

# NG-Ultra: a system-on-chip suited for the upcoming space missions

DASIA

DEFENCE AND SPACE

May 17<sup>th</sup> 2022



# AGENDA

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Introduction

NG-Ultra Performances Status

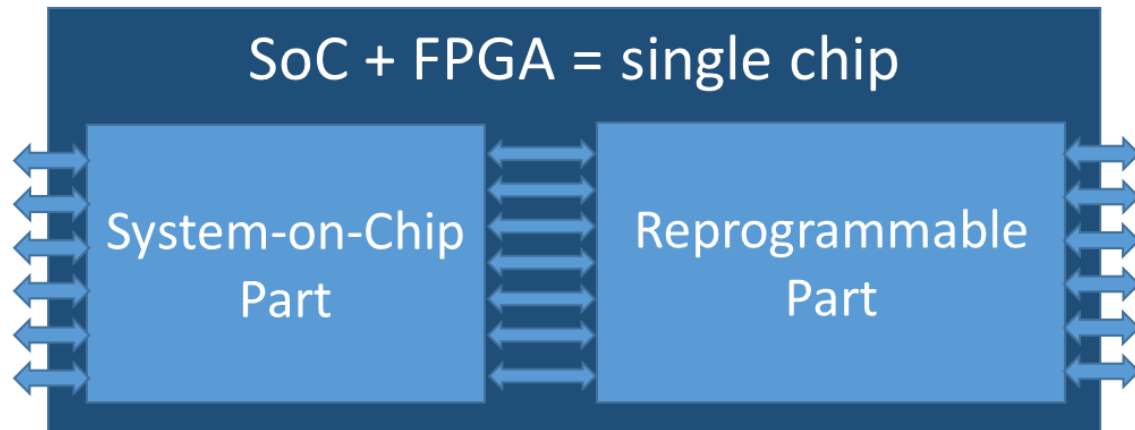
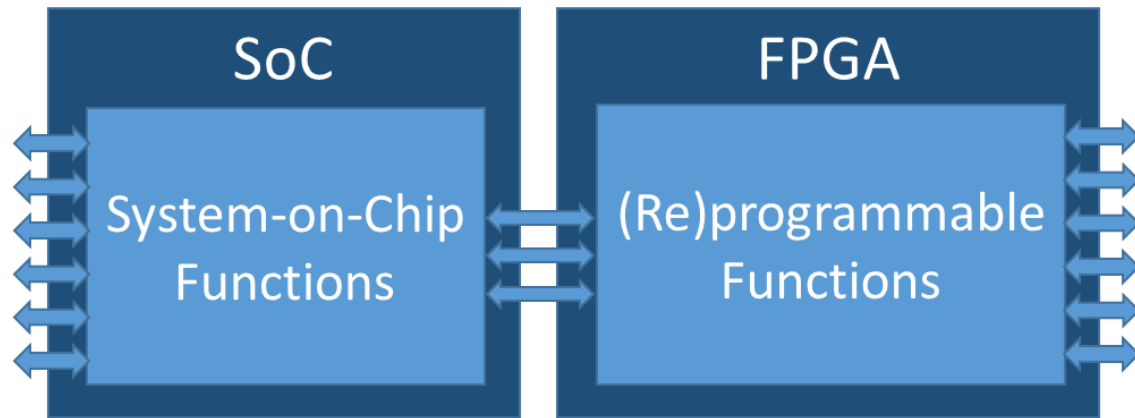
NG-Ultra Ecosystem Status

