Modbus Newsletter

Spring 2009

Modbus Protocol Celebrates 30 Years

The Modbus Protocol messaging structure was developed by Modicon in 1979. Used to establish client/server communication between intelligent devices, it is the most widely used network protocol in the industrial manufacturing environment. It has been implemented by hundreds of vendors on thousands of different devices to transfer discrete/analog I/O and register data between control devices. Industry analysts have reported over 7 million Modbus nodes in North America and Europe alone.

Modbus remains a lingua franca — or common denominator — between different manufacturers...

Why does Modbus remain so popular? Its simplicity is compelling: Modbus development costs are exceptionally low; minimum hardware is required; and development is easy under any operating system. There are no exotic chipsets required and one can use standard PC Ethernet cards to talk to a Modbus device. As an open protocol, the specification is available free of charge for download, and there are no subsequent licensing fees required for using Modbus or Modbus TCP/IP protocols.

Today there are a multitude of Modbus devices available. Interoperability among different vendors' devices and compatibility with a large installed base of Modbus-compatible devices makes Modbus an excellent choice. The Modbus Organization has listed almost a thousand Modbus devices in its searchable online device directory for users to identify the right Modbus devices for their applications.

Please join us in celebrating 30 years of success. Modbus — in gas and oil and substation applications, manufacturing, building, infrastructure, transportation and energy. **30 years - still growing and still going strong.**

Modbus: Still the Best Choice for Building Automation

John Rinaldi, Real Time Automation

Unless we're successful or lucky enough to live in a grass hut in Tahiti, all of us live our lives in one building or another. As you would expect, those buildings are increasingly automated. Modbus and Modbus TCP make up a great deal of that automation infrastructure, accounting for the vast majority of low-level sensors and devices.

No matter if the building is an office complex, restaurant, government office, or automobile service station, there are multiple control systems with multitudes of controllers, sensors, and actuators at work. You have everything from fire control, elevators, heating, cooling, and lighting to roof top ventilators, exhaust systems, and sub metering of water, electricity, and gas. In light industry you might have controls and sensors for pneumatics, water quality, and electronic filtering. The list is truly endless.

If you look, you'll probably find Modbus TCP and Modbus RTU devices at the heart of many of these systems. The reason is simple: Modbus is the most widely supported, easiest to implement and easiest to understand open network in the world today. That means there are thousands of tested and cost-effective devices for building automation integrators to choose from. It's been that way for a number of years and it won't change anytime soon.

Some still argue that Modbus' dominance will change in the future. They say that devices with more sophisticated interfaces like BACnet, Lonworks and others will replace Modbus-enabled devices. I don't think so.

(*continued on page 3*)

Meet Some of Our Members...

Danfoss is one of the largest industrial companies in Denmark.

Danfoss serves the industrial automation market with products such as solenoid valves, sensors, transmitters and switches for pressure or temperature. The company's products can be found in many industries requiring state-of-the-art technology, such as industrial boilers and district heating, hydraulics, power generation, and marine applications.

Since 1968 Danfoss Drives has been dedicated to developing VLT® variable frequency drives to control speed, torque, acceleration, synchronization, positioning, and the overall performance of AC motors. The reliable and innovative VLT® drives are designed to support any automation application and provide major energy savings.

(www.danfoss.com)

Thermokon Sensortechnik was founded in 1987 with the production of special sensors for the heating industry. Over the years, the product line has extended to include air quality, humidity, light, and occupancy sensors.

At its location in Mittenaar, Thermokon is supported by 70 dedicated employees; worldwide sales and service are offered by qualified system and distribution partners.

Thermokon offers various sensors and operator panels that communicate using Modbus.

Thermokon is also a founding member of the EnOcean Alliance, a consortium of companies working to further develop and promote self-powered wireless monitoring and control systems for sustainable buildings.

(www.thermokon.com)

Eaton Corporation's electrical business is a global leader in electrical control, power distribution, uninterruptible power supply and industrial automation products and services. Eaton's global electrical brands, including Cutler-Hammer®, Powerware®, Holec® and MEM®, provide customer-driven PowerChain Management™ solutions to serve the power system needs of the industrial, institutional, government, utility, commercial, residential, IT, mission-critical, and OEM markets worldwide.

