

Ramon Chips

RC64-Based NOGAH Systems

Enabling Software Defined Satellite Payloads



Ramon Chips is named in memory of Col. Ilan Ramon, Israeli astronaut who died on board the Columbia space shuttle, 1/2/2003

Prof. Ran Ginosar, CEO
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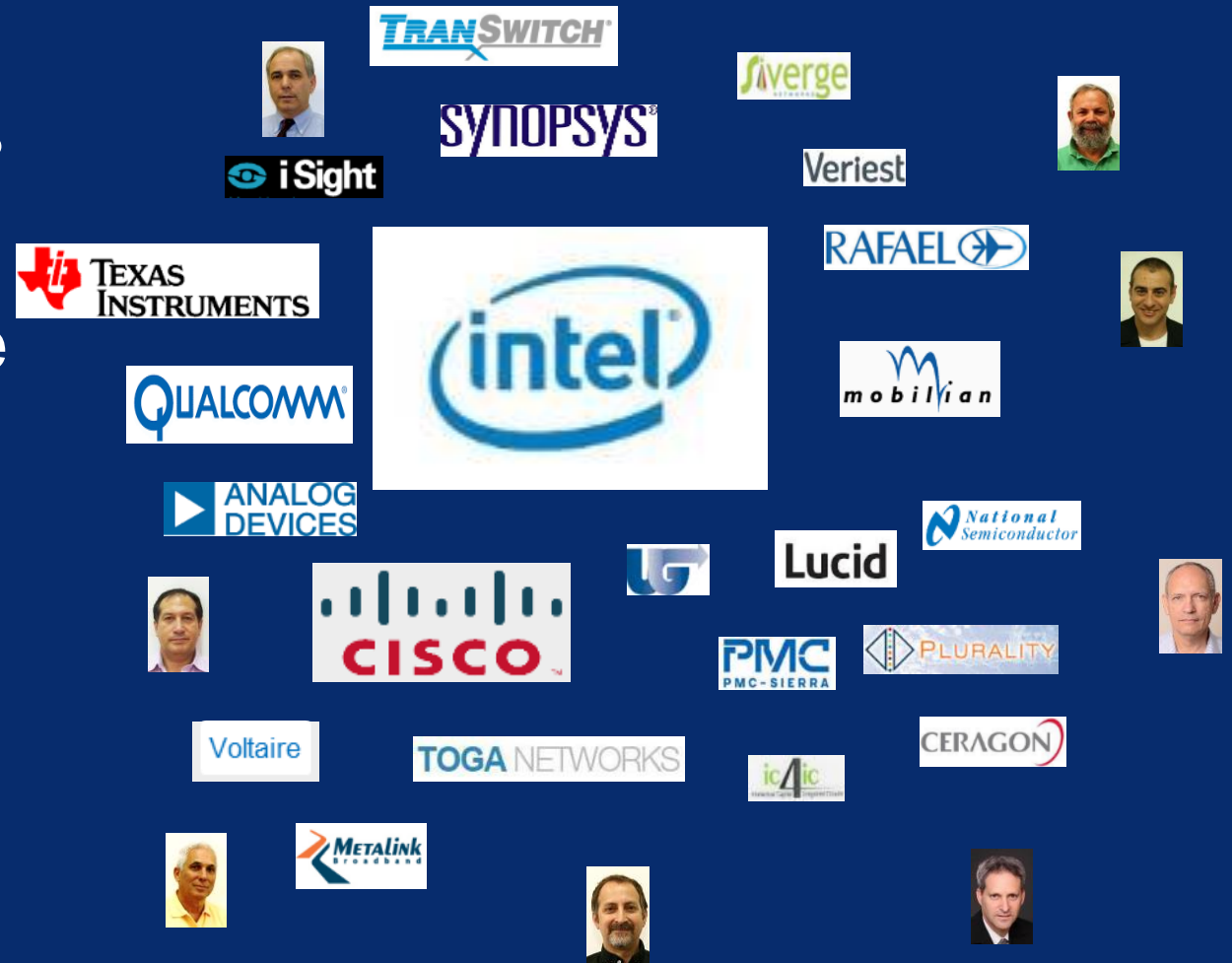
Peleg Aviely, David Goldfeld, Moshe Goren,
Fredy Lange, Gilad Danin

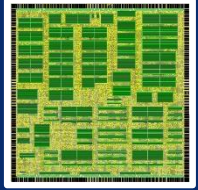
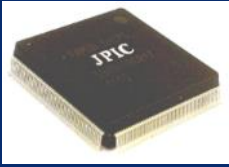
Guglielmo Lulli
Giuseppe Tomasicchio



Ramon Chips is a Computer Company

- Rather than a Space company
- But we only do Space computers
- Fully funded by government(s)
- The team comes with experience in computing, communications, semiconductors, software and space

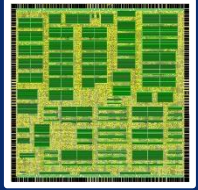
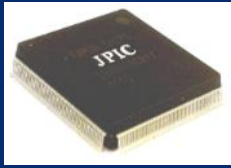




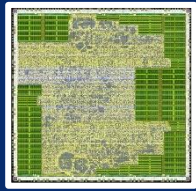
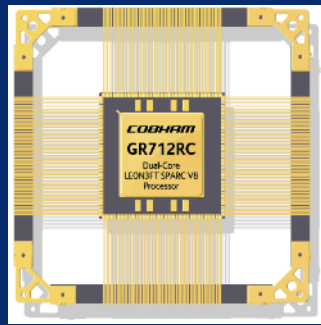
JPIC

JPEG200 Image Compression

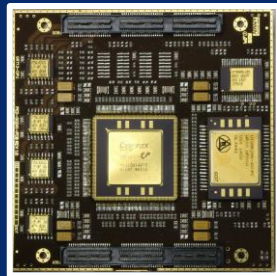
- First product by Ramon Chips
- Custom made
- Plastic QFP better than ceramic



JPIC



GR712RC

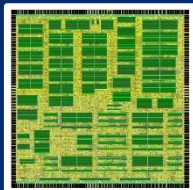


Beresheet
Lunar Lander

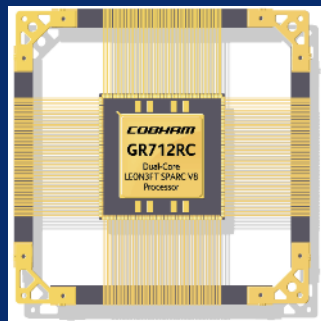
GR712RC dual core Leon3FT

- Gaisler IP cores
- Ramon Chips added RHBD and silicon
- Space Off The Shelf (SOTS, not COTS)
- Extremely successful—used everywhere
- Most recently last week
BERESHEET Lunar Lander

