

Embedded Processing Overview



- Critères de choix- les grandes familles
- Bibliothèques de fonctions et systèmes d'exploitations temps réel
- Kit d'évaluations et outils de développement
- Exemple de mise en oeuvre

Juin 2012

Critères de choix - les grandes familles



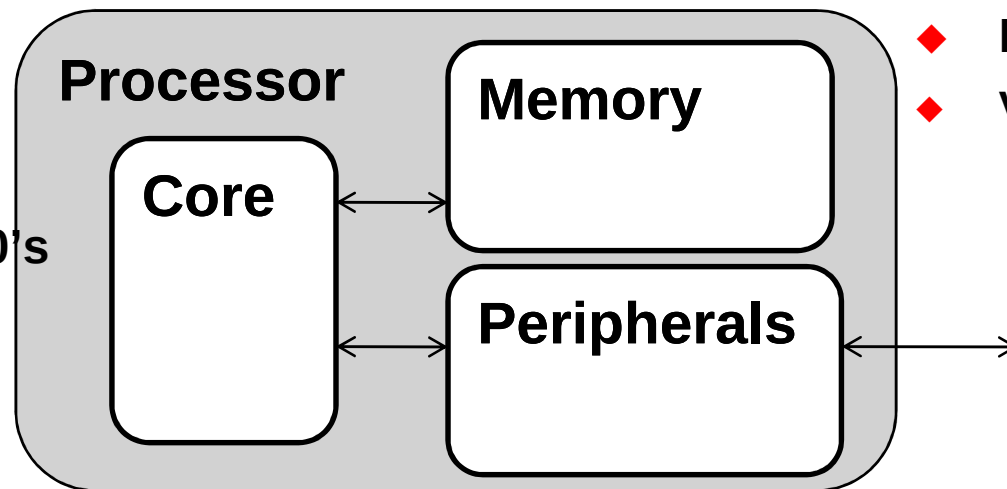
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Characteristics of a Processor?

--- Core ---

- ◆ 8/16/32-bit
- ◆ Speed
- ◆ Type
 - ◆ Proprietary
 - ◆ Standard
 - ◆ Single/multi
 - ◆ W or w/o accel
- ◆ Works on 1's and 0's
- ◆ Makes Decisions



--- Memory ---

- ◆ Amount
 - ◆ Code and Data
- ◆ Speed
- ◆ Type
 - ◆ Non-Volatile
 - ◆ Volatile

--- Peripherals ---

- ◆ Serial I/O (i.e. UART)
- ◆ Analog (i.e. ADC)
- ◆ Performance
- ◆ Configuration/Mix

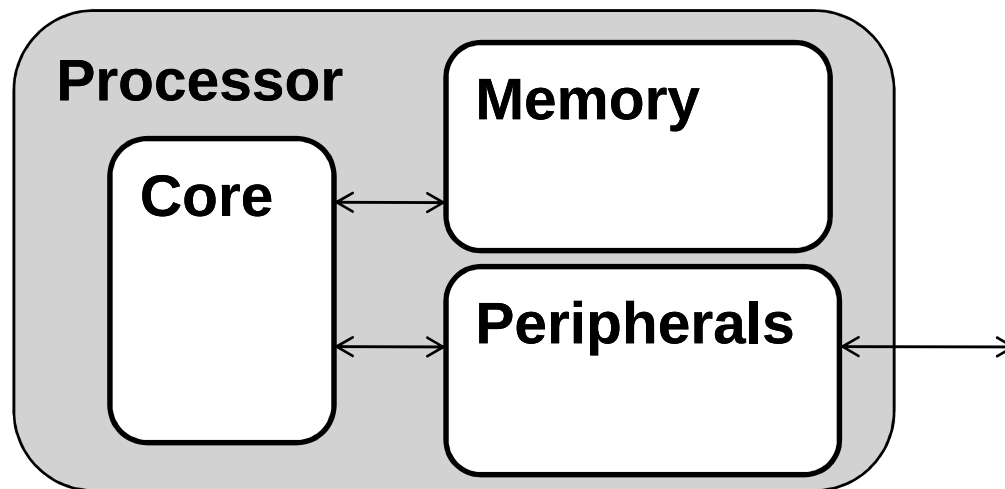
How do you choose?

