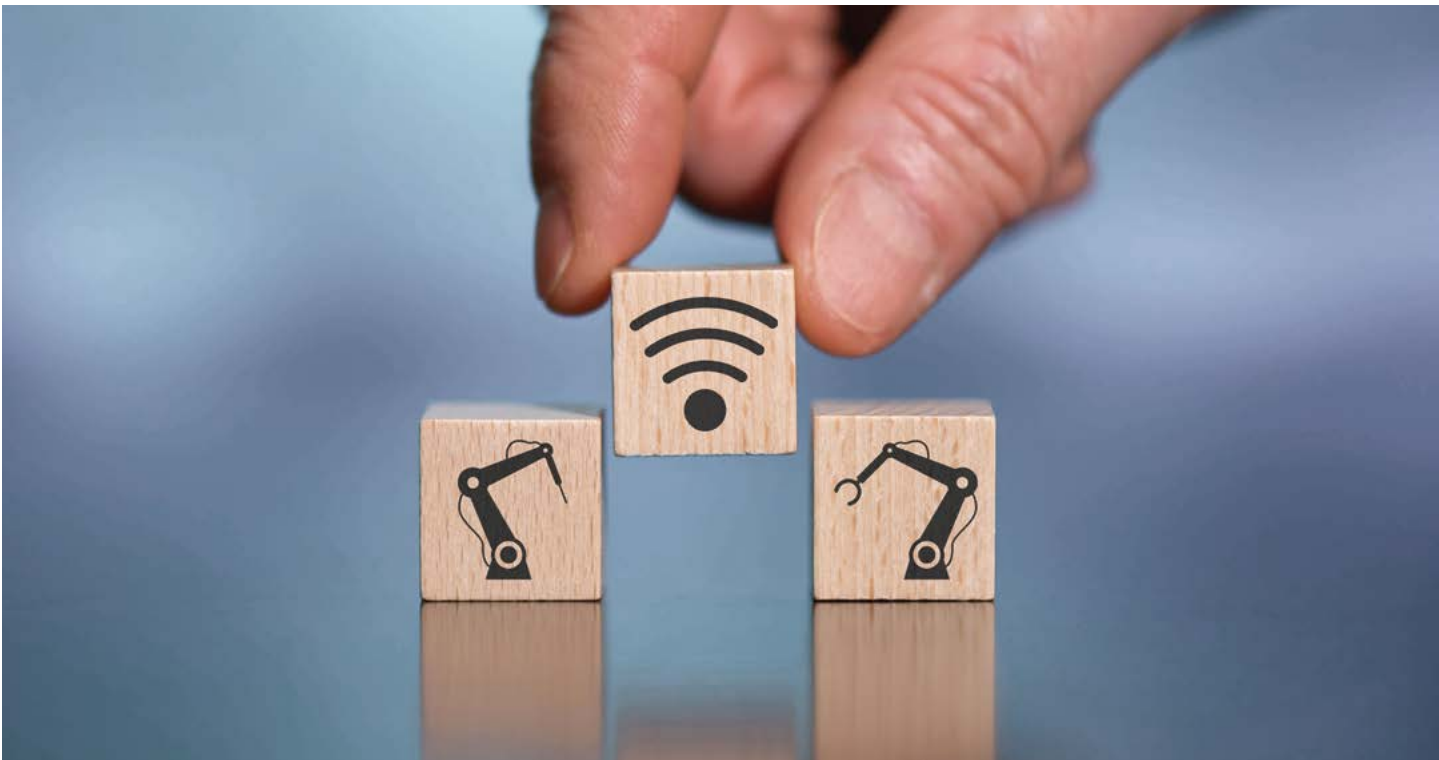# Factory Automation Goes Wireless

IO-Link Wireless: Simple, Flexible, Efficient

IO-Link wireless

Based on the wired IO-Link global standard (IEC 61131-9), the IO-Link Wireless extension is designed specifically for factory automation, coexisting with other networks – both wired and wireless. IO-Link Wireless is a deterministic, low latency (5 msec), and highly reliable protocol extension of IO-Link. For maximum interoperability, the wireless extensions are standardized as community standard as well as international standard IEC 61139-3:2023.