Eaton offers an exceptional array of equipment, tools, and services to reduce energy consumption and leave a smaller footprint on the world's environment.

(www.eaton.com/electrical)

Shouldn't your company be a member?

Modbus Newsletter

This is the newsletter of the Modbus Organization, the international non-profit organization devoted to the evolution and support of the Modbus protocols. For more information about membership and other services, please refer to our website: www.modbus.org

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The Modbus Organization Mission

The Modbus Organization, Inc. is a group of independent users and suppliers of automation devices that seeks to drive the adoption of the Modbus communication protocol suite and the evolution to address architectures for distributed automation systems across multiple market segments. Modbus Organization also provides the infrastructure to obtain and share information about the protocols, their application, and certification to simplify implementation by users resulting in reduced costs.

Modbus in Building Automation, cont'd from page 1

I agree that each of those other options are attractive. They are attractive for lots of reasons, but in the end Modbus still provides the fastest time to market and still brings the most bang for the buck for building automation system developers and product developers. Not only does it keep their BOM (build of materials) cost low, it requires the smallest amount of engineering resources and is the easiest to interface to higher-level control and information systems through those Ethernet, BACnet, and Lon protocols.

Our company recently integrated a vast number of Modbus RTU devices in an energy application for a company in Singapore. The requirements for this building automation system included sub-metering of power meters throughout a four-story medical research lab, and controlling many of the building services with small programmable controllers (Telemecanique Twido™) The data then needed to be integrated into their Johnson Control Metasys®.

The system integrator for this project chose Modbus RTU as the sensor network for his building automation system for three important reasons:

- Device Availability – There are an enormous number of low-cost power meters and PLCs that support Modbus RTU communications.
- Cost – Lon-, Ethernet- and BACnet-enabled devices were substantially more expensive, sometimes as much as five times the cost. Ethernet devices also required the addition of switches. Even though switches are now a commodity item, they still contribute to overall project cost.
- Simplicity, reliability, and supportability – Modbus RTU devices are well understood, easily integrated, and supportable.

Integration of the Modbus RTU devices was a key consideration for the system integrator on this project. The selected devices had to extract Modbus data from a large number of devices, scale each register, and combine it with the ancillary string data required to fully identify each point. This ancillary data included data strings such as the Tag name, unit identifier, and other descriptive data needed to fully present the data in the Metasys HMI screens.

The system integrator chose Modbus RTU as the sensor network for his building automation system for three important reasons:

- **Device availability**
- **Cost**
- **Simplicity, reliability & supportability**

After careful consideration, the integrator selected Real Time Automation's Modbus RTU to BACnet Device Converter module (ww.rtaautomation.com/products/460/mmbs.html). This module extracted the Modbus Register data from all the power meters and Twido PLCs, appropriately scaled each data point, and combined the ancillary data for each point.

The project was so successful that two additional buildings will go online with the identical system over the next several months. Real Time Automation's Modbus RTU to BACnet Device Converter module is part of the company's complete line of Modbus Device Converters.

Integration challenges are typical for many building automation system integrators. Modbus continues to be the best choice for low-level automation devices. As in this application, system integrators are finding that not only do they get a vast choice of possible devices, they find low-cost solutions and exceptional device converters with the ability to interface easily to high-level building control systems.

John Rinaldi founded Real Time Automation in 1988. To learn more about the company's products and services, visit http://www.rtaautomation.com/products.

Modbus Discussion

Q&A

From the Modbus Discussion Forum...

Modbus RTU over Ethernet...

Craig posed the following question:

I have a controller that uses Modbus RTU over Ethernet. How can I get a touch panel that has Modbus TCP to communicate with this controller? Am I going to need a third-party device or do I need a new driver to be written?

Jerry Miille replied:

Well you might need a new driver and you might need some additional hardware — it "depends."

The devil is always in the details, so you need to define what you mean by Modbus RTU over Ethernet. Is this a "serial port tunneling" application where Modbus RTU packets are delivered inside a TCP or UDP connection? If so is it TCP or UDP packets? Is your touch panel a Modbus TCP client or a server?

Also, you need to consider the performance issues like how fast do you need this to work, what happens if there is a communication failure, could your plant "blow up" if there is a problem?