NG-Ultra Suitability for Upcoming Missions

Conclusion

# NG-Ultra : To integrated SoCs and beyond

## Current generation



## Next generation



+

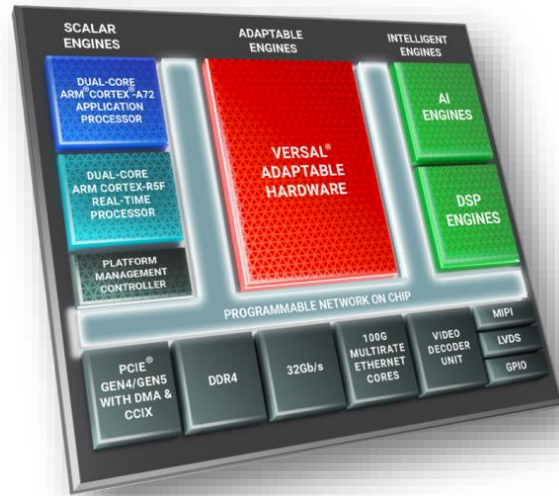


Example : SCOC3 + RTAX2000

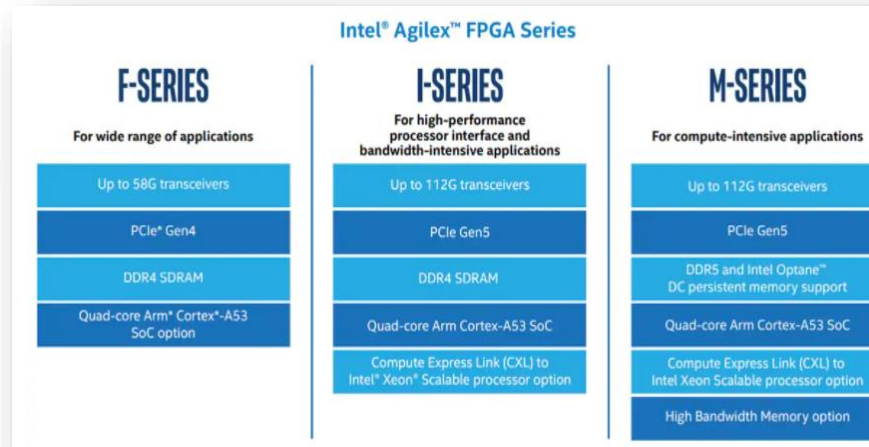


Example : NG-Ultra

# To integrated SoCs and beyond



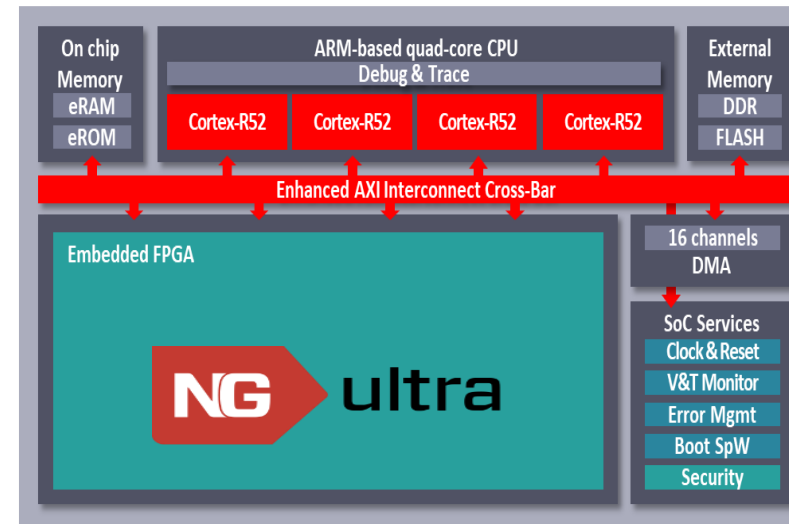
*2021-2022 in the American industry*



Rad Hard



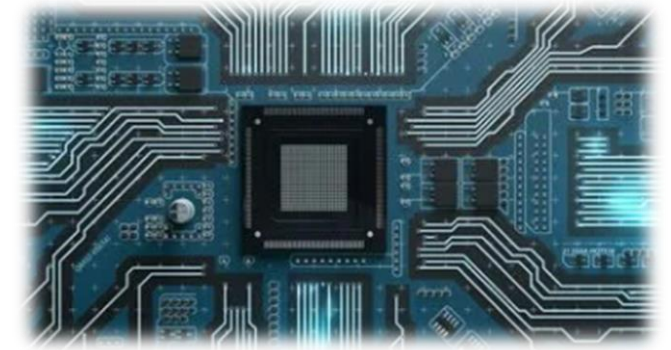
*2022 in the European industry*



## Integrated SoC+FPGA

- Consistent with the design of processing boards
- Optimized interfaces SOC  $\leftrightarrow$  FPGA
- Key enabler for more integrated designs & cost reduction





## A global trend towards SoC+FPGA

- Initiated by American manufacturers (Zynq, Versal, Agilex...)
- Suiting integration trend of smartphone and automotive industries

## European Non-dependance

- The only Rad Hard European SoC+FPGA
- High performances breakthrough compared to available European solutions

## Airbus, a key player on this complex chip

- Involved since the beginning
- SoC architecture WP leader
- IP designer (e.g. DDR Ctlr)
- Several boards already under development at Airbus



