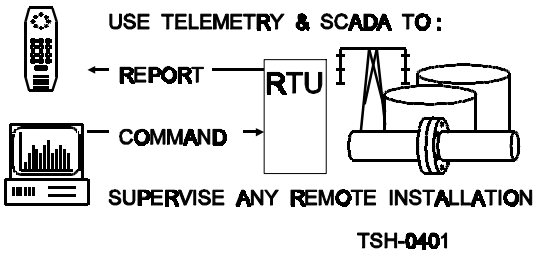
CHAPTER 4, DO I USE RTUs OR PLCs?

4.A SUMMARY:

There is sometimes some confusion as to what device should be used for a certain application. Sometimes PLCs are used where RTUs could do a better job and sometimes RTUs are used for tasks that are better suited to PLCs. Sometimes the best solution is to use RTUs and PLCs combined.



Basically, use RTUs for what they do best: communicate measurements and commands to and from a remote site. And use PLCs for what they do best: control industrial processes.

This chapter deals with some of the differences between these two devices and discusses how they work together and how they are best used.

4.B RTU FEATURES:

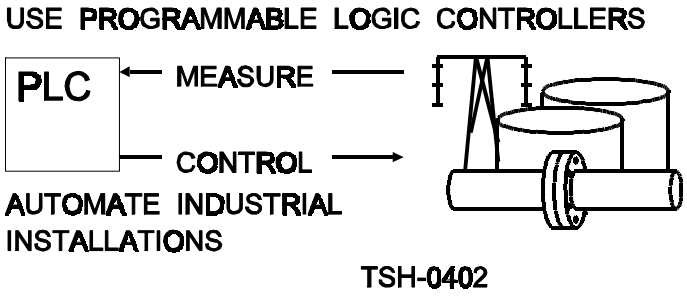
One of the advantages of RTUs (Remote Telemetry Units) is that they communicate very well with their built in modems. No programming is necessary; they start performing automatically when power is applied. Another is that the cost per I/O point in an RTU is normally far less than the cost per I/O point in a PLC (Programmable Logic Controller).

Recent developments blur the line between PLCs and RTUs, however. Scan-Data manufactures a very cost effective PLC, the 2BY4, which is used with RTUs in many installations where automatic control is needed. Scan-Data also manufactures RTUs with built in PLCs, such as the LMX and M-system RTUs.

You can now easily combine PLCs with RTUs, wherever you need automatic and programmable control.

4.C PLC FEATURES:

PLCs generally do not communicate well as they are primarily designed to control industrial processes. They need outside modems such as the MDM-202A and often need special programming to communicate at all. This PLC communication programming can be a lengthy cut and try process.



The advantage of PLCs, on the other hand, is that they program easily to automatically perform complex industrial control sequences. It is also relatively easy for the end user to do the often necessary adjusting and fine tuning of the control process in most PLCs.

4.D COMBINING THE BEST OF BOTH WORLDS:

WHAT IS A PLC?

Controllers of different kinds are in use in every walk of life. Your home probably has a number of controllers. To control the water pressure as it enters your home. To control the gas pressure, the oven temperature, the air conditioner temperature. Your washing machine has a programmable controller so that you can use to set the temperature of the water, the length of the wash and spin cycles, etc.

Many VCRs have complex programmable controllers that some of us don't really understand.

A Programmable Logic Controller (PLC) is similar to a washing machine controller, except that it can do many more things. It is called Controller because it is used to control (automate) industrial processes.

It is called Programmable because you can program it to perform different functions (just as you can program your washing machine and VCR). Many PLCs use external programming devices such as laptops or (formerly) complex proprietary programming devices.

The term Logic in the PLC name refers to the manner in which the programming is done. Most PLCs use a system of programming called Ladder Logic. It simplifies programming of complex industrial control processes as it uses a number of easily defined logic ladder steps.

Where do we use RTUs and where do we use PLCs? Again, let the RTUs do what they do best: communicate. Let the PLCs do what they do best: control.

