MICROCHIP

Aerospace & Defense

ESCCON 2019

COTS to Rad Tolerant and Rad Hard solutions

- A&D BU in Europe
- Scalable ARM SoC
- Products Portfolio (A&D BU)

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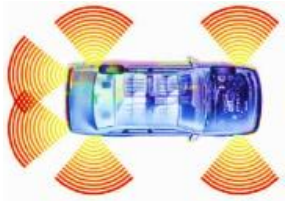
- **Scalable ARM SoC**
- **Products Portfolio (A&D BU)**

Combined Portfolio Aerospace & Defense

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

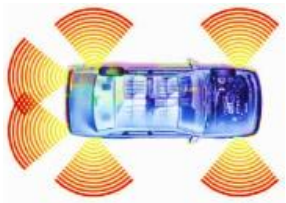
Combined Portfolio Aerospace & Defense

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 (Microchip)

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

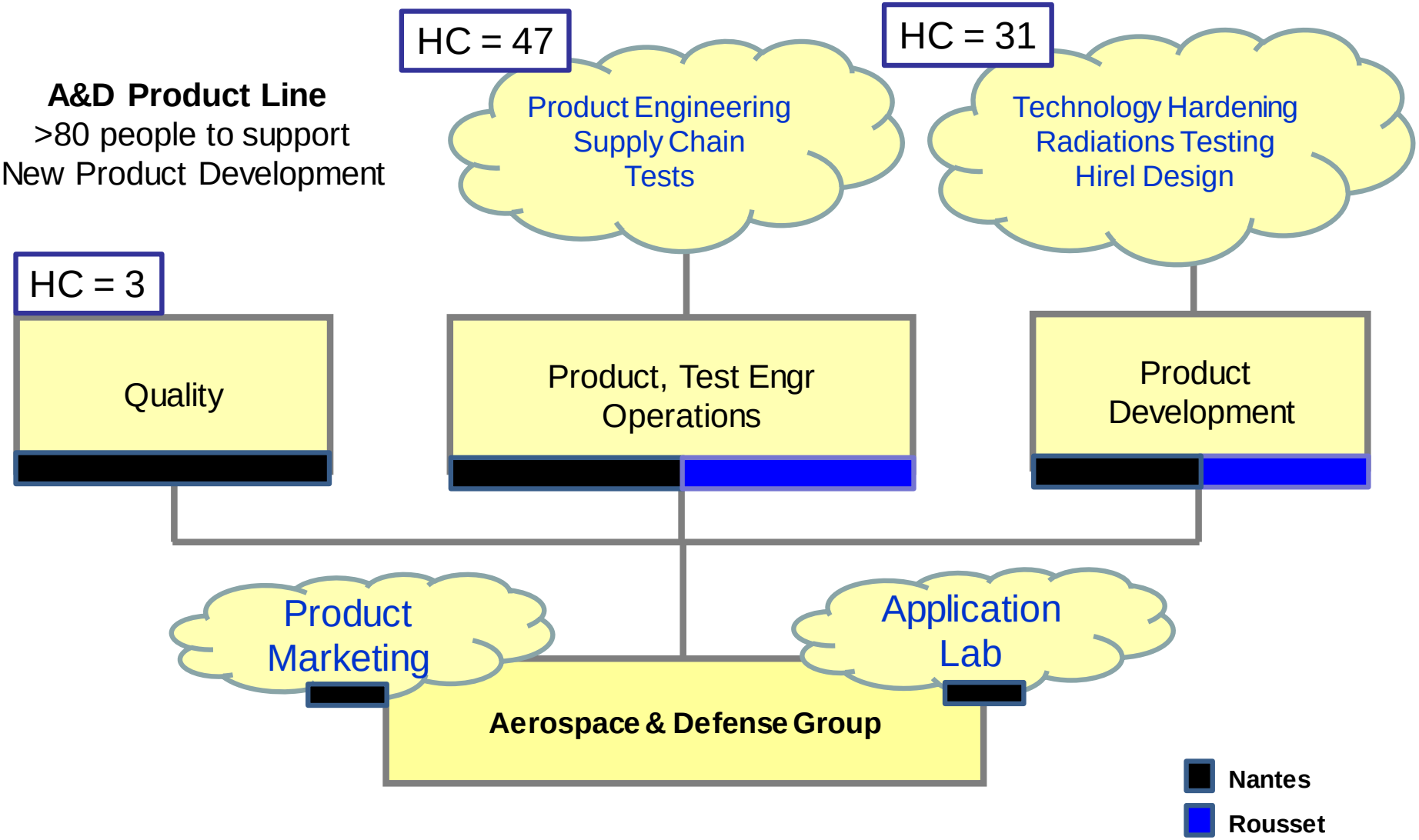
- **Major Products Focus**
  - ASICs
  - Processors & Microcontrollers
  - Communication Interfaces and Memories

