Modbus-IDA News
the architecture for distributed automation

Modbus-IDA: *Where Do We Come From? What Are We? Where Are We Going?*

Modbus Organization celebrates its fourth birthday this year. In October 2002, the organization was formally incorporated and began its support of the ubiquitous Modbus protocol with one member (guess who?) and the following mission: *to drive the adoption of the Modbus communication protocol suite and the evolution to address architectures for distributed automation systems across multiple market segments.*

As the industrial communications protocol with the largest number of installed nodes worldwide, we pride ourselves in being a service-oriented organization.

Our membership fees are modest; our certification fees are modest; and we make the Modbus protocols and Implementation Guides freely available for download on our web site, www.modbus.org.

Paul Gaugin's famous painting titled, *Where Do We Come From? What Are We? Where Are We Going?* is a great reminder that organizations are always changing and growing.

Birthdays are a good time to reflect. What have we accomplished? Where do we hope to go from here? Since October 2002, the organization has grown to over 50 members, including companies from around the world.

We continue to build our membership, inviting companies that supply Modbus devices and software to join and take advantage of our growing device directory and systems integrator database.

Users looking for particular devices for their applications frequently contact us after finding potential components for their systems on our website, and we put them in contact with members that supply the types of devices they need.

In 2004, we released the first version of the Modbus TCP/IP Toolkit, which is a free benefit to members, and available for a fee to all others. This year we released an updated version.

We continue to offer certification services, and list certified devices preferentially in our device directory. We plan to offer local services in addition to the laboratories in the United States and in China before the year ends.

This October, as we turn four, we are exhibiting in our eighth tradeshow, ISA EXPO 2006, and we are delighted to remind you that:

- Modbus is the World's No. 1 industrial protocol, with the largest installed base.
- Modbus TCP/IP is the No. 1 protocol for industrial Ethernet.
- Modbus is open and royalty free.
- Modbus is easy to deploy, scalable, and requires a very small footprint.
- Modbus is media independent, with implementations over Ethernet, RS-232/485 serial links, wireless, fiber optic, radio, cellular...
- Hundreds of devices that use the Modbus protocol are available on the market.

At modbus.org you will find:

- Free discussion forums for users and developers
- Technical resources such as the Modbus protocol standard documents, and links to tutorials and free Modbus drivers
- Hundreds of Modbus serial line and TCP/IP devices catalogued for easy identification of potential devices/software for your application
- Modbus System Integrator's Directory, and more...

If you happen to be at ISA EXPO 2006 October 17-19, stop by and wish us Happy Birthday!

Where Do We Come From? What Are We? Where Are We Going?
Paul Gauguin, 1897–98

oil on canvas, Museum of Fine Arts, Boston
image © 2006 Museum of Fine Arts, Boston

News about the World's Most Popular Industrial Protocol

Meet Some of Our Members...

Comtrol Corporation is a worldwide leader of device connectivity for industrial applications. In 1982, Comtrol pioneered device integration by inventing, HOSTESS®, the industry's first multi-port serial controller card for personal computers. The company then released RocketPort® - the first multi-port serial controller offering high performance at a low cost.

Comtrol now provides serial device control technology with its DeviceMaster® device servers that provide Ethernet-attached serial ports. Devicemaster is programmable so that it can run applications that enable it to eliminate the need for standard PCs on the factory floor.

Comtrol's technology is involved in many postal automation systems, baggage handling systems, power utility automation, automotive assembly facilities, as well as other machine control and data acquisition applications.

Comtrol manages communications for PLC or PC platforms, between plant floor devices and information management systems. Comtrol's platforms support protocols for serial devices including RFID readers, weight indicators, bar code scanner and label printer/applicators. Comtrol partners with peripheral manufacturers, OEMs, software developers, industrial distributors and other industrially focused organizations to provide systems integrators and OEMs the right tools for data communications and device connectivity.

