

Flexible and secure payload integration

CDPU a RISC-V
'New Space' approach

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T Technolution

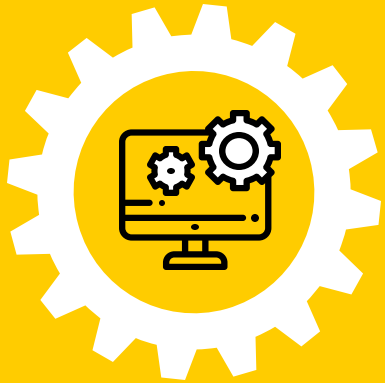


About us

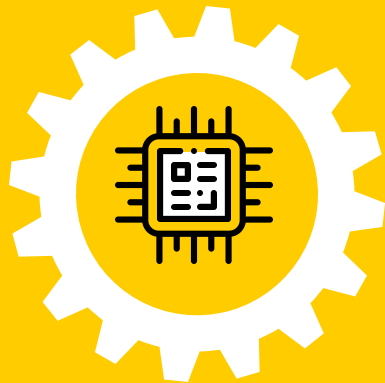
- Innovative technology company
- Founded in 1987
- Multidisciplinary
- 300 colleagues
- Operating worldwide



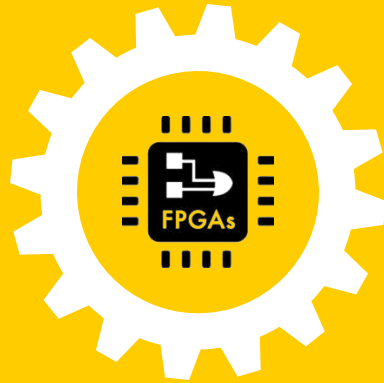
Advanced electronics and embedded systems



Software



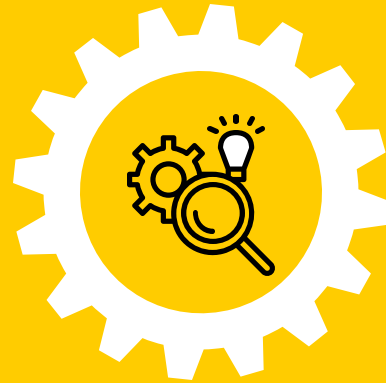
Electronics



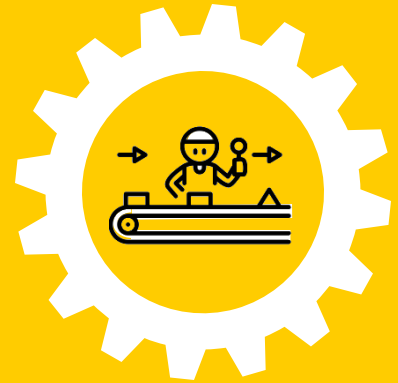
Programmable
Logic



Services



Research &
Development







Trusted
Assembly

- Ruggedized design / **security by design**
- Sensor and sensor interface design
- **Data acquisition, handling, processing** and storage, including AI
- Networking, wired and wireless data- and telecommunications

- **Post-quantum encryption** technology
- Information driven control and decision support (automated)
- Distributed embedded control systems