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

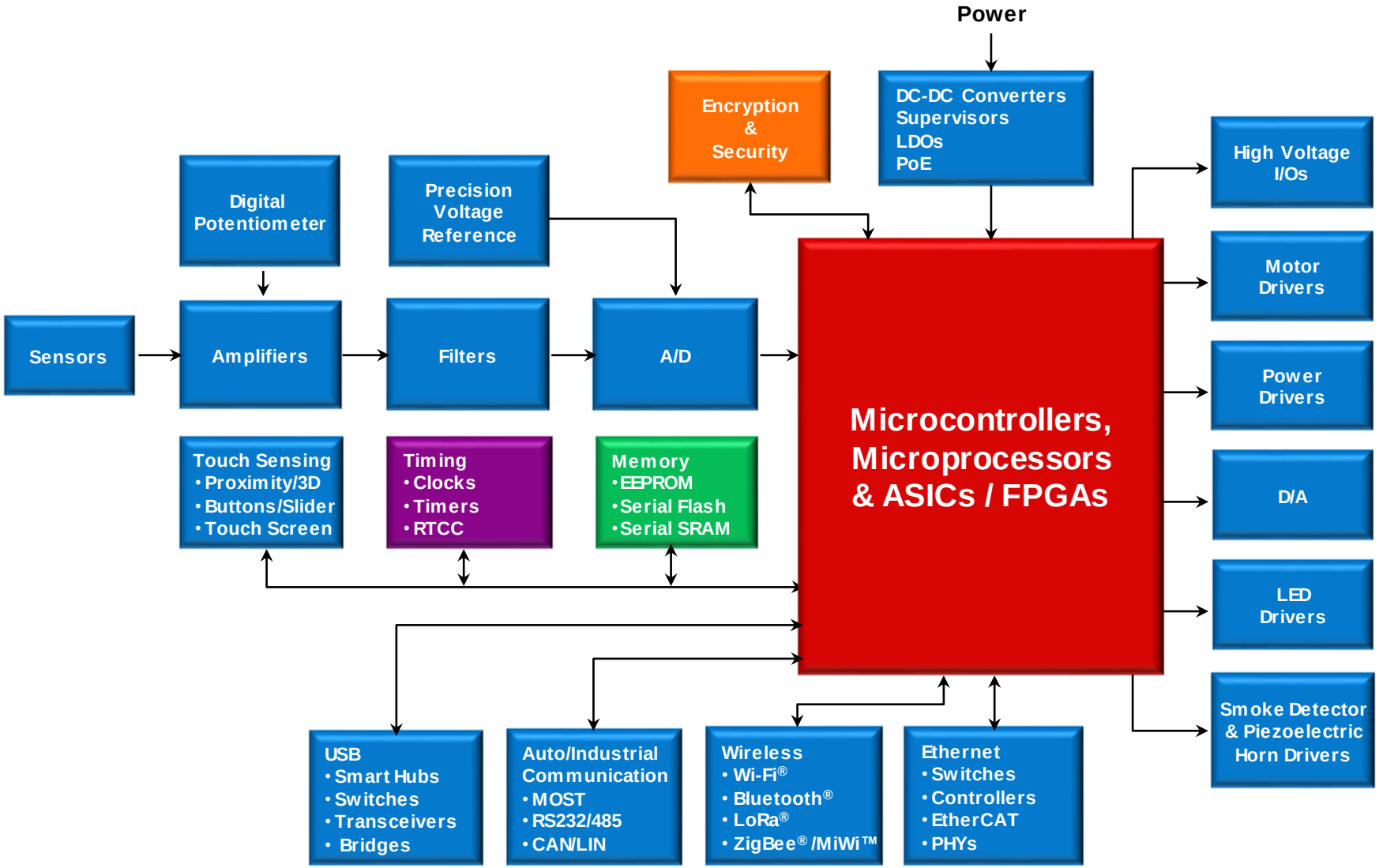
- **Long term cooperation with European agencies:**
  - ESA, CNES, DGA, DLR….

