

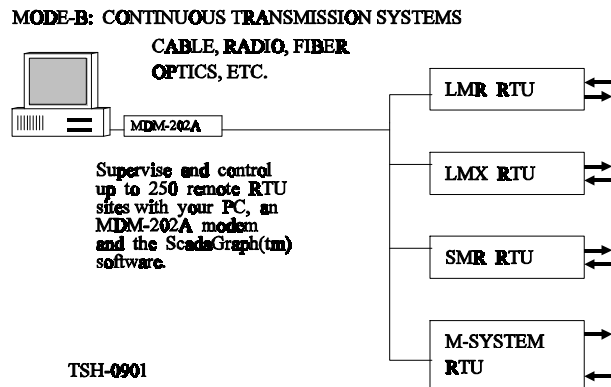
CHAPTER 9, CONTINUOUSLY SCANNING THE RTUS

9.A SUMMARY:

Continuous communication offered by cables leased from the phone company, proprietary cables or radio links has many advantages when used in SCADA and Telemetry systems. The information is updated continuously. Alarms arrive as they occur. Commands are acted upon the moment they are issued. Continuous communication systems are suited to Mode-B, continuous supervision, and Mode-C, signal multiplexing.

Supervising and controlling ongoing processes such as refineries, pipe lines, clean and waste water treatment plants, etc., require continuous communication and continuous supervision, either automatically by a computer or manually by an operator (or both).

Modern computer error detecting technologies make the signal transfer in Mode-B virtually error free. All ScanData RTUs are capable of operating in Mode-B.



As an example of how simple and cost effective a Mode-B SCADA system can be, a single LMR-202 RTU can be used to communicate with a Windows PC 486 computer, running the Lookout or other SCADA program. The PC communicates with the LMR-202 over an MDM-202A modem and over a 2-wire or 4-wire cable circuit or over radio.

This system allows continuous updating of color graphic screens, alarms, trends, manual and automatic commands to the RTU, automatic report printing, etc.

9.B HOW DOES A SCADA SYSTEM WORK?

A continuously scanning supervisory system consists of a computer with software, a modem, a radio or cable network and one or more RTUs with modems.

The computer talks continuously with the RTUs so that all the information from the RTUs is continuously transferred to the computer. The software draws different operator selectable screens, depicting the industrial process being supervised.

The operator can read pressures, flows, alarms, etc., on these screens. He can also send commands to the remote RTUs to open and close valves, start and stop pumps, etc.

9.C WHAT KIND OF COMPUTER DO I NEED?

Today, ScanData and most other reputable RTU manufacturers make RTUs which can talk a variety of commonly used protocols. These are open protocols which means that documentation describing the protocols are easily available. Few, if any, manufacturers make RTUs that speak a secret, proprietary protocol as most end users are reluctant to lock themselves into these.

These open protocol RTUs can communicate with virtually any software package, as long as the software package is also able to handle these open protocols. Most of them do. They have to, to stay competitive. Manufacturers who offer central station software packages with secret, proprietary protocols (hoping to lock their customers in on their RTUs) are facing a dwindling market.

What all this means, in effect, is that any open protocol RTU can communicate with any software package, running on any computer. Connect a Bell-202 modem to the computer's serial port, connect the modem to your cable or radio system and you are ready to go.

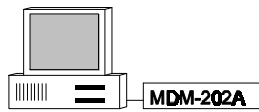
9.D WHAT SOFTWARE PACKAGE SHOULD I USE?

A number of excellent software packages are available. These packages are being constantly improved as new releases are issued. Check with the different software companies for the package that best suits your need.

ScanData has two simple and cost effective software packages available. ScadaMaster(TM) is designed for Mode-A, dialing the RTUs and ScadaGraph(TM) is designed for Mode-B, continuously scanning the RTUs.

As mentioned before, any good software package, such as National Instrument's Lookout, will handle most common open protocols.