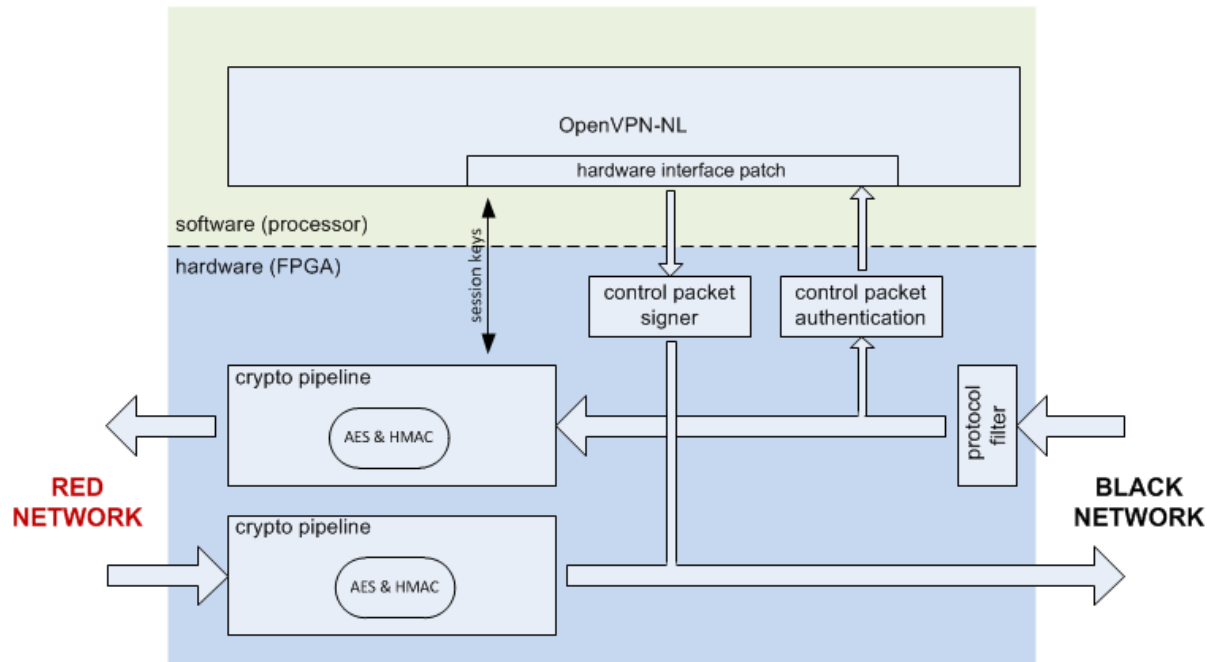
RISC-V[®] at Technolution

- We develop supplier-independent Programmable Logic designs
 - Implemented in  intel  XILINX.  Microsemi  NX
- FreNox RISC-V IP
 - RISC-V processor family, 100% developed by Technolution
 - No dependencies on open-source implementations
 - Implemented in **NLD/NATO/EU** classified security



Secure line encryption

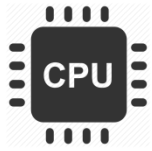
- Hardware VPN solution (NLD/NATO/EU classified)
 - Control flow in software /  RISC-V®
 - Data encryption in hardware logic



Secure line encryption