A&D BU in Europe

A&D Product Line
>80 people to support
New Product Development



Supporting Total System Solutions



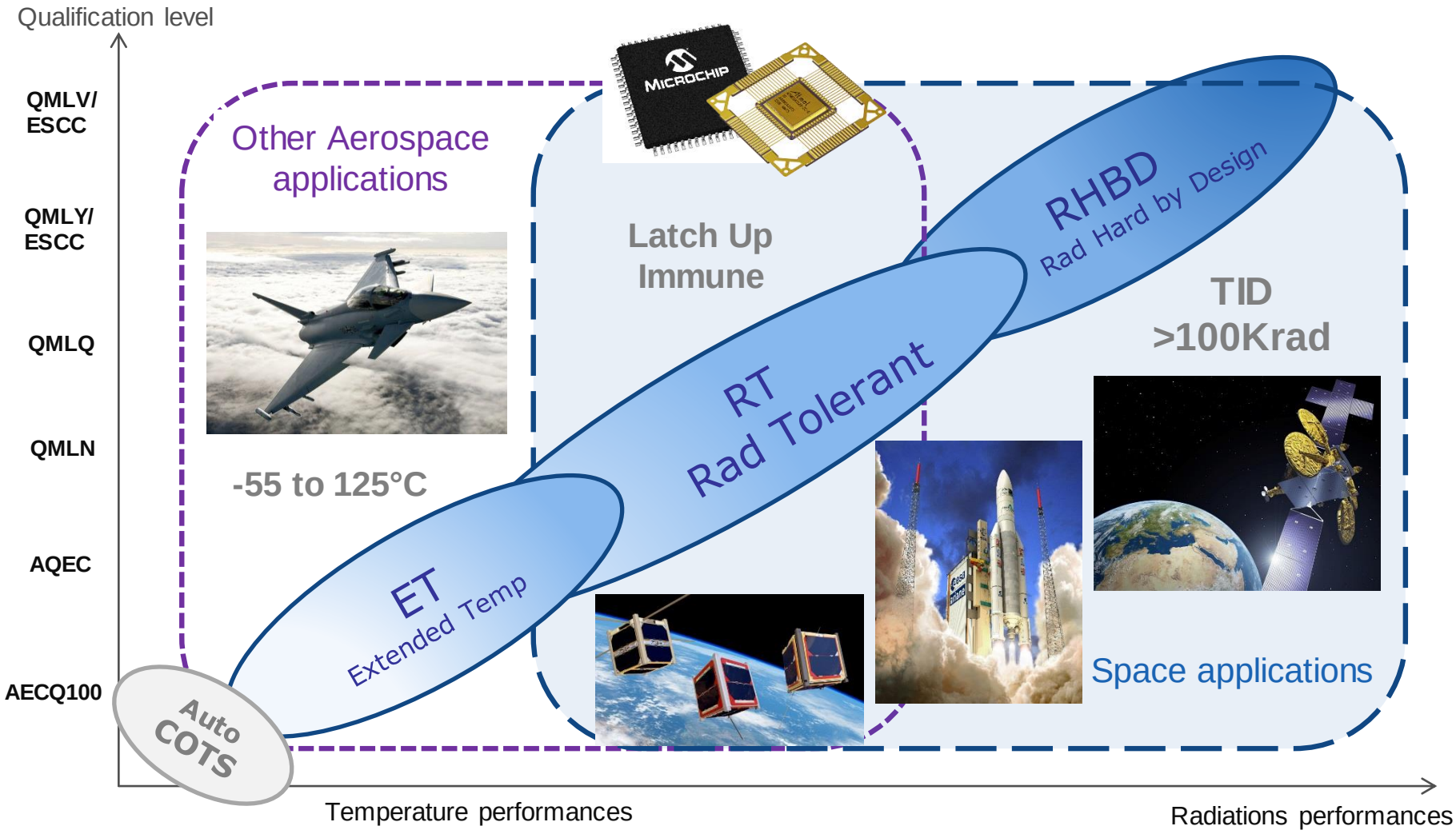
Long product life times – customer driven obsolesence

- A&D BU in Europe
- **Scalable ARM SoC**
- Products Portfolio (A&D BU)

