WHITE PAPER

A New Standard for Serial Connectivity: Longevity, Adaptability, and Cybersecurity in Industrial Networks

- Part I: Longevity -

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Part I: Longevity

In the era of digital transformation, industrial communication networks need to be more reliable and secure than ever. What's more, evolving communication demands necessitate infrastructure upgrades across industries. While some are embracing new infrastructure with modern communication protocols, the majority must modernize their legacy systems to keep up. Serial connectivity, a long-time cornerstone of industrial automation, continues to be vital in bridging legacy systems and modern digital operations. During this transition, secure and durable serial connectivity solutions are especially crucial for businesses across sectors like energy, infrastructure, transportation, and manufacturing.

Challenges arising in modern industries mandate a new serial connectivity standard based on three key principles.

- **Longevity:** Extending existing serial systems and enhancing their lifespan
- **Adaptability:** Integrating a new design with an updated green policy and improved interoperability
- **Cybersecurity:** Upgrading serial-based systems so that they are ready to be connected to cyber-resilient networks

Released on April 2, 2025

Moxa is a leading provider of edge connectivity, industrial computing, and network infrastructure solutions for enabling connectivity for the Industrial Internet of Things. With 35 years of industry experience, Moxa has connected more than 82 million devices worldwide and has a distribution and service network that reaches customers in more than 80 countries. Moxa delivers lasting business value by empowering industry with reliable networks and sincere service for industrial communications infrastructures. Information about Moxa's solutions is available at www.moxa.com.

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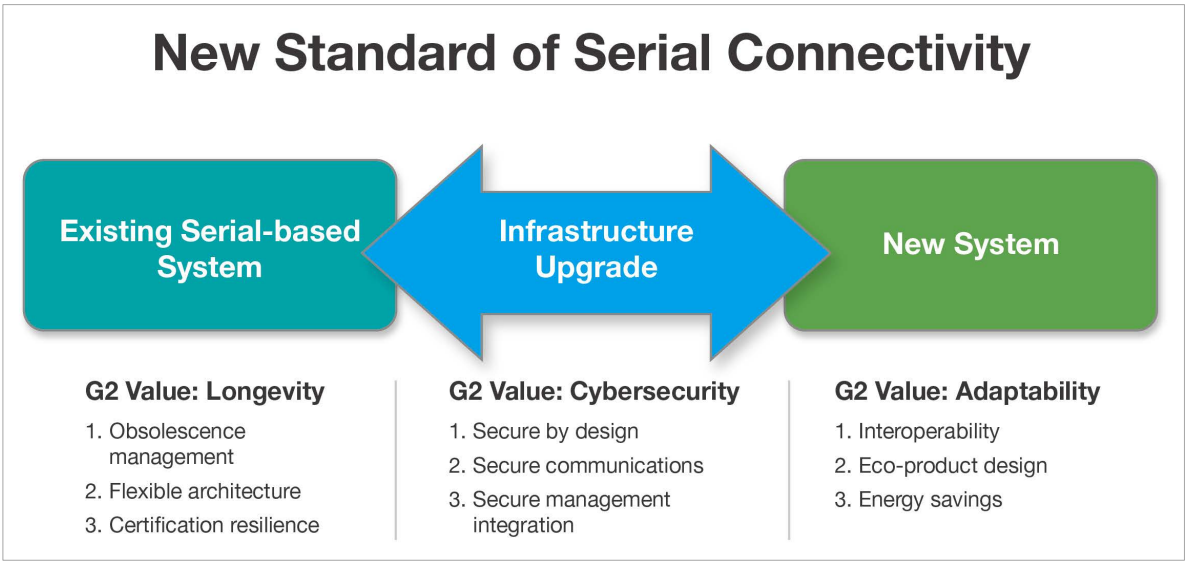
In a series of white papers, we explore the importance of long-lasting, secure serial connectivity solutions. These solutions must adapt to new digital infrastructures while integrating with existing systems. Amidst increased hyperconnectivity, they enable data-driven, value-creating applications like digital twins and industrial edge AI. These technologies optimize industry efficiency and outcomes, shaping the future of industrial communications. This series also highlights the need for a trusted serial partner that adheres to these standards.