If you need automatic control at a site, in addition to reports and commands, add an inexpensive PLC to the RTU. Let the PLC get its digital and/or analog setpoints from the RTU. Many excellent low cost PLCs, like the Scan-Data 2BY4, are now available.

Using the RTU for reporting, remote commands and setpoint entries and using the PLC for local control is a very practical, easily installed and cost effective solution for most remote control applications.

4.E A PRACTICAL EXAMPLE:

Say you have a farm, to take an easy to visualize example. Say you have added a fancy glass enclosed greenhouse, for example, and that you are tired of running over to the greenhouse to adjust the temperature and to turn the sprinklers on or off, several times every day (and every night).

4.E.1 INSTALLING A PLC:

You buy a PPC controller. The cost is low and it is easy to program. It will turn the sprinkler and heater and off based on its internal clock. You can wire one analog input to a soil moisture sensor and another to an air temperature sensor.

The PPC will run your greenhouse better than you could yourself, even if you spent 24 hours every day over there adjusting your sprinklers and heaters.

4.E.2 PROGRAMMING THE CONTROLLER:

The Programmable Logic Controllers (PLCs), have come way down in price because of the fierce competition. They are also relatively simple to program. The PPC controller, for example, lets you plug in a laptop and simply edit the program text file, like you edit any other text file. All you do is add new program statements or instructions.

Load the program again and the PPC starts running with your new instructions.

4.E.3 THE NEED FOR REMOTE REPORTING AND CONTROL:

Everything is fine until one day the water supply line freezes and breaks and you loose the crop. Or the electric power fails. Or some hoodlum decides to break the glass.

4.E.4 CAN YOU MAKE THE PLC REPORT?

Now what? You could maybe make the PLC communicate with your office. To do that you would have to buy a modem and do some involved programming and you would have to buy some device for your office with another modem that could understand your greenhouse PLC. Probably another PLC which would need a modem and would also need to be programmed.

4.E.5 IT IS SIMPLER TO INSTALL AN RTU:

As explained elsewhere in this Handbook, RTUs are designed to do remote reporting. They have built in modems. They need no programming, just plug them in and they work. They offer a wide choice of communication methods, telephone, radio or cable. They can communicate with you in voice which you understand or in ASCII, American Standard Code for Information Interchange, which every computer understands.

4.E.6 SELECTING A MODE-A (DIALING) RTU:

Installing a VBX-7 at the greenhouse allows you to be called on the phone if something happens, giving you a complete alarm report in your own voice. You can also call the VBX-7 anytime you wish to get temperature and moisture readings and a check on up to 16 alarm and status conditions. You can turn pumps on and off and send commands to the 2BY4 directly from the keypad on your phone.

COMBINING RTUS AND PLCS.

Combining RTUs and PLCs in one installation combines the best of both worlds. How do you connect them together?

Assume that the PLC is connected and working, controlling the industrial process. It is using analog and digital inputs from the process instrumentation so that it can decide what to do. It may also use analog and digital control inputs from a remote central station in its work.

These remote inputs come from the outputs of the RTU. Connect the analog and digital outputs from the RTU directly into the PLC.

Your central station may also need to see the same analog and digital input that the PLC sees. You can wire the digital outputs from the process instrumentation to the RTU input in parallel with the PLC input, provided that both inputs are 5V levels (which is the norm in most cases). You can connect the analog outputs from the process instrumentation to the RTU and PLC inputs in series, provided that they are 4-20 mA loops. If one or the other of the inputs is grounded (often the case) use a Scan-Data I2I 4-20 mA isolator.

Note that you cannot wire outputs from the PLC together with outputs from the RTU. A process instrumentation input can have only one master or source.

4.E.7 SELECTING A MODE-B (CONTINUOUS COMMUNICATING) RTU:

If you have a PC or other computer available in your office and if you feel you need a top of the line supervisory system for your greenhouse, you may opt to install an LMR or LMX RTU at the greenhouse.

