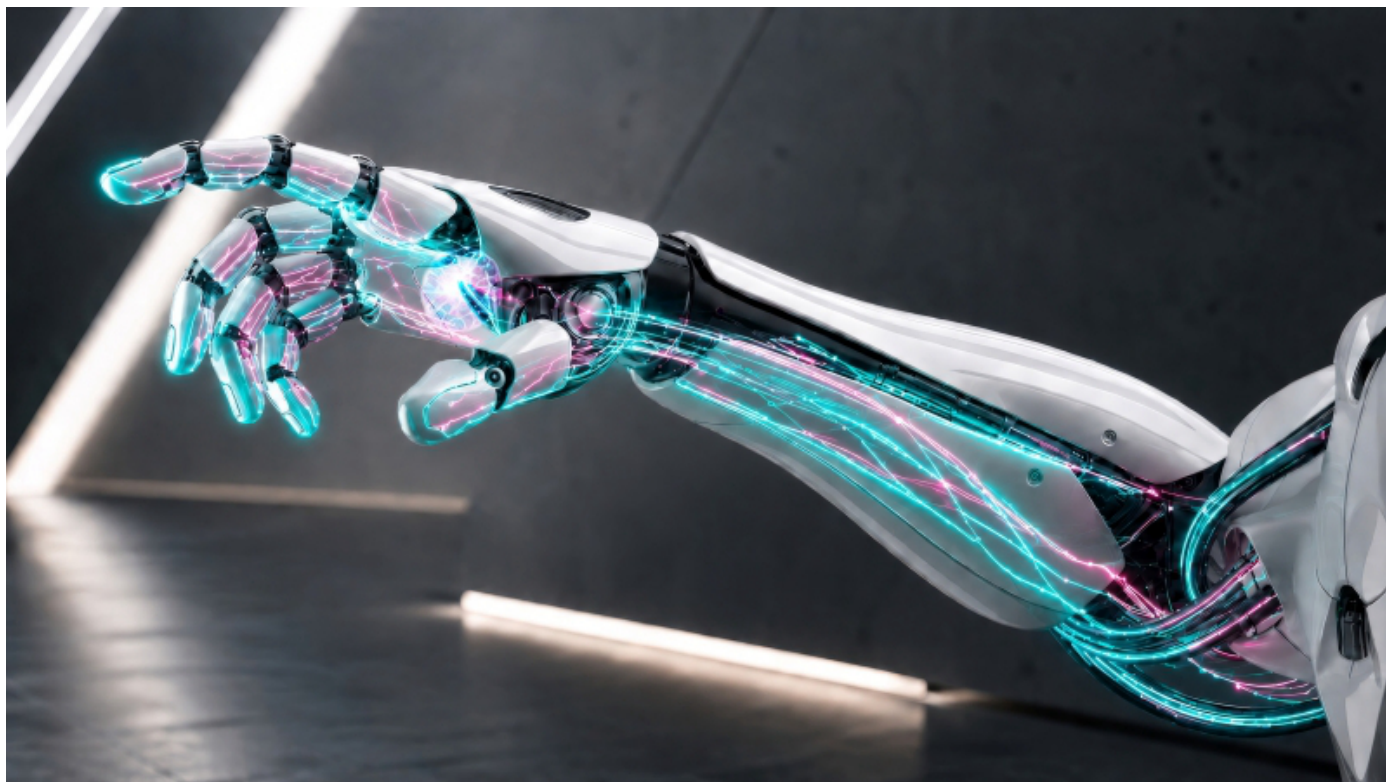


# How CAN XL fills the gap between CAN FD and Ethernet

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Humanoid robots, collaborative arms and autonomous mobile robots are generating more data for motion control, sensor fusion, diagnostics and software than traditional controller area network (CAN) technologies were designed to support. At the same time, many of these systems don't need the bandwidth, architecture or added complexity of Ethernet at every endpoint. CAN XL extends CAN-based networking for systems that need more bandwidth than CAN FD can provide without requiring a move to Ethernet.

## Why did the industry need another networking option between CAN FD and Ethernet?

CAN has been fundamental to automotive and industrial networking for more than 35 years. Its evolution from classic CAN to CAN FD and now CAN XL reflects the growing demands of modern systems, including more higher-complexity sensing and actuation, larger software payloads, and greater security requirements.

Designers have long balanced increasing data-rate requirements with the need for deterministic communication. While Ethernet offers higher bandwidth, achieving comparable deterministic communication through time-sensitive networking (TSN) can add complexity and cost that many industrial applications don't require. In contrast, CAN uses carrier sense multiple access with collision detection and arbitration on message priority (CSMA/CD+AMP) to provide predictable, priority-based network access.

CAN XL increases data capacity while retaining CAN's CSMA/CD+AMP arbitration model, preserving the timing and prioritization guarantees that safety-critical systems depend on, while supporting communication data rates up to 20Mbps and payloads up to 2,048 bytes.