--- Core ---

- ◆ Determined by the *scope* of problem
 - ◆ How much work, how fast
 - ◆ How much memory
- ◆ *Standard vs. Proprietary*

--- Memory ---

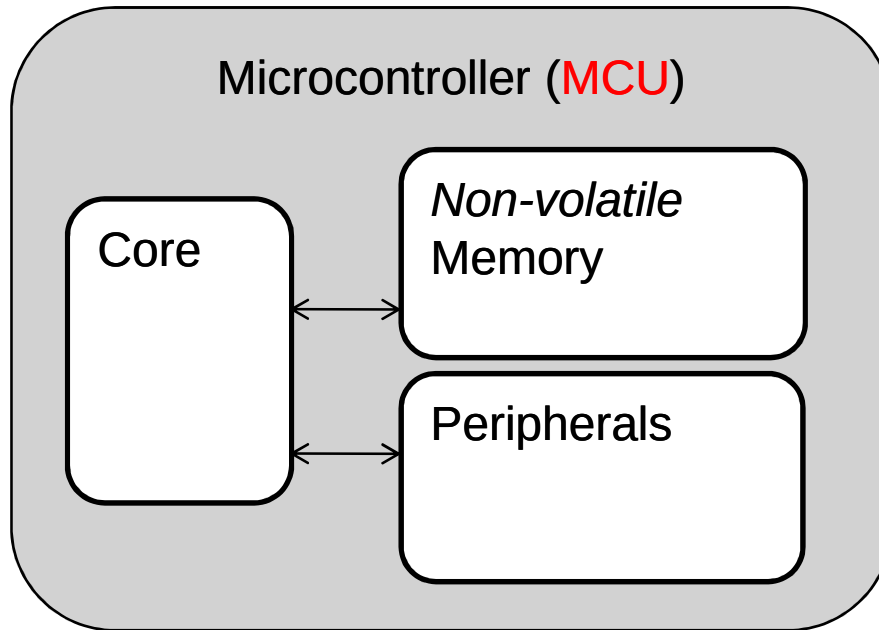
- ◆ Determined by the *size* of the problem(s)



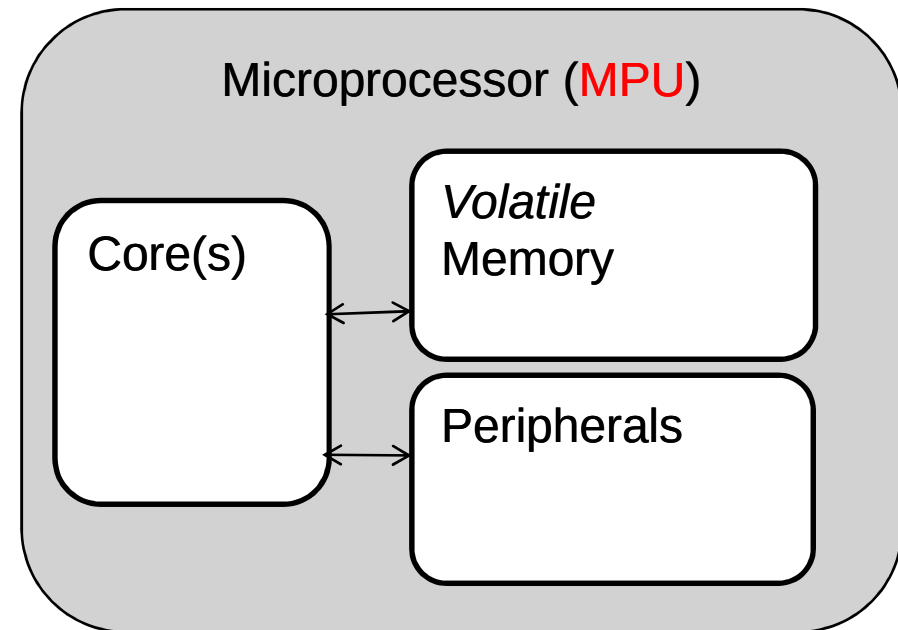
--- Peripherals ---

- ◆ Determined by required *interfaces*

Types of Processors? (MCU, MPU, DSP*)



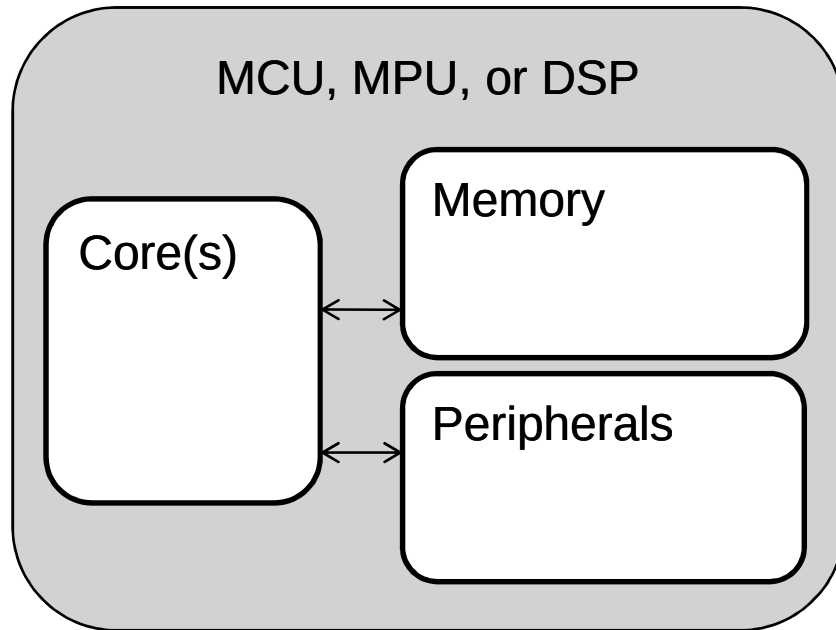
- ◆ 8/16/32 Bit core
- ◆ Non-volatile memory for program storage (FLASH)
- ◆ Typically 8 – ~300 MHz
- ◆ Lots of analog integration



