Security, visibility and extendibility are becoming increasingly important in today’s Modbus installations. Engineers are being asked to provide more visibility to Modbus installations and, at the same time, are also being asked to keep devices secure from unauthorized access and errant configuration changes. To make things more challenging, they are also being asked to do more with existing equipment. And let’s not forget the all-too-common limited budgets and tight schedules.

So, how does one add a SCADA or HMI system to an existing Modbus network without compromising the security of existing Modbus devices? How does one design a Modbus installation that limits control of Modbus slave devices to a single Modbus master and yet can provide status information from those same device(s)? How does one add additional equipment quickly, easily and economically? And how does one maintain such an installation once it is operational? That is not easy – unless if you have a DeviceMaster UP running Modbus Router.

At Comtrol, we are constantly looking for innovative ways to help solve such challenges. Unique and extensive functionally designed to solve the most difficult problems with ease-of-use, robustness, and maintainability – that is what we are all about.
### Private Modbus Serial Bus Definition

**Table of Contents**

1. Private Modbus Serial Bus Definition
   - Provides Modbus Network Connectivity to Private Serial Bus Masters
   - Provides Security for Private Modbus Slaves
   - Simplifies Deployment
   - Increased Fault Tolerance
     - Private Serial Bus Loses Connection to DeviceMaster UP
     - Multiple Modbus Master Latency and Congestion Problems
2. Private Serial Bus Capabilities
   - Provides Modbus Network Connectivity to Private Serial Bus Masters
   - Provides Security for Private Modbus Slaves
   - Simplifies Deployment
   - Increased Fault Tolerance
     - Private Serial Bus Loses Connection to DeviceMaster UP
     - Multiple Modbus Master Latency and Congestion Problems
3. Web Pages
   - Private Serial Bus Configuration
   - Display Known Slave Devices
   - Display Serial Port Logs
   - Display Serial Port Communications Page
4. Examples of Common Installations Using Private Serial Bus(s)
   - Connecting Public Modbus Slaves to an Existing Modbus Serial Bus
     - Connect to Local Serial Slaves
     - Connect to Serial Slaves over Ethernet Network
     - Connect to Modbus/TCP Slaves
   - Providing Master-to-Master Communication
     - Communicate Between Serial Modbus Masters
     - Ethernet Based Modbus Master(s) to Serial Modbus Masters
   - Access to Remote Installations
1 Private Modbus Serial Bus Definition

So, what exactly is a Private Modbus serial bus? A private Modbus serial bus is one that:

1. Contains both a Modbus master and one or more Modbus slaves on the same serial bus.
2. Allows only the Modbus master the ability to communicate directly to the Modbus slaves.
3. May provide access from the Modbus master to public Modbus network(s) via an advanced gateway, such as the DeviceMaster UP running Modbus Router firmware.
2 Private Serial Bus Capabilities

The Private Modbus serial bus functionality, combined with the many other Modbus Router features, provides powerful capabilities to aid plant engineers and system integrators.

2.1 Provides Modbus Network Connectivity to Private Serial Bus Masters

A serial Modbus master can communicate to slaves on its' own private serial bus as well as public slaves and other Modbus masters on a Modbus network. The connectivity includes the following:

- Modbus RTU/ASCII slave(s) on its own serial bus.
- Public Modbus RTU/ASCII serial slave(s) connected to the same DeviceMaster UP.
- Modbus/TCP slaves.
- Remote Modbus RTU/ASCII serial slave(s) via an Ethernet attached Modbus gateway.
- All other Modbus master(s) on the Modbus network via the Shared Memory functionality provided on every DeviceMaster UP running Modbus Router.
- The private master can provide data to/from its private slave(s) to the Modbus network, and other Modbus masters, via the Shared Memory functionality.
2.2 Provides Security for Private Modbus Slaves

The Modbus slaves on the serial bus are “private” to the master on that serial bus.