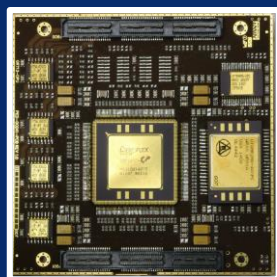




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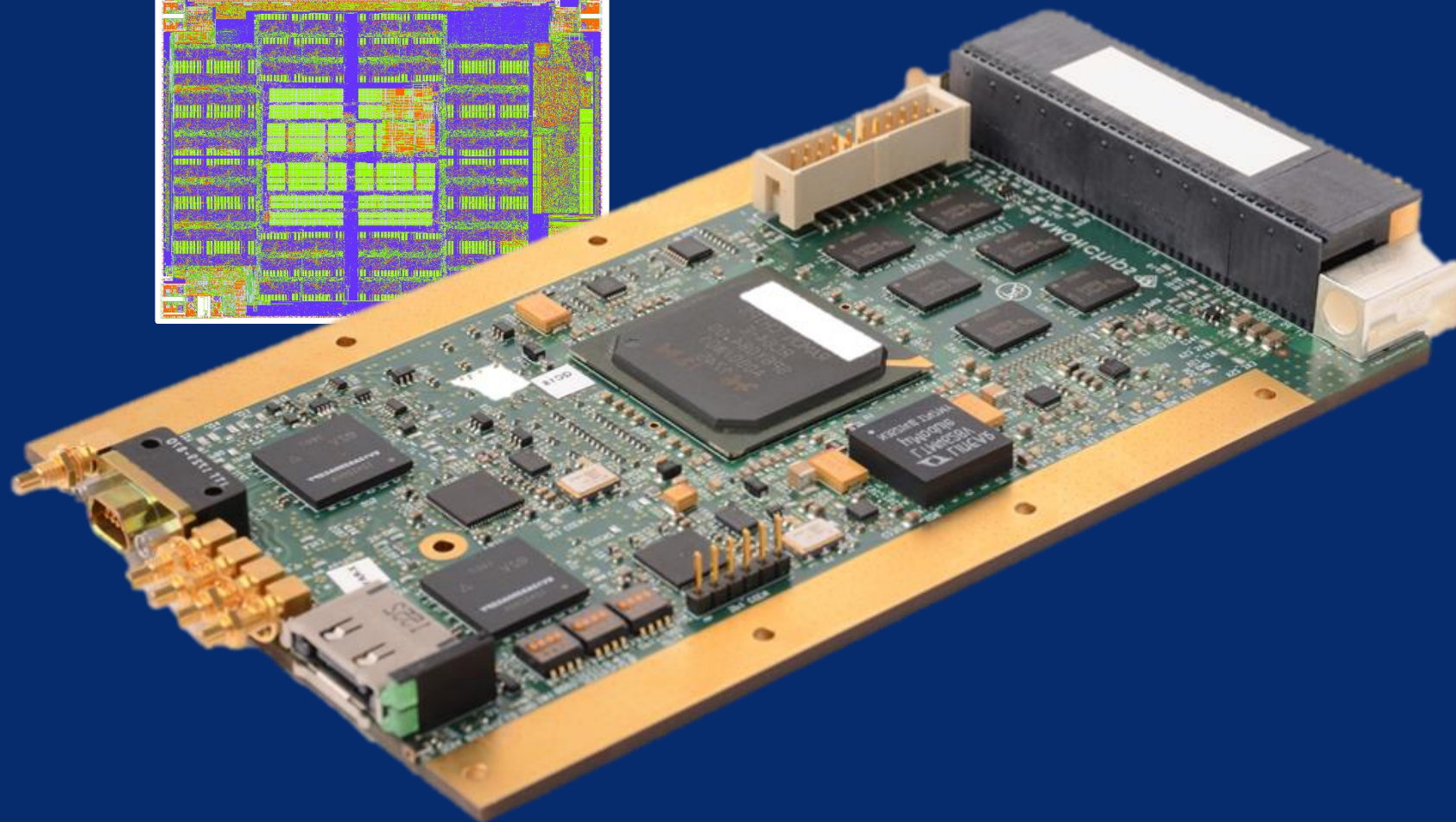
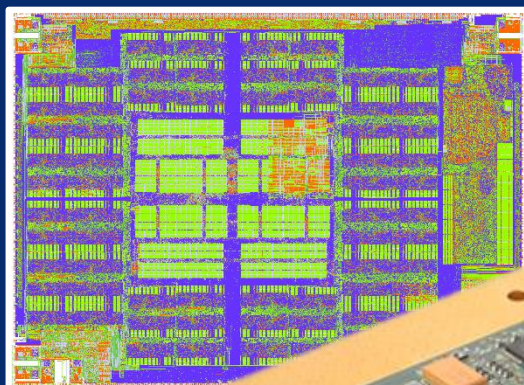
GR712RC



Beresheet
Lunar Lander



RC64



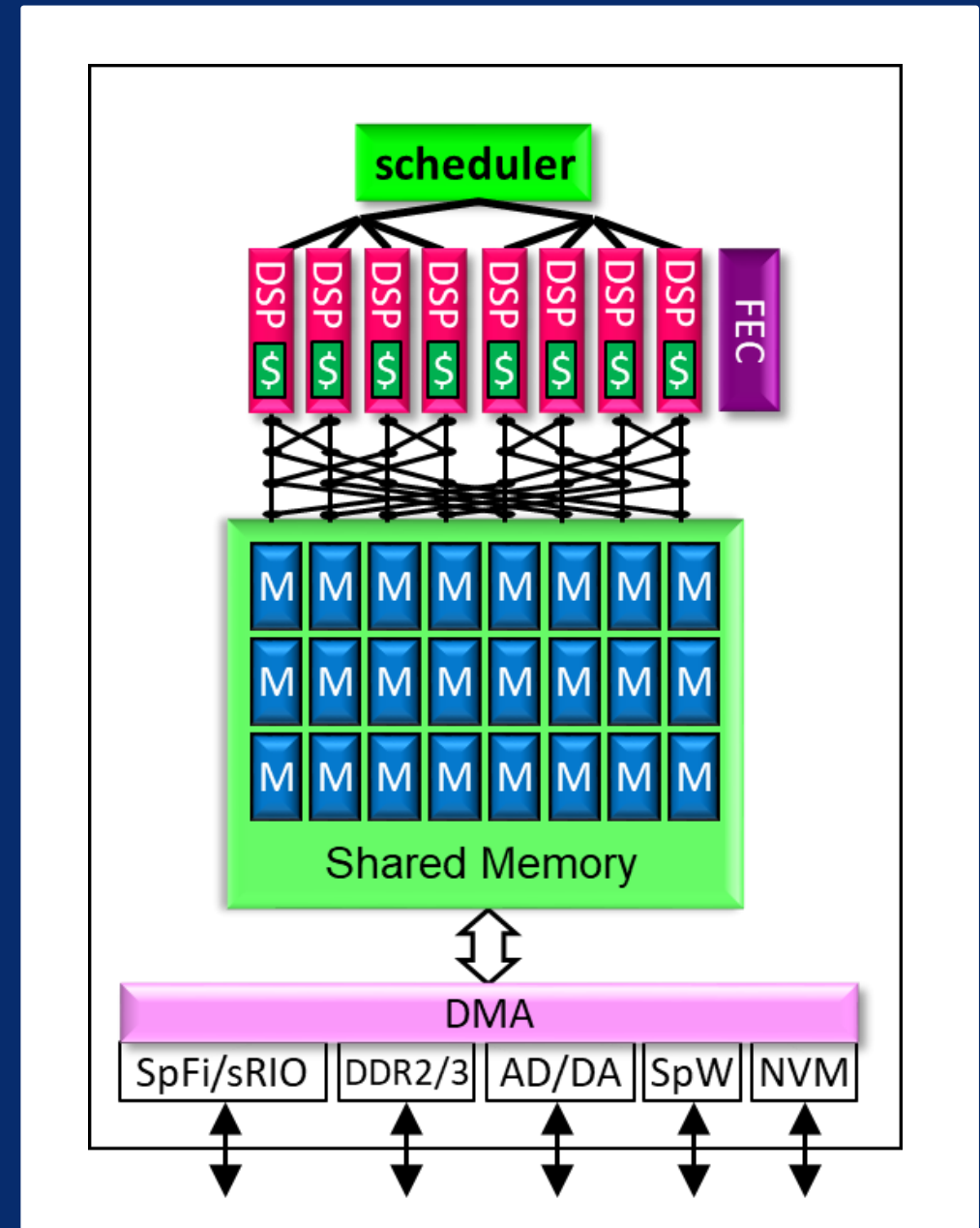
RC64

- Rad Hard
 - 300 kRad, SEL free, managed SEU
 - Always recovers from SEFI
 - HW + SW FDIR
- High Performance
 - Competitive with FPGAs, GPU, ...
- Low Power
 - BEST in MIPS/Watt
- Fast I/O
 - 12x SpFi (5 Gb/s) 48 LVDS / parallel
 - 6 SpW DDR3
 - Flash
- Software Defined
 - C, rather than VHDL / Verilog / CUDA / ...
 - Also C-from-Matlab



