Introduction

With its open and simple specifications, the Modbus protocol is widely used to control device communications in industrial applications. As indicated in the following table, Modbus modes and functions differ depending on cable type.

<table>
<thead>
<tr>
<th>Cable type</th>
<th>Serial</th>
<th>Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>ASCII</td>
<td>RTU</td>
</tr>
<tr>
<td>Functions</td>
<td>Master/slave</td>
<td>Master/slave</td>
</tr>
</tbody>
</table>

Project Overview

Yokogawa Engineering Asia Pte. Ltd. was engaged in an upstream supervisory control and data acquisition (SCADA) system project where there was a requirement for Modbus systems that could operate simultaneously as master and slave nodes. As STARDOM field control node (FCN) autonomous controllers allow both Modbus master and slave functions to run simultaneously, they were selected for this project.

While functioning as a Modbus master mode in this application, the FCN polls the fire and gas system (FGS) to obtain data. As a Modbus slave node, it then transmits FGS data to the Yokogawa FAST/TOOLS SCADA system via a Modbus gateway and a WAN. This gateway converts the Modbus RTU protocol to Modbus TCP protocol for communication over the WAN. The serial modules are duplexed for network redundancy.

Expected benefits

The NFLR121 FCN serial communications module has two ports for either RS-422 or RS-485 communications, and each can be configured as slave or master. By installing two of these modules, the second module is made to be a backup.

With STARDOM, the following benefits are expected:
- Reduced installation costs
- Simplified system configuration
- Increased system reliability

STARDOM Engineering

STARDOM supports the IEC61131-3 programming language. The following two engineering tools are available:
- Resource Configurator: for hardware settings
- Logic Designer: for application logic

By keeping the application logic separate from the physical addresses, engineers can write programs for specific applications without having to consider the hardware configuration. This allows programs to be reused and improves engineering efficiency. The following screenshot from the Resource Configurator tool shows how the virtual name for a physical port is defined. In this case, SERIAL 1 is set for port1 and SERIAL 2 is set for port2 of the NFLR121 module.

http://www.yokogawa.com
Application Overview

The NFLR121 FCN serial communications module has two ports for either RS-422 or RS-485 communications that support communication speeds between 300 bps and 115.2 kbps. In this project, one port was set as a Modbus master and the other as a Modbus slave. For redundancy purposes, two modules are installed in the following side-by-side configuration:

<table>
<thead>
<tr>
<th>PSU Power Supply Unit</th>
<th>PSU Power Supply Unit</th>
<th>CPU</th>
<th>CPU</th>
<th>Spare</th>
<th>Al</th>
<th>DI</th>
<th>DO</th>
<th>COM</th>
<th>COM</th>
</tr>
</thead>
</table>

Figure: Unit Configuration

For this application, the following tasks were carried out in the sequence shown:
1. Port configuration
2. Modbus RTU master and slave programming for the same module
3. Redundant Modbus RTU slave programming

Port Configuration

With the Resource Configurator, the following communication settings were made for each port:
- Port name
- Wiring method (2 wire/4 wire connection)
- Half duplex/full duplex
- Baud rate
- Data bits
- Parity setting

Figure: Setting of wiring method for port 2 on NFLR121

Programming the Same Module as Modbus RTU Master and Slave

For this application, port name SERIAL 1 was set to port 1 and port name SERIAL 2 was set to port 2 for the NFLR121 module in slot 9.

Figure: Port name definition with Resource Configurator

Redundant Modbus RTU Slave Programming

NFLR121 modules were installed in slots 9 and 10. In this application, port name SERIAL 3 was set to port 1 and SERIAL 4 was set to port 2 for the redundant NFLR121 module in slot 10.

Figure: Port name definition with Resource Configurator

As shown below, two POUs were used in this application: SD_CMDBSM_BM_OPEN POU for the Modbus RTU master node and SD_CMDBSM_BS_OPEN POU for the slave node. Port 1 on the NFLR121 module was used for communication as a Modbus RTU master node and port 2 was used as a slave node.

Conclusion

Each of the communications modules on a STARDOM FCN autonomous controller can simultaneously function as Modbus master and slave nodes without affecting the other settings in the customer site. The use of two modules makes communications fully redundant.

In this application, the FCN Modbus master node simultaneously polls data from the FGS while the Modbus slave node transmits the FGS data to FAST/TOOLS. This keeps installation costs to a minimum. Furthermore, the use of the redundant module configuration ensures that there will be no interruption in the communications between FAST/TOOLS and the FCN autonomous controller.