- ◆ Mostly 32/64 Bit, many multi-core
- ◆ Very high performance (GHz), even multi-core
- ◆ More complex peripherals
- ◆ Volatile memory only

*DSP = Digital Signal Processor

Hardware is Just *One* Piece of the Puzzle



- ◆ The processor(s) represent part of the Hardware (HW) Solution
- ◆ HW is just part of the story
- ◆ What else is needed?
 - ◆ Software – code written, bits
 - ◆ Tools – EVM*, IDE**, Reference Design

HW + SW + Tools = Processor Design

If you are only selling 1 or 2, you are not selling the complete product...

*EVM – Evaluation Module

**IDE – Integrated Development Environment



Attracting Every Engineer in the Room

Hardware

Lowest Power MCU	• Industry's lowest power MSP430 microcontroller • Large MCU portfolio with >500 devices
Proven ARM® Supplier	• Large, feature-rich portfolio across Cortex™-A, M and R cores • Lead partner • Most ARM-based processors shipped
Best-in-Class DSPs	• From lowest power to highest performance • 20 years of DSP system expertise

Software

Easily scale	• One development environment across the portfolio • Software compatible product platforms
Fast to Market	• SDKs and kits to demo in 10 minutes and develop in 1 hour • Free software...Libraries, codecs, algorithms
Responsive Support	• Large team of >1000 FAEs • E2E on-line community • Broad 3rd Party Network • Open source leadership

Embedded

Optimized Products	• Video & Vision Analytics • Security • Multimedia • Metering • Comm. Infrastructure • Auto Infotainment • Motor Control and more...
To Differentiate	• Long battery • HD video • Power efficient • Highest performance • Real-time analytics • Connectivity options • 3-D Gesturing
Time to Advantage	• Application-specific software and development kits • Reference designs • Application notes • System block diagrams and BOM analysis

TI embedded processors fit various applications requirements

Fast-growing markets



Energy Harvesting & Building Automation



Intelligent Sensing & Metering



Human Interface



Renewable Energy



Digital Motor Control



Industrial Applications



Auto Vision



Communications Infrastructure



Portable Medical



Transaction Control & POS



Digital Power



Lighting



Video Conferencing & Video Surveillance



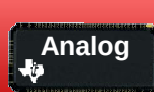
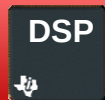
Embedded processing needs

Ultra-low power • Performance from 25 MHz to 1.5 GHz
Connectivity • Fast time to market • Complete signal chain

