TI Technology Days 2010

Stellaris® Cortex-M3

MCUs für umfangreiche HMI- und Connectivity-Aufgaben

Andreas Görgner, Texas Instruments

TI Embedded Processing Portfolio

Microcontrollers | ARM-Based | DSP

16-bit	32-bit Real-time	32-bit ARM	ARM+	ARM + DSP	DSP
MSP430	**C2000™**	**Stellaris Cortex™-M3**	**ARM9 Cortex A-8**	**C64x+ plus ARM9/Cortex A-8**	**C647x, C64x+, C55x**
Ultra-Low Power	Fixed & Floating Point	Industry Standard, Low Power	Industry-Std Core, High-Perf GPP	Industry-Std Core + DSP for Signal Proc.	Leadership DSP Performance
Up to 25 MHz	Up to 300 MHz	Up to 100 MHz	Accelerators	4800 MMACs/ 1.07 DMIPS/MHz	24,000 MMACS
Flash 1 KB to 256 KB	Flash 32 KB to 512 KB	Flash 8 KB to 512 KB	MMU	MMU, Cache	Up to 3 MB L2 Cache
Analog I/O, ADC LCD, USB, RF	PWM, ADC, CAN, SPI, I^2C	USB, ENET, EPI ADC, PWM, SPI	USB, LCD, MMC, EMAC	VPSS, USB, EMAC, MMC	1G EMAC, SRIO, DDR2, PCI-66
Measurement, Sensing, General Purpose	Motor Control, Digital Power, Lighting, Sensing	Energy, Security, Connectivity	Linux/WinCE User Apps	Linux/Win + Video, Imaging, Multimedia	Comm, WiMAX, Industrial/ Medical Imaging
$0.35 to $9.00	$1.50 to $20.00	$1.00 to $8.00	$8.00 to $35.00	$12.00 to $65.00	$4.00 to $99.00+
					

Stellaris® Value Proposition

High performance Features

20-100 MHz ARM-M3 CPU

- Optimized for single-cycle flash usage
- Integrated 32-ch DMA for ease of use & high data rate without CPU overhead
- Thumb-2 ISA with high code density
- Flexible clock system sources up to 8 timers
- Single-cycle multiply and hardware divide
- Three power modes and battery-backed hibernation with non-volatile memory

Connectivity

- Ethernet MAC & PHY with 1588 PTP support
- USB Host, Device, or On-The-Go
- CAN 2.0 A/B with 32 mailboxes
- External Peripheral Interface supporting SRAM, SDRAM, M2M, FPGA, CPLD
- Integrated UART, I2C, SSI module
- Integrated I2S master or slave

Broad Portfolio

- ***Largest ARM MCU portfolio in the world with 167devices***
- 8KB to 256KB Flash and up to 96KB RAM
- Up to 8 advanced PWM modules
- RTC, and integrated LDO
- Analog comparators and temp sensor
- 28 to 108 pin from SOIC to BGA
- 10-bit, 8ch ADCs from 250ksps-1MSPS

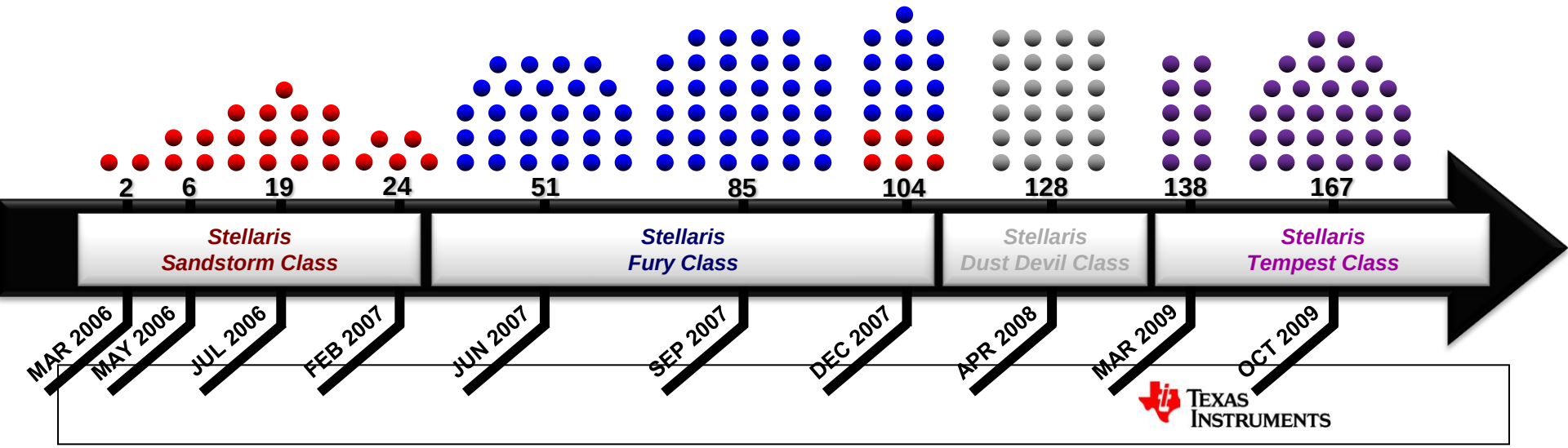
Speed to Market

- StellarisWare on ROM includes driver and peripheral libraries to ease development
- C friendly IDE and compilers from industry leaders
- Low cost development tools
- Application specific and advanced development kits
- Production-ready application modules

Stellaris®: First in ARM Cortex-M3 Microcontrollers

- **TI AEC Austin: Stellaris MCU Design, Systems, Software, Product, and Applications Engineering**
  - In May of 2009, TI acquired (intact) Luminary Micro, Inc.
  - Luminary Micro was ARM's lead partner for Cortex-M3 architecture
  - TI now offers four generations of Stellaris ARM Cortex-M3 MCUs – today!

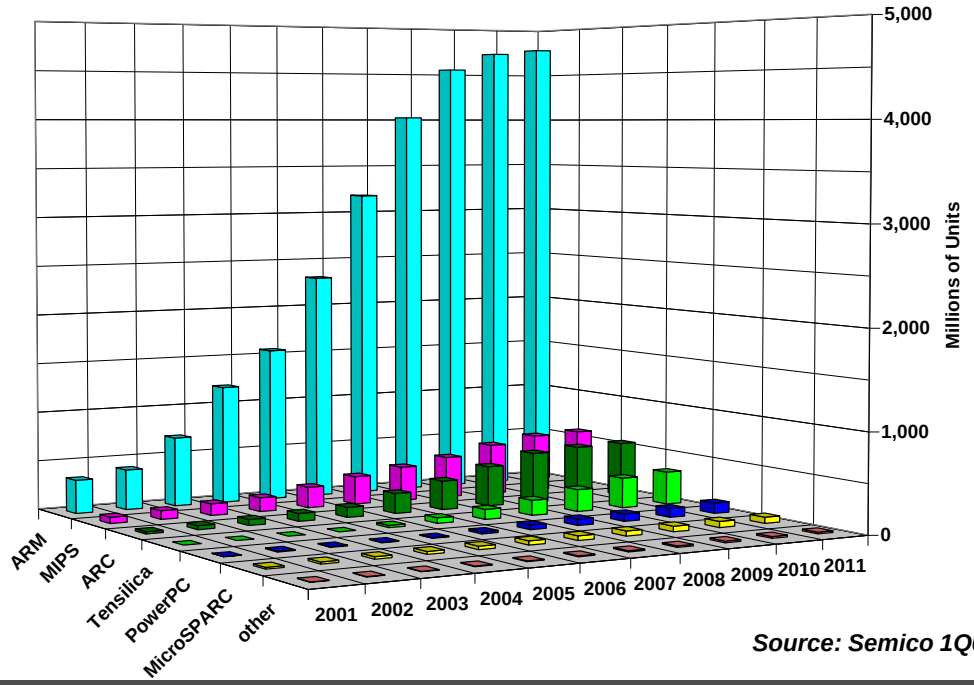
- **Stellaris® family has over 160 microcontrollers!**
  - Broad line card of mixed-signal microcontrollers focused on applications in energy, security, and connectivity markets
  - Unique IP for motion control applications, real time connectivity (Ethernet, Controller Area Network, and USB), intelligent analog functionality, and power conservation
  - Experience fastest time-to-market for the most cost effective, standardized, market-leading solutions through extensive Stellaris hardware tools, StellarisWare® software, documentation, technical support, and ARM's vast 3rd party ecosystem



ARM -- The Embedded Industry's Standard Architecture

- **Chart reports and forecasts 'unit' growth**
- **Demonstrates ARM overall growth in consumer, industrial, automotive, and networking.**
- **ARM is the market share leader for licensable Core IP**
- **Why?**
  - Result of ARM's R&D spend of nearly 500% more than the closest licensable competitor over the past 4 years.
  - ARM's extensive ecosystem and developer community

Worldwide Unit Production and Forecast



Source: Semico 1Q07

The ARM Ecosystem—the companies that provide:

- **Development tools**
- **Training and support**
- **Design tools**
- **Operating systems**
- **Systems support**
- **Silicon**

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ARM® Cortex™-M3 Features

- **Cortex-M3 is the Microcontroller Version**
  - Optimized for single-cycle flash usage
  - Deterministic, fast interrupt processing: as low as six cycles, no more than twelve
  - Single-cycle multiply instruction and hardware divide
  - Native Thumb2 mixed 16-/32-bit instruction set—no mode switching
  - Three sleep modes with clock gating for low power
  - Superior debug features including data breakpoints and flash patching
  - Atomic operations — read/modify/write in single instruction
  - 1.25 DMIPS/MHz — better than ARM7 and ARM9

Cortex
Intelligent Processors by ARM

Stellaris® Family Technology

ARM® Cortex™-M3 v7-M Processor Core
- Up to 100 MHz
- Up to 125 MIPS (at 100 MHz)

On-chip Memory
- 256 KB Flash; 96 KB SRAM
- ROM loaded with Stellaris DriverLib, BootLoader, AES tables, and CRC

External Peripheral Interface (EPI)
- 32-bit dedicated parallel bus for external peripherals
- Supports SDRAM, SRAM/Flash, M2M

