MICROCHIP

Aerospace & Defense

High End Digital Processing Technology w Rad Tolerant COTS

1st October 2018

Aerospace & Defense Product line

Design

Foundry

Probe

Assembly

MMT

Test

Support

- **Committed to High Reliability and Long Term Supply**
  - Delivering Aerospace ICs for more than 30 years
  - Strong Flight Heritage in Space & Avionics applications
  - Leverage from Automotive solutions for “New Space” challenges : Volumes, Costs and Time To Market

- **Major Products Focus**
  - ASICs
  - Processors & Microcontrollers
  - Communication Interfaces and Memories

- **Internal Qualified Supply Chain**
  - DLA / ESCC : Wafer lot to Qualified parts (France)
  - DLA : Assembly line (Thailand)

- **Long term cooperation with European agencies:**
  - ESA, CNES, DGA, DLR….

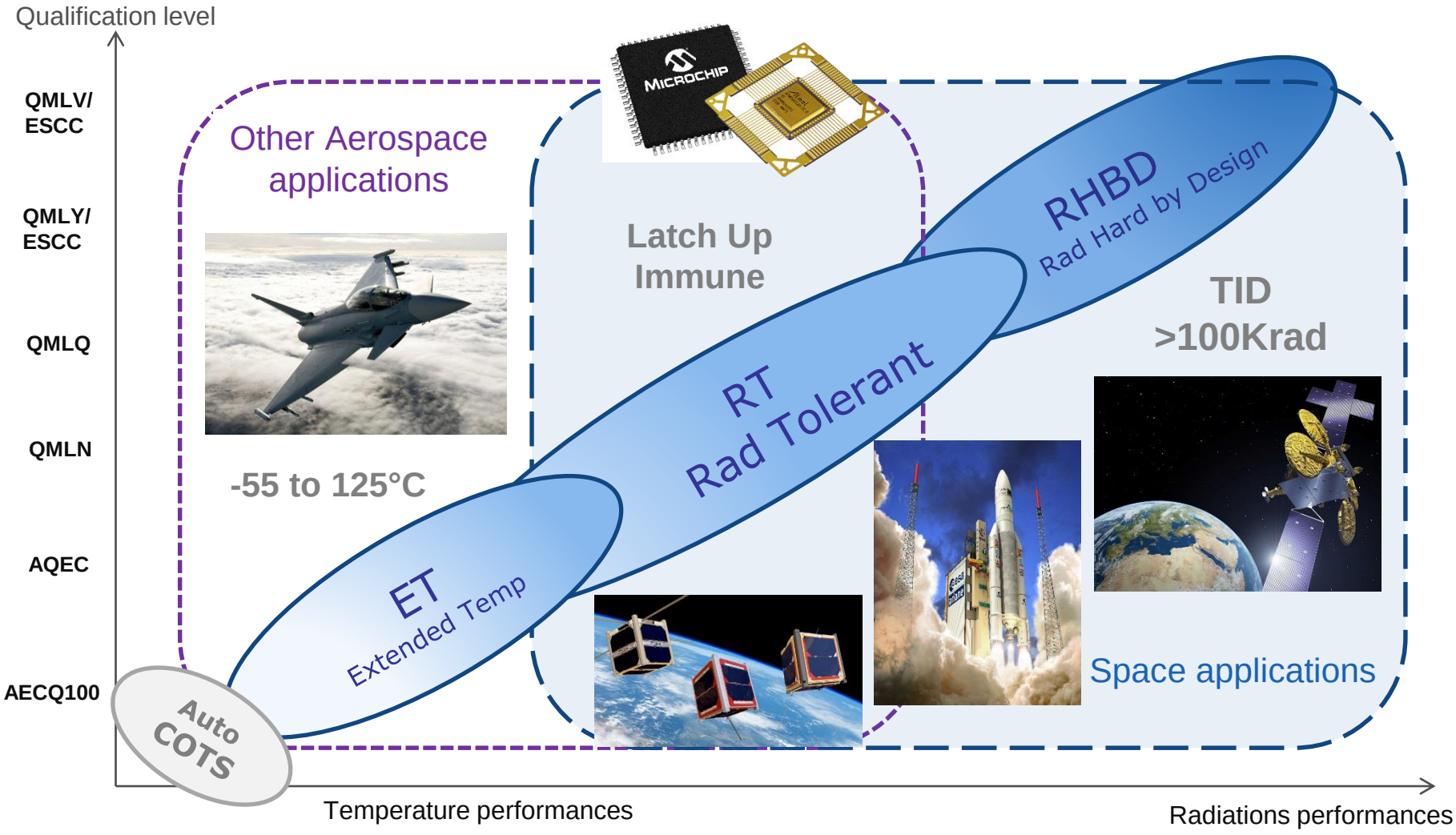
Use of COTS in Space

- **Advantages**
  - Easy access and costs effectives (volume)
  - AECQ100 Automotive qualified parts
  - Reliability linked to high volumes & high nb of users
  - Wide access to State of art technologies & architectures
  - Access to free ecosystem and benefit from community

- **Drawbacks**
  - No traceability, No SLDC, High silicon lots discrepancy
  - Limited access to qualification & supply chain datas

    => PPAP only for “specific” auto customers / volumes
  - Products turnover, versioning & obsolescence (EOL)
  - Weak or Unknown radiations performances. Not always lucky.