(www.comtrol.com)

Modius, Inc. is a technology company aimed at solving the challenges of industrial device interoperability, integration of devices with enterprise business applications, and access to these devices using open standards over IT networks. Modius' OpenData™ solutions solve the challenges of device interoperability across the

enterprise by enabling businesses to collect important data over the web with a single, consolidated view of all critical infrastructure devices, regardless of location, device type, or manufacturer. OpenData technology provides secure network routing of health and performance data for business-critical power and infrastructure devices, including: uninterruptible power systems, generators, computer room air conditioning, power distribution units, switch gear, automatic transfer switches, fire detection and suppression systems, static switches, building automation systems, and other equipment types.

(www.modius.com)

Precision Digital Corporation has been in business for 30 years. The company's product line consists of a wide variety of digital display devices, many with Modbus interface capabilities. These products include digital panel meters, PID temperature controllers, and multi-input controllers. Standard process (4-20 mA) and temperature (T/C & RTD) inputs are available, as well as relay and 4-20 mA output options.

(www.predig.com)

Become a Member

see back cover for details...

Q&A

From the Modbus Discussion Forums...

Modbus *Server* Behavior...

On September 8th an anonymous poster wrote:

I'm new to Modbus, can someone help to answer the question below?

If a Modbus server receives the second request before it sends a reply for the first request, what will Modbus the server do? Will it send two replies (reply1, reply2) or will it only send a reply for request 2?

Jerry Miille replied:

Excellent question! Going to be interesting to see the responses to this message.

In theory this should not happen but in the real world, it can, and it does all the time.

The answer for you is that the server should respond to all VALID messages in the order that they arrive. I am defining VALID here as a message that has a good CRC or BCH AND is addressed to the remote (broadcast messages do not get a response anyway). The server should never throw a valid messages away, ever. Just take the client messages in one at a time, process them and return the answer. This is not a server problem. A server should always answer a valid message in the order it was received. The server has no control over anything. It can only respond when spoken to and that is that.

This a client problem and it can lead to all sorts of problems.

CH added:

The main thing you should know is that the Modbus client should only issue a second request either after a timeout, or after a response (be it successful or not). So, it sounds like your client device should up its response timeout.

No telling what the server device will do, as it all depends on how the server

manufacturer coded its Modbus driver, whether it can buffer incoming commands, etc. I would suspect it will choke on the second request.

Chris suggested:

With the Modbus Network, there should be one client, and up to 247 servers. The client will initiate a query to a server and wait for a response. If no response from the server is received within a timeout period, the client will abort the current query and get the next message query to transmit.

A client should not transmit another query until it has either received a response from the server, or the message has timed out. If the server cannot respond within the timeout period, it should not send a response.

Francois said:

On a Modbus TCP network there can be several clients...

Johnson added:

I think the previous question was regarding the capacity of client to send/initiate several queries at the same time to a server (without waiting for previous response) by using Modbus Plus or TCP and not about the number of clients allowed.

Is it right or not?

An anonymous additional question:

Just a curiosity: Does this behavior happen/apply to Modbus RTU or is the same for Modbus Plus and Modbus TCP/IP?

A response from Modbus-IDA:

This behavior is defined for Modbus/TCP, where several queries can be sent and be pending on the same connection or on different connections.

The transaction identifier (that must be unique on a connection) is used to pair the queries with the responses. There is no guarantee that the responses will respect the order of query submission; this is implementation dependent and

not required.

The number of concurrently open connections is also implementation dependent, as is the maximum number of pending queries per connection.

For Modbus ASCII or RTU the protocol works with alternating query/response, with time-out (excluding broadcast, that has no response).

The client should not send the next query before deciding on the whereabouts of the previous query.

The time-out duration is implementation dependent. By the time the client sends the next query there is no longer any expectation about the response to the previous query. Such response has either been received (successful or not as far as the application is concerned) or it timed out.

The application reaction to a time-out is application/implementation dependent.

If a response arrives and it is not expected (e.g., after a time-out), then it is discarded, like if the query for it had never been sent.

If a response arrives late and there is an expectation from a subsequent query, then it is expected to be the response to that subsequent query, and an error will be issued if it is not (based on the possible recognition).

Most ASCII/RTU servers in the field, while processing a query, silently drop any query after the first, until after the response to the first query is sent.