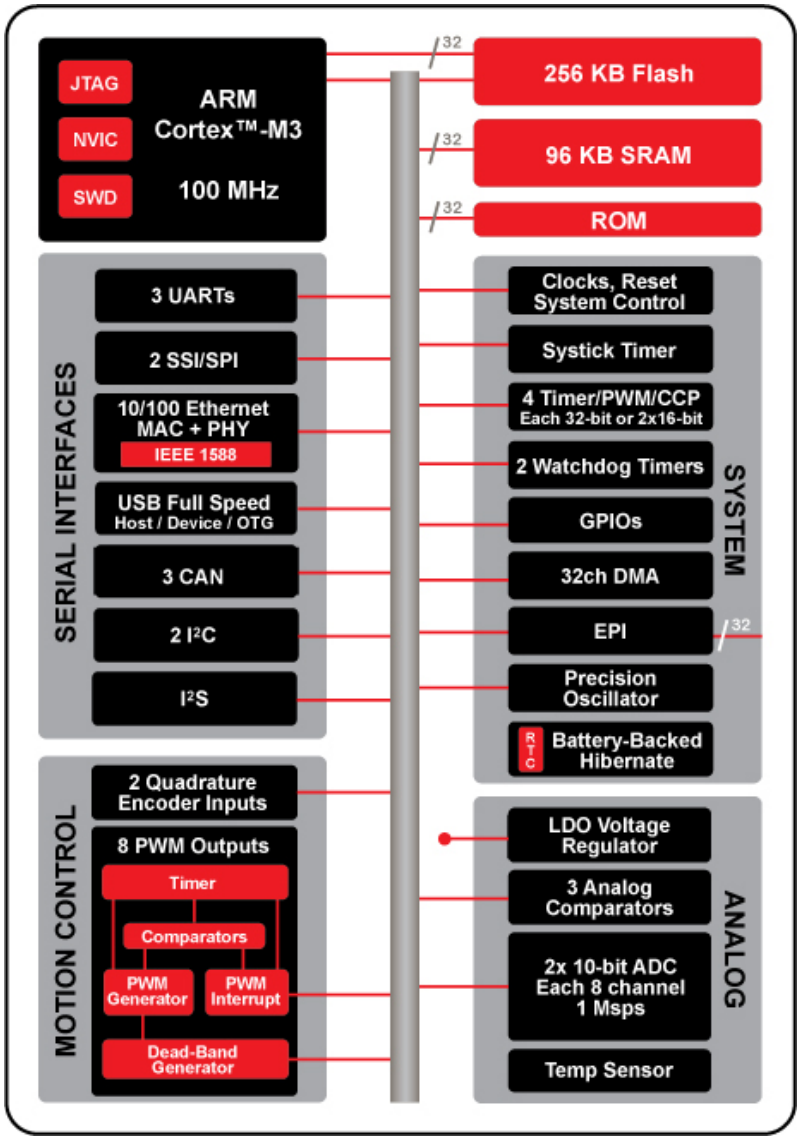
Advanced Serial Integration
- 10/100 Ethernet MAC and PHY
- 3 CAN 2.0 A/B Controllers
- USB (full speed) OTG / Host / Device
- 3 UARTs with IrDA and ISO 7816 support*
- 2 I^2Cs
- 2 Synchronous Serial Interfaces (SSI)
- Integrated Interchip Sound (I^2S)

System Integration
- 32-channel DMA Controller
- Internal Precision 16MHz Oscillator
- Two watchdog timers with separate clock domains
- ARM Cortex Systick Timer
- 4 32-bit timers (up to 8 16-bit) with RTC capability
- Lower-power battery-backed hibernation module
- Flexible pin-muxing capability

Advanced Motion Control
- 8 advanced PWM outputs for motion and energy applications
- 2 Quadrature Encoder Inputs (QEI)

Analog
- 2x 8-ch 10-bit ADC (for a total of 16 channels)
- 3 analog comparators
- On-chip voltage regulator (1.2V internal operation)

*** One UART features full modem controls**



RoHS COMPLIANT

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Stellaris® Product Lines

- LM3S1nnn non-CAN, non-Ethernet

- LM3S2nnn CAN
- LM3S3nnn USB
- LM3S5nnn CAN + USB

- LM3S6nnn Ethernet
- LM3S8nnn Ethernet + CAN
- LM3S9nnn Ethernet + CAN + USB

Stellaris® Roadmap

Sandstorm
- 64K flash
- 8K SRAM
- Motion control
- 1MSPS ADC

Fury class
- 256K flash
- 64K SRAM
- Motion control
- ETH MAC+PHY
- CAN 2.0
- Ethernet+CAN

DustDevil class
- 128K flash
- 64K SRAM
- Motion control enhancements
- USB 2.0 O/H/D
- 32ch DMA

Tempest class
- Higher performance
- Low power
- ETH+CAN+USB OTG
- External bus capability
- I2S
- Precision OSC

512K Firestorm
- Advanced analog
- 512KB Flash
- Larger pin count
- Expanded serial connectivity

1024K Firestorm
- Advanced analog
- KB Flash
- r pin count
- nded serial
- ctivity

Blizzard class
- Small form factor
- Low pin count
- Expanded serial connectivity

Whiteout class
- Small form factor
- Low pin count

2006 2007 2008 2009 2010 2011

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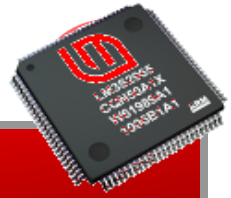
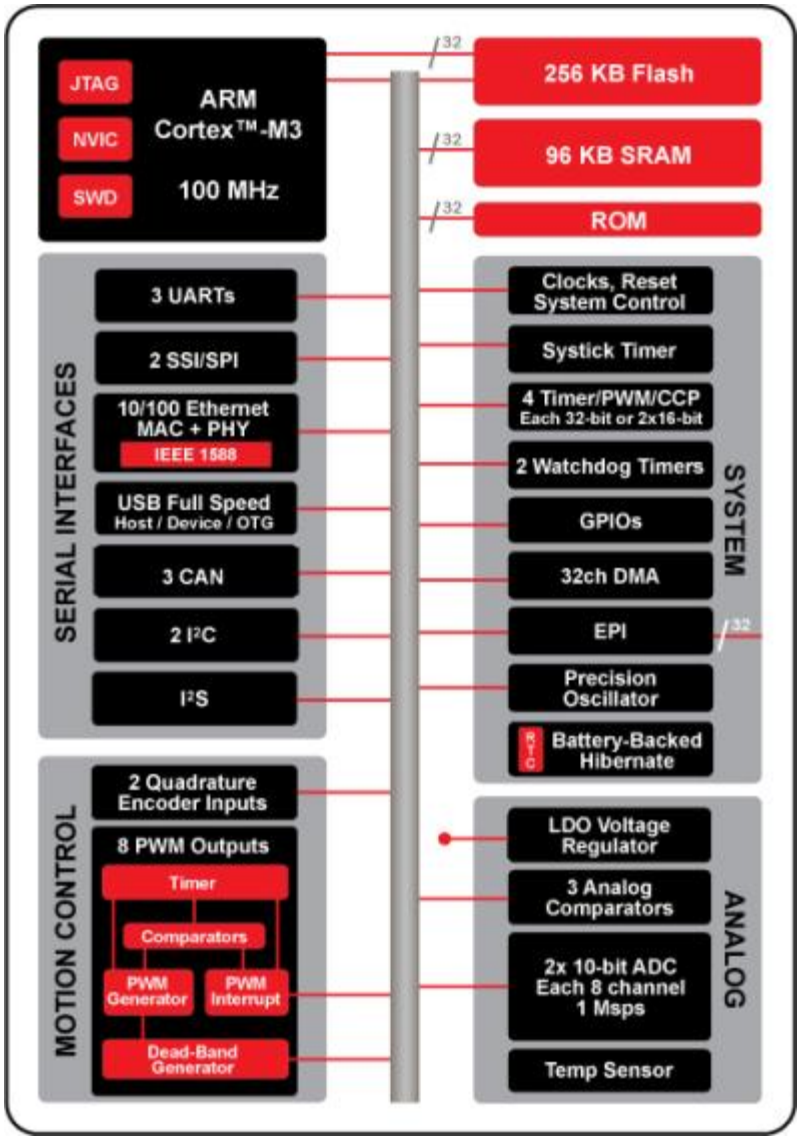
Stellaris® Performance Features

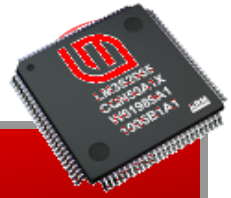


Stellaris® Performance Features

- ARM® Cortex™-M3 Processor Core
  - Up to 100 MHz
- On-chip Memory
  - 256 KB Flash, 96 KB SRAM
  - **ROM loaded with Stellaris DriverLib**, BootLoader, AES tables, and CRC
- External Peripheral Interface (EPI)
  - 32-bit dedicated parallel bus for external peripherals
  - Supports SDRAM, SRAM/Flash, M2M
- Advanced Serial Integration
  - 10/100 **Ethernet MAC and PHY**
  - 3 CAN 2.0 A/B Controllers
  - USB (full speed) OTG / Host / Device
  - 3 UARTs with IrDA and ISO 7816 support*
  - 2 I2Cs
  - 2 Synchronous Serial Interfaces (SSI)
  - Integrated Interchip Sound (I2S)
- System Integration
  - 32-channel DMA Controller
  - Internal Precision 16MHz Oscillator
  - Two watchdog timers with separate clock domains
  - ARM Cortex Systick Timer
  - 4 **32-bit timers** (up to 8 16-bit) with RTC capability
  - Lower-power battery-backed hibernation module
- Flexible pin-muxing capability
- Advanced Motion Control
  - 8 advanced PWM outputs for motion and energy applications
  - **2 Quadrature Encoder** Inputs (QEI)
- Analog
  - 2x 8-ch 10-bit ADC (for a total of 16 channels)
  - 3 **analog comparators**
  - **On-chip voltage regulator** (1.2V internal operation)



Stellaris® Ethernet



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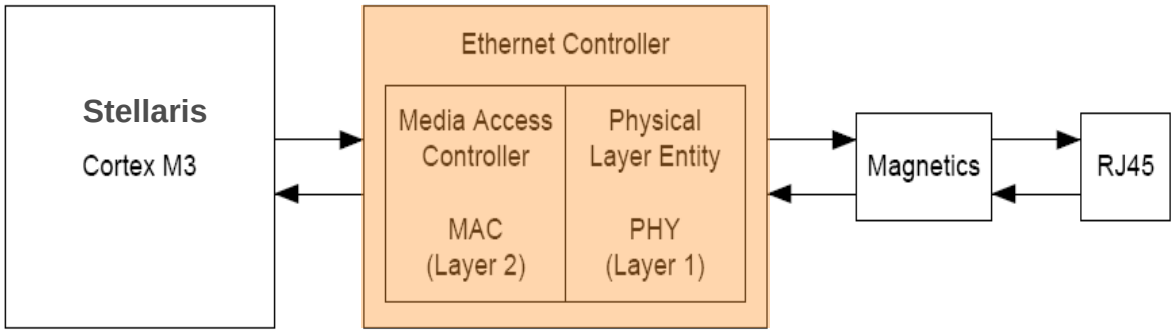
What is Ethernet?

