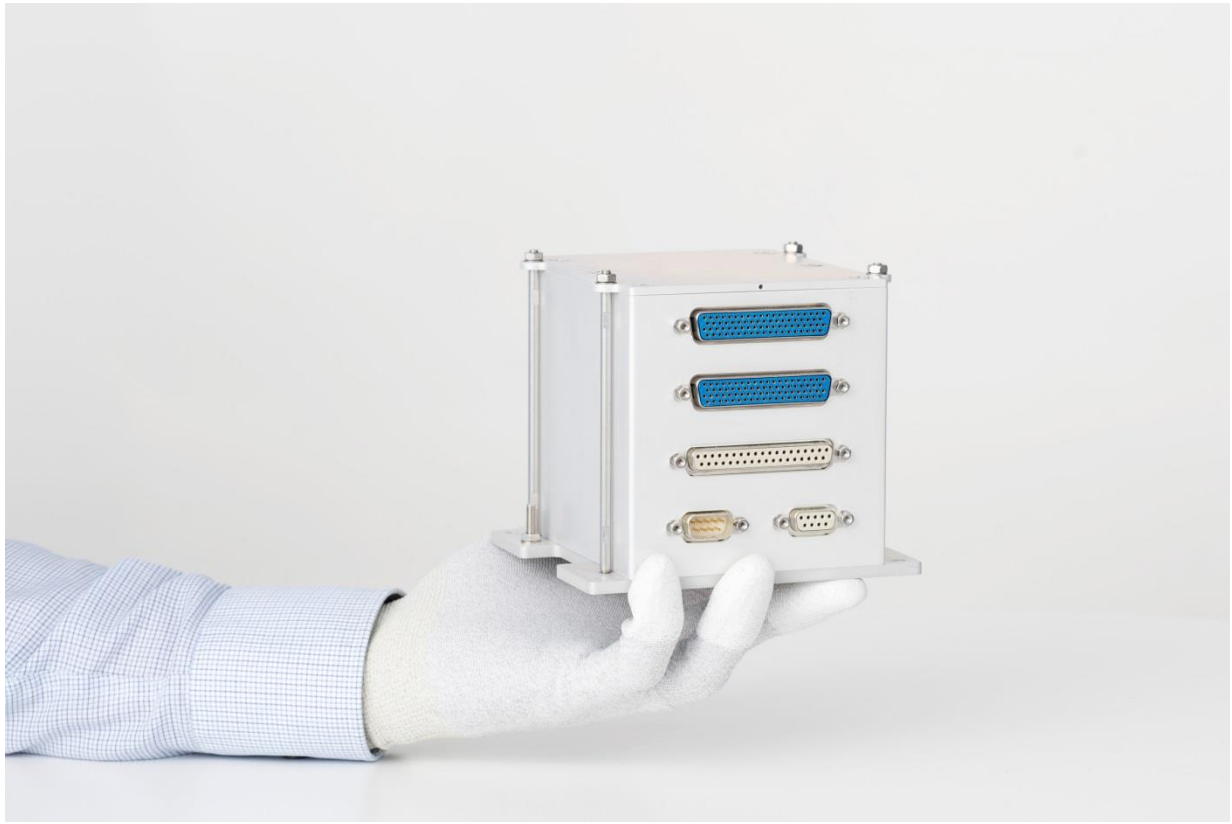
CAN Bus based Constellation Interface Unit - CIU