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



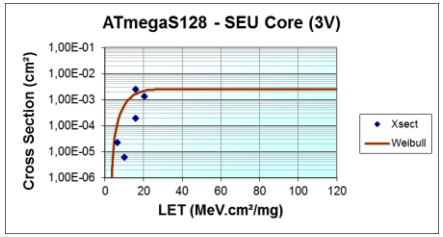
COTS to Rad Tolerant devices

- ***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***

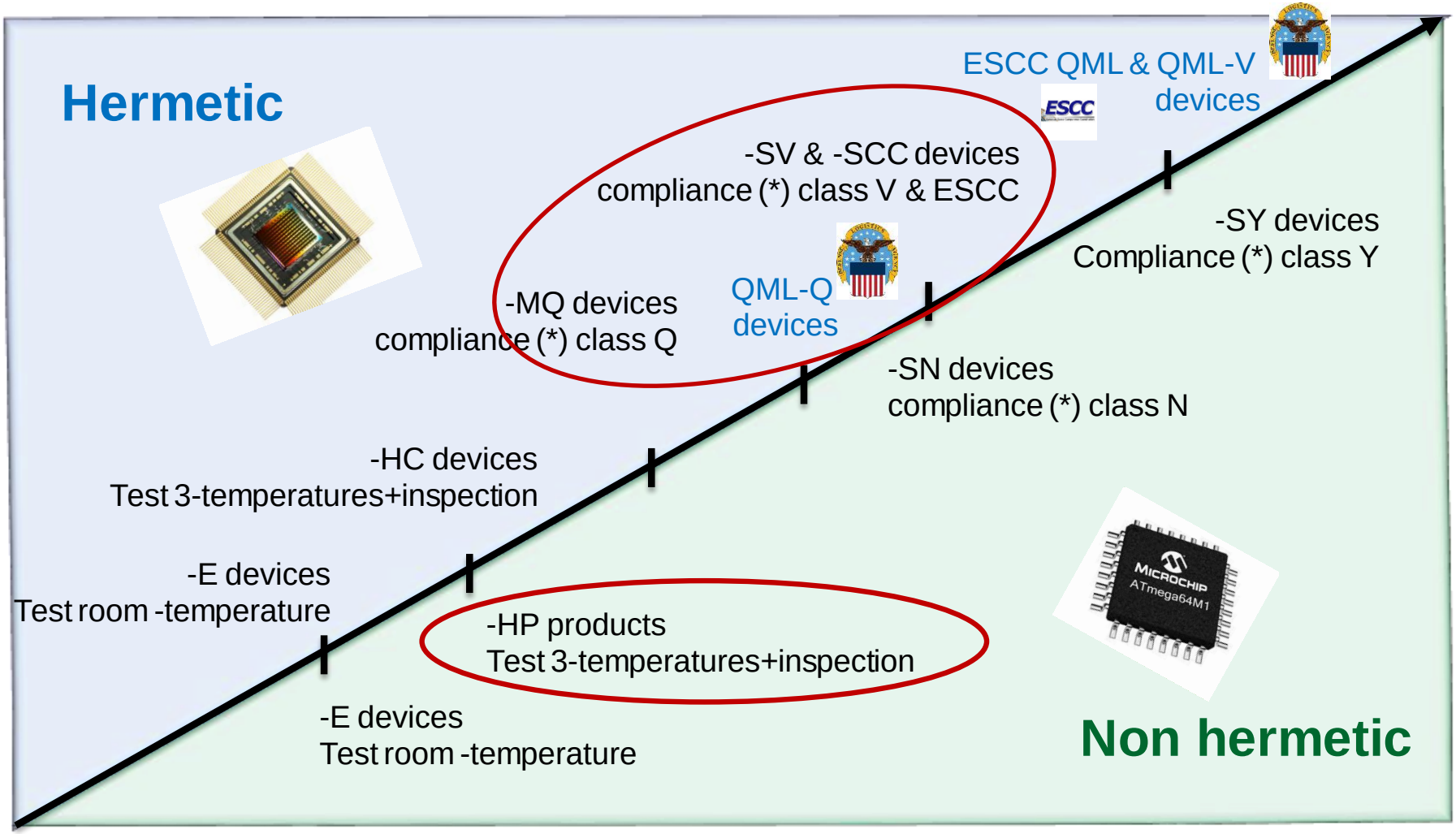
Heavy ions
Protons

  - 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** : SV / MQ qualification & screening, QML equivalent
  - **Hirel Plastic** : Temp screening, Auto / AQEC like qualification, Full lot traceability