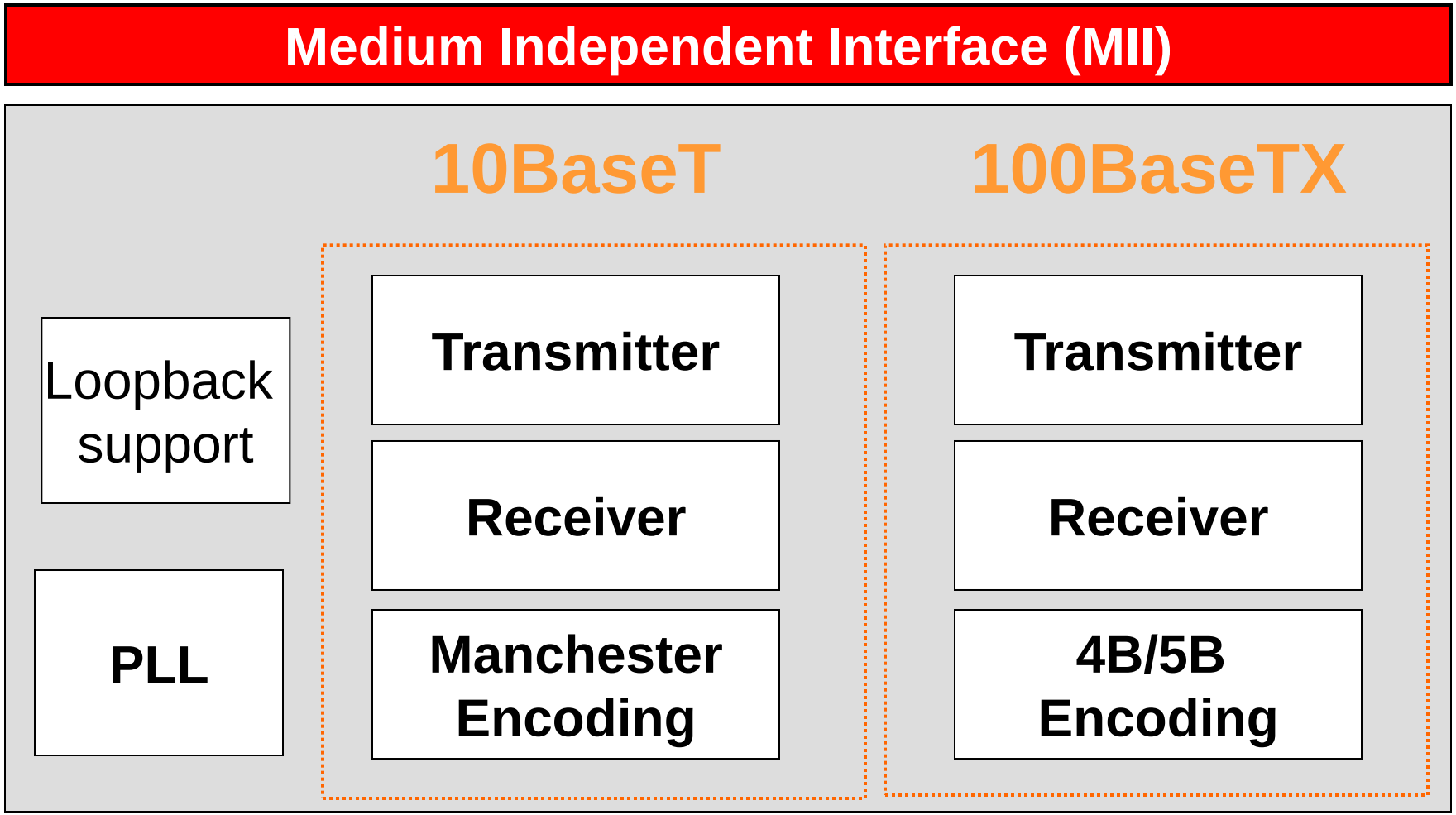
- Family of local-area network (LAN) products covered by the IEEE 802.3
- Several data rates are currently defined for operation over optical fiber and twisted-pair cables: 10Base-T Ethernet (1 Mbps/10 Mbps), Fast Ethernet (100 Mbps), …
- Ethernet & network layers

Application layer	**DHCP, DNS, FTP, HTTP, …**
Transport layer	**TCP, …**
Network/Internet layer	**IP (IPv4, IPv6), …**
Data link layer	**Ethernet, 802.11 (WLAN), …**
Physical layer	**Ethernet physical layer, Optic fiber, …**

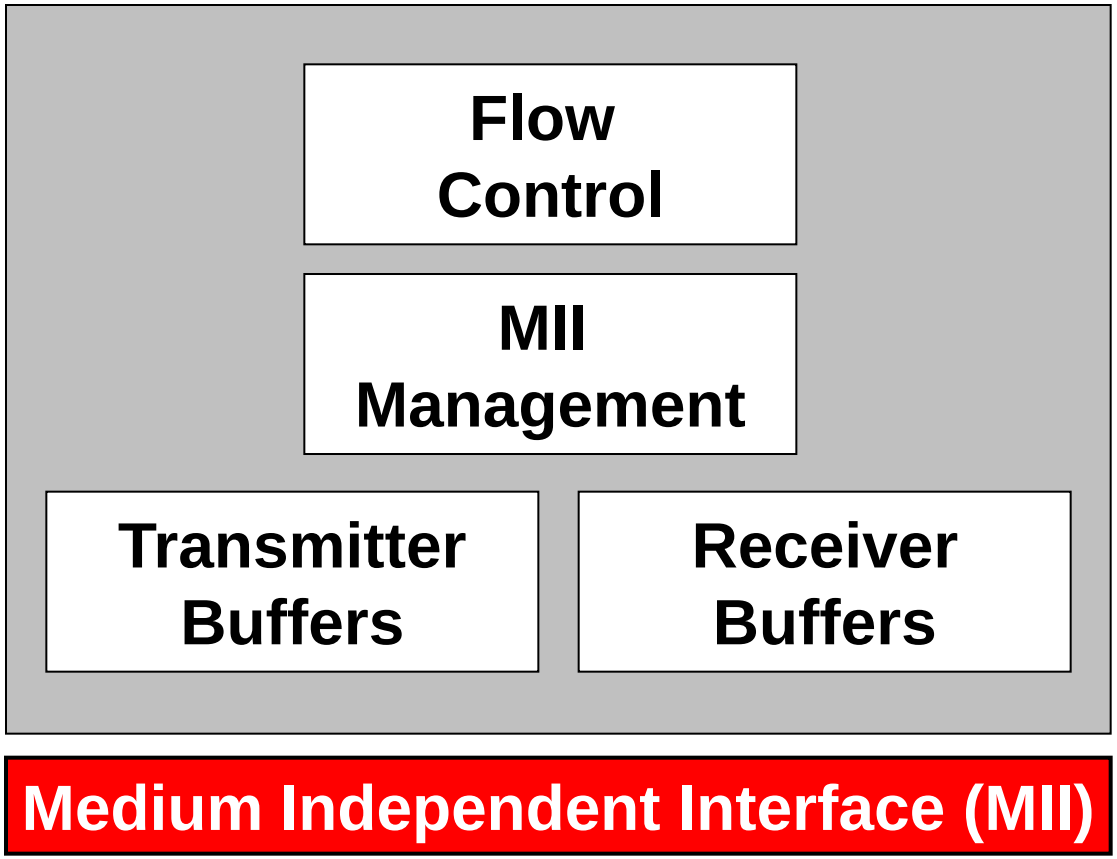
- Ethernet system on Stellaris



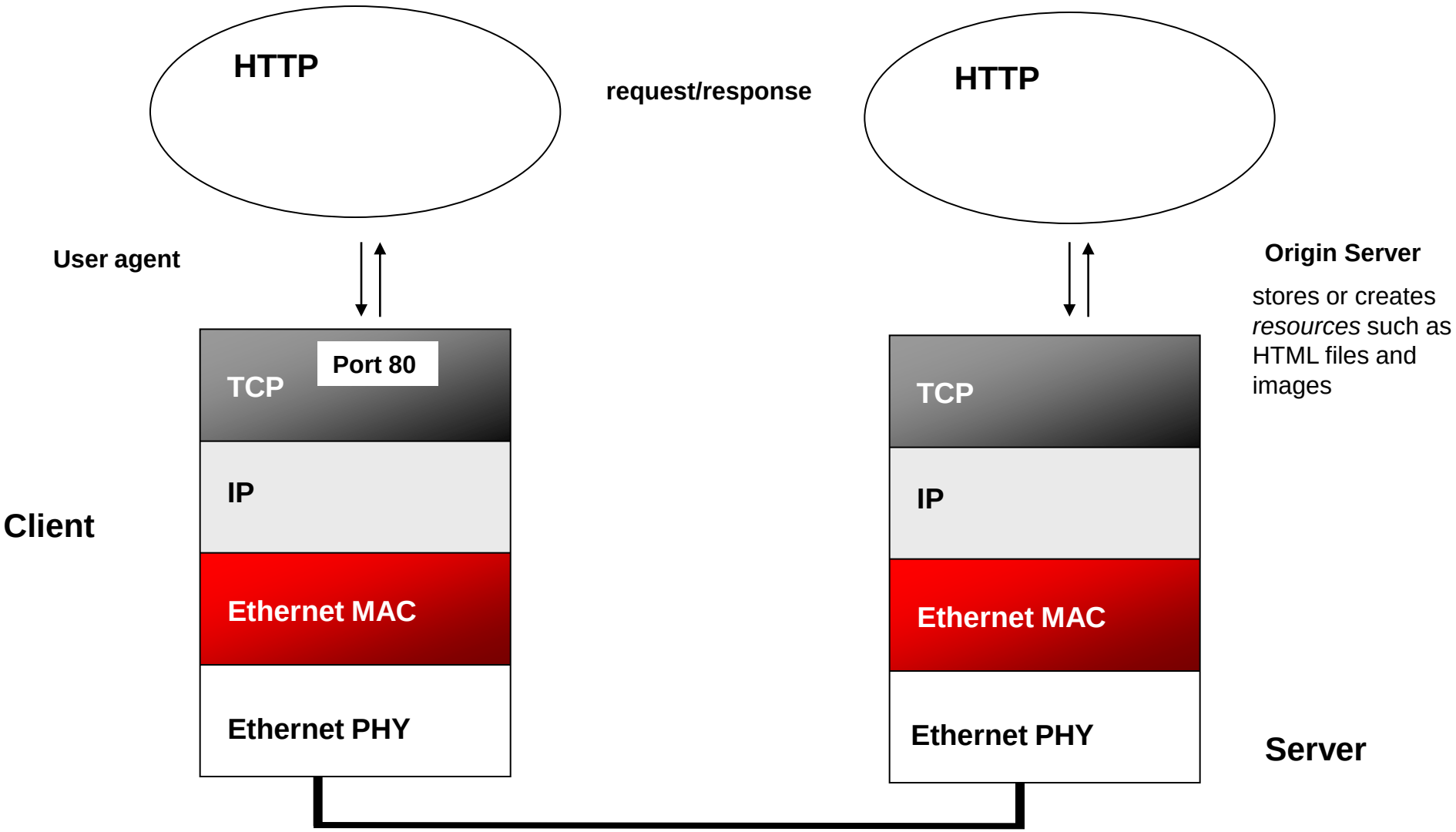
Ethernet PHY



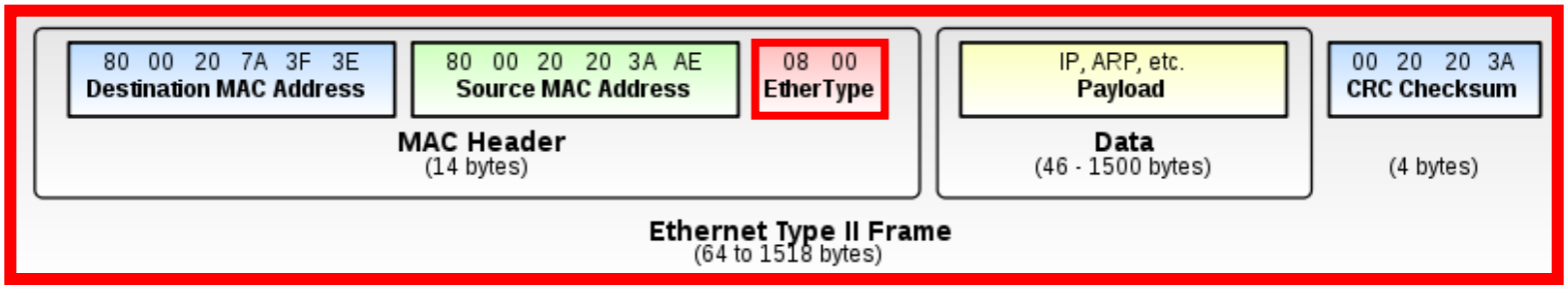
Media Access Control (MAC)