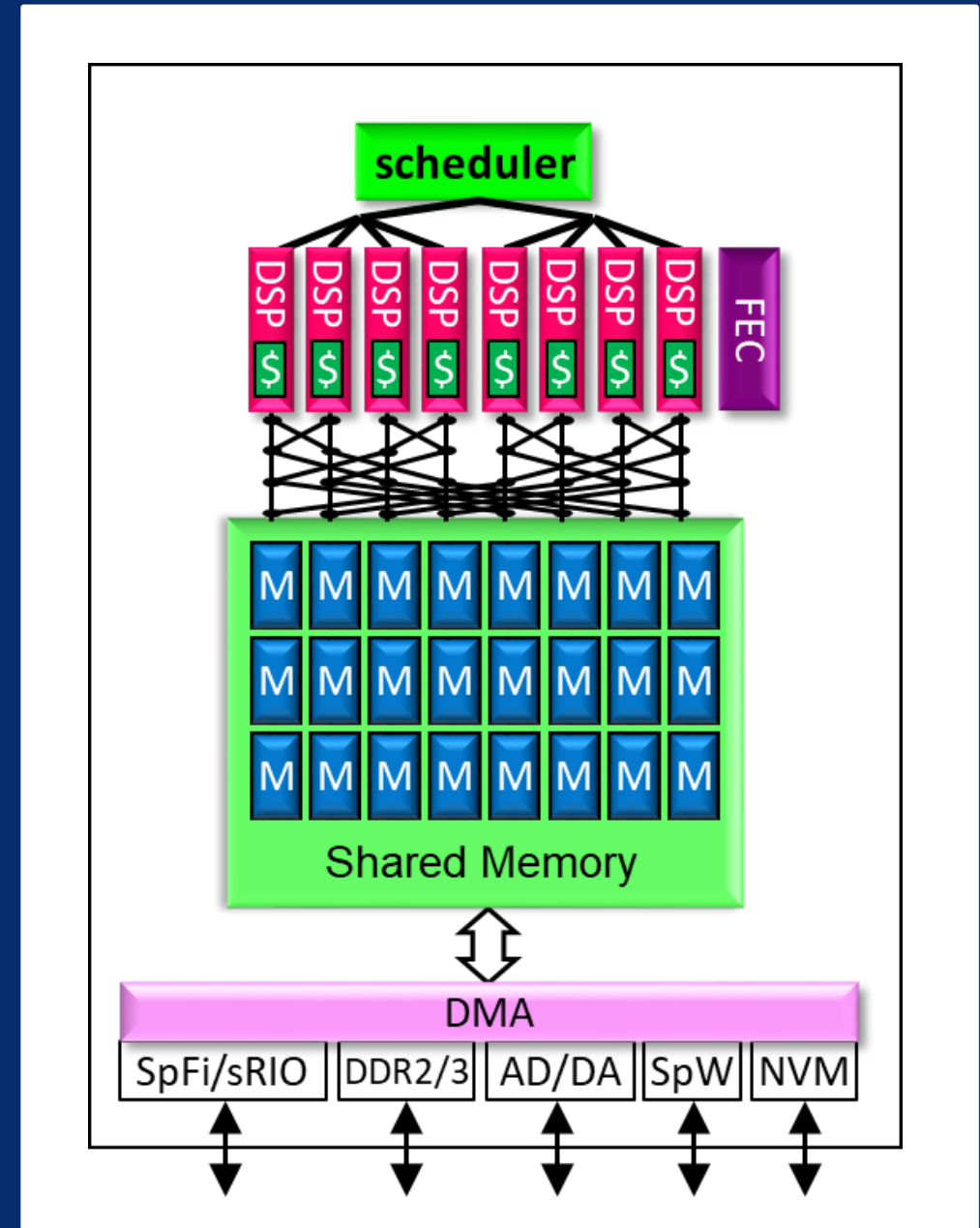
RC64

- 64 DSP cores
- Shared memory 4 Mbytes in 256 banks
- Hardware scheduler
- Log-net cores \leftrightarrow shared memory 100×256
- Cores are NOT inter-connected
- All I/O to shared memory



RC64 Programming Model

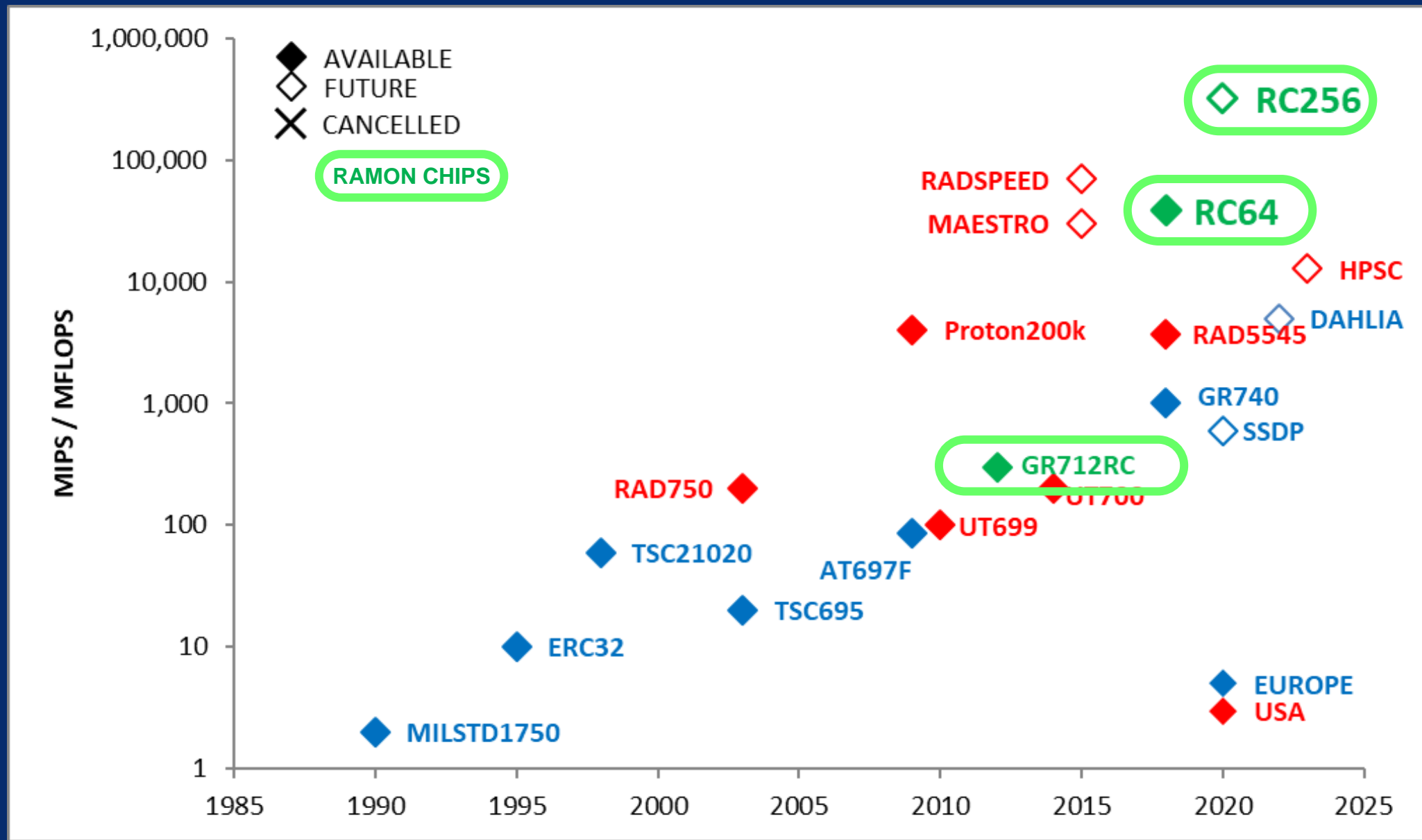
- Task Oriented
- Programmer creates
 - Task Dependency Graph
 - Sequential Task Codes
- Task Graph loaded into Scheduler
- Task Codes loaded into Shared Mem
- Scheduler “executes” the Graph
 - Dispatches tasks to cores
- Shared Memory Model
 - Correct By Design
 - Formally Verifiable