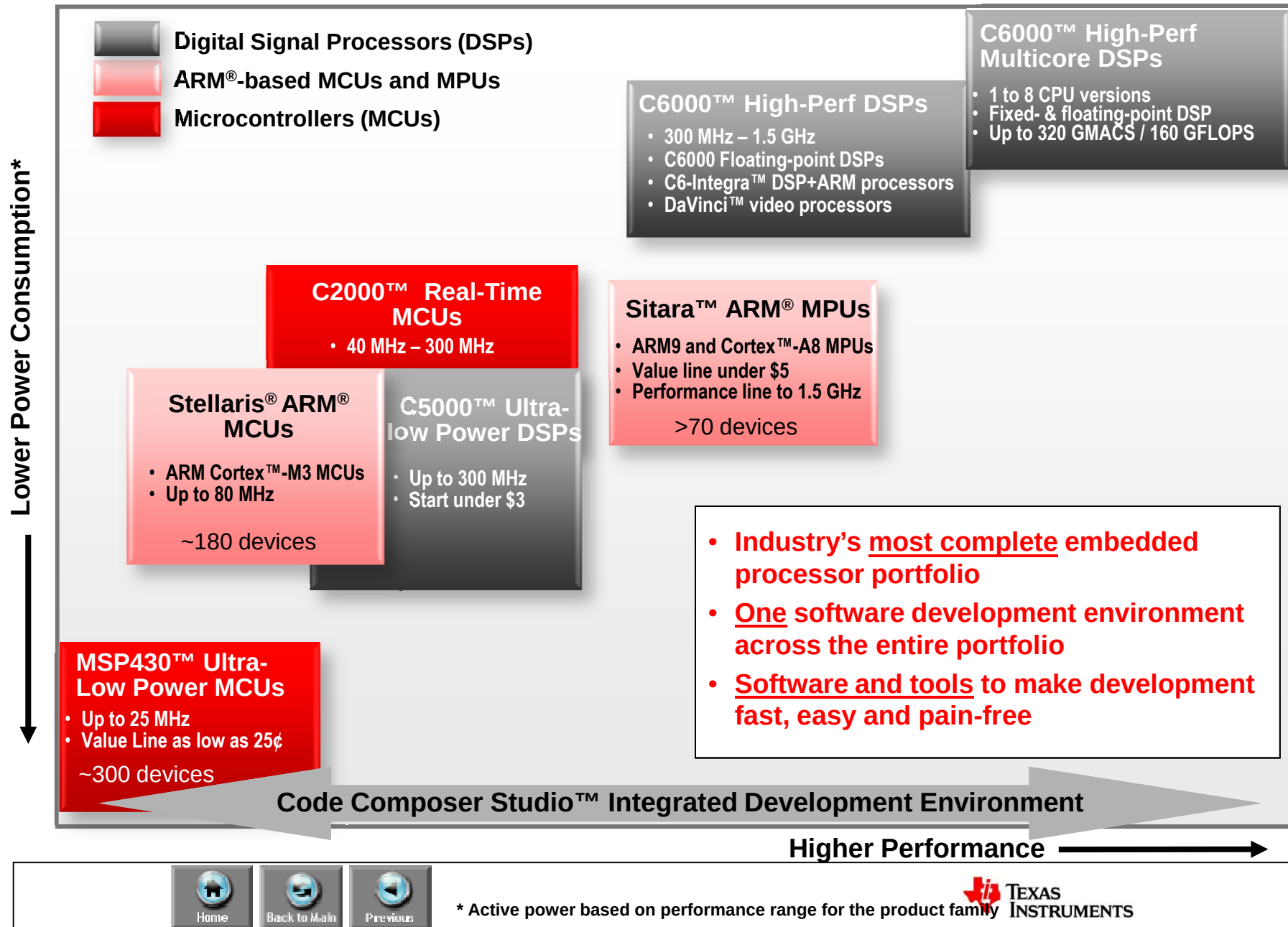


TI delivers:

Broad product portfolio • Support • Software & tools • Reference designs



A TI embedded processor to meet your needs



TI has a broad and growing embedded processing portfolio

TI Embedded Processors

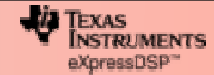
Microcontrollers (MCUs)

ARM®-Based Processors

Digital Signal Processors (DSPs)



Software & Dev. Tools



16-bit ultra-low power MCUs

MSP430™

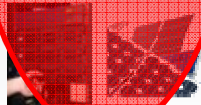
Up to 25 MHz



32-bit real-time MCUs

C2000™
Delfino™
Piccolo™

40 MHz to 300 MHz



32-bit ARM® MCUs

Stellaris®
Hercules®
ARM® Cortex™-M3/M4/R4
Up to 80 MHz



32-bit ARM® MPUs

Sitara™
ARM® Cortex™-A8 & ARM9
Value line to 600 MHz
Perf. Line to 1.5 GHz



DSP
DSP+ARM®

C6000™
C6-Integra™
DaVinci™
Video processors
300 MHz to >1.5GHz
Floating point + Video Accelerators



Multicore DSPs

C6000™
Up to 10GHz
Multi-core, fixed/floating + Accelerators



Ultra Low power DSPs

C5000™
Up to 300 MHz
16-bit fixed point + FFT Accelerator



MPUs – Microprocessors



Home



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Previous



What is the Control Law Accelerator (CLA)?

