER THE NET

When a poll request is made for an RTU, SCADAWARE normally reacts by activating the link for the current or specified RTU. In the case of RTU's on a View Node, this is not desired because that unit cannot directly access the RTU. Instead, the desired action is for the View Node to send a message to the Host system which will activate the appropriate link on the Host computer.

When a poll request is made for an RTU which has a Network link, the system will send a message to the default network task in the form:

```
READ NETPOLL RTU_NAME
```

The `rtu_name` field will be replaced with the actual name of the RTU for which the poll request was issued at the view node. The network task will process a file called NETPOLL, which will do whatever is necessary to activate the link on the appropriate computer. This procedure can be very simple, as in the NetPoll example:

```
Dial HOST  
BLOCK POLL NOW $1  
BYE
```

This procedure is executed by the network task. The \$1 parameter will be replaced at runtime with the name of the RTU which was passed as the first parameter on the command line. The block line will send the line POLL NOW `rtu_Name` to the Host system. At that point, processing of the link will occur at the Host system just as if the poll request had been made at the Host system itself.

Additional processing may be required at the View Node as part of the NetPoll operation. If this is the case, additional statements can be placed in the procedure. The only fixed requirement is that the procedure name be NetPoll. It can be a separate RTU file, or it can be a procedure in the library.

IMAGE FILES

The image file system is described in the System Design Manual (1010). This system maintains a "snapshot" image of the data contained in each SCADAWARE computer. By putting this file on a network server, it makes all important data available to other units on the network. This data can be read as one large block, or it can be selectively loaded so that the view node maintains its own setup and configuration data.

Network applications require that only a single computer access the Image file in a read/write mode. Multiple units can read the file simultaneously, but only a single system can write to it. The

writer will normally be the Server computer. If no options are specified in the IMAGE FILE statement, then SCADAWARE opens the image file in an exclusive DOS mode, where only one computer can access the file.

Options on the IMAGE FILE NAME line allow operation in DOS, SERVER, or CLIENT mode. DOS mode is the default which is used if no other is specified. SERVER mode is a network option which provides full privileges (read-write) to the software. CLIENT mode opens the file in networked read-only mode.

```
SERVER EXAMPLE:  
Image File HOST.IMG SERVER  
Image Save
```

```
VIEW NODE EXAMPLE:  
Image File D:Host.IMG Client  
Image Load
```

Note that the SET SHARE option can be used to set the default Share mode for Image file access. This eliminates the need to specifically provide a Share mode for each Image file.

DATABASE ACCESS

Database access included similar features as the Image file described above. The database file can be opened in DOS, Server, or Client mode. The same restrictions apply - only a single system can open the file in Server mode.

Mode choice is made on the DB SELECT line which initially opens the database file. It takes the form of:

```
DB Select Filename [mode]
```

Once a file is opened on a machine, it can be used by multiple tasks on the same system in the same mode. Note that the Set SHARE command can be used to set the default share mode for all database access procedures.

NET COMMAND

The NET command allows various parameters to be set and viewed within SCADAWARE. All commands affect the task which executes them, so they must be placed in the appropriate procedures and not in the STARTUP procedure processed by task 0.

NET NAME name	Define NetBios name for this network "port."
NET TASK taskname	Define the system wide default Network task.
NET DUMP	Display detailed network configuration information.
NET RESET	Complete NetBios reset, which may crash network.

FILE SHARE CONTROL

File "sharing" is network jargon for access rights to DOS files. When a file is shared, multiple users can access the file at the same time, often with different privilege levels. The default file share mode is exclusive, where the user is the only one with read or write access. Other users who try and access the file are denied access. In order for sharing to occur, non-default operations must occur among all users. These special access modes are included in SCADAWARE in a form which simplifies concurrent file access.

A new SET option, SET SHARE [mode], determines the default share mode for DataBase and Image file accesses over the network. The possible modes are:

DOS	Normal (default) mode, with exclusive read/write access.
SERVER	Shared access, with this user having read/write privileges.
CLIENT	Shared access, with this user having read only privilege.

Share control can be handled in most cases with a single SET SHARE command during startup. On a SERVER, which will maintain the data files, a SET SHARE SERVER command would be used. On view nodes, which simply access the server files, a SET SHARE CLIENT would be used.

Setting the default share mode allows less complex transfer of procedure files from a host to a view node. The main difference in the procedures is the file access, so leaving this as a computer-specific default allows files to be used on either system without modification.

Share functions require that the SHARE.EXE (or equal) be included in the network startup. The DOS SHARE is used for some networks, although most now supply an independent SHARE system as part of the network itself. TEST has produced a program called SHARETST.EXE which will determine if a suitable share system is available on a particular computer.

WINDOWS 95 NETWORKS

SCADAWARE operation under Windows 95 permits the networking facilities of Windows to be used without any additional cost or software. The network links established in Win95 are accessible to the DOS programs which run on a virtual machine on the Win95 PC. The following guidelines will assist in proper operation under Win95:

1. WIN95 networking must include a NetBios or NetBeui service. This is established in the Networking configuration. This permits operation on any Network supported by Win95, including Windows NT and Novell.
2. The START.BAT file should include a /T=S parameter on the RTUMON3 line. This tells SCADAWARE to use software task switching instead of either DOS or Timer based switching.
3. If SCADAWARE cannot locate the security key (dongle), then The START.BAT file should include a /D=xxx parameter to specify the exact port address of the parallel port. Details on this are found in document 1010, System Design Concepts.
4. Directory Sharing must be established on the windows machines. This can be done in a variety of ways. Right clicking on a directly in Win95 Explorer allows quick access to the share setting for that directory.

————— END OF SCADAWARE NETWORK MANUAL —————

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