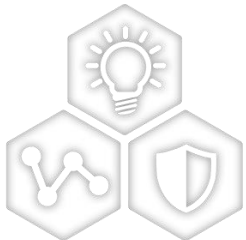


Revolution Through Single Pair Ethernet (SPE) – Microchip SPE Solutions



A Leading Provider of Smart, Connected and Secure Embedded Control Solutions



SMART | CONNECTED | SECURE

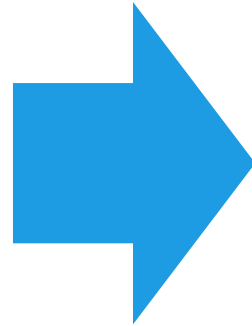
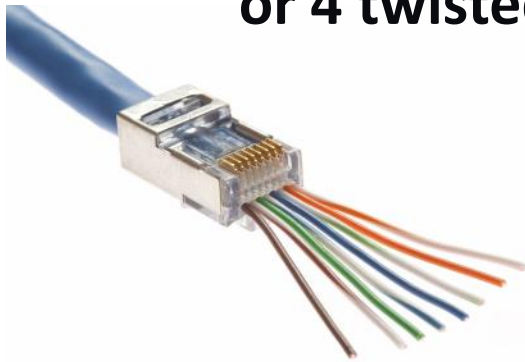
Presented by:
Brandon Kim, Senior Embedded Solutions Engineer
February 14, 2023

Agenda

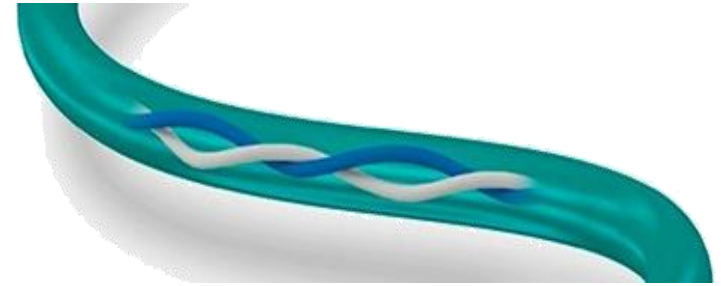
- **Single Pair Technology**
- **Standards and speeds**
- **Single Pair Ethernet (SPE) is not just automotive**
- **Challenges and benefits**
- **SPE solutions**
- **Use cases**

What is Single Pair Ethernet (SPE)?

- Traditional ethernet uses 2 or 4 twisted pairs



- SPE = Single Pair Ethernet
- T1 = 1-Twisted Pair



- Just a new Ethernet transceiver (PHY)
- Network layers 2-7 remain the same
- Independent of speed; 10BASE-T1, 100BASE-T1, NGBASE-T1...

Why Single Pair Ethernet?

Single Pair Ethernet Reduces:

- System cost
- Weight
- Wiring complexity

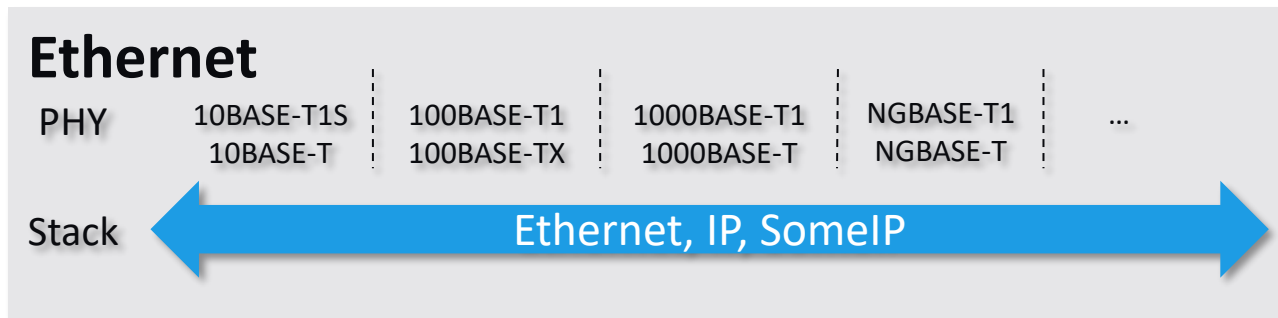
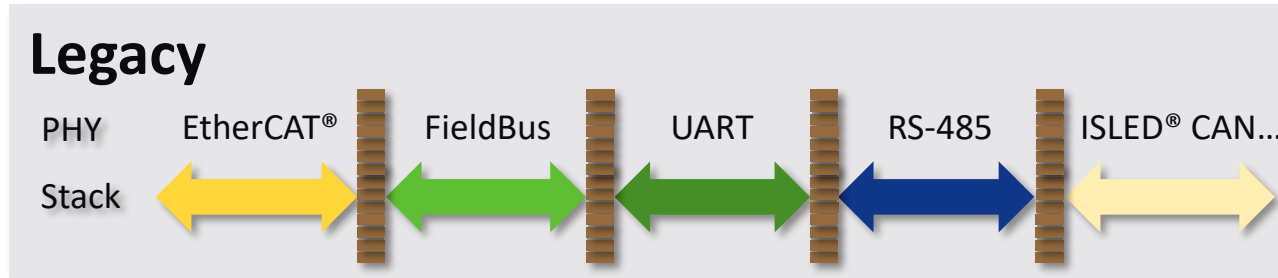
Single-Pair (T1) Ethernet IEEE® Standards

Increasing Speeds

- **IEEE 802.3cg – 10BASE-T1S and 10BASE-T1L**
 - 10 Mbit/s connection over a single two-conductor cable
- **IEEE 802.3bw – 100BASE-T1**
 - 100 Mbit/s over single twisted pair
- **IEEE 802.3bp – 1000BASE-T1**
 - 1000 Mbit/s over single twisted pair cable
- **IEEE 802.3ch – NGBASE-T1**
 - 2.5Gbit/s, 5Gbit/s, 10Gbit/s over single twisted pair cable
- **IEEE 802.3cy – 10G+ (in progress)**
 - 25Gbit/s, 50Gbit/s, 100Gbit/s over cable



Scalable from Low to High Bandwidths



- **Common network software stacks**
- **Physical layer independent**

100BASE-TX vs 100BASE-T1

	100BASE-TX	100BASE-T1
Specification	IEEE 802.3u	IEEE 802.3bw
Bandwidth	100Mbps	100Mbps
Line Coding	MLT3	PAM3
DSP	N/A	Echo cancelation
Cable Type	2-Pair (CAT5)	1-Pair
Cable Reach	100m	15m (4x in-line connectors)
Power over cable	PoE	PoDL

- **802.3bw 100BASE-T1 primary focus is automotive**
 - Trades off cable reach for single pair

1000BASE-T vs 1000BASE-T1

	1000BASE-T	1000BASE-T1
Specification	IEEE 802.3ab	IEEE 802.3bp
Bandwidth	1000Mbps	1000Mbps
Line Coding	PAM5	PAM3
DSP	Echo cancelation	FEC, Echo cancelation
Cable Type	4-Pair (CAT5e)	1-Pair
Cable Reach	100m	15m (type A), 40m (type B) (4x in-line connectors)
Power over cable	PoE	PoDL

- **802.3bp (1000BASE-T1) primary focus is automotive**
 - < 15 m for passenger vehicles and < 40 m for commercial vehicles

NBASE-T, 10GBASE-T vs NGBASE-T1

	NBASE-T	10GBASE-T	NGBASE-T1
Specification	IEEE 802.3bz	IEEE 802.3an	IEEE 802.3ch
Bandwidth	2.5G/5Gbps	10Gbps	2.5G/5G/10Gbps
Line Coding	PAM16	PAM16	PAM4
DSP	FEC, Echo cancelation	FEC, Echo cancelation	FEC, Echo cancelation
Cable Type	4-Pair (CAT5e)	4-Pair (CAT6a/6)	1-Pair
Cable Reach	100m	55m / 100m	15m (4x in-line connectors)
Power over cable	PoE	PoE	PoDL

- **802.3ch NGBASE-T1 primary focus is automotive**
 - Trades off cable reach for single pair

SPE is Everywhere!



Networking Mega Trends

IoT/Edge Computing



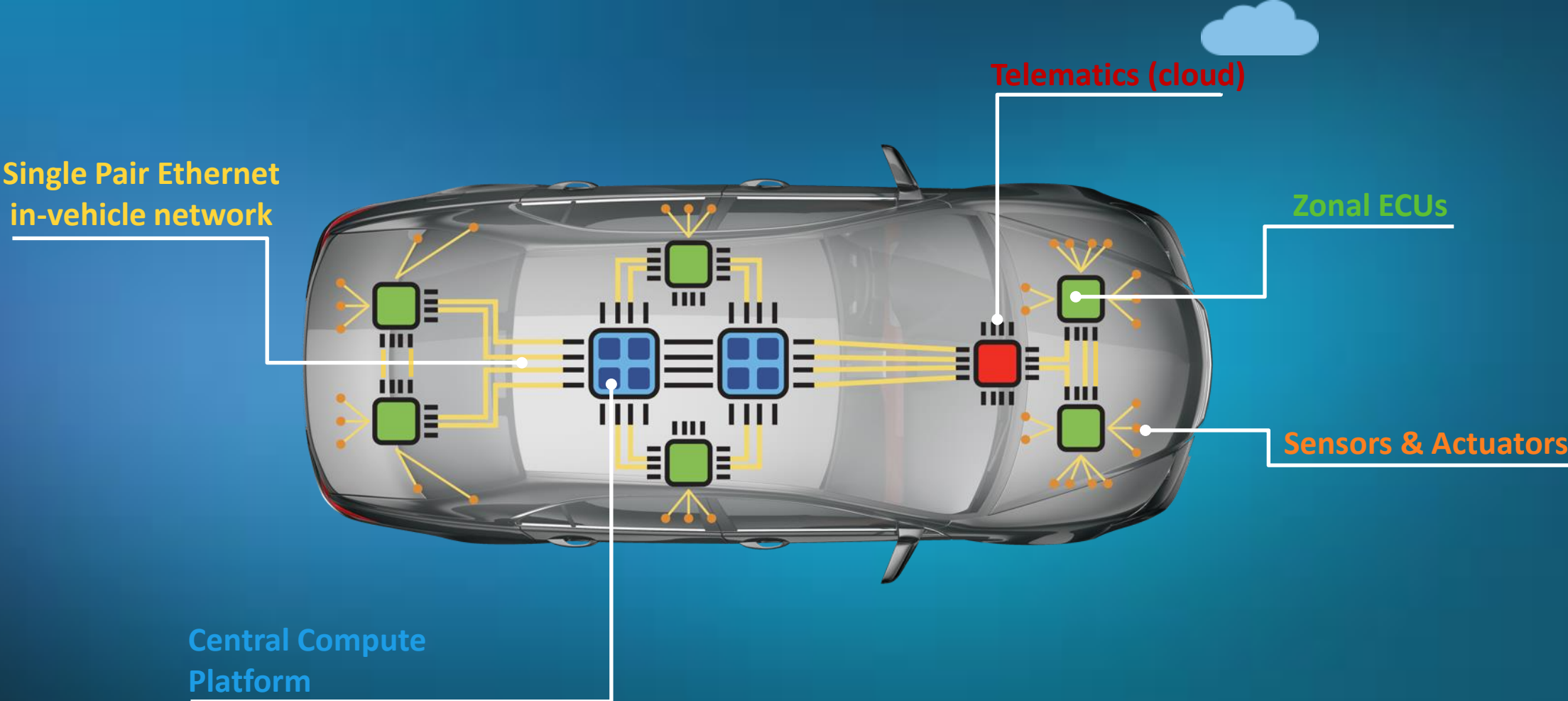
Data-centers process large amounts of device data in the cloud

Push to “IoT/Edge” computing

Increasing number of IoT devices and data

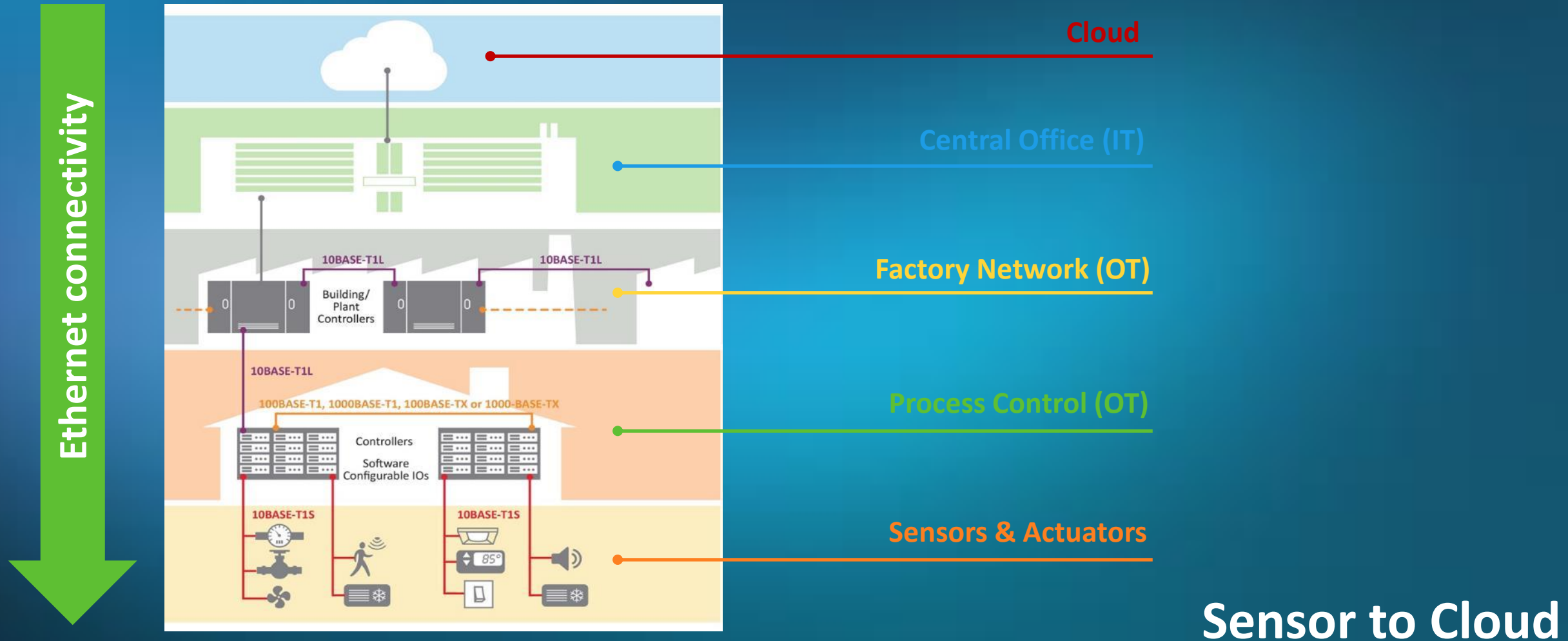
- **The vehicle is just another IoT device**

Automotive Networking Architecture



Sensor to Cloud

Factory Networking Architecture



SPE Challenges and Benefits

Cost

- Removes gateways
- Technology shrinks
- 10T1S bus topology

Cable Reach

- Extended reach PHYs
- New IEEE® standards*
- 10T1S bus topology

Eco System

- Cables, connectors
- Industrial devices
- Ref designs, EVB, tools

There are also many benefits for non-automotive applications!