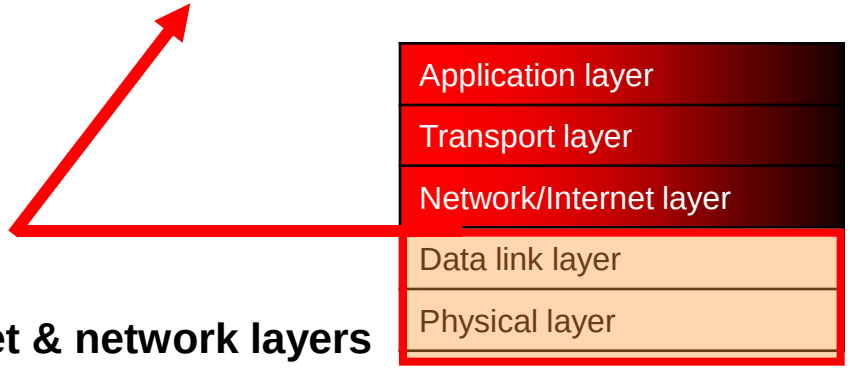


Hypertext Transfer Protocol Example



Stellaris® Ethernet MAC + PHY





DHCP, DNS, FTP, HTTP, …

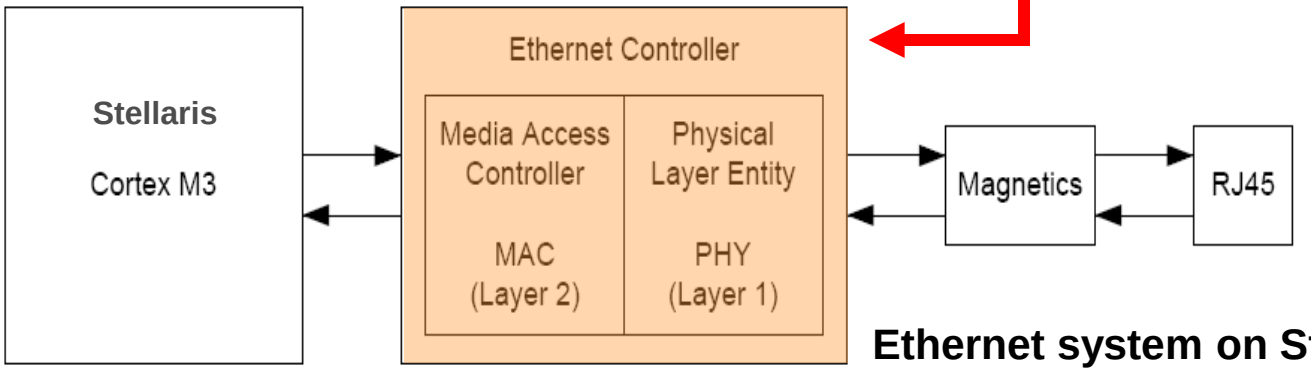
TCP, …

IP (IPv4, IPv6), …

Ethernet, 802.11 (WLAN), …

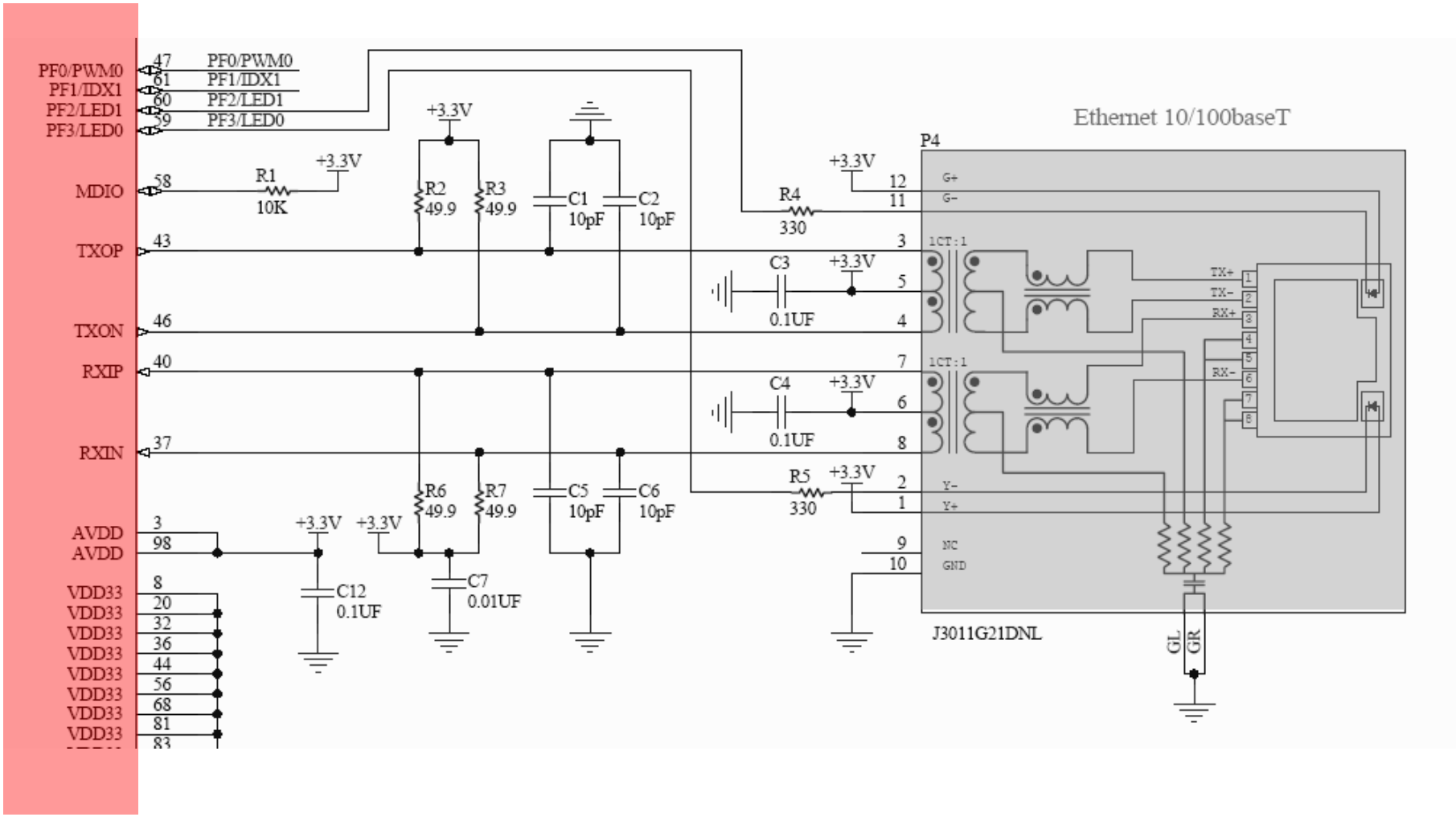
Ethernet physical layer, …

Ethernet & network layers



Ethernet system on Stellaris

Stellaris® Ethernet Hardware design



Communications Stacks for Stellaris®

µC/TCP-IP Protocol Stack	Micriμm µC/TCP-IP
expresslogic	Express Logic NetX™ TCP/IP protocol stack
CMX SYSTEMS	CMX-MicroNet™ protocol stacks
interniche technologies, inc.	InterNiche TCP/IP NicheStack™, NicheLITE™, and add-on modules such as HTTP, SNMP, and security protocols
REAL TIME AUTOMATION INC.	EtherNet/IP™ protocol stacks
freeRTOS	FreeRTOS.org Open-Source µIP Embedded web server
µIP	**Open source** TCP/IP stack for small footprint embedded systems
lwIP	**Open source** light-weight implementation of the TCP/IP stack for small RAM embedded systems
IXXAT	IEEE 1588 PTP (Precision Time Protocol)
SEVENSTAX EMBEDDED TECHNOLOGIES	SEVENSTAX TCP/IP Protocol Stack

Communications Stacks for Stellaris®

TPV	Product	Stack	ARP	AutoIP	BOOTP	BSD	DHCP	DNS	FTP	HTTP	ICMP	IGMP	IKE	IP	IPSec	NAT	POP3	PPP	PTP	RARP	RIP	RTP	SLIP	SMTP	SNMP	SNTP	SSL	TCP	Telnet	TFTP	UDP	802.11
CMX Systems	CMX-MicroNET	TCP/IP	●		●						●	●		●				●					●					●			●	
CMX Systems	CMX Add Ons	Networking SW Options					●	●	●	●							●	●						●	●	●				●		●
ExpressLogic	NetX	TCP/IP	●								●	●		●						●								●			●	
ExpressLogic	NetX Add Ons	Networking SW Options		●		●	●	●	●	●						●	●	●						●	●	●			●	●		
Interniche	NicheLITE	TCP/IP	●		●		●	●			●			●														●		●	●	
Interniche	NicheStack	TCP/IP	●		●	●	●	●	●		●	●		●														●	●	●	●	
Interniche	Interniche Add Ons	Networking SW Options					●	●	●	●			●		●	●	●	●			●	●		●	●	●	●		●			
Micrium	µC/UDP-IP	UDP/IP	●			●					●			●																	●	
Micrium	µC/TCP-IP	TCP/IP	●			●					●			●														●			●	
Micrium	Micrium Add Ons	Networking SW Options					●	●	●	●							●							●		●			●	●		
SEVENSTAX	SEVENSTAX TCP/IP	TCP/IP									●															●		●			●	
SEVENSTAX	SEVENSTAX Add Ons	Networking SW Options	●		●		●	●		●				●			●	●						●								
SEGGER	embOS/IP	TCP/IP	●		●		●	●	●	●	●	●		●			●			●				●			●	●	●		●	
uIP	open source	TCP/IP	●									●		●														●			●	
lwIP	open source	TCP/IP	●				●					●		●				●										●			●	