- Hardware VPN solution (NLD/NATO/EU classified)
 - Control flow in software /  RISC-V®
 - Data encryption in hardware logic
- ⇒ Full understanding of our custom implementation
- ⇒ Transparency for customer/evaluator
- ⇒ Lifecycle management (transparency & portability)

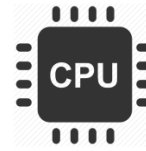




FreNox-E

Embedded processor

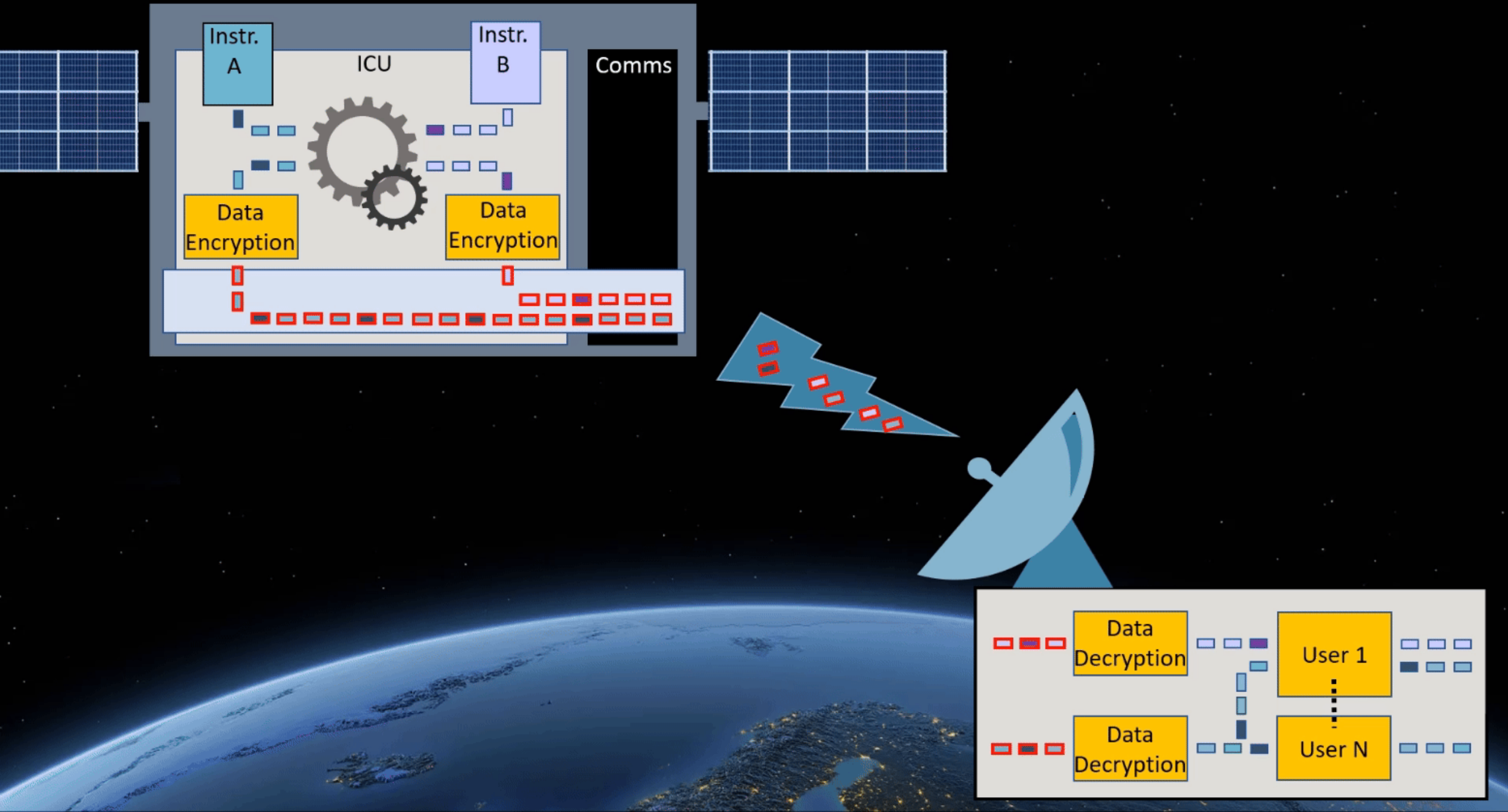
- hardware
 - RV32I(MA)
 - 32bits, mul/div
 - 5 stages - Harvard arch
 - cache or internal RAM
 - IO space
- software
 - Bare metal (C, embedded Rust)
 - FreeRTOS
 - ThreadX