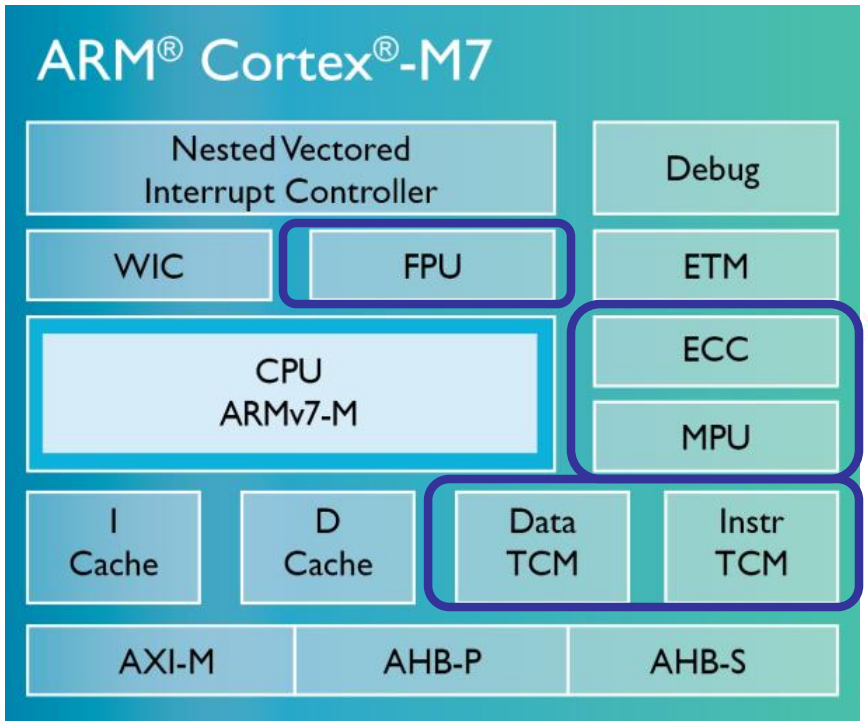
RHBD and RT devices – quality levels

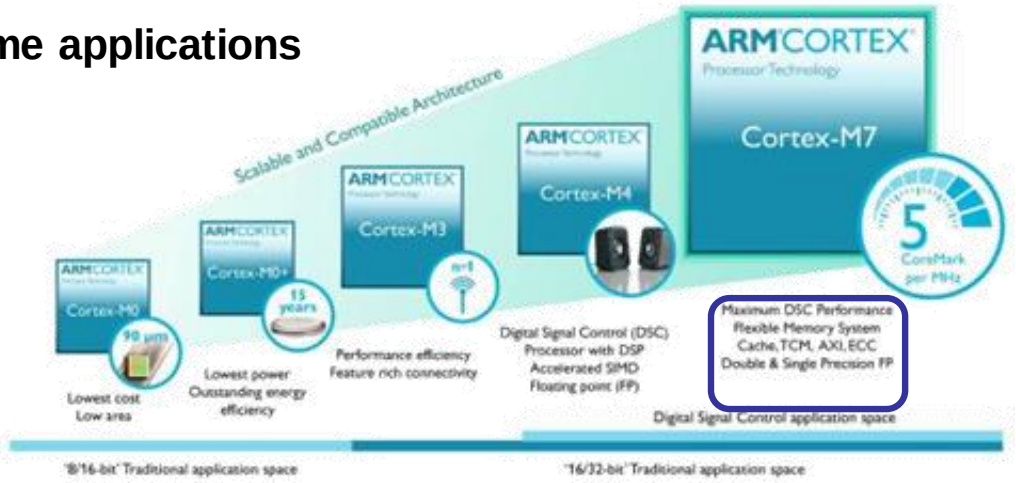


(*) compliance = Qualification testing, screening testing, and TCI/QCI inspections meet MIL-PRF 38535 or ESCC9000 requirements

ARM Cortex-M7 Architecture

Designed for Safety and Powerful real time applications





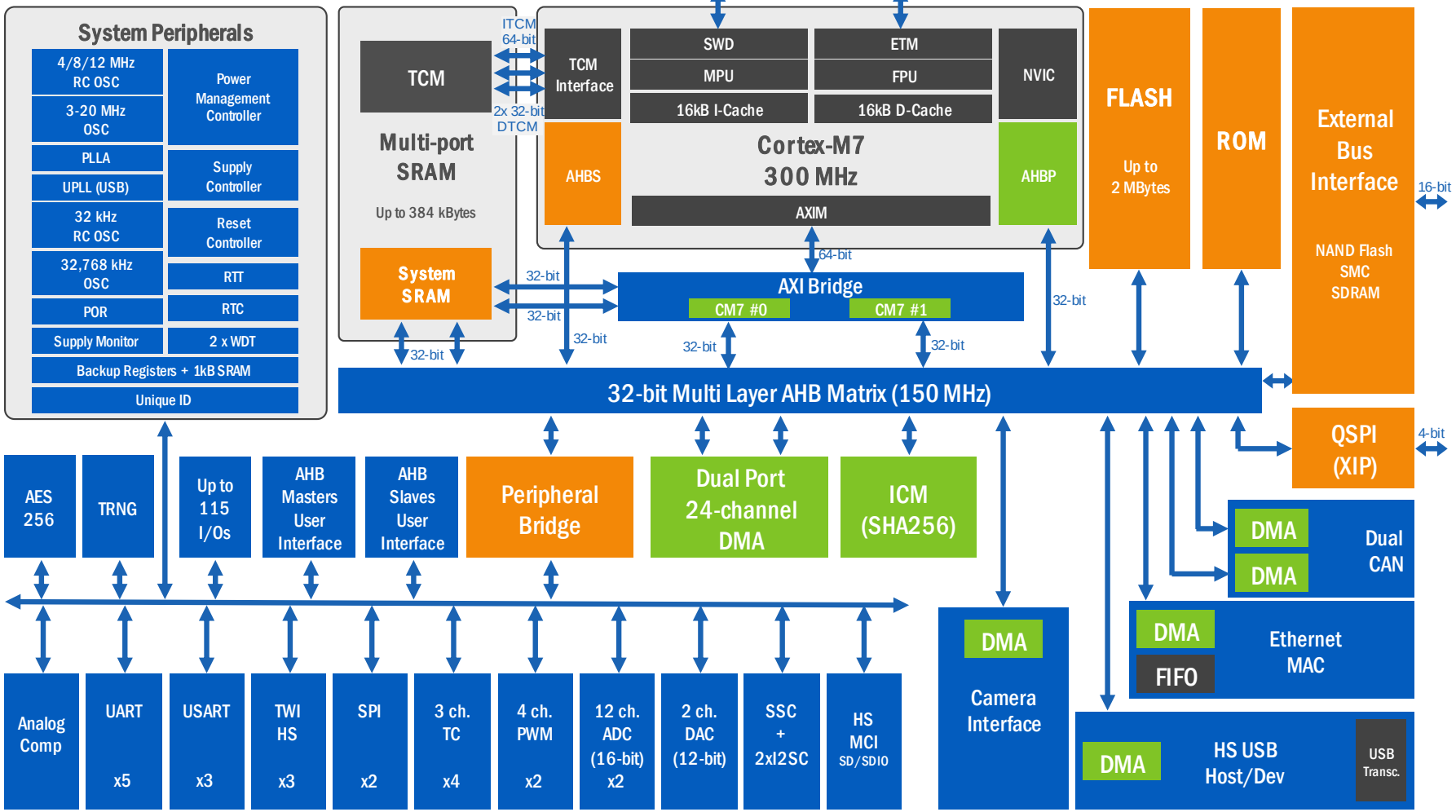
Cortex Core	Architecture	Pipeline	Thumb / Thumb 2	MPU	DSP	FPU	Performances (DMIPS/MHz)	Dynamic Power consumption (uW/MHz)
M0	Von Neumann	3	Most / Subset	No	No	No	0.84	16.4
M0+	Von Neumann	2	Most / Subset	Opt.	No	No	0.93	9.8
M3	Harvard	3	All / All	Opt.	No	No	1.25	32
M4 Multicore	Harvard	3	All / All	Opt.	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