Modbus TCP is almost a standard and is well supported by many companies. There are several "bridges" that can make the Modbus TCP to Modbus RTU conversion for you. They differ in what functions they can perform and, of course, in what they cost.

Lots of questions for you, and the best starting point might be for a direct conversation with potential vendors of this type of equipment. You can contact me directly if you choose. My name and phone number are on our web site ww.miille.com.

Manikandan suggested:

You can use a Modbus Gateway to convert Modbus RTU to Modbus TCP. ...Many third-party gateways like Moxa, ADAM, etc. are readily available and can reduce your development time.

Fred Loveless commented:

Modbus over Ethernet is usually Modbus RTU encapsulation in an Ethernet packet. Modbus TCP is Modbus with a special header and it does not use the checksum that Modbus RTU does. You could easily talk to the device using a serial-to-Ethernet converter, using a serial driver to go serial to the converter and then out to the device.

You could also use Kepware's Modbus serial driver with Ethernet encapsulation to connect directly to the device (www.kepware.com).

Craig responded:

So you're saying if I use a serial RTU driver and go through a RTU to TCP convertor I should be good?

From Fred Loveless:

Yes, as long as it is not adding a Modbus Ethernet header and footer to the packet. You want a raw TCP/IP header.

KirkC disagreed:

That won't work, Craig. If you want to encapsulate Modbus RTU serial in a TCP or UDP packet, you need a serial device server, not a Modbus RTU to Modbus TCP converter. Most serial device servers will come with software that will let you create a virtual COM port on a PC. With that you can use most any Modbus RTU driver. But Kepware's OPC driver, for example, lets you directly create a channel to the serial device server using either TCP or UDP encapsulation. If your client is not a PC, you can use two serial device servers, back to back.

Craig:

Basically what I have is a touch panel (HMI) that has a Modbus RTU driver in it. If I run this through a standard serial-to-Ethernet converter would I get RTU over Ethernet? If so has anyone done this before and, if so, do you have a recommendations on a converter to use?

Fred Loveless:

Yes, that should work. The serial-to-Ethernet converter will be configured to connect the IP of the device that is Modbus RTU over Ethernet.

Forgot to mention that this is what our Modbus RTU Serial driver does when you enable Ethernet connection. It wraps the RTU packet in a simple Ethernet header and footer. When it gets to the serial-to-Ethernet converter the header and footer are stripped off, and the RTU message goes to the RTU. The RTU responds and the message goes to the serial side. A header and footer are placed around it and sent back to the driver.

We also have customers that have done this in reverse, i.e. the client on the serial side sends the RTU request; it is wrapped by a header and footer. The RTU receives the request, responds, and so on. In this process there is nothing special done in the communications driver.

Add your commects to this thread at modbus.control.com/thread/1236017142

Modbus users & suppliers get together on the Modbus Community for:

- **Interactivity**
- **Knowledge aggregation**
- **Contact with Modbus users and suppliers**

Discussion supported by...

control.com®

More from the Modbus Discussion Forum...

Monitoring TCP Traffic between Two Modbus Devices...

Mikey asked:

I've got a small network setup at a customer site: wireless modem, Linksys router, and then a Modbus controller with three servers. One of the servers is not communicating with the client —no response is the error code I get on the client. I have used a Modbus TCP/IP tool and have verified that the server is transmitting the data, so I suspect the controller.

I'd like to connect my laptop again as a node, and just watch the traffic between my controller's attempted queries (like a third-party observer) to try and pinpoint the problem. Are there any software tools out there that can do that (i.e., monitor traffic between other devices, NOT have your PC simulate client and or server)? I've tried Wireshark, but I can only seem to get it to read traffic to and from my laptop.

Paul Wacker suggested:

A useful tool to diagnose problems on Ethernet networks is Wireshark (formerly Ethereal, see ww.wireshark.org). It will allow you to see requests, responses, and data within these messages.

To connect your laptop as a node and see this traffic, you may need some extra hardware. Remember that Ethernet switches segment traffic, so even if you connect your laptop to the switch ports on the router, you won't see unicast (point-to-point) traffic of other devices.

You'll need to find an Ethernet hub or a managed switch that supports port mirroring. This will let you eavesdrop on the connected devices.

