

**The New Standard for Serial Connectivity:
Longevity, Adaptability, and Cybersecurity in
Industrial Networks
- Part II: Adaptability -**

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Part II: Adaptability

To thrive in the digital age, industrial communication networks must prioritize reliability and security. Additionally, industries must upgrade their infrastructure to keep up with evolving communication. Although many are embracing new infrastructure and modern communication protocols, most still need to upgrade their legacy systems to stay relevant. Thus, industrial automation's reliance on serial connectivity remains crucial for integrating older and newer systems. For a variety of sectors including energy, including energy, infrastructure, transportation, and manufacturing, robust and dependable serial connectivity solutions are extremely important in this transition period.

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 July 31, 2025

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Moxa is a leading provider of edge connectivity, industrial computing, and network infrastructure solutions for enabling connectivity for the Industrial Internet of Things. With over 35 years of industry experience, Moxa has connected more than 111 million devices worldwide and has a distribution and service network that reaches customers in more than 91 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.

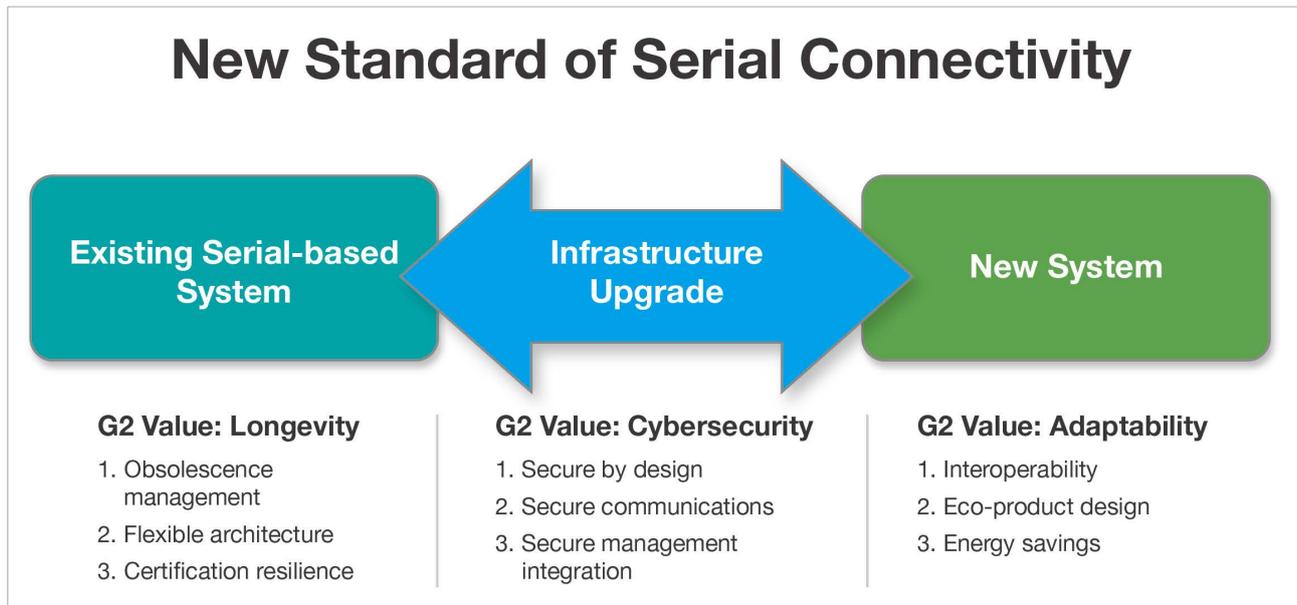
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In a series of white papers, we explore the importance of long-lasting, secure serial connectivity solutions. These solutions must adapt to new digital infrastructures while integrating with existing systems. Amidst increased hyperconnectivity, they 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.



Adaptability is crucial for integrating new and legacy systems. This white paper underscores this, showing how seamless upgrades can futureproof infrastructure for evolving technologies. New technologies must prioritize flexible system interoperability, including communication integration, and eco-friendly, energy-efficient designs to modernize sustainably. Choosing a reliable vendor providing adaptable, interoperable, and sustainable solutions will help you streamline retrofits, enhance operational resilience, and speed up digital transformation.

Why Is Bridging Legacy Systems So Challenging?

Digital transformation in industries faces several adaptability hurdles in integrating new devices and legacy systems. Legacy industrial infrastructures, designed with proprietary protocols and closed architectures, often make the seamless integration of modern, network-capable devices difficult without extensive retrofitting. While important energy, automation, and transportation operations depend on these older systems, their rigidity significantly hinders the complex and lengthy undertaking of modernization. Hexagon and Forrester Consulting¹ found that 98% of manufacturers have at least one data problem impacting their use of AI and automation. Moreover, 97% of manufacturers struggle with collaboration and productivity, and almost 40% have slow automation adoption, hindering their digital transformation.