CAN in Space Workshop 2019



Ari Aho
System Engineer
RUAG Space Finland

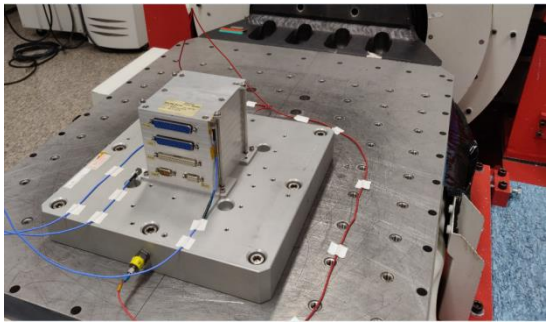
Together ahead. RUAG

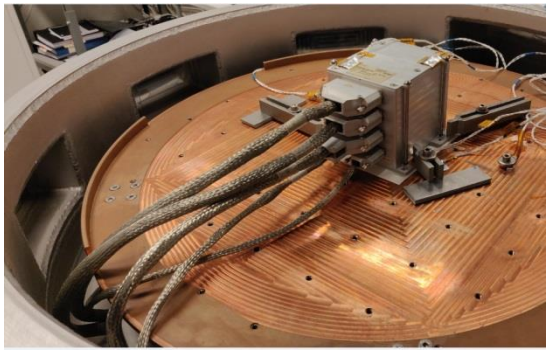
RUAG Constellation Interface Unit - CIU

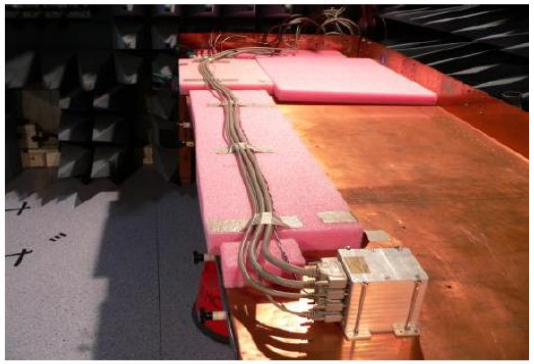
- CIU is a compact, lightweight, modular and flexible spacecraft interface unit
- Interface between spacecraft On Board Computer and either Payload functions or Platform functions
- Target markets are in highly cost sensitive LEO satellite megaconstellations
- Reliability and cost optimized for constellations by using Automotive electronics components
  - Automotive electronics components are to be suitable for New Space type applications.
  - Radiation testing/mitigation technics!
- Design is optimized for serial manufacturing, up to 1000s units/year

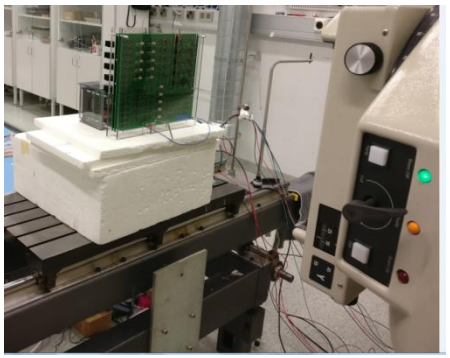
CIU Development

- CIU development was partially funded by ESA ARTES 3-4 Megaconstellation Electronics programme
- CIU is part of RUAG constellation electronics product family development
- Current status: CIU Engineering Qualification Model (EQM) qualification completed successfully.





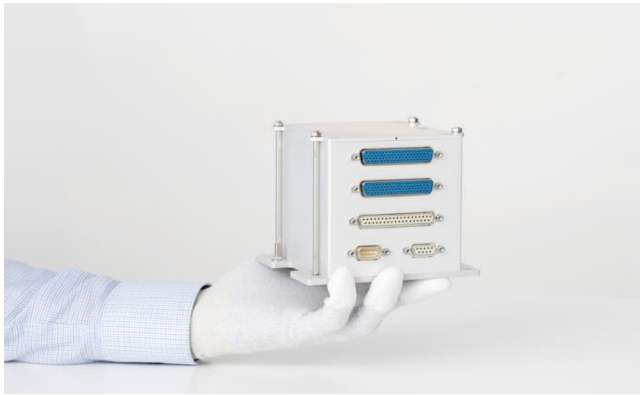




CIU – Key Functions and Budgets

- CAN Bus TM/TC interface
- CANopen based TM/TC protocol
- 64 x Digital, analog and thermistor input signal acquisition
- 28V power bus input
- Isolated DC/DC converter, with discrete on/off command lines
- 4 x Stepper motor drive electronics
- Motor position sensor and end stop switch input acquisition

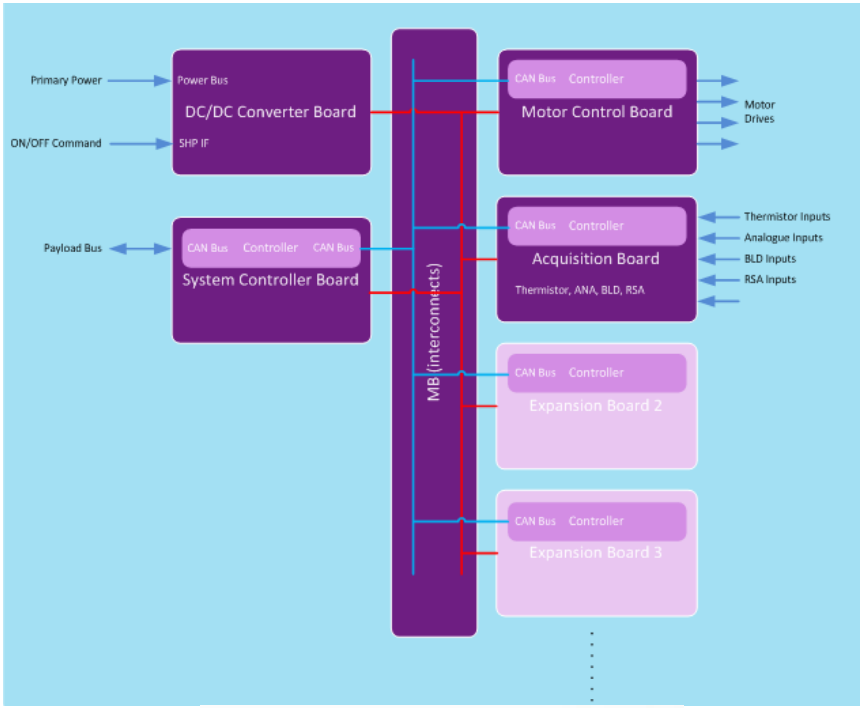
- Size: 120x130x114 mm3 (WxDxH)
- Mass 1.3 KG
- Power Dissipation: < 10 W
- Operation Environment:
  - Temperature: -20C to +60C
  - Random Vibration: 25 grms in plane, 30 grms out of plane
  - Shock Level:2000 g
  - Sustain total dose: up to 10 years in LEO
  - Reliability < 600 FIT (FIDES)