* IEEE 802.3da, IEEE 802.3dg

SPE Solutions

10BASE-T1S
PHY

10BASE-T1S
Controller

100BASE-T1
PHY

GigE
AVB/TSN
Switch

1000BASE-T1
PHY

10/100T1
AVB/TSN
Endpoint

- **Flexible and scalable system solutions**
- **Extended cable reach**
- **Smallest packages**
- **Lowest power, wake/sleep**
- **Security support**
- **Functional safety ready**
- **Ambient temperatures up to 125 °C**
- **Comprehensive software & tool support**

Enhanced Features—Diagnostics and Safety

Link Quality

- Signal quality indicator
- Extended cable reach
- Forward error correction



Wiring Defect Detection

- Short/open defect detection
- Polarity detect/correct
- Error and link drop counters



Health Checks

- Under voltage, over temperature
- Loopbacks, interrupts, diagnostics
- Performance monitor counters



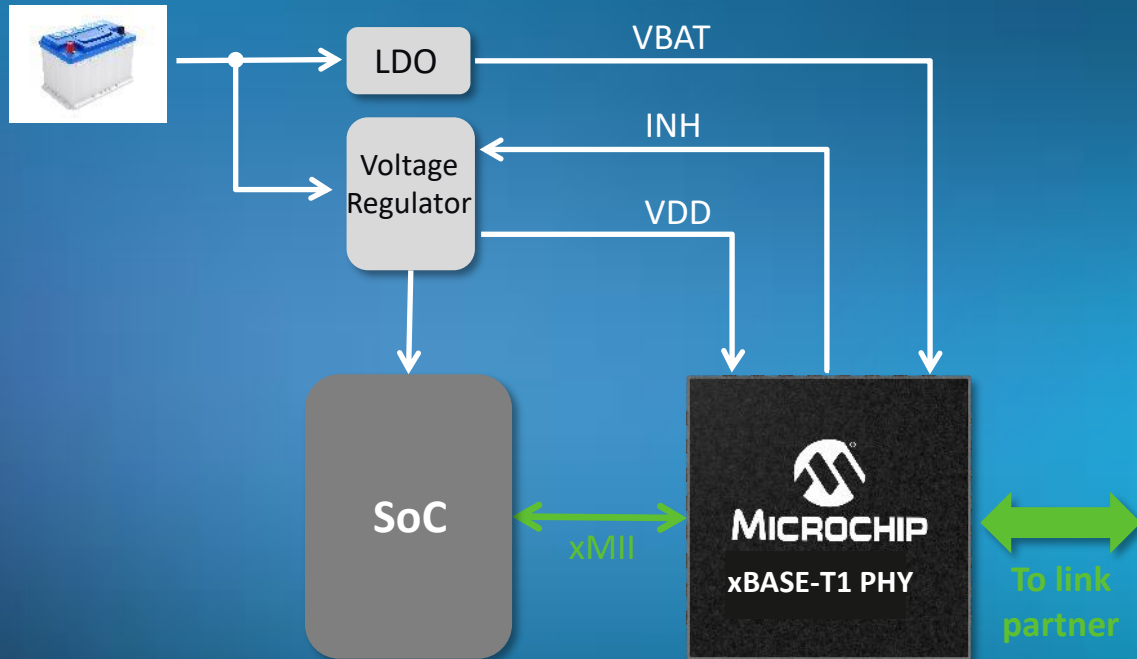
Functional Safety

- TUV certified ISO26262 ASIL B Ready
- FMEDA and safety manual
- ECC RAM memory

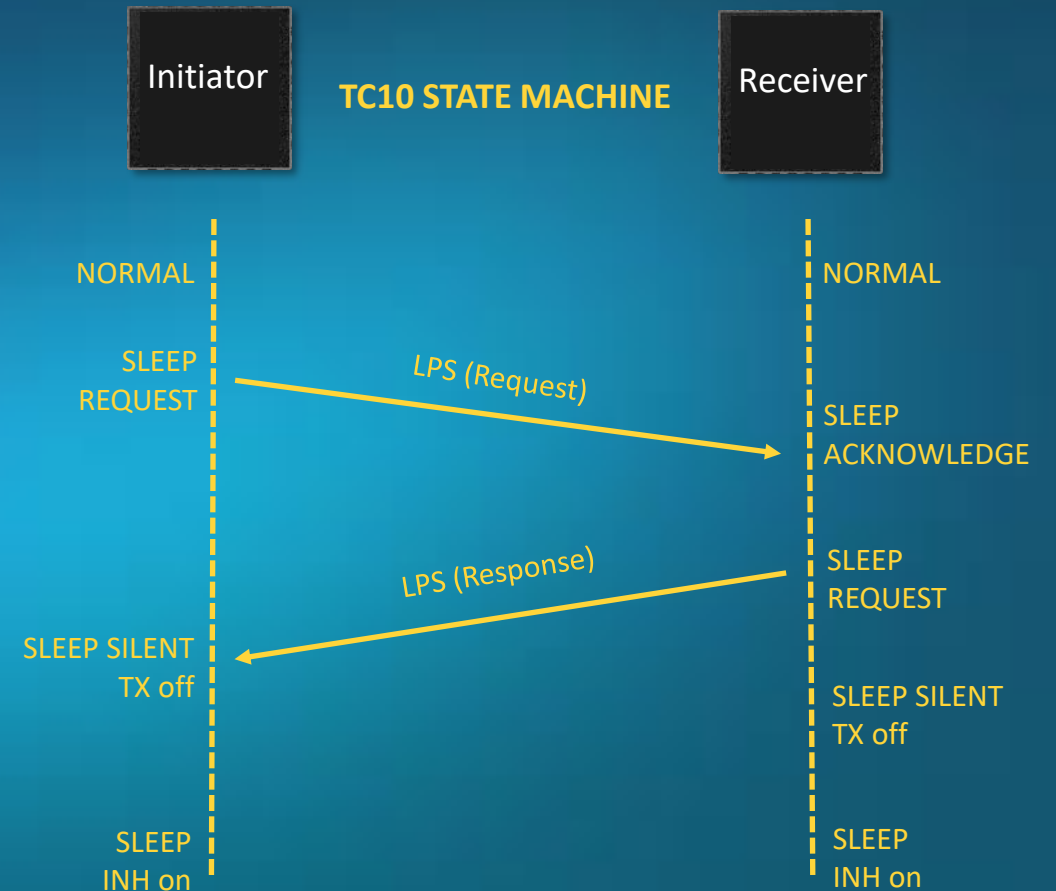


FMEDA: Failures modes, effects and diagnostic analysis

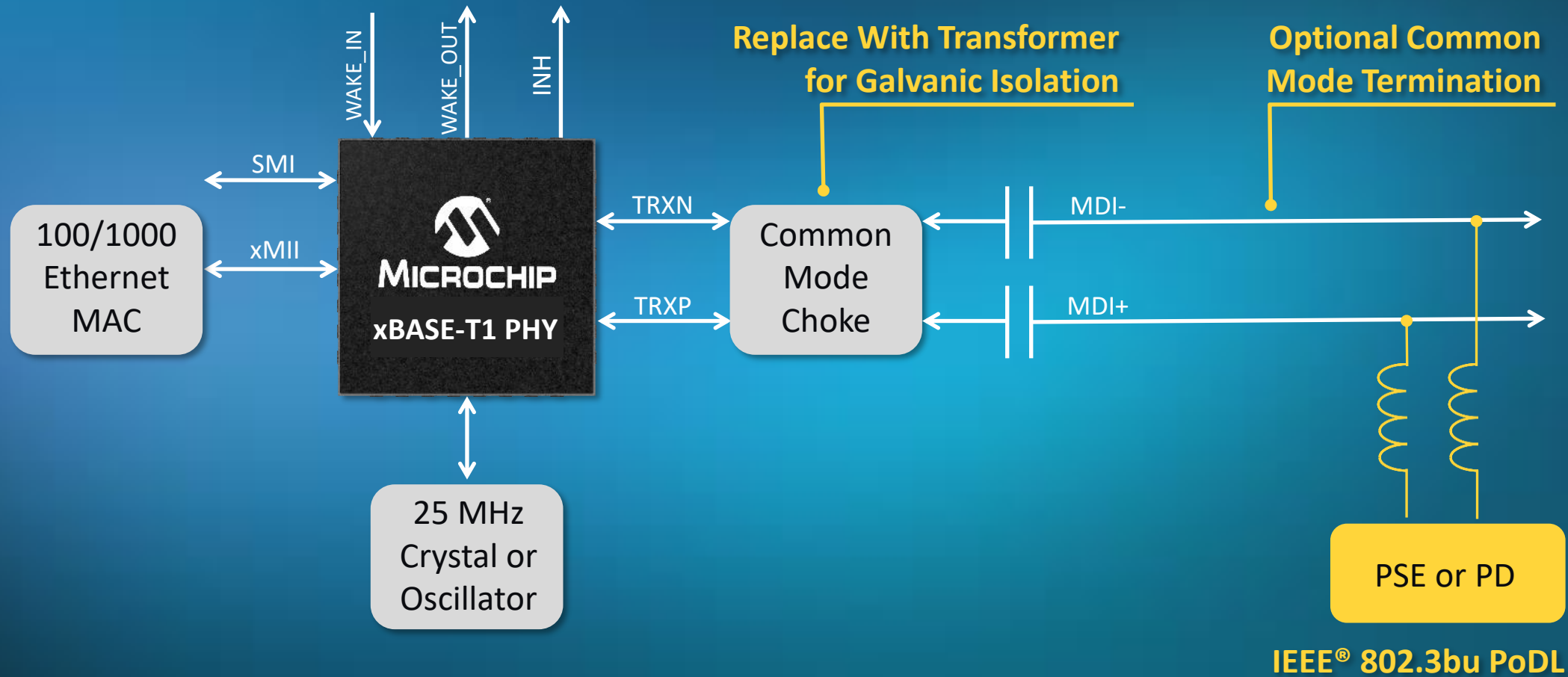
Enhanced Features – Wake and Sleep (TC10)



- PHY Sleep < 35 μ A
- Switch Sleep < 25 μ A + 10 μ A/port



Bill of Materials

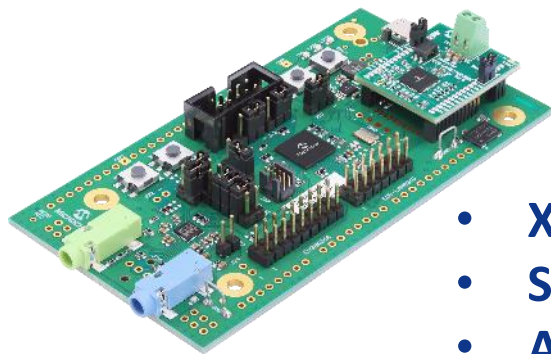


SPE PHY and Switch Evaluation Platforms

Modular MCU + SPE kits



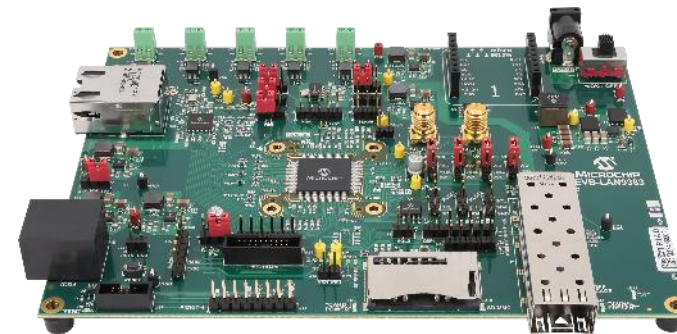
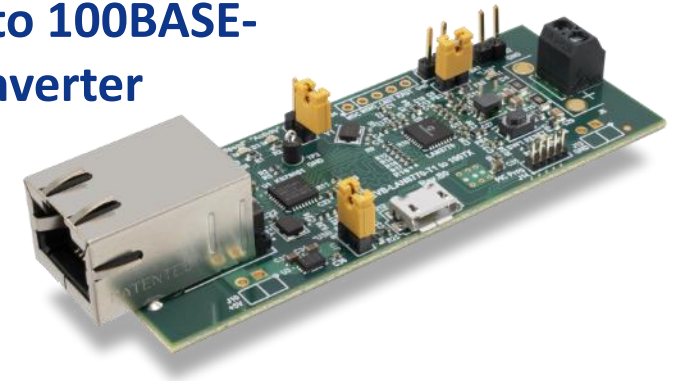
- 10BASE-T1S & 100BASE-T1 PHY and Switch daughter cards



