Introduction to the Sitara™AM57x Processor Industrial Software Development Kit (ISDK)

Agenda

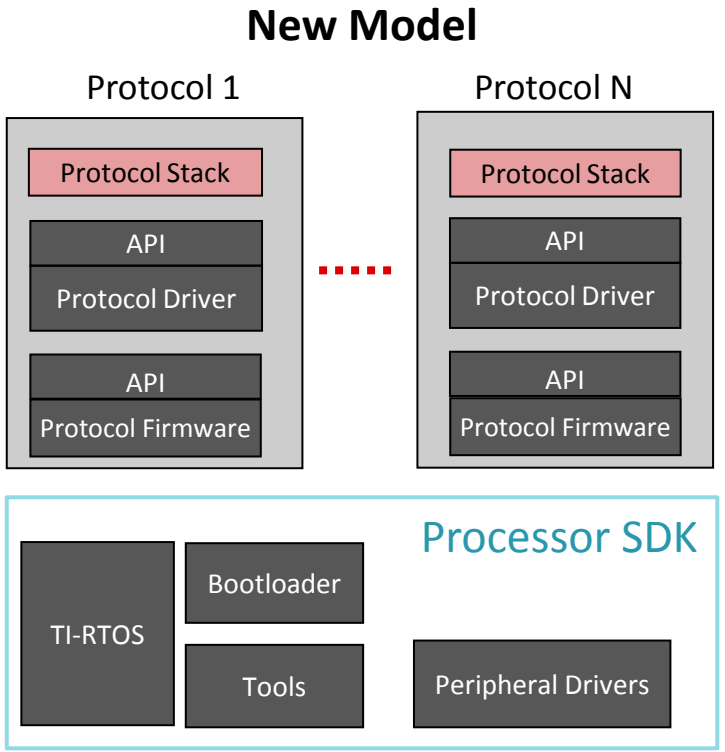
- Provide an overview of the Industrial SDK Architecture
- Description of the ISDK capabilities and supported protocols
- Show AM57x and the ISDK supports an Industry 4.0 application

Industrial Software for the AM57x

- New model of industrial protocol delivery for AM57x
- PRU-ICSS-Industrial-SW is delivered as additions to the PROCESSOR-SDK-RTOS-AM57X: RTOS Processor SDK for AM57x
- The PRU-ICSS-Industrial-SW tool folder contains individual packages for each industrial protocol:
  - Available at www.ti.com/tool/PRU-ICSS-INDUSTRIAL-SW
- The current Industrial SDK for AM335x and AM437x will continued to be delivered with support for all of the industrial protocols until they migrated to PRU-ICSS-Industrial-SW and the PROCESSOR-SDK-RTOS architecture

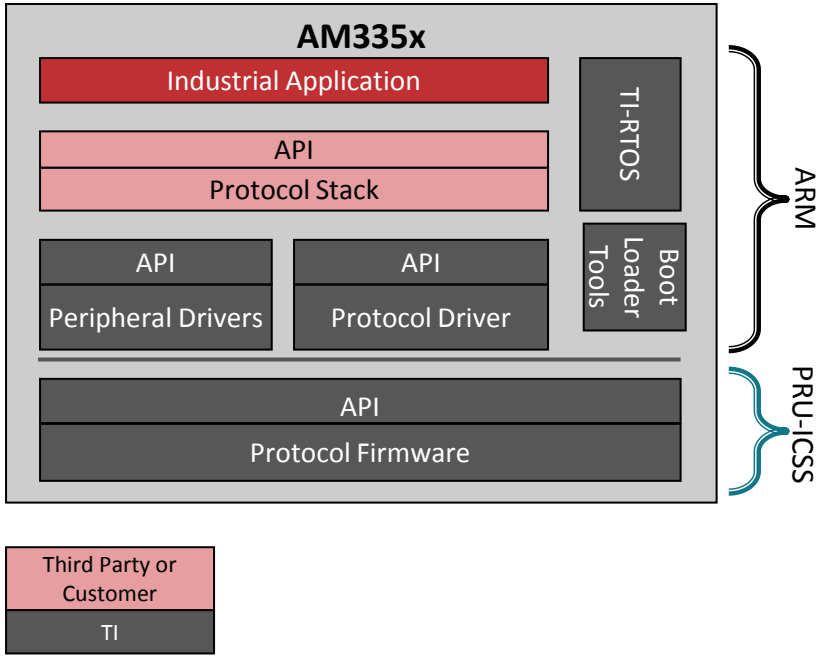
PRU-ICSS-SW Industrial Software Delivery

- Each Industrial protocol package sits on top of Processor SDK instead of as a stand-alone Industrial SDK.
- Industrial protocol packages are baseline to the Processor SDK:
  - Better support
  - Ease of migration to other platforms
  - Improved maintenance of existing protocols
  - Simplify addition of new protocols
- This model will extend to “all” platforms:
  - AM335x and AM437x will move from Industrial SDK to the new model in 2017
- This change is transparent for the stack architecture and engagements with third parties. No change is required from third parties.