Together ahead. RUAG

CAN Bus based Modular Architecture

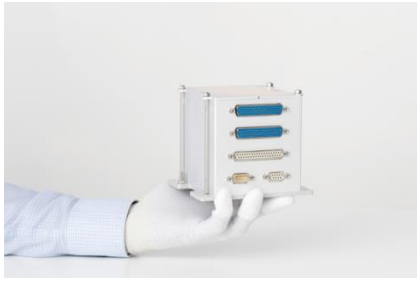
- CIU has following functional subsystems: System Controller, Acquisition, Motor Control (+ DCDC power supply)
- Each subsystem has local microcontroller, with embedded CAN controllers
  - A automotive grade dual core lock step microcontroller
- Two CAN buses:
  - External CAN bus towards spacecraft OBC
  - Internal CAN bus for Unit Internal subsystems data traffic
- Extension functions: Pulse command outputs, Power Distribution and Heater Outputs, MTQ Rod Drive



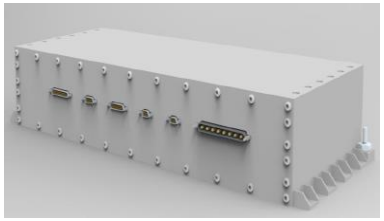
Together ahead. RUAG

Modular Architecture

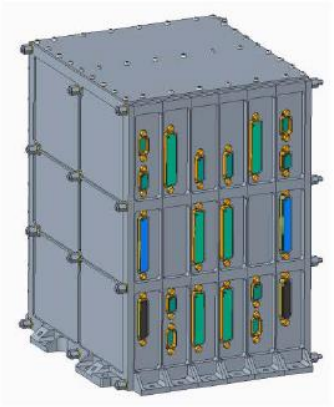
- "One size does not fit for all" – we have seen customer interest for:
  - CIU as stand alone Unit
  - CIU and constellation OBC functions integrated to single Unit (RUAG constellation OBC)
  - Stacked board architecture
  - Flat single board architecture
  - Redundant, non-redundant or partially redundant functions
- The CIU functional subsystems has been used as building blocks for different architectures.
  - "The lego brick building block approach".
- CAN bus supports modular architecture approach



Stacked CIU



Flat CIU



CIU and cOBC Integrated

Together ahead. RUAG

CAN Advantages

- CIU is designed by using automotive COTS electronics.
  - CAN is THE bus in automotive electronics, therefore obvious choice for CIU
  - Controllers are built in for automotive microcontrollers
- CANopen – standard for higher level protocol
- Possibility to implement CAN controller with FPGA IF if functional block does not include microcontroller.
- Network topology
  - Supports modular architecture

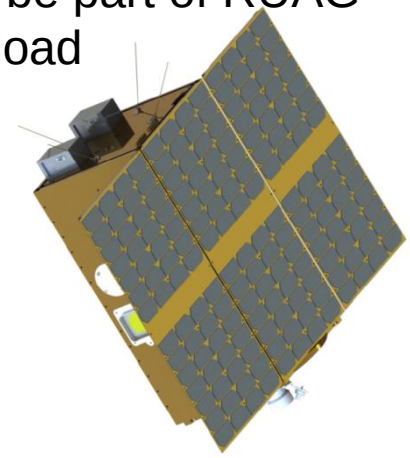
CAN Disadvantages

- Not suitable for high data rates
  - But OK for TM/TC type data
- Not “hard” real time
  - OK for “Soft” real time.
- CAN complexity may be “overkill” for really simple systems
  - If simple point-to-point serial bus meets the requirements, keep the system simple.