Independent 32-bit floating-point math accelerator

Operates independently of the C28x CPU

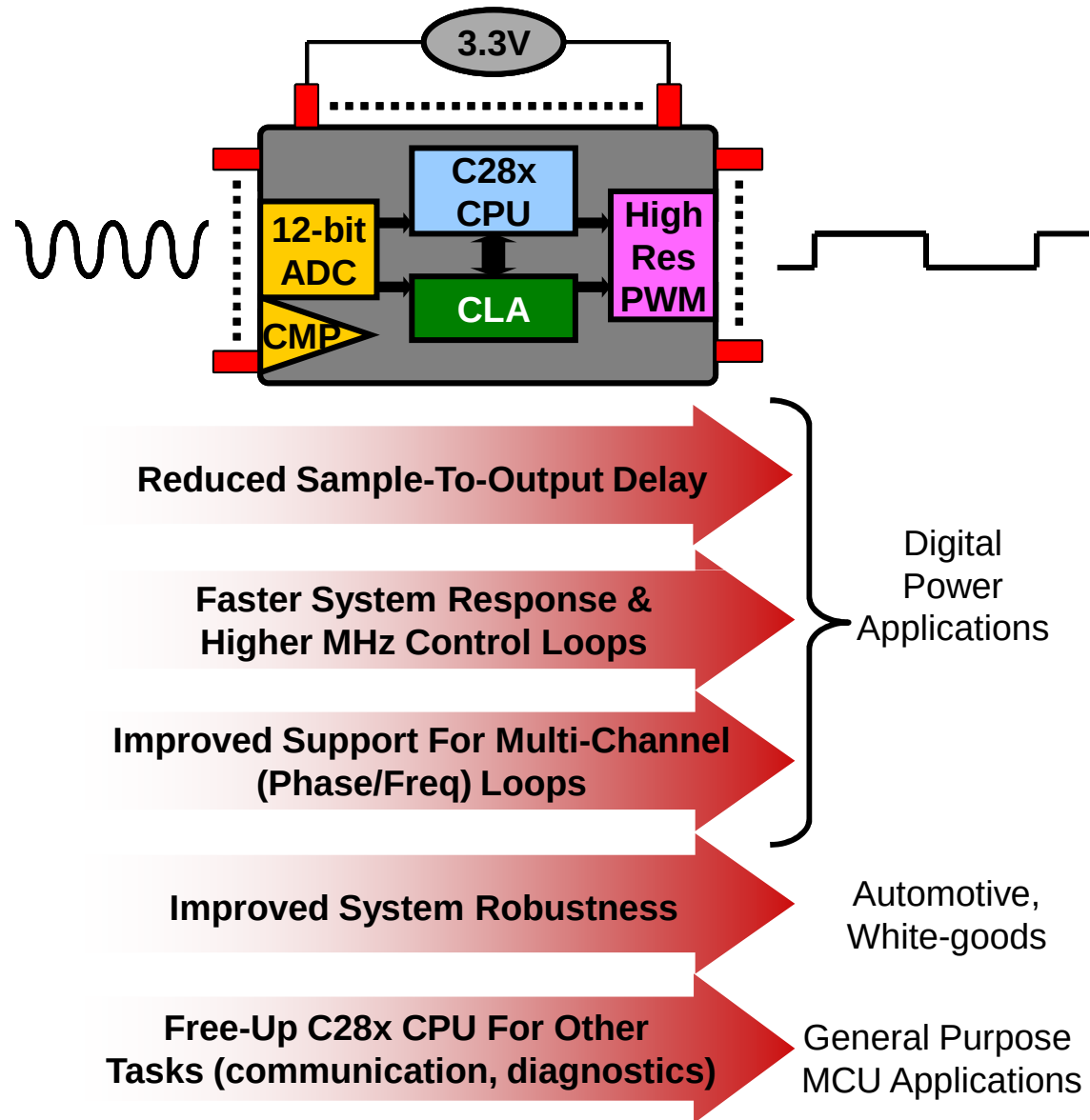
- Independent register set, memory bus structure & processing unit
- Low interrupt response time