  - Product knowledge & costs for radiations testing/screening
  - No FM support from silicon provider, no guarantee & RMA

Scalable Solutions for Aerospace



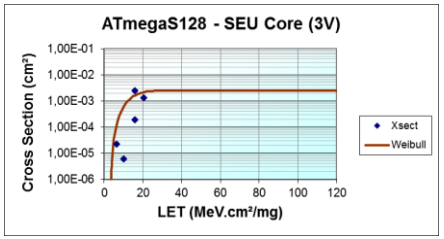
COTS to Rad Tolerant devices

- ***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***

Heavy ions
Protons
Neutrons

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



- ***Scalable solution, 2 proposed Quality Flows***
  - **Space Grade Ceramic** : QMLV / QMLQ qualification & screening equivalent
  - **Hirel Plastic** : Temp screening, Auto / AQEC like qualification, Full lot traceability

HIREL MCU/MPUs

Production
Development
Roadmap

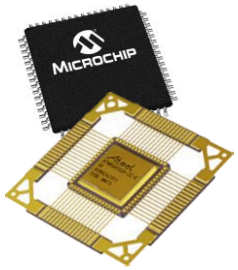
*105°C/-55°C (85°C plastic)

Radiation Tolerant & Extended Temperature

Products	Type	ET/RT	Summary / Highlights	Flight Models
ATmega128	AVR8	ET/RT	<20DMIPS, SPI,TWI, UART, ADC	**Available**
ATmega64M1	AVR8	ET/RT	<20DMIPS, CAN, DAC & Motor Control	**Available**
SAMV71Q21	ARM32 M7	RT	600DMIPS, CAN FD, Ethernet TSN, DSP	Nov 2018
dsPIC33EP128GS	MCU16	ET	50DMIPS, DC/DC converter, Digital power	Q4 2018
SAM3X8E	ARM32 M3	RT	100DMIPS, CAN, Ethernet, Dual Ban	Q1 2019
SAMC21J18A	ARM32 M0+	ET	45DMIPS, CAN FD, 5V, 1Msps ADC	Q4 2018
SAMA5D2	ARM A5	ET/RT	850DMIPS, Gbit Eth TSN, DDR3, MMU	H2 2019

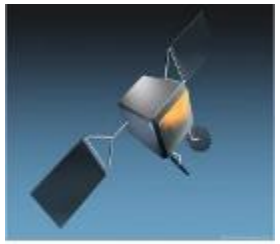
ATmegaS128

Flight 2017
ESA GOMX-4B



Radiations results ✔
- SEL immune up to 62.5MeV
- SER 1 event every 1000 days in LEO
- TID 30Krad