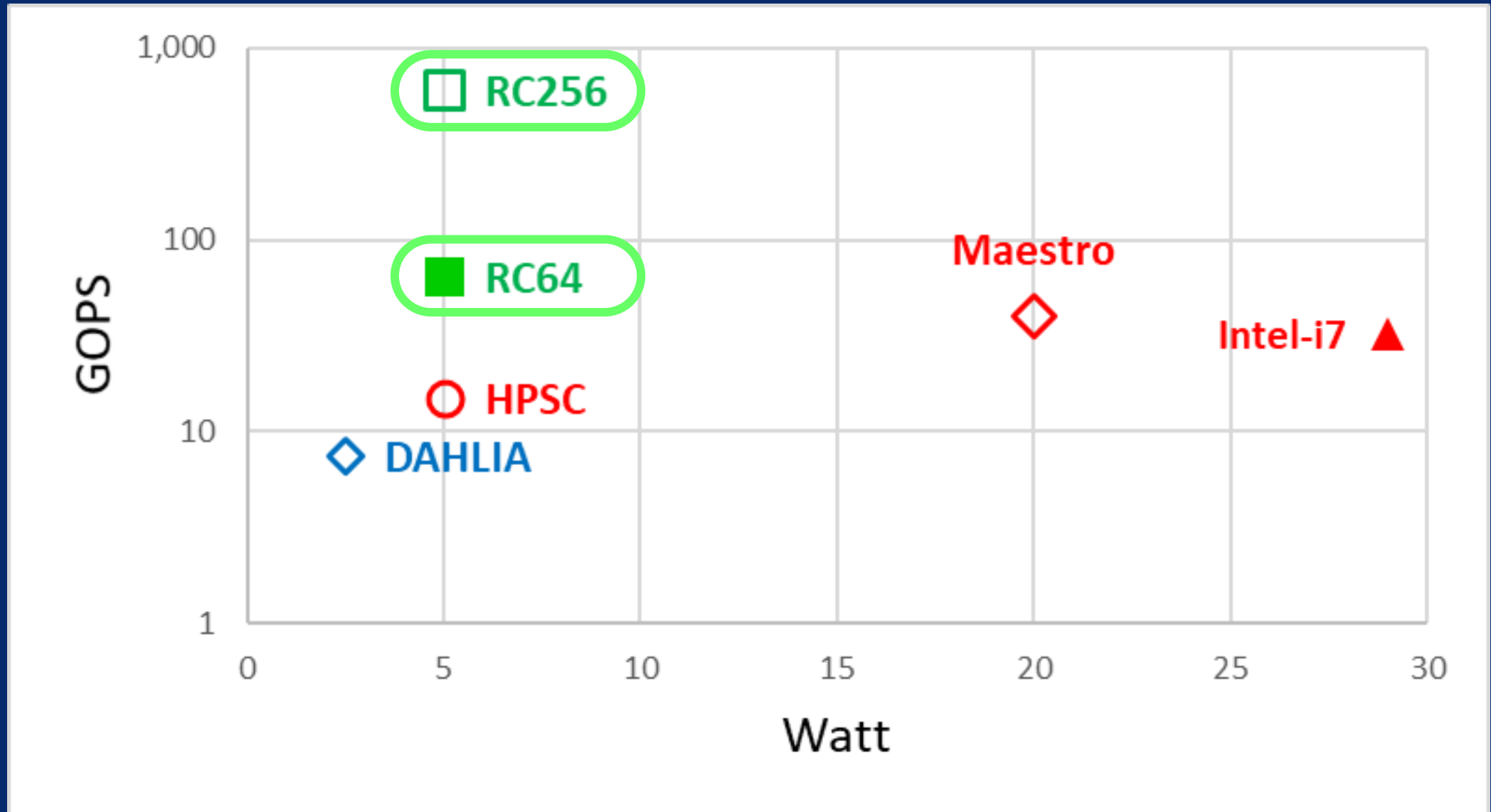
RC64

- Almost fully tested
 - Logic clean
 - SEL free
 - Recovers from all SEFI
 - SW control of thermal cycles (plastic BGA)
 - Ramon Chips Own Screen + Qual Flow
- TRL 7
- Available now
- Long shelf life. Long lifetime in Space. Long commitment of support
- Low cost (almost COTS)
- Lower total cost (and shorter schedule) than COTS