MODE-B PC/386/486 SOFTWARE OPTIONS:



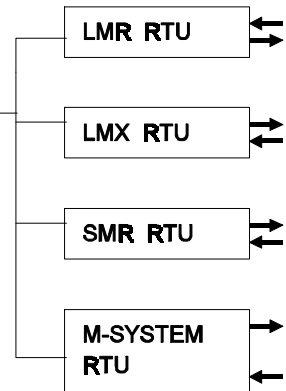
USING ScadaGraph(TM):

Continuously scans up to 250 RTUs and reports on up to 20,000 points. Color graphic screens with industrial symbols and trends. Complete math, auto-command and alarm packages. Up to 250 user configurable screens and a user configurable engineering file allow custom configurations to any industrial application.

USING OTHER CENTRAL STATION PROGRAMS:

The RTUs are normally programmed in CAP to communicate with the ScadaGraph(TM) software.

They can also be programmed to communicate in OPTO-MUX or MODBUS. Drivers for these two protocols are available for most commercially available central station software packages.



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In today's competitive market, shop around for the software package that best suits your needs.

9.E WHAT KIND OF MODEM TO USE?

The computer needs to use a continuous transmission modem, not a Hayes compatible dial up modem. There is a world of difference between the two.

The dial up Hayes compatible modem works into a 2-wire RJ-11 telephone jack. It knows how to go off hook (lift the handset), wait for a dial tone, dial the desired phone number and how to perform the proper hand shakes once the dialed party is reached.

The continuous transmission modem such as the ScanData MDM-202A works on 4-wire connections, one pair for the transmit direction and one pair for the receive direction. It stays on line all the time. It does not know how to dial but it knows how to turn a radio transmitter on and off and it knows how to respond to the RS-232 signals, such as RTS (Ready To Send). It also knows how to send Data Set Ready and Carrier Detect back to the computer.

The MDM-202A works equally well over cables and radios.

9.F USING CABLES:

You have a choice between leasing cables from the telephone company or using your own. The telephone company will charge you a monthly fee and will maintain the cable connection for you.

9.F.1 LEASED CABLES:

Leased cables are almost always 4-wire. One of the reasons for that is that a cable pair going in one direction only (one transmit pair and one received pair) is easy to amplify, maintain and troubleshoot. A 2-wire leased cable must allow signals to travel in both directions which means no amplifiers (or worse, 2-wire amplifiers).

AN EXAMPLE OF A MEDIUM SIZE SCADA SYSTEM

The County of Los Angeles, Department of Sanitation, is supervising their water treatment plant at Whittier Narrows and at Pomona over a IBM PC computer installed at their headquarters. One ScanData M-system RTU is installed at the Whittier Narrows treatment plant and another at the Pomona treatment plant.

The Department is running the ScadaGraph(tm) supervisory software program in a PC 386.

An LMX RTU is installed at the headquarters location and is used to repeat out alarms coming in from the remote water treatment plants. The software re-directs incoming alarm (digital signals) from the Whittier Narrows and Pomona RTUs to the LMX RTU where alarm bells are actuated over the digital outputs.

Over 50 different graphic displays are available on this system, as are 40 different trend displays, over 100 different alarms, automatic alarm printing, automatic transfers of all alarms to a relay at the local LMX RTU, etc.

This system also required splitting and combining the Department's leased four wire circuits, using several FSD-202A splitter amplifiers.

These leased cables (when properly maintained) have good transmission qualities and low attenuation. The phone company will install 4-wire drops (see below) at each RTU connection point. You can often specify the levels you would like to see at the cable entry and exit points. There is no norm for this level. A large western electric utility specifies -15 dbm for both entry and exit. -10 dbm is another figure often used. It gives you an extra 5 db over any possible noise.

9.F.2 USING YOUR OWN CABLES:

If you lay your own cables you should shielded 4-wire cables with a maximum attenuation, end to end, of 15 db. For longer runs you can use cable amplifiers such as the ScanData FW4-A.