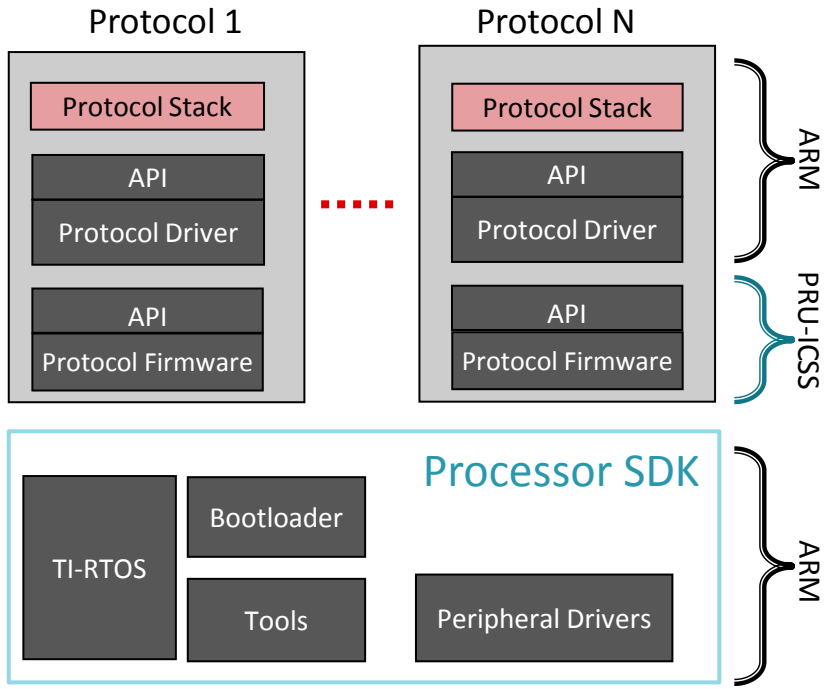


Industrial SDK vs PRU-ICSS-INDUSTRIAL-SW

Current Model: **Industrial SDK**
(AM335x, AM437x)