Exomars 2020



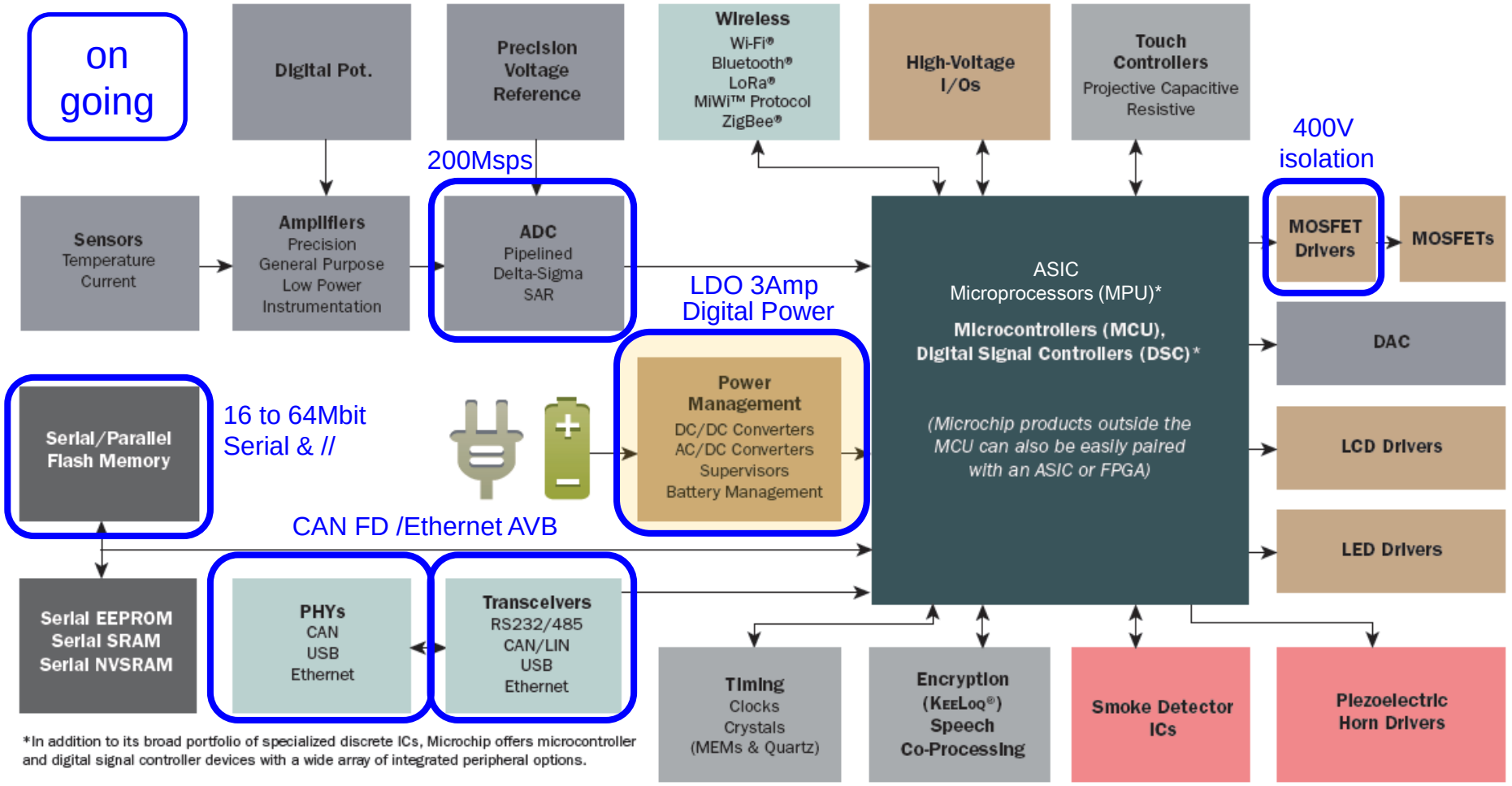
Constellation LEO
Launch 2018

Rad Tolerant Microcontrollers Space Targeted Applications

- Platform & Payload data storage
- Platform Data Handling
- Remote Terminal Units (RTUs)
- Propulsion system control
- Sensor bus control
- Robotics applications
- Mechanisms and motor control
- Power control
- OBC for nano-satellites
- Thermal control
- Simple instrumentation (particle detector, radiation monitor, etc)
- Angular & Sun sensor
- Star Tracker
- Gyroscope
- ….

