Webinar

Multi-protocol industrial communication: empowering next-generation industrial automation

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Agenda

- Application overview
  - Multi-protocol approach
  - Device families
- Insights to available protocols
  - Key features and performance parameters
- Application use case scenarios
  - Profiles
  - Problems solved
  - Example applications
- Support and additional services

Application overview | Multi-protocol approach

Programmable Logic Controllers

Industrial & Collaborative Robots

Single & Multi-axis Motor Control

Multi-protocol w/ Same HW Design	Single Chip Solution	One Stop Shop
Different firmware images	Fieldbus communication	TI is the main contact for SoC and protocol related topics for the product
Select during boot time e.g. HW/SW switch	Sensor/Actuator/Gateway application	
Automatic detection by listening first	Add-on services - webserver or monitoring	
Ready for Gigabit protocols e.g. TSN		

PROFINET® EtherCAT® EtherNet/IP™ IO-Link

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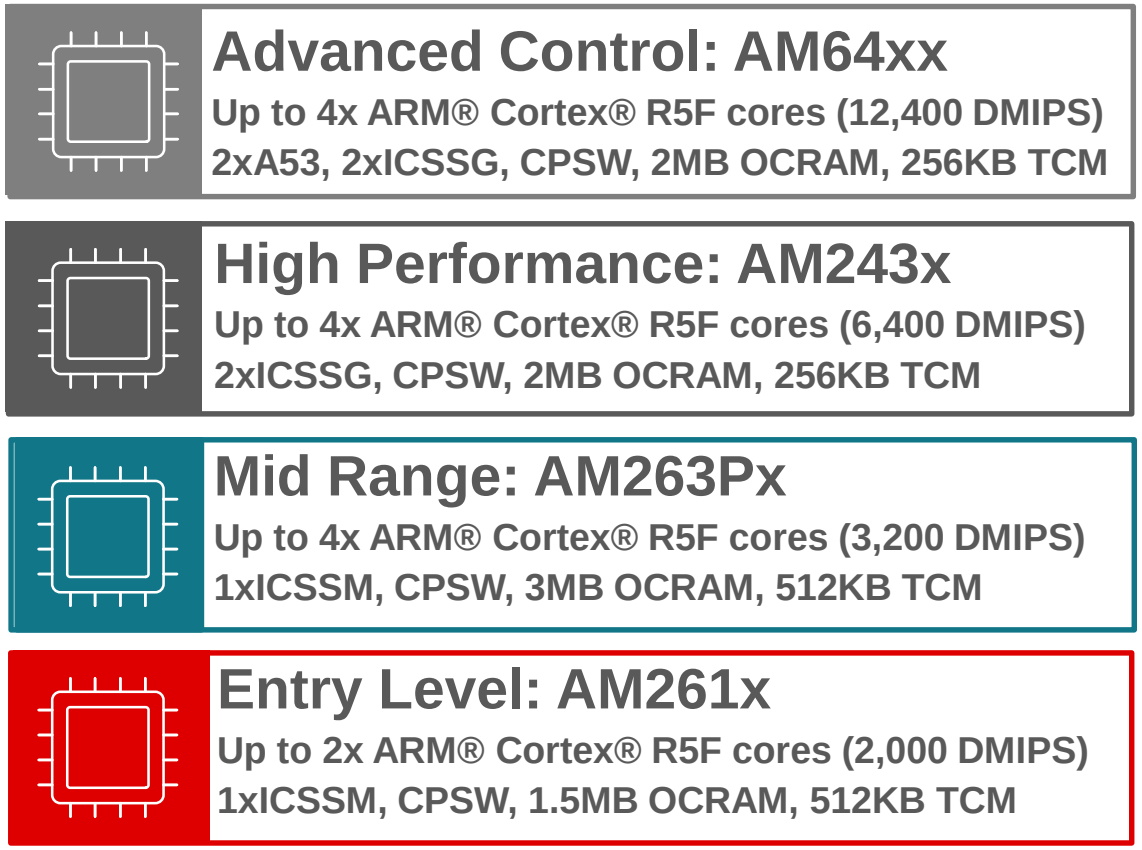
Industrial comms | Device families