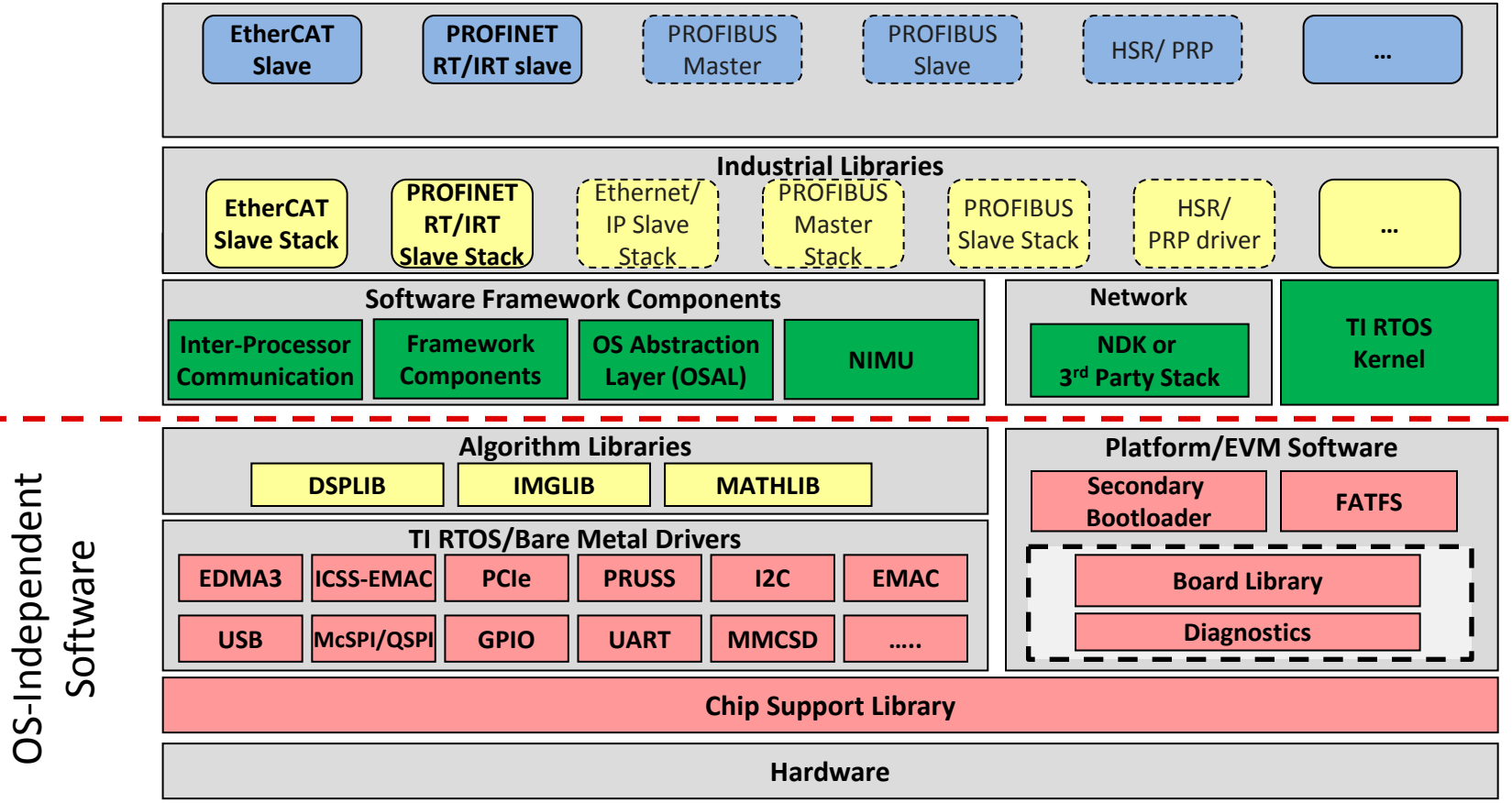


New: **Industrial Library Model**
(AM57x first)