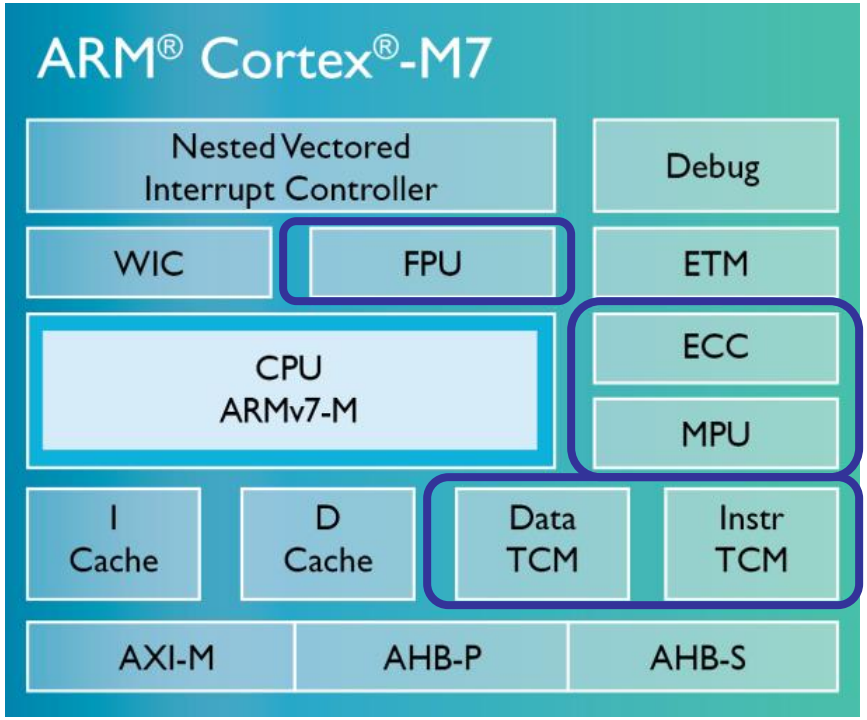
=> Develop System Solution approach around Microcontrollers based on Microchip portofolio