- The private slave device(s) are protected from all other Modbus masters on the Modbus network.
- The private master has total control of communication to the slave(s) on its private serial bus.
2.3 *Simplifies Deployment*

Deployment can be greatly simplified.

- An existing serial bus can be left intact, thusly reducing the rewiring effort.
- The only required wiring change is to attach the DeviceMaster UP to the serial bus anywhere there is access.
2.4 **Increased Fault Tolerance**

Implementing Private Serial bus(s) can increase a communication systems’ fault-tolerance.

2.4.1 **Private Serial Bus Loses Connection to DeviceMaster UP**

In the event the private serial bus is accidentally disconnected from the DeviceMaster UP or the DeviceMaster UP is accidentally powered off, the master and slaves on the private serial bus can still communicate to each other.

*Note:* If the Modbus master and all Modbus slaves were attached to a Modbus gateway on separate serial ports, accidental disconnection or loss of power to the gateway would result in the master losing communication to all slaves. A private serial bus can eliminate such situations.
2.4.2 Multiple Modbus Master Latency and Congestion Problems

In standard Modbus gateways, multiple Modbus masters communicating to Modbus slave device(s) can cause increased response latency and, in extreme cases, can cause the gateway to become congested. The main causes are:

1. **Latency**: By eliminating routing through the gateway, there is no added message latency between the master and private slave device(s). While routing Modbus messages through the DeviceMaster UP adds minimal latency, that latency can become more significant if other Modbus masters are attempting to read from the public device(s) at the same time. This is especially true when communicating to slow responding public device(s).

2. **Congestion**: In worst-case scenarios, multiple Modbus masters sending requests to public slave device(s) faster than they can respond may cause the gateway to become congested. This, in turn, can force the gateway to reject some Modbus requests. By preventing other masters from communicating to the slave devices on the serial bus, a private serial bus can eliminate possible communication disruptions between the serial master and slaves caused by gateway congestion.
2.5  Web Pages

Embedded web pages provide configuration, diagnostics and status of the Private Serial Bus(s).

2.5.1  Private Serial Bus Configuration

The Serial Port Configuration page provides the interface to configure a serial port to connect to a Private Serial bus.

Note: A serial connection can also be made with a 1-Port or 4-Port DeviceMaster UP.
2.5.2  Display Known Slave Devices

This page displays diagnostics for all known Modbus slaves including those on private serial bus(s).

![Known Modbus Slave Device List](image_url)
2.5.3 Display Serial Port Logs

This page displays Modbus message activity for all serial ports including those attached to private serial bus(s).
2.5.4 Display Serial Port Communications Page

This page displays the serial port communication statistics for all ports including those connected to private serial bus(s).

![Serial Port and Ethernet TCP/IP Communication Statistics](image)

<table>
<thead>
<tr>
<th>Interface Statistics</th>
<th>Port-1</th>
<th>Port-2</th>
<th>Port-3</th>
<th>Port-4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TX Byte Count (To Device):</strong></td>
<td>3985009</td>
<td>2662000</td>
<td>24313470</td>
<td>9472230</td>
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<td><strong>TX Message/Response Count:</strong></td>
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<td>992368</td>
<td>380712</td>
</tr>
<tr>
<td><strong>RX Byte Count (From Device):</strong></td>
<td>1328392</td>
<td>8918750</td>
<td>8552052</td>
<td>15507149</td>
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<tr>
<td><strong>RX Message/Response Count:</strong></td>
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<td>332750</td>
<td>992389</td>
<td>380713</td>
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<tr>
<td><strong>TX or RX Broadcast Msg Count:</strong></td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td><strong>Master/Slaves Private Messages:</strong></td>
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<td>N/A</td>
<td>755253</td>
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<td><strong>Parity Error Count:</strong></td>
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<td><strong>Framing Error Count:</strong></td>
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<tr>
<td><strong>Dropped Message/Response Count:</strong></td>
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<td><strong>Invalid Message/Response Count:</strong></td>
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<td><strong>Device Timeouts:</strong></td>
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<td>N/A</td>
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<tr>
<td><strong>Blocked Write Messages:</strong></td>
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<td>N/A</td>
<td>N/A</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethernet TCP/IP Interface Statistics</th>
<th>Socket-1</th>
<th>Socket-2</th>
<th>Socket-3</th>
<th>Socket-4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TX Byte Count (To Application):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TX Response Count:</strong></td>
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<tr>
<td><strong>Dropped TX Responses:</strong></td>
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<td></td>
<td></td>
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<tr>
<td><strong>RX Byte Count (From Application):</strong></td>
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<td></td>
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<tr>
<td><strong>RX Message Count:</strong></td>
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<tr>
<td><strong>Dropped RX Messages Due to Congestion:</strong></td>
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<tr>
<td><strong>Dropped Invalid or Incomplete RX Messages:</strong></td>
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<tr>
<td><strong>Dropped RX Messages Due To Invalid CRCs:</strong></td>
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</tbody>
</table>
3  Examples of Common Installations Using Private Serial Bus(s)