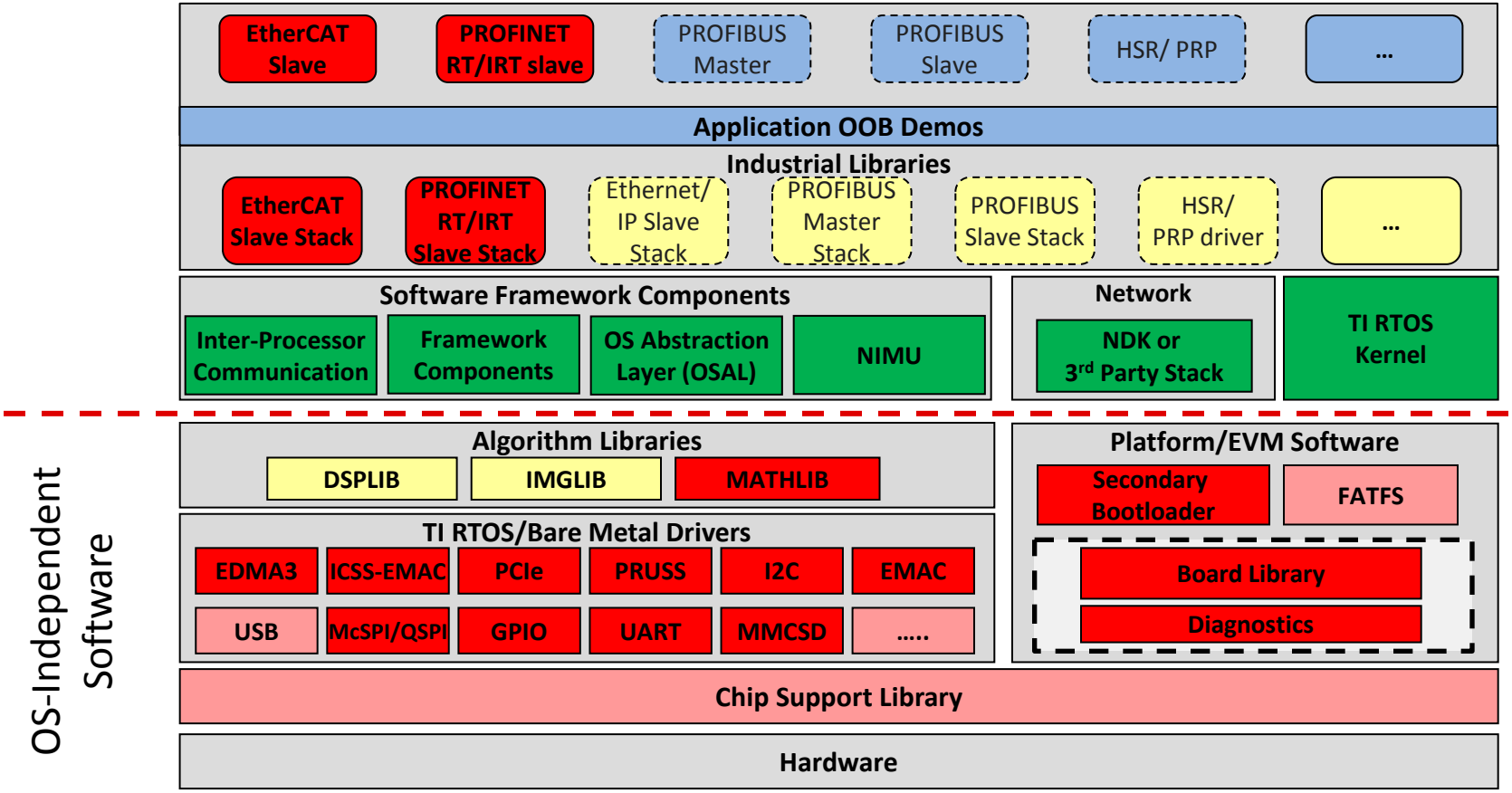
AM57x Industrial Software Stack

Future Offerings



AM57x Industrial Software Stack

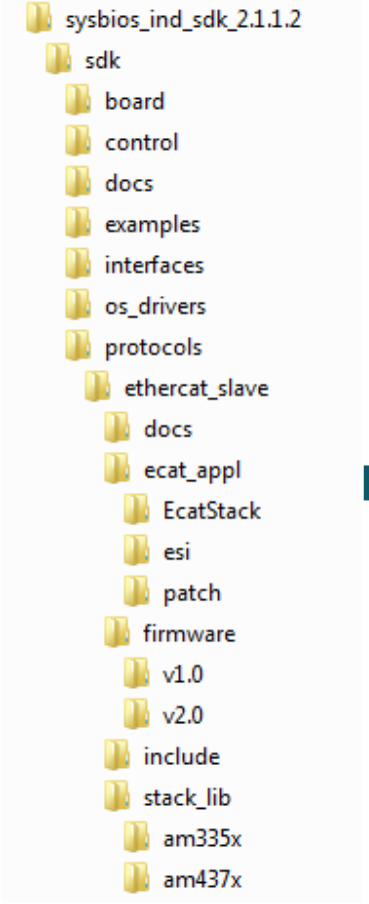
Future Offerings



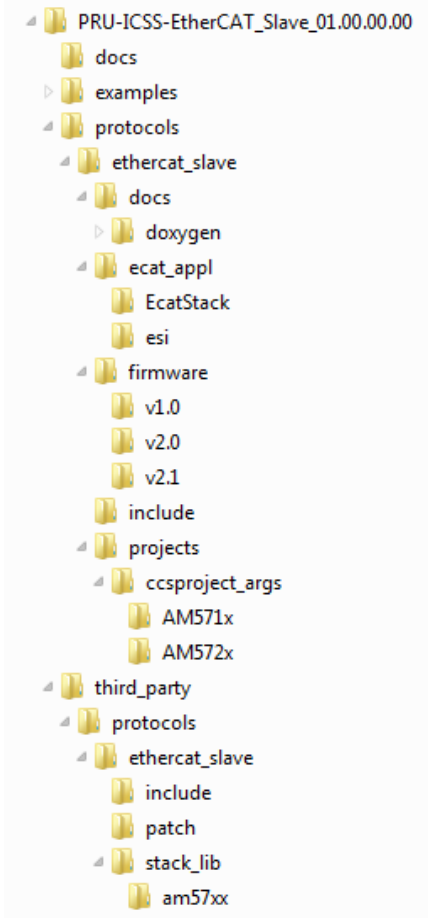
Industrial Protocol Library Example: EtherCAT Slave

- **Board:** Board components included in Processor SDK
- **Documentation:**
  - User Guide, Release Notes, Porting Guide, etc.
  - Future: Protocol data sheets
- **Examples:** Sample application for evaluation
- **Projects:** Scripts to generate CCS projects
- **Protocols:** SDK code, firmware and driver sources
- **Third_party:** Third party driver sources and evaluation libraries

