Insider Tips for Optimised Industrial Gateway Performance and Management

Executive Summary

To optimise production, efficiency, and operational cost, administrators take advantage of industrial networking to manage intelligent devices. With this demand for optimisation, more and more operators are using industrial gateways to integrate field devices into the most popular industrial Ethernet protocol—Modbus TCP. The fact that Modbus TCP is openly published allows operators to quickly customise their programs for remote control applications.

In mission-critical industrial applications, such as oil and gas, the failure of even a single link can affect operational efficiency. For this reason, reliable performance and management are very important in process automation. In this article, we provide “insider tips” that can be used to optimise the integration of multiple intelligent devices, as well as improve the performance and management of the devices.

Overview

More and more operations in industrial applications use industrial networking protocols such as EtherNet/IP, PROFINET, and Modbus TCP for the centralised control of real-time data and to improve response time, along with reducing operational costs. Modbus TCP is the most popular industrial Ethernet protocol as it is openly published and easy-to-deploy.

Operations in industrial applications are kept running using different devices, with each device running its own protocol. More and more operators are using industrial gateways to integrate Modbus TCP with these devices to keep operations running smoothly while retaining traditional devices to minimise cost. With industrial gateways, traffic from different fieldbus protocols (e.g., PROFIBUS and Modbus RTU/ASCII) can be integrated on one Modbus TCP network with minimised cost and integration effort.

Modbus TCP uses the master-slave technique, where the master sends a request to the slave and the slave feeds data back to the master in a continuous cycle. In certain situations, the reply must be sent within a pre-set time interval or it will be considered timed-out and cause a communication failure. The gateways, which act as the bridge that enables two or more devices with different protocols to communicate with one another, must have enough processing power to execute requests as quickly as possible, and also be easy to manage.

However, the failure of one link can cause a delay in the cycle that affects the efficiency of the entire operation, which is particularly critical for industrial applications such as oil and gas. Therefore, reliable performance and management are very important in process automation.

What Gateways Need to Optimise Performance

Processing Power

It is important to consider the processing power of a gateway since it supports industrial Ethernet interfaces and must able to handle multiple connections, both as a master and as a slave. As a slave, the gateway allows administrators to collect data from several masters simultaneously, while as a master, it bridges multiple slave devices and enables communication among these devices. When handling such a wide network connection, the gateway must possess enough processing power to support multiple connections while translating all requests within a predetermined time frame, and without affecting the response time.

Some gateways use only 16-bit processing power, which limits the capability of the gateway in terms of device support and response time. With a higher processing power, gateways can support more devices, without affecting the response time or the reliability of data transmissions. This is the reason some gateways can support up to 16 incoming connections, while some can support only 8 connections.

Intelligent Mechanism
In addition to the processing power, the gateway should also support an intelligent mechanism to prioritise urgent requests and make sure they are processed as soon as possible. The priority of a request can be determined by the Modbus TCP command function code, slave ID, or IP address/TCP port. In a network connection where multiple requests are made from several devices, the gateway can be set up to filter a specific Modbus TCP command as urgent and send it to the front of the queue, such as an urgent “suspend” command to stop a drive. Administrators could also assign the highest priority to a specific slave ID because that slave device transmits important I/O signals related to the safety of the system.

How Gateways Efficiently Manage Devices

Intelligent gateways should be able to respond to any communication problem as it happens, such as a power failure or Ethernet disconnection. In addition, when there is unauthorised access or login failure, the gateway provides a historical log that can be used for troubleshooting.

Relay Output
For urgent hardware issues, such as power supply and network connection events, the best way to receive notification is through a relay output for on-site troubleshooting. The administrator can use this relay output to control the I/O to turn on the alarm in the event of an error. In addition, for reliability, the gateway should support dual power inputs—the first input being the main power supply and the second one being the backup power supply (such as battery power). When the main power supply fails, the battery supplies the gateway enough power to signal to the administrator that the main power supply has failed.

Another frequent hardware issue is the Ethernet link. Factors such as the quality of cables and connectors, and even the Ethernet switch, may cause disconnections. The gateway should be able to notify the administrator as soon as this happens before the problem affects the entire operation.

Event Log
Like most network devices, the gateway provides an event log for troubleshooting, recording important events such as unauthorised access or login failures, network problems, protocol issues, and power cycles or system reboots. When the gateway undergoes power cycling, possibly due to firmware issues, the gateway must record the event to facilitate troubleshooting.

Console or Utility Tool
You may encounter issues with protocol settings from the start while installing and configuring the gateway. Using the wrong slave ID, wrong data address, or even incorrect baud rate will result in the inability to establish a connection between the gateway and the devices. In most cases, even after a connection has already been established, it is necessary to check whether the I/O data transferred between the networks is correct. You can validate data accuracy by changing the device I/O data and checking if the gateway shows the correct data or not.

The gateway records all traffic information, and displays the latest I/O data with decoded information. Since these functions are quite complicated, it is useful to have a utility that shows detailed event information and provides a better user interface that can be used to investigate any number of issues.

The Solution

This article has highlighted several tips to optimise interoperability performance and management of Modbus TCP masters and field devices. A number of these features are combined in Moxa gateway products, such as the MGate MB3000 series and MGate 5101-PBM-MN series.

- **High processing power handles multiple connections.** Moxa gateway products are designed with a powerful 32-bit ARM processor that allows these gateways to handle up to 16 connections simultaneously in slave mode, and communicate with SCADA, HMIs, and PLCs. When set up as a master, they can handle up to 32 connections with slave devices.

- **Automatic detection eliminates manual data input. The** Moxa gateway products optimise data monitoring and remove the burden of needing to take care of every different protocol. The MGate 5101-PBM-MN gateway's AutoScan function enables automatic scanning of connected PROFIBUS slave devices and their I/O modules, eliminating the need to manually input data, and resulting in zero chances for errors. The MGate MB3000 gateway's auto response time-out function enables gateways to automatically detect response time-out for each of the connected devices.

- **Priority control gives a higher priority to urgent requests on Modbus networks. The** Moxa MGate MB3000 features a patented priority control design, allowing urgent requests to be prioritised, and forcing an immediate response to certain commands.

- **Web-based monitoring tool enables online data monitoring.** Moxa gateway products provide a web-based utility to categorise all the data that passes through, and show real-time status information. With this utility, users can easily monitor the translated data, and monitor the commands, responses, and exceptions for each transaction.

- **Event log and alarm functions optimise troubleshooting.** Moxa gateway products support relay alarm settings, event logging, and a powerful utility to analyse and monitor the protocols, providing optimised performance and management, as well as dual power input and -40 to 75°C operating temperature for reliability. In addition, the MGate 5101-PBM-MN gateway has passed PI certification, a qualified certification system for PROFIBUS devices, to assure its quality.

For further information on how industrial Ethernet gateways can optimise your industrial network integration, visit http://www.amplicon.com