Scalable:
Multiple A53/R5F core options optimized for control or device-side applications

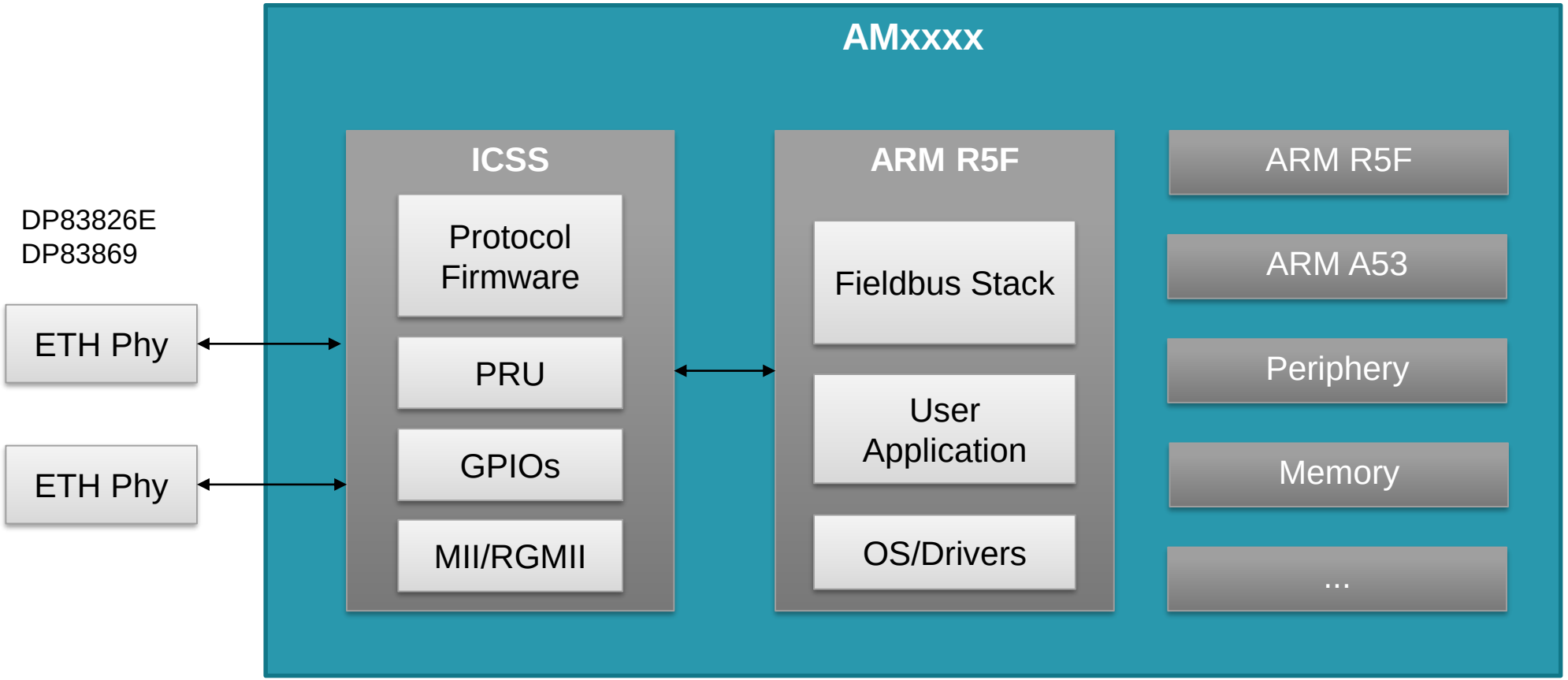
General Periphery:
MCSPI, GPIO, I2C, ADC, UART
FSI, EPWM, ECAP, EQEP, CAN

Industry Standard & Certified:
Licensed and pre-certified protocol stacks & unified SDK

Safe & Secure:
Boot and runtime security, lock step core function.