- Xplained SAMV7x MCU board
- SAMA5 MPU board
- AVB/TSN End Point board

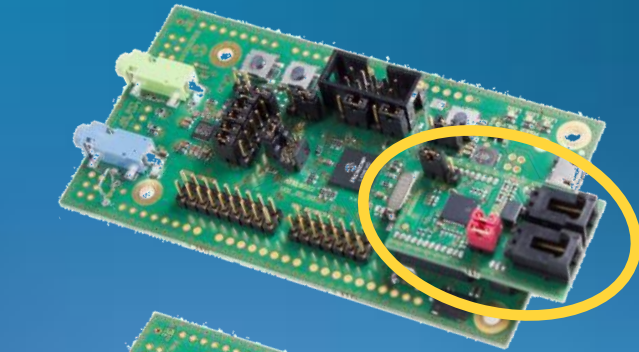
Standalone boards

- 100BASE-T1 to 100BASE-TX media converter

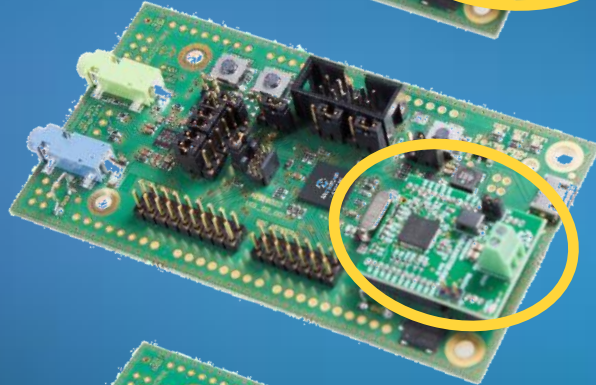


- AVB/TSN 100T1 GigE Switch

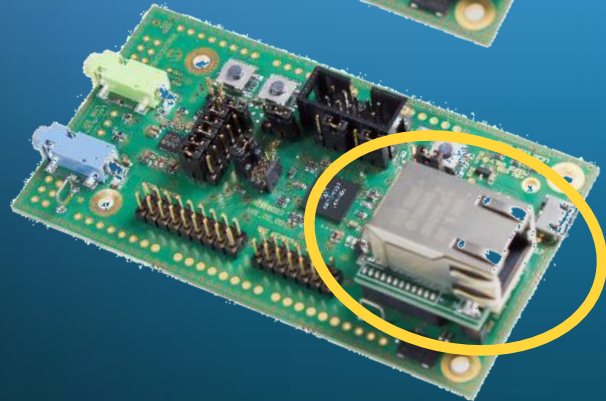
Plug in SPE PHY Kits



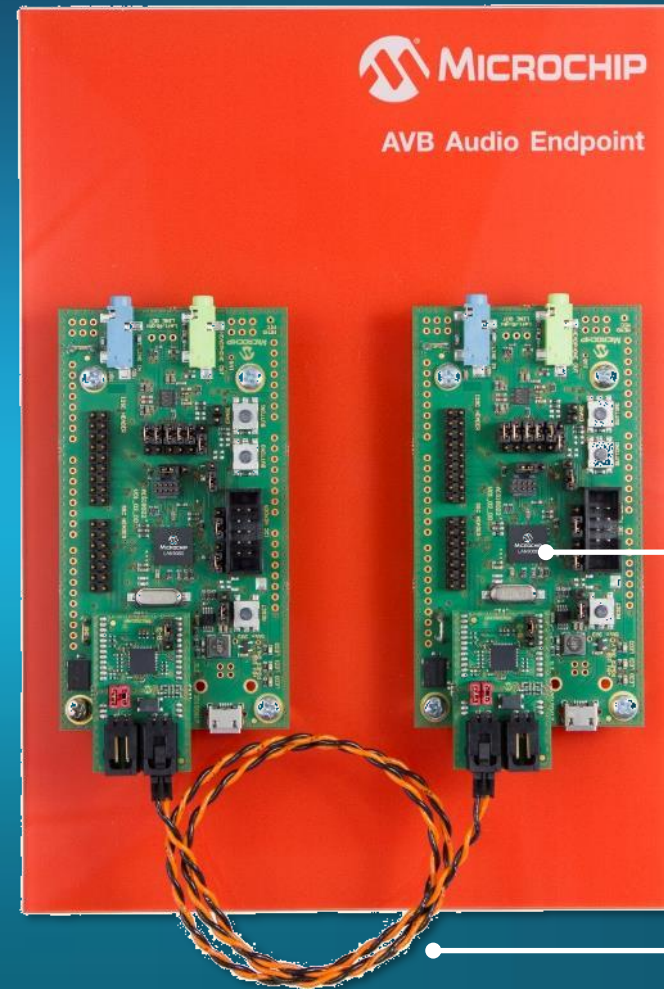
10BASE-T1S



100BASE-T1



100BASE-TX

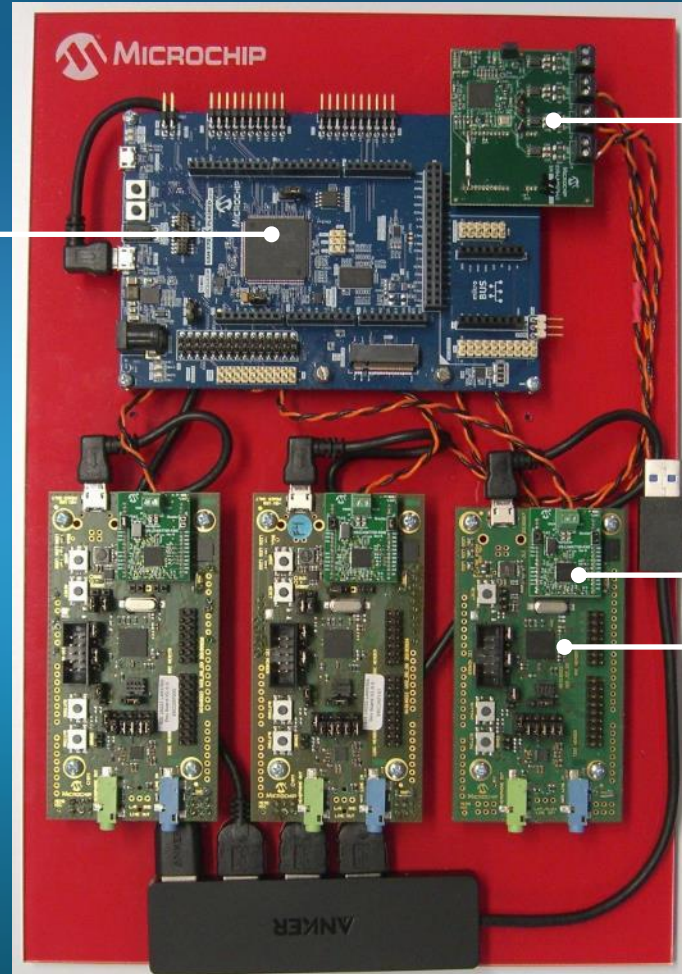


AVB Endpoints

UTP cable

Total System Solutions

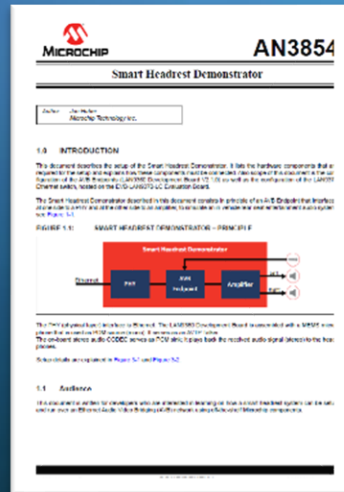
SAME70 MCU
Xplained EVB



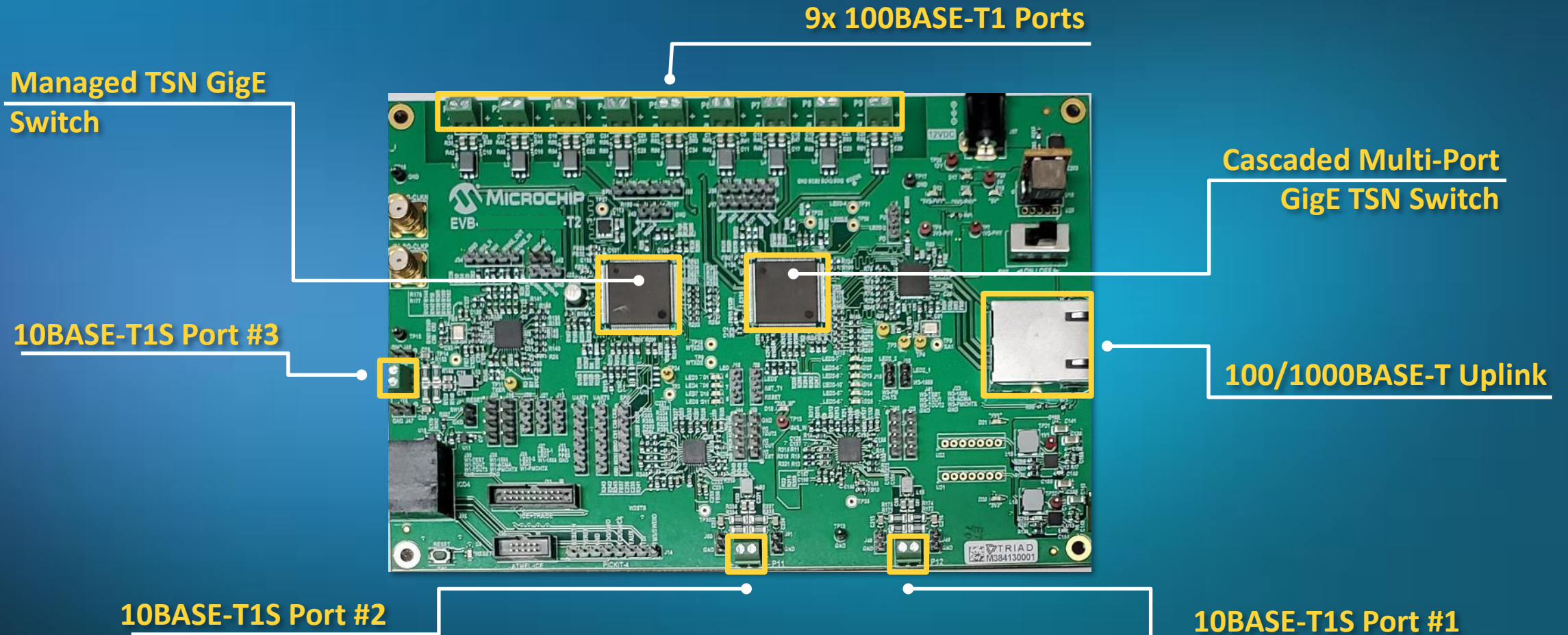
LAN9370
100T1 TSN GigE Switch

LAN8770
100T1 PHY

LAN9360
AVB Endpoint



Multi-Rate SPE Evaluation Kits



Software and Tools

Switch Configurator

Ethernet Editor

Network Overview

type filter text

- Microchip Automotive Ethernet Solution
 - Switch (LAN937x)
 - 100BASE-T1 Port
 - Head Unit
 - Talker Endpoint V0.0.4 (AVTP)
 - [Talker] Radio
 - [Talker] Announcement
 - 100BASE-T1 Port
 - Amplifier
 - Listener Endpoint V0.0.4 (RTP/AVTP)
 - [Listener] Radio
 - [Listener] Announcement
 - 100BASE-T1 Port
 - Door Module
 - AVB Endpoint (LAN9360)
 - 100BASE-T1 Port
 - Mic Array
 - AVB Endpoint (LAN9360)

Up Down Clone Delete

DESCRIPTION

NETWORK STREAM INFO & TRANSPORT PROTOCOL

Listener Stream Name: Radio

Listener Stream ID: 00 04 25 1C A0 80 00 01

Content Protection: None

Transport Protocol: IEEE1722 (AVTP)

AVTP Static Multicast Address: 91:E0:F0:00:FE:01

Media Clock Source: Stream

AUDIO PROPERTIES

Number of Channels: 2

Sampling Rate: 48 kHz

Sampling Resolution: 16 bits

PCM Sample Endianness: Big-Endian

Local Streaming Port: TDM-SSC

Streaming Overview

type filter text

State	Stream Name	Listeners	Additional Info
● Linked	Radio	1	StreamID: 00 04 25 1C A0 80 00 01
● Linked	Announcement	1	StreamID: 00 04 25 1C A0 80 00 02

Editor

10BASE-T1S Spy Tool

ESPRESSO T1S™

The device is a small, black, rectangular unit with a textured top surface. It features a USB port, a 10BASE-T1S port, and a 10BASE-T1S port. The text "ESPRESSO T1S" is printed on the front panel.

The screenshot shows a network traffic analysis tool interface with a list of network streams. The list includes columns for Stream Name, Listener Stream ID, Content Protection, Transport Protocol, AVTP Static Multicast Address, and Media Clock Source. The streams are filtered to show only those with the name "Radio" or "Announcement".

The screenshot shows a Device Manager window with the following information:

Device	Manufacturer	Device ID	Driver
Device 0	Espresso T1S - 192.168.1.100	192.168.1.100	Espresso T1S

Software Drivers

Linux[®], Autosar[®], FreeRTOS

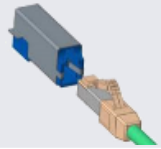



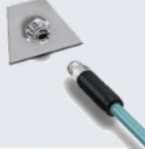




SPE Connector Standard – Current Status

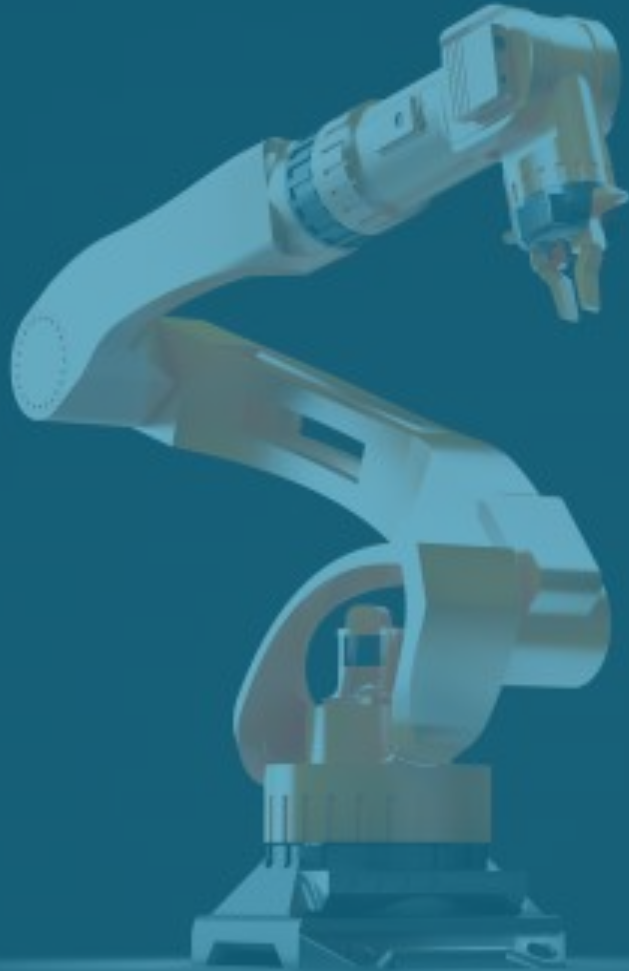


ISO/IEC 63171 CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT

New

	IEC 63171	IEC 63171-1	IEC 63171-2	IEC 63171-3	IEC 63171-4	IEC 63171-5	IEC 63171-6	IEC 63171-7
Initiator	N/A	Commscope	R&M	SIEMON	BKS	Phoenix Contact	Harting	TE
Picture								
Type		LC-Style	Rectangle	TERA 1P	Square-shaped	M8/M12	Rectangle/M8/M8 Hybrid/M12	M12 Hybrid
Variants		1	1		1	2	4	7
IP-class		IP20	IP20	IP20	IP20	IP67	IP20 / IP67	IP67
Status Norm		Published	ED1 published ED2 in progress	Published	-	CDV	2. CDV New publish in 2022	ED1 published ED2 in progress
Target markets	N/A	Building	Building/ Industry	-	Building/ Data Center	Industry	Industry	Industry
Available products		-	Sockets, Patchcables	-	-	M8 sockets, M8 Patchcable	IP20 sockets, Patchcables	-

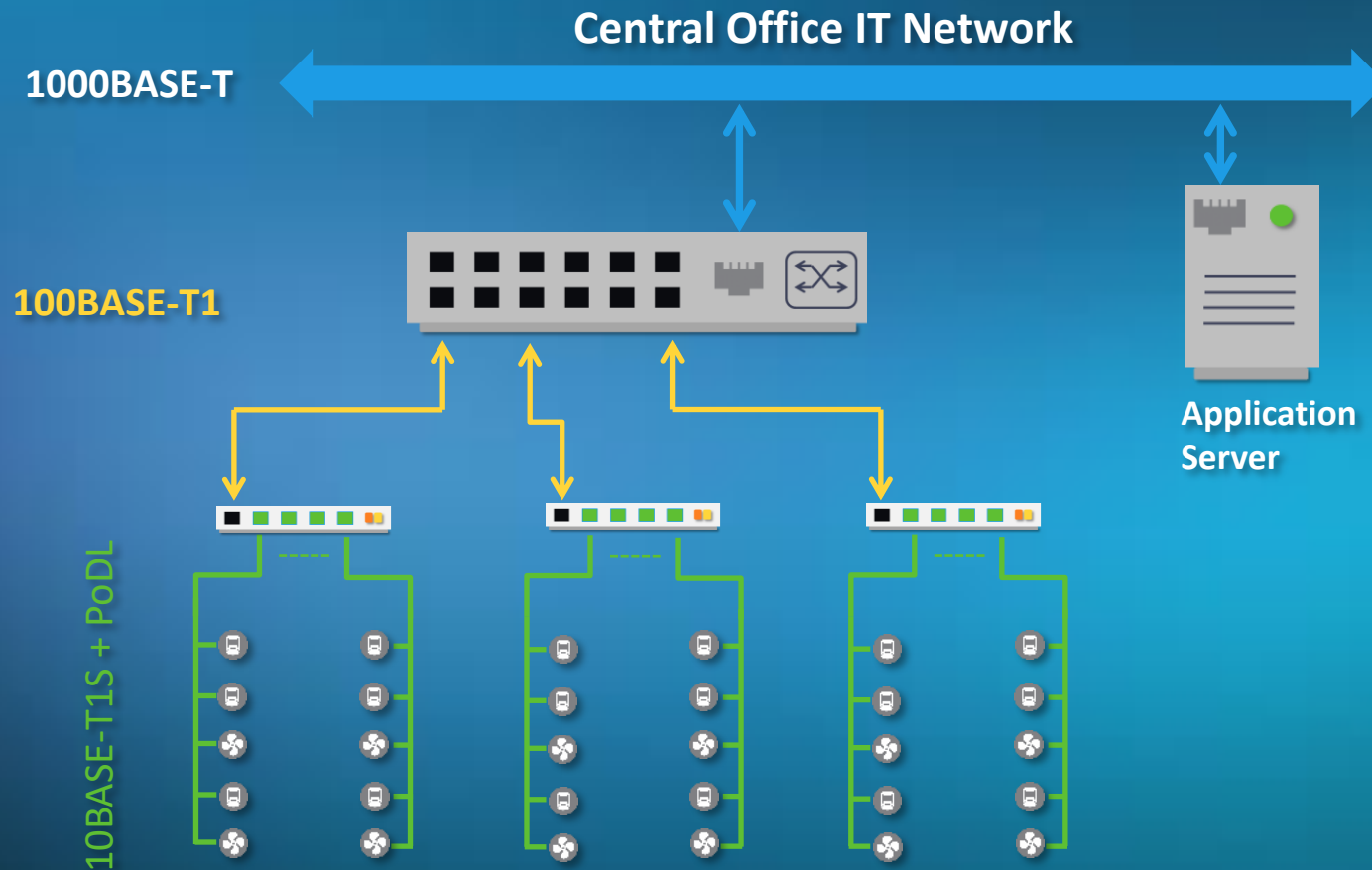
Use Cases



- Passenger vehicles
- Industrial vehicles
- Transportation
- Robotics & warehouse automation
- Industrial automation
- IIoT
- Building automation
- Energy management
- Media transmission

and many more!