Direct access to on-chip peripherals

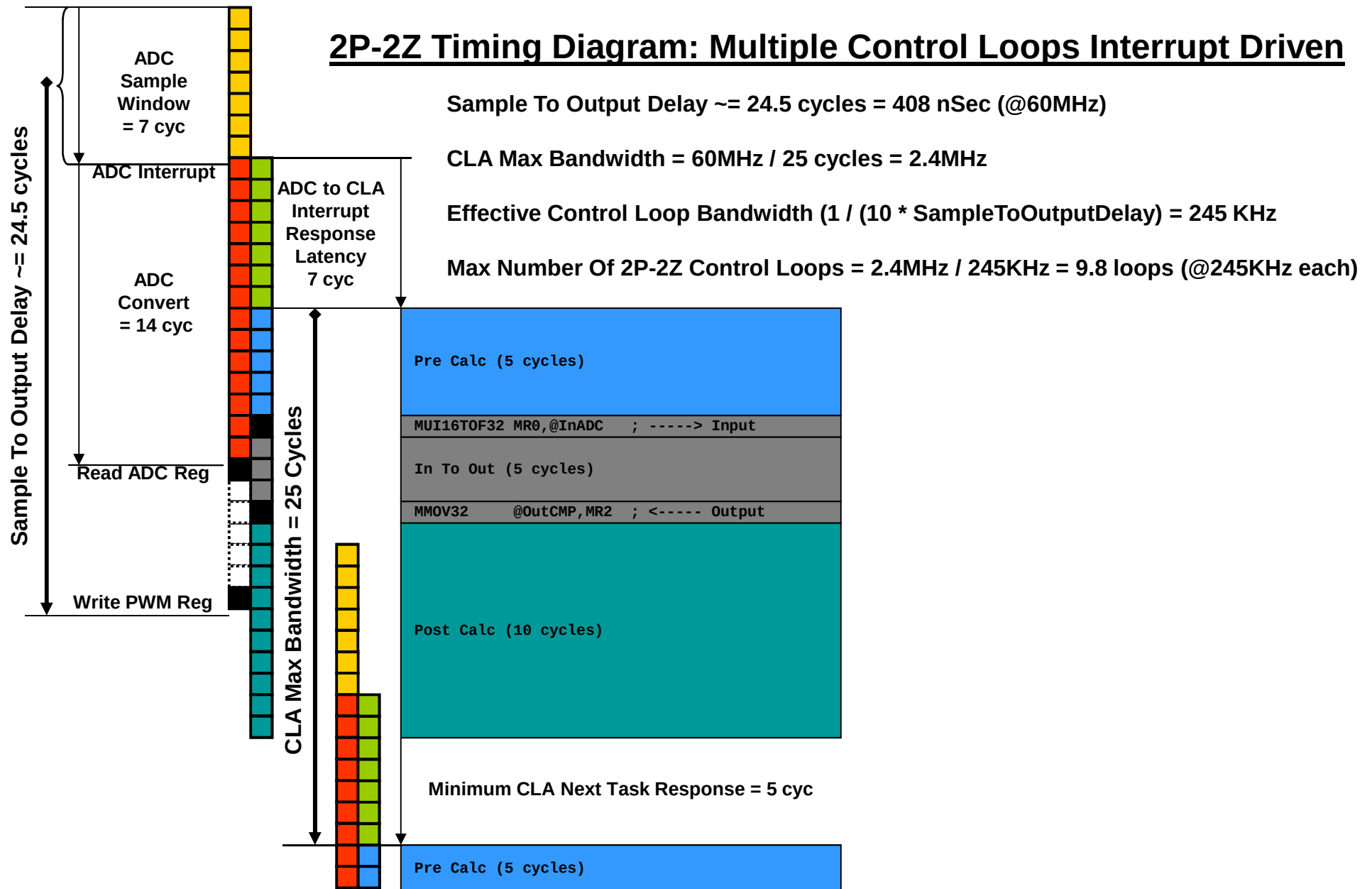
- Execution of algorithms in parallel with the C28x CPU

Fully programmable: IEEE 32-bit floating

- Removes scaling and saturation burden



2P-2Z Timing Diagram: Multiple Control Loops Interrupt Driven



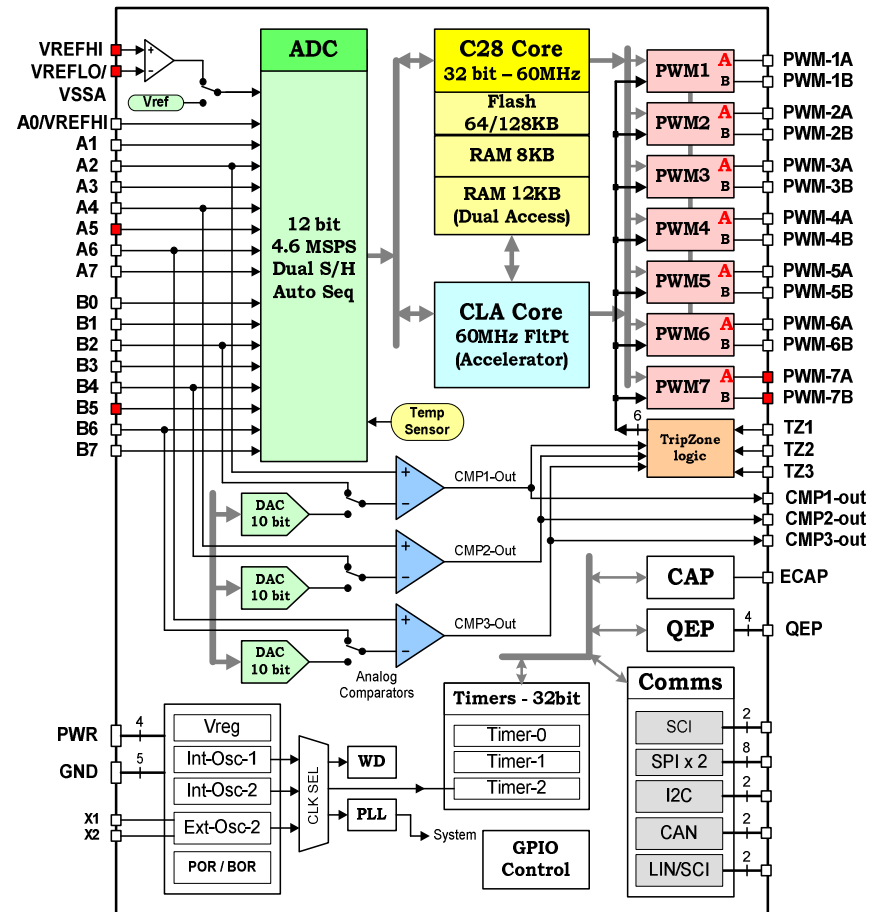
F2803x (Piccolo with CLA)