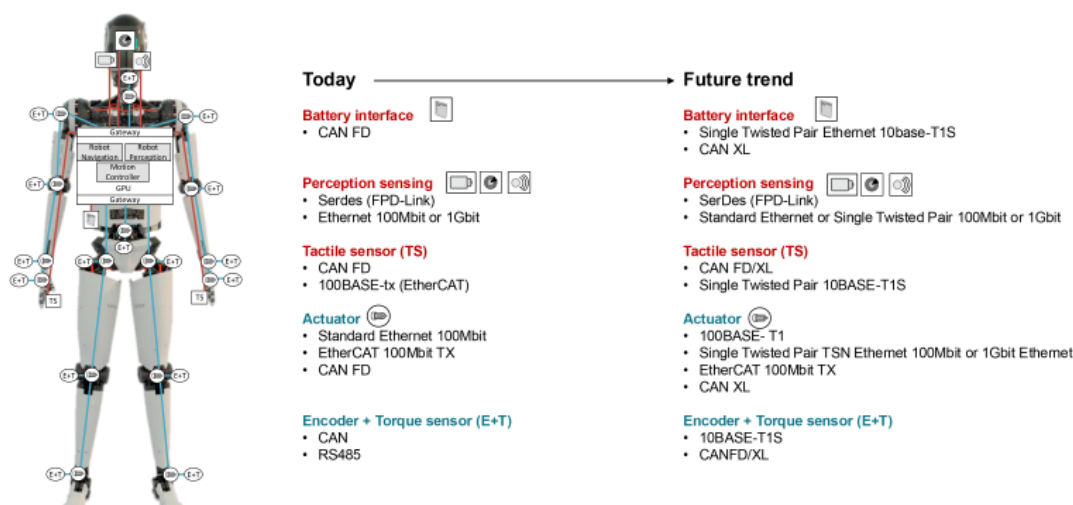
The timing matters as much as the technology. With the CAN XL physical layer specification (ISO 11898-2:2024), companies are actively building the ecosystem to support it. Automotive and humanoid robotics manufacturers are making network architecture decisions for platforms that will reach production several years from now. CAN XL also supports CANsec®, which adds authentication and data protection as CAN-based networks increasingly connect with IP-based systems. For more information, read the application note, [Extending CAN Performance: CAN FD, CAN SIC, and CAN XL](#).

### How does CAN XL give engineers more bandwidth without adding unnecessary network complexity?

Engineers designing sensor-dense or control-dense systems often face a choice between CAN FD and Ethernet. CAN FD's 64-byte payload requires larger messages to span across multiple frames, adding node complexity and timing uncertainty to every diagnostic cycle. Ethernet provides more bandwidth, but can require additional hardware and software to connect with existing CAN nodes.

The CAN XL's 2,048-byte payload enables a large diagnostic data segment to fit into one frame instead of as many as 32 separate CAN FD segments. Its larger payload also enables higher-layer protocols, such as IP and the tunneling of complete Ethernet frames over CAN XL.

Think of a humanoid robot hand that needs deterministic, low-latency motor control alongside increasing amounts of sensor data. That combination would previously require two separate networks for control and high-bandwidth traffic. CAN XL can carry both types on the same bus. Similarly, an industrial robot can use CAN XL to transport IP-based traffic, such as firmware updates, across the existing control network while reusing existing board layouts. [Figure 1](#) is an example of various communications interfaces in a humanoid, and what that may look like in a future design.



**Figure 1. Example of communication interfaces in a humanoid robot design**

### What does a production-ready CAN XL transceiver mean for design teams today?

It means engineers can move CAN XL from architectural planning into hardware development. TI's [TCAN6062](#) CAN SIC XL transceiver supports FAST data-phase communication up to 20Mbps while maintaining compatibility with CAN, CAN FD and CAN SIC networks. As the first commercially available CAN XL transceiver, it gives design engineers a way to begin implementing and validating CAN XL in production designs today.

Migration can also be relatively straightforward for existing CAN designs. The TCAN6062 is pin-compatible with 8-pin CAN transceivers such as TI's TCAN1044A-Q1 and TCAN1472-Q1, enabling designers to reuse existing board layouts. Its signal improvement capability (SIC) technology reduces ringing by as much as 80%

in complex, high-node networks, helping designers address signal-integrity and electromagnetic compatibility (EMC) challenges. Wide I/O voltage compatibility and  $\pm 58\text{V}$  bus-fault protection also help address electrical demands in factory environments.

### **Looking ahead, where will CAN XL fit alongside CAN FD and Ethernet in robotics and automotive designs?**

Five years from now, CAN FD, CAN XL, and Ethernet will work together in the same designs. CAN FD will remain important for cost-sensitive control networks, while CAN XL will support applications that exceed the practical capabilities of CAN FD. Ethernet will continue to provide the high-speed backbone for systems with much greater bandwidth-intensive systems.

Humanoid robots and autonomous mobile robots will increasingly need deterministic communication across dozens of nodes at higher bandwidths. In AI-defined vehicles and EVs, increasing amounts of battery data, diagnostics and telemetry will create similar demands.

CAN XL won't replace CAN FD or Ethernet. It changes where engineers draw the boundary between them, giving designers more flexibility to match the network to the needs of each part of the system.

### **Additional resources**

- Order the [Universal Evaluation Module for CAN Transceivers](#) to get started.
- Read the application note, [Extending CAN Performance: CAN FD, CAN SIC, and CAN XL](#).

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