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# SoC Benchmarks

- First tests on NG-Ultra prototypes at 600MHz on one ARM Cortex-R52 core

CoreMark	Freq (MHz)	CoreMark (Iterations/sec)	CoreMark/MHz
ERC32	15	16	1.067
LEON2 (MDPA)	81	125	1.543
LEON4 (GR740)	250	511	2.044
Cortex-R52 Eval board (NG-Ultra)	<b>600</b>	<b>1 818</b>	<b>3.03</b>

Dhrystone	Freq (MHz)	DMIPS per core	DMIPS/MHz
LEON4 (GR740)	250	425	1.7
Cortex-R52 Eval board (NG-Ultra)	<b>600</b>	<b>1250</b>	<b>2.085</b>

- ARM Coremark maximum performance : 4,3 CoreMark/MHz, without interconnect, without robustness features
- ARM Dhrystone maximum performance : 2,09 DMIPS/MHz
- Performance on quad-core expected to be close to 4x the single core performance thanks to AXI architecture

✓ **NG-Ultra SoC performance breakthrough demonstrated @600 MHz !**



## High performances DDR interface

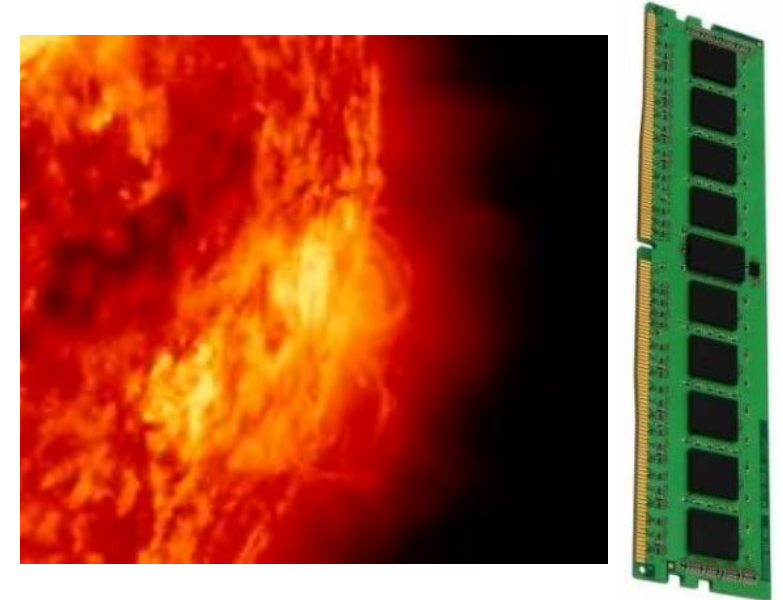
- DDR2, DDR3 and DDR4 supported for up to 16-bit devices
- Maximum useful DDR4 bandwidth of about 100 Gbps @1,6GHz (compared to 3,2 Gbps for GR740)
- 4 virtual channels to maximize bandwidth availability
- Integrated Quality of Service (QoS)

## Very high level of protection against failures

- Error detection and correction against SEU
- Robustness against SEFI up to the loss of two 16-bits devices
- Software warned as soon as one device is in error

## User-oriented features

- Integrated zero-padding
- Integrated autotest







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For both hardware and software developments

## Synthesis, Place & Route → NXMap

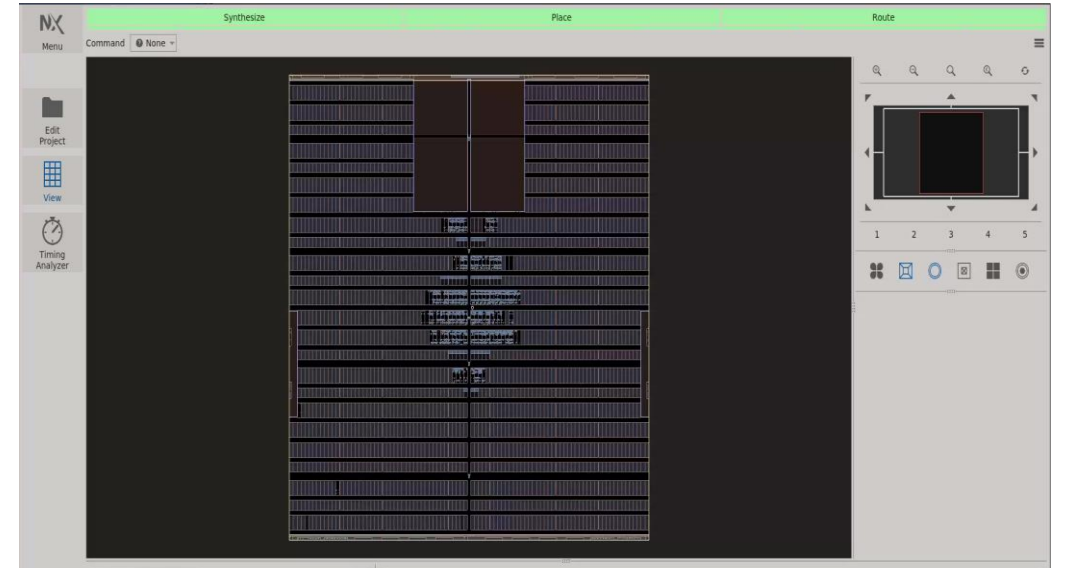
- Available
- Algorithm updates
- Updates according to industry needs