Current Model: Industrial SDK

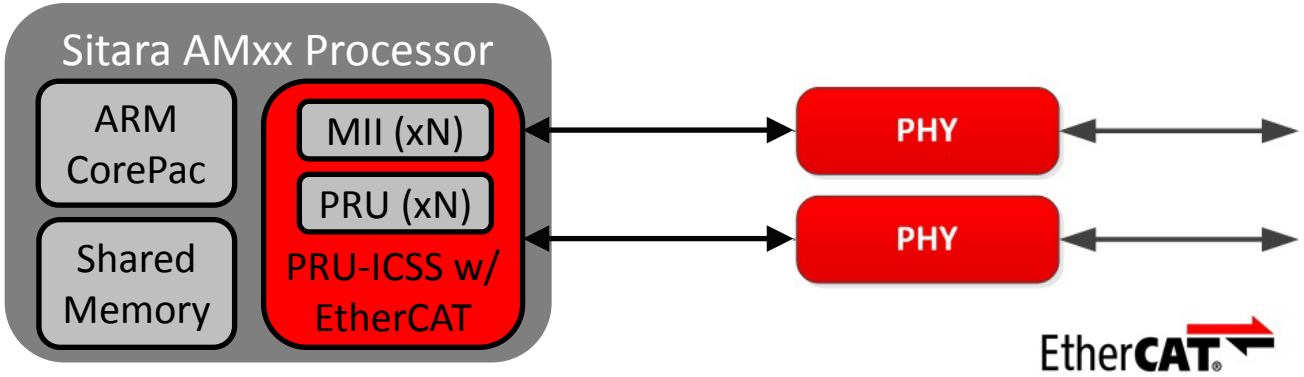


New Model: Industrial Packages



SDK Industrial Communications SW: EtherCAT

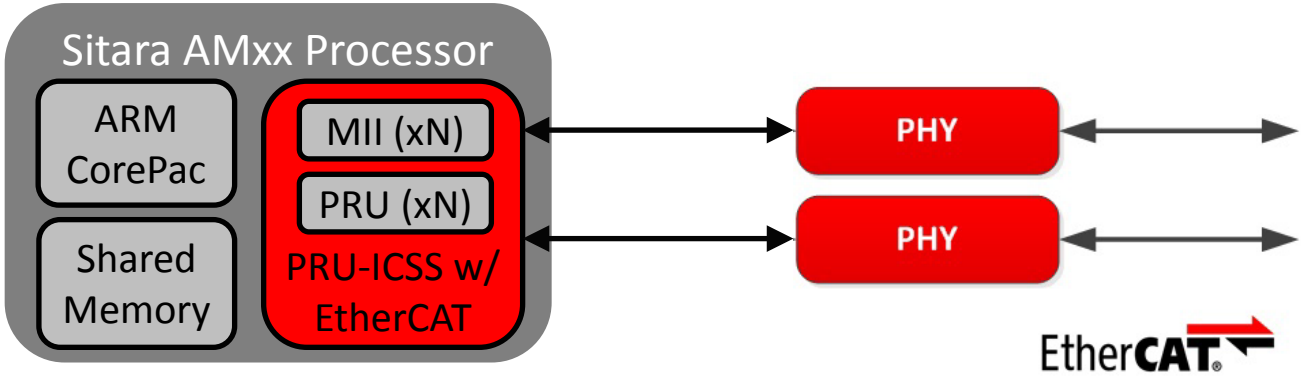
EtherCAT Slave Controller



- Beckhoff Slave Stack Version 5.11
- All EtherCAT commands (NOP, APRD, APWR, APRW, FPRD, FPWR, FPRW, BRD, BWR, BRW, LRD, LWR, LRW, ARMW and FRMW)
- 8 Fieldbus Memory Management Units (FMMU) supported in firmware
- 8 SYNC Manager (SM) supported in firmware (stack supports only 4)
- 8KB process data RAM

SDK Industrial Communications SW: EtherCAT

EtherCAT Slave Controller

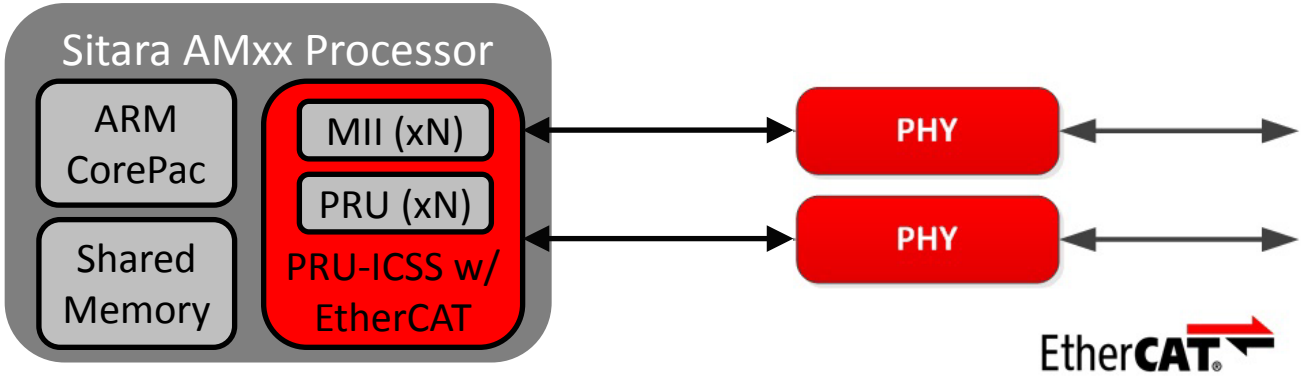


- Distributed clocks:
  - 64-bit DC
  - SYNC0 out generation single-shot and cyclic-mode support
  - SYNC1 out generation; SYNC1 cycle time multiple of SYNC0 cycle time
  - Latch0 and Latch1 inputs
  - System Time Process Data Interface (PDI) control
- DL Loop Control:
  - Using MII_RX_LINK (fast - depending on PHY link loss detection latency)
  - Using PRU-ICSS MDIO state machine