SoC Architecture

SAMV71Q21 ARM Cortex-M7



ICM: Integrity Chek monitor

SAMV71 Scalable Unique Solution

Qualification level

QMLV/ ESCC

QMLY/ ESCC

QMLQ

QMLN

AQEC

AECQ100

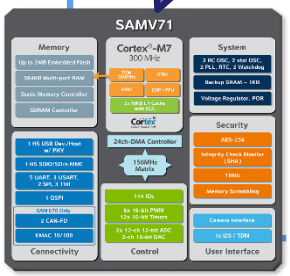
ARM Cortex M7 SoC

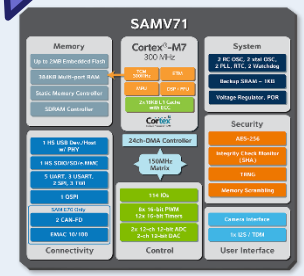
RHBD

Other Aerospace applications

Hirel & RT

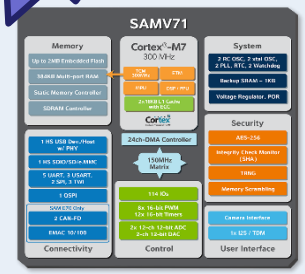
Auto COTS





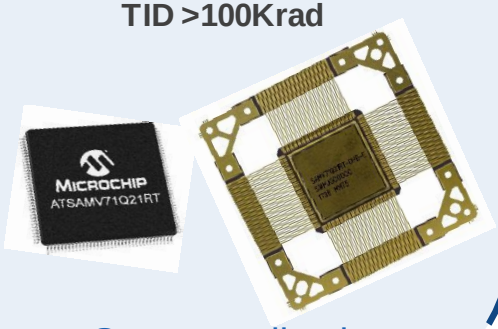
SAMV71Q21RT
600DMIPS
Rad Tolerant

Latch Up Immune



SAMRH71
>200DMIPS
Rad Hard

TID >100Krad



Space applications

1553

SpaceWire

Radiations performances

SAMRH71

End User Measurements Benchmark

Targeted application: Geostationary orbit application

Customer Algorithms used:

- Algo 1: Basic correlation algorithm on a small pixel matrix 21x21
- Algo 2: Advanced correlation algorithm on a large pixel matrix 512x128

Execution time of customer algorithms running @ 48 MHz	Algo 1	Algo 2
LEON3-FT (UT699)	4,3 ms	2600 ms
Cortex-M7 (SAMRH71)	1,4 ms	548 ms

SAMRH71 is 3 to 5 time more performant

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 · Micro Digital YOUR RTOS PARTNER · Micrium

On going BSP projects : RTEMS, Xstratum

fentISS · N7 SPACE · RTEMS

- A&D BU in Europe
- Scalable ARM SoC
- **Products Portfolio (A&D BU)**

COTS Rad Tolerant MCU/MPUs

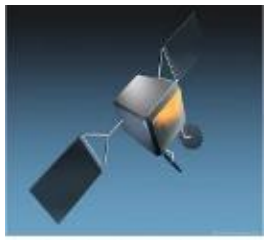
Production
Development
Roadmap

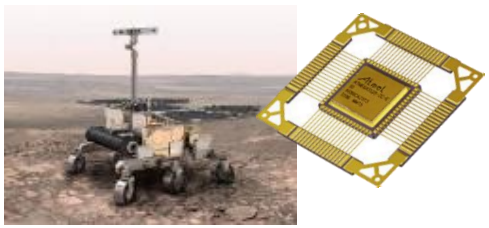
Radiation Tolerant & Extended Temperature

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	ET/RT	600DMIPS, CAN FD, Ethernet TSN, DSP	**Available**
SAM3X8E	ARM32 M3	RT	100DMIPS, CAN, Ethernet, Dual Ban	Q2 2019 (Apr19)
dsPIC33CH128MP	MCU16	ET/RT	16Bit DSC w High-Resolution PWM & CAN FD	H2 2019
SAMA5D2	ARM32 A5	ET/RT	850DMIPS, Gbit Ethernet TSN, DDR3, MMU	H1 2020
SAMCA2	ARM32 M0+	ET/RT	45DMIPS, ECC Flash& SRAM, 150°C	H2 2020