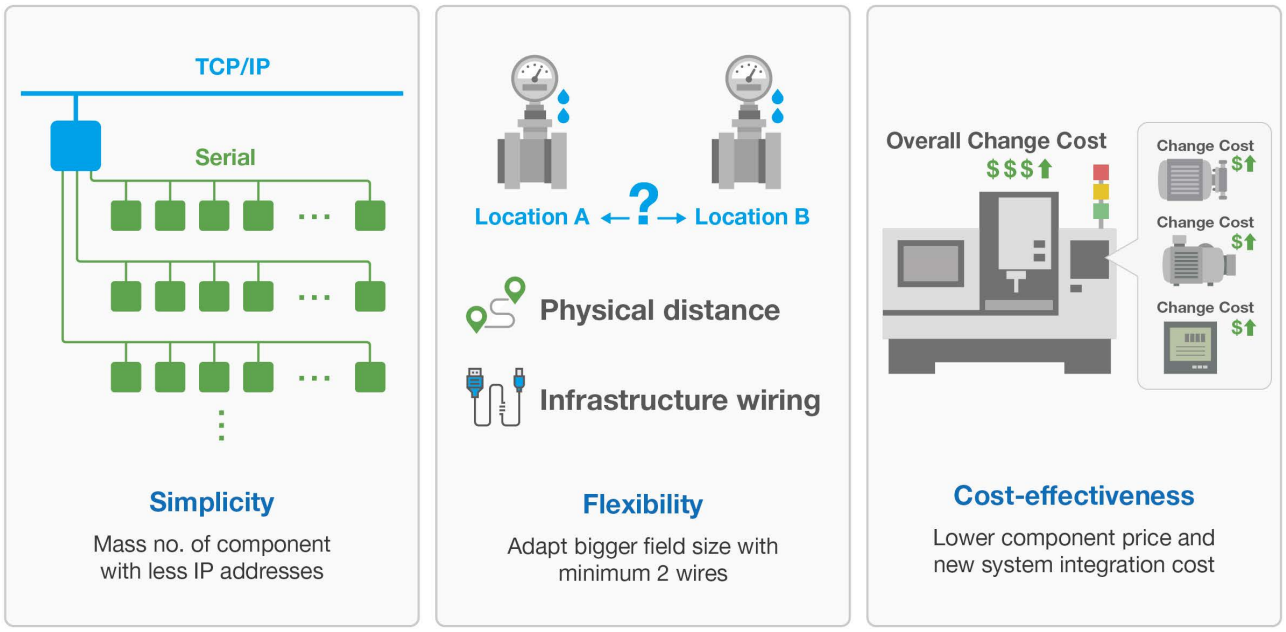


This white paper explains why industrial applications still favor serial connectivity solutions, emphasizing the need for long-term support for serial infrastructure to maintain efficiency and prevent costly disruptions. Hence, choosing a reliable vendor with robust obsolescence management, flexible design architecture, and certification resilience ensures long-term stability in an ever-changing technological landscape.

Why Industrial Applications Still Favor Serial Connectivity

The design of industrial systems prioritizes durability and long-lasting performance. While consumer-grade technology is evolving at a rapid pace, with new generations emerging yearly, industrial equipment and systems typically operate for five to 15 years or more, ensuring operation stability and financial return of investment. Field-proven, stable systems usually run for an extended lifetime. Integrators of industrial systems, therefore, must prioritize longevity when selecting components for their solutions. Despite the rise of new communication technologies, serial communication (RS-232/422/485) remains essential in many industrial applications because of its simplicity, flexibility, and affordability.

Three Aspects for Continued Use of Serial Connectivity



These three aspects have solidified the crucial role of serial communication in connecting field equipment, underscoring its relevance in the market. The diagram above and the table below show application value changes across different scenarios over time.