    NOTE: Not recommended for cable redundancy support, enhanced link detection in EtherCAT firmware

SDK Industrial Communications SW: EtherCAT

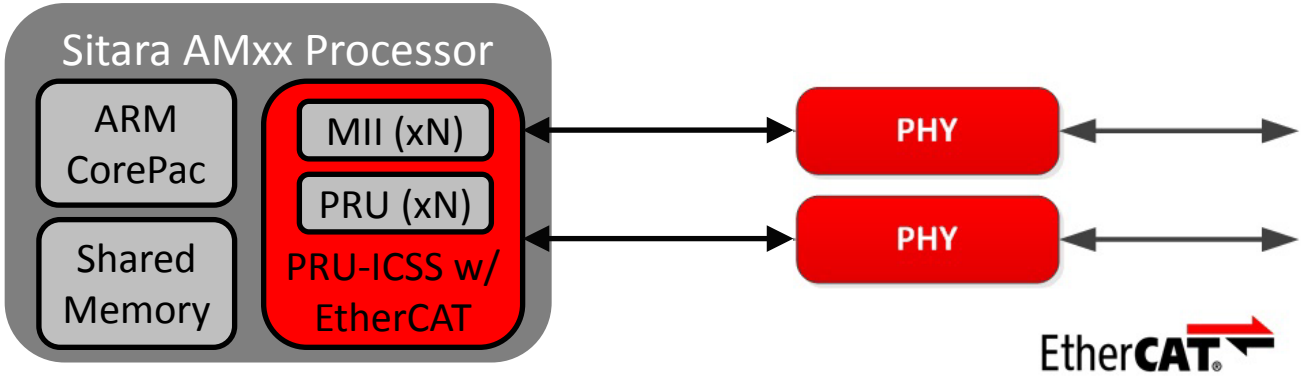
EtherCAT Slave Controller



- Interrupts:
  - AL/ECAT events
  - SYNC0, SYNC1 and PDI interrupt events on external SoC pins
- Watchdog support for both PDI and Synchronization Mode (SM) parameters
- Error Counters:
  - RX Invalid Frame Counter Port 0/1
  - RX ERR Counter Port 0/1
  - Forwarded Error Counter Port 0/1
  - ECAT Processing Unit Error Counter

SDK Industrial Communications SW: EtherCAT

EtherCAT Slave Controller



- LED
  - Run, Error and Port0/1 activity based on firmware feedback
  - Controlled via GPIO from Host CPU or directly from PHY
- EEPROM emulation for QSPI flash non-volatile storage support
- Management interface for PHY over EtherCAT
- PHY address configuration and host side PRU-ICSS MDIO API for PHY programming
- Cable redundancy support

SDK Industrial Communications SW: PROFINET

PROFINET RT/IRT Device

- PROFINET I/O RT/IRT Device(slave) conforms to PROFINET Conformance Classes A, B, and C functionality.
- Integrated with Molex PROFINET stack
- PROFINET I/O RT/IRT Device Features:
  - Supports minimum cycle time of 250 µs
  - Integrated two-port cut-through switch, 100 Mb/s full duplex
  - PROFINET Quality of Service (QoS)
  - Up to 8 Application Relations (ARs)
  - Data Hold Timer
  - Discovery and Basic Configuration Protocol (DCP) Identify Filter
  - PROFINET Precision Time Control Protocol (PTCP)

SDK Industrial Communications SW: PROFINET

PROFINET RT/IRT Device

- Device features:
  - 1 ms buffering per port
  - 8 IOCR with 40 to 1440 Bytes
  - 802.1d Learning Bridge for received source MAC addresses
  - PNIO static routing and custom Filter Data Base (FDB) for multicast addresses
  - Interrupt Pacing
  - Watchdog: When host crashes/stops, then PRUs stop generating PPM frames.
- Compliant with PROFINET IO Tester Version 2.3.5.25.4437
- Compliant with PROFINET IRT SPIRTA Module Version 2.32.2.0002

SDK Software Components

- **SDK Software**
  - Code Composer Studio Integrated Development Environment
  - Processor SDK RTOS for AM57xx
  - Compiler GNU v4.8.4 (Linaro)

- **Required Additions**
  - Serial console terminal application (i.e., Tera Term, Minicom, HyperTerminal)