Interoperability is a major hurdle to overcome. Picture a long-established factory, using serial communications, needing to add Ethernet or cloud devices. Without proper bridging solutions, businesses face network fragmentation and data flow disruption from incompatible protocols and systems. Integrating systems is a laborious process, wasting time, resources, and money while reducing efficiency. Grady Andersen & MoldStud Research Team² emphasizes interoperability as a significant barrier hindering industrial IoT adoption, requiring strategic investment in scalable, flexible solutions.

But interoperability isn't the only challenge. Global pressure is pushing companies to modernize and reduce their carbon footprint for environmental sustainability. Simply replacing old equipment is not enough. New devices must be energy-efficient, eco-friendly, and designed with sustainability in mind.

This adds complexity to the transition. Upgrading to energy-efficient systems may mean changes to infrastructure, staff training, and operational workflows. Ensuring sustainable manufacturing, energy efficiency, and e-waste reduction for new devices adds complexities to decision making. According to a study by Khan et al.,³ integrating Industry 4.0 technologies promotes sustainable industrial operations. A 2023 World Economic Forum case study reveals a leading electronics manufacturer in China achieved a 24% energy reduction, 48% waste reduction, and 92% production increase through technological advancements. Although high initial investment, cybersecurity risks, and workforce upskilling pose challenges, embracing new technologies is crucial for sustainable industrial growth.

Adaptability, interoperability, and sustainability are interconnected challenges that businesses must address to modernize industrial operations effectively. A smart approach ensures lower costs, less environmental harm, and seamless integration of legacy and modern technology in our dynamic digital landscape.

¹ Advanced Manufacturing Report was conducted by Forrester Consulting and released by Hexagon on March 07, 2024 (<https://hexagon.com/advanced-manufacturing-report>)

² Grady Andersen & MoldStud Research Team, 2025, Navigating the top ten challenges of IoT interoperability in industrial environments and effective solutions to overcome them (<https://moldstud.com/articles/p-navigating-the-top-ten-challenges-of-iot-interoperability-in-industrial-environments-and-effective-solutions-to-overcome-them>)

³ M. Imran Khan, et al., 2025, Integrating industry 4.0 for enhanced sustainability: Pathways and prospects, Sustainable Production and Consumption 54, 149–189 (<https://www.sciencedirect.com/science/article/pii/S2352550924003555>)

The Role of Adaptability in Sustainable Industrial Transformation

Adaptability is key to modernizing industrial operations without disrupting legacy systems. Adaptability enables businesses to incorporate new technologies, improve energy efficiency, and maintain system compatibility for long-term success in meeting environmental and operational goals. Successful digital transformation strategies should consider the following aspects.

1. Interoperability as the foundation of digital transformation

New devices must support both legacy and modern communication protocols for smooth integration. Solutions like protocol gateways, serial-to-Ethernet device servers, and IoT-based communication bridges, which help integrate legacy systems into modern digital infrastructures, facilitate this. Moreover, these integrations mustn't hinder performance; prioritizing operational efficiency improvements is key. Interoperability systems also allow for gradual infrastructure upgrades, reducing costs and minimizing downtime.

2. Sustainable product design for a greener future

When choosing new devices, sustainability should be a primary concern. Businesses ought to prioritize vendors committed to recyclable, harmless materials, eco-friendly manufacturing, and energy-efficient components. Growing regulatory pressures, including the EU's Corporate Sustainability Reporting Directive (CSRD) and the UN's Sustainable Development Goals (SDGs), are driving a shift toward sustainable product standards. Choosing eco-friendly devices helps businesses lower their environmental impact and comply with regulations throughout a product's life.

3. Continued use of serial-based and other legacy products helps

Environmental, Social, Governance (ESG) goals aim to reduce e-waste. Many industrial systems rely on serial-based equipment, and their removal would create significant waste. Alternatively, businesses can leverage serial-to-Ethernet device servers, gateways, or similar technologies to seamlessly integrate legacy infrastructure with modernizing networks, extending the lifespan of serial products.

4. Energy efficiency and carbon footprint reduction

To cut operational costs and carbon emissions, modern industrial devices need energy-saving designs that minimize power use in operation and idle states. Assessing the carbon footprint from production and operation to end-of-life disposal ensures we meet sustainability goals without compromising performance. Based on Lythouse's findings⁴, a product's energy consumption and emissions heavily influence its overall environmental impact. Generally, a product with a 5-year warranty accounts for approximately 50% of its total carbon dioxide equivalent (CO₂e) emissions over its entire life cycle.

