WHITE PAPER

A New Chapter in the Legacy of RS-485 Data Acquisition

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Executive Summary

As technology continues to advance and industrial processes become increasingly sophisticated, data acquisition systems in both mission-critical and commercial-grade applications will need to measure and manipulate more and more detailed information about the physical environment. Although many proprietary communication interfaces and industrial fieldbus protocols are being developed at a steady pace to keep up with the varying and changing demands of modern-day data acquisition systems, the latest and most sophisticated remote I/O devices on the market may not be the right solution for everyone.

Two commonly adopted communication interfaces used in data acquisition and control systems are RS-485 and Ethernet. Remote I/O devices based on these standards are used in data acquisition systems to bridge communications between field devices, such as sensors and data loggers, and a central computer in applications including building control, utility automation, intelligent transportation systems, factory automation, and more. Although Ethernet I/O devices are generally considered to be faster and more sophisticated than traditional RS-485 I/O devices, the latter may be sufficient for budget conscious system integrators. Nonetheless, there are still ways device manufacturers can improve upon the lasting legacy of RS-485 data acquisition devices.

Overview

Even before the RS-485 standard was approved by the Electronic Industries Alliance (EIA) in 1998[1], RS-485 based I/O devices had been used in industrial automation and mission-critical data acquisition applications due to the communication standard's ability to reliably transmit signals across long distances without succumbing to electrical noise. However, the biggest drawback of using RS-485 remote I/O devices instead of alternative technologies, such as Ethernet I/O devices, is probably the communication speed. For example, RS-485 networks only offer data transmission speeds from 1.2 to 115.2 kbps whereas Ethernet networks can transmit data at rates of 10/100 Mbps.

In light of all the new technologies becoming available, it may be tempting to predict that RS-485 data acquisition devices will eventually be replaced by newer and faster alternatives like Ethernet I/O. However, RS-485 based remote I/O devices remain some of the most commonly used data acquisition devices in both commercial and industrial applications today despite their

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physical limitations and maintenance difficulties.

Traditional Limitations of RS-485 Remote I/O Devices

Although RS-485 data acquisition devices remain popular in the field of automation, a number of practical limitations and time-consuming maintenance problems persist. As technology continues to advance and industrial data acquisition devices become more and more sophisticated, system integrators tasked with choosing between RS-485 and Ethernet I/O devices for their data acquisition networks often cite the following issues for turning away from RS-485.

Physical Limitations

Although RS-485 data acquisition devices can be used to build multi-point communications networks, the standard architecture is limited to 32 drivers and up to 32 receivers on a single (2-wire) bus. Furthermore, RS-485 data acquisition devices have no intrinsic method of avoiding data packet collisions. As a result, only one node in the entire network can transmit data to the bus at any given time, and all other nodes must wait in receiving status. If two or more nodes transmit data to the bus at the same time, all transmissions will fail.

Troublesome Troubleshooting

The process of configuring or updating RS-485 data acquisition devices can be excruciatingly time-consuming because engineers must adjust each communication parameter one by one. Replacing RS-485 devices or expanding an existing RS-485 network usually requires an engineer to bring a personal computer to various field sites to configure parameters or upgrade firmware for each field device. In a network comprised of hundreds of devices spaced up to 4,000 feet apart from each other, one can only imagine the hassle and cost of hiring an engineer to haul a personal computer from one field device to the next.

When Simple Serial Communication is Sufficient

Despite the traditional shortcomings discussed above, many system integrators continue to choose RS-485 I/O devices over faster Ethernet based alternatives due to the former's simple design, ease of control, and low cost of deployment and maintenance. In addition, RS-485 can establish peer-to-peer communications between devices up to 4,000 feet (1,220 meters) apart before repeaters are needed, whereas Ethernet switches and I/O devices are limited to only 328 feet (100 meters) before repeaters are required to re-amplify communication signals.

Compared to Ethernet I/O devices, RS-485 I/O devices are still relatively inexpensive and thus attractive options for organizations that lack economies of scale and cannot afford the more expensive Ethernet option. Many small and medium-sized enterprises, especially those in developing countries, opt for RS-485 remote I/O devices because the low deployment and material costs make replacing broken machines an economical alternative to investing limited resources in training skilled maintenance professionals or building an expensive Ethernet network. However, it is important to note that such cases are *not mission-critical*, which explains the low priority placed on preventing data loss, establishing network redundancy to ensure continuous connection, or reducing system downtime.

