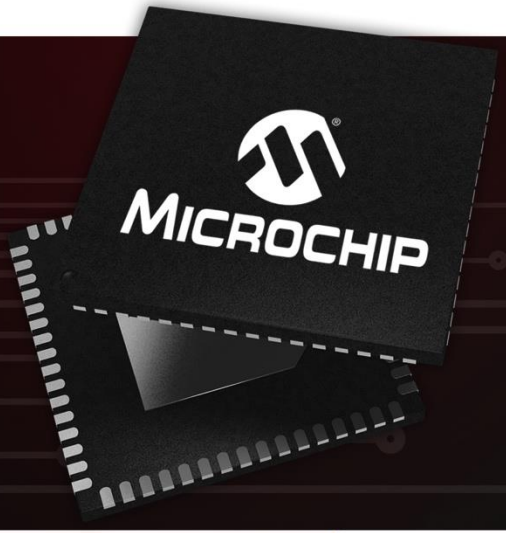
MICROCHIP



A Leading Provider of Microcontroller, Security, Mixed-Signal, Analog & Flash-IP Solutions




COTS scalable solutions for Space

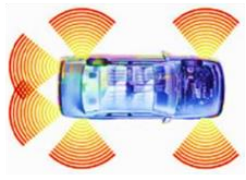
Nicolas Ganry

ACCEDE COTS 2019

Microchip COTS Portfolio Overview

MCUs	Analog	Mixed Signal	Interface	Memory	Power Mgmt.	Switches & Controllers	High-Rel Discrete	Enterprise Storage	FPGA

Industrial 27%	Automotive 17%	Consumer 16%	Communication 13%	Computing 12%	A&D 11%






COMBINED CAPABILITIES

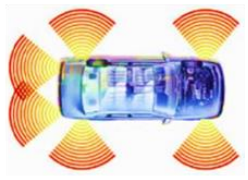
Industry Leading Portfolio Aerospace & Defense

ADG*

A&D Products Line

Combined Products Portfolio for Aerospace & Defense Total System Solution (TSS)

Industrial	Automotive	Consumer	Communication	Computing	A&D
27%	17%	16%	13%	12%	11%