Be aware that the longer you run the cable, the more your high frequency attenuation increases as cable pairs attenuate higher frequencies more than low frequencies. This causes group delay distortion. Modems such as the MDM-202A are designed with group delay distortion compensation, but there is only so much distortion even these excellent modems can handle.

A SMALL SCADA SYSTEM EXAMPLE

A good example of a relatively simple Mode-B system is with the Nalco Chemical Corporation in Carson, California. They are supervising approximately 100 chemical tanks, using a single ScanData M-system RTU with 100 analog inputs (A/Is), reading 100 level meters.

They have two PCs, running the same ScanData ScadaMaster(TM) program, both communicating with the M-system RTU. Several color graphic screens are used to give the operators the level of each tank. The software also calculates the correct compensated contents of each tank. These values are automatically updated every two seconds.

This installation required splitting a single 4-wire cable circuit into two circuits (Nalco Chemical is running their own communication cables). Splitting, combining and amplifying 4-wire circuits is a common requirement which is easily solved by the FSD-202A splitter amplifier and the FWA 4-wire amplifier.

Check with your cable supply company. Maybe they can supply loading coils. Loading coils flatten the frequency response of the cable. The high frequency attenuation is lowered and the low frequency attenuation is raised, giving a flat frequency response across the speech band (300 to 3,000 Hz).

Use the ScanData TTS Telemetry Test Set to ascertain the loss of any cable run. The TTS is five instruments in one. Two of the built in instruments, the signal generator and the instantaneous level meter, makes it easy to check cable attenuation. Try not to use cable runs with more than 20 db of loss.

9.F.3 STAR OR MULTI-DROP CABLE CONFIGURATION?

How do you tie several RTUs together into one cable? It has to be done somehow, because the modem at the central station needs to be connected to a single 4-wire cable. There are two choices:

9.F.3.a THE STAR CABLE CONFIGURATION:

One choice is to bring all the cables together into the central in a star configuration, like the spokes of a wheel. This is very wasteful of cables but sometimes it is the only solution. Now you have a number of 4-wire cables that have to be connected together. What do to? You cannot simply connect them all together, that would raise havoc with the impedance, cause severe attenuation and endless grief.

Use the ScanData FSD-202A multi-drop and line combiner unit. One of these will neatly tie two 4-wire cables together into one, without any loss of signal. It has transformer isolation in all six branches so you don't have to worry about DC imbalance. Use as many as you need, combining them until you finally have only one 4-wire circuit left which you then connect to the modem.

9.F.3.b THE MULTI-DROP CABLE CONFIGURATION:

The second choice is to run your cable from the central station modem along all the RTUs, using a multi-drop amplifier at each RTU, christmas tree light style. Use the FSD-202A multi-drop and line combiner amplifiers at each drop. This is what the telephone company will do, when you ask them to lease you multi-drop circuits.

Note that you use the same amount of FSD-202A amplifiers in both the star and the multi-drop configurations. Which one you choose depends on geography and cable costs.

9.F.4 USING 4-WIRE TO 2-WIRE CONVERTERS

What to do when you have only one cable pair left or when the phone company can only lease you a single pair for your telemetry circuit? Use the ScanData 4W2 four wire to two wire converter. It is transformer isolated and surge protected in all three directions.

The 4W2 comes in two versions. The 4W2-A active amplifier unit has 0 db loss in both transmit and receive directions and 20 db loss between the two directions (across the hybrid). The 4W2-P passive converter has 5 db of loss in each direction.

Note that the 4W2 converter is not the answer to all problems. 2- wire circuits transmit information in both directions (or at least they should). This means that anything you send out comes right back into your receiver. The system will work if your modem and computer can handle this. The system will work if there is no undue amplification which will cause instability as the 2-wire circuit feeds everything right back. There are a number of other ifs.