## Bitstream loading → NXBase2

- Available
- Mature

## Debug and trace probe → ARM ecosystem

- NG-Ultra supported by Lauterbach as a predefined chip



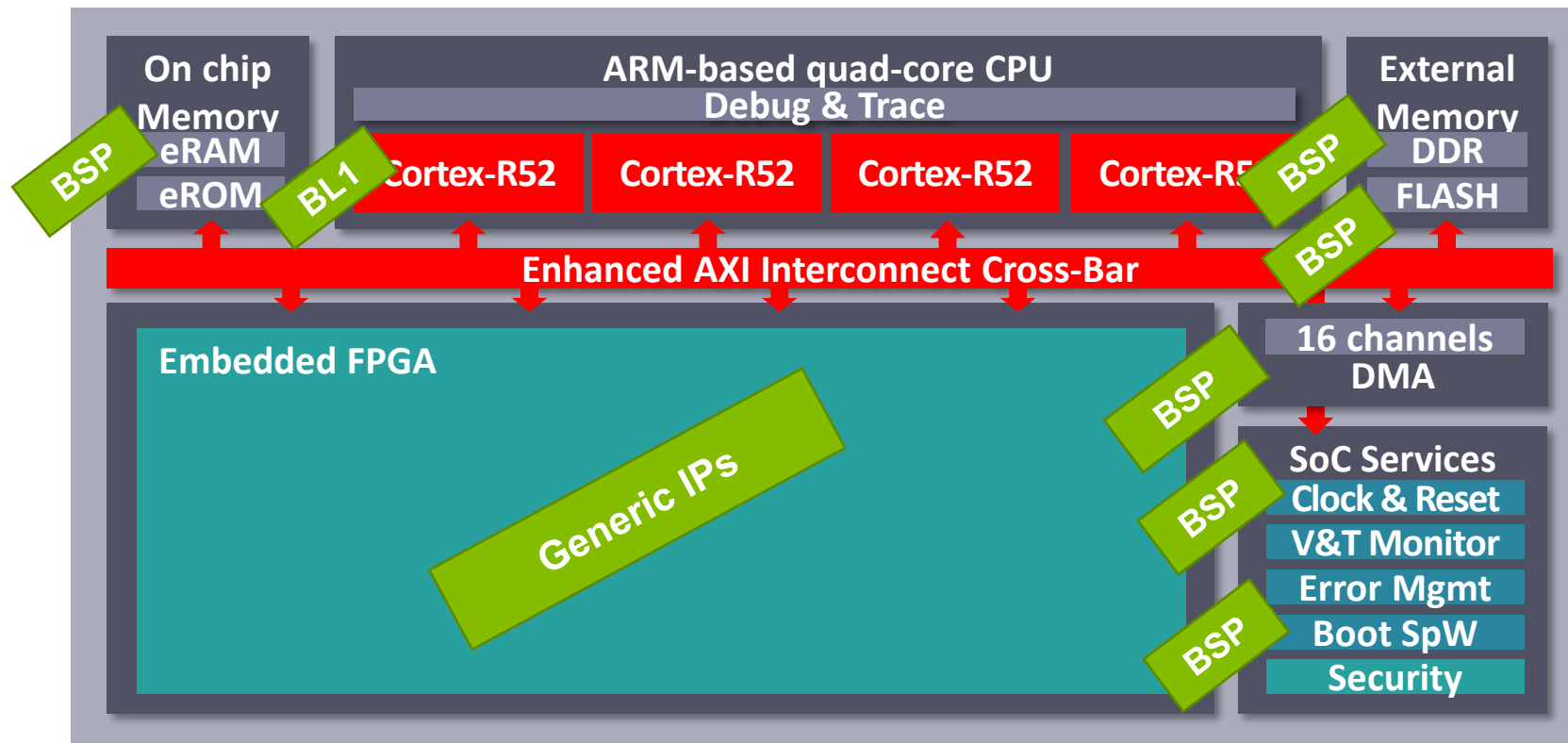
# On going HW and SW Developments – Consortium initiatives

## Low Level Software

- SoC BSPs (drivers)
- Generic Boot Loader 1 to complement Boot Loader 0 (in the ROM)

## Hardware

- Generic IPs embedded in NXMap for the FPGA



HW and SW developments to maximise reuse of building blocks

Developed by the consortium and completed by Airbus internal R&D

Enabler for non recurring cost reduction for future projects

The more users we are, the more the ecosystem can keep growing !