RC64 vs other space processors

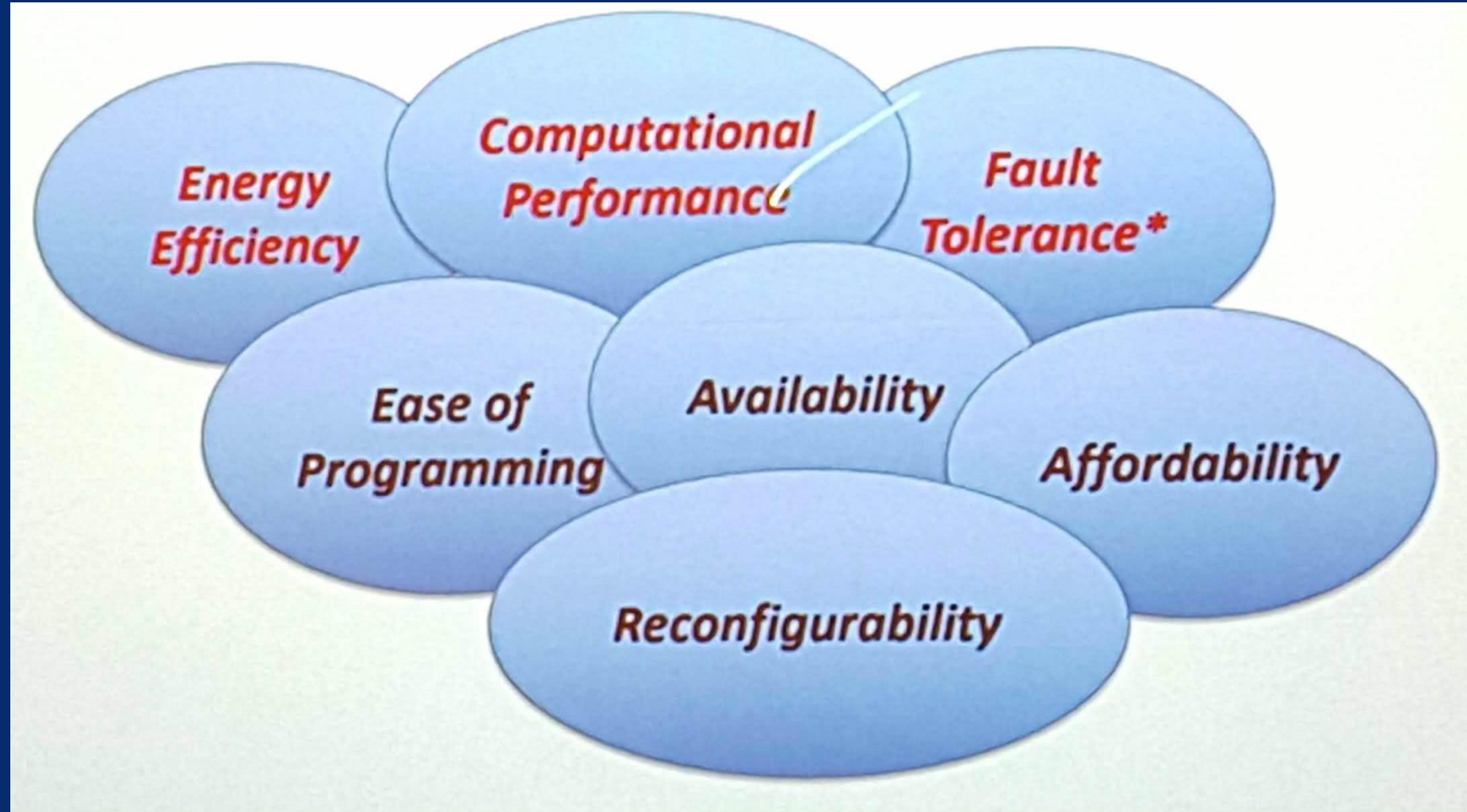


Performance to Power



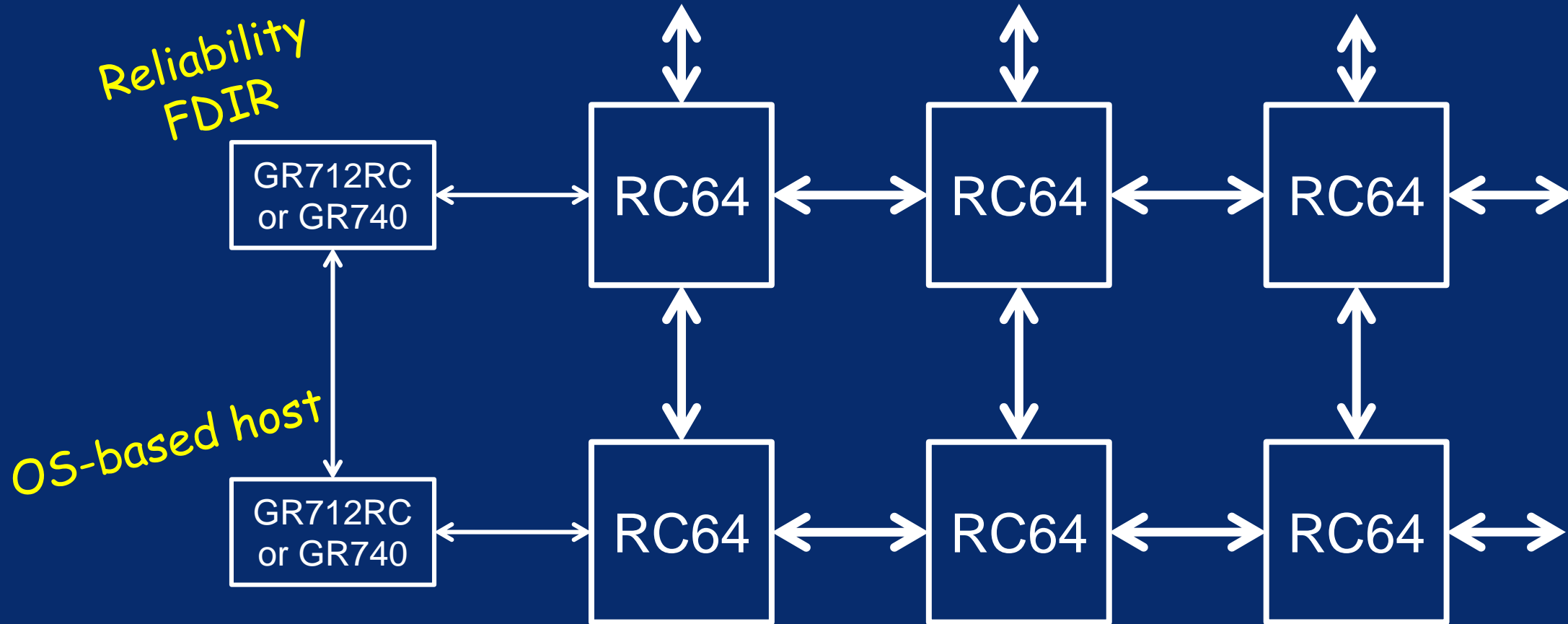
RC64 answers the Goddard list

- Plus scalability

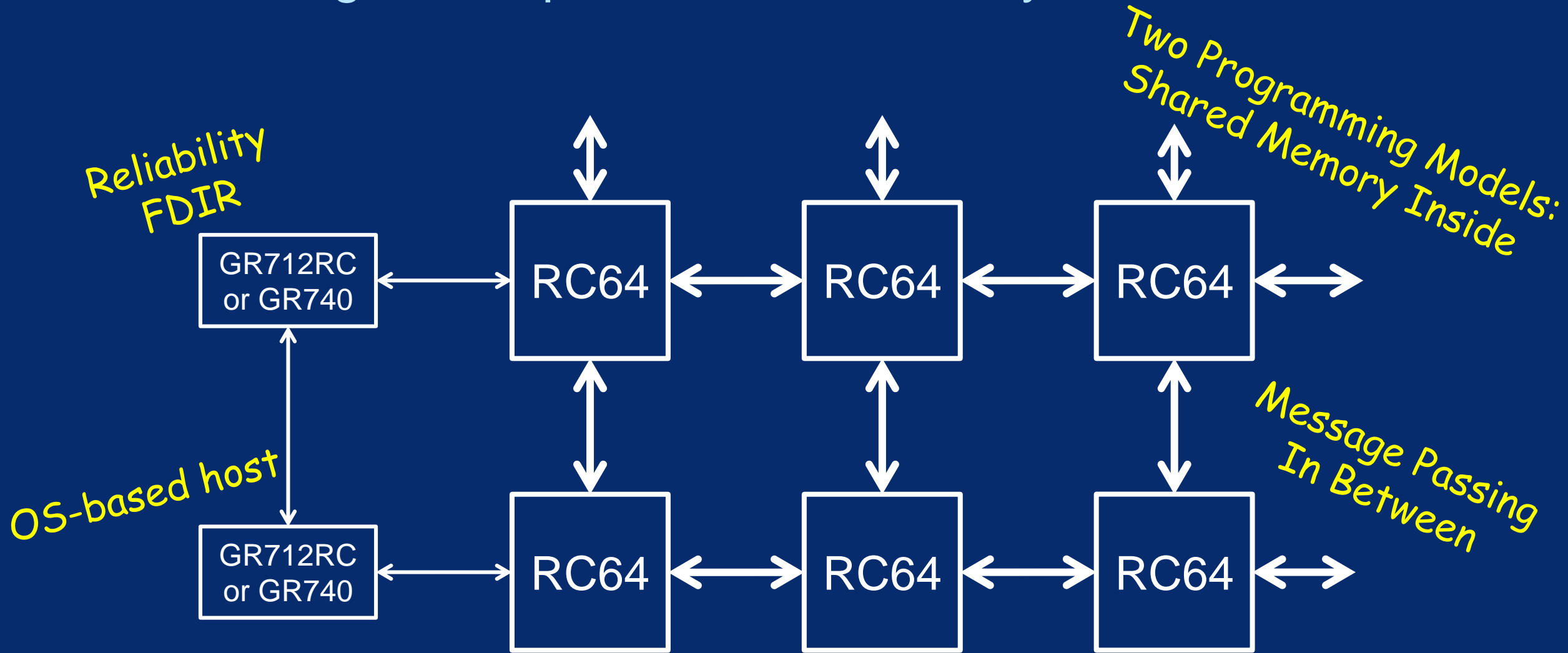


Cornelius Dennehy, NASA view, OBDP 2019

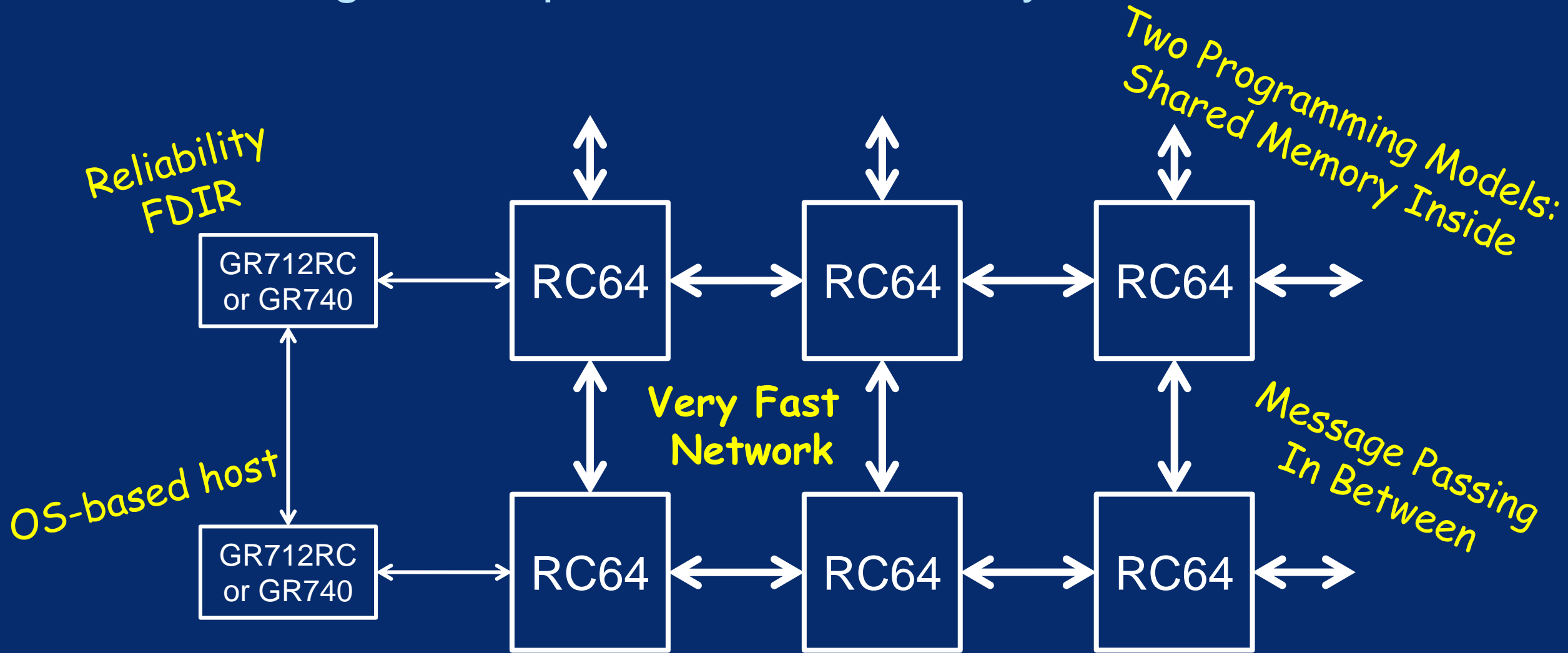
RC64 is designed for parties → NOGAH systems



