

Closed-loop Delfino Control Systems: Multiple Industrial Protocol Support using the AMIC110 Sitara Processor

Part 3: Industrial software and multiprotocol support

Training series overview

AMIC110 Multiprotocol Industrial Interface for Closed-loop Delfino Control Systems:

- Part 1: Product solutions supported by the AMIC110 and Delfino system architecture
- Part 2: Implementation of multiprotocol industrial communications solutions
- **Part 3: Industrial software and multiprotocol support**

Training agenda

- Part 1: Product solutions supported by the AMIC110 and Delfino system architecture:
 - Solution space
 - The capabilities and advantages of this system solution
 - Applications of this systems solution
- Part 2: Implementation of multiprotocol industrial communications solutions:
 - AMIC110 architecture
 - (TIDA-00299) AMIC110 ICE integration with dual-core MS320F2837x Delfino MCUs LaunchPad
- **Part 3: Industrial software and multi-protocol support:**
 - **Software architecture**
 - **Multi-protocol support**
 - **Simple Open Real-Time Ethernet (SORTE)**

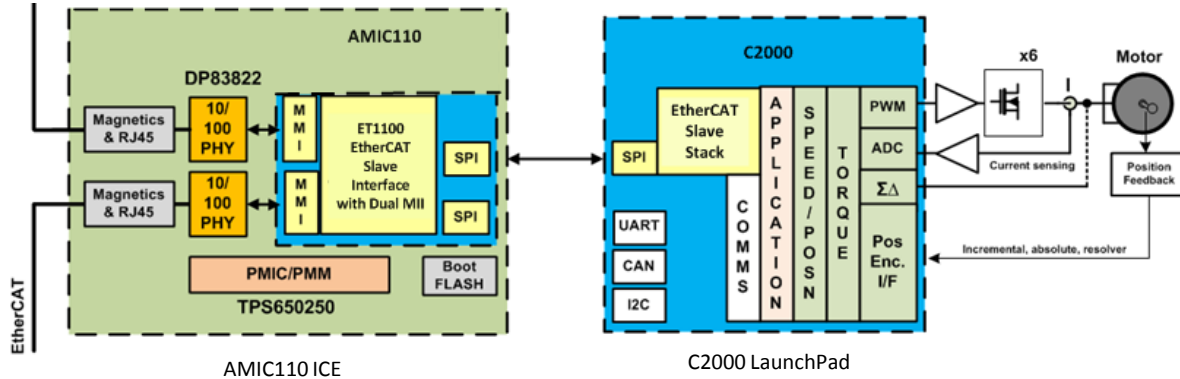
Industrial software and multiprotocol support

Software architecture

AMIC110 software

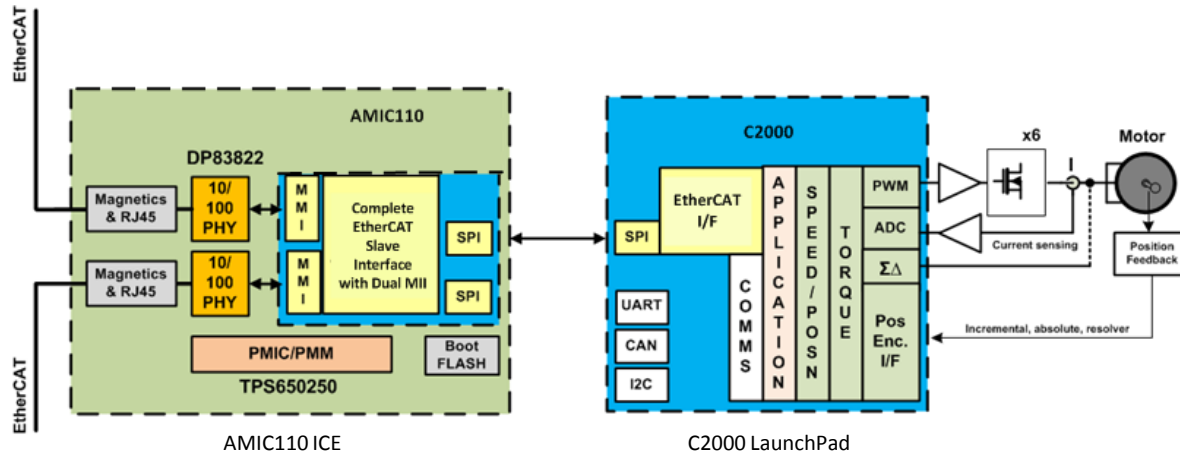
- AMIC110 software will be delivered as PRU-ICSS Industrial packages based upon Processor SDK.
- The AMIC110 Processor SDK is included in the Processor SDK for AM335x Processors <http://www.ti.com/tool/processor-sdk-am335x>
- AMIC110 PRU-ICSS EtherCAT available on mysecuresoftware
- Standard release PRU-ICSS Industrial with AMIC110 support - 2Q 2017
- More AMIC110 details: <http://www.ti.com/tool/tmdxice110>

AMIC110 + C2000-connected industrial drive



- The AMIC110 emulates an ET1100 slave controller.
- The EtherCAT slave stack runs on the C2000 Delfino.