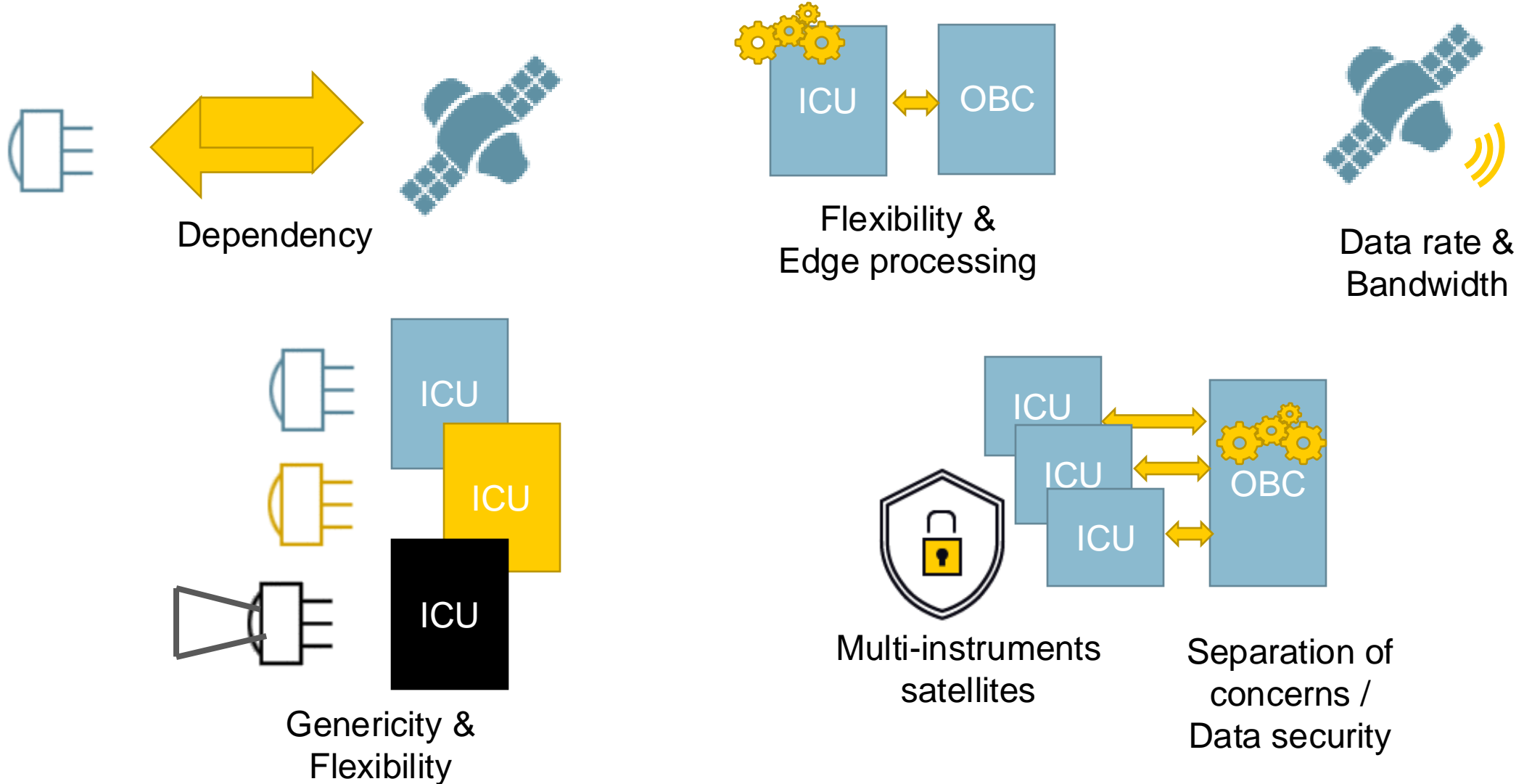
FreNox-S

Application processor

- hardware
 - RV32IMA (S-mode)
 - 32bits, mul/div, atomic, supervisor
 - 5 stages - Harvard arch
 - iMMU, dMMU (1 - 128 entries)
 - 8 way associative cache (4 - 32k)
 - cache coherency (DMA)
 - IO space
- software
 - Linux
 - Buildroot



'New Space' instruments ask for Separation of concerns and standardization in satellites