On-going CIU development

- More building blocks:
  - Magnetic torque rod drive electronics
  - HPC pulse outputs, GPIO Outputs
  - Power Distribution Outputs
  - Heater Outputs
  - RS485/RS422 Serial Interface

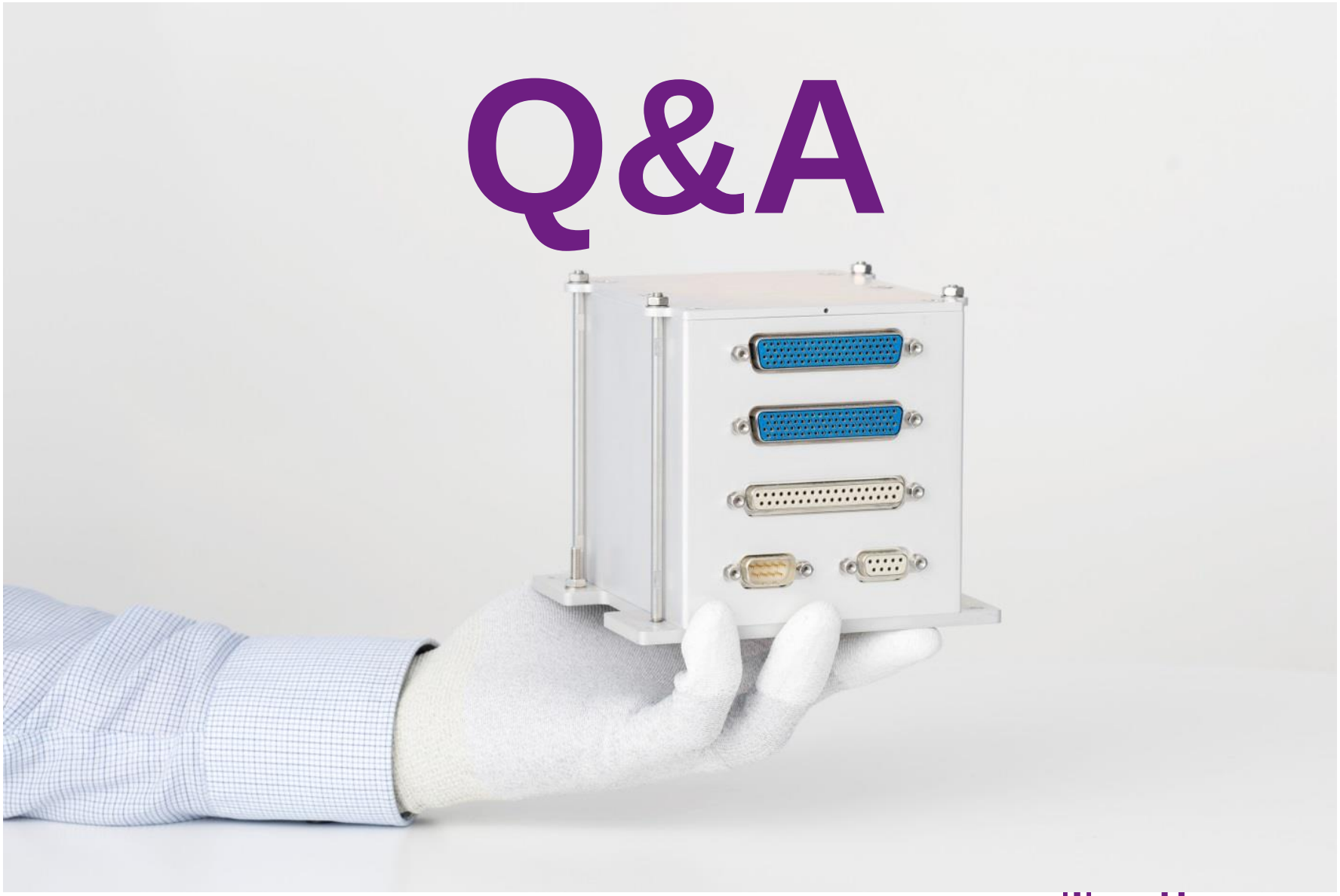
- Increase CIU TRL to level 9
  - RUAG has been selected as one of the payload providers for SITAEL's STRIVING IOV/IOD mission
  - The main purpose is to demonstrate that our low cost products can successively operate in the spare environment
  - CIU boards will be part of RUAG STRIVING Payload
  - Launch 2020



S-75 Platform with deployable Solar Arrays

Together ahead. RUAG

Q&A



Thank You

Together ahead. RUAG