Factory Automation Goes Wireless

Wireless connectivity in industrial automation offers significant advantages for monitoring and control. It eliminates the need for cumbersome wiring, reducing maintenance costs and enhancing flexibility in system design.

Wireless networks enable real-time data transmission, ensuring precise monitoring of machinery and timely adjustments to optimize performance. This is particularly beneficial for rotating or moving equipment, where traditional wiring can be impractical.

Also retrofitting applications can be put into operation very quickly by means of simple power daisy chaining without any point-to-point data cabling.

Overall, wireless connectivity enhances operational efficiency, minimizes downtime, and supports the dynamic demands of modern industrial environments, enabling innovative machine designs that were not possible before and empowering production lines to achieve greater capabilities.

IO-Link Wireless: Simple and Efficient

IO-Link Wireless, similar to wired IO-Link, provides bidirectional digital communication at a low cost to field devices.

Enables the simplest and most reliable deployment of wireless control & monitoring on the factory floor.

Allows for seamless integration with industrial PLC systems along with IT and other enterprise applications.

Provides fieldbus independet integration with multiple types of sensors, actuators and devices.

Can be combined with any upper layer IP technology like Ethernet/TSN, Wi-Fi or 5G.

IO-Link Wireless Characteristics

- **Fast** – 5msec deterministic latency, works with fast-moving applications
- **Reliable**, packet-error-propability of 10^{-9}, million times more reliable than Wi-Fi, BLE, deterministic protocol
- **Blacklisting mechanism** to ensure co-existence with other wireless systems
- **Frequency-Hopping** for synchronized switching to free, unused frequency bands
- **Configurable** – master-device pairing, device scanning, scale up to multiple Masters and multiple devices per Master
- **No speed limit** for moving devices within one zone
- **Controlled roaming** for easy tool change within one zone

IO-Link Wireless industrial-grade communication for sensors & actuators on moving and rotating machine parts yields new abilities and benefits for various industrial automation applications.

IO-Link Wireless progresses an array of industries into a new era, revolutionizing and enabling them to be more agile, adaptive and efficient than ever before.

Conveying Systems
Multiple Product/Package Variations per Machine | Increased Sustainability | Reduced Time-to-Market | Reduced Changeover Time
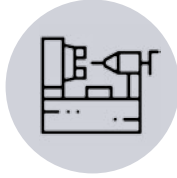
Consumer Packaged Goods (CPG)
Primary/Secondary Packaging | Bottling| Palletizing | Material Handling | and more

Intelligent Tooling
Automatic Setup | Enhanced Machine Tuning & Predictive Maintenance | Increased Safety

Automotive
EV Battery Assembly | Energy Conservation | Tire/Seats Manufacturing | and more

Robots & Cobots
Increased Flexibility | Reduced Complexity, Payload & Maintenance | Reduced Cost

Logistics
Sortation Systems | Smart Warehouses | AMR/AGV/ASRS | and more

IIOT & Condition Monitoring
Improved OEE | Quick & Easy Deployment | Reduced Downtime & Maintenance

Discrete Manufacturing
Intelligent Tooling | Converting Machines | Metalworking and Woodworking | and more
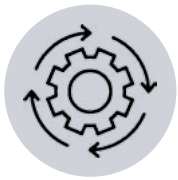
Sortation Systems
High Capacity | Maximized Up-Time | Scalable | Cost Effective

AMRs/AGVs/LGVs & Mobile Equipment
Simple Deployment | Scalable | Independent | Reliable

Rotary Units & Carousels
Increased Capacity | Maintenance Reduction | Simple Deployment

How Does it Work

Eight IO-Link point to point connections are grouped to one so called track. The challenge-response timing of each track (TDM) is fixed and synchronized (single multicast down-link followed by eight unicast uplinks with fixed sending slots per device).

Up to five synchronized tracks (with a total of 40 devices) are supported by one Master (remote I/O).

All tracks in a Wireless Master communicate simultaneously on different frequencies (FDM), ensuring optimal network utilization.

Up to three IO-Link Wireless Masters can coexist within the same airspace (FDM).

Frequencies can be reused after appropriate static channel fading distance (~ 50m).

