

Gigabit xMII for 100BASE-T1: Why Are RGMII & SGMII Important for 100 Mbps PHYs?



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Ethernet offers a more flexible networking technology for advanced driver assistance systems (ADAS), infotainment systems, body electronics and power trains; previous in-vehicle communication technologies required dedicated, special-purpose links and expensive cabling. The automotive amendments of the Institute for Electrical and Electronics Engineers (IEEE) 802.3 standard (100BASE-T1 and 1000BASE-T1) addressed electromagnetic interference (EMI)/electromagnetic compatibility (EMC) and enabled the use of unshielded single twisted pair cabling, which saves both cost and weight.

However, the 100 Mbps networks that have been widely used in ADAS, body electronics and power train do not provide enough bandwidth to connect all of these domains over a common backbone network that facilitates data fusion. Data fusion can enhance both the driver and passenger experience as well as create new opportunities to optimize vehicle performance and operation. With the advent of the 1000BASE-T1 standard supporting 1 Gigabit Ethernet (GbE), automotive network architects are now able to connect multiple 100 Mbps Ethernet domains and move data all over the vehicle. This need for a higher speed backbone is being driven by high resolution sensors (e.g., RADAR, LIDAR), the expansion of higher resolution video sources such as high definition (HD) cameras, HD video players, and HD resolution displays in front and back seats, and higher bandwidth telematics.

Connecting to 5G wireless networks under both mobile and static conditions will also force the migration from 100BASE-T1-based in-vehicle networks – which were sufficient to support 4G connections – to 1000BASE-T1 networks that can support links up to 1Gbps for 5G.

With the steady progression to gigabit streams, automotive processors and switches now support 1GbE+ Media Independent Interfaces (MII), which connect the Media Access Control (MAC) layer in the central processing unit (CPU), or switch, to network physical layer (PHY) transceivers. The 100Mbps versions of the MII (15-pin MII and nine-pin Reduced MII [RMII]) are complemented by 1Gbps versions, which include Reduced Gigabit MII (RGMII) and Serial Gigabit MII (SGMII). RGMII is a 12-pin interface, while SGMII can operate as either a four- or six-pin interface.

With a mixture of 100Mbps and 1GbE nodes, system designers prefer to develop common, reusable platforms that support both types of nodes. For example, connecting either a 1000BASE-T1 PHY or a 100BASE-T1 PHY to the same RGMII or SGMII port on a switch with little to no modification saves development time and cost and lowers system complexity, which improves reliability.

A 100BASE-T1 PHY that supports RGMII or SGMII offers an easy migration path to a 1000BASE-T1 PHY when needed. SGMII, using low voltage differential signaling (LVDS), offers the benefit of 10x the data bandwidth with fewer signal lines, shrinking solution size. RGMII still uses single-ended signaling, but again, offers a 10x increase in data bandwidth for only 3 additional signal lines, compared to RMII.

TI's IEEE 802.3bw-compliant automotive Ethernet 100BASE-T1 PHY, the DP83TC811S-Q1, enables system designers to achieve the goal of systems that are more easily upgraded to 1 Gbps. It supports MII, RMII, RGMII and SGMII; all are selectable through either hardware bootstraps or register programming. The DP83TC811S-Q1 also makes RGMII and SGMII system verification and debugging faster and easier with its extensive diagnostic toolkit. The diagnostic toolkit supports several built-in-self-test (BIST) capabilities, such as a pseudo random bit sequence (PRBS) generator/checker and configurable loopback options. For example, the PHY is configurable for RGMII or SGMII loopback, allowing the connected MAC to send data to the PHY, which internally routes it to the receive data pins of the RGMII or SGMII port, enabling the MAC to verify continuity.

With its ability to support either RGMII or SGMII, the DP83TC811S-Q1 gives system designers the flexibility to implement 100 Mbps systems that can be easily upgraded to 1 Gbps when needed. The DP83TC811S-Q1 is fully supported by evaluation modules with user guides and graphical user interface, an input/output buffer information specification (IBIS) model and software drivers.

Additional Resources

- Check out the [evolution of automotive networking](#) white paper.
- Explore TI's automotive and industrial [Ethernet PHY](#) products

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