Ask your question or help out a fellow engineer on the Modbus Discussion Forums:
modbus.control.com

New 802.11b/g Connectivity for SeaI/O Data Acquisition Modules

SEALEVEL®

Sealevel Systems, Inc. is expanding its popular SeaI/O data acquisition line with the introduction of new wireless SeaI/O modules at the ISA 2006 exhibition in Houston. Choose from a variety of I/O options including Reed and Form C relays, optically isolated inputs, TTL interface to industry standard solid-state relay racks, A/D and D/A functionality. Connect to your SeaI/O network from any 802.11b/g host. All wireless SeaI/O modules offer WEP and WPA encryption for secure, reliable communications.

For maximum configurability, multiple units of any I/O type can be daisy chained together easily using convenient pass-through connectors. Removable terminal blocks are standard, enabling fast, versatile field wiring. SeaI/O modules operate from 9-30VDC, and power can be input via terminal block or DC jack. For easy software integration, application programs or 3rd party software can use the Sealevel SeaMAX library or industry-standard Modbus protocol. Both table mount and DIN rail mounting options are available, and installation is easy using Sealevel's software configuration tools.

For more information, visit www.sealevel.com.

Anybus X Gateway

NetBiter® webSCADA Gateway

IntelliCom Innovation AB, is proud to announce a new web gateway with built-in alarm manager and data logger. The NetBiter webSCADA Gateway is an industrial serial to Ethernet gateway that gives remote access to serial devices over Ethernet, Internet, LANs, telephone modems, GSM and GPRS. The gateway contains built-in features for alarm handling (SMS, e-mail, SNMP), data logging and web-based data access.

The NetBiter® webSCADA Gateway's built-in web server is used for all configuration and data presentation through a standard web browser. Users can access devices easily and securely from anywhere at anytime.

The device's main features include:

- GSM, GPRS and modem support
- Built-in I/Os
- Built-in web server for data access using standard web browsers
- Alarm / Status management by email, SMS and SNMP
- Data logging into built-in memory with historical trend graphs
- No Windows tools or HTML editors are needed
- No licenses or royalties
- OPC Server available
- Transparent Modbus RTU/TCP Gateway
- Multi language support
- webSCADA Design Kit available for designing custom web pages
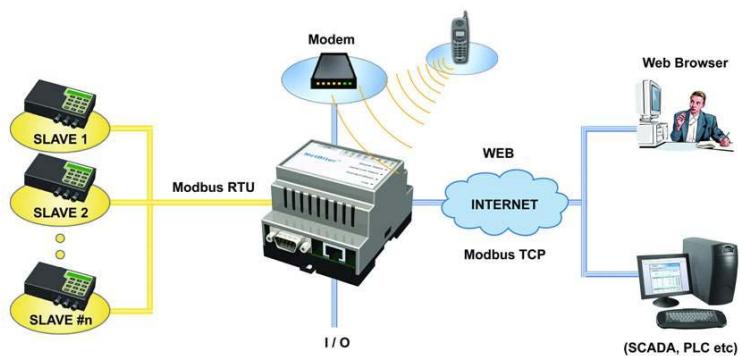
For more information, visit www.netbiter.com.

NetBiter webSCADA Gateway

TMW Announces: Modbus .Net Component

Triangle MicroWorks new .NET component for Modbus can be used with any .NET language (e.g., VB.NET, C#, Managed C++, J#), and is an ideal way to add Modbus support to your .NET applications. The component supports Modbus serial, Modbus RTU, Modbus TCP, and (with the proper hardware) Modbus Plus.

Purchase includes one year of Maintenance and Enhancement Plan (additional years may be purchased), which provides technical support and free updates. Support includes assistance integrating the .NET Component into your product as well as assistance troubleshooting any communications problems that may occur in the field.

TRIANGLE MICROWORKS, INC.

Key features include:

- Conformance to Modbus Application Protocol Specification V1.1 (including all data types and function codes required to pass the Modbus-IDA Conformance Tests)
- No royalty fees per unit sold
- Supports any physical communication network including RS232/485 (for Modbus RTU and Modbus ASCII), Modbus Plus, and TCP.
- Simple configuration for byte order: most-significant-first (Motorola) or least-significant-first (Intel)
- Extensive built-in diagnostics including a protocol analyzer to visually display and decode protocol messages.
- Records communication protocol errors such as "Unsupported function code," "Database errors," "Address range errors," "Exception response, FC=xxx, Exception Code = xxx"
- Both runtime and source code versions are available.
- Based on .NET 2.0.