CDPU: Control & Data Processing Unit

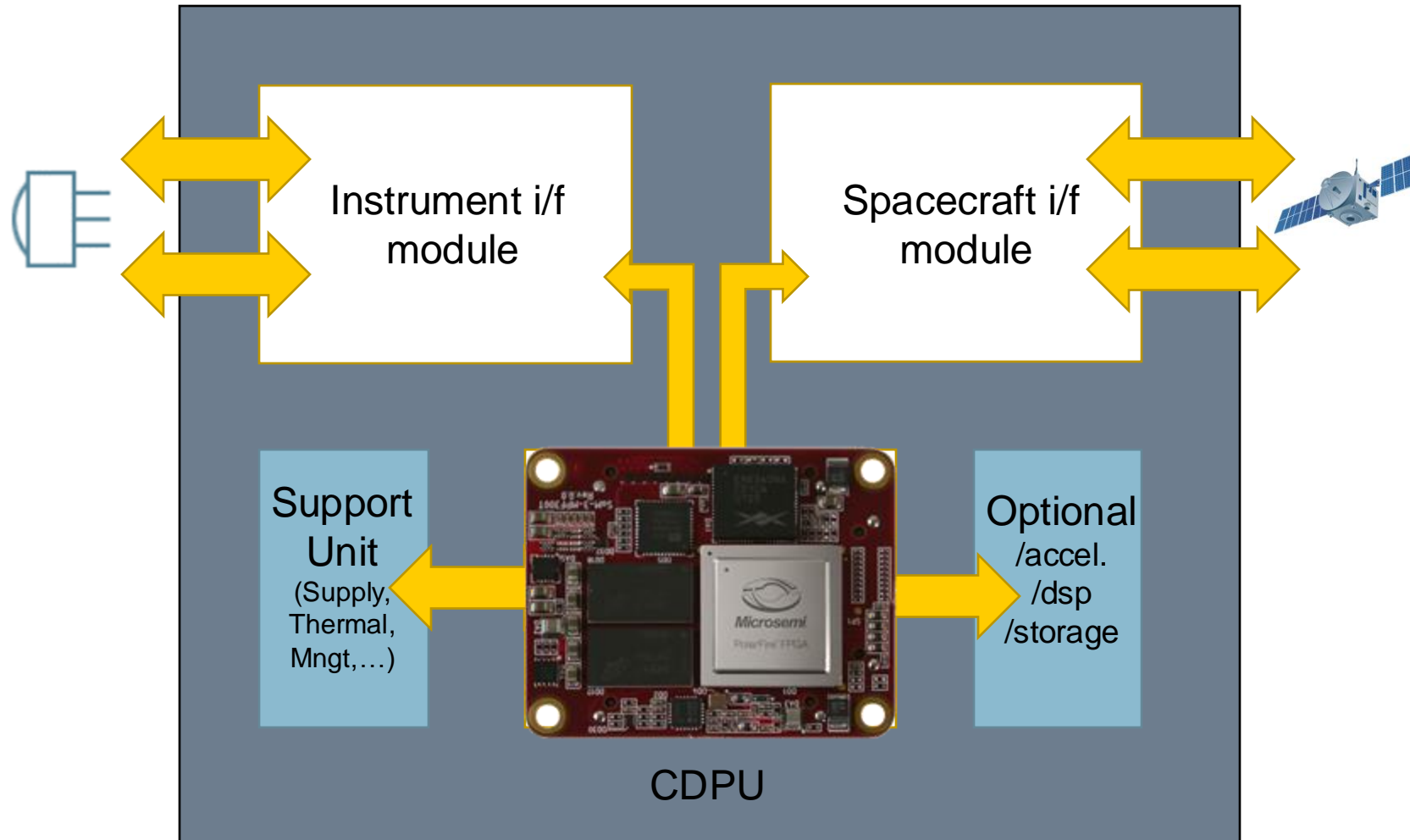
for SmallSat instruments

Netherlands
Space
Office



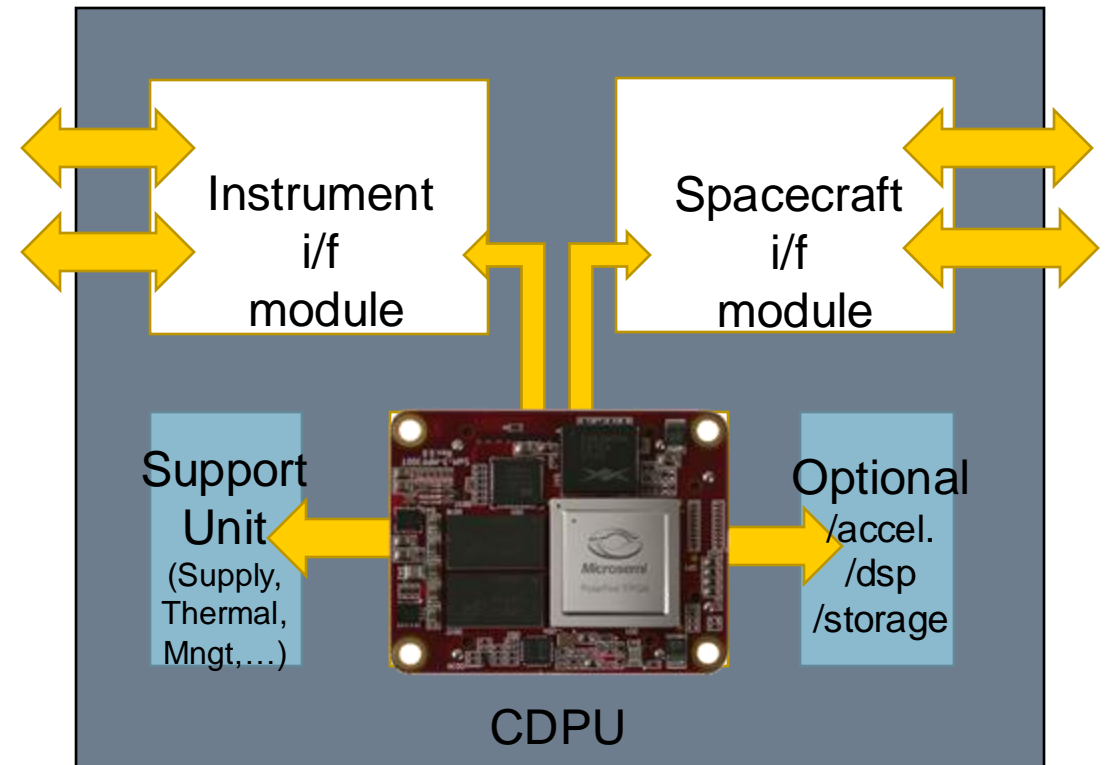
Technolution
Advance

Flexible & secure integration of sensor and platform

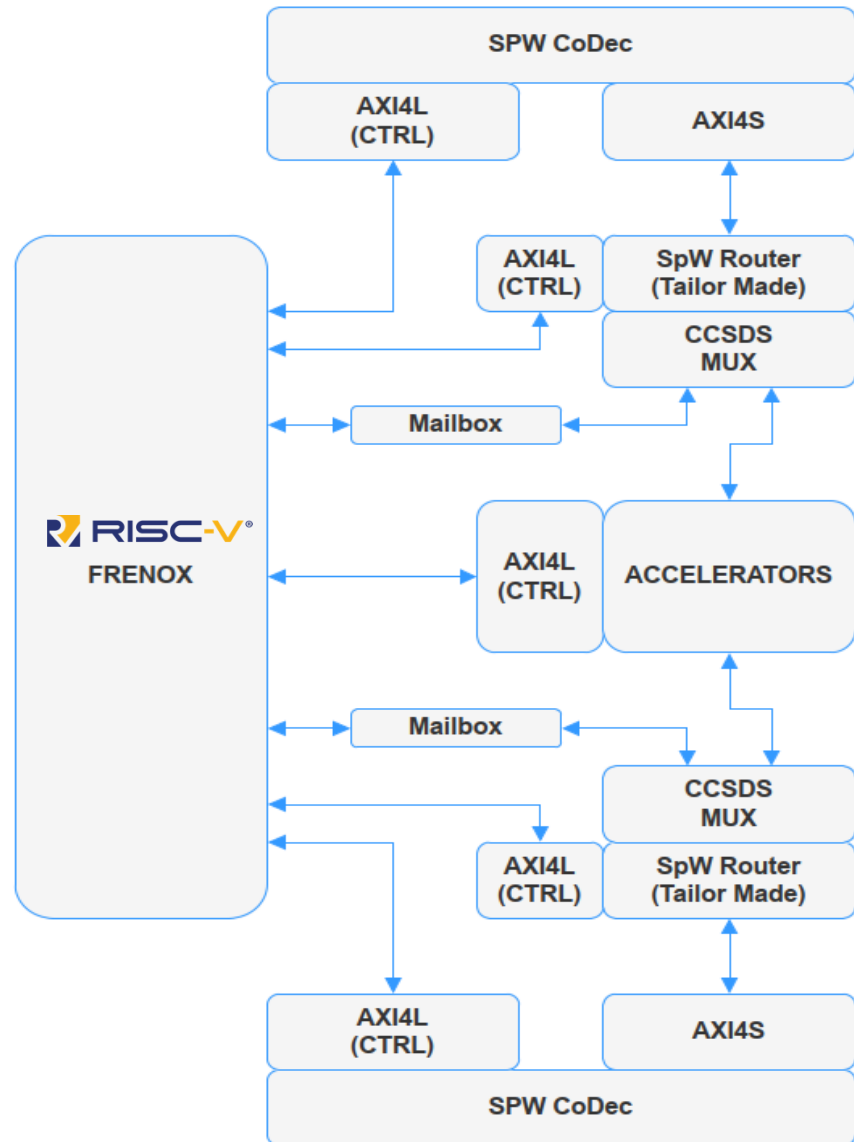


Modular electronics to bridge sensor with satellite platform

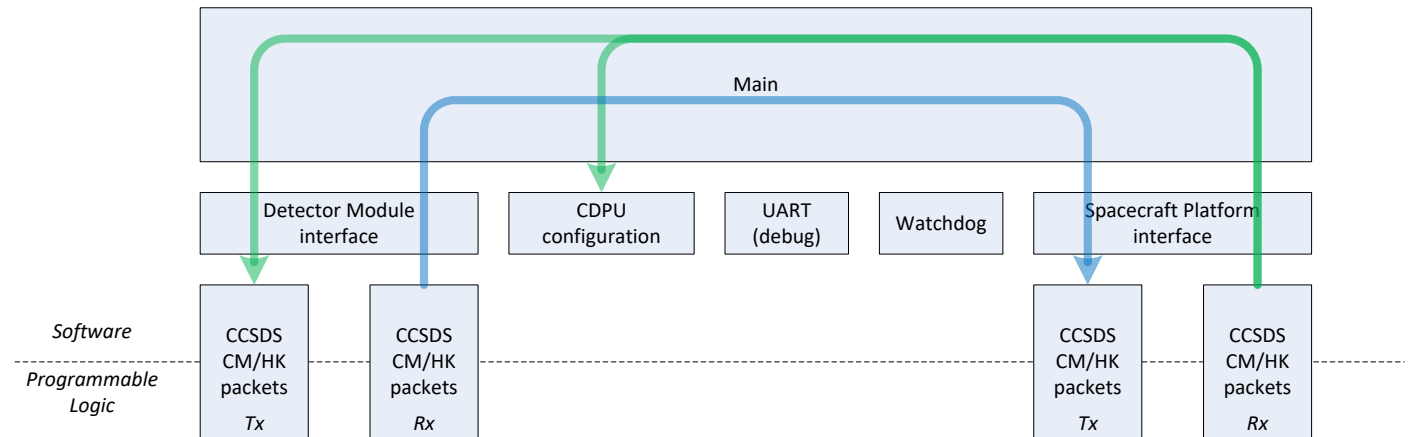
- Enabling reuse of modules in new projects → **NRE cost sharing**
- Separation of concerns between satellite platform and instrument developers
 - **Reducing** overall satellite build time
 - **Reducing** instrument development and test time
- **Rapid prototyping**
- Design for rad.-hard (and COTS-equivalent) components
 - **Reliability trade-off** depending on mission needs