Hybrid Topology



- Energy management
- Building automation
- Lighting
- Industrial automation

BMW 10BASE-T1S Proof of Concept

10BASE-T1S Proof of Concept

10BASE-T1S enables the expansion of the Ethernet network within the vehicle for applications with increasing bandwidth requirement.
 → Suppression of gateways such as CAN/LIN to Ethernet and reduction of switches.

Objectives :

- Technology evaluation and estimation of the integration efforts within an Automotive context

MII SPI

- Ramp-up center of competence for series development
- Multivendors
- Preparation of the ecosystem on multiple development stages

Partners with BMW, EE-3 for this cooperation :

- KPIT : SW Integration on the AUTOSAR Stack, troubleshooting driver implementation
- Microchip Technology: Hardware solution and driver development

KPIT **MICROCHIP**

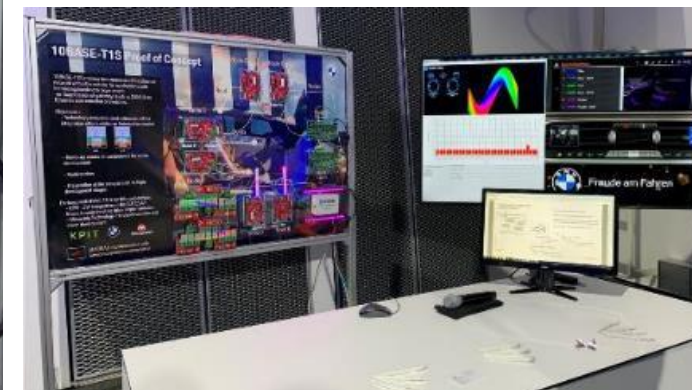
AUTOSAR implementation with Service oriented communication

Node 2 Radars
 Node 3 Roof
 Node 4 Doors
 Node 5 Seat
 Node 6 Interior Lights
 Node 0 Stimulation
 Node 7 Logging
 Network Management

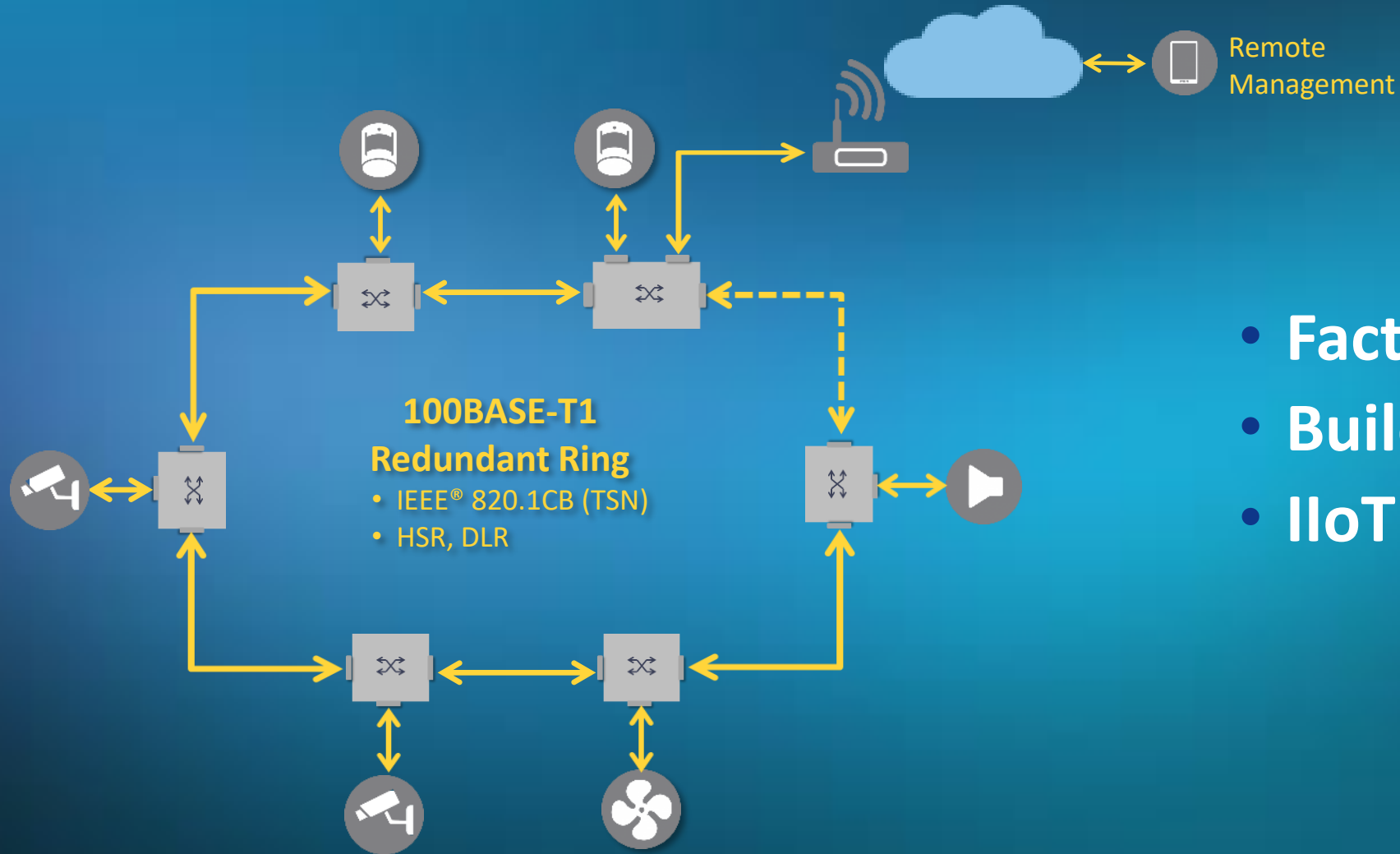
- Presented on IEEE® Ethernet Tech Days, Munich, 2021
- Cooperation between BMW, Microchip and KPIT
- Demonstration of multi-rate real time SPE Network

100 Mbps / 1 Gbps

10 Mbps



Ring or Daisy Chain Topology



- Factory automation
- Building automation
- IIoT

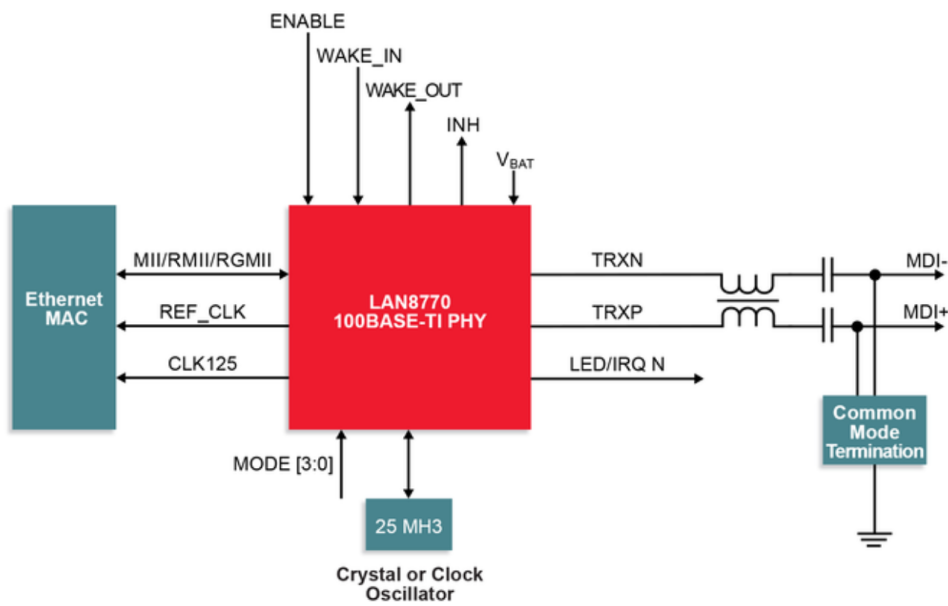
Summary

- **Would your Ethernet designs benefit from using a single twisted pair?**
 - Reduced weight
 - Simpler and quicker installation
 - Lower system cost
- **If YES, we can help!**



Product Details

100BASE-T1 PHY: LAN8770



- **Fully Compliant IEEE® 802.3bw Single-Port PHY**
- **Leading Energy Efficiency**
 - Low Power ~ 130 mW operation
 - TC10 Wake up/Sleep (< 15 uA)
- **Reduced BOM**
 - Fully integrated line termination and filtering
 - RGMII, RMII, MII w/flexPWR®
 - 125 MHz RGMII output
- **Enhanced LinkMD™ Diagnostics**
 - OPEN Alliance (TC1) Advanced diagnostics compliant
 - SQI counter w/MSE, peak, threshold interrupt
- **Functional Safety Ready**
 - SGS TUV Certified ISO 26262 ASIL B ready
 - FMEDA, Safety Manual
- **Smallest T1 PHY**
 - 32-Pin & 36-Pin Wettable QFN (5 x 5 mm, 6 x 6 mm)
- **AEC-Q100 Grade 1 (-40 °C to +125 °C)**

Why LAN8770?

100BASE-T1 Ethernet PHY

LAN8770

100BASE-T1 Ethernet PHY Offering Industry's Leading Ultra-Low TC10-Compliant Sleep Current

- OPEN Alliance TC1, TC8, TC10 compliant
 - 4x lower TC10 sleep current
- Linux®, Autocar, Free RTOS drivers
- Functional safety ready

Applications Include

- Telematics
- Infotainment
- ADAS
- Gateways

LAN8770M-E/PRAVAO

- 32-VQFN (MII/RMII) Tray

LAN8770MT-E/PR

- 32-VQFN (MII/RMII) Tray

LAN8770M-E/PR

- 32-VQFN (MII/RMII) Tray

LAN8770MT-E/PR

- 32-VQFN (MII/RMII) Tray

Support Tools

- Evaluation Kits
- LANCheck®
- MPLAB® Network Creator

LAN8770 1-Pager

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www.microchip.com

- **Market Leading sleep current**
 - < 15 uA, 4x lower than the competition!!
- **Smallest T1 PHY**
 - 32-Pin/36-Pin QFN
- **Extended cable reach**
- **Reduced BOM**
- **AEC-Q100 Grade 1 (-40 °C to +125 °C)**

Industry Leading Sleep current and Size

How Two Low-Power Versions of Automotive Ethernet are Cutting CO2 Emissions

August 05, 2020 by Steve Arar



Road vehicles are responsible for more than 17% of global CO2 emissions. Two types of automotive Ethernet designs may trim that percentage down.

Global Wake-Up Through the Ethernet Network

The OPEN Alliance has developed a wake-up mechanism where a wake-up signal can distribute throughout the network and activate all ECUs that were previously in the sleep mode. In this model, a wake-up (WUP) signal is triggered by the microcontroller. This wake-up signal spreads very quickly to all ECUs in the network.

After a global wake-up, the units that are not needed go back to the sleep mode as quickly as possible. The advantage of a global wake-up rather than a selective wake-up is that the knowledge of what device is going to turn on remains in the relevant layer of the communication stack.

Note that the wake-up signal is distributed through the Ethernet link itself rather than a separate wake-up line. Hence, we need to keep a portion of the PHYs always active to detect any imminent wake-up signals.

Microchip's Single-Port Ethernet PHY

Microchip's new single-port 100BASE-T1 Ethernet PHY, the LAN8770, demonstrates the efficiency possible in global wake-ups through the Ethernet network; specifically, this device supports the OPEN Alliance TC10 sleep standard. It has a sleep current of less than 15 μA that, according to Microchip, is about four times lower than the sleep current of other products on the market.



MARKET / AUTOMOTIVE

Tiny Automotive Ethernet PHY Transceiver Does the "Big Sleep," Wakes Up Big Time

The LAN8770 transceiver developed by Microchip features extremely low sleep current and size, both major virtues for that application, and it adheres to the OPEN Alliance TC10 standard.

Bill Schweber

AUG 03, 2020

ElectronicDesign.

industrial ethernet book

Enhancing Automation and Internet Connectivity

Single-pair Ethernet PHY

An ubiquitous Ethernet architecture simplifies the design, configuration, and control of many different applications. This is especially true for connected mobility that requires more high-speed data delivery than ever before. Automotive networks rely heavily on partial networking in which some segments are hibernated and woken up on demand. The Microchip LAN8770 is an OPEN Alliance TC10 sleep standard Ethernet physical layer transceiver (PHY) with a sleep current of less than 15 μA .

News
AUTOMOTIVE

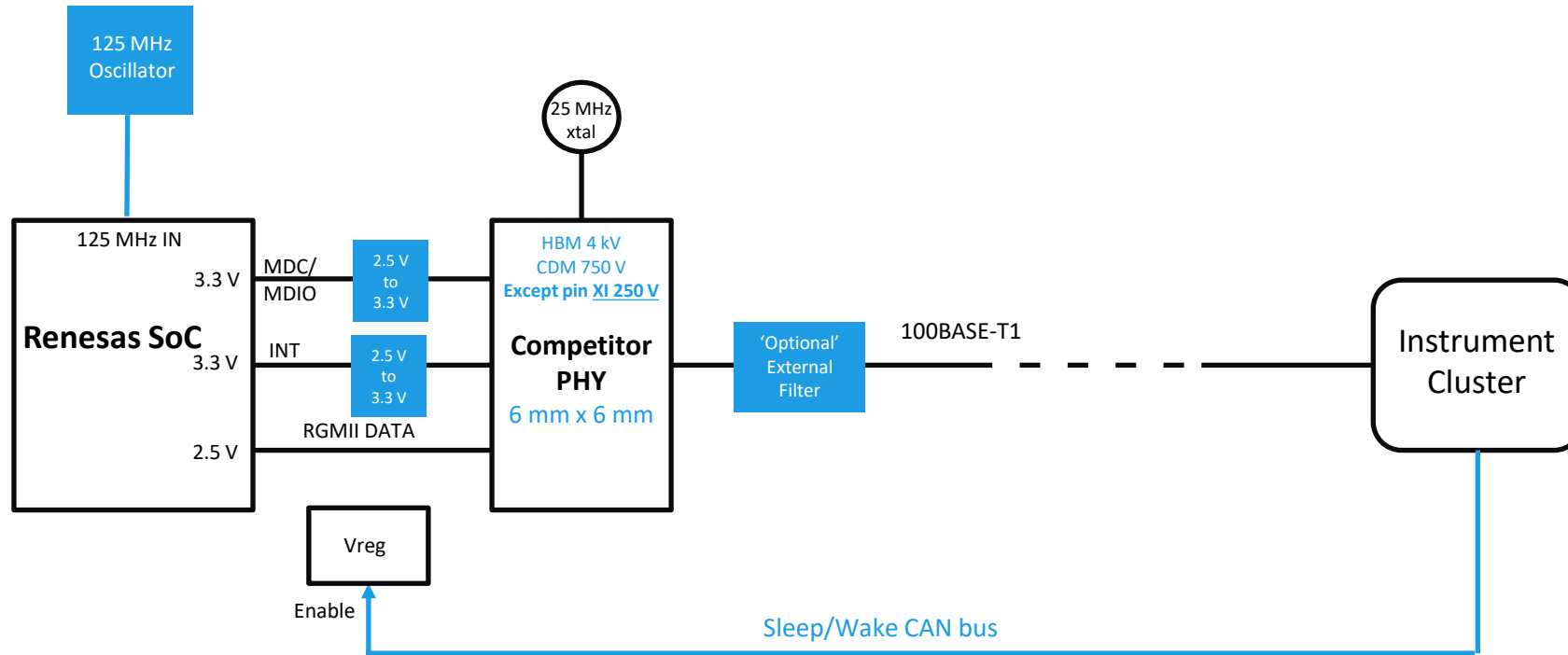
Ethernet PHY chip targets space-constrained applications in the car

Data networks in vehicles rely on sub/partial networks in which some areas are put into sleep mode and activated when required. With the LAN8770, Microchip Technology now introduces an Ethernet PHY (Physical Layer Transceiver) that complies with the TC10 quiescent current standards of the OPEN Alliance. At less than 15 μA , it offers the industry's lowest quiescent current - comparable devices on the market require about four times more power, Microchip says.