## Hardware Developments

- Elementary modules usable for all NG-Ultra-based projects
- Common platform for all NG-Ultra-based projects in Airbus DS

## Software Developments

- RTOS selected & adapted to NG-Ultra
- Hypervisor selected & adapted to NG-Ultra
- Common Platform BSPs



## Common framework for all NG-Ultra projects

- Reducing non-recurring costs
  - Reducing time-to-market
- 
- Fully in line with ADHA objectives

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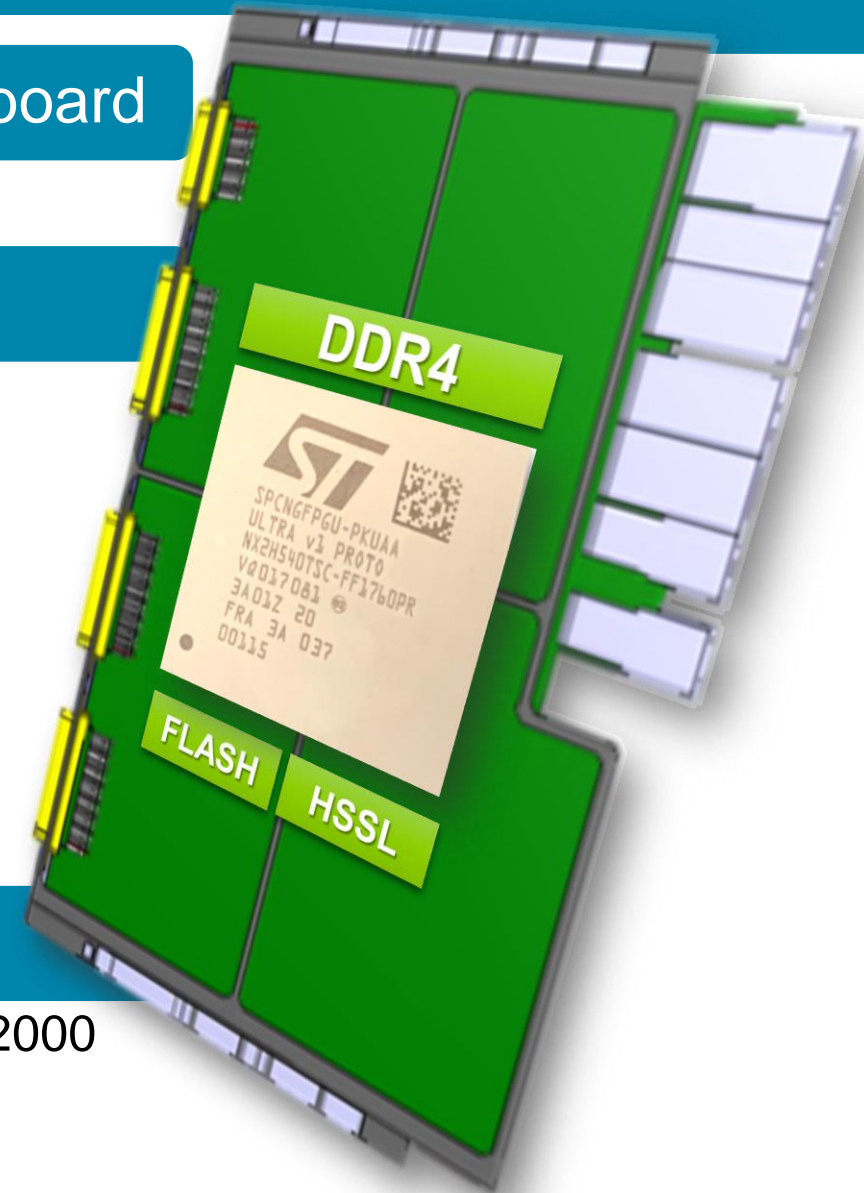
NG-Ultra already implemented on an Airbus processing board