Key New Features:

- 60 MHz CPU
- New acceleration unit (CLA)
- CLA has 32bit floating Pt precision
- Single 3.3V supply
- 12-bit ratio-metric ADC
- Low latency ADC trigger & seq.
- 3 Analog comparators, < 30nS
- 10 bit DAC reference, < 2uS settling
- 150ps PWM resolution Duty & Freq
- Dual “zero-pin” on-chip oscillators
- **64-pin or 80-pin TQFP**

In production now

F2803x (Piccolo w/ CLA) Series



Bibliothèques de fonctions et systèmes d'exploitations temps réel

- Critères de choix - les grandes familles
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 - Bibliothèque de fonction - ControlSuite (C2000)
 - Systèmes d'exploitations temps réel:
 - Problématique
 - Introduction rapide a SysBios
- Kit d'évaluations et outils de développement
- Exemple de mise en oeuvre

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controlSUITE™ software

Real-world software for real-time control

Modular software for every design stage

Intuitive framework provides comprehensive building blocks that simplify evaluation, adaptation, debug and test

Leverage a la carte software solutions throughout the design cycle

Unique, optimized real-time control IP

Examples, libraries & complete application solutions rooted in 15+ years of real-time control systems engineering

Focus on differentiation

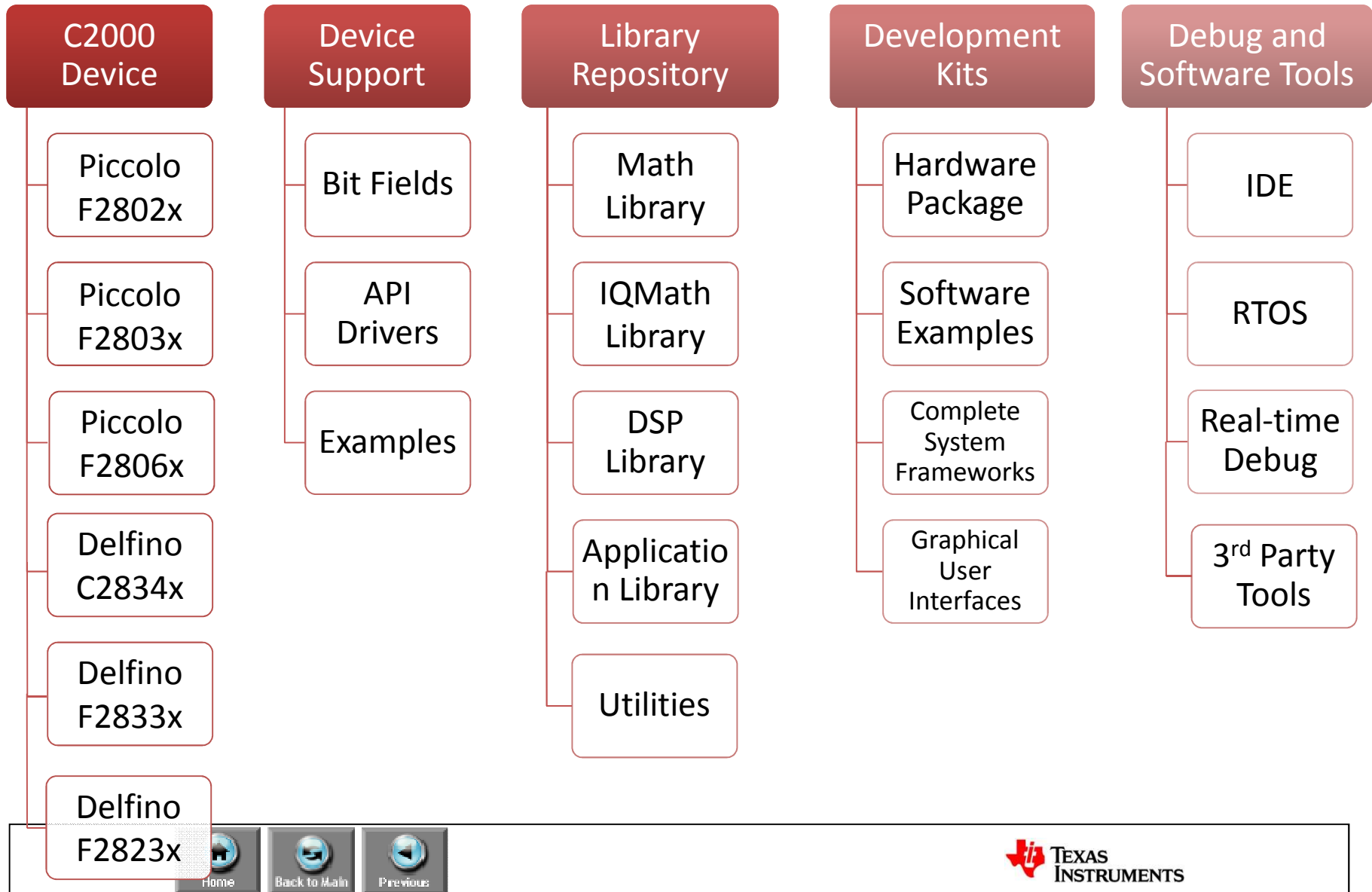
Unparalleled access & support

Free software coupled with intuitive installation environment, full documentation and active community

Save months of development time



controlSUITE Content Snapshot



Problematique des OS temps reels

- RTOS deterministic amount of time to accept and retrain from a task
- hard real-time vs soft real-time
- RTOS philosophies:
 - preemptive tasks – higher priority task interrupt execution of lower priority
 - round robin - Time-sharing designs switch tasks on a regular clock interrupt, and on events, called.

SYS/BIOS 6.x Real-Time Operating System

- SYS/BIOS is an open-source real-time kernel for TI Embedded Processors
 - BSD licensed: all source code included with build support
 - Free: no development or runtime licensing costs
 - Integrated with TI's IDE, CCS/Eclipse
- Portable
 - ARM: Cortex M3, M4, A8, ARM926
 - C2000 DSC Family
 - MSP430 MCU Family
 - C6000 DSP Family
- High Performance
 - Minimal interrupt latency, fast context switch, multiple thread levels
 - Memory efficient for both code and data
- Scalable
 - From small, static kernel-only to dynamic, multi-core networked systems