The LAN8770 is a compact 100BASE-T1 Ethernet PHY with one port available in a 5mm x 5mm or 6mm x 6mm QFN package with wettable edges. The compact housing is ideal for applications with limited space such as the infotainment head

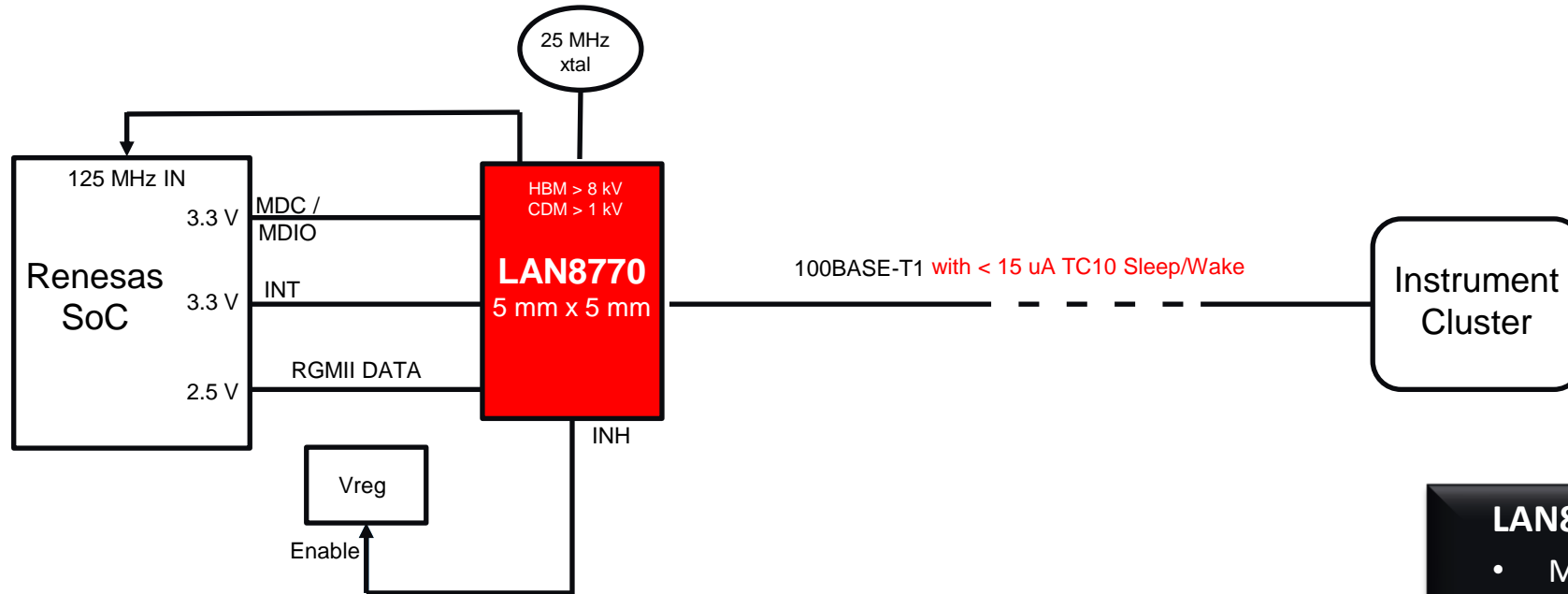
100BASE-T1 PHY

Real case OEM design; Competitor solution



100BASE-T1 PHY

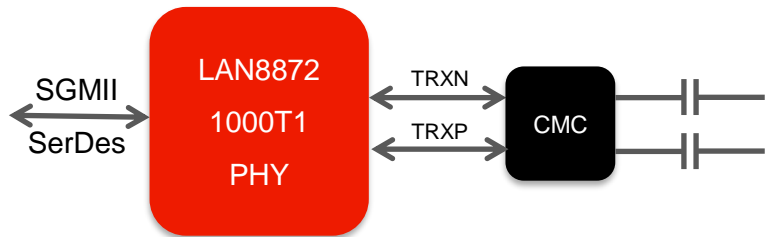
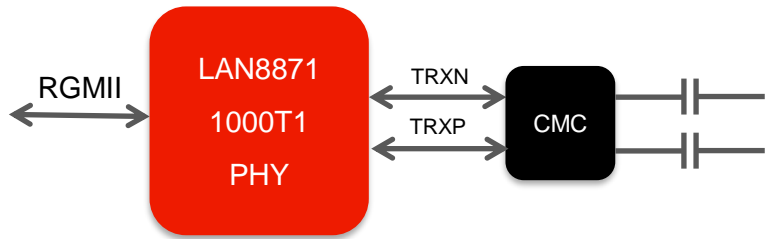
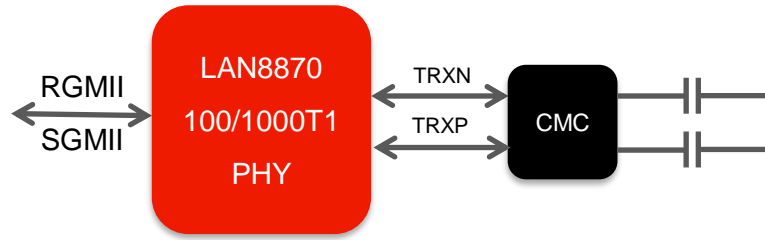
Real case OEM design; Microchip LAN8770 solution



LAN8770 offers

- Minimized BOM
- Smallest package
- Superior ESD
- 'TC10' wake and < 15 uA sleep
- > 40% power consumption reduction

LAN887x 1000BASE-T1 PHY



- **Fully compliant IEEE[®] 802.3bw/bp Single-Port PHY**
 - Force or auto-negotiation mode
- **Reduced BOM**
 - SGMII, RGMII, RMII, MII w/flexPWR[®]
 - 125 MHz RGMII output and programmable output clock
- **IEEE 1588/.1AS Time synchronization support**
 - 8 ns jitter accuracy
- **Cable reach**
 - Type A (15 m) and Type B (40 m)
 - Extended reach (> 40 m*)
- **TC10 Sleep and Wakeup support**
 - < 20 uA standby power consumption
- **Enhanced Diagnostics**
 - Cable diagnostics, Signal Quality Indicator
 - BIST, link, error, temperature, voltage and clock monitoring
- **Functional Safety Ready**
- **48-Pin (7 mm x 7 mm) package**
- **AEC-Q100 Grade 2 (-40 °C to +105 °C)**

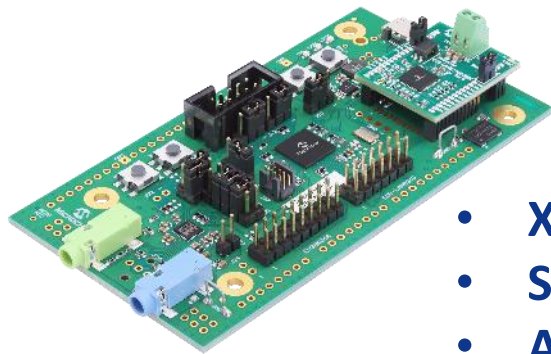
* To be determined

SPE PHY and Switch Evaluation Platforms

Modular MCU + SPE kits



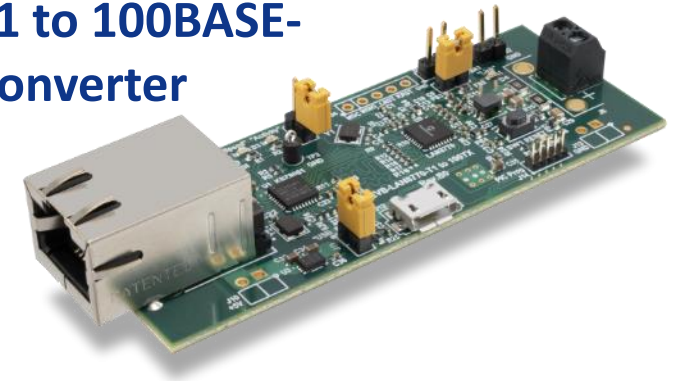
- 10BASE-T1S & 100BASE-T1 PHY and Switch daughter cards



- Xplained SAMV7x MCU board
- SAMA5 MPU board
- AVB/TSN End Point board

Standalone boards

- 100BASE-T1 to 100BASE-TX media converter

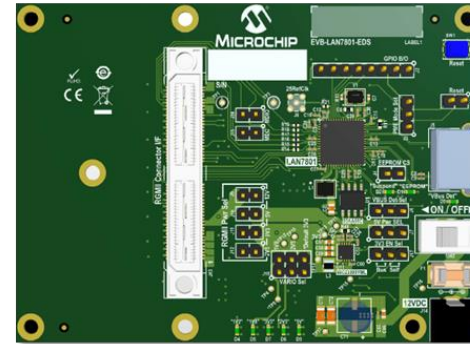
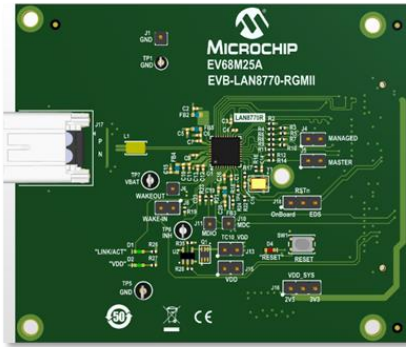


- AVB/TSN 100T1 GigE Switch



100/1000 BASE-T1 Plug-in Bridge Solutions

100BASE-T1
LAN8770

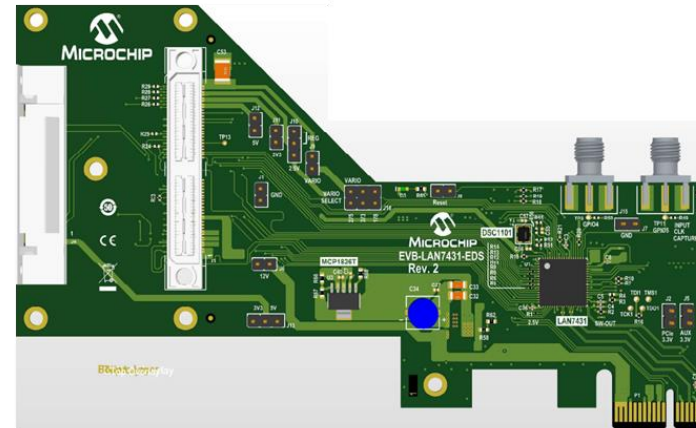
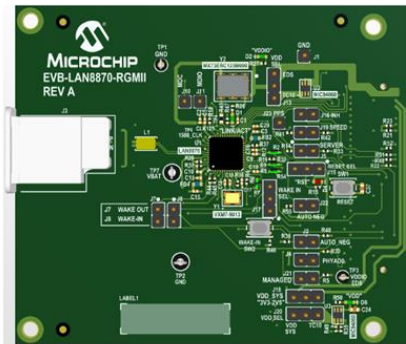


LAN7801



Software

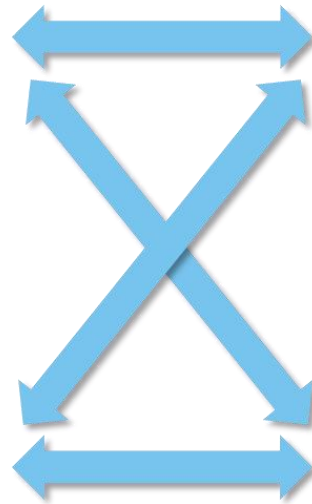
1000BASE-T1
LAN8870



LAN7431

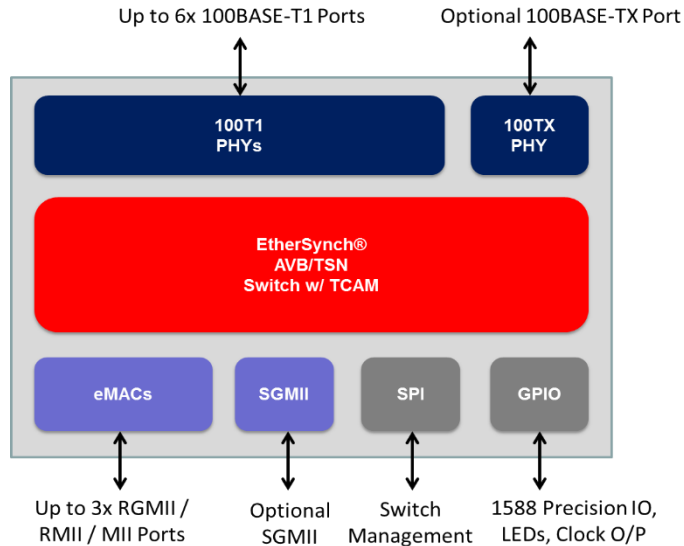


Software

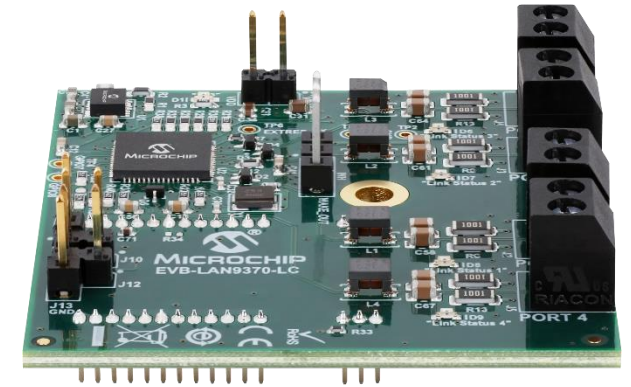


LAN937x 100T1 GigE Switch

Cost Optimized, single-chip AVB/TSN switch



Part Number	T1 PHY Ports	TX PHY Ports	RGMII/RMII/MII Ports	SGMII Ports	Temperature	Package
LAN9370	4	0	1	0	-40°C +105°C	64-QFN
LAN9371	3	1	2	0	-40°C +105°C	128-TQFP
LAN9372	5	1	2	0	-40°C +105°C	128-TQFP
LAN9373	5	0	2	1	-40°C +105°C	128-TQFP
LAN9374	6	0	2	0	-40°C +105°C	128-TQFP