Perfect demonstration for a future NG-Ultra-based OBC

- DDR4 Memory
- NAND Flash
- High Speed Serial Links
- Enhanced Security features (SDLS extended)
- High performances multicore processing
- Bitstream encryption included
- ADHA-compatible format

Very integrated OBC

- 500 kLUT compared to ~20kLUT for previous generation with RTAX2000
- More embedded functionalities
- Very compact product



# Payload Missions

## Payload missions requirements analysis

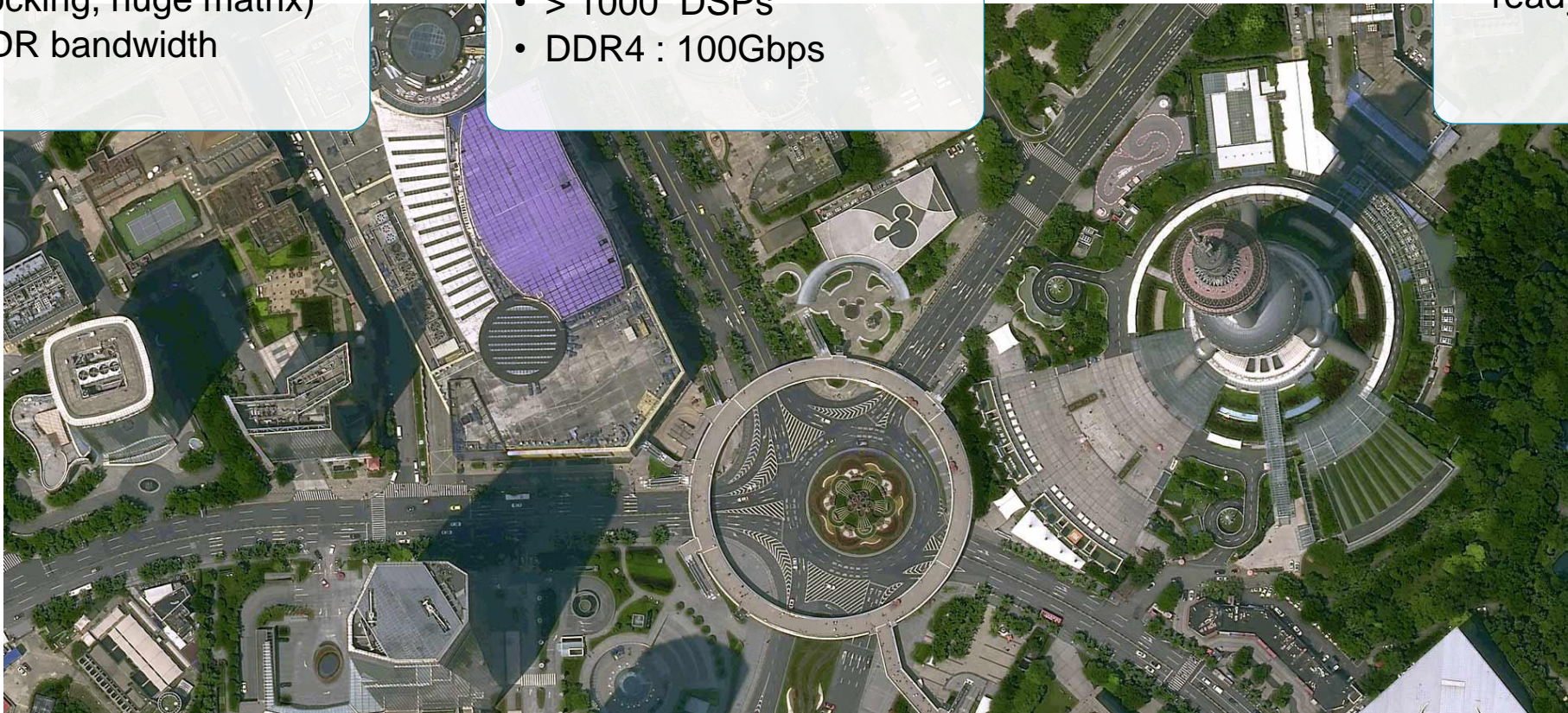
- Very performant FPGA (fast clocking, huge matrix)
- High DDR bandwidth