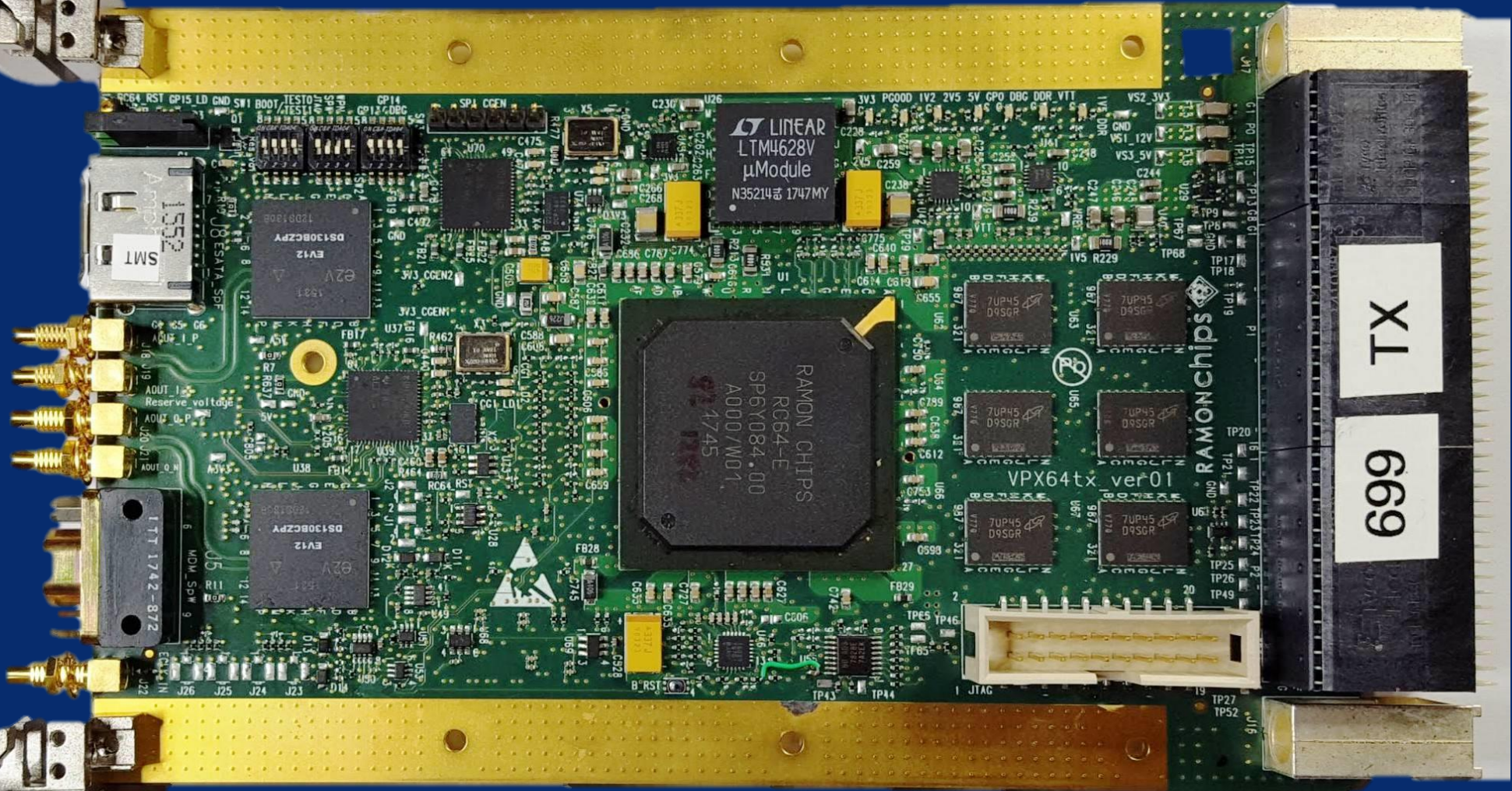
RC64 is designed for parties → NOGAH systems



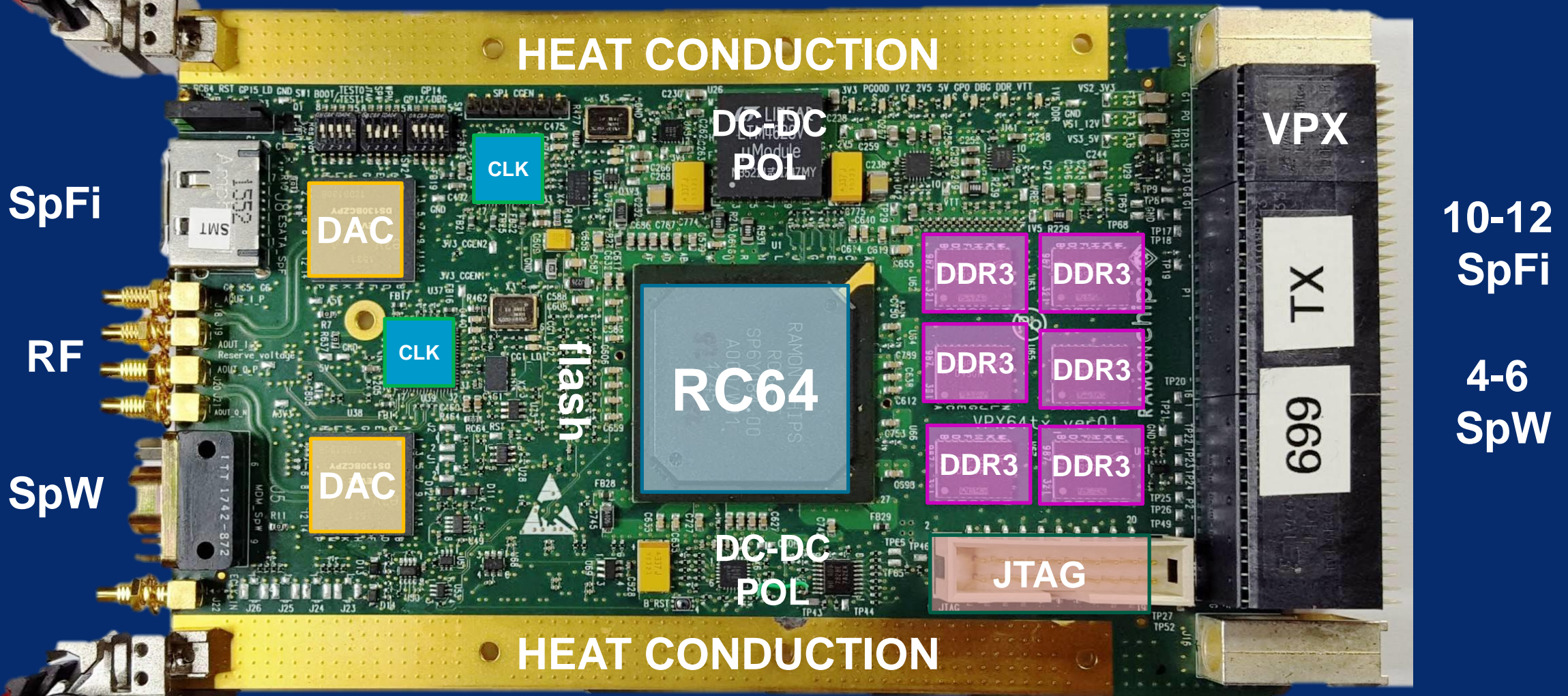
RC64 is designed for parties → NOGAH systems



Example: 3U VPX Downlink Transmitter (1 Gb/s)



Example: 3U VPX Downlink Transmitter (1 Gb/s)