∇ List is subject to change

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Stellaris® Serial-to-Ethernet kit

Example applications:

- SCADA Remote Terminal Units (RTUs)
- Electronic Flow Meters (EFMs)
- Medical Point-of-Care and Retail Point-of-Sales Machines
- CCTV RS-232 Recorders
- RS-232 Stepper Motor Controller Systems

- **LM3S6432 in a 10 x 10 mm BGA package for reduced board size**
- **10/100 Mbit Ethernet port**
  - Auto MDI/MDIX cross-over correction
  - Traffic and link indicators
- **Serial ports**
  - UART0 has RS232 levels, transceiver runs at up to 250 Kbits/sec
  - UART1 has CMOS/TTL levels, can run at 1.5 Mbits/sec
  - UART ports include RTS/CTS for flow control
- **Software**
  - IP configuration with static IP address or DHCP
  - Telnet server for access to serial port
  - Web server for module configuration
  - UDP responder for device discovery
  - Telnet client for Ethernet-based serial port extender
- **Module supports 5 V and 3.3 V supplies**
- **JTAG port pads for factory programming**

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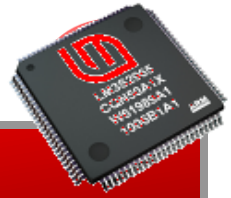
Stellaris® USB



USB standards

- **Standards**
  - USB 1.1
    - Defines Host (master) and Device (slave)
    - Speeds to 12Mbits/sec
    - Devices can consume 500mA (100mA for startup)
  - USB 2.0
    - Speeds to 480Mbits/sec
    - OTG addendum
  - USB 3.0
    - Speeds to 4.8Gbits/sec
    - New connector(s)
    - Separate transmit/receive data lines

USB layers

- **Bottom layer**

  Bus interface that transmits and receives packets

- **Middle layer**

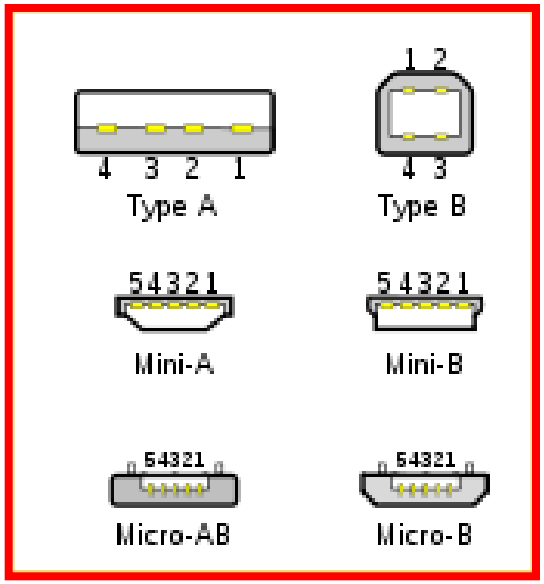
  Handles routing data between the bus interface and various endpoints on the device. An endpoint is the ultimate consumer or provider of data. It may be thought of as a source or sink for data

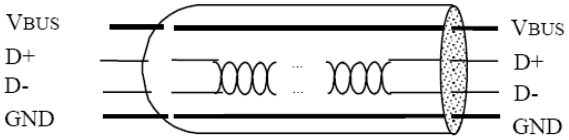
- **Top layer**

  Is the functionality provided by the serial bus device, for instance, a mouse or mass storage classes

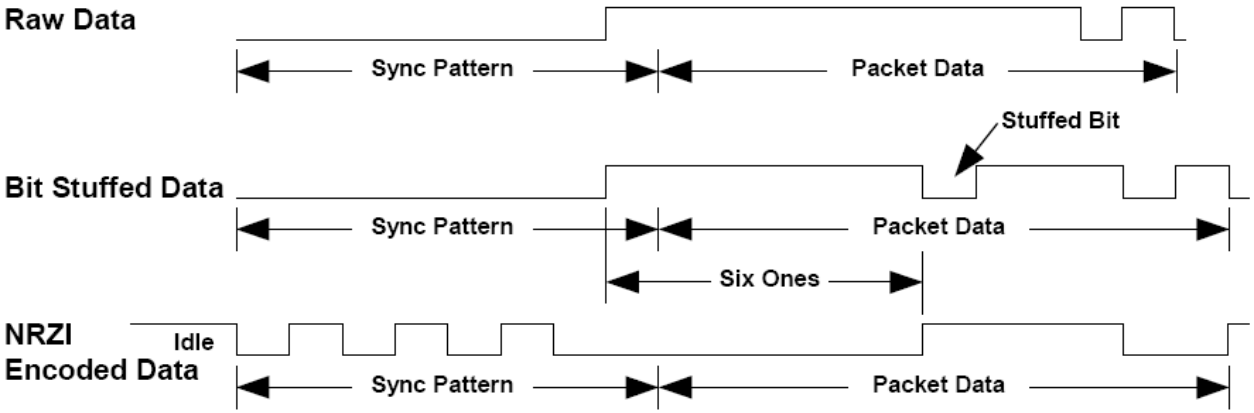
USB bottom layer

- Connector types
- USB bit rates
  - The USB high-speed signaling bit rate is 480 Mb/s
  - The USB full-speed signaling bit rate is 12 Mb/s
  - The USB low-speed signaling bit rate is 1.5 Mb/s
- Four-wire + pin ID for USB 2.0 connectors



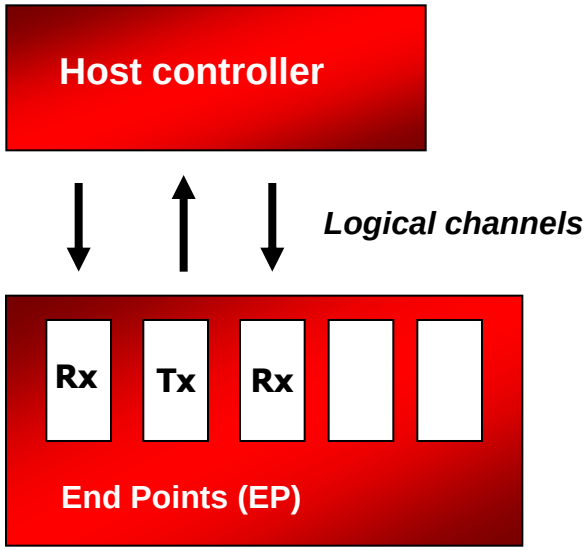


- USB signaling



USB Medium layer - Definitions

- **USB types**
  - USB Device … most USB products are slaves
  - USB Host … usually a PC, but can be embedded
  - USB OTG … On-The-Go
    - Allows a single port to be either a Device (a printer connected to a PC) or a Host (a printer connected to a camera)
- **USB EndPoints:**
  - IN, OUT
  - Control, Isochronous, Bulk, Interrupt
- **USB Classes**
- **USB Descriptors**

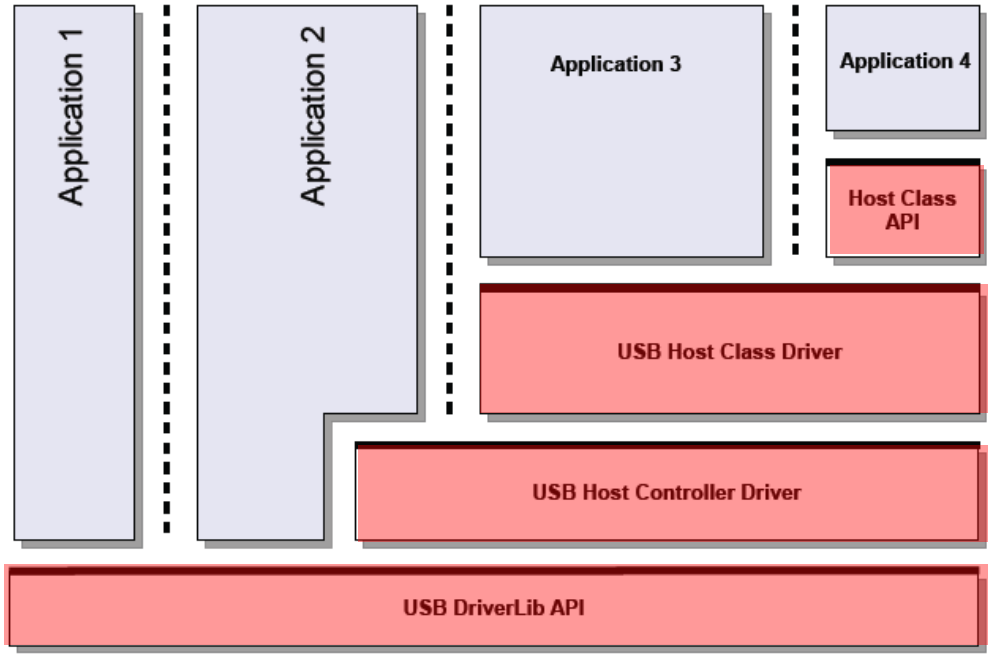


Stellaris® USB Medium layer

- **Up to 32 Endpoints**
  - 1 dedicated control IN endpoint and 1 dedicated control OUT endpoint
  - Up to 15 configurable IN endpoints and 15 configurable OUT endpoints
  - 4 KB Dedicated Endpoint Memory
  - DMA capability (up to 3 IN Endpoints and 3 OUT Endpoints)
  - One endpoint may be defined for double-buffered 1023-bytes isochronous packet size

StellarisWare USB Library solution

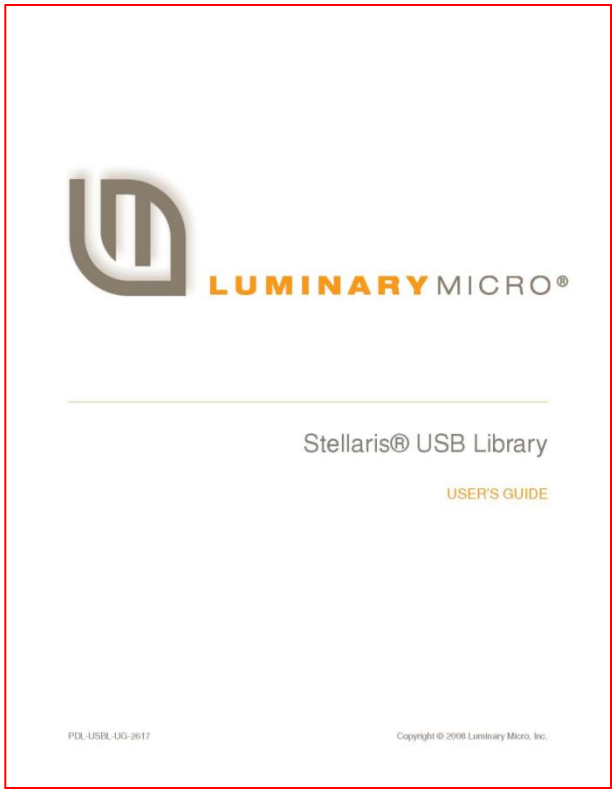
- Device APIs (Mouse, Keyboard, Filesystem)
- USB Class Driver APIs (HID, Mass Storage)
- USB Host Controller APIs
- DriverLib USB Driver APIs