There may be times when a cheap and simple RS-485 data acquisition device is enough, but as the world becomes smarter and enterprises become more sophisticated, so must network devices used in modern data acquisition systems. As a result, savvy system integrators are not only on the lookout for easy-to-use and cost-effective solutions, but also network devices that are more dependable, easier to deploy and maintain, and reliable enough for backup or redundancy.

Exploring New Ideas for RS-485 Data Acquisition Devices

A smarter RS-485 data acquisition device should not only be equipped with all the basic benefits of RS-485 communication, but also address the standard's traditional limitations. Although not much can be done about the standard's physical limitations, innovative device manufacturers can still find ways to improve upon the tried and true foundation of RS-485 serial communications.

Software Configuration Interface for Easier Maintenance

Instead of manually turning hundreds of dials and switches across an expansive field site, using software to configure all the RS-485 devices on the network would greatly reduce deployment and maintenance effort. This software should enable quick access to all the RS-485 data acquisition devices' status information and settings in a user-friendly graphic interface. In addition, the software configuration tool should also provide an easy method for updating firmware remotely for all the data acquisition devices on the RS-485 network.

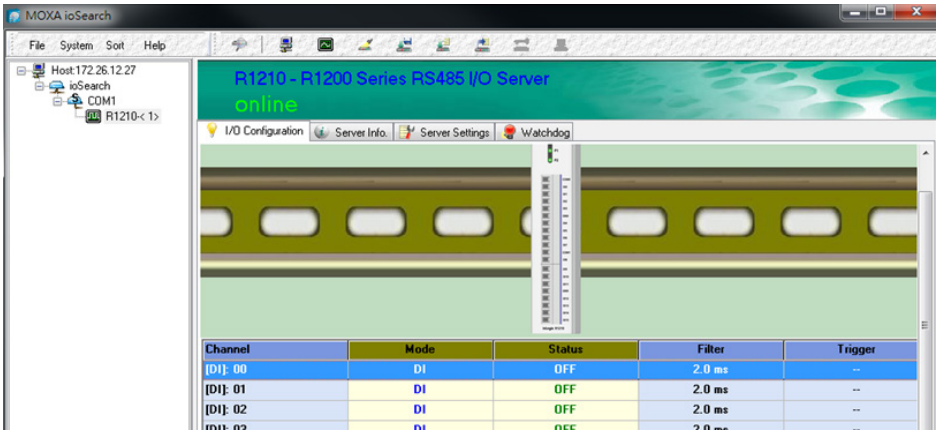

Figure 1
A user-friendly software interface can make configuring hundreds of network devices easy and less time-consuming.

The ideal software configuration tool would also allow users to set up their RS-485 data acquisition device's communication parameters from a remote location. So, instead of turning hundreds of dials to configure COM ports and device IDs during initial setup for all the data acquisition devices on the same RS-485 network, simply configure and duplicate the baudrate and mode for each network device through the graphical user interface. Converting manual hardware configuration to user-friendly software configuration will not only ease the effort of maintenance engineers, but also simplify the process of upgrading traditional device configurations and firmware.

"Plug and Chug" Deployment and Maintenance by USB

Although RS-485 is a relatively simple technology, RS-485 networks are not necessarily easy to maintain. In particular, companies are still required to train a specialized engineer who must carry a personal computer to the field site when remote access is insufficient. A simpler way to troubleshoot and repair field devices when field visits are necessary would not only allow system integrators to reduce labor costs, but also alleviate the maintenance effort of field engineers.

One solution is to add a USB port to the serial data acquisition device. This would serve as an alternative method for upgrading and configuring RS-485 remote I/O communication devices and firmware if remote maintenance was not feasible. All the engineer needs to do is upload the configurations onto a USB drive, bring the USB drive to the field site, plug it into the field device's USB port, and all the configurations and firmware updates will upload to the field device automatically.

Figure 2
Uploading device configurations and firmware upgrades by USB can help reduce maintenance time and effort.