COMBINED CAPABILITIES

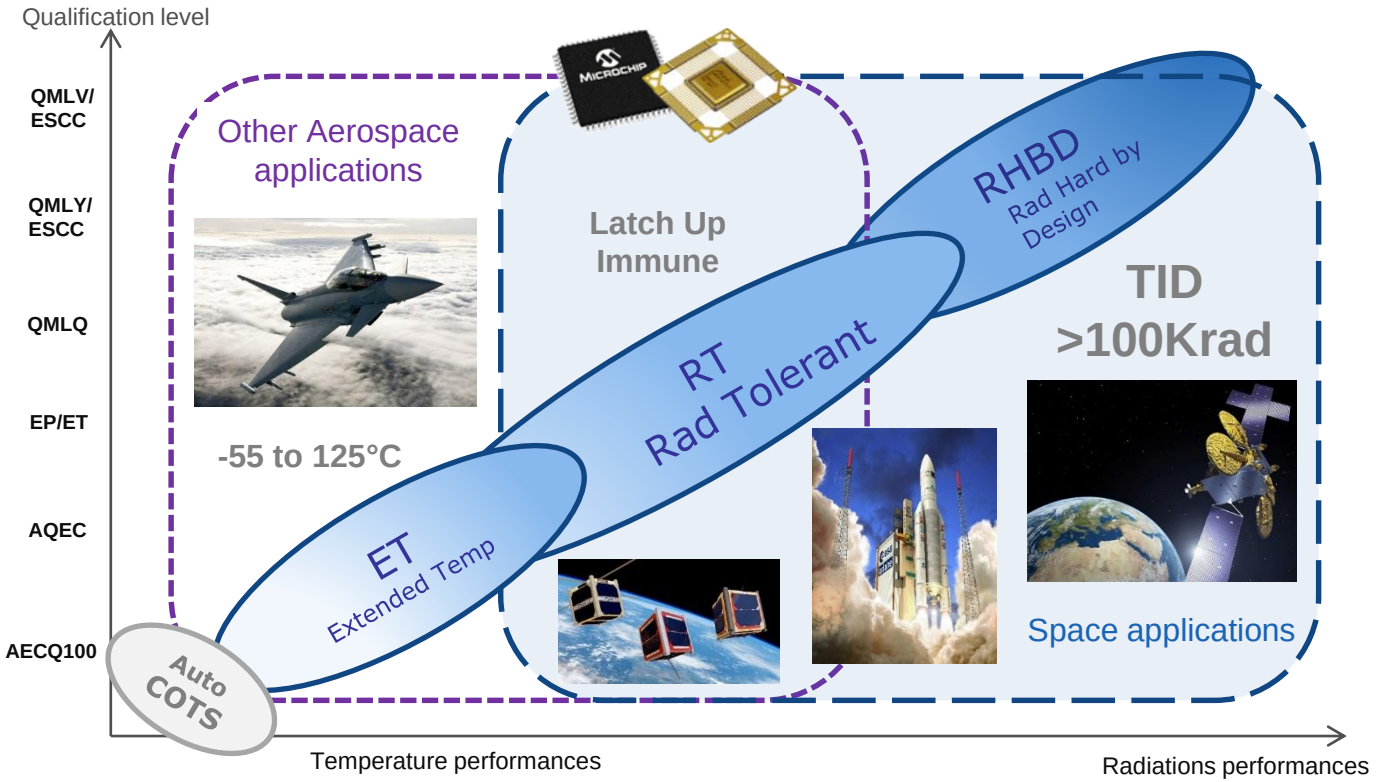
*Aerospace & Defense Group

Aerospace & Defense Product Line in France

Design
Foundry
Probe
Assembly
Test
Support

- **Committed to High Reliability and Long-Term Supply**
  - Delivering aerospace ICs for more than 30 years
  - Strong flight heritage in space and avionic applications
  - Leverage from automotive solutions for “new space” challenges: volumes, costs and time to market
- **Major Products Focus**
  - ASICs
  - Processors and microcontrollers
  - Communication interfaces and memories
- **DLA/ESCC Microchip Qualified Supply Chain**
  - Foundry and Assembly in Asia
  - Design, electrical tests, qualification & controls in France
- **Long term cooperation with European agencies:**
  - ESA, CNES, DGA, DLR….

COTS Scalable Solutions for Aerospace

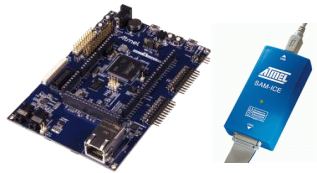


Use of COTS in Space

Advantages	▪ Easy access and costs effectives (volume) ▪ AECQ100 Automotive qualified parts ▪ Reliability linked to high volumes and high nb of users ▪ Wide access to State of art technologies and architectures ▪ Access to free ecosystem and benefit from community
Drawbacks	▪ No traceability, No SLDC, High silicon lots discrepancy ▪ Limited access to qualification and supply chain data => PPAP only for “specific” auto customers / volumes ▪ Products turnover, versioning and obsolescence (EOL) ▪ Weak or Unknown radiations performances. Not always lucky. ▪ Product knowledge and costs for radiations testing/screening ▪ No FM support from silicon provider, no guarantee and RMA

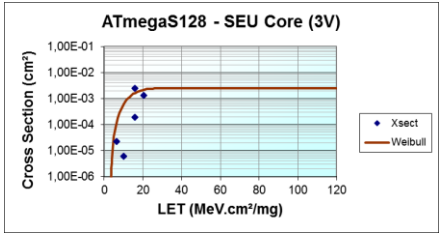
COTS Rad Tolerant Devices

- ***Start from industrial/automotive products***
  - Same mask set
  - Same functionality
  - Same development tools
  - Easy access via commercial eval kit
  - Free tool chain & libraries
  - Same pin out as commercial device