StellarisWare USB Library Stacks

Examples available

- Device Examples:
  - Mass Storage
  - HID Keyboard
  - HID Mouse
  - CDC Serial
  - Generic Bulk
  - Oscilloscope
- Host Examples:
  - Mass Storage
  - HID Keyboard
  - HID Mouse
- Windows INF for supported classes
  - Points to base Windows drivers
  - Sets config string
  - Sets PID/VID
  - Precompiled DLL saves development time
- Device framework integrated into USBLib



Available in the StellarisWare Download

Stellaris® & USB vendor ID/license

- Vendor ID need for developing a USB product
  - each VID is assigned to one company
  - Vendor Identification Number (VID) and use of Texas Instruments' assigned USB Product Identification Numbers (PID)

- Logo license agreement

Stellaris® USB summary

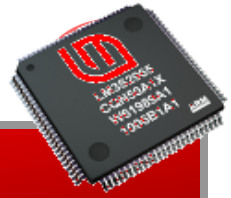
Integrated controller and PHY

- USB 2.0 Full Speed (12 Mbps) operation
- Devices with OTG/Host/Device or Host/Device
- Transfer: Control, Interrupt, Bulk and Isochronous
- Up to 32 Endpoints
  - 1 dedicated control IN endpoint and 1 dedicated control OUT endpoint
  - Up to 15 configurable IN endpoints and 15 configurable OUT endpoints
  - 4 KB Dedicated Endpoint Memory
  - DMA capability (up to three IN Endpoints and three OUT Endpoints)
  - One endpoint may be defined for double-buffered 1023-bytes isochronous packet size

Stellaris collaterals

- Luminary Micro is a member of the USB Implementers Forum.
- Stellaris pUSB device and host compliance testing and therefore listed on the USB-IF Integrators List and approved to use the USB logo
- Luminary Micro sublicenses VID & PIDs for customer use
- StellarisWare USB lib including USB low layer drivers, USB Host & device classes support
- Evaluation kits like EK-LM3S3748 with USB class implementations examples

Stellaris® HMI



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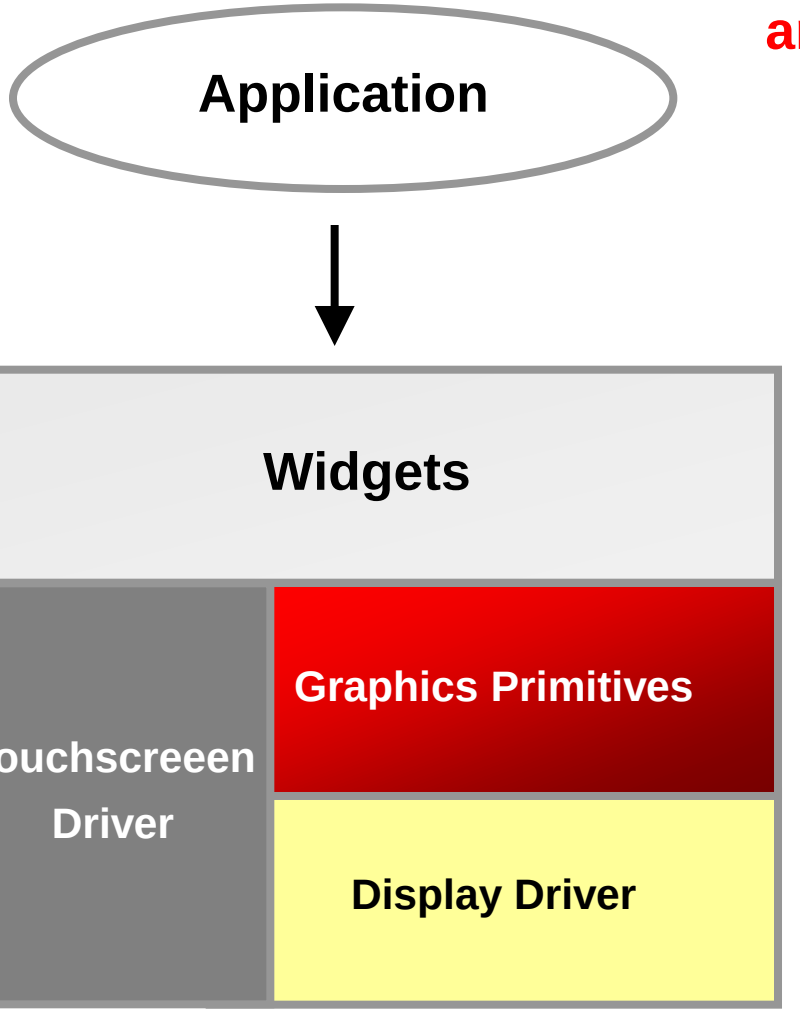
Stellaris® Graphics Library

→ Set of graphics primitives and widgets



Canvas, Checkbox, Container, Push Button, Radio Button, Slider, ListBox

Lines, Circles, Text, Point, Rectangle, Circle, Image, …

Bitmap/Pixel Control

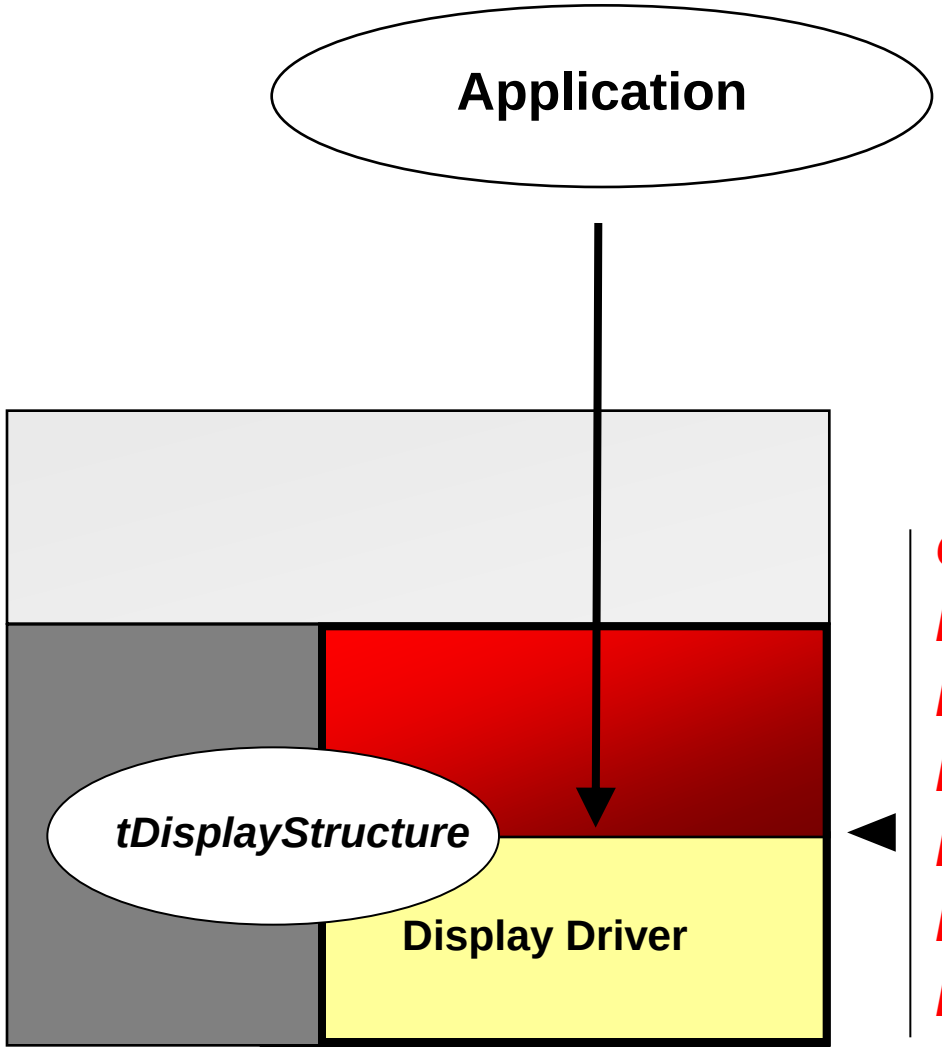
Widget definition

Graphical rendering

Input from the user

Function Call

Stellaris® Display driver



ColorTranslate *- 24-bit RGB into palette*

Flush *- flush cached drawing operations*

LineDrawH *- Horizontal line, single color*

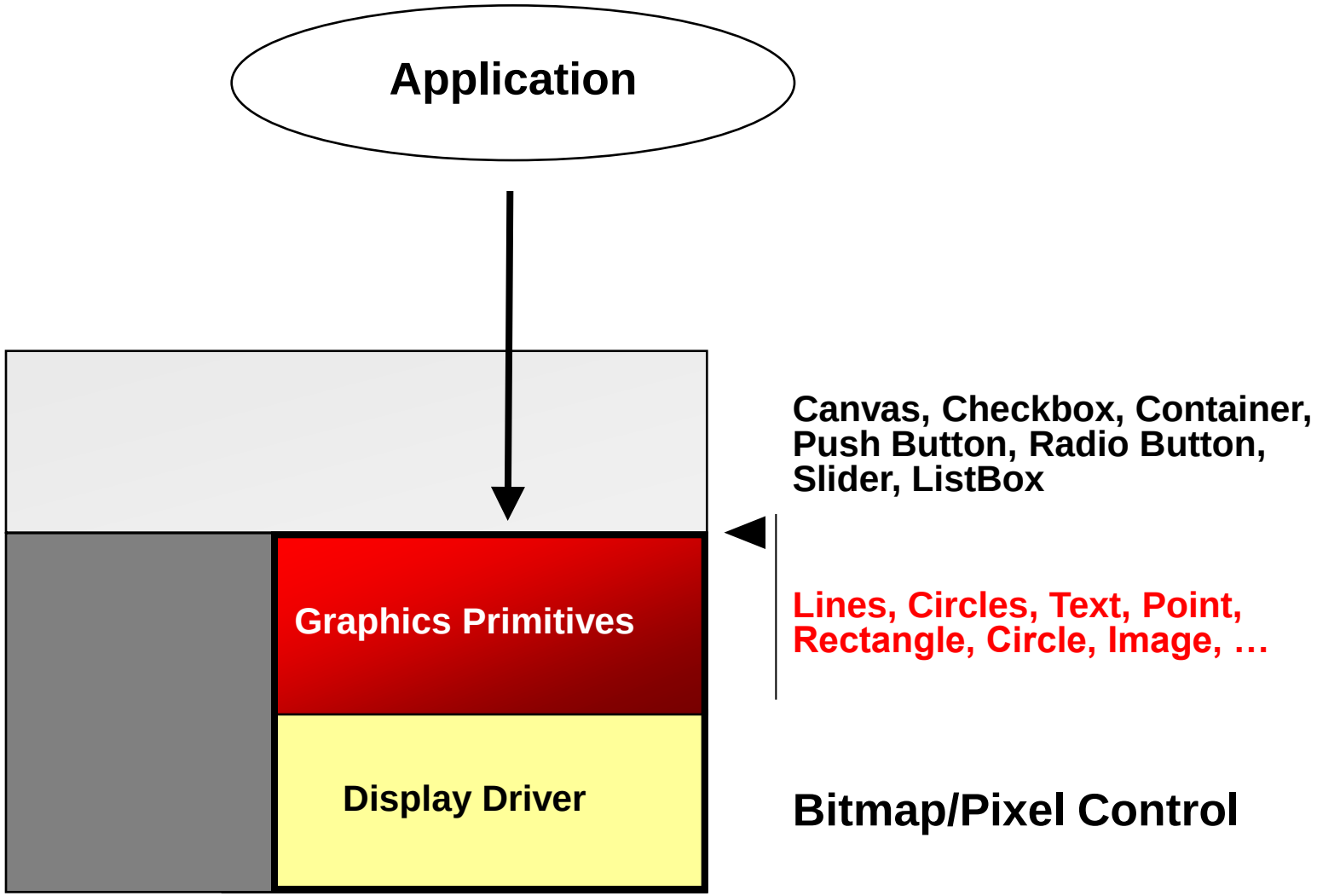
LineDrawV *- Vertical line, single color*