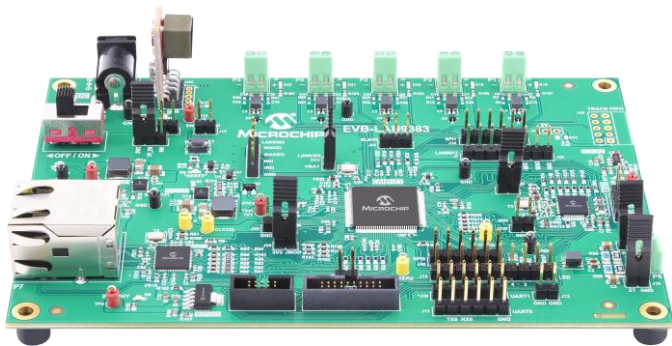
- 5 to 8-Port AVB/TSN Switch
- Cascade for up to 14-Ports
- Software and pin compatible
- TC11 compliant
- TC10 wake up and sleep
- AEC-Q100 Grade 2
- Advanced AVB/TSN support
 - 802.1AS Time Sync
 - 802.1Qat Stream Reservation
 - 802.1Qav Shaper
 - 802.1Qbv Scheduler
 - 802.1Qci Ingress Policing

EVB-LAN9370

- Partner: SAME70 XULT, SAMA5D3-EDS, Audio End Point
- Software: Autosar®, FreeRTOS, Linux®

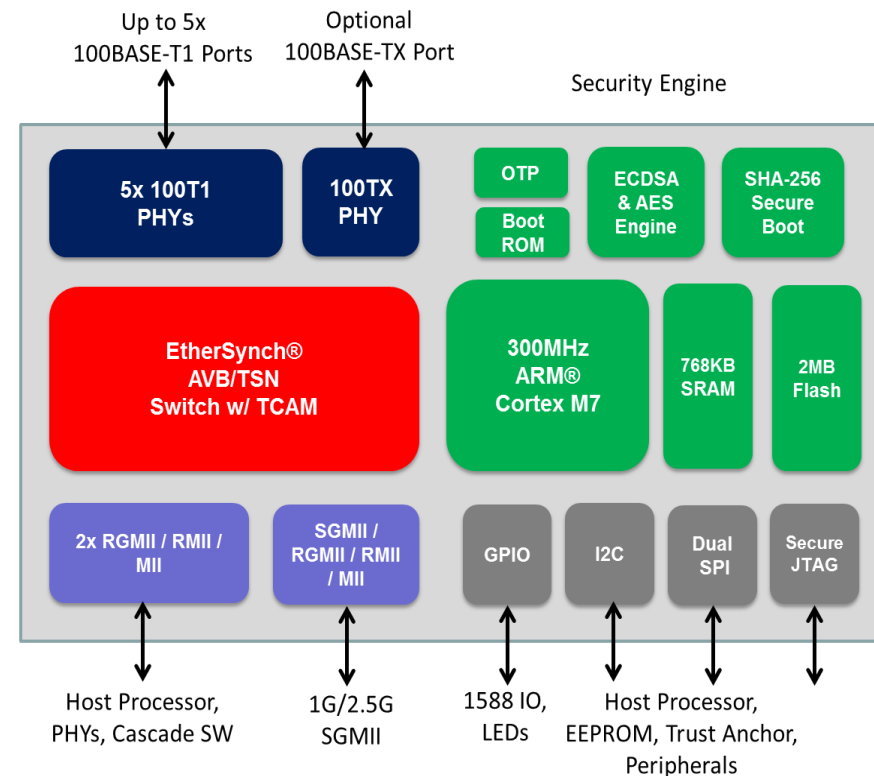
LAN938x 100T1 GigE Switch w/ CPU

Safe & Secure, fully Integrated, single-chip AVB/TSN switch

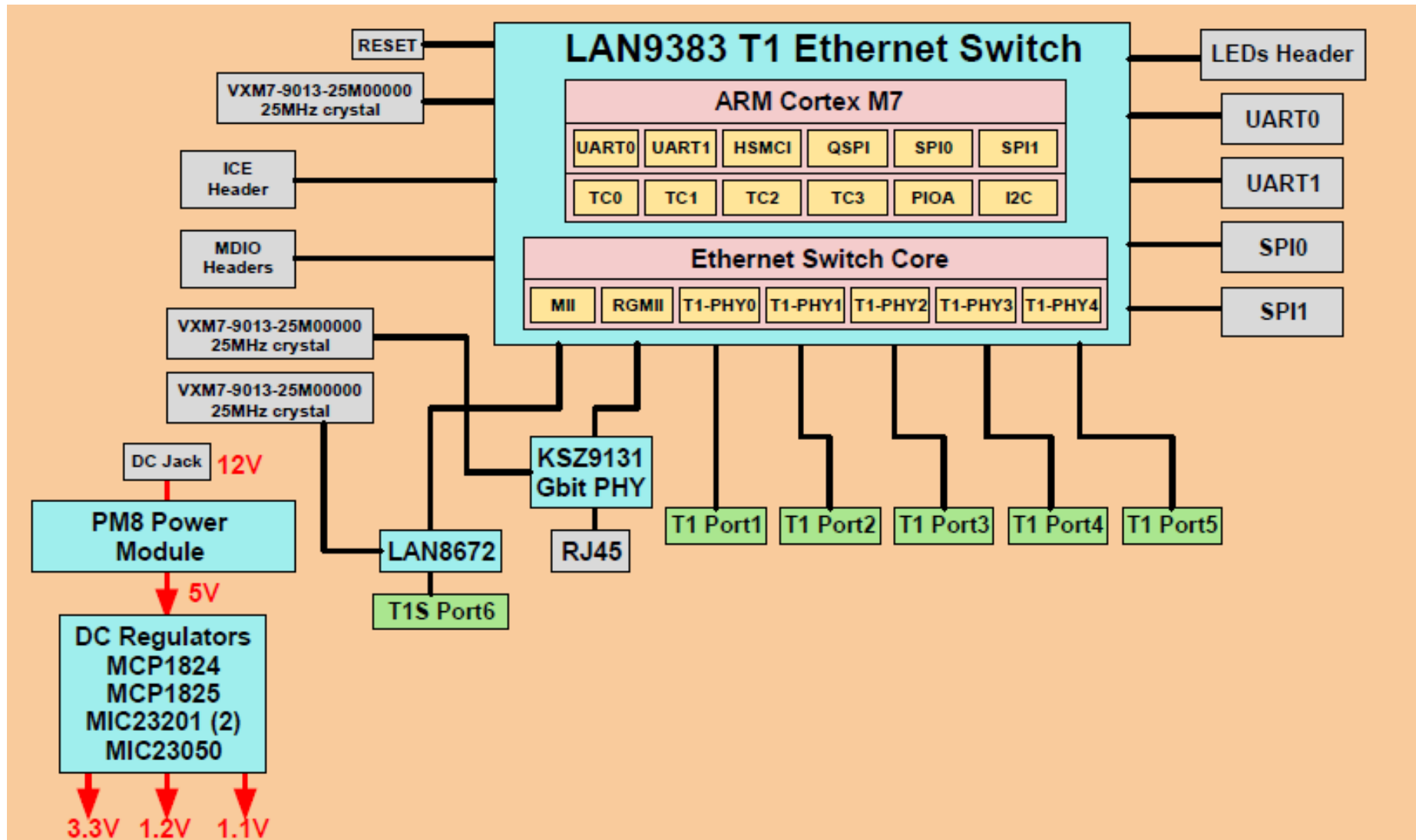


Part Number	T1 PHY Ports	TX PHY Ports	RGMII / RMII / MII Ports	SGMII OR RGMII MUX Port	Temperature	Package
LAN9384	5	1	0	1	-40 +105	128-TQFP
LAN9383	5	0	1	1	-40 +105	128-TQFP
LAN9382	4	1	1	1	-40 +105	128-TQFP
LAN9381	4	0	2	1	-40 +105	128-TQFP

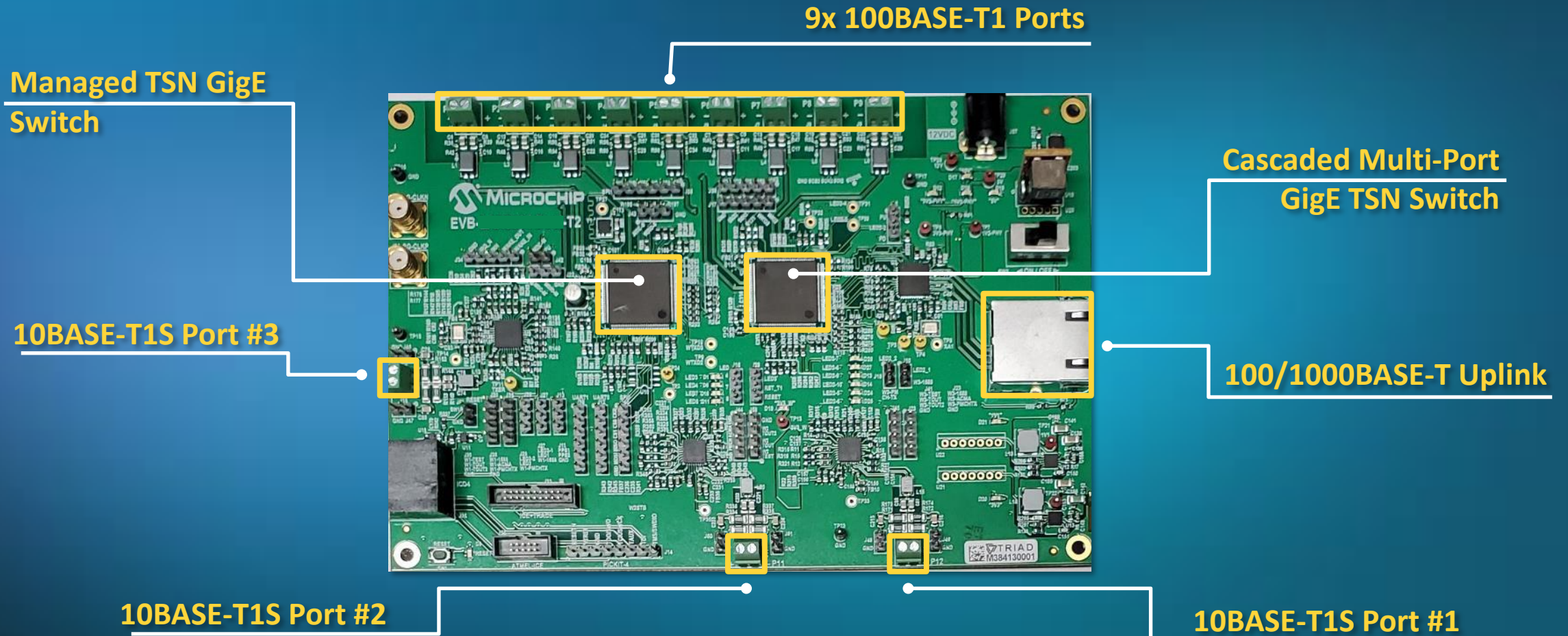
- **7-Port AVB/TSN Switch**
- **300 MHz Cortex M7**
- **Integrated Flash & ECC RAM**
- **1G/2.5G SGMII Uplink**
- **Advanced TSN support**
 - 802.1AS-2020 Time Sync
 - 802.1Qbv Scheduler
 - 802.1Qci Ingress Policing
 - 802.1CB Redundancy
- **Advanced Security Engine**
- **TC10 wake up and sleep**
- **Functional Safety ready**
- **AEC-Q100 Grade 2**



New LAN938x EVB With 10T1S Support

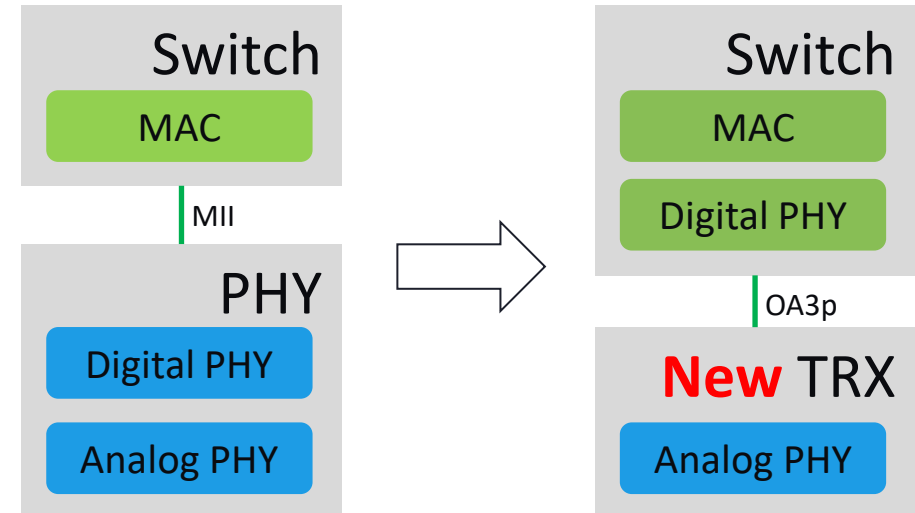
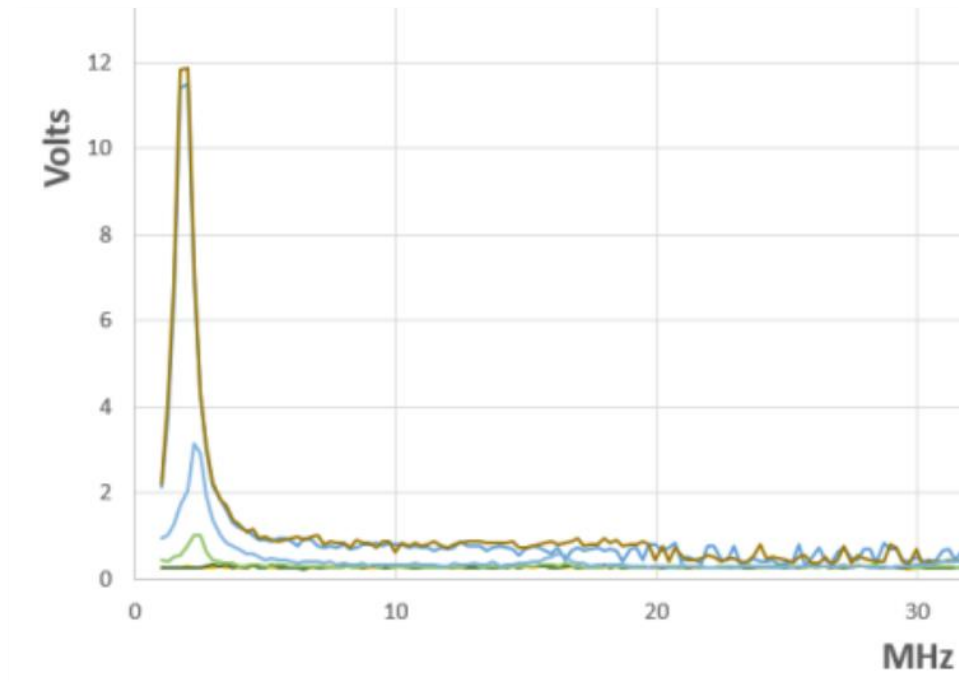


Multi-Rate SPE Evaluation Kits



10BASE-T1S Low-Cost Transceiver LAN8679 (ES Q4 2022)

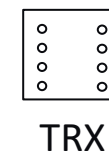
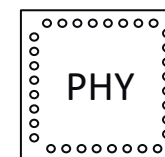
- **Reflections due to multidrop**
 - High common mode voltages
 - Requires high voltage process for semiconductors