10-12
SpFi

4-6
SpW

Same Same but covered



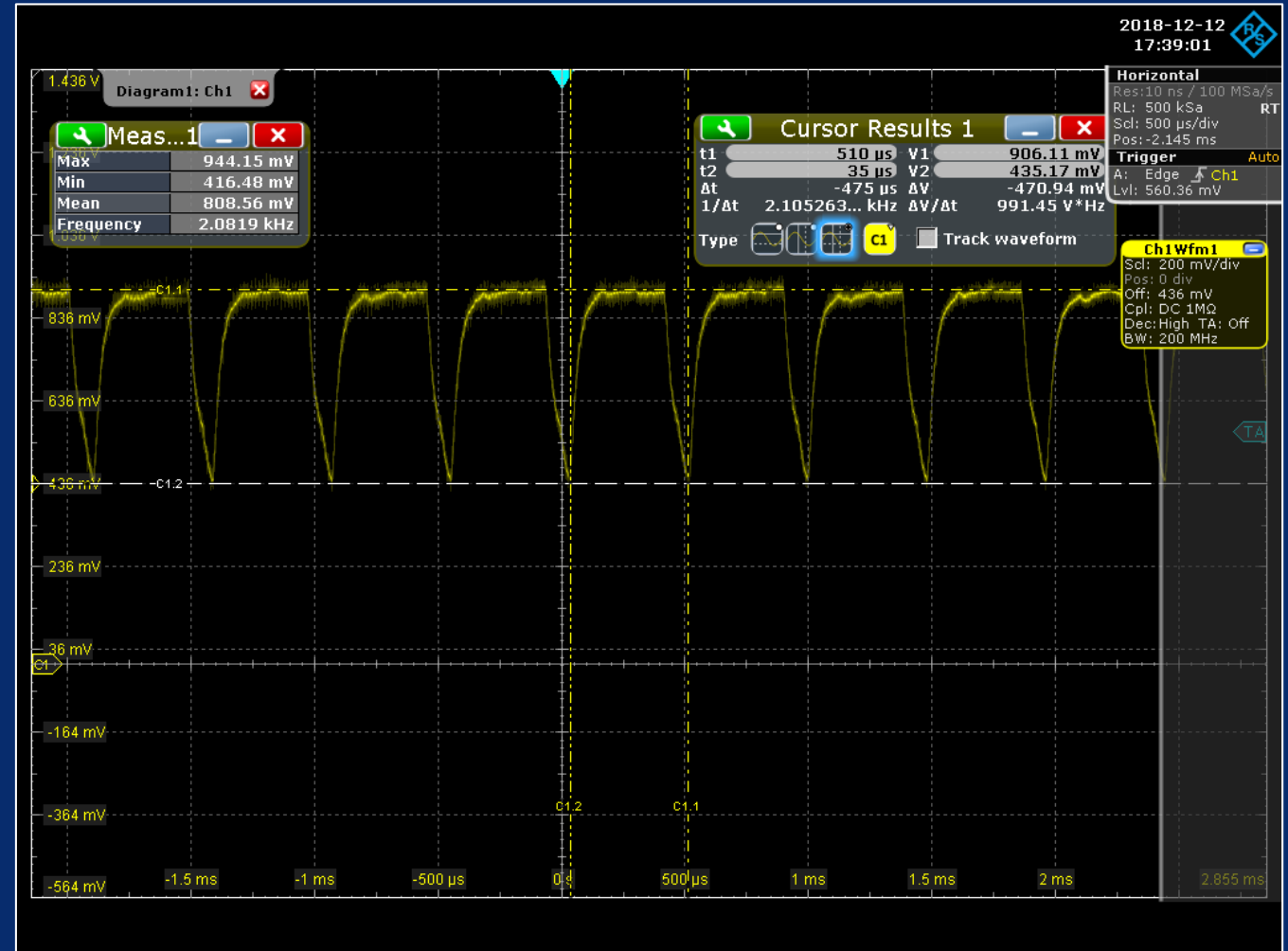
“FOSTER” Ramon Chips—Thales Alenia Space Collaboration

- ESA DSP Benchmarks
- Telecom Applications
 - DBFN
 - Channelization
 - Modems
 - Interference Detection and Mitigation
- More next week here at ESTEC

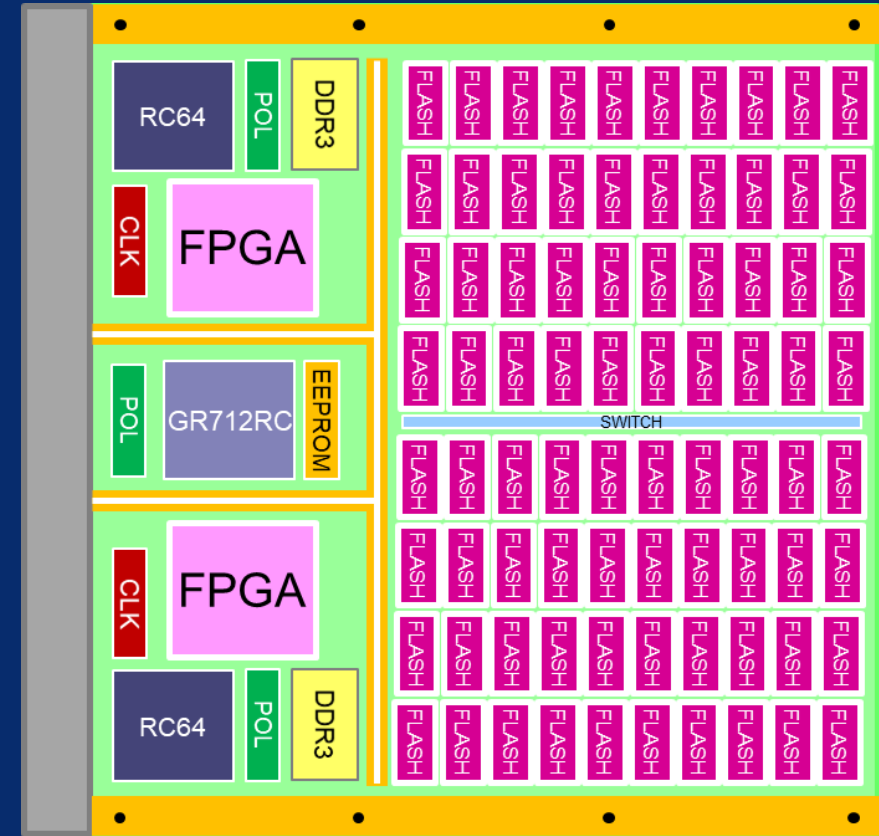
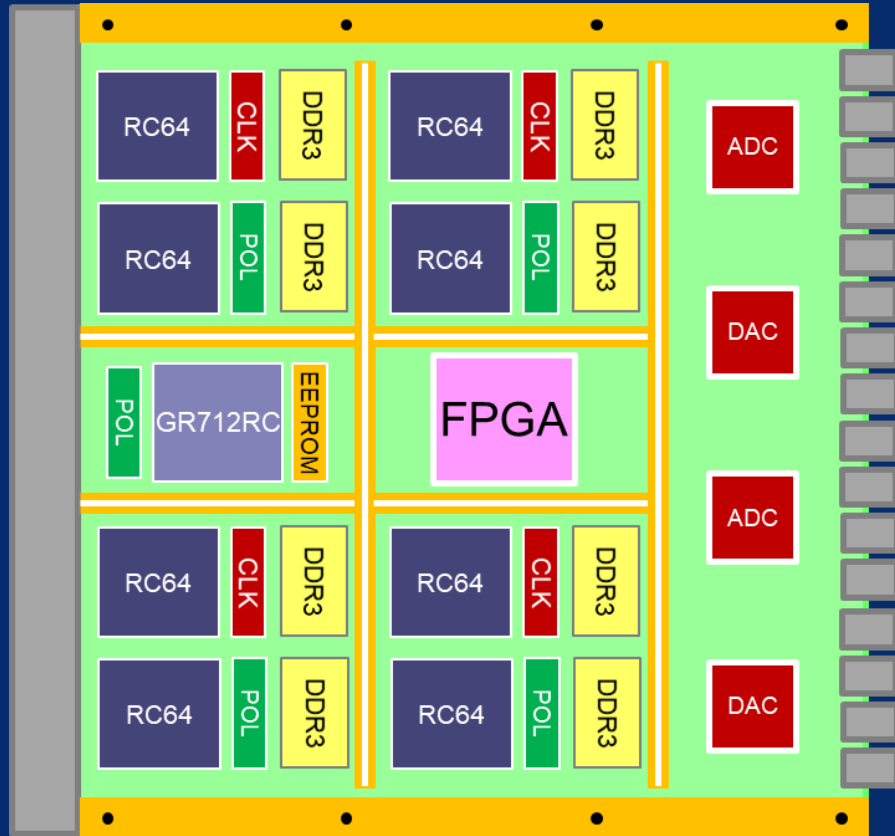