Simplified communication and control in a single device

Multi-protocol approach



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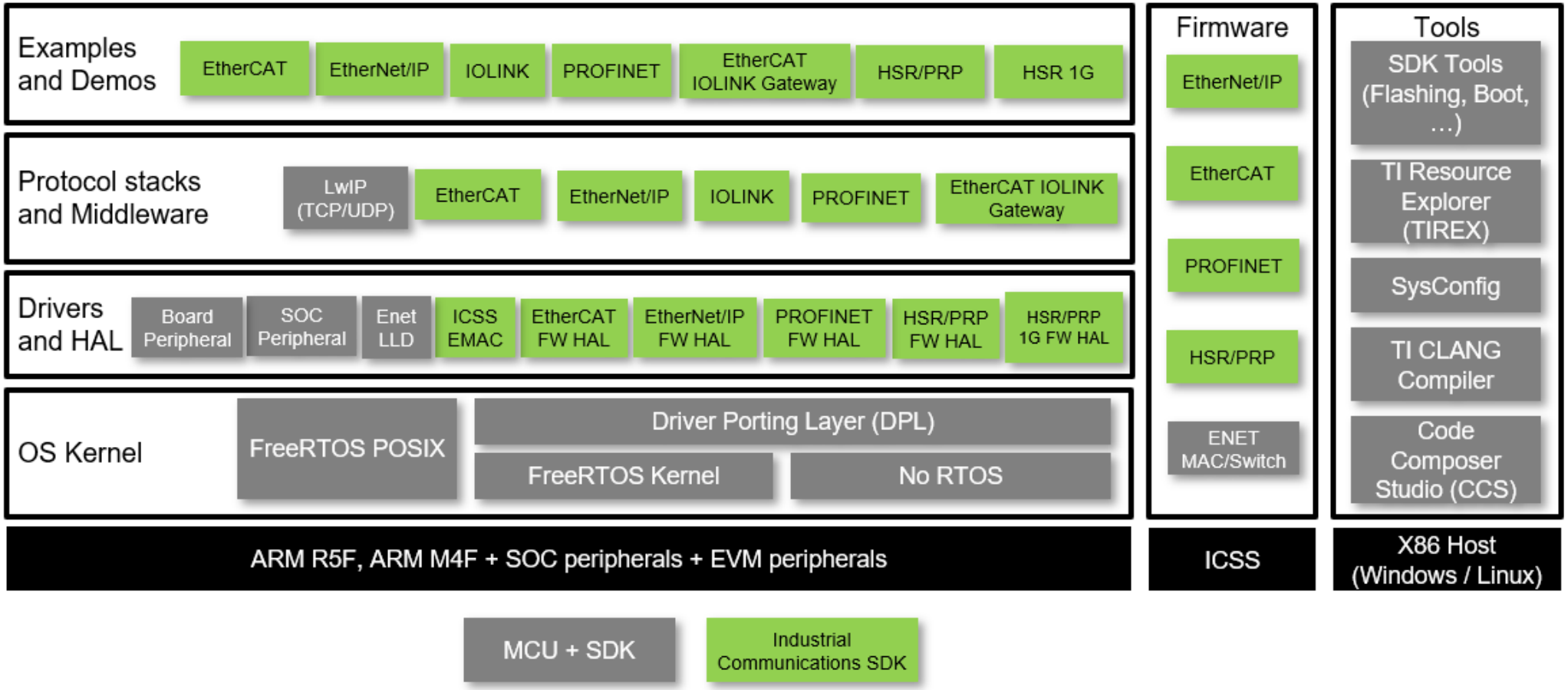
Industrial communications SDK



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Multi-protocol offering & key features