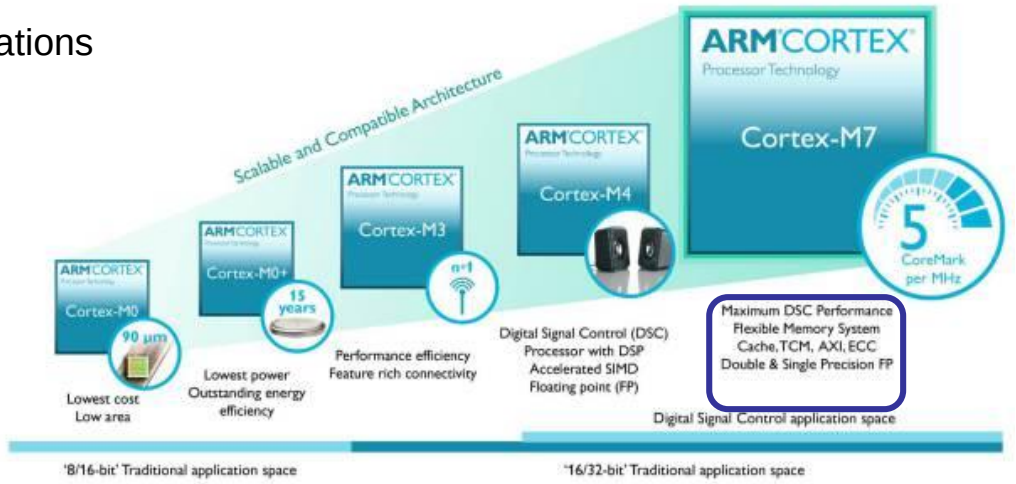
Hirel companions Candidates for ET/RT



ARM Cortex-M7 Architecture

Designed for Safety and Powerful real time applications



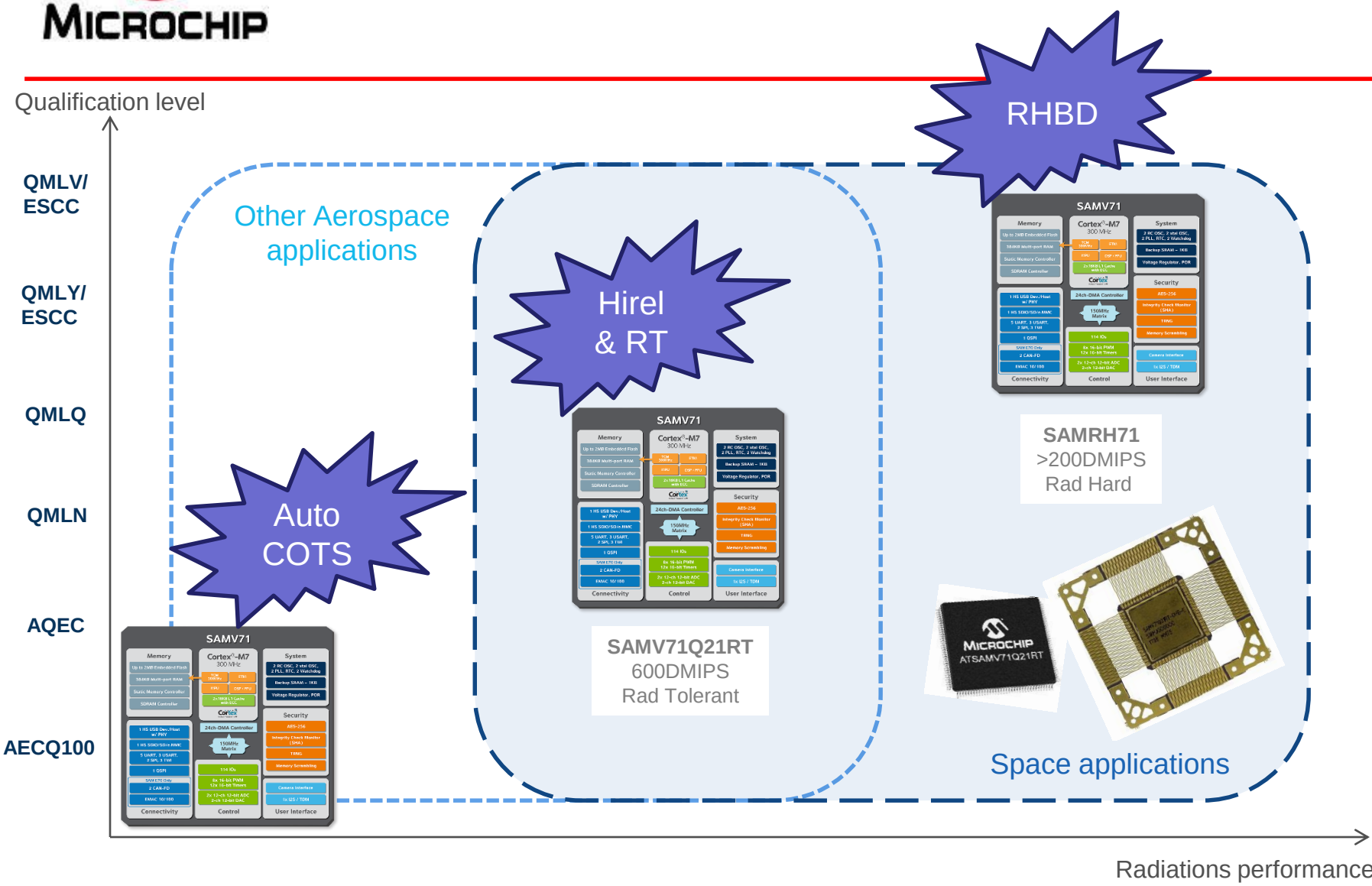


Cortex Core	Architecture	Pipeline	Thumb / Thumb 2	MPU	DSP	FPU	Performances (DMIPS/MHz)	Dynamic Power consumption (uW/MHz)
M0	Von Neumann	3	Most / Subset	No	No	No	0.84	16.4
M0+	Von Neumann	2	Most / Subset	Opt.	No	No	0.93	9.8
M3	Harvard	3	All / All	Opt.	No	No	1.25	32
M4 Multicore	Harvard	3	All / All	Opt.	Yes	Opt.	1.25	33
M7 Multicore	**Harvard**	**6**	**All / All**	**Opt.**	**Yes**	**Opt.**	**2.14**	**33**
A5 Multicore	Harvard	8	All / All	MMU Trust Zone	Yes	Opt.	1.57	
A7 Multicore	Harvard	8	All / All	MMU Trust Zone	Yes	Opt.	1.9	

MPU : Memory Protection Unit
ECC: Error Checking & Correction
FPU: Floating Point Unit
TCM: Tightly Coupled Memory