Further from Mikey:

I've got a Sixnet managed remote access switch that I am connecting on the LAN as well. I configured the port mirroring, but I still can't see the traffic. Am I missing something else? I've tried Wireshark with promiscuous mode both on and off: no luck. Very frustrating…

Paul Wacker:

First, make sure you've set up port mirroring properly. You'll need to select which port(s) you would like to listen to, and which port you would like to monitor on. I would suggest that you monitor Tx/Rx on your Modbus TCP server, and then connect your laptop/PC to the monitoring port.

As for Wireshark: If this is your first time using it, try some packet captures with your laptop/PC connected to other devices, to make sure you have it working. If you have multiple network adapters on your laptop/PC, like wired and wireless, make sure you're selecting the right interface. There is a lot of great information at wireshark.org.

Carl Ellis asked more questions:

...What did you use to see the server response? What did the response look like? When you used the other tools, were you unable to see any traffic or just a lack of message response from server in question? Using the other tools, could you see responses from functioning servers?

From Mikey:

Let me clarify. I cannot get my Modbus client to communicate with the server, but when I connect my laptop as a node on the same LAN and run one of those Modbus TCP tools, I can read/write to the server no problem.

I'm trying to watch the communications (or lack thereof) between the client and server to try and understand why the server is not responding to the client (error message is "no response"), when it does respond to my own prompts from my laptop.

I have since ordered some hardware to test. It's called a barracudatap. Not sure how this will perform.

From Carl Ellis:

So, the third server is responding to the Modbus client tool, but not to the customer's Modbus field client. Hmmm. If the server hears its server ID, it should return a response, even if it's an error code. If your Modbus tool can get a response, why can't the customer's client?

Does the customer's Modbus client display or indicate Modbus error codes? Could the command from the client be "incorrect" for whatever reason and the server is returning an error that is not evident?

You've checked the query statement in the customer's Modbus client and confirmed that the server address is correct? The command function is legitimate?

How are you tying in your Modbus tool PC on the LAN? Same switch to which the customer's Modbus client is connected? Or into a switch next to the server? Is the cabling between the customer client and the third server used in your client tool test?

Are all devices (Modbus client, three servers and temporary PC) on the same subnet? 192.168.x.xxx (or whatever)?

What subnet mask is used on the client and servers?

Is this third server separated from the client by a router? A managed switch?

Are all three servers identical devices or different devices? Does the third server have Modbus TCP natively or is its comm port serial Modbus RTU connected to the LAN through a serial server?

Editor's note: After a long discussion, the author solved his problem. Find out how or add your comments to this thread at modbus.control.com/thread/1237510299

Modbus Products and Innovations

YASKAWA SI-EM3 Communications Option for AC Drive-V1000 Certified

Yaskawa's SI-EM3 has been certified for conformance to the Modbus protocol through Modbus Organization's Conformance Testing Program. SI-EM3 communication cards provide a Modbus TCP/IP interface between industrial networks and Yaskawa AC drives. The SI-EM3 option allows for Modbus communication over 10/100 Mbps Ethernet networks. The SI-EM3 has the ability to configure the IP address from a user-specified IP address, from a DHCP host, or from a BootP host. All parameters, diagnostics and operational commands are accessible via Modbus TCP/IP. This option supports up to 10 simultaneous PLC/PC connections.

For more information, visit www.yaskawa.com.

V1000 AC Drive

SCADA/Meter Gateway Granted Safety Recognition

SCADAmetrics recently announced that its EtherMeter™ SCADA/Meter Gateway was granted safety recognition in the United States for UL standard 60950-1 (Safety of IT

Equipment) and for the equivalent Canadian standard, CSA C22.2 No. 60950-1.

In addition to safety certification, the EtherMeter was tested for radiated emissions and deemed compliant with all applicable FCC and ICES standards.

The EtherMeter met Underwriters Laboratories' strict standards for insulation system integrity and product safety. Additionally, NRTL-recognition facilitates the inclusion of the EtherMeter as a component in UL508A industrial control panels, such as those within treatment plants and pumping stations.

SCADAmetrics is the manufacturer of the EtherMeter ™ SCADA/Meter Gateway – the device that enables Telemetry and SCADA System Integrators to read large municipal and industrial water meters using Modbus and Rockwell Automation industrial protocols.