OR



The AMIC110 provides a complete EtherCAT slave interface.

EtherCAT slave architecture

Auto-Forwarder

Receives frames, performs frame checking, affixes time stamps, and forwards it to the loop-back function

Loop-back Function

Forwards Ethernet frames to the next logical port

Fieldbus Memory Management Unit (FMMU)

Supports bitwise mapping of logical addresses to physical addresses of the ESC

EtherCAT Processing Unit

Coordinate access to the internal registers and the memory space of the ESC, from the EtherCAT master and from the local application.

Monitoring Unit

Contains error counters and watchdogs

Distributed Clock (DC)

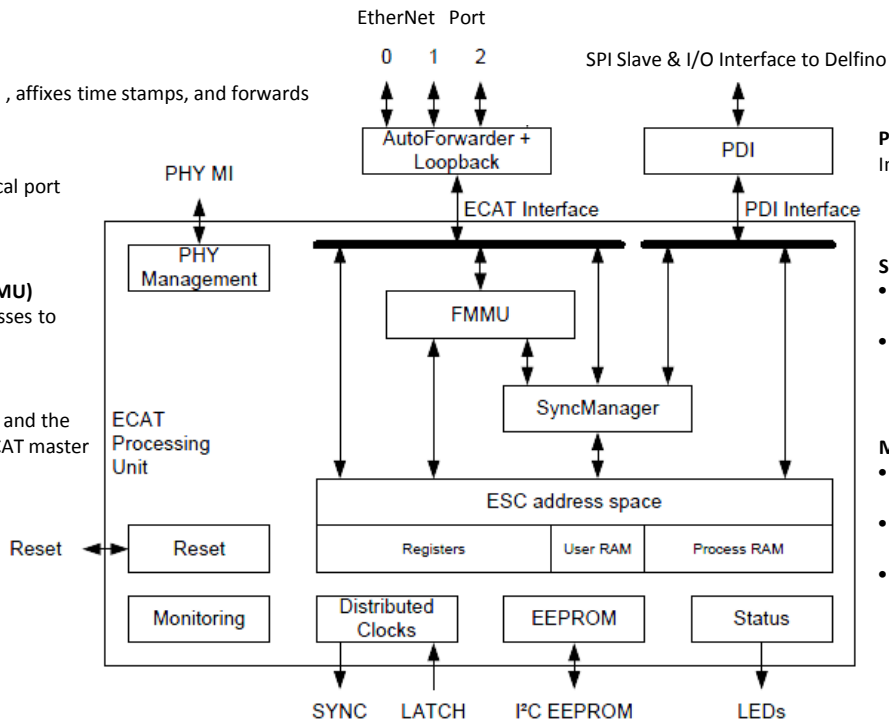
Allow for precisely synchronized generation of output signals, input sampling, and time stamp events.

SII EEPROM

Non-volatile memory for EtherCAT Slave Information (ESI) storage

Status / LEDs

- Provides ESC and application status information
- Controls external RUN LED/ERR LED and port Link/Activity LEDs



Process Data Interface (PDI)

Interface to the application / Stack on the Delfino

SyncManager

- Manages register, data exchange and mailbox communication between EtherCAT master and slaves
- Read or write transactions may generate events for the EtherCAT master and the attached Delfino/Sitara ARM controller respectively