- ***Hardening of critical parameters***
  - Technology process change / tuning
    => Target no **single event latch-up up to 62 MeV/mg/cm2** @ 125°C
  - Embedded Flash & SRAM robustness, **SEFI LET > 30 Mev**
  - SEU full characterization, blocks by blocks
  - **TiD** between **20 to 50 Krad** (Space)

Heavy ions
Protons
Neutrons



- ***Scalable solution, 2 proposed quality flows***
  - **Space Grade Ceramic**: QMLV / QMLQ qualification & screening equivalent
  - **Hi-Rel Plastic**: Temp screening, Auto / AQEC like qualification, full lot traceability

Hi-Rel Plastic Quality Flow Qualification

- ***Initial qualification***
  - ***Generic data from comm/auto device***
  - Wafer Level Reliability (WLR) data: EM, SM, NBTI, HCI…
  - AEC-Q100 qualification data (or equivalent)
  - ***Datas specific to -HP Rad-Tolerant device (1 lot)***
  - Electrical qualification (ESD, electrical latch-up, electrical characterization full temp. range)
  - Outgassing test
  - Construction analysis
  - NVM endurance, NVM data retention, life test up to 4000h/125°C with electrical test full temp. range
  - Assembly capability tests (bond pull/bond shear tests, solderability, lead integrity…)
  - Assembly reliability tests (thermal cycling, HAST…) with electrical test full temp. range
  - ***Radiation test (TID, SEE)***

Hi-Rel Plastic Quality Flow Screening

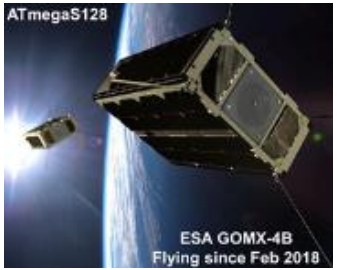
- ***Screening 100%***
  - Electrical screening over full temperature range
  - External visual inspection and coplanarity
  - *Options: thermal cycling and burn-in*

- ***Traceability & Documentation***
  - Wafer and assembly lots full traceability
  - In addition to the datasheet, a Product specification is available with description of electrical tests, electrical parameters limits and fault coverage
  - Qualification report, including life-time estimation and detailed TID/SEE report.
  - Certificate of compliance vs Product Specification

COTS to Rad Tolerant MCU/MPUs

Production
Development
Roadmap

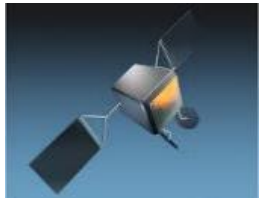
Products	Type	ET/RT	Summary / Highlights	Flight Models
ATmega128	AVR8	ET/RT	<20 DMIPS, SPI,TWI, UART, ADC	**Available**
ATmega64M1	AVR8	ET/RT	<20 DMIPS, CAN, DAC and Motor Control	**Available**
SAMV71Q21	ARM32 M7	ET/RT	600 DMIPS, CAN FD, Ethernet TSN, DSP	**Available**
SAM3X8E	ARM32 M3	RT	100 DMIPS, CAN, Ethernet, Dual CAN	Q4 2019
Digital Power MCU	MCU16	ET/RT	16 Bit DSC High-Resolution PWM and CAN FD	
MPU	ARM32 A5	ET/RT	850 DMIPS, Gbit Ethernet TSN, DDR3, MMU	
Low end MCU	ARM32 M0+	ET/RT	45 DMIPS, ECC Flash and SRAM, 150°C	



