CHAPTER 7, HOW DO THE RTUs COMMUNICATE?

7.A SUMMARY:

The native Americans needed clear weather to communicate; in fog their smoke signals were useless. The RTUs also have to communicate, either with other RTUs or with a central computer. The difference is that RTUs have to communicate reliably, fog or not.

7.B A BRIEF COMMUNICATIONS HISTORY:

The first practical telemetry in the US (after the smoke signals used by the native Americans and the various signaling systems used by the Army) was used by the railroads. They had to transmit (telemeter) the time the trains arrived and left the stations, for instance, to avoid disasters.

The railroad stations first communicated with each other using Morse code over a wire running on poles along the track. As the wire quality improved they started communicating in voice.

The voice communication systems expanded rapidly with the expanding phone companies. When the need arose to transmit telemetry information (and recently, computer communications) there was a ready network of voice grade channels covering most of the populated world.

Today, computer and data communications use about half of the voice channels available in the world. The other half is used for what it was originally designed to do, allowing people to talk to each other by telephone.

7.C TYPES OF TELEMETRY SIGNALS:

When telemetry started coming into its own, primitive pulse duration (PDM) and later, tone signals were transmitted over these voice circuits. They worked after a fashion, but their main drawbacks, complexity, high cost, inefficient use of the voice band and lack of error detection prohibit their use in new installations.

The wide use of computers with their sophisticated error detection techniques and

the need for compatibility has made ASCII (American Standard Code for Information Interchange) the preferred method for Telemetry and SCADA systems to communicate. You can now interconnect computers, modems, RTUs, radios and cable systems with few problems.

7.D WHAT COMMUNICATION CIRCUITS ARE AVAILABLE:

There are a number of different voice grade circuits from which to choose when you design a system. There are phone company dialing circuits, cellular phone circuits, phone company leased lines, fiber optics, LDR-A license free data radios, LDR-U FCC licensed 150 MHZ and 450 MHZ data radios and LDR-S license free spread spectrum data radios, satellite and proprietary cable runs, to mention a few. The RTUs and PLCs can also be placed on the WEB, using WEB modems (Mode-D). This is often a costly solution and avoided where WEB downtimes by software errors or sabotage cannot be tolerated.

7.E WHAT RTUs WORK WHERE?

All ScanData RTUs (except the VTM-7) work equally well in Modes-A, -B, -C and -D, with built in modems. The VTM-7 voice telemetry RTU and alarm dialer works in Mode-A only. The six different ScanData RTUs are designed to meet virtually all telemetry and SCADA applications, from low point count low cost applications (use the SLR and LMR RTUs) to high point count programmable RTUs (use the M-system RTU). Each RTU has also a number of options available, in addition to the basic I/O points. Check the RTU fact sheets for details.

DIALING OR CONTINUOUS COMMUNICATION?

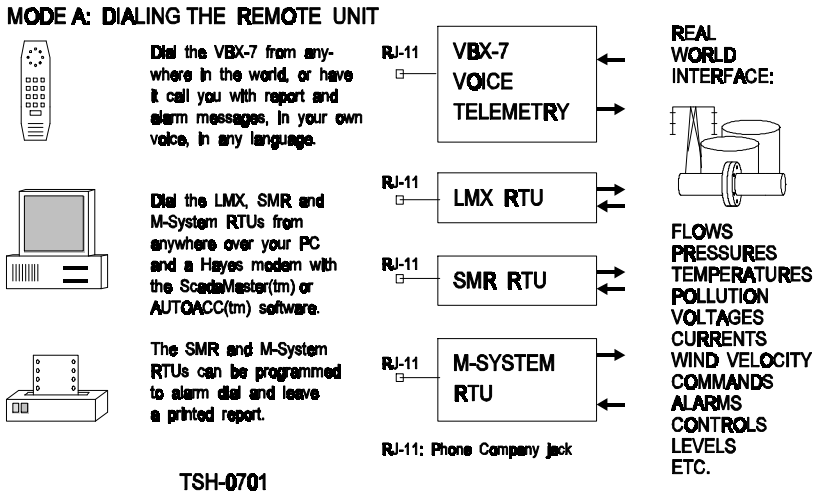
The choice between these two modes of communication is often given by the circumstances. If you have to read a tank level in Nebraska, say, from your office in New Jersey, dialing the RTU is the only practical choice.

To take another example: If you have to supervise a liquid pipeline with rapid pressure fluctuations and complex commands to multiple valves and pumps, continuous communication to all the RTUs along the pipe line is the only way to go.