PixelDraw *- Single pixel (single color)*

PixelDrawMultiple *- Pixel bitmap*

RectFill *- Filled rectangle, single color*

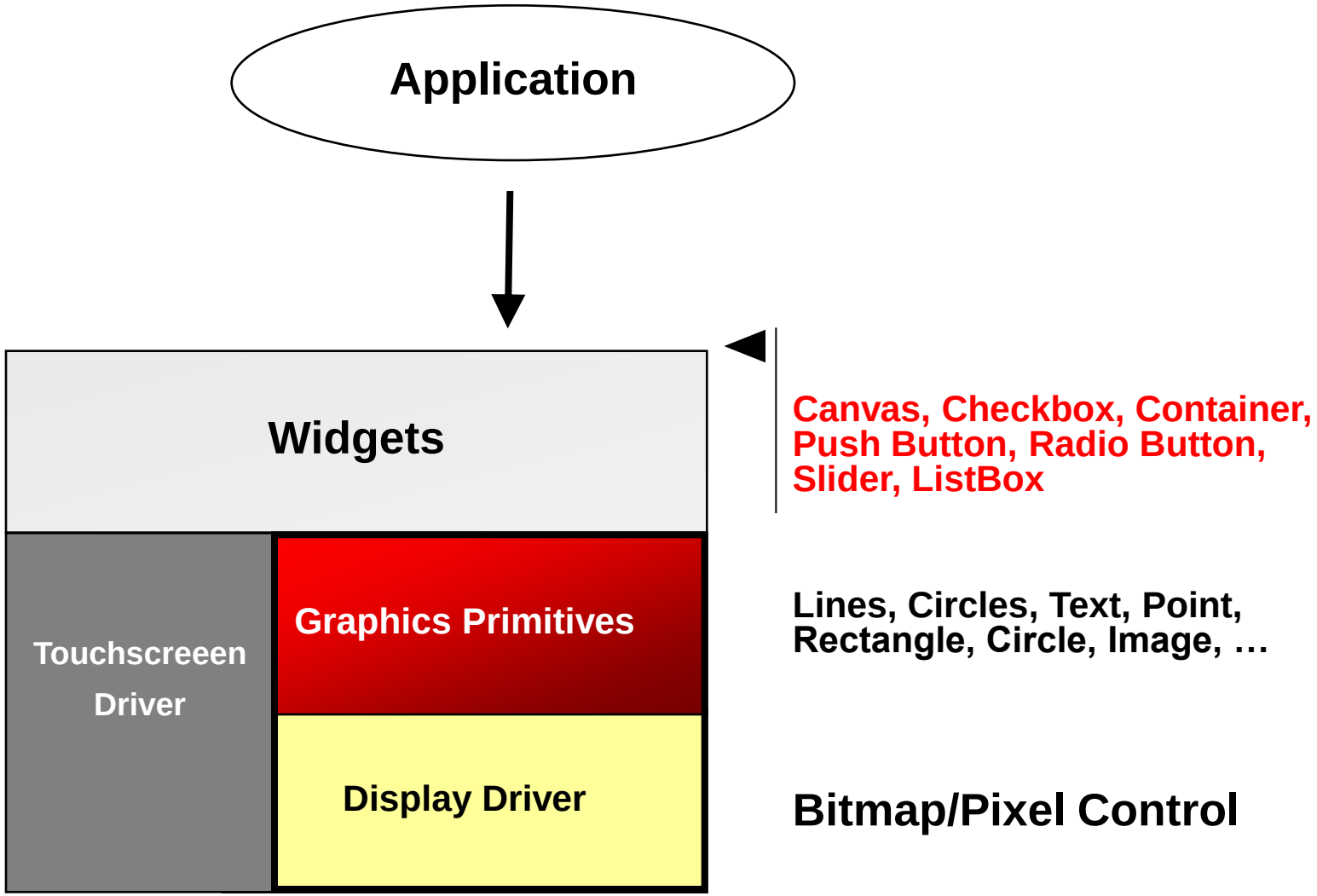
Stellaris® Graphics primitives



Graph. primitive - functions examples

- GrCircleDraw
- GrCircleFill
- GrImageDraw
- GrLineDraw
- GrLineDrawH
- GrLineDrawV
- GrRectDraw
- GrRectFill
- GrRectIntersectGet
- GrRectOverlapCheck
- GrStringDraw
- GrStringGet

StellarisWare Widgets



Widget Types examples

- Canvas Widget – Draws a picture with no user interaction
- Checkbox Widget – User selects on or off
- Container Widget – Groups multiple child widgets into container
- Image Button Widget – Push button with user-defined on and off
- ListBox Widget – User selects one of a list of strings
- Push Button Widget – Simple push button
- Radio Button Widget – Circle that fills when selected on
- Slider Widget – User selects a range of values

Stellaris® Graphics lib widgets Ex.

Primitives

Radio Buttons

Checkbox

Security Keypad

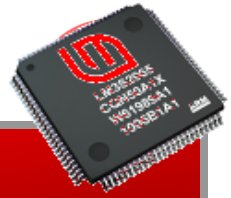
Canvas

Push Buttons

Container

BLDC Touchscreen

Stellaris® Tools



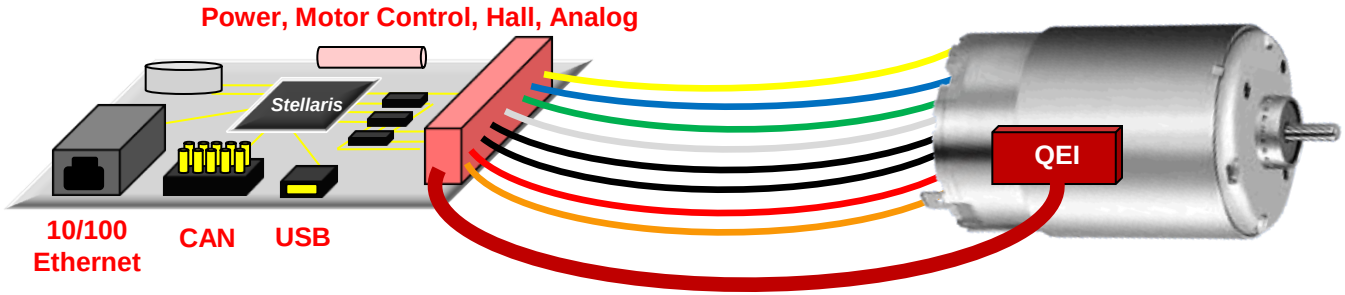
The Full-Solution Approach

Fully Integrated Stellaris MCUs

- ARM Cortex-M3 core with single-cycle Flash
- Advanced Motion Control
- Integrated Deterministic Connectivity
- Easy adoption / learning curve through 10-min Out-of-the-Box Evaluation Kits

Production-ready Modules

- Customizable modules for drop-in implementation
- Multiple motors supported
- Multiple connectivity options
- Copy-exactly with Open-tooled HW and SW



Complete Open-tooled RDKs

- Open-tooled HW/SW Reference Design Kits
- Motor included for out-of-the-box demonstration
- Fully documented, available for download, and in stock

Proof-of-Concept

- Stellaris MCUs / Modules
- Putting our Motion Control to the test before you do.

End-to-End Solution Source Files

Royalty-Free

Schematics

Placement

Bill of Materials

Gerbers

Motor App and StellarisWare® Source

Control / Config GUI

Texas Instruments

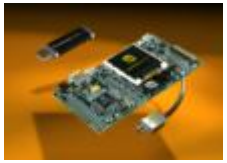
Stellaris® Evaluation Kits

- Start in 10 minutes or less
- Evaluation board packages includes:
  - Cables
  - A choice of evaluation tools suites for popular development tools
  - Documentation (QuickStart guide, User's guide, …)
  - StellarisWare® software
  - Applications notes

EK-LM3S811
Low pin count
49 USD

EK-LM3S1968
High pin count
59 USD

EK-LM3S2965
CAN Functionality
79 USD



EK-LM3S3748
USB Host/Device
109 USD

EK-LM3S6965
Ethernet MAC+PHY
69 USD

EK-LM3S8962
Ethernet+CAN
89 USD

EK-LM3S9B90
Ethernet+USB OTG
99 USD

EK-LM3S9B92
Ethernet+OTG+MC
99 USD

- Function both as an evaluation platform and as a serial in-circuit debug interface for any Stellaris microcontroller-based target board

Stellaris® RDK - Open-Tool Motor

RDK-ACIM
$379

AC Induction Motor Controller Design

Example applications:

- White goods
- Residential and light commercial HVAC
- 3-ph Industrial Motor Drives

RDK-STEPPER
$199

Stepper Motor Controller Design

Example applications:

- 2 and 3 axis CNC equipment
- Sorting and grading equipment
- Specialized printers and scanners

RDK-BLDC
$219

Brushless DC Motor Controller with CAN/Ethernet

Example applications:

- Small appliances
- Electric wheelchairs and mobility devices
- Pumping and ventilation systems

RDK-BDC
$219

Brush DC Motor Controller with CAN

Example applications:

- Small appliances
- Electric wheelchairs and mobility devices
- Pumping and ventilation systems

Official FIRST KoP Speed Controller – FRC 2009

Texas Instruments

Stellaris® RDK - Open-Tool

RDK-IDM
$219

Touch-screen Intelligent Display Module with PoE

Example applications:

- Security Systems & Building Access Controllers
- White Goods and other Home Appliances
- Factory Automation (System Status and Configuration)

RDK-IDM-L35
$219

Landscape-oriented Touch-screen Intelligent Display Module

Example applications:

- Security Systems & Building Access Controllers
- White Goods and other Home Appliances
- Factory Automation (System Status and Configuration)

RDK-IDM-SBC
$299

Stellaris 3.5” Landscape IDM Single Board Computer

Example applications:

- Security Systems & Building Access Controllers
- White Goods and other Home Appliances
- Factory Automation (System Status and Configuration)

RDK-S2E
$139

Tiny Footprint Serial-to-Ethernet Module

Example applications:

- SCADA Remote Terminal Units (RTUs)
- Electronic Flow Meters (EFMs)
- CCTV RS-232 Recorders

Stellaris® Development Kits

- DK-LM3S1xx/3xx/8xx Development Kits
  - Development Board with a choice of daughtercard
  - UART transceiver and DB9 male connector
  - All I/O available on headers
  - One potentiometer and one photocell for driving the comparator inputs
  - Eight user LEDs and one pushbutton for use with the Stellaris™ GPIOs
  - Standard ARM® 20-pin JTAG debug connector
  - USB 2.0 full-speed interface allows JTAG/SWD debug
  - 1 Mbit SPI-based flash memory
  - One buzzer for PWM use
  - User-prototype area

- DK-LM3S9B96 Development Kit
  - 80 MHz Stellaris LM3S9B96 MCU with fully-integrated Ethernet, CAN, and USB OTG/Host/Device
  - Bright 3.5” QVGA LCD touch-screen display
  - Navigation POT switch and select pushbuttons
  - Integrated Interchip Sound (I2S) Audio Interface
  - EPI cards: I/O break-out board and 8 MB SDR SDRAM module
  - MicroSD card interface
  - LM3S9B96 I/O available on labeled break-out pads
  - ARM® 10-pin JTAG debug connector with input and output modes

KEIL An ARM® Company
code_red
IAR SYSTEMS
CodeSourcery

Texas Instruments

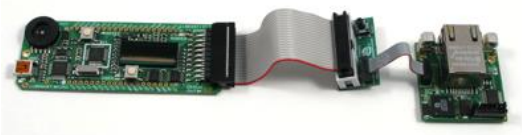
Stellaris® Ecosystem

Compilers, Debuggers	KEIL An ARM® Company; IAR SYSTEMS; Rowley Associates; hitex DEVELOPMENT TOOLS; code_red; CodeSourcery; 1 SYSTEM
RTOS	KEIL An ARM® Company; IAR SYSTEMS; Micrium; µTasker; CMX SYSTEMS; PUMPKIN INCORPORATED; freeRTOS; expresslogic; SEGGER; SCIOPTA; Quadros Systems Inc.
Stacks, Specialty	SEGGER; PCB MATRIX; IXXAT; Willert Software Tools — Pioneers in Embedded Software Engineering; Quadros Systems Inc.; interniche technologies, inc.; WhizNets; SEVENSTAX EMBEDDED TECHNOLOGIES; Micrium; port; expresslogic; NATIONAL INSTRUMENTS; Micromint USA; RoweBots; CMX SYSTEMS
Programmers	BPM MICROSYSTEMS; SYSTEM GENERAL; XELTEK; ZHIYUAN ELECTRONICS

IDE Stellaris® MCUs

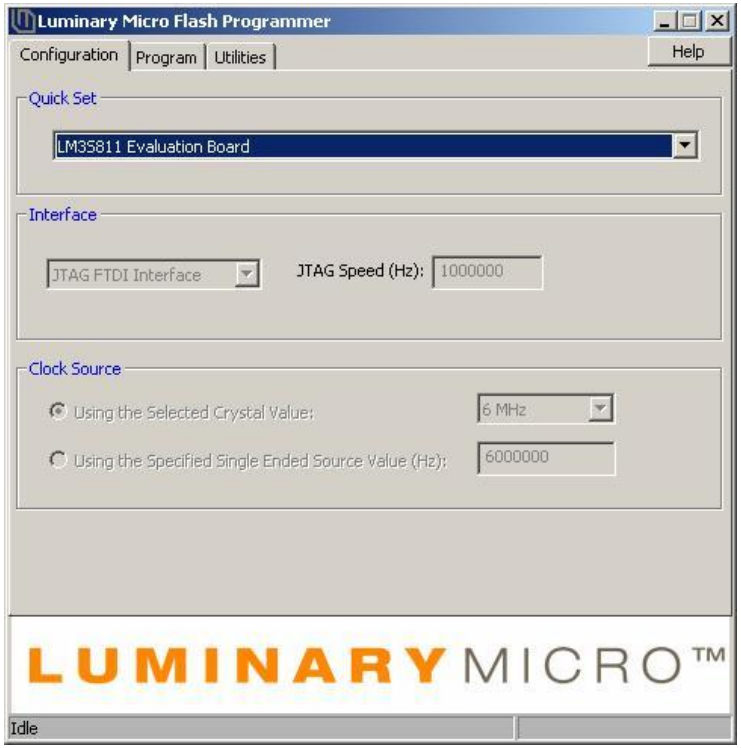
	CodeSourcery	IAR Systems	ARM KEIL An ARM® Company	code_red
Eval Kit License	30-day full function. Upgradeable.	32KB address-limited. Upgradeable.	32KB address-limited. Upgradeable.	Full functional; locked to board. Upgradeable.
Compiler	GNU C/C++	IAR C/C++	RealView C/C++	GNU C/C++
Debugger / IDE	gdb / Eclipse	C-SPY / Embedded Workbench	µVision	code_probe / Eclipse-based tool suite
Full Upgrade	199 USD personal edition / 3000 USD full support	2700 USD	MDK-Basic (256 KB) = €2000 (2895 USD)	999 USD (upgrade to run on customer platform)
JTAG Debugger		J-Link, ~299 USD	U-Link, ~199 USD	Red Probe, 150 USD

Note: ***In addition to its original use as an evaluation kit, each Stellaris evaluation kit has the built-in capability for use as a simple USB-to-20-pin JTAG debugger.***



Stellaris® Flash Programming GUI

- LM Flash Programming GUI
  - Simple graphical user interface
  - Support for all Evaluation Kits
  - Key features include:
    - Program
    - Verify
    - Erase
    - Read memory
  - Available now



StellarisWare

- **Free license and royalty-free source code:**
  - Peripheral Driver Library
  - Graphics Library
  - USB Library
  - Boot Loader
  - IEC 60730 Library

  - Code examples for each kit
  - Supports different compilers and IDEs

Enabling our customers with the ability to rapidly develop and deploy their products at competitive costs yielding a higher overall value for the Stellaris solution!

Stellaris® IEC 60730 support

The International Electrotechnical Commission (IEC)

IEC: World's authority in international standards for household appliances

StellarisWare extension provides support for IEC 60730 Class B safety requirements

Class B covers most home appliances, such as washers/dryers, refrigerators, freezers, and cookers/stoves

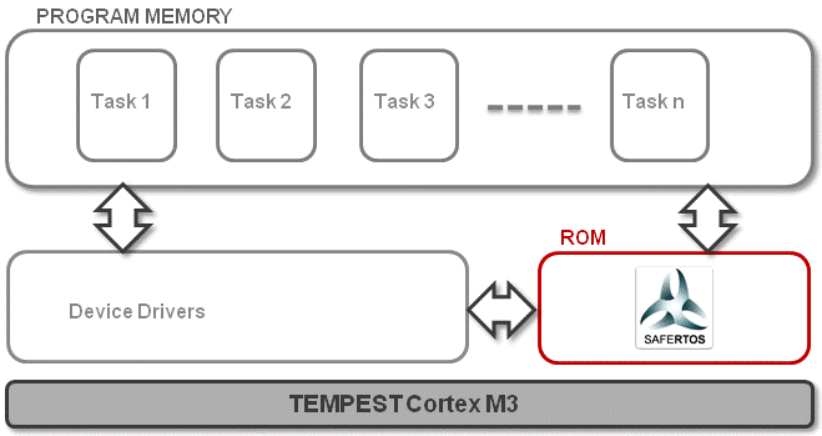
Free license and royalty-free use for use on Stellaris MCUs

Library supports both startup and periodic testing requirements of IEC 60730

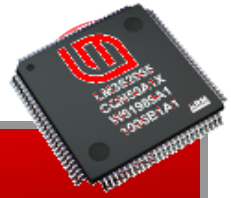
	Module	Description
StellarisWare™ Software	Reset Handler	Performs basic register and memory test out of reset.
	CPU Test	Performs stuck bit testing on the CPU PC and registers.
	SRAM Test	Performs stuck bit testing on the SRAM.
	Flash Test	Performs a CRC test on the Flash.
	ADC Test	Performs a conversion test on an ADC channel connected to a known voltage reference.
		Performs ADC temperature sensor test.
	GPIO Test	Performs GPIO input/output plausibility test.
	Clock/Interrupt Test	Performs tests to check the clock frequency, interrupt handling, and execution.
Stellaris® Hardware	Nested Vector Interrupt Controller	Deterministic, fast interrupt processing for execution certainty.
	Automotive-grade Flash Memory	High reliability non-volatile memory for robust environments.
	Cyclical Redundancy Check in ROM	Especially useful in verifying the contents of memory in a Stellaris microcontroller.
	2 Watchdog Timers	Clocked with precision oscillator, a seoncd WDT takes advantage of the non-maskable interrupt (NMI) handler safety feature of the ARM Cortex-M3 processor.
	Precision Oscillator	Supplies an accurate, independent time base when periodic safety tests are executed.
	Advanced Motion Control with Multiple Fault Conditioning Inputs	Provides quick motor shutdown in low latency situations.
	Quadrature Encoder Inputs	Provides precise, closed loop control of motors.
	Integrated Analog Comparators	Used to trigger Stellaris' accurate ADC and to trigger an interrupt when needed, which is useful for infrequent out-of-range events such as a current or voltage spike.
		Eliminates the performance-wasting requirement of constant CPU polling.
	Internal Temperature Sensor	Used to monitor and shut down an appliance if the appliance overheats.
	10/100 Ethernet MAC/PHY with IEEE 1588 PTP	Offers highly synchronized connectivity features for precision internetworking.
	Controller Area Network (CAN) 2.0 MACs	

On-chip SW Enhancements (ROM)

SAFERTOS for Tempest



- High-integrity RTOS in ROM
- RTOS value $65k free with Tempest LM3S9B96
- Can be used as a standard operating system OR as part of a high integrity application which requires certification to IEC61508 or FDA510(k)
- Integrated hardware/software solution shortens the time to market and significantly reduces cost for Industrial and Medical Applications
- Innovative Design Assurance Pack available separately from WITTENSTEIN provides complete turnkey evidence and process documentation



☺ The End ☺