## NG-Ultra suitability ? Confirmed !

- Huge 500k LUT matrix
- > 1000 DSPs
- DDR4 : 100Gbps

## NG-Ultra board for payload processing under development at Airbus

- Ground demonstrator ready for Q4 2023







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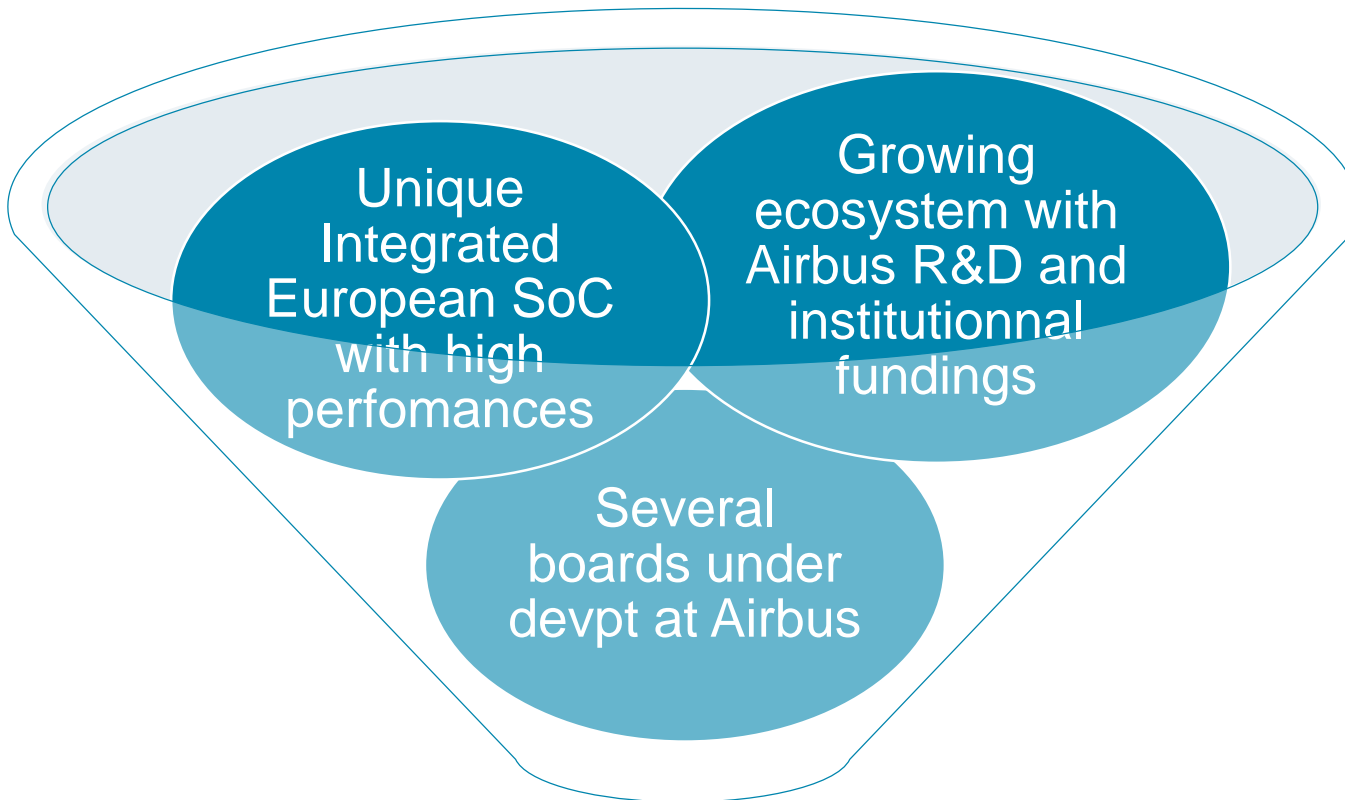
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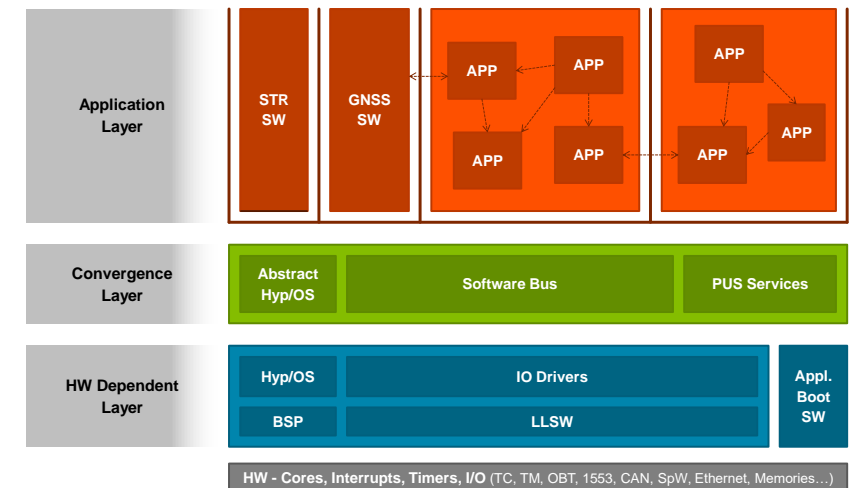