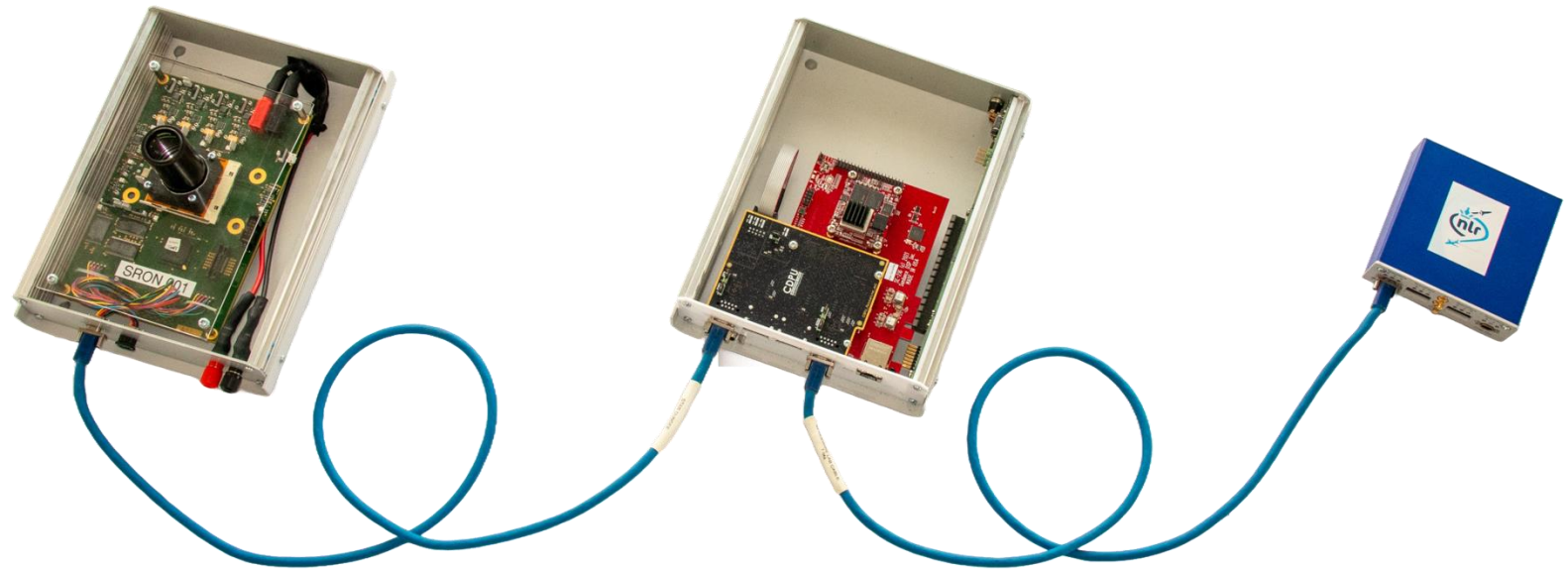
CDPU FPGA Functional Design



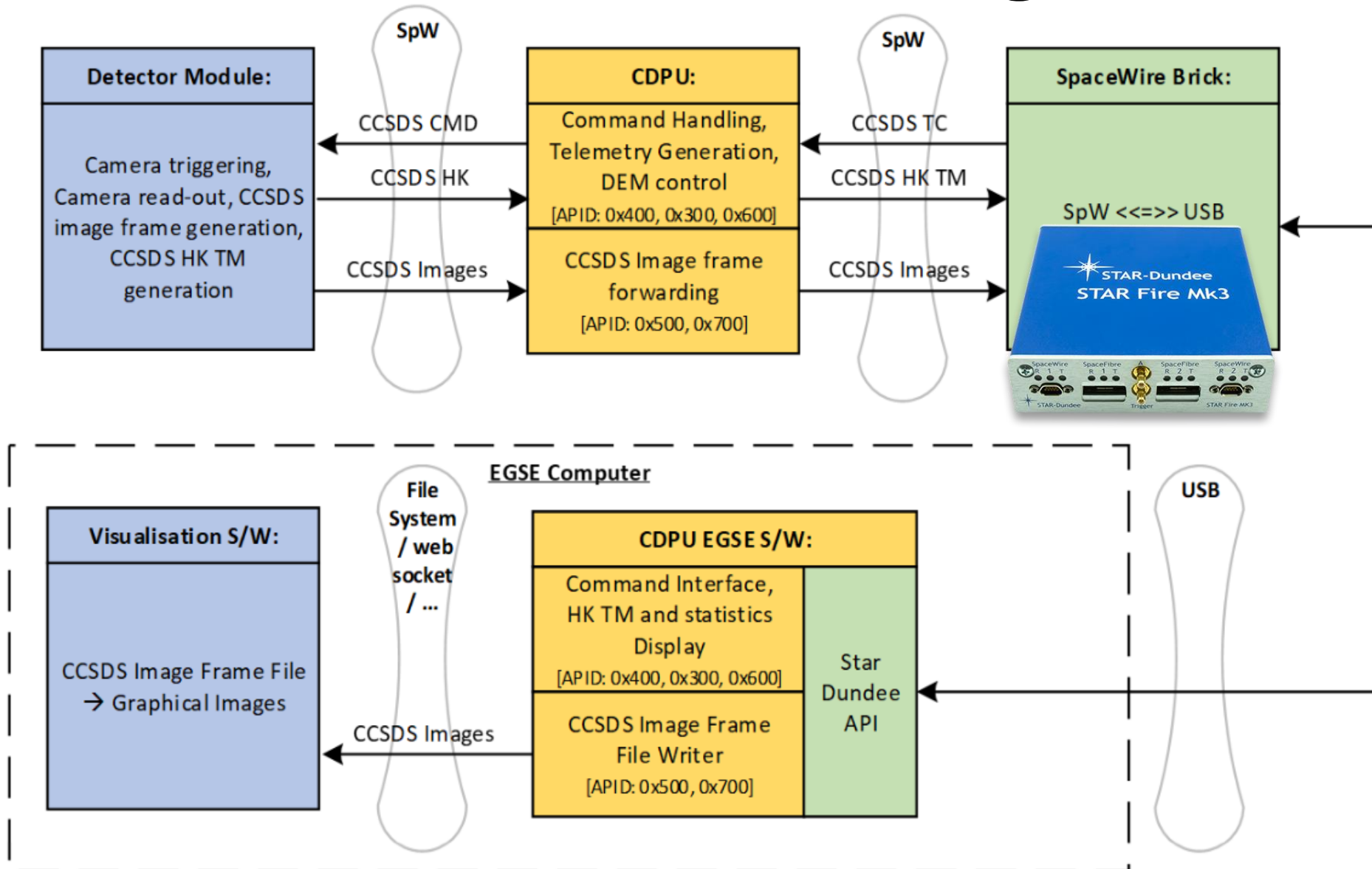
- Programmable logic design
 - FreNox RISC-V (μ Controller, EDAC, lock-step, ...)
 - SpW interface IP
 - SpFi interface IP
 - Interconnect infrastructure; accelerator extensions
- Embedded software design
 - TC/TM handling



Pre-engineering model demo setup



CDPU Demo – Instrument Integration



Netherlands Space Office



s[&t] esa
AIRBUS
SRON
Netherlands Institute for Space Research

Supported by Instrument Developers (Airbus/SRON)

Technolution



PoC

Implementation EM HW



Flight Model

EFM

EM Qualification

FM

- FreNox-E SoC demonstrated in NG-Medium RH-FPGA
- FreNox-E SoC demonstrated in PolarFire FPGA

NX NanoXplore → all-European components CDPU
MICROCHIP

Innovation & collaboration



UNIVERSITY
OF TWENTE.