PRU-ICSS-Industrial-SW Reference Documents

Industrial Protocol Packages Common Documentation		
Common	Software Developer Guide	http://processors.wiki.ti.com/index.php/Industrial_Protocol_Package_Software_Developer_Guide
	Getting Started Guide	http://processors.wiki.ti.com/index.php/Industrial_Protocol_Package_Getting_Started_Guide
Protocol-specific Documentation		
EtherCAT	Release notes	http://processors.wiki.ti.com/index.php/PRU_ICSS_EtherCAT_Release_Notes
	User Guide	http://processors.wiki.ti.com/index.php/PRU_ICSS_EtherCAT
	Protocol data sheet	https://sps05.itg.ti.com/sites/tiisw/bu/armmpu/Documents/Industrial%20FieldBus/Datasheets/EtherCAT_Slave_Datasheet.doc
	API documentation	Part of installer package. Install respective protocol package and access documentation.
Profinet	Release notes	http://processors.wiki.ti.com/index.php/PRU_ICSS_Profinet_Release_Notes
	User Guide	http://processors.wiki.ti.com/index.php/PRU_ICSS_Profinet
	Protocol data sheet	https://sps05.itg.ti.com/sites/tiisw/bu/armmpu/Documents/Industrial%20FieldBus/Datasheets/PROFINET_IRT_Slave_Datasheet.doc
	API documentation	Part of installer package. Install respective protocol package and access documentation.

Industry 4.0 Gateway

Industrial Communication and Control Platform for Industry 4.0

TI = Innovation

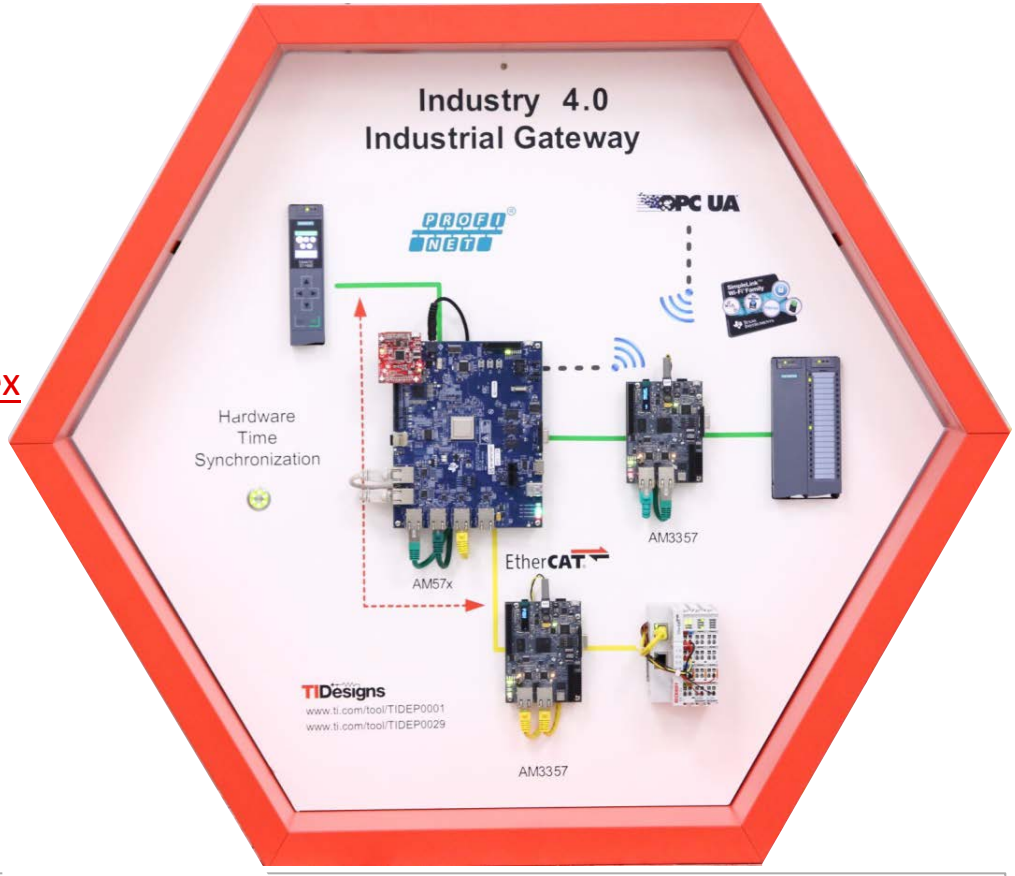
- Integrated Automation platform AM572x
  - Computing performance with options to leverage
    - dual Cortex A15
    - dual Cortex M4
    - dual TMS320C66x floating point DSP
  - Simultaneous access to 6-port Ethernet, including 4-port Industrial Ethernet
  - Industrial and high speed peripherals