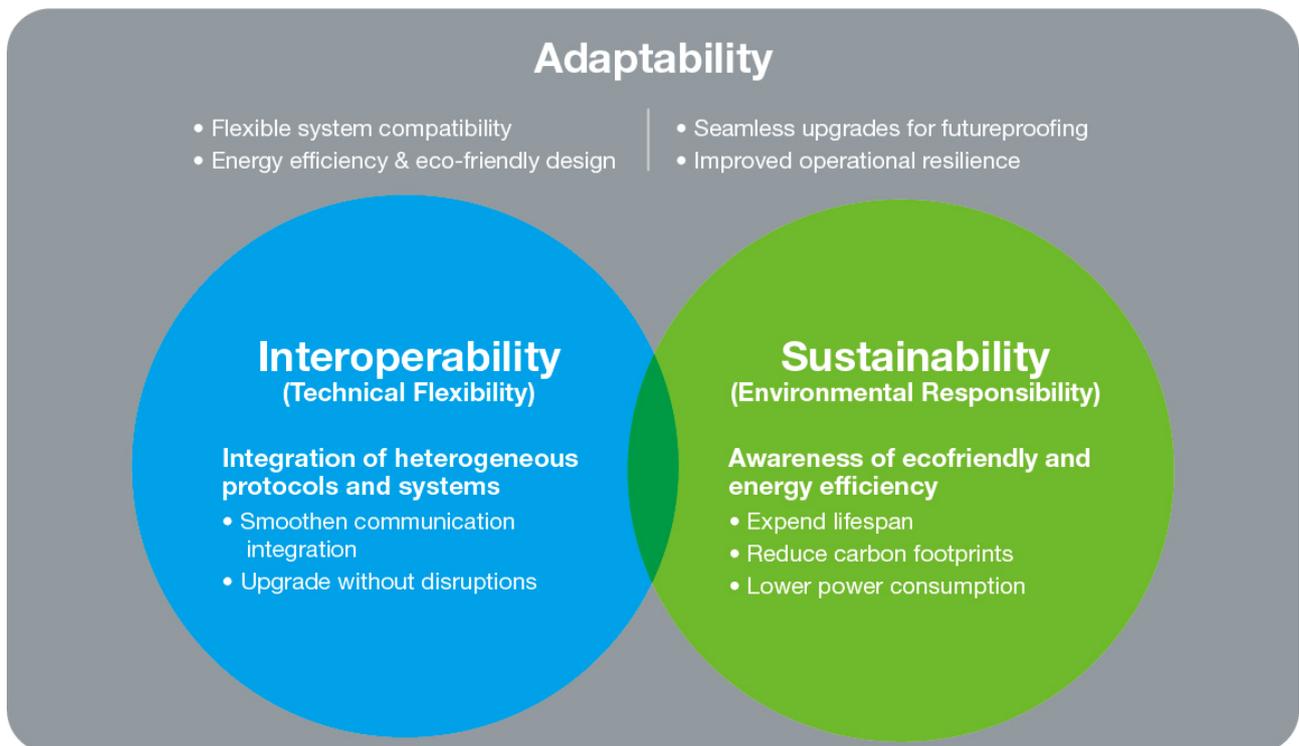
⁴ <https://www.lythouse.com/blog/understanding-product-carbon-footprint>

5. Long-term sustainability and futureproofing

Choosing solutions with extended life cycles is essential for both cost-effectiveness and sustainability. Devices should receive continuous firmware updates to ensure future compatibility and extended lifespans and reduce the carbon footprint associated with retrofitting. For long-term support, assess vendors based on their sustainability commitment, encompassing consistent firmware or driver releases, comprehensive product life-cycle planning, and user adoption strategies that deliver investment value.

Businesses must consider interoperability, eco-friendly design, and energy efficiency as linked elements—not isolated issues—for operational and sustainable success. Interoperability ensures that new devices seamlessly integrate with existing infrastructure, reducing costly disruptions and preserving past investments. Eco-friendly design contributes to corporate sustainability initiatives, helping companies meet environmental regulations and Corporate Social Responsibility (CSR) commitments. Energy efficiency lowers power consumption, reduces carbon emissions, and enhances long-term cost savings.

Incorporating all the above elements in the selection process allows businesses to create a high-performance, sustainable, and futureproof industrial system. For example, choosing energy-efficient, eco-friendly devices with modern communication protocols makes digital transformation more than just an upgrade—it’s a strategic step toward a greener, more efficient future.



Choosing the Right Partners With the Supply of Interoperability and Sustainability

To integrate new devices with legacy systems, challenges related to interoperability, eco-friendly design, and energy efficiency must be addressed. Partnering with vendors focused on these priorities helps businesses modernize infrastructure while minimizing their environmental impact. Industrial operations will thrive in the future by embracing connectivity, sustainability, and energy efficiency for improved performance and long-term viability.

Moxa is committed to leading this transformation by implementing carbon reduction initiatives, developing green products, and maintaining a responsible supply chain. According to Moxa's "[Sustainability Report 2024](#)", approximately 70% of a product's carbon footprint is generated during its operation life cycle. Thus, through energy-efficient designs, life-cycle assessments, and transparency in sustainability reporting, Moxa ensures that its next-generation solutions support digital transformation while meeting ESG goals. With a long-term vision for industrial edge connectivity, Moxa's innovations provide not just compatibility and performance but also a sustainable path forward for decades to come.

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

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