For more information, visit www.trianglemicroworks.com.

China's Water

ProSoft Technology helps China realize its goal of enough clean, fresh water for all its citizens.

Danetta York

The face of China is changing... and so is its water. Water pollution, wastewater treatment and water resource protection have become top priorities for the Chinese government. Over the last ten years, the Chinese government has enacted a number of anti-pollution laws and begun to educate citizens on the importance of water resource management. In 2005 China's Ministry of Construction proposed that the central government allocate $2.4 billion USD to combat water pollution over the next five years.

"A decade ago, you could not see a single fish in any of China's main rivers, especially the Suzhou River." said Alex Xu, manager for Shanghai Yuandong Science & Technology Ltd., System Integrators for a number of water projects throughout China. "I was living by the river at that time and had to put up with the smell from the river over 200 days out of the year. But things are changing quickly in China. Now I regret that I moved away from the river because today it is clean and fish and crabs have reappeared."

The coastal city of Shanghai, with a population of over 16 million, has positioned itself as a leader in the drive to revamp China's water resources. Shanghai's Mayor Xu Kuangdi stated at a conference on environmental protection that the "Shanghai government pledged to transform Shanghai into an ecological city."

Taihe Fresh Water Factory

Flowing from west to east, across the heart of China is the Yangzi River. It is the longest river in China and the third longest river in the world. Originating in Tibet, it flows past the construction site for the world's largest dam, the Yangtzi River Three Gorges Dam, into the Pacific Ocean at the city of Shanghai. Raw water is collected from the Yangzi, filtered, purified, and then sold to tap water factories such as the Taihe Water Factory in Shanghai.

SCADA System

In 1995, Shanghai Taihe Tap Water Manufacture Ltd. began construction of the Taihe Water Factory. Phase I of the project established a SCADA system for the factory consisting of an ABB Modcell Multiloop Controller/Processor communicating with Modbus and ABB proprietary network, ICN. Clean water would be pumped through a series of pipes to supply the daily tap water needs for over 43,000 Shanghai residents.

"When the factory was established," said Alex Xu, "It used a SCADA system only to supervise the working processes without any control functionality."

In any water system as complex as this one, the water flow can vary dramatically from hour-to-hour and day-to-day, depending on domestic demand cycles and unpredictable aspects such as rainfall and storms. This makes it essential that the Master Control System be equipped with both monitoring and control capabilities.

Control Ability

"The second phase of the project planned to add control ability to the plant," said Xu. "But they found it impossible, since the substations were communicating as servers, thus couldn't exchange data and information with each other. The main problem was that data exchanged between the servers needed to be accomplished through the master node. As long as a personal computer carried out the master task, we could not count on its performance, steadiness, and security. Use of a PLC instead of a PC was preferred."

The Modbus-IDA Mission

Modbus-IDA 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-IDA will also provide the infrastructure to obtain and share information about the protocols, their application and certification to simplify implementation by users resulting in reduced costs.
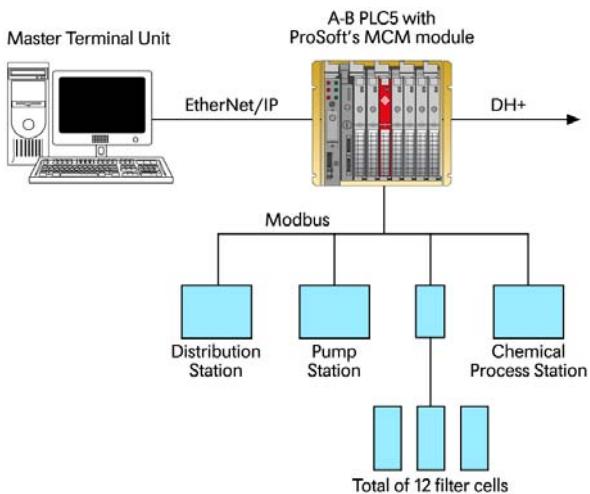
Taihe Water Factory Schematic

To add the required control, Xu added an Allen-Bradley PLC5/20E with Ethernet capabilities. However, since the original SCADA system was ABB communicating with Modbus, an interface was needed to allow the Modbus end devices to communicate with the Allen-Bradley processor. The solution Xu found was ProSoft Technology's Modbus Communication Module.