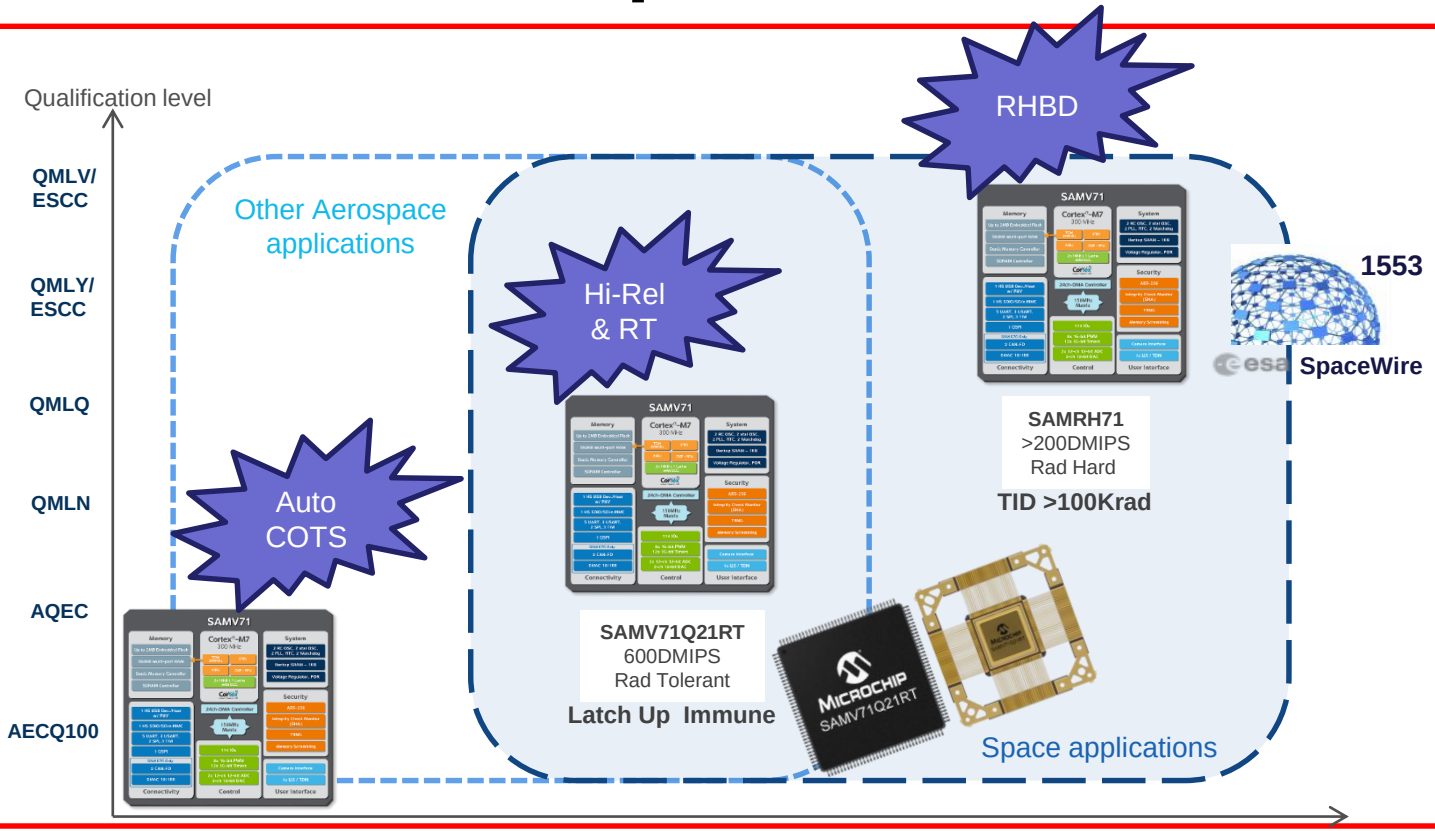
Exomars
2020

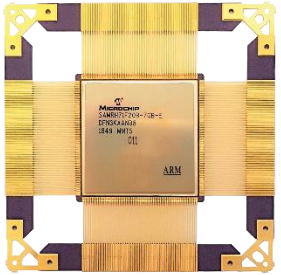
ATmegaS128

MegaConstellation
LEO Orbit
In flight 2019



SAMV71 for Space
Unique Scalable Solution





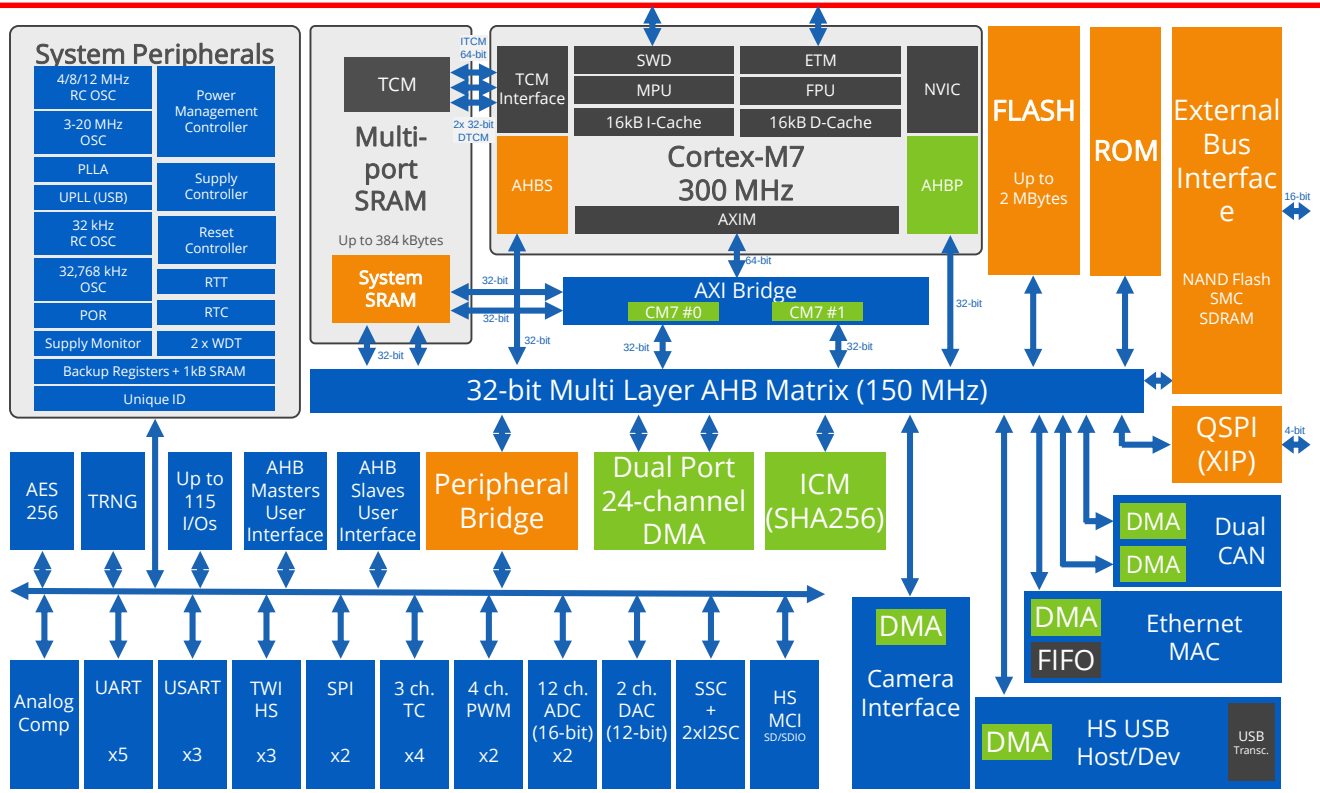
SAMRH71
ES available
FM Q1 2020

SAMV71Q21RT
FM available

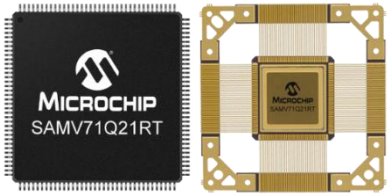
Arm® Cortex®-M7
SAMV71Q21RT

Legend:
AHB Masters | AHB Slaves

ICM: Integrity Check Monitor