130 nm



40 nm

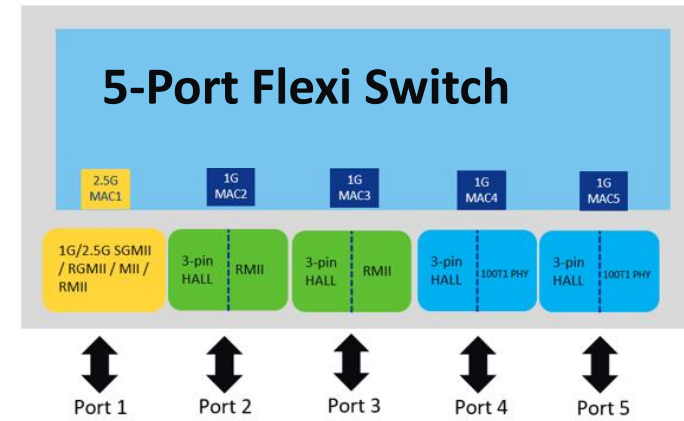


Flexi Switch LAN932x

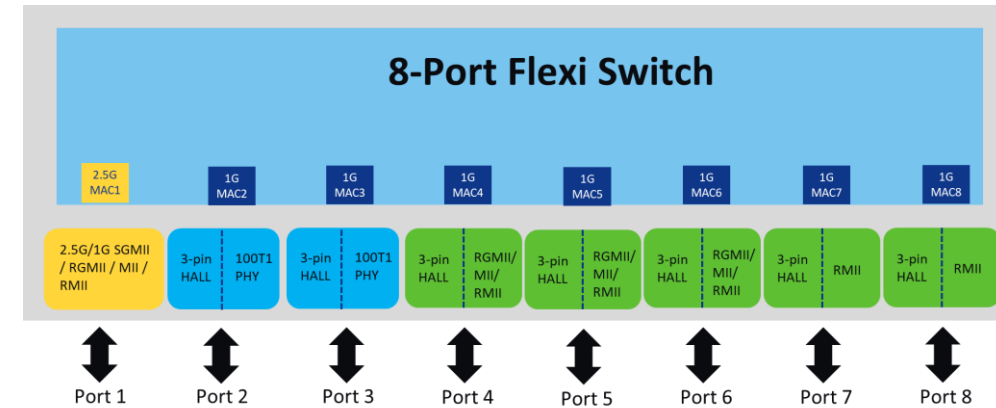
10 Mbps to 2.5 Gbps Flexi-Switch

- Scalable family; 3 to 14 ports
- Addresses new broad market needs
 - Automotive Zonal ECUs – 10 Mbps to 2.5 Gbps switch support
- Low risk, fast time to market
 - Based on LAN938x and 3-Pin Transceiver IP
- Low cost

From 10Base-T1S Phy to a complete Switching solution with 100/1000/2.5GBase-T1



Bulli



Automotive

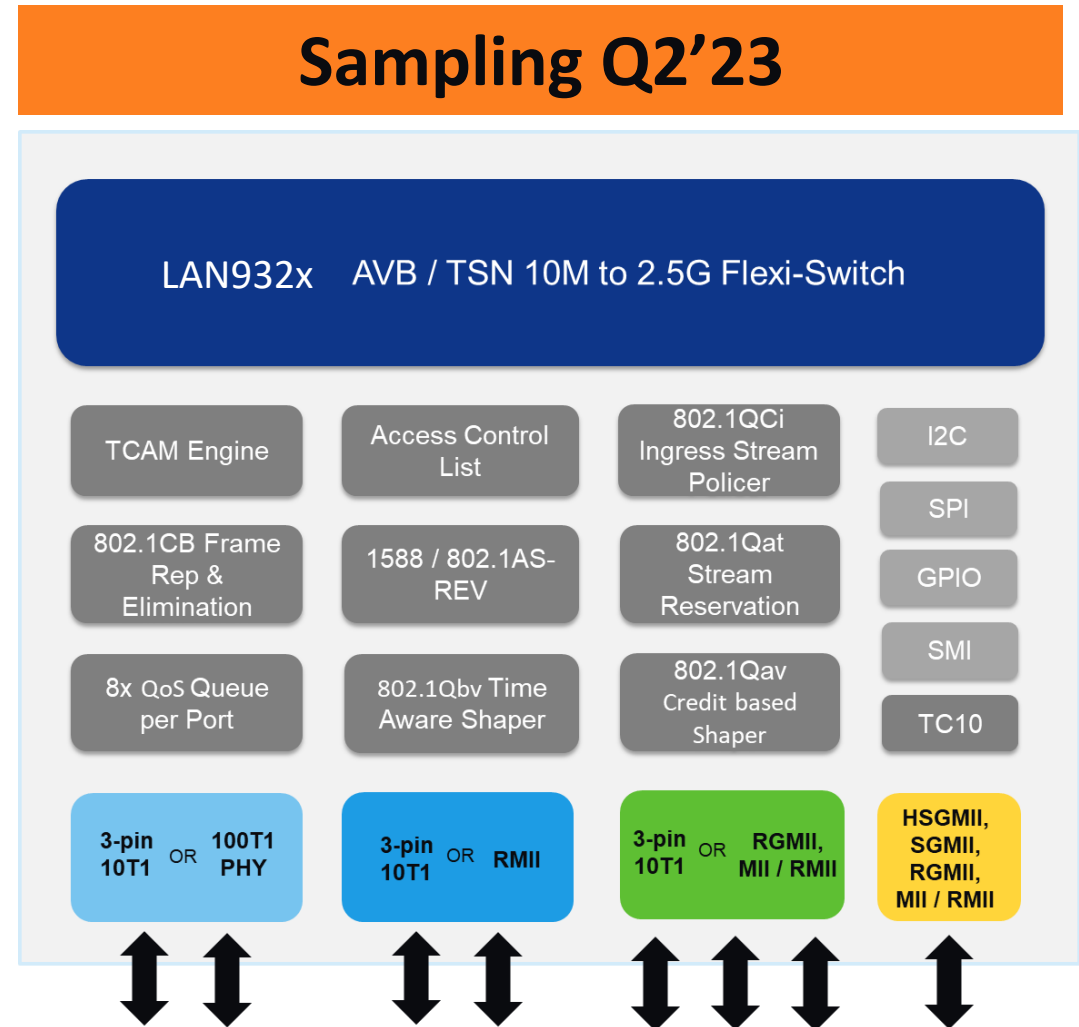
- Lighting
- Zonal ECUs
- CAN, FlexRay, IO replacement
- Audio, Microphones
- Ultrasonic sensors

LAN932x 10M to 2.5G Switch Family

Flexi-Switch

Bulli

- **Flexible and Scalable Automotive switch solution**
- **Proven AVB/TSN core**
 - 10BASE-T1S, 100BASE-T1
 - RGMII/MII /RMII
 - 1G/2.5G SGMII
 - Cascade option
 - LAN937x, LAN938x
 - QFN, TQFP packages



Automotive Ethernet Switch Overview

Status	Automotive	Switch Bandwidth	Max # of Ports	10BASE-T / 100BASE-TX	10BASE-T1S (OA3p)	100BASE-T1	RMII / MII	RGMII	1Gbps SGMII	2.5Gbps SGMII	5Gbps USXGMII QSGMII	10Gbps USXGMII QSGMII XFI	25Gbps 25GBASE-CR/KR/SR/LR/ER	PCIe	VLAN	DPI + ACL	802.1AS gPTP	802.1Qav	802.1Qbv	802.1Qat	802.1Qci	802.1CB	802.1Qbu / 802.1br	802.1Qch	Host	Secure Boot	MAC sec	Ambient Temp Range Min	Ambient Temp Range Max	Packages
Production	Yes		7	5			up to 2	up to 2	up to 1						x	x	x	x	x	x					SPI, IBA	NA		-40	105	128-TQFP
Production	Yes		5	4			up to 1	up to 1	up to 1						x	x	x	x	x	x					SPI, IBA	NA		-40	105	128-TQFP
Production	Q1 2022	64GB	64						up to 64	up to 24	up to 12	up to 6			x	x	x		x	x	x	x	x	x	SPI, IBA, PCIe	external (TA100)		-40	85	25mm 25mm 888-Ball FCBGA (0.8mm pitch)
Production	Q1 2022	90GB	64						up to 64	up to 36	up to 18	up to 9			x	x	x		x	x	x	x	x	x	SPI, IBA, PCIe	external (TA100)		-40	85	25mm 25mm 888-Ball FCBGA (0.8mm pitch)
Production	Q1 2022	128GB	64						up to 64	up to 48	up to 24	up to 12	up to 4		x	x	x		x	x	x	x	x	x	SPI, IBA, PCIe	external (TA100)		-40	85	25mm 25mm 888-Ball FCBGA (0.8mm pitch)
Production	Q1 2022	160GB	64						up to 64	up to 64	up to 32	up to 16	up to 6		x	x	x		x	x	x	x	x	x	SPI, IBA, PCIe	external (TA100)		-40	85	25mm 25mm 888-Ball FCBGA (0.8mm pitch)
Production	Q1 2022	200GB	64						up to 64	up to 64	up to 32	up to 20	up to 8		x	x	x		x	x	x	x	x	x	SPI, IBA, PCIe	external (TA100)		-40	85	25mm 25mm 888-Ball FCBGA (0.8mm pitch)
Production	Yes		5			4	up to 1	up to 1							x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI	NA		-40	105	64-VQFN
Production	Yes		6	1		3	up to 2	up to 2							x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI	NA		-40	105	128-TQFP
Production	Yes		8	1		5	up to 2	up to 2							x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI	NA		-40	105	128-TQFP
Production	Yes		8			5	up to 2	up to 2	up to 1						x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI	NA		-40	105	128-TQFP
Production	Yes		8			6	up to 2	up to 2							x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI	NA		-40	105	128-TQFP
Pre-Production	Oct'22		7			4	up to 3	up to 3	1	1					x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, SMI	x		-40	105	128-TQFP
Pre-Production	Oct'22		7	1		4	up to 2	up to 2	1	1					x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, SMI	x		-40	105	128-TQFP
Pre-Production	Oct'22		7			5	up to 2	up to 2	1	1					x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, SMI	x		-40	105	128-TQFP
Pre-Production	Oct'22		7	1		5	up to 1	up to 1	1	1					x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, SMI	x		-40	105	128-TQFP
Development	Eng Samples Q2'23		5		up to 2	2	up to 3	up to 1	up to 1	up to 1					x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI, I2C	NA		-40	105	64-QFN
Development	Eng Samples Q2'23		5		up to 4		up to 3	up to 1	up to 1	up to 1					x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI, I2C	NA		-40	105	64-QFN
Development	Eng Samples Q2'23		8		up to 5	2	up to 6	up to 4	up to 1	up to 1					x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI, I2C	NA		-40	105	128-TQFP
Development	Eng Samples Q2'23		8		up to 7		up to 6	up to 4	up to 1	up to 1					x	x	x	x	x	x	x	x	x	x	SPI, IBA, SMI, I2C	NA		-40	105	128-TQFP
Development	Eng Samples Q1'23	40GB	12					2	Up to 10	Up to 10	Up to 10	Up to 8			x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, PCIe	x		-40	105	17mm x 17mm 361-Ball FCBGA (0.8mm pitch)
Development	Eng Samples Q1'23	65GB	12					2	Up to 10	Up to 10	Up to 10	Up to 8			x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, PCIe	x		-40	105	17mm x 17mm 361-Ball FCBGA (0.8mm pitch)
Development	Eng Samples Q1'23	90GB	12					2	Up to 10	Up to 10	Up to 10	Up to 8			x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, PCIe	x		-40	105	17mm x 17mm 361-Ball FCBGA (0.8mm pitch)
Development	Eng Samples Q1'24	40GB	12					2	Up to 10	Up to 10	Up to 10	Up to 8		Gen4x2 SR-IOV	x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, PCIe	x	x	-40	105	17mm x 17mm 361-Ball FCBGA (0.8mm pitch)
Development	Eng Samples Q1'24	70GB	12					2	Up to 10	Up to 10	Up to 10	Up to 8		Gen4x2 SR-IOV	x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, PCIe	x	x	-40	105	17mm x 17mm 361-Ball FCBGA (0.8mm pitch)
Development	Eng Samples Q1'24	95GB	12					2	Up to 10	Up to 10	Up to 10	Up to 8		Gen4x2 SR-IOV	x	x	x (2020)	x	x	x	x	x	x	x	SPI, IBA, PCIe	x	x	-40	105	17mm x 17mm 361-Ball FCBGA (0.8mm pitch)

x	Supported
NA	Not Applicable
IBA	In Band Access (over Ethernet port)
OA3p	OPEN Alliance 3-Pin 10BASE-T1S Analog (high voltage) Transceiver interface

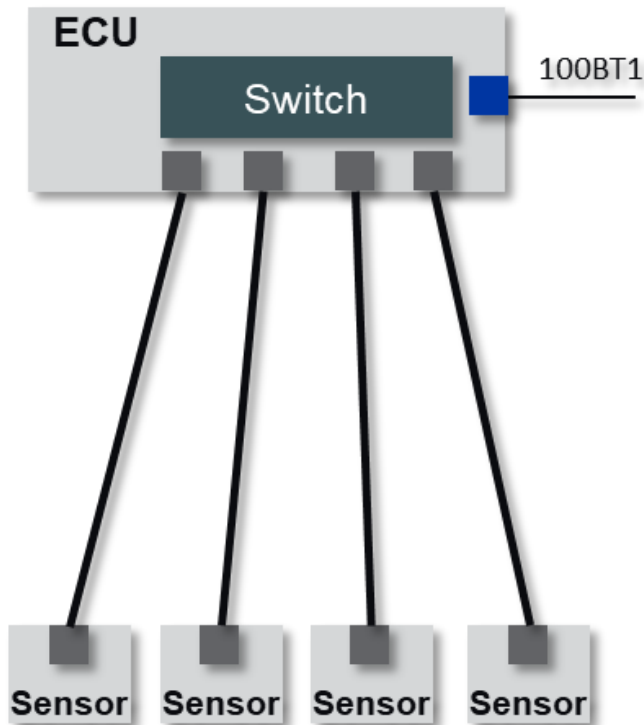


What is 10BASE-T1S ?

