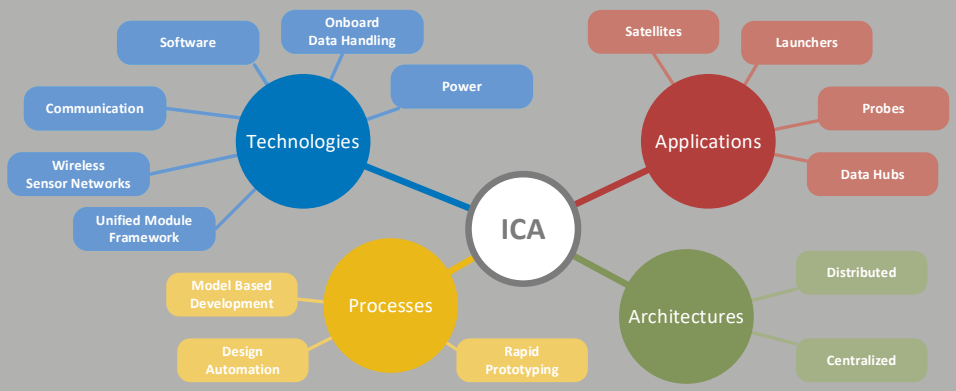


Integrated Core Avionics (ICA) Facts and Features

Integrated Core Avionics (ICA) is a space avionics framework that addresses a wide variety of mission scenarios in an innovative and developer friendly fashion. It provides a coherent and scalable solution for the full set of core avionic domains of power, onboard data handling, communication and software, based on latest avionics research.

Motivation

As Avionic Systems Department, we routinely face the challenge to provide innovative solutions for a wide variety of space missions. Yet, we are in the unique position to regularly have the system leadership role and at the same time are in charge to develop the missions core avionics. This provides the opportunity to influence almost all aspects of the space system design. Together with the close collaboration of our experts in the domains of power systems, onboard data handling, communication, and flight software, we can offer an Integrated Core Avionics (ICA) solution for diverse mission scenarios. We aim for a solution that is:

- Easy to scale for different applications and spacecraft classes
- Easy to extend with new functionality and external technologies
- Easy to update with latest research findings

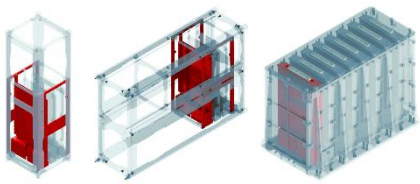
Approach

From the start, ICA is designed in close collaboration by experts from core avionics domains. The goal is to provide solutions that integrate the domains by design instead of requiring dedicated integration effort later. This is achieved by two key aspects:

1. Early definition of shared functional, hardware, and software interfaces
2. Clear definition of the combined design space and its limits

Solution

Integrated Core Avionics provides solutions that can be used in a wide variety of scenarios. The hardware is based on the ICA Unified Module Framework (UMF) that allows the integration of the same modules in CubeSat structures or stand-alone enclosures for larger systems illustrated on the left side. A variety of modules can provide functionality from power and data handling to communications. All of them are supported by our own Open modUlar sofTware PlatfOrm for SpacecrafT (OUTPOST).
Overall, small, centralized solutions as well as larger distributed systems with remote terminal units are supported. This allows the application of ICA in larger CubeSats, small satellites, launchers, probes or other space equipment, with reduced redesign effort and reduced risk.



Application spectrum for ICA UMF modules (in red) showing compatibility with 3U/6UCubeSat structures and integration with stand-alone box for larger systems.

Features

Power System

- Up to 28V Bus voltage, 840W max. power
- MPPT Array Power Regulators in discrete analog or digital implementation
- Up to 200W per Array Power Regulator channel
- Analog, software independent under-voltage-protection for battery interface
- Fully protected distribution of regulated and unregulated voltages
- Up to 10 A output current per channel
- Valve / Actuator drivers and pyro drivers possible with constant current output

Onboard Data Handling

- Flexible processing and interface solution configurable from available modules
- Fault and radiation tolerant LEON3FT based processing modules with up to
    - 160 DMIPS / 160 MFLOPS
    - 128 MiB RAM with ECC and 4 GiB NAND flash memory
- COTS based processing modules for application acceleration with up to
    - 8660 DMIPS / 410 MFLOPS (double precision)
    - 1 GiB RAM with ECC and 4 GiB NAND flash memory
- Mission specific interface modules with a selection of standard interfaces like RS422/RS485 serial, CAN, SpaceWire, and discrete I/O

ScOSA
Scalable On-board Computing for Space Avionics

Communication

- Fully software-controlled radio platform (SDR)
- Radiation-tolerant and modular design
- Adjustable in RF range up to 6 GHz by software
- 4x Rx and 4x Tx design for MIMO applications
- Up to 56 MHz bandwidth per channel
- Customizable FPGA design for user-defined comms systems
- In-flight reconfiguration, redundant boot mechanism and automatic failure recovery

GSDR
Generic Software Defined Radio System

Flight Software

- Flight-proven and hardened code base
- Hardware abstraction layer and real-time operating system integration
- Pre-implemented PUS-compliant services
    - Telemetry and telecommand verification and parsing
    - Parameter storage with statistics, monitoring and events
    - Flexible function management with time and location scheduling
    - Compressed data and housekeeping reporting
- Various internal and external communication protocols
- Sparse logging with ground parsing
- Supporting ecosystem with mission control software and document exchange tools

OUTPOST

Selection of Technologies that are applied in the context of ICA.

Wireless Sensor Network

- Reliable wireless communication for low to medium data rate applications
- Reduces harness mass and design complexity
- Can provide precise localization of network nodes

German Aerospace Center (DLR)
Institute of Space Systems | Avionics Systems (DLR-RY-AVS) | Robert-Hooke-Str. 7 | 28359 Bremen
Telephone: +49 421 24420-1079 • E-Mail: ica@dlr.de • DLR.de

DLR Deutsches Zentrum für Luft- und Raumfahrt