ModbusPal Listed on Technical Resources Page

ModbusPal is an on-going Java project to create a realistic Modbus server simulator. Register values are generated dynamically thanks to predefined math functions and/or Python scripts. In the future releases, ModbusPal will improve its support of Modbus standards and offer more automation mechanisms. ModbusPal relies on Rx/Tx for Serial communication, and Jython for script support.

The Modbus Technical Resource page includes many offsite links that Modbus users and developers may find useful. These sites are not under the control of the Modbus Organization and we are not responsible for their contents or internal links; we simply provide these links as a convenience — with no implied endorsement.

Advertise Your Modbus Products at Modbus.org

With our growing number of site visitors and the increasing popularity of our device directory, what better place to advertise your Modbus devices and software than at **www.modbus.org**? E-mail lenore@modbus.org for a rate sheet.

Join! Design! Test! Promote! Apply!

We're with you. The Modbus Organization exists to help suppliers and users of Modbus protocols succeed. Our members range from suppliers of Modbus-compliant products, to system integrators, end users, and educational institutions.

The common link? They all value the information and services provided by the Modbus Organization, and they all play a role in determining the future of the world's most broadly applied protocol.

To join the Modbus Organization, order a Toolkit, or arrange conformance testing, visit our website:

modbus.org

Designing with Modbus

Each day, Modbus developers turn to the Modbus Organization for valued assistance with their projects:

• Start with downloading specifications and other design documents from the modbus-ida.org website.

• To really save time, purchase the Modbus TCP Toolkit CD (FREE with general membership); it contains source code and a myriad of other resources.

• Then, if you come across technical issues that have you stumped, post your question on our active developer's forum. One of the many experienced Modbus implementers who frequent this forum will likely have your answer.

Conformance Testing

When your project's done, what then? How do you know it really conforms to Modbus specifications? How do your users know?

The answer starts with running the conformance test suite included with your Modbus TCP Toolkit. This self-test helps you check your design assumptions and catch the subtle "gotchas" that might otherwise slip through your design review.

To make the definitive statement of your company's commitment to open protocols, submit your product for testing to the independent Modbus Organization Conformance Test Lab. We'll certify your product as compliant, and post that information on the Modbus website for the world to see.

Visibility: Your Company & Your Products

Your membership in the Modbus Organization also opens the door to a powerful range of visibility options to highlight your company as a supplier of Modbus-based products.

Exposure on our website, our newsletter, and through our various trade show appearances are all options that allow you to make the most of your Modbus Organization membership.

If your company is truly on the cutting edge of new technology, you'll likely also value the opportunity to participate in our technical committees. There, your company's knowledge, experience and technology can help guide future enhancements, extensions and adaptations of Modbus to keep it the world's leader for decades to come.

Time to Apply

When it comes time to get your Modbus network up and running, it's comforting to know that hundreds of thousands of applications have preceded yours. But what if things don't go as planned?

The modbus.org users forum is ready to answer your questions and provide guidance. Thousands of users from diverse backgrounds read the forum, giving you a powerful base of experience from which to draw.

The Future is Yours

So, whatever your role in the use of Modbus, consider joining the Modbus Organization. You'll get the support you need today, and have opportunities to help guide Modbus to a dynamic future.

The Modbus TCP Toolkit

The Modbus TCP Toolkit provides all the necessary pieces to develop a Modbus-compliant device, including documentation, diagnostic tools, sample source code, and pre-test software to prepare for Modbus conformance certification. The toolkit is available as a benefit of membership in the Modbus Organization or can be purchased separately for US$500 plus shipping and handling.

Toolkit Contents

Modbus Documentation

• Modbus Application Protocol Specification, V 1.01b

• Modbus Messaging on TCP Implementation Guide, Rev. 1.0b

Tools

• Modbus/TCP Client Diagnostic Tool

• Modbus/TCP Server Diagnostic Tool

Sample Source Code

• Modbus/TCP Sample Client Code for Visual Basic Win32

• Modbus/TCP Sample Client Code for C/C++ Win32

• Modbus/TCP Sample Server Code for C/C++ Win32

• Modbus/TCP Sample Server Code for C VxWorks

• Modbus/TCP Sample Server Code for C++ VxWorks

Conformance Testing

• Modbus/TCP Conformance Test Software