Benchmarks measure performance and power

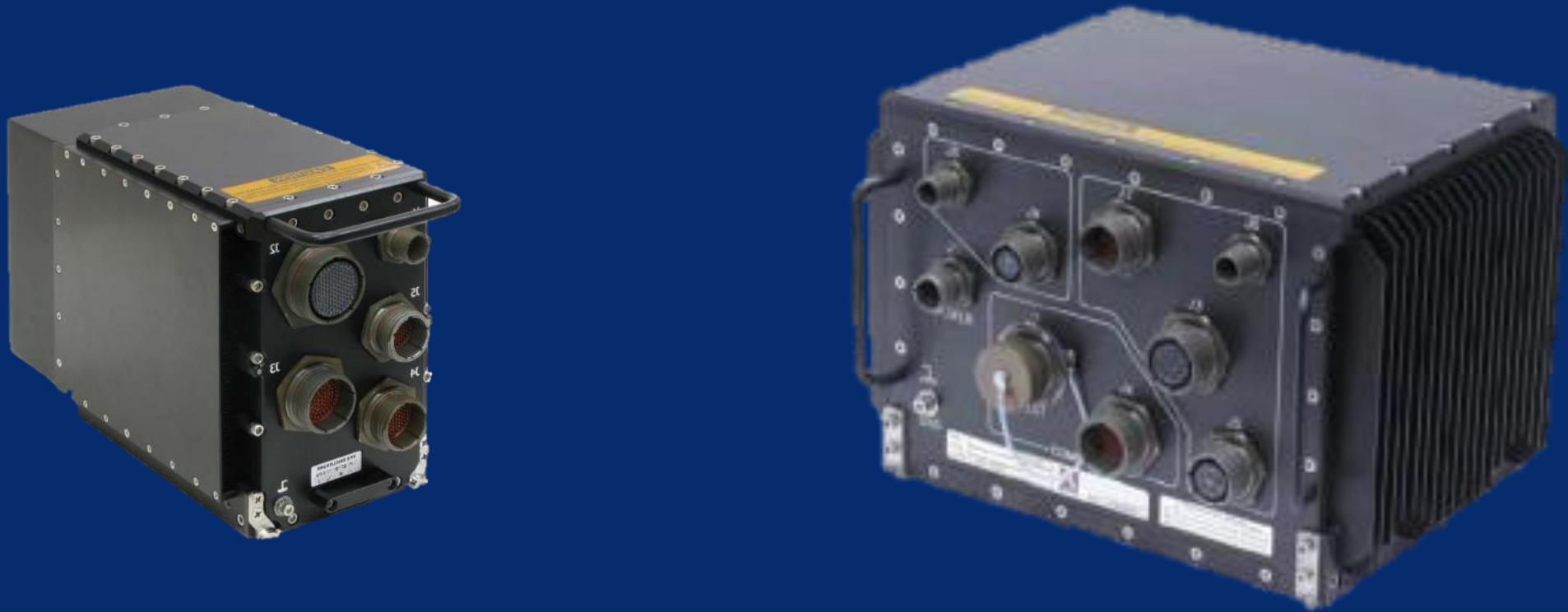
- Example: FIR filter
- Showing 5 uSec
- Showing varying power
- 65 GOPS (16 bits)
- 4 Watt
- 16 GOPS / Watt



Preliminary ideas for 6U-220 cards



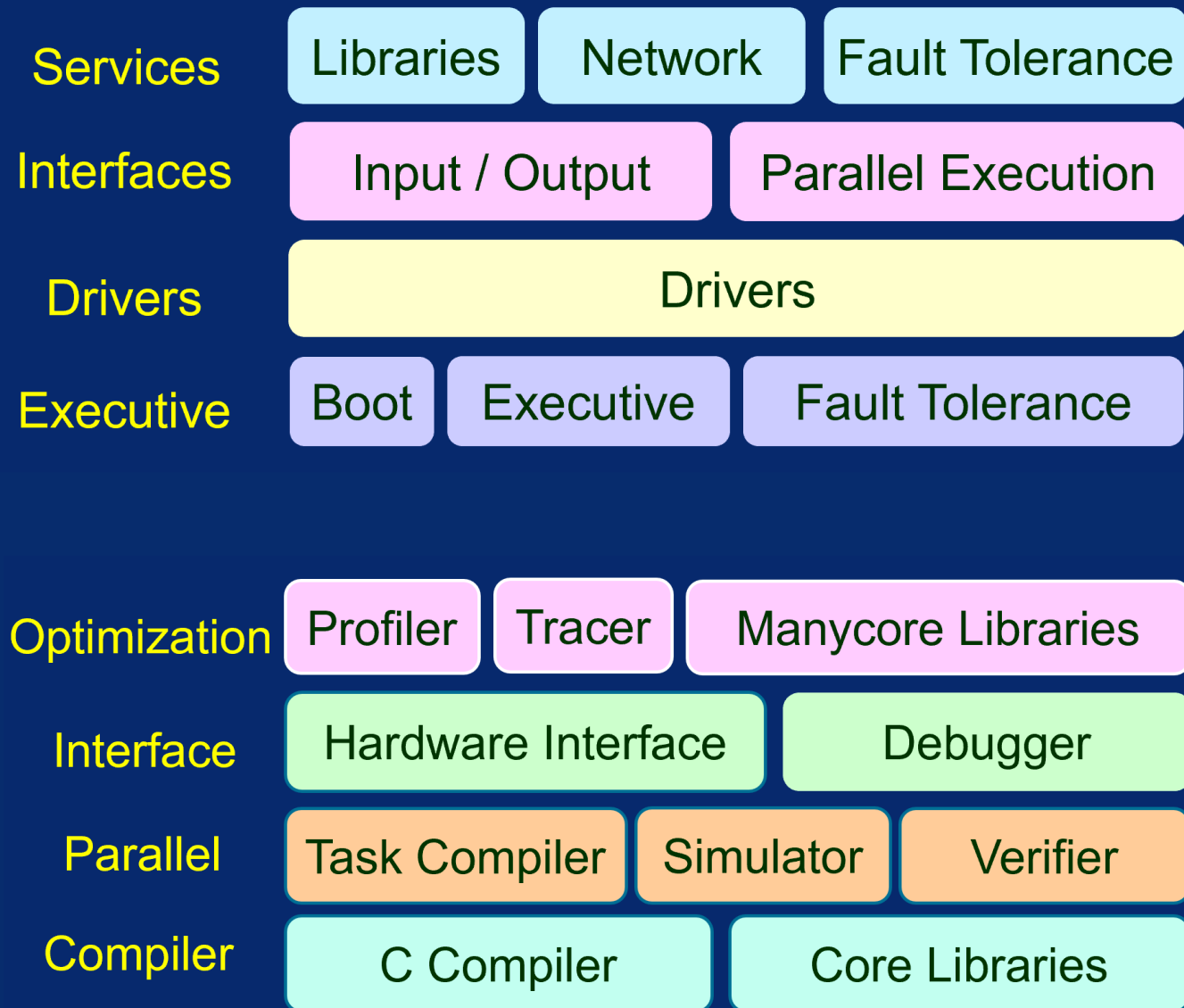
NOGAH systems: Cards, enclosures, software



These two examples are made by Altech (Los Angeles, USA—www.rugged.com)

Software Systems

- Software “Operating System”
 - Services
 - Library Kernels
 - Interfaces
 - Drivers
 - Run Time Executive “RCEX”
- Software Development Tools
 - Integrated Environment
 - Optimization
 - Libraries
 - Debugger
 - Parallel Task Compiler
 - C Compiler



Software Applications

■ TELECOM

- Spectrum Analysis
- Digital Beam Forming
- Interference mitigation
- Channelization
- Transparent switching
- DVB-S2X & RCS2 modems
- IP routing
- SDN
- Constellation Networking

■ COMPUTING

- Resilient Storage
- Machine Learning (inference)
- Cyber Security

■ GNSS

- Ultra-high Precision Receiver
- Steerable Beam Transmitter

■ EOS-OPTIC

- Pixel processing
- Time Delay & Integration
- Detection of Changes
- Accurate Positioning
- Selective Reduction
- Image Compression

■ EOS-Hyperspectral Imaging

- Hyperspectral Imaging Real Time Identification
- Hyperspectral Image Compression

■ EOS-SAR

- 2D/3D FFT
- BAQ Compression
- Object Identification
- Interferometry
- Digital Beam Forming



Conclusions

- RC64 is best high-performance, low-power processor for Space
- NOGAH systems excel in Performance, Power, Fault Tolerance, Ease of Programming, Availability, Affordability, Reconfigurability and Scalability
- Advantageous in both Incumbent and New Space
- Effectively no export restrictions
- Web page posts published papers and presentations



www.ramon-chips.com