 - Additional packages for IPC, TCP/IP, filesystems, multimedia frameworks
- Modular and Extensible
- Latest generation in a family of RTOS products going back 20 years

SYS/BIOS - Graphical Configuration Tool

The screenshot displays the CCS Edit interface for the file `ssM3/stairstep.cfg`. The main window is titled "Task Thread Management - Module Settings". It features a "Module" tab and an "Instance" tab. Below the tabs, there is a description: "The Task module allows you to create one or more prioritized threads, each with a separate stack, that can block on one or more events." A checkbox labeled "Add Task threads to my configuration" is checked. Below this, there are two sections: "Global Task Options" and "Default Task Options".

Global Task Options:

- Number of priorities: 16
- All blocked function: `ti.sysbios.knl.Task.allBlockedFunction`
- ☒ Initialize stack

Default Task Options:

- Default stack size: 2048
- Default stack section: `.bss:taskStackSection`
- Default stack heap: null

At the bottom of the window, there is a "Console" window showing a table of tasks. The table has columns: address, label, priority, mode, fxn, arg0, arg1, stackPeak, stackSize, stackBase, and blockedOn. The tasks listed are:

address	label	priority	mode	fxn	arg0	arg1	stackPeak	stackSize	stackBase	blockedOn
0xc30685b8		1	Ready	taskLoad	0x00000000	0x00000000	604	2048	0xc30d7a70	
0xc3068600		2	Blocked	ti_ndk_config_Glob...	0x00000000	0x00000000	1380	8192	0xc30d8270	Semaphore: 0xc30c31d8
0xc3068648	ti.sysbios.knl.Task.IdleTask	0	Running	ti_sysbios_knl_Idle...	0x00000000	0x00000000	892	2048	0xc30da270	
0xc3068690	Adaptor Tx	1	Blocked	ti_uia_runtime_sup...	0x00000000	0x00000000	668	2048	0xc30daa70	Event: 0xc3068408
0xc30686d8	Adaptor Rx	1	Blocked	ti_uia_runtime_sup...	0x00000000	0x00000000	668	2048	0xc30db270	Semaphore: 0xc30c58a8
0xc30c33d8	ConfigBoot	5	Terminated	NS_BootTask	0xc3052cc4	0x00000000	884	4096	0xc30c3428	
0xc30c4bb8	DHCPclient	5	Blocked	dhcpState	0xc30c4478	0x00000000	828	3072	0xc30c4c08	Task_sleep(14399780)

The bottom of the window shows a "SYS/BIOS" window with tabs for "Task", "Swi", "M3/Boot", and "Source". The "Task" tab is selected, showing a list of tasks. The bottom status bar indicates "Licensed" and "LE".

Kit d'évaluations et outils de développement

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Exemple de mise en oeuvre

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