The Technology

IO-Link Wireless creates virtual point-to-point connections via challenge-response message for downlink and uplink.

Each IO-Link Wireless cycle of 5msec is comprised of 3 sub-cycles each with a duration of 1.6msec and is communicated on a different frequency.

The sub-cycle includes:

- ◈ A downlink portion – broadcasted by the Wireless Master to all Wireless Devices on the track.

- ◈ An uplink portion – single-cast time-multiplexing message sent from the Wireless Devices by a defined timeslot.

The extraordinary insensitivity against temporal channel fading has been achieved by a special hopping algorithm which is optimized in a way that the "jumping cycle" for each track is smaller than the coherence time and the "jumping interval" is greater than coherence bandwidth.

Typical coherence time and bandwidth of the temporal channel fading have been measured and confirmed within laboratory setups and concrete industrial environments.
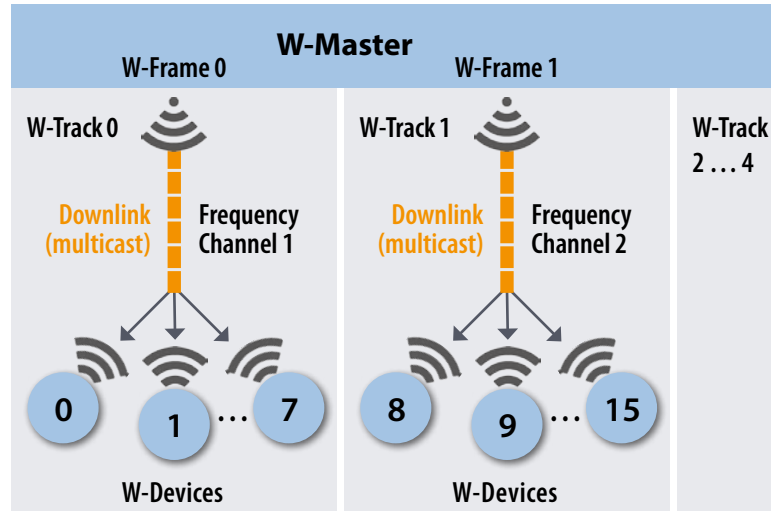
Furthermore, the hopping gradients of all tracks have been optimized for minimal overlap.
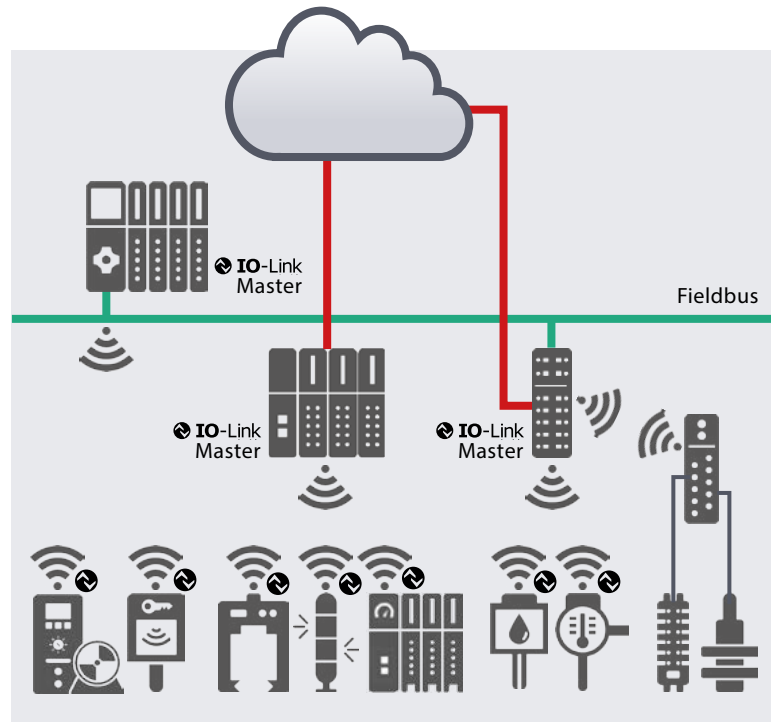
Downlink

Uplink

The timely staggered delivery of single cast W-Messages of W-Devices to their W-Master

IO-Link wireless