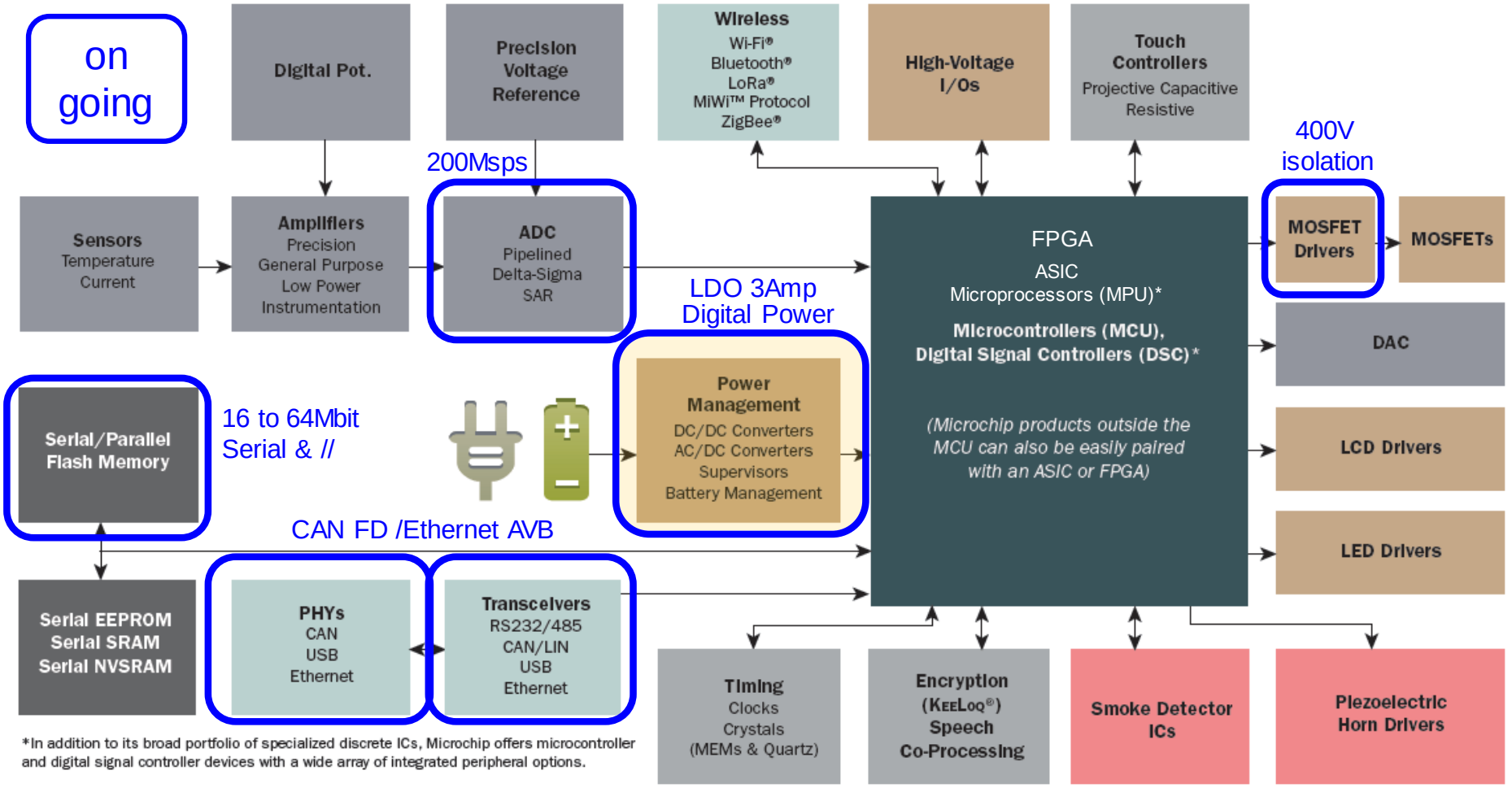
ATmegaS128

Flight early 2018
ESA GOMX-4B





Hirel companions Candidates for ET/RT



*In addition to its broad portfolio of specialized discrete ICs, Microchip offers microcontroller and digital signal controller devices with a wide array of integrated peripheral options.