Embedded in **SAMV71** High End Automotive SoC

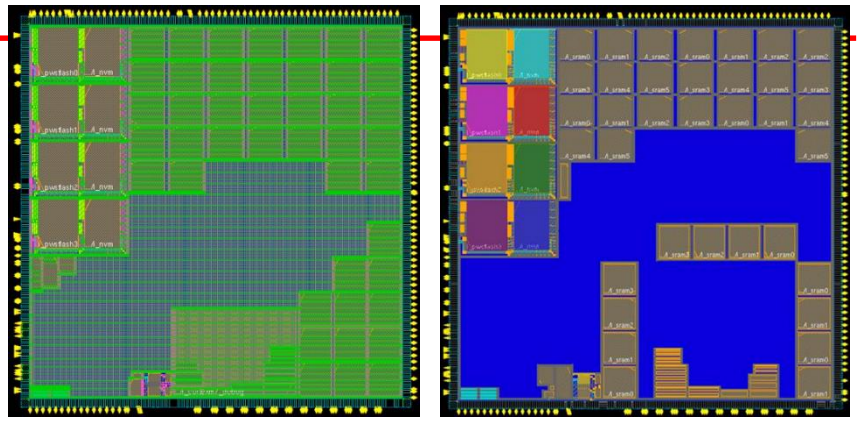
SAMV71 Scalable Unique Solution



SAMRH71 Status

- **First Silicon available for MCHP validation (N1)**
- **1st Radiations campaign done Aug18, next Nov18**
- **Full perfs/functions Tape Out Jul18 (N2)**
- **First results confirm V71 architecture benefits**
- **Customer engagement Q119 w full ecosystem HW & SW**

N1 N2



- AT697F 0.86 DMIPs/MHz
- SAMRH71 2.14DMIPs/MHz
- SAMRH71 >5Coremark/MHz

- AT697F/ SAMRH71 ~9mW/DMIPs

MPLAB HARMONY

Atmel Studio 7

ARM Cortex M7 SoC
Benefits from same HW/SW ecosystem

Xplained board
Ordering Code: ATSAMV71-XULT

SW Tools suite

MPLAB HARMONY

Atmel Studio 7

Atmel SAM-ICE Emulator
Ordering Code: AT91SAM-ICE

Atmel ICE programmer and debugger
Ordering code P/N: ATATMEL-ICE

Ready to SW use example projects

- demo with detailed documentation
- samv71_softpack_1.5_for_astudio
- exist for other software environment (IAR, EWARM, KEIL, XULT GNU)

Already ported OS for M7 SoC (V71)

IAR SYSTEMS
KEIL Tools by ARM
SEGGER
HCC embedded
freeRTOS
µLinux
expresslogic
µd Micro Digital YOUR RTOS PARTNER
Micrium

On going BSP projects : RTEMS, Xstratum

fentISS
n7 SPACE
RTEMS

MICROCHIP

Microsemi

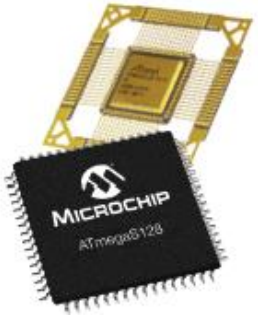
Power Matters.™

Rad Tolerant Concept

Rad Tolerant Products

COTS to RardHard "A scalable ARM SoC family"

- ASICs, MCUs, MPUs and memories
- Mixed-signal interfaces and analog solutions
- High-reliability qualification flow (AQEC, QML, ..)
- Long-term supply and lot traceability
- Plastic and ceramic packages
- Extended and high-temperature range: -55'C/125'C and >175'C
- Radiation-tolerant and immune to neutron SEL



Aerospace & Defense Web Site :

http://www.microchip.com/design-centers/aerospace-and-defense

MICROCHIP

Microsemi

Power Matters.™

THANK YOU!

Hirel Plastic Quality Flow

- **Initial Qualification**
  - AQEC, QMLN, AECQ100 equivalent
  - Wear-out reliability, ESD, Electrical latch-up, Outgassing, Construction analysis
  - Group B : Solderability
  - Group C : NVM endurance, Electrical 3 temp, Life tests, Ext Visual inspection, …
  - Group D : Thermal cycling, Wire pull, CSAM inspection, Lead integrity,…

- **Unitary Screening**
  - Full temperature range
  - Temperature cycling (opt.)
  - Unitary Burn-in (opt.)

- **Traceability & Documentation**
  - Qualification Package
  - Certificate of Compliance / Product Specification
  - Wafer, assembly, tests ID and locations
  - Die & Package characteristics (size, material, …)
  - Fault grade coverage, Tests & Process exposure conditions