Memory

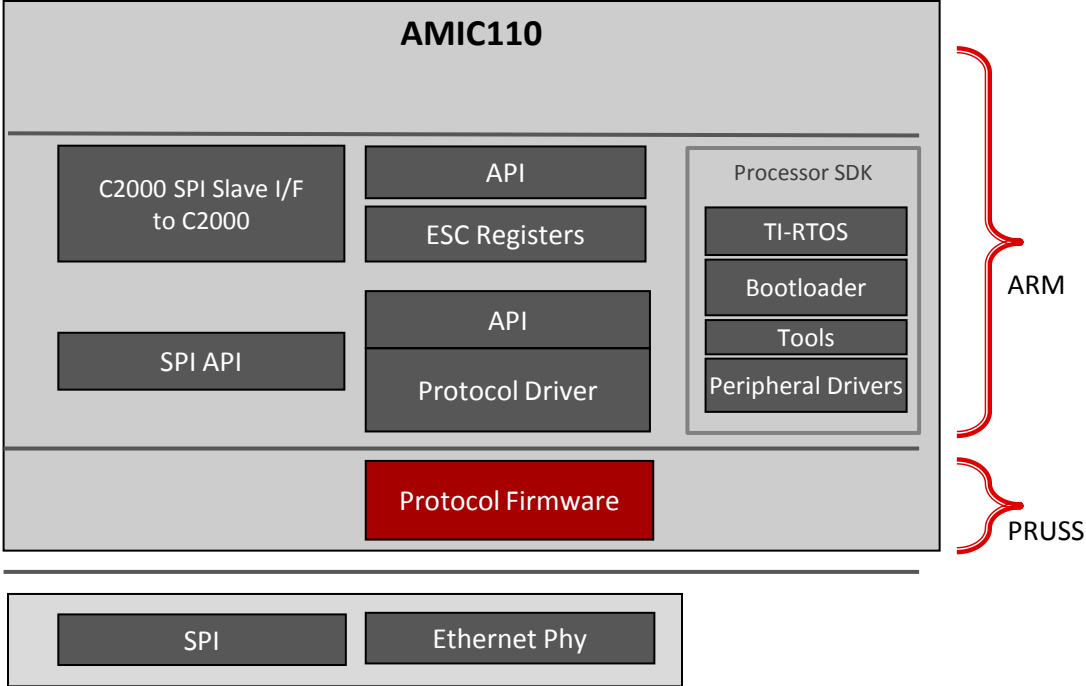
- The first block of 4 Kbyte (0x0000-0x0FFF) is used for registers and user memory.
- The memory space from address 0x1000 onwards is used as the process memory (8 Kbyte).
- The ESC address range is addressable by the EtherCAT master and the attached Delfino/Sitara ARM.

EtherCAT slave features

Feature	AMIC110
Ports	2 MII
FMMUs	8
SyncManagers	8
Process Data RAM (Kbyte)	8
ESC Register (Kbyte)	4
Distributed Clocks	64-bit
Process Data Interface (PDI)	SPI slave

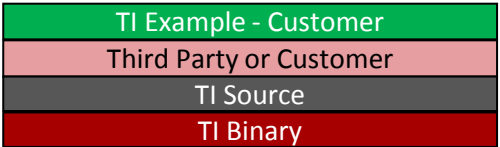
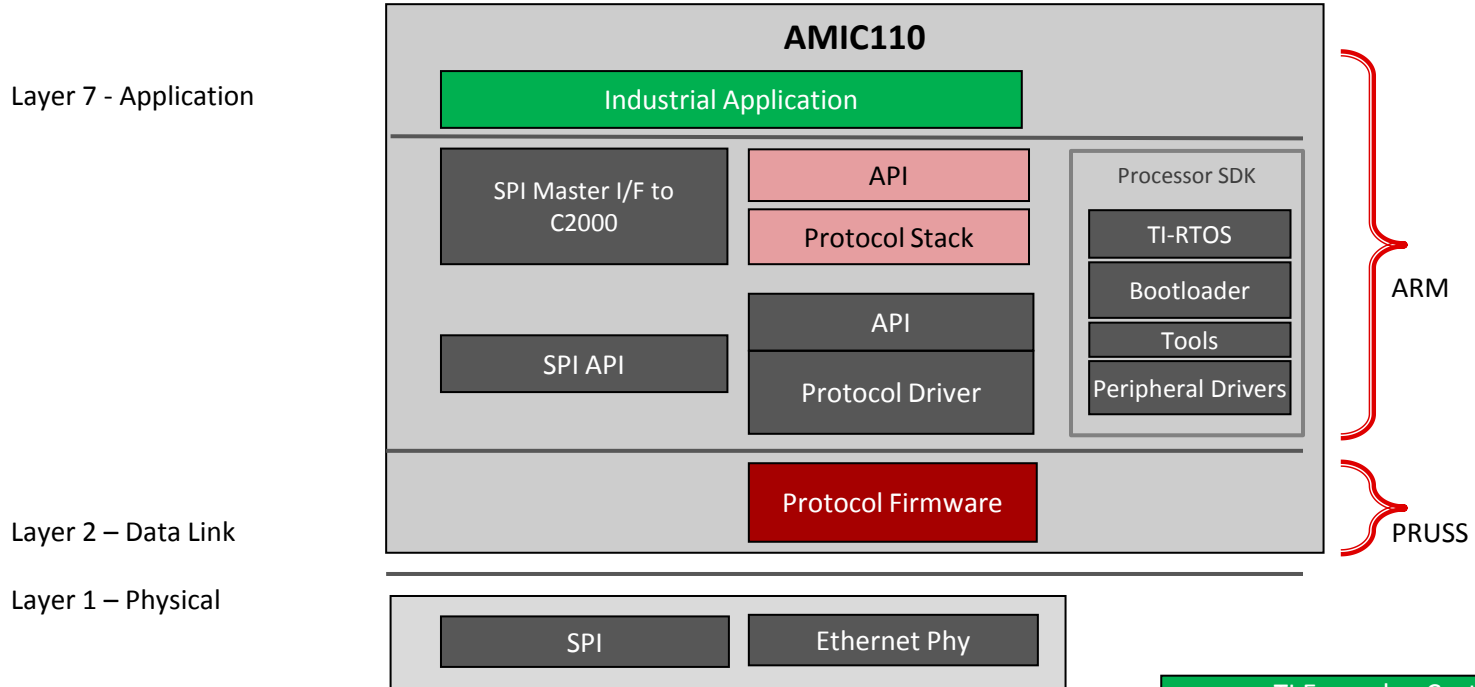
AMIC110 processing model when stack is on Delfino