PROFINET	EtherCAT	EthernetIP	IO-Link

• Certified with Test Bundle 2.45 (Spec Version 2.44)
• Netload Class I, II, III
• IRT with 250µs cycletime
• Shared Device / Shared Input support
• System Redundancy S2
  • Configuration in Run
• Fast Startup (~460 µs)
• Network Redundancy - MRP (MRPD in progress)
• Diagnostics/Alarms database management by Stack
• I&M Data managed by Stack
	• Beckhoff SSC and TI Stack Layer with additional features
	• Distributes Clocks (DC) up to 50µs cycle-time
	• CoE with Object dictionary management
	• ESI Parser
	• CiA 402 example
	• AoE – ADS over EtherCAT
	• Diagnosis and Emergency support
	• EoE with LWIP stack adaptation
	• FoE for Firmwareupdate and File storage
		• Conformance with ODVA CT21
		• Examples for Generic Device and Discrete I/O Device Profile
		• Standard Objects implemented in Stack
		• Wide Range of supported Datatypes
		• Addressing by DHCP, BOOTP and static
		• Quick Connect
		• VLAN tagging
		• Statistics
		• CIP Sync (PTP/IEEE1588)
		• Network features: LLDP, DLR (Supervisor), ACD, QoS
			• Compliant with specification V1.1.4
			• Frame Handler in PRU
			  • Support all Frame types and Baudrates
			  • Up to 8 Ports at 400µs
			  • Low CPU Load
			  • Feature extension possible (not fixed in silicon like SPI transceivers)
			• Configuration Tool for development purpose
			  • Standard interface over UART
			  • Standard interface over TCP/IP (LWIP)
			• Porting Layer for different Phys

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Profinet performance

KPI	TI devices	Competition SoC
Min cycle time	250us	625us
Ti, To, Tsync jitter	Less than 100ns	~1us
Memory footprint	1MB Flash 1.3MB (9/11 slot/sub-slot)	Requires SDRAM
Fast startup	460ms (not XIP)	490ms
Network Redundancy	MRP and MRPD	Only MRP
PROFIsec	Scalable architecture for CRA	Need new silicon/ASIC

Additional TI PROFINET Performance

- 8 PPM / 8 CPM in PRU
- 1440 Byte cyclic frame
- 5% CPU @ 1ms cycletime
- IRT Sync signal as GPIO or Interrupt
- Direct Buffer Interface for fast cyclic exchange
- XIP (Execute from Flash) is possible

Profiles

General

- Profiles are used to provide features in a harmonized way
- TI provides some examples, but stacks are ready for many other profiles

EtherCAT

- CiA401 generic I/O device profile
- CiA402 device profile for drives and motion control
- FSoE

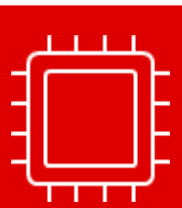
Ethernet/IP

- Generic Device Profile
- CIP safety
- CIP motion
- General Purpose Discrete I/O Device Profile

PROFINET

- PROFIsafe
- PROFIdrive
- PROFIenergy (not yet in example)

Problems TI device stacks solves



Scalability & Reusability

- Scalable portfolio with all other required components like PHY and power management
- Pre-certified with many features makes it easy to move to custom application

Development Efficiency

- Single point of contact from SoC to all protocol solutions
- Single HW platform for all Ethernet based protocols