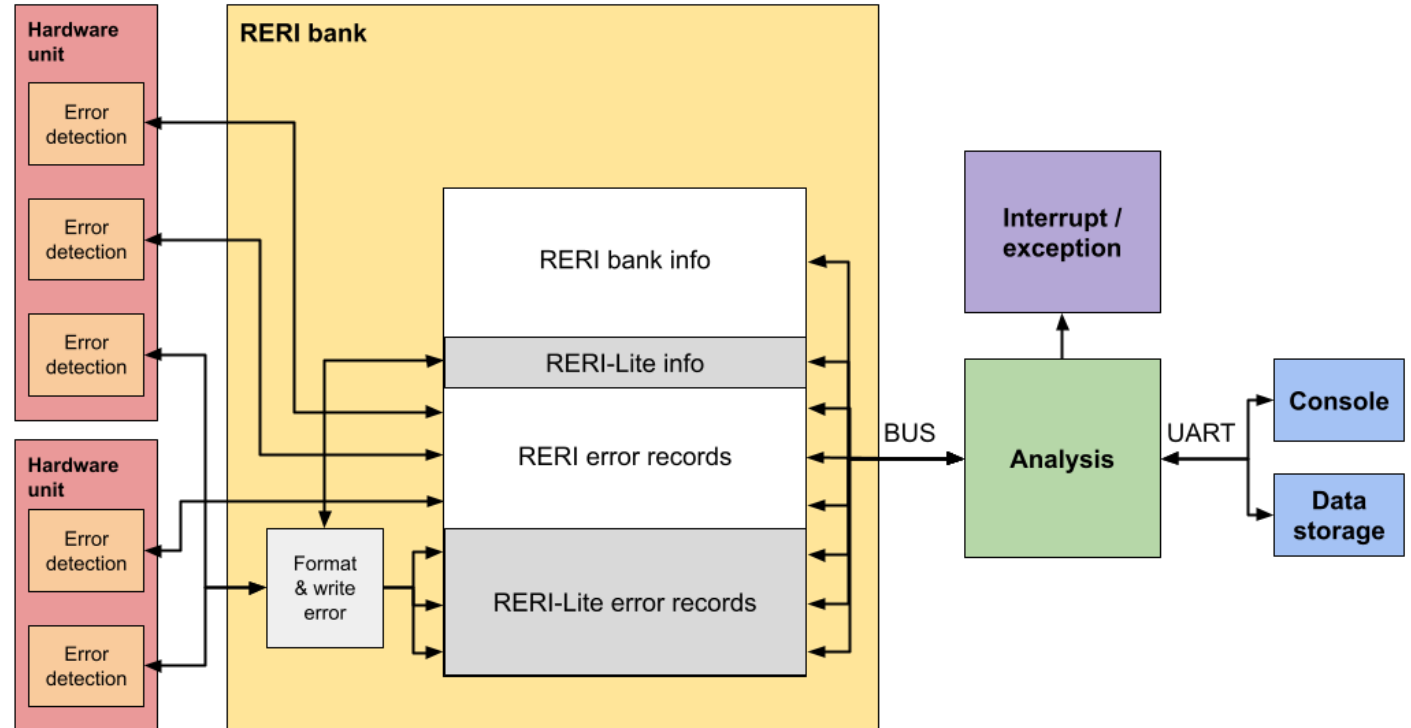


14.15 Test-in-the-loop: Designing RISC-V Soft-Cores through Methodic Validation

Tijmen Smit - University of Twente

P16. The RERI-Lite Error Logging Framework

Michiel Koenderink - University of Twente

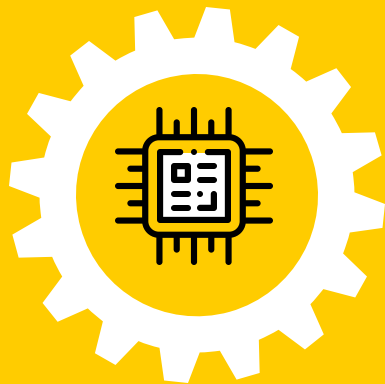


Joint research with University of Twente on (reduced) RERI, checkers, radiation testing and fault simulation for reliability & security

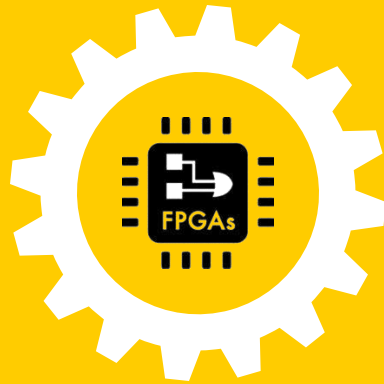
Conclusion: advanced electronics and embedded systems



Software



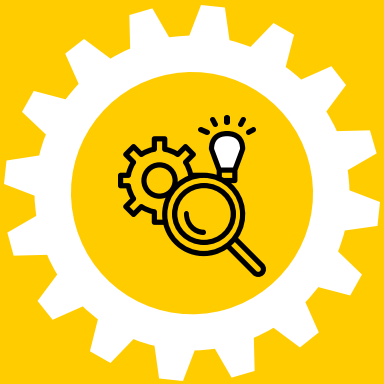
Electronics



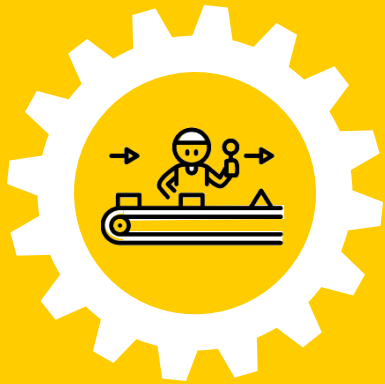
Programmable
Logic



Services



Research &
Development



Trusted
Assembly

Modular electronics enable re-use

Modularity gives **reduced instrument development & test time**

Benefit from standardization: transparency, portability & flexibility

We build high-security & high-reliability systems using  **RISC-V**[®] (since 2014)



14.15 Test-in-the-loop: Designing RISC-V Soft-Cores through Methodic Validation
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Thanks for your attention!

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