Designed to fit in an Allen-Bradley

Tourist's View of Three Gorge's Dam
photo credit: Richard Chambers, 2004

1771 PLC rack, the module contains two active serial ports, each supporting RS-232, RS-422 and RS-485, full radio, modem and multi-drop and configured using simple ladder logic. Since the module communicates over the backplane, needing only standard ladder programming, it provided highly configurable Modbus Client and Server capability to the existing A-B PLC.

"It was the first time Shanghai Yuandong Science & Technology had used our 3100-MCM module," said Lenus Hong, regional sales manager for ProSoft Technology. "Since the MCM module fits directly into Allen-Bradley's PLC5 racks, it provided a seamless integration of technologies."

"The 3100-MCM module played an important role in the second phase of this project," said Xu. "Without the ProSoft module, this phase could not have been realized."

A Unique Partnership

This unique partnership of integrated technologies between Rockwell Automation and ProSoft Technology has enabled SCADA systems around the world to gather data and control operations in a multitude of plants just like the Shanghai Wastewater Plant and the Taihe Water Factory.

"The 3100-MCM Modbus module was also used at the Xin Ning Wastewater Plant in Suzhou, China," said Hong. "According to Rockwell Automation-Shanghai, the customer needed to collect data from Diris Power Meters, which have embedded Modbus communications. They elected to use the 3100-MCM module, which allowed them to collect 30 parameters from the power meters instead of three parameters they would have gotten using Analog I/O. The bottom line is, our interface module made more data available for better control and monitoring."

"We take great pride in our ability to help Rockwell Automation interface with alternate networks," said Doug Sharratt, CEO for ProSoft Technology, Inc. "We have been able to provide a number of solutions for the water/wastewater industry in China. We are currently presenting SCADA solutions in conjunction with Rockwell on two other large water projects."

The seamless integration of Rockwell Automation and ProSoft Technology is helping China realize its goal of enough clean, fresh water for all of its citizens.

"China has its problems," said Xu. "But it has faced these problems and is attempting to tackle them. Sometimes the progress may be a little slow and seem small, but it is steady and good willing. As the international community continues to give real help and useful advice, things will go better, smoother and [more] expeditiously."

Danetta York is a staff writer for ProSoft Technology, Inc.

Join! Design! Test! Promote! Apply!

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

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

To join Modbus-IDA, order a Toolkit, or arrange conformance testing, visit our website:

WWW. modbus- ida.org

Designing with Modbus

Each day, Modbus developers turn to Modbus-IDA 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 (hint: it's FREE with membership), which 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 highly 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.

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

Visibility for You and Your Products

And, speaking of the world seeing your products, your membership in Modbus-IDA 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, in our newsletter, and through our various trade show appearances are all options that allow you to make the most of your Modbus-IDA 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-ida.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 Modbus-IDA. You'll get the support you need today, and have opportunities to help guide Modbus to a dynamic future.

The Modbus TCP Toolkit CD

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-IDA conformance certification. The toolkit is available as a benefit of membership in Modbus-IDA or can be purchased separately for US$500 plus shipping and handling.
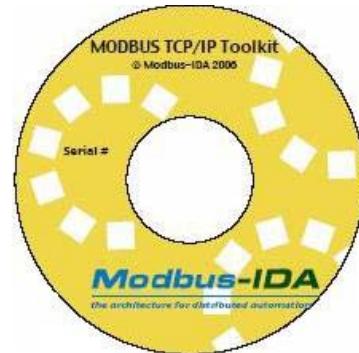
Toolkit Contents

Modbus Documentation

• Modbus Application Protocol Specification, V 1.01a

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

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