Future-Proofing & Support

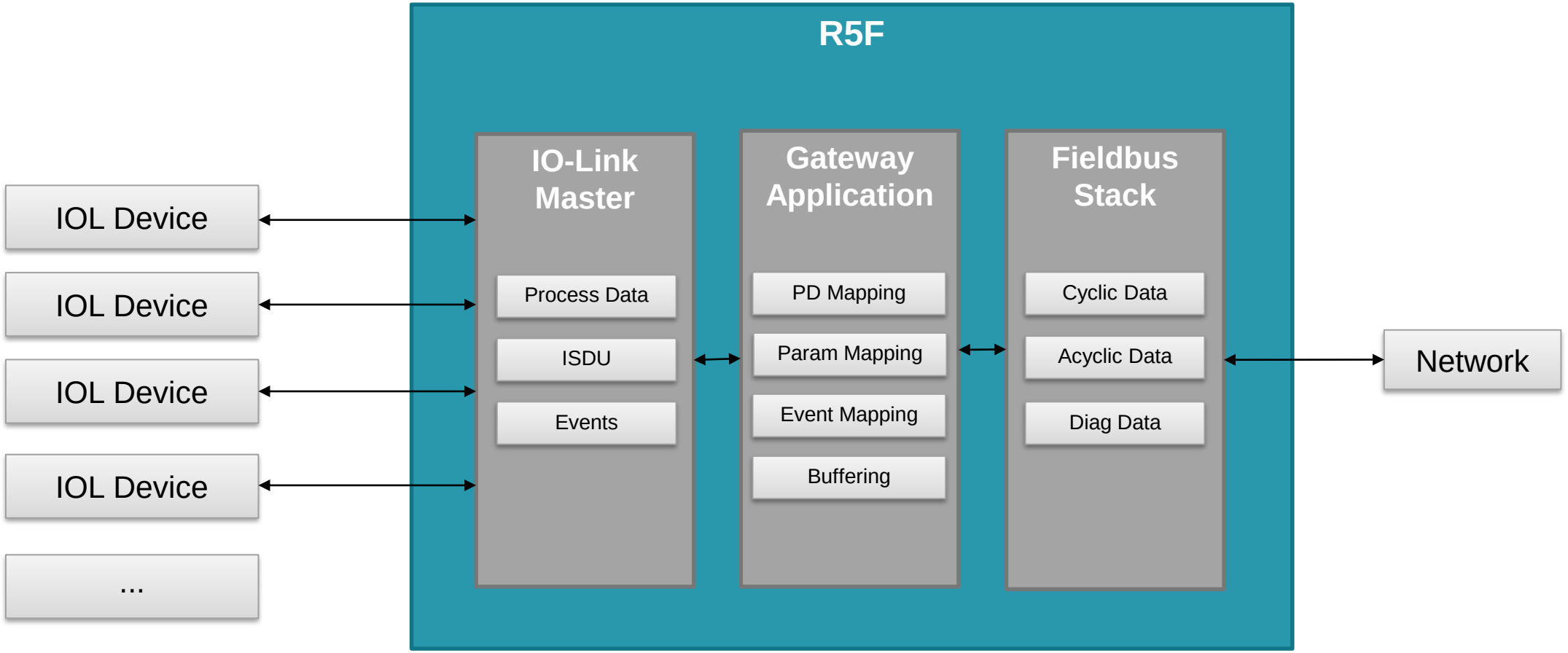
- Ready for future platform which adds new features without the need for new SoC (ICSS + PRU concept)
- Long term support ensures long and stable product life

Application example | IO-Link Gateway

- **Simple mapping between Protocols**
  - Example application provided in IND-COMMS-SDK
  - EtherCAT and Ethernet/IP (in upcoming release)

- **Specification for integration**
  - ODVA Volume 7c: Integration of IO-Link Devices into CIP
  - EtherCAT: ETG.5001-6220
  - PROFINET: IO-Link Integration – Profile for PROFINET