Dual RS-485 Ports for Backup and Redundancy

Even though packet loss and transmission failures are common issues encountered by RS-485 networks, these problems can be easily prevented. System integrators for mission-critical applications generally deploy some type of backup system or redundant network to ensure that devices operate continuously without failing. If an RS-485 data acquisition device were equipped with dual RS-485 ports, system integrators could easily set up dual wiring or dual computer redundancy to back up their network.

For wiring redundancy, when the central computer detects that one of the RS-485 connections is not responding, it can quickly switch over to the other RS-485 line to guarantee continuous communication between the field sensor and the central computer. Alternatively, the additional RS-485 connection on the I/O device could connect field devices to a secondary computer on a local network to provide system operators with a secure backup in case the primary system goes down.

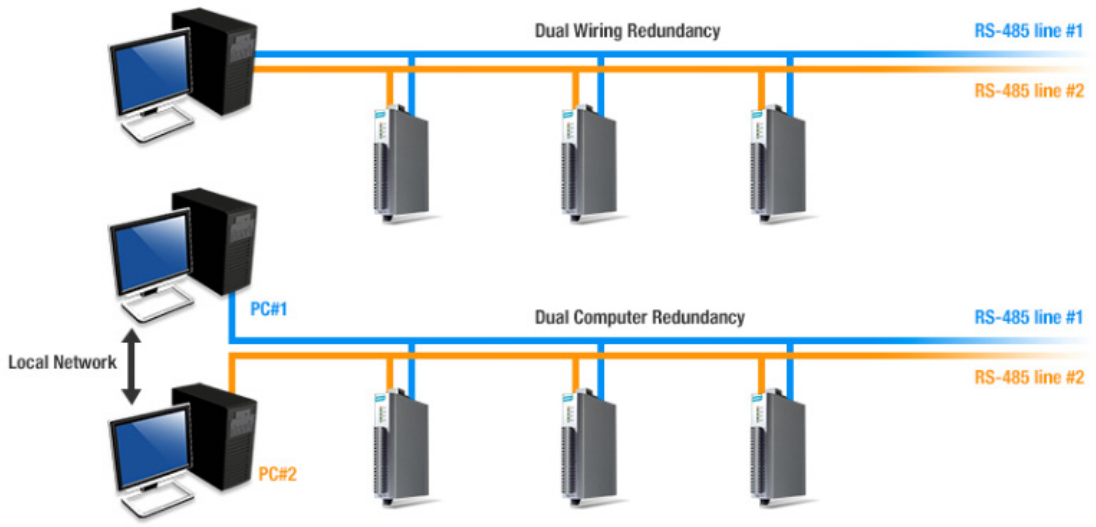

Figure 3
Dual RS-485 ports open up more network topologies for backup and redundancy.

Although dual RS-485 ports are nothing new, an additional RS-485 port enables maintenance engineers to test or repair an I/O device more quickly when one of the RS-485 ports is damaged. So even though RS-485 remote I/O devices are already considered a low-cost technology, the addition of dual RS-485 ports can help system integrators save even more down the road without compromising on reliability.

Writing the Next Chapter in the Legacy of RS-485 Data Acquisition Devices

Thanks to their affordability and simplicity, RS-485 serial devices like Moxa's ioLogik R1200 series RS-485 remote I/O devices are here to stay because they not only provide all the basic benefits of RS-485 communication, but also address some of the common limitations of traditional RS-485 remote I/O devices. In particular, time-consuming maintenance can be greatly reduced by introducing user-friendly improvements like the ioLogik R1200 series' communication configuration via ioSearch software, uploading configurations or firmware via USB, dual RS-485 ports, and built-in repeater. These are all practical solutions that can help enterprises around the world integrate RS-485 I/O devices into an existing network, ease maintenance effort, reduce costs, and generate business growth at the same time.

Customer-centric and forward-looking remote I/O device manufacturers like Moxa understand that one size does not fit all and, instead, offer affordable reliability for all budgets. By adding simple modifications to improve usability while leaving room for backup or redundancy without breaking the bank, Moxa's ioLogik R1200 series is writing a new chapter in the legacy of RS-485 data acquisition devices.

For further information on how RS-485 remote I/O devices can benefit your data acquisition system, visit http://www.moxa.com/product/Serial_Remote_IO.htm.

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Sources

1. *Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*, ANSI/TIA/EIA-485-A-1998, Telecommunications Industry Association, 1998.