Layer 7 - Application



TI Source
TI Binary

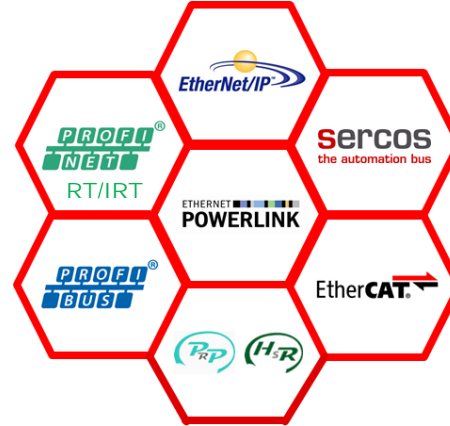
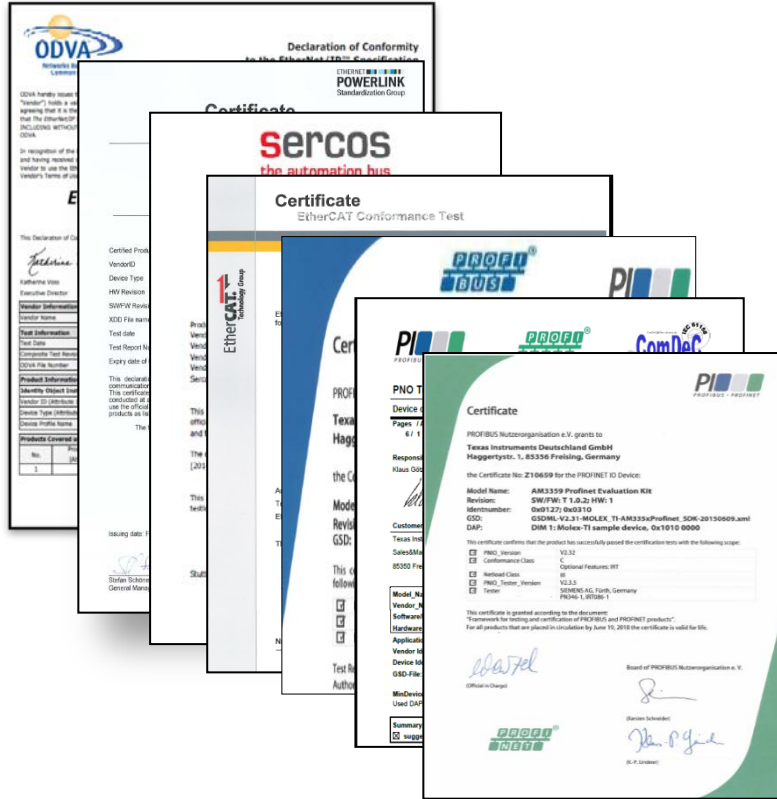
AMIC110 processing model when stack is on AMIC110



Industrial software and multiprotocol support

Multiprotocol support

Certified industrial communication protocols



Faster time to market!