Application example | IO-Link Gateway



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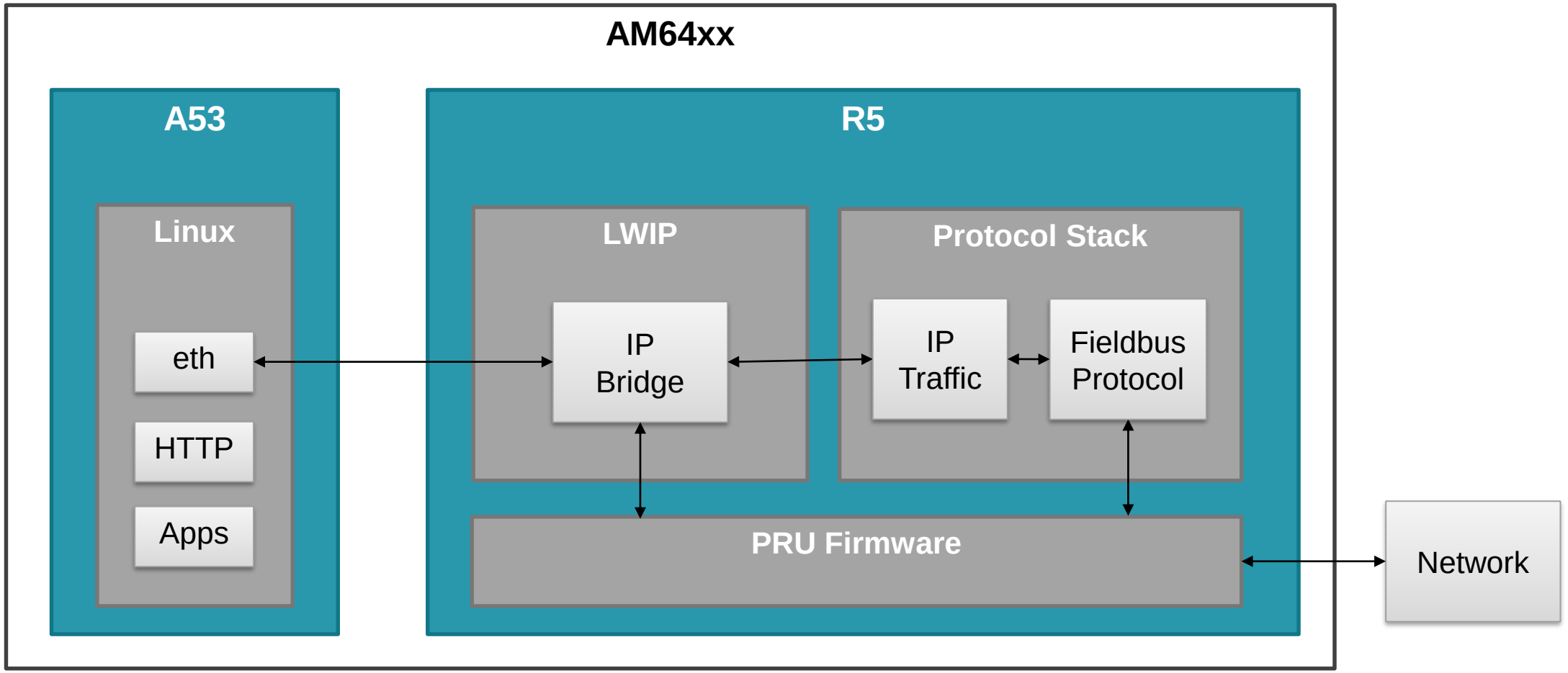
Application example | Intercore tunneling



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Third party solutions

If customers want to work with a 3rd party, we have the following:

Device Stacks

- EtherCAT, EtherNet/IP, PROFIBUS, PROFINET, Powerlink, CC-Link IE TSN, OPC UA TSN, Modbus TCP