The best thing is to try. There are a lot of older cable circuits out there, some with unpredictable performances, and trying different solutions is often the only approach.

9.G USING RADIOS:

Radio links are used when you need continuous communication for your system and laying cables is not possible. Radio can bridge distances of up to 50 miles but there are a number of restrictions and pitfalls. License free radios are available in

two frequency bands, 49 Mhz and in the Spread Spectrum 920 MHz band. Licensed radios are available in several bands. Of these, 450 MHz is the most commonly used for new installations.

All the ScanData radios in these three bands are designed to connect directly to the MDM-202A or similar modem and to all ScanData RTU modems. The radios will all transmit the amount of digital and analog information that the RTUs can handle.

9.G.1 USING 49 MHz LICENSE FREE DATA RADIOS:

These radios operate on flea power and will reach over 1/4 mile if there is no interference from any other operator. As the band is license free, it is used by many others such as bikers, cordless phone users, crib watchers,etc.

If you operate in a non-urban area, these radios can still help you save money. Crossing a road with a cable, having to dig a trench across, for instance, is far costlier than to place two ScanData LDR-A license free data radios on each side of the road.

The ScanData LDR-A 49 MHz transmitter and receiver combination is housed in a weather proof enclosure and is designed to connect directly to all ScanData RTUs and modems.

9.G.2 USING 920 MHz or 2.4 Ghz LICENSE FREE SPREAD SPECTRUM DATA RADIOS:

The ScanData LDR-S Spread Spectrum Data Radios operate with a transmit power of close to one watt and can span several miles, line of sight. These bands is also license free and there is therefore no guarantee that you will not have interference from other users.

The spread spectrum technology, where the frequency constantly jumps between a number of discreet bands, makes interference less likely than when using a single frequency. The ScanData LDR-S Spread Spectrum Data Radios also lets you select between 21 different groups of frequencies. If you have interference in one group, simply switch to another group.

The ScanData LDR-S transmitter and receiver combination is designed to connect to any computer or RTU over a 9-pin RS-232 connector. Specify RS-232 connectors when you order RTUs to work with the LDR-S.

9.G.3 USING 150 or 450 MHz FCC LICENSED RADIOS:

When you get your own operating frequency from FCC you own that frequency, for that particular geographic location, and you can be fairly certain that nobody else will operate on your frequency.

This is the interference free and a sure way to go. You can bridge large distances with your radio links, up to 50 miles at 150 Mhz if you have line of sight and use high gain antennas.

9.H SELECTING RTUS FOR SCANNED OPERATIONS:

The selection of RTUs depends on the number of input and output (I/O) signals required at each RTU. Select among the ScanData LMR, LMX, SMR and M-system RTUs. They have I/O capacities from 5 to 4,000 points. They all work equally well with built in modems in all continuously scanned systems.

WHERE CAN I GET MORE INFORMATION?

The following descriptions, pertinent to this chapter, are included in the DESCRIPT directory on the SCADAtch(TM) CD:

pri-0901.pdf Design Guide and Price List.
app-1289.pdf Programming Lookout for Scan-Data RTUs.
mdmc0866.pdf Bell-202 cable and radio modem.
app-1238.pdf How the serial port and Bell-202 modems connect.
app-1239.pdf How to connect 4-wire modems to 2-wire cables.
fwa-1020.pdf 4-wire to 2-wire cable converter.
ttsc1033.pdf Telemetry test set for cables and leased lines.
msyc0870.pdf M-system modular RTU fact sheet.
lmr-0926.pdf LMR RTU technical description.
lmx-1441.pdf LMX RTU technical description.
lmxc0794.pdf LMX RTU fact sheet.

An easy way to get the latest and most recently updated versions of these descriptions is to go on our WEB site:

www.scan-data.com

When you are there, click on the blue button near the bottom of the WEB page that says **Technical Information**. Then click on the description # you need.