Customer Need/Challenge	Serial Solution/Feature	Benefit	Example
Connects many field components in a simple way	• Multi-drop topology (RS-485): multiple components on the fieldbus • Serial-to-Ethernet conversion to save IP addresses	• Simplified cabling compared to Ethernet star-shaped topology • Less complexity in IP address planning	• Circuit breaker in switchgears • Water plant sensors (flow, pH)
A larger scale of field connections with limited wiring	• RS-485 communication distance extends up to 1,200 m • RS-485 operation requires a minimum 2-wire twisted-pair	• Large-scale sites see lower costs for extending communication distances • Existing wiring can be leveraged to reduce costs and eliminate high-overhead rewiring	• Factory system upgrade: Uses existing wiring • Pipeline transmission gauges monitoring in large-scale sites
Cost-effective system (if performance is sufficient)	• Lower component unit cost • Well understood with lower risk in system integration	• Stable cost structure with optimized component cost • Lower TCO and save integration cost overhead	• Existing machinery that runs properly • Sensors in FMCS/HVAC systems

Market research confirms the continued demand for serial connectivity, projecting the global market for serial device servers will grow at a compound annual growth rate (CAGR) of 4% to 6% through 2030 and beyond. Key sectors driving this growth are manufacturing, energy, utilities, and healthcare. These industries rely on robust, long-lasting equipment, making reliable connectivity solutions essential.

Supply Continuity Under Pressure

Challenges in Industrial Serial Connectivity

While the demand for serial connectivity remains strong, industrial sectors face a range of emerging challenges. Since 2020, global supply chain disruptions caused by international cargo limitations and component shortages (largely driven by the automotive electronics boom and COVID-19 effects) have affected production timelines. Also, more challenges are on the horizon.

- **Supply chain disruptions:** Geopolitical tensions and trade uncertainties have occasionally disrupted the supply of vital components for serial connectivity products.
- **Shifts in silicon manufacturing:** Consumer electronics and AI are driving the semiconductor industry's shift toward advanced (<28 nm) manufacturing. The transition to advanced processes pushes out older processes that serve industrial needs, including mature serial connectivity chipsets, thus causing the obsolescence of critical components. This transition poses challenges for maintaining long-term compatibility and supply stability in industrial solutions.
- **Solution availability:** Over the last decade, we have seen a consolidation of serial connectivity vendors, a shift in product focus, and a converged serial connectivity solution scope, leading to potential supplier changes, solution redesigns, and added operational costs for users.

Strategic Responses Needed for Industrial Connectivity Challenges

Paving the Way for a Reliable Future in Serial Communication

In short, serial communication will remain important in the industry for decades. For industrial users, sustained serial connectivity—reliable and trustworthy—is critical for optimizing long-term operational costs and business continuity.

Here are some key elements for building a serial connectivity solution:

- **Component life-cycle management:** For manufacturers of serial connectivity solutions, proactively managing the life cycle of key components is becoming increasingly critical. Managing component life-cycle risks effectively means analyzing vendor roadmaps, continuously monitoring key component supply status, and maintaining component pools for long-term availability. Executing and monitoring mitigation plans strengthens component life-cycle management in serial solution products, resulting in more resilient supply chains for organizations.

- **Design architecture flexibility:** We must consider several design principles to ensure long-term serial connectivity product availability:
  - Future replacements for component EOL replacements
  - Performance upgrade flexibility for enhancements

  For example, evolving cybersecurity in industrial networks demands ever-increasing hardware and software capabilities to meet advanced functional needs like stronger encryption. Selecting a CPU with a mainstream architecture and an embedded operating system that can adapt to different CPU platforms provides flexibility, allowing the design to function like building blocks and easily accommodate future changes or upgrades.

- **Industrial Certifications: Proven Resilience:** To guarantee the continuous supply of products and services with the same industrial-grade certification level and quality over the long term, we must explore alternative component combinations during early design stages.

Building the Future of Industrial Connectivity

Moxa aims to be the leading industrial edge connectivity partner, providing high-availability solutions through 2035 and beyond, leveraging its robust component life-cycle management, proprietary ASICs, and decades of in-house driver technology expertise. Moxa's next-generation industrial serial edge connectivity products aren't just upgrades—they're a comprehensive strategy for longevity, cybersecurity, and sustainability. With its next-generation platform, Moxa is ensuring the long-term success of industrial serial communication.

Learn more about our next-generation products and long-term commitment as your trusted serial partner at our Trusted Serial Partner site.