ES/FM Available



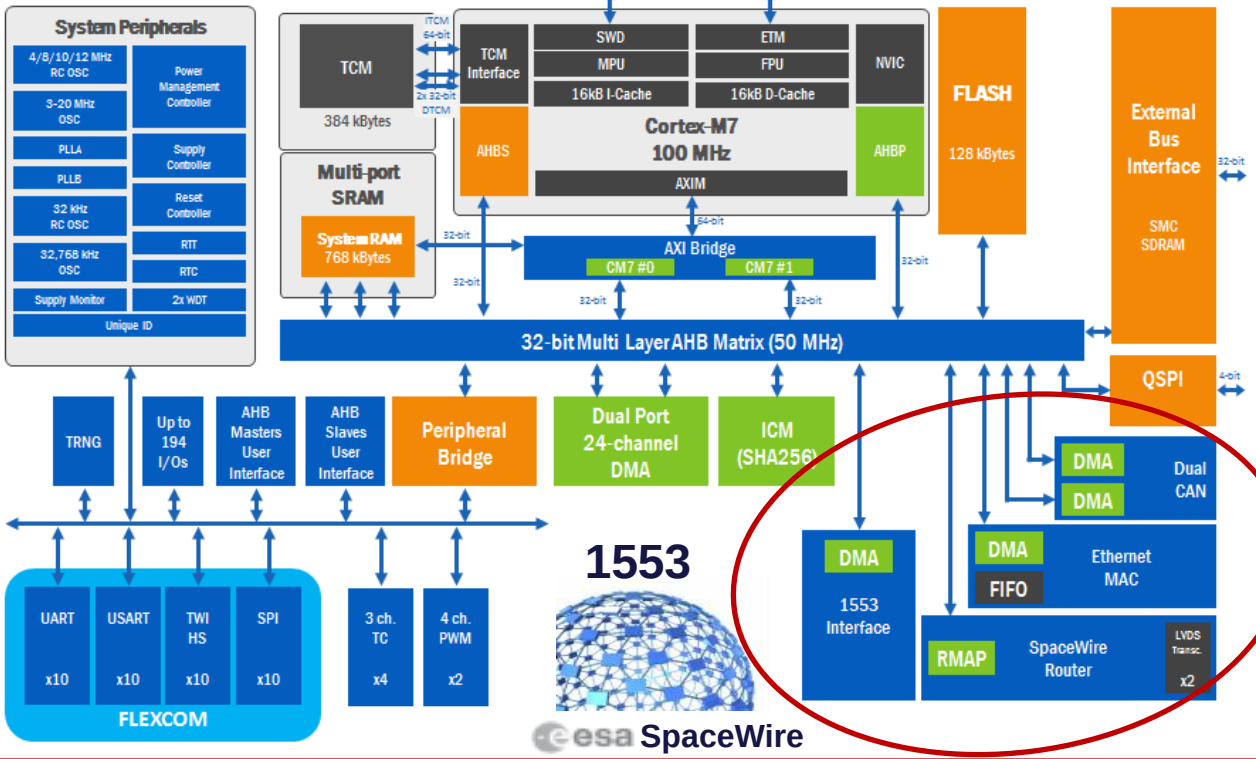
>600DMIPS
2 MB Flash w ECC
384 KB SRAM
Ext Mem
QFP144

FPU/DSP
Dual CAN FD
Ethernet TSN
Crypto AES

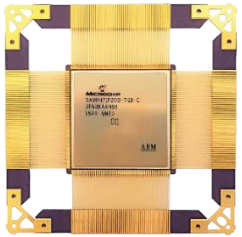
SEL immune
TID 30 Krad

SAMRH71 Architecture

Legend:
AHB Masters | AHB Slaves



ES Available, FM Q120



>200DMIPS
128 KB Flash w ECC
1MB SRAM, (384 TCM) ECC
Ext Mem ECC
QFP256

Spacewire 200Mbit/s
1553 M/S
FPU/DSP, CAN FD, Eth. TSN

SEU LET >20 Mev, no SEL/SEFI
TID > 100 Krad

Arm® Cortex®-M7 SoC

Benefits from Same HW/SW Ecosystem

Xplained board

Ordering Code: ATSAMV71-XULT

SW Tools suite

Atmel Studio 7

MPLAB HARMONY

Atmel SAM-ICE Emulator

Ordering Code: AT91SAM-ICE

Atmel ICE programmer and debugger

Ordering code P/N: ATATMEL-ICE

Ready to use software, example projects

Already ported OS for M7 SoC (V71)