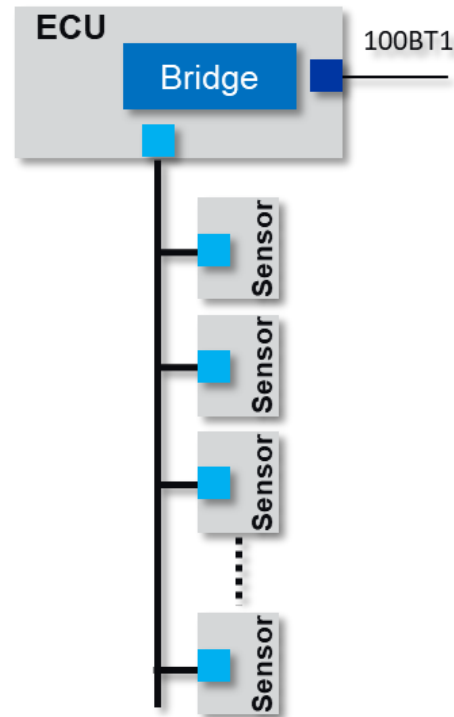
IEEE® 802.3cg 10 Mbps Single Twisted Pair

- Legacy transceiver
- 10BASE-T1S PHY
- 100BASE-T1PHY

Legacy



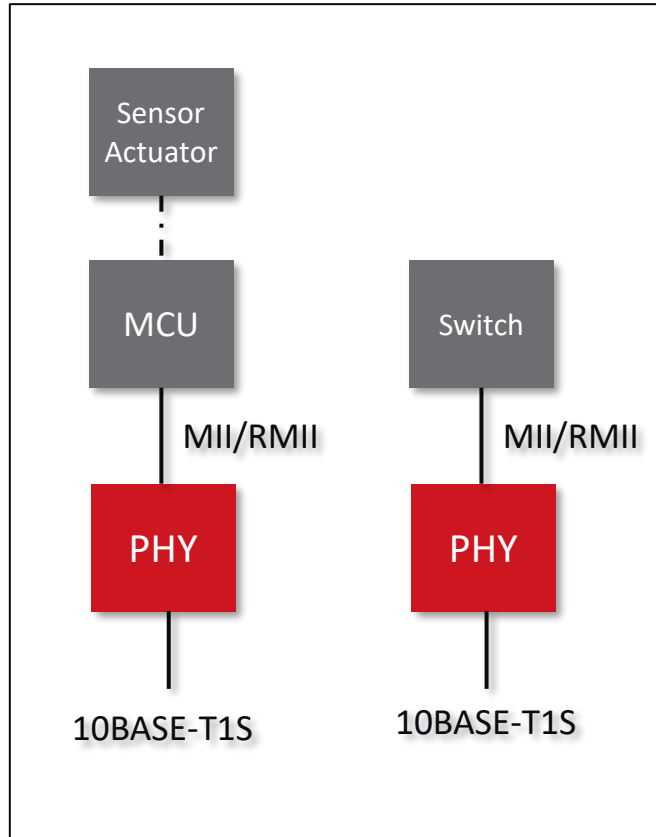
10BASE-T1S



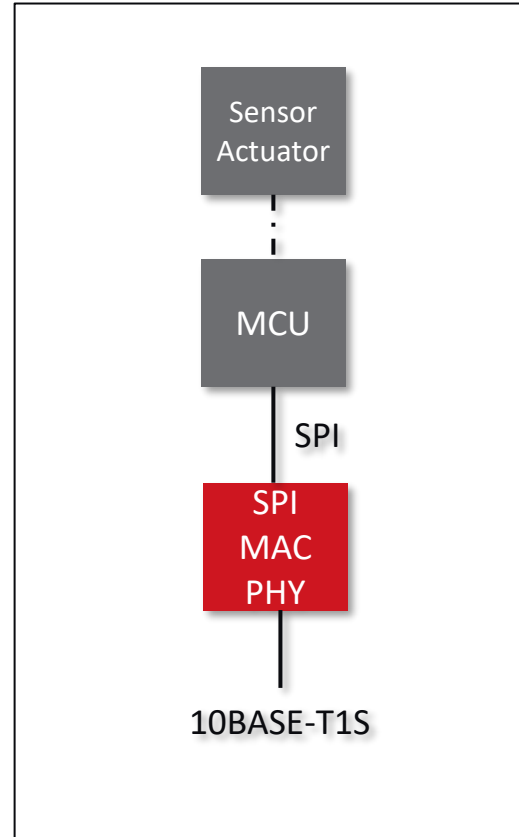
- No switch required
- Less PHYs and cabling
- Low latency/Deterministic
- Secure & Safe
- Scalable

10BASE-T1S Products

LAN867x PHY



LAN865x MAC/PHY



- Low Power
- AEC-Q100 Grade 1
- ISO26262 compliant



10BASE-T1S PHYs: LAN8670/LAN8671/LAN8672

- **Ecosystem**

- **Interfaces**

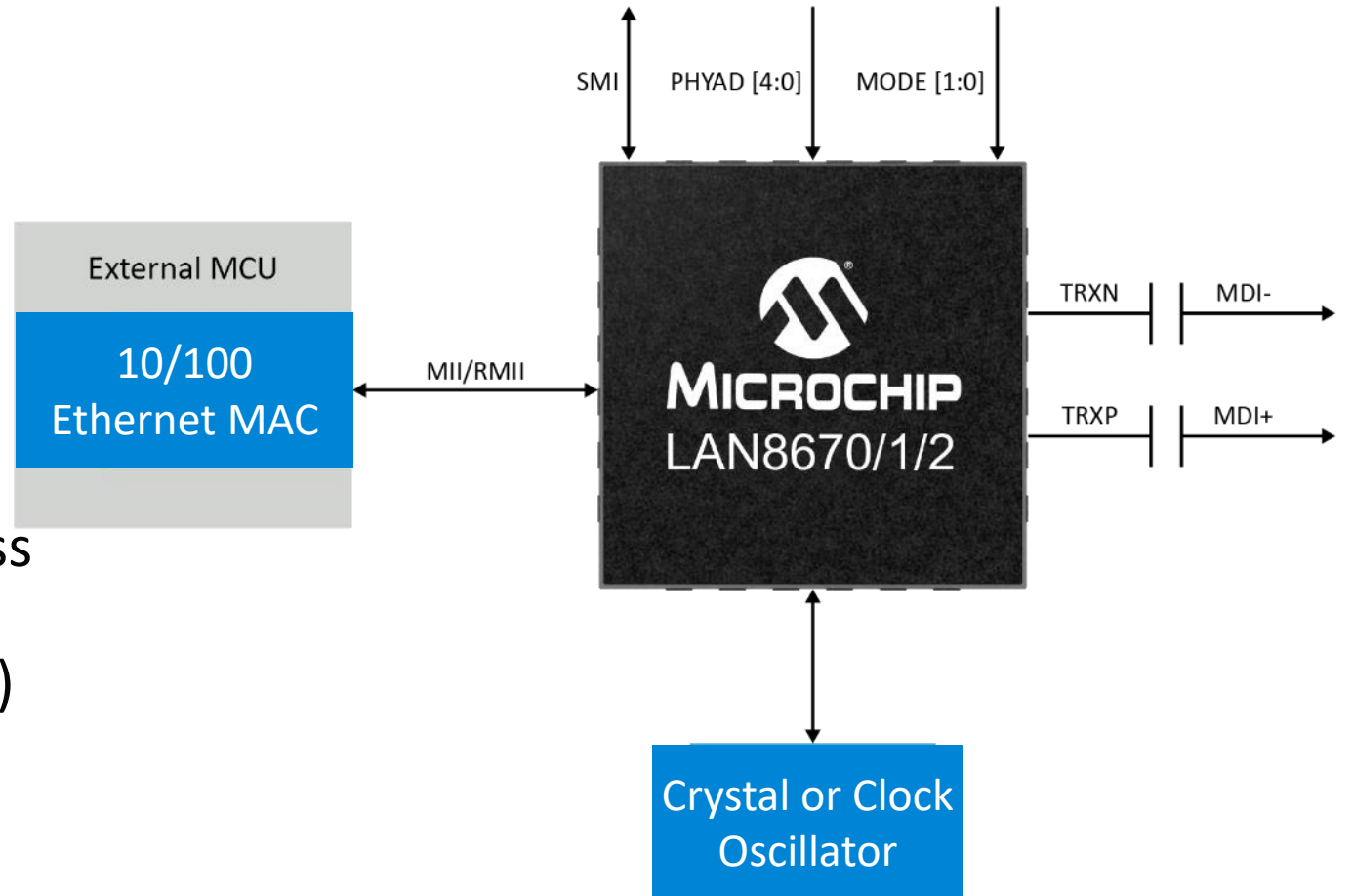
- MII/RMII
- MDIO
- GPIO

- **Features**

- Multidrop
- CSMA/CD, PLCA
- Extended Control of Media Access
- ISO26262
- Temperature Grade 1 (AEC-Q100)
- Low Power

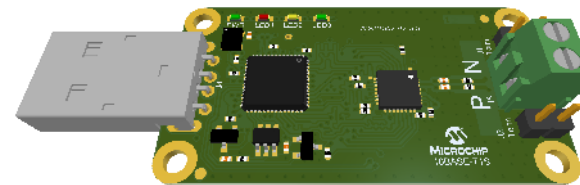
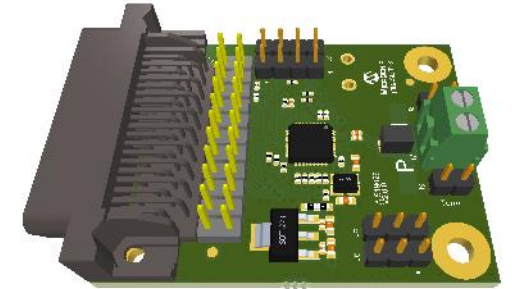
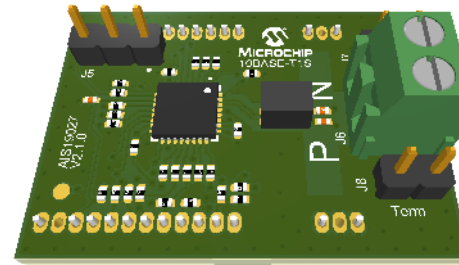
- **Package:**

- QFN 36/32/24
- 6 x 6/5 x 5/4 x 4 mm



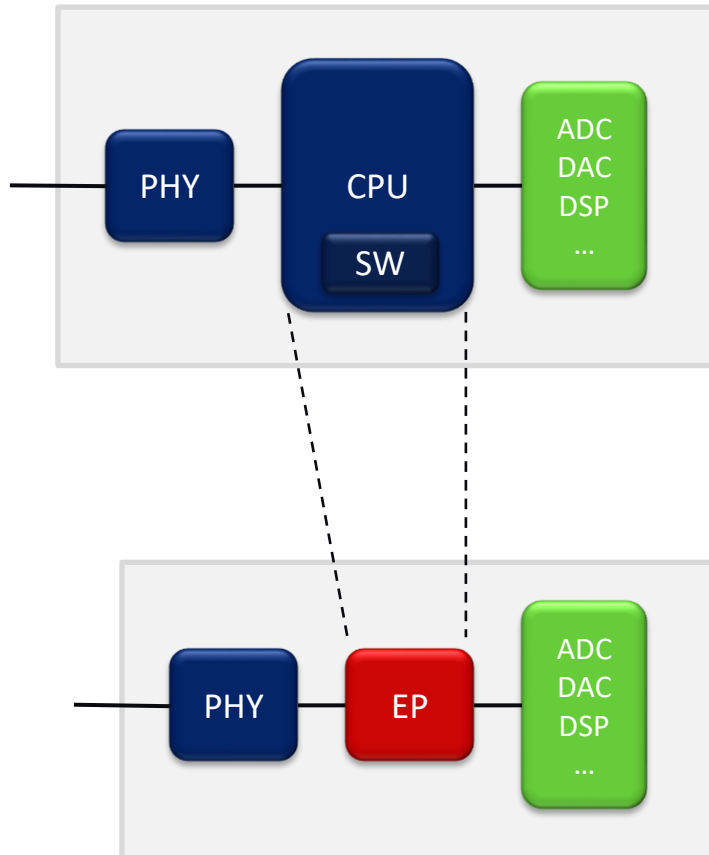
SPE Tools for 10BASE-T1S – Microchip Eval Boards

- **10BASE-T1S PHY RMII and MII Evaluation Boards**
 - Standard form factor to connect to Microchip MCU platforms
 - Includes the Bus Interface Network (analog front end)
- **10BASE-T1S PHY USB Evaluation Board**
 - Any USB host can be a 10BASE-T1S node
 - Drivers for Linux® and Windows
- **MPLAB® Harmony 3 Development Framework**
 - Integration into development framework for Microchip microcontrollers and microprocessors
 - <https://www.microchip.com/en-us/tools-resources/configure/mplab-harmony>



Ethernet Endpoint

"TSN Out-of-the-Box"



Classic TSN Node

- High-end TSN capable CPU
- Complex Software Integration
 - Operating System
 - TSN Hardware Driver
 - TSN Software Stack
 - Streaming Application

Optimized TSN Node

- Integrated HW solution
- Cost optimized
- Small formfactor
- No SW development

EP = EndPoint

Functional Safety Ready



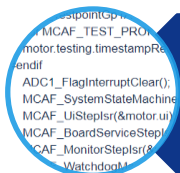
Development Process



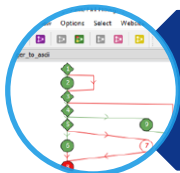
FMEDA



Safety Manual



Diagnostic Software



Development Tools

MICROCHIP **LAN8770**
FUNCTIONAL SAFETY MANUAL

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- Preface 5
- Chapter 1. Overview 5
 - 1.1 Introduction 9
 - 1.2 References 9
- Chapter 2. Abbreviations and Definitions 11
 - 2.1 Introduction 11



Components	FIT Rate Distribution for this Failure Mode (% of total FIT rate) for Each Instance/Unit of the Module	Number of Module Instances/Units	FIT Rate Distribution for this Failure Mode (% of total FIT rate) for All Instances of the Module	Failure Mode	Effect	Component level FIT Split	Device level FIT Split	Diagnostics for Single Point Failure
Digital Communication Block				xMII Communication Fail	No Communication	75.0%	20.1225%	(H) MII_LOOPBACK_TEST (H) PCS_LOOPBACK_TEST
	28.83%	1	28.83%	IRQ_N Assertion Fail	Event depending on IRQ will be missed	12.5%	3.3538%	(M) PHY_STATUS_READ
				LED Output Fail	Digital signal will not drive the desired system design	12.5%	3.3538%	(L) GPIO_READ_WRITE_TEST
Transmitter Block							19.8080%	(M) LINK_TIMEOUT_MONITORING (M) MAC_CRC
							4.9520%	(M) MONITOR_ERROR_COUNTER (M) LINK_TIMEOUT_MONITORING (M) MONITOR_ERROR_COUNTER (M) SQL_TEST
							13.5680%	(M) LINK_TIMEOUT_MONITORING

Page 3 of 20
Certification Report No. S0YG0001

SGS **TÜV SAAR**

1 Task

With the certificate No. **FS/71/220/21/0740** it is confirmed that the product:

“LAN8770”

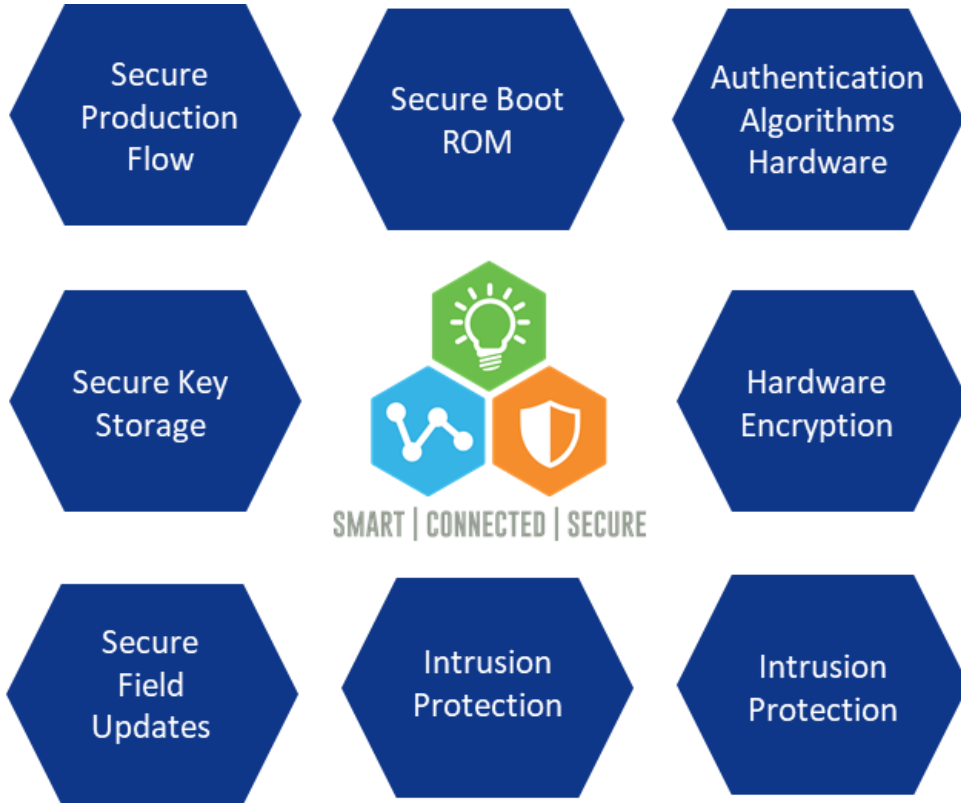
has been developed in accordance to the requirements of ISO 26262-5 [R1].

The product is rated with **ASIL B ready** ¹.



Microchip Security Assets

Autonomous Driving Increases Security Attack Surfaces



• Microchip Security Solutions

- 20+ year track record
- Scalable from secure elements to HSM
- End-to-end/Total System Solutions
- Ethernet secure switching

Access control

Deep packet inspection

Ingress Policing

Thank you!