Installing a dialing (Mode-A) RTU is not difficult. You simply ask the telephone company to install an RJ-11 jack at the RTU site. The cost is minimal if the site is in an urban service area. If not, you may have to pay the phone company to bring in a subscriber's phone line. If the phone company can't bring in a line, you may be able to arrange for cellular phone service at the site.

7.F MODE-A, DIALING THE RTUS:

Installing a dialing remote supervisory system carries no communication costs, other than paying the telephone company for a telephone line with an RJ-11 jack at each end.



In many ways it works as if you placed a person instead of an RTU out at the remote site, a person you could call anytime, day and night. This person (or this RTU) answers the phone and tells you what is going on, the level of the tank, what pumps are on and off, what the pressure and temperature is, if there are any alarms, etc.

You can tell the person (or RTU) to start and stop pumps, to open and close valves, etc.

7.F.1 VOICE TELEMETRY AND ALARM DIALING RTUS:

If you installed a ScanData VBX-7 RTU, it will tell you in your own pre-recorded phrases the condition of 16 alarm and status points, the engineering value of two analog inputs and the accumulated flow count from a flow pulse counter.

With the VBX-7 you can also send commands to the remote station over your telephone keypad to start and stop pumps, open and close valves, etc. You can also remote program the VBX-7 with alarm telephone numbers to dial, span and zero analog calculation values, alarm limits, etc.

7.F.2 ASCII TELEMETRY DIALING RTUS:

If you install an ASCII compatible RTU, such as the ScanData SLR, LMX, SMR or M-system RTU, you can call the RTU with your PC computer and modem

combination, just as you routinely call bulletin boards and other dialing computer services.

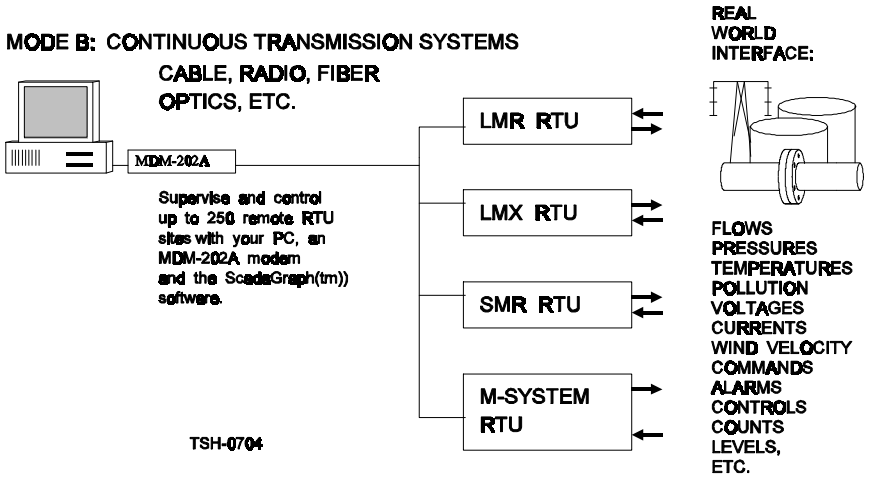
The RTU will answer with a **'READY'** message and you can ask it, from your keyboard, to send you a report or to issue commands to open and close valves, start and stop pumps, etc.

All this can also be done automatically, under program control, and the information from the RTU can be logged onto disk for future formatting into reports, transmission to other computers, etc.

Once you have the information from the RTU in your computer, it is easily treated by one of the many data handling programs available. The format of the information the RTU delivers is in ASCII (American Standard Code for Information Interchange). It is well documented and can easily be imported into any data base.

7.G MODE-B, CONTINUOUS SUPERVISION:

Mode-B systems are used where you need continuous communication and continuous supervision. Typical examples are petroleum and gas pipe lines where large and expensive amounts of product are transported at high pressures.



The pressures, temperatures and flows in these pipe lines have to be monitored continuously, generally over computer graphic screens or over large mimic panels that are manned continuously.

7.G.1 CONTINUOUS SUPERVISION COMMUNICATION CHOICES:

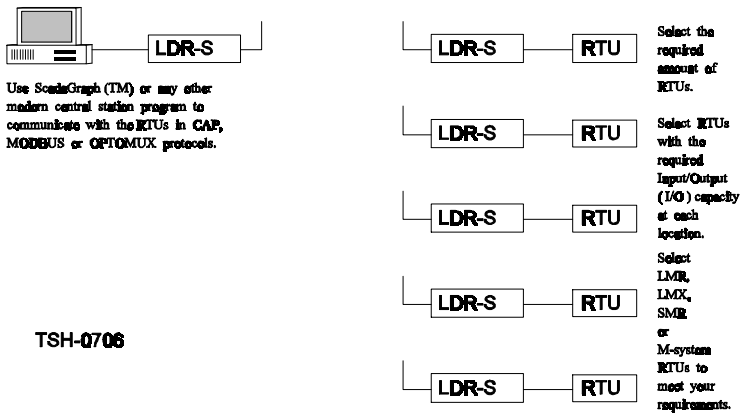
These are your choices if you opt for continuous communication:

1. Lease a line from the phone company (if they have them available). They will probably charge you somewhere around $5.00 to $10.00 per mile per month. Tariffs vary from country to country. You may get by with an unconditioned leased line or lease one under FCC tariff 260 type 3002 which can be conditioned to C1, C2, C3, C4 or C5 (with increased quality and cost). Be aware that many phone companies are gradually canceling their old DC leased lines and going to fiber optics instead (which cannot pass DC). If you have some of these old systems, install LMR-202 RTUs in Mode-C for transmitting your analog signals over fiber optics circuits.

2. Install your own cable. This can be expensive if you have to bury cable for long distances. How far can we go with a 4-wire cable? That depends on the quality of the cable. For instance, 22 AWG cable, unloaded, has an attenuation of about 1.8 db per mile. The MDM-202A modem can work with attenuations of up to 40 db, which theoretically means you can run 20 miles with this cable. To be conservative, it is best to limit the attenuation of any cable run to about 20 db. Install ScanData FWA amplifiers for longer distances. Install the FSD-202A to split and combine 4-wire circuits.

3. Install radios. If your distances are no greater than about 1/4 mile, use the license free ScanData LDR-A radios, else use the LDR 150 and 450 MHz radios. For the LDR-U, you need an FCC license. You can also use the license free LDR-S Spread Spectrum radios for distances up to several miles. If you use any of the license free radios, be aware that, as they are license free, you have no control over who may be operating on the same band.

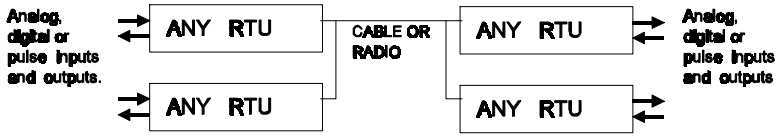
A Telemetry (SCADA) Mode-B System using LDR-S radios:



4. Use satellite communication. Large SCADA systems can use the VSAT (Very Small Aperture Transmission) satellite communication system. You can get direct RS-232 communication to virtually any site in the world, but the cost is very high.

7.H MODE-C, SIGNAL MULTIPLEXING:

MODE C: SIGNAL MULTIPLEXER SYSTEMS



In back-to-back or signal multiplexer mode, two or more RTUs send and receive analog and digital signals from point to point.

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The Mode-C signal multiplexing systems use exactly the same continuous communication circuits as the Mode-B systems. The same considerations apply. Refer to section 7.G.1 above.

A Signal Multiplexing Mode-C System using LDR-S radios:

In Mode-C operation, any analog or digital signal input at any RTU will be repeated out at the designated far end RTU.

Use any ScanData RTU. Use multiple RTUs if you need to transmit signals to and from more than two sites.

Examples of Spread Spectrum Telemetry Radio applications.

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7.H MODE-D, PLACING THE RTU OR PLC ON THE WEB:

A variety of WEB interface devices are now available to place virtually any ASCII communication capable device (RTU, PLC, Tranduscer, Controller, etc.) on the WEB. This gives the device a WEB address which can be accessed from

anywhere in the world (and by any one). The cost of these WEB interface devices are reasonable and is expected to drop even further. The cost of the WEB registry and hosting is another matter. There is also the possibility of software sabotage (viruses, Trojan Horses, etc.) shutting down the service.

7.I TRANSMISSION RELIABILITY:

Transmission disturbances and interruptions can occur in all transmission modes, cable, radio and satellite. On good circuits they occur less often. Most supervisory software (and all ScanData RTUs) do several overrun, CRC and other checks to insure that the received string is without errors. If not, the string is rejected.

The net effect of this is that the data transfer on bad circuits is slowed down, sometimes 50% or more. Erroneous commands and measurements are never transmitted.

WHERE CAN I GET MORE INFORMATION?

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

pri-0901.pdf Design Guide and Price List.

gui-0980.pdf How to design SCADA and Telemetry systems.

app-1127.pdf How to test RTU communication circuits.

app-1561.pdf RTU and PLC communication methods.

ttsc1033.pdf Telemetry test set.

alt-1543.pdf Automatic leased line tester.

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.