IAR SYSTEMS

KEIL Tools by ARM

SEGGER

HCC embedded

freeRTOS

µ Linux

expresslogic

Micro Digital YOUR RTOS PARTNER

Micrium

Ongoing BSP projects : RTEMS, Xstratum

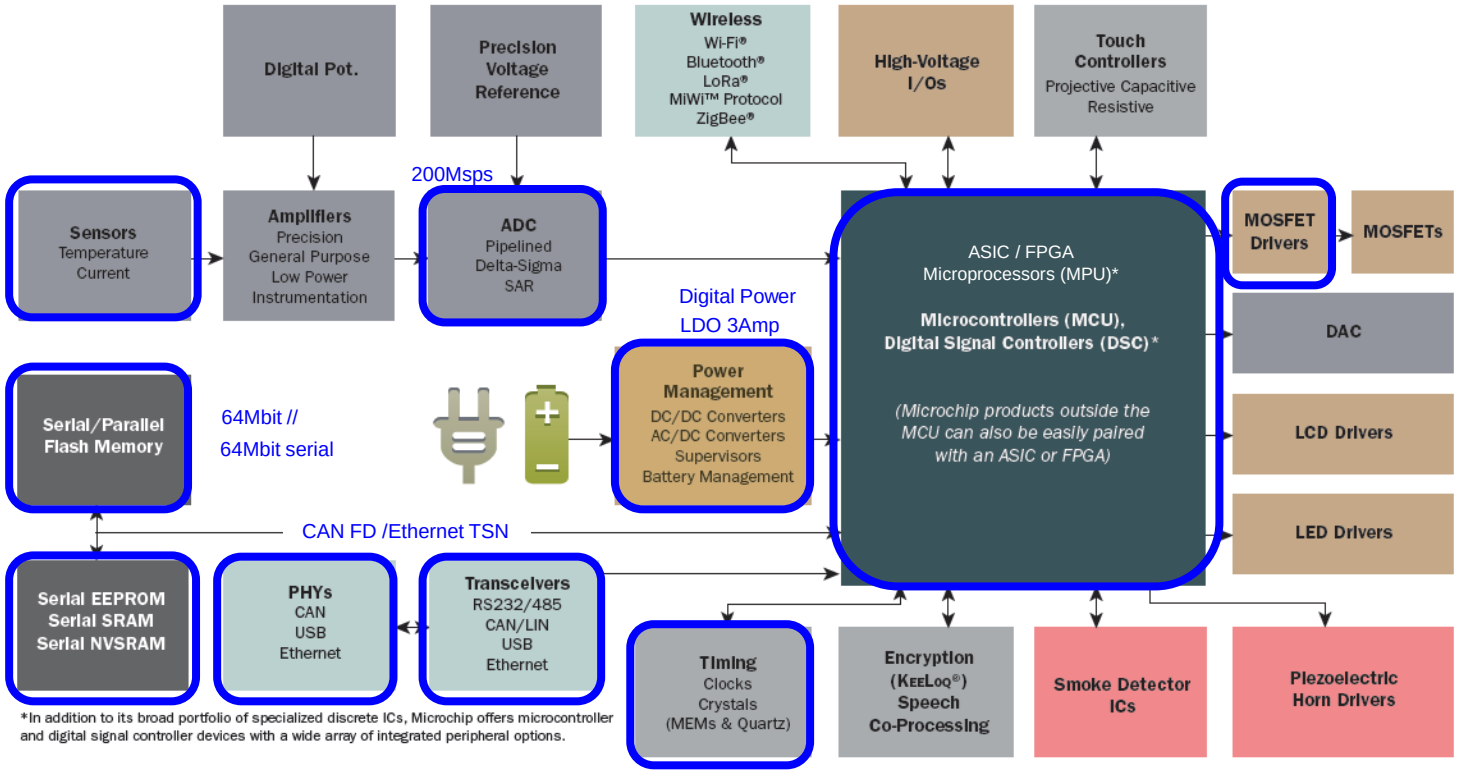
fentISS

n7 SPACE

RTEMS

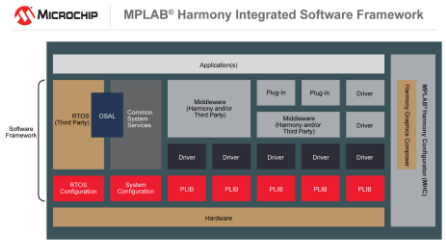
Companion RT Products for Space

COTS RT



Total System Solutions
Aerospace & Defense

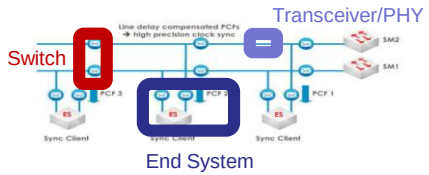
- **Enabling complete solutions with :**
  - Companions : transceivers, switches, interfaces, …
  - Applications notes, system and hardware design examples
  - Software libraries as example and tools for targeted application

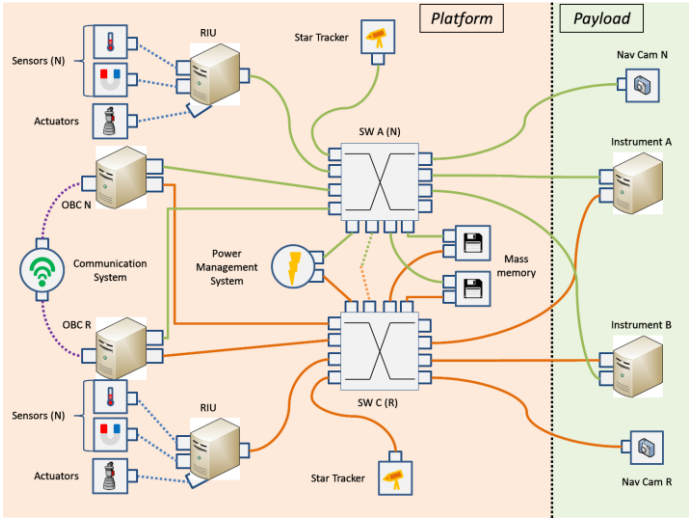


- **Ethernet safety – AVB/TSN**

- **CAN/CAN FD networks**
- **Motor control solutions**
- **Digital power migration**
- **Non-Volatile Memories**
- **ADCs & IO extension devices**
- **FPGA companions (reprogramming, powering)**

Ethernet Safety
COTS RT TSS example





- **End System**

Products	Rad	Type	Available
SAMV71RT	RT	Arm MCU w Ethernet TSN 100Mb	FM
SAMRH71	RH	Arm SoC w Ethernet TSN 100Mb	ES
RT FPGA	RH	w TSN IP targeting 1Gbit	
MPU RT	RT	Arm SoC Ethernet TSN 1Gbit	

- **PHY**

Products	Rad	Type	Available
VSC8540/41 RT	RT	100Mb/1Gbit Ethernet Transceiver, RMII/RGMII	ES H219 FM H120

- **Switch**

Products	Rad	Type	Available
Gbit Switch	RT	Gbit Ethernet Switch TSN/AVB	

Production
Development
Roadmap

Conclusion

- Microchip A&D dedicated product line in France
- COTS to RT concept, Available AVR and Arm MCU
- Hi-Rel Plastic proposed flow for space applications
- Arm® Cortex®-M7 SoC unique scalable solution, from COTS to RH, benefits from same ecosystem
- Total System Solution to propose COTS to RT companions around MCU/MPU and FPGAs

For More Information

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Thank You