Private Serial bus connectivity can be used to solve many challenging installation requirements. The following examples display a few of the many ways that Private Serial Bus technology can be used to enhance and simplify installations.

3.1  Connecting Public Modbus Slaves to an Existing Modbus Serial Bus

3.1.1  Connect to Local Serial Slaves

Requirements:

- A serial Modbus master on an existing serial bus requires communication to serial Modbus devices that can be connected to the same gateway.

Solution:

- Use a 2-Port or 4-Port DeviceMaster UP to provide both the public and private serial connections. Messages from the serial master will be forwarded to the public devices.
3.1.2 Connect to Serial Slaves over Ethernet Network

Requirements:

- A serial Modbus master on an existing serial bus requires communication to Modbus devices over an Ethernet network.
- The Modbus slave devices on its own serial bus must be secure from the rest of the Modbus network.

Solution:

- Use the Ethernet network and two DeviceMaster UP gateways to connect the Modbus devices to the serial master.

Connecting Serial Modbus Master to Remote Modbus Slaves
3.1.3 Connect to Modbus/TCP Slaves

The Serial Port Configuration page provides the interface to configure a serial port to connect to a Private Serial bus.

Requirements:

- A serial Modbus master on an existing serial bus requires communication to Modbus/TCP devices.
- The Modbus slave devices on its own bus need to be secure from the rest of the Modbus network.

Solution:

- Use a DeviceMaster UP to provide the communication from the private serial bus to the Modbus/TCP devices.
3.2 Providing Master-to-Master Communication

3.2.1 Communicate Between Serial Modbus Masters

Requirements:

- Communication is required between two serial Modbus masters residing on existing serial buses.
- Existing serial Modbus slaves are to remain protected from the Modbus network.

Solution:

- Use a 2-Port or 4-Port DeviceMaster UP running Modbus Router:
  - 2 serial ports configured to Private Loop mode (To-Master/Slaves)
  - Shared Memory configured to allow the two masters to communicate to each other
3.2.2 Ethernet Based Modbus Master(s) to Serial Modbus Masters

Requirements:

- Communication is required between Modbus/TCP and/or Modbus RTU/ASCII over Ethernet master(s) to serial Modbus master(s) on existing serial buses.
- Existing serial Modbus slaves are to remain protected from the Modbus network.

Solution:

- Use a DeviceMaster UP running Modbus Router:
  - Serial port(s) configured to Private Loop mode (To-Master/Slaves)
  - Shared Memory configured to provide communication between all masters
3.3 **Access to Remote Installations**

Requirements:

- Communication is required between multiple installations. This may include Ethernet and/or serial based masters combined with private serial buses.
- Modbus slave devices on each installation must be protected from other installation(s).

Solution:

- Use a series of DeviceMaster UP running Modbus Router:
  - Serial port(s) configured to Private Loop mode (To-Master/Slaves)
  - Shared Memory configured to allow the Ethernet master(s) and serial master(s) to communicate to each other