Lease a cable from the phone company, or run your own cable or install a pair of radios between your greenhouse and your office. Connect a MDM-202A modem to your computer's serial port. The RTU already has a built in 202 modem. These modems will work equally well over cables, radio or over leased lines.

Install a supervisory software package, such as Lookout, and you now have color screen displays, depicting what is happening in your greenhouse. You can print reports, add hundreds of more greenhouses, send commands to the greenhouses from your computer, and do complex reporting, calculations and control. The sky is the limit.

4.E.8 SELECTING A PAIR OF MODE-C (SIGNAL MULTIPLEXING) RTUS:

A pair of RTUs, one at the greenhouse and one in your office, talking to each other over a cable or over a pair of radios, is another choice. It will transfer (multiplex) all the inputs at the greenhouse and give you constant meter readings in your office on temperature and moisture and also light alarm lamps. You also transfer switch closures from your office to your greenhouse.

These multiplexing systems simply repeat the readings in the greenhouse out to meters and lamps in your office and also repeat signals from your office switch closures and analog commands out to the greenhouse. Sure saves you from running out there all the time.

4.F SOME INFORMATION THEORY:

Designing a control system is not very different from designing a company organization. Nor is it a difficult process, as long as you keep these basic information theory rules in mind:

4.F.1 WHERE THE COMMAND DECISION SHOULD BE MADE:

The command decision should be made at the point where all the necessary information to make the decision is available. If the controller in the greenhouse knows that a higher temperature is needed, it should immediately crank the heater up.

4.F.2 ONLY ONE COMMAND DECISION LOCATION:

You cannot have the computer in your office watch the temperature and also send commands to the heater that is already controlled by the greenhouse controller. Confusion and errors would result. This should be obvious but it is often sinned against, especially in human organizations.

4.F.3 INFORMATION SHOULD BE FREELY DISTRIBUTED:

This rule is also often sinned against in human organizations where information is power and is therefore sometimes jealously guarded.

In control systems this is not acceptable. The temperature information and the heater on times, for instance, is used by the greenhouse controller to control the heaters. The same information may be useful to your accountant when he goes to negotiate better electric power rates from the electric company. The more complex your operation becomes the more important it becomes to have updated, accurate information available to all levels of your control organization. Here is where SCADA and Telemetry systems really shine. Analog and digital information is speedily passed from any point to any other point in the system.

4.F.4 THERE CAN BE DIFFERENT LEVELS OF DECISION:

Decisions on the greenhouse temperature are made in the greenhouse, as described.

Decision on when to pump water into your main tank, on the other hand, should be made at your central office, as that is the place where all the information is available, such as the need for water at each outlying location, the best time to pump (lowest electrical rate), how long to pump, etc.

4.F.5 ALL UNITS IN THE SYSTEM SHOULD SPEAK THE SAME LANGUAGE:

Imagine the chaos you would have in an organization where one third of the employees spoke only Swahili, another third only Swedish and the rest only Spanish.

Making the PLCs and RTUs in a SCADA system communicate with each other was difficult in the past. Some manufacturers went so far as to have secret protocols for their devices in the hope of locking in the customers on their products.

This practice is today largely abandoned. Scan-Data offers open protocols that are well documented, widely used and easy to deal with for the average programmer.

4.G WHERE TO GO FROM HERE:

This chapter has only scratched the surface of the information and control theory. There is a large amount of literature available for those who are interested. You will also find more details on how to design SCADA and Telemetry systems in the following chapters and on our WEB site, **www.scan-data.com**

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-1105.pdf	How to add automatic control to RTUs.
ppc-1559.pdf	Programmable analog and digital controller PLC.
plcr-1364.pdf	LMX/PLC fact sheet.
lmp-1342.pdf	LMX/PLC technical description.
mrp-1521.pdf	Rabbit 3200 M-system co-processor module.
mrs-1532.pdf	StampII M-system co-processor module.

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.