Industrial protocols: 3P engagement model

Protocol	3P	Initial Engagement	Production
PROFIBUS	TMG: info@tmgte.de	Evaluation license included in TI SDK	Production license : 1-time fee of 5000€ plus maintenance
PROFINET	Molex: Bieber, Thierry Thierry.Bieber@molex.com		Available for free with ETG membership which is also free. Support from ETG
EtherCAT	EtherCAT Technology group (http://www.ethercat.org)		
Ethernet/IP	Molex: Bieber, Thierry Thierry.Bieber@molex.com		
SERCOS III	Automata: Christoph Melzer chmelzer@automata.de	Limited evaluation is free; Full license based on Time/IO/Vendor	Contact automata
EtherCAT Master	Acontis: Stefan Zintgraf s.zintgraf@acontis.com	Evaluation images found on TI designs (TIDEP0043, TIDEP0079) & on Acontis landing page	Production license: NRE for stack, plus fee per unit shipped. Contact Acontis for details.
PLC SW	3S: CodeSys PLC Framework KW-Soft: Boris Waldeck bwaldeck@kw-software.com		
IEC61850	Triangle Microworks: Joe Stevens jstevens@trianglemicroworks.com	Evaluation license is free	Contact Triangle Microworks
HSR	Netmodule: Franziska Stettler franziska.stettler@netmodule.com	Evaluation license included in TI SDK	License included. Netmodule open to customization work.
PRP	Netmodule: Franziska Stettler franziska.stettler@netmodule.com		License included. Netmodule open to customization work.
Powerlink	Port: Christian Bornschein cb@port.de		

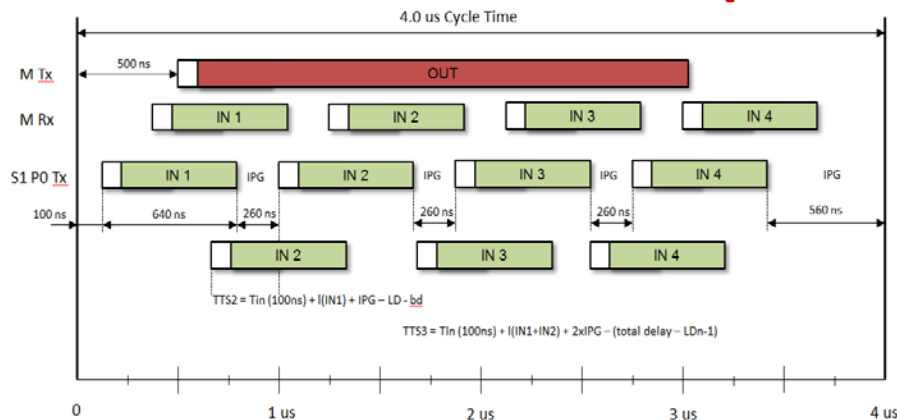
Industrial software and multiprotocol support

Simple Open Real-Time Ethernet (SORTE)

SORTE summary

- Simple Open Real-Time Ethernet (SORTE) is a process data efficient and fast real-time Ethernet protocol leveraging PRU-ICSS and MII_RT.
- Delivered as PRU firmware source code:
 - Enables customer differentiated products
 - Fully customizable PRU Firmware
- Real-time Ethernet programming example for PRU-ICSS and MII_RT (“build your own” protocol)
- Currently available in Processor SDK for AM335x and AM437x

Simple Open Real-Time Ethernet (SORTE) overview



- Fast and efficient real-time Ethernet protocol implementation on PRU-ICSS:
 - Master and device(s) network line topology
 - 4μs cycle time for process data exchange with one master and four devices
 - 100Mbit, full duplex
- Removes external ASIC or FPGA support and integrates industrial Ethernet.
- Training and programming example for real-time Ethernet on PRU-ICSS:
 - Fully customizable PRU firmware
 - PRU firmware provided in source code
 - Reference PRU firmware with user guide, PRU firmware, and ARM driver software

For more information

- AMIC110 Multiprotocol Industrial Interface for Closed-loop Delfino Control Systems Training Series: <http://training.ti.com/industrial-closed-loop-delfino-amic110-series>
- TI Designs:
 - EtherCAT Slave BoosterPack Plug-in Module with SPI Interface: <http://www.ti.com/tool/TIDA-00299>
 - Simple Open Real-time Ethernet (SORTE) Device with PRU-ICSS Reference Design: <http://www.ti.com/tool/TIDEP-0086>
- AMIC110 Industrial Communications Engine (ICE): <http://www.ti.com/tool/tmdxice110>
- Sitara Industrial FAQ: http://processors.wiki.ti.com/index.php/FAQ_Sitara_Industrial
- For questions about this training, refer to the TI E2E Community Sitara Processor Forum: https://e2e.ti.com/support/arm/sitara_arm/f/791



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