ASIC System Solution

With Mixed Signal Capabilities

- MCHP proprietary 0,15 µm SOI technology initially developed for Automotive circuit design purpose

- Enhancement to achieve Space requirements (**ATMX150RHA**)

  Radiation hardened standard cell libraries for Space

  Proven Technology

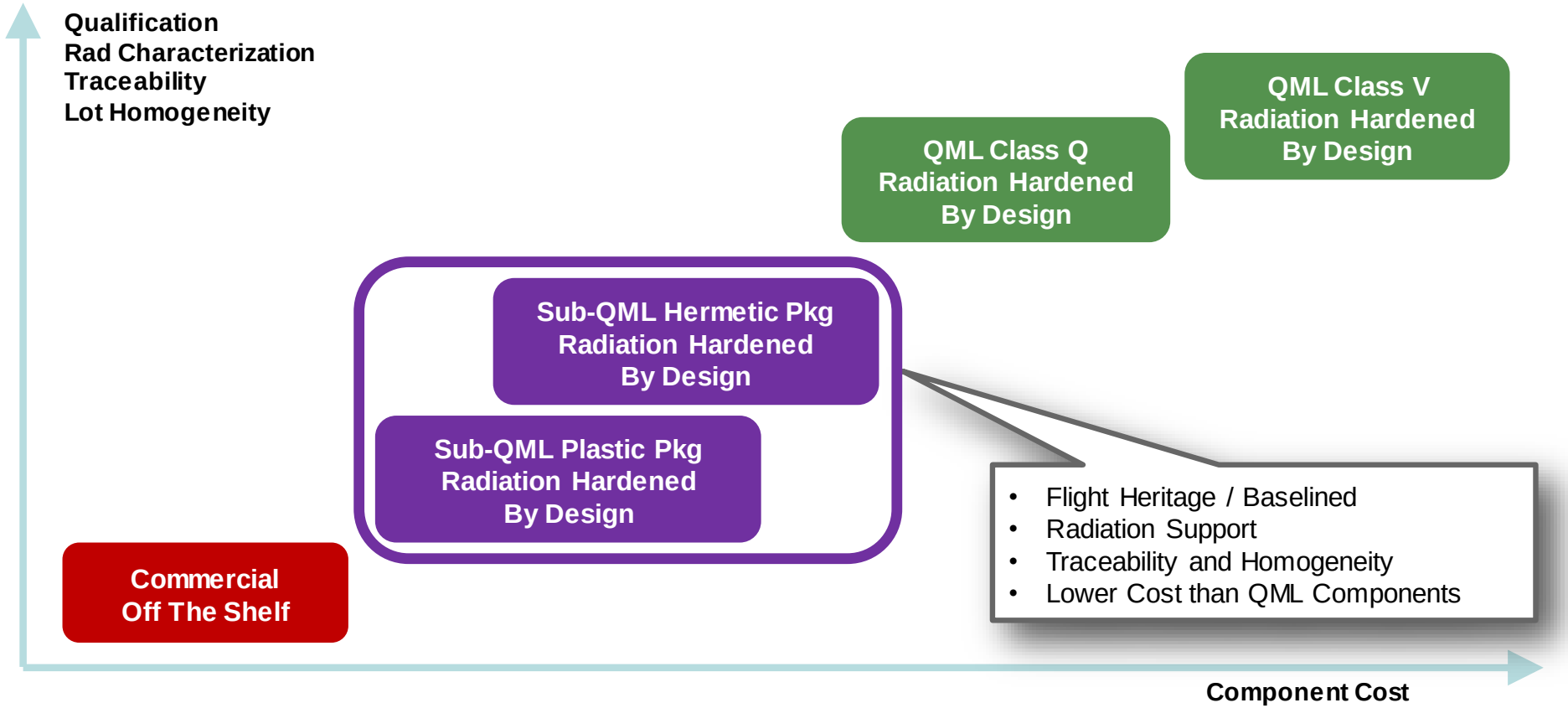
  Radiation Hardened SEL immune, TID>100 Krad (Si tested)
  Extended temperature range -55°C to +125°C
  Reliability Life Time 20 years

- **Digital, Analog and Mixed** signal circuit development
  - Digital up to 22 usable Mgates equivalent NAND2
  - 5V compatibility
  - A set of qualified **Analog IP :** PLL, Voltage regulator, Voltage reference, Clock synthetizer, Signal conditioning

- Dedicated local design and development team (Assy, PE/TE)

- Fast and low cost prototyping with quarterly **MPW**

Sub-QML: Bridging the Gap Between QML and COTS



Microsemi
a Microchip company

Microchip Quality levels – All Possible

Purpose	Microsemi MCHP	Package	Temperature range	Reference
NSS, NASA Class1	QML-V / EV QMLV/SV ESCC QML	Hermetic Ceramic	-55°C – 125°C	MIL-PRF-38535
Entry Level Trad. Space	QML-Q / EQ QMLQ/MQ	Hermetic Ceramic	-55°C – 125°C	MIL-PRF-38535
Engineering samples	ES -E	Ceramic (Hermeticity not Guaranteed)	-55°C – 125°C (majority)	Internal spec
Hermetic devices for New Space	R or M -HC	Hermetic Ceramic	-55°C – 125°C	MIL-STD-883 Class B
Plastic devices for new space	-SN	Plastic	-55°C – 125°C (majority)	MIL-STD-883 class N
Plastic devices for new space	M or I HP	Plastic	-55°C – 125°C (majority)	JEDEC's AEC-Q's

MICROCHIP

THANK YOU!