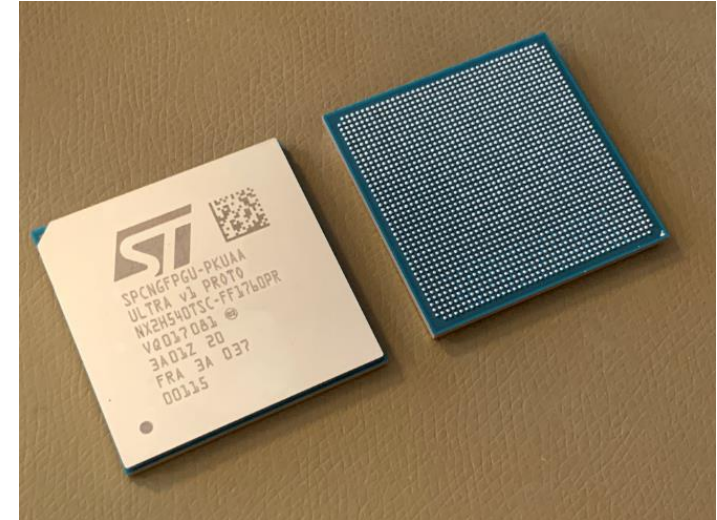
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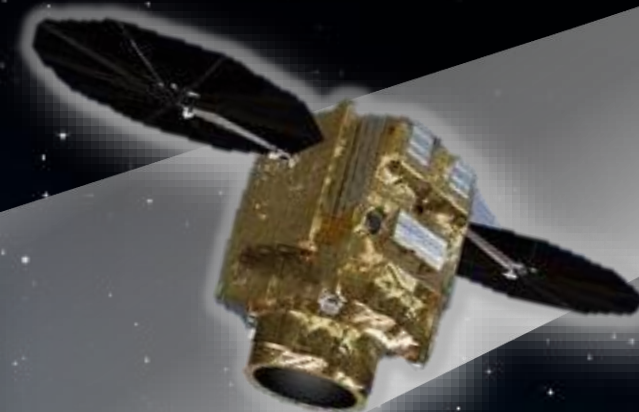
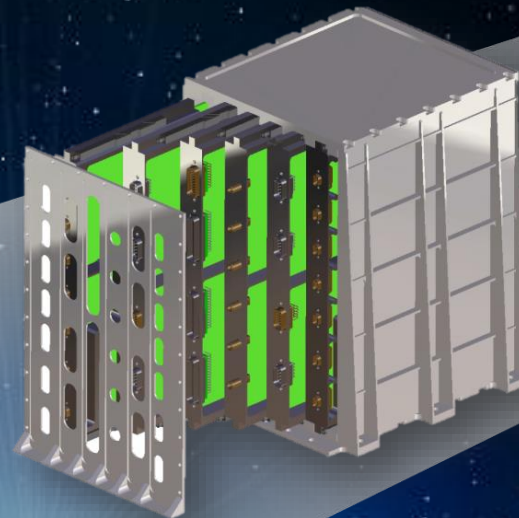
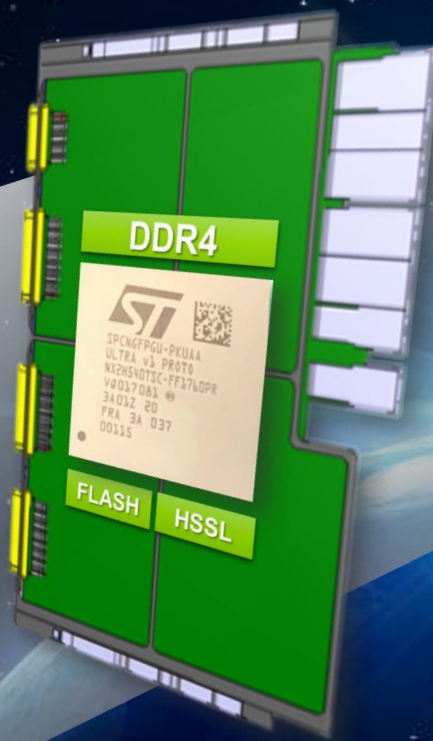
# Conclusion : To Infinity and Beyond



NG-Ultra suitable for many upcoming missions !



# THANK YOU



## End to end competences in Airbus



# Thank you

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