- Multi-Protocol industrial communication

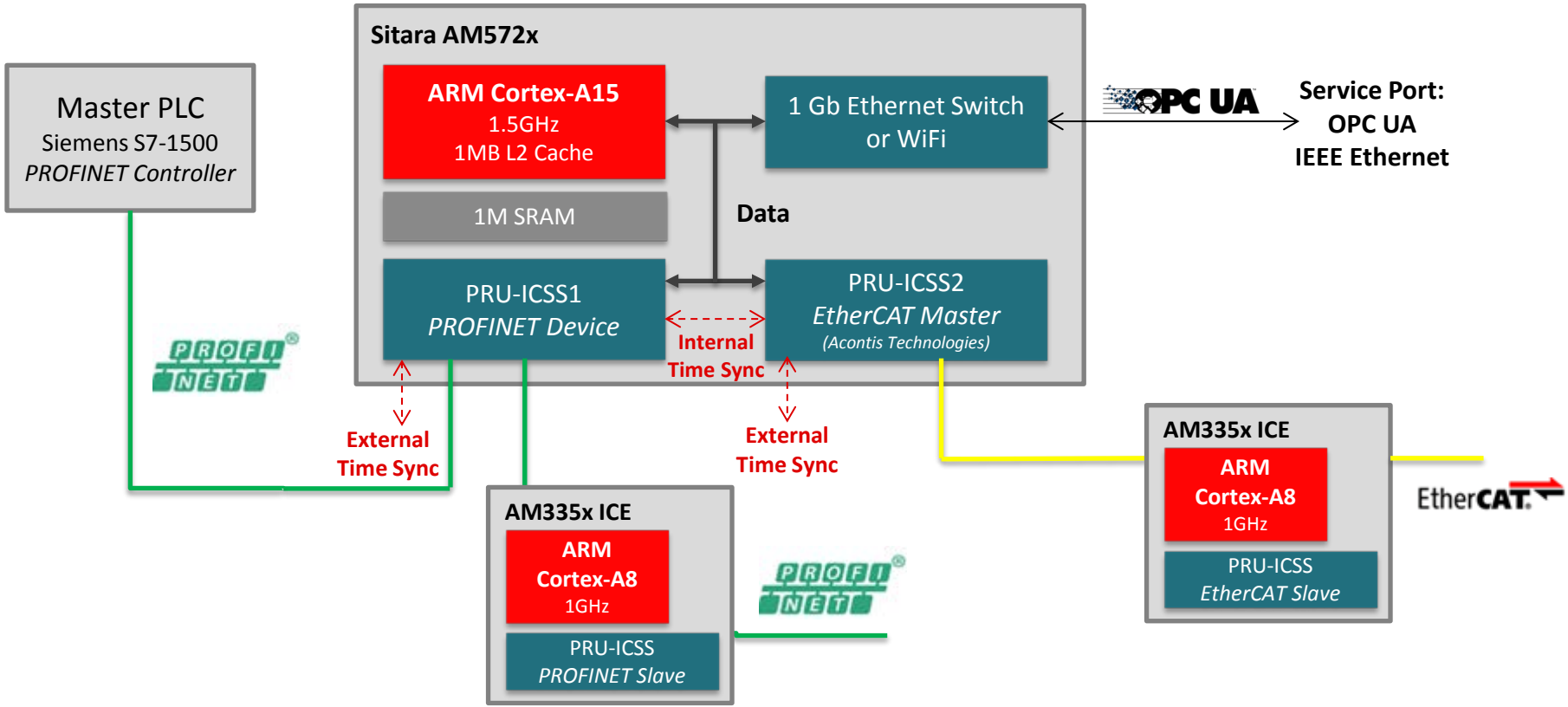
- Real-time synchronization
  - External event generation and synchronization
  - Internal time synchronization between multiple Ethernet ports

Industry 4.0: Industrial Gateway

- Siemens S7-1500 PLC master
- Sitara AM572x IDK with SimpleLink:
  - PROFINET IRT to EtherCAT Gateway:
    - PROFINET IRT device stack by Molex
    - EtherCAT master by Acontis
  - Hardware Time Synchronization
  - OPC UA uplink over Wireless LAN
  - Matrikon OPC UA Server on AM572x



Industry 4.0 Gateway Demonstration



For More Information

- AM57x Sitara™ Processors
- Industrial Communications Overview
- TI Designs:
  - TIDEP0001: EtherCAT Communications Development Platform
  - TIDEP0029: Certified PROFINET IRT V2.3 Device with 1 GHz ARM Application Processor
- For questions regarding topics covered in this training, visit the support forums at the TI E2E Community website: http://e2e.ti.com