Controller Stacks

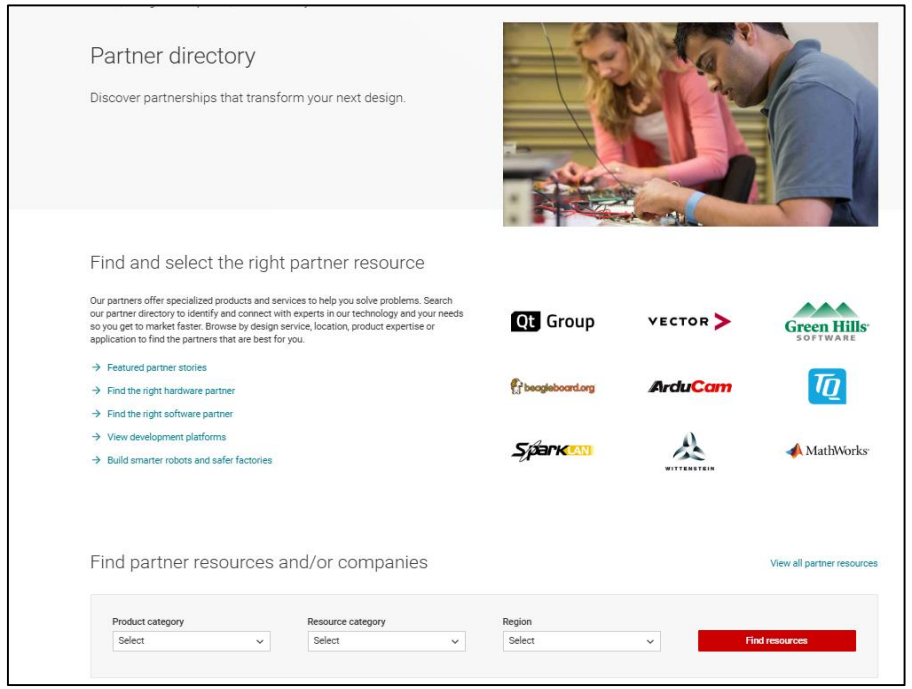
- EtherCAT, EtherNet/IP, PROFINET

Safety Profiles

- FSoE, CIP Safety, PROFsafe

Drive Profiles

- PROFIdrive, CIP Motion, CiA402



Industrial communications services

Standard model

- No additional licensing cost; basic protocol functionality is included in the device cost.
- Support: through standard TI support channels – E2E forum
- SW Release: Standard protocols available via ti.com SDK releases.

Premium model

- Pricing available for individual stack, multi-protocol as well as multi-platform based.
- Please contact TI for more details.
- Annual extended license and support packages: Per Protocol packages or Multi-Protocol Packages available.
  - ❖ multi-protocol for device family
  - ❖ Multi-protocols for any device family.
- Gateway Example Included: All features and configurations supported on TI EVM & and **customer hardware based on TI BOM**.
- Support: Expert Support for **customer-specific protocol configuration** through a **private E2E**
- SW Release: Standard Protocol release plus **frequent patches for bug fixes, additional updates as available (LTS)**.

Custom model

- Pricing based on technical scope.
- Development, deployment, and support packages for customer-specific projects and defined HW.
- Direct support from TI or 3rd Party experts.
- Example packages may include:
  - ❖ Custom IC SDK
  - ❖ safety / security application profiles support
  - ❖ LTS for I Comms SDK.[> 2 years]
  - ❖ LTS of Custom IC SDK
  - ❖ Training on Stacks
  - ❖ Onsite support
  - ❖ Backporting features to old SDK
- Please contact TI sales for details

Getting started

You can start evaluating this device leveraging the following:

Content type	Content title	Link to content or more details
Product folder	Industrial Communication enabled devices	AM2612, AM263P4, AM2434, AM6442
Reference design	Evaluation boards for different targets IO-Link extension boards	TMDS64EVM, LP-AM243, LP-AM261, LP-AM263P BOOSTXL-IOLINKM-8, TMDS64DC01EVM
Technical blog content or white paper	White Paper: Industrial Comms on AM26xx White Paper: Real-Time Com for Industrial Apps App Note: Industrial Comms protocols on Sitara	https://www.ti.com/lit/wp/spradl5/spradl5.pdf https://www.ti.com/lit/wp/slaaem2/slaaem2.pdf https://www.ti.com/lit/an/sprach6e/sprach6e.pdf
Development tool or evaluation kit	Industrial Communication SDK for different platforms	https://www.ti.com/tool/IND-COMMS-SDK

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