esc Aerospace

2023 2024 PRODUCTS AND SERVICES CATALOGUE SPACE

PRODUCTS AND SERVICES CATALOGUE

About esc Aerospace

esc Aerospace is a leader in the field of on-board avionics in Europe and is one of the leading SMEs in innovative R&D projects with a focus on aerospace. **esc Aerospace** is experienced in the areas of Avionics, Autonomous Software, Counter-Unmanned Aerial Systems (C-UAS) and Guidance, Navigation & Control (GNC) systems. **esc Aerospace** offers services in the field of UAS and satellite payload chains modelling, as well as target UAS and drone defence services to eliminate your threats. To localize the radioactive waste we offer CBRN services.

esc Aerospace & its employees are members of the following associations

AFCEA	www.afcea.org	the Armed Forces Communications and Electronics Association
AIAA	www.aiaa.org	the American Institute of Aeronautics and Astronautics
BavAIRia e.V.	www.bavairia.net	Association of companies engaged in aerospace and navigation in Bavaria
Czech Optical Cluster	www.optickyklastr.cz	Optical industry development in the Czech Republic
Czech ICT Alliance	www.czechict.cz	Association of Czech ICT companies
Czech Space Alliance	www.czechspace.eu	Association of Czech SMEs involved in space industry
DSIA CR	www.dsia.cz	Defence and Security Industry Association of the Czech Republic
DTIHK	tschechien.ahk.de	Czech-German Chamber of Commerce
ITS&S	www.sdt.cz	Intelligent Transport Systems and Services
UAV DACH	www.uavdach.org	Der deutschsprachige Dachverband für unbemannte Luftfahrt in Europa

Services

On-site engineering support	Integration and validation services
Space qualified software engineering	Quality assurance
Space qualified hardware design and manufacturing	Project and configuration management

CONTENTS

SATELLITE COMMUNICATION & NAVIGATION

Satellite Communication

esc Aerospace provides comprehensive solutions for satellite communication all around the world.

There are important applications in humanitarian missions in underdeveloped countries. Several areas provide only obsolete or even no communication infrastructure, making the management and controlling of missions complicated and inefficient. For these purposes, esc Aerospace offers complete communication solutions. While the satcom-related hardware (antenna and satellite modem) is the fundamental part of the communication system, it is also possible to deliver adjacent networking equipment, data storage and backup devices. esc Aerospace 's experts are ready to set up the system in the target area and to provide operational support.

Tracking and Data Relay Satellite (TDRS) on orbit
© NASA

Telemetry on flying vehicles is another remarkable satcom application. They operate in considerable heights, flying at high speeds. A completely new private communication platform would require expensive development of tailored hardware and creation of on-ground transceiver network. Satellite communication poses an attractive alternative. Antenna is usually the only part requiring substantial tailoring while the RF electronics can be assembled rather in
a routine way, shortening the development time and saving costs. There are several satellite communication platforms offering global coverage – an essential feature in many applications.

(SBIRS) missile warning satellite
© Lockheed Martin

Satellite Navigation

esc Aerospace provides solutions for satellite navigation.

Fast and precise positioning and navigation are essential tasks of every UAV on-board control unit. esc Aerospace is able to deliver tailored positioning devices, including antennas. esc Aerospace also has extensive experience with positional data processing and navigation. For the purpose of UAV controlling, signals from gyroscopes and Pitot tubes can be processed together with satellite navigation data. However, applications of satellite positioning in UAVs are not limited to automatic vehicle navigation but allow the measured data (e.g. video recordings, radiation measurements, etc.) to be accompanied by precise coordinates that are necessary for proper data evaluation.

Global Navigation Satellite Systems (GNSS) © BeiDou

esc Aerospace has been participating in several work-packages of the Iris programme, including:

Iris Programme Overview

Iris, element 10 of the ESA´s ARTES (Advanced Research in Telecommunications Systems) programme, aims to develop a new Air-Ground Communication system for Air Traffic Management (ATM). It is a satellite-based solution for the Single European Sky ATM Research (SESAR) programme. It supports the implementation of the Single European Sky by looking at all aspects of ATM. It also intends to modernize communication infrastructure and increase safety for air traffic participants. By 2020 it will contribute to the modernization of ATM by providing digital datalinks to cockpit crews in continental and oceanic airspace replacing a voice communication channel between the pilot and ATM controller.

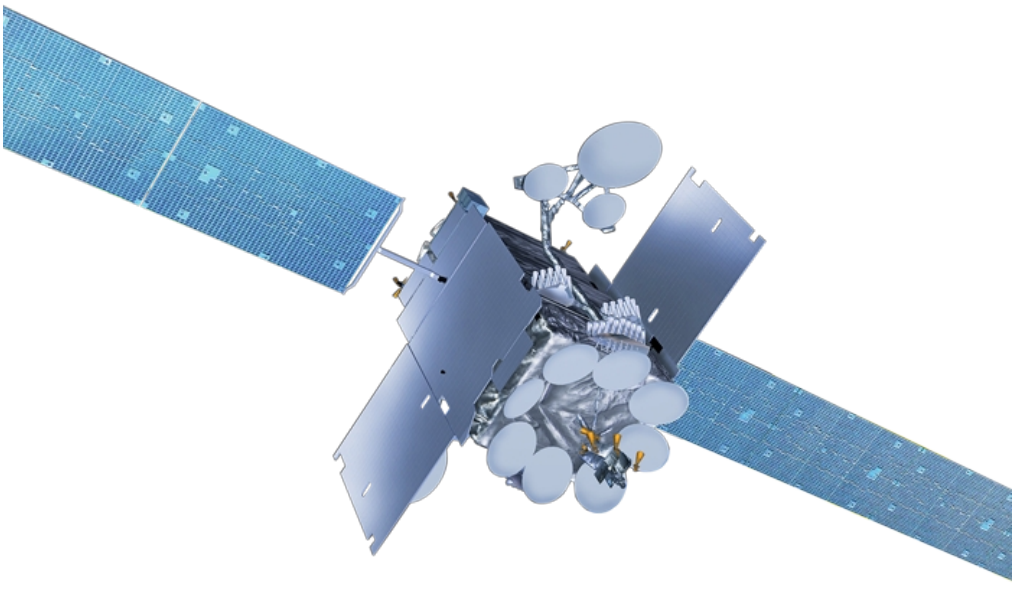
ATM System Load Emulator

esc Aerospace is a member of a team that defines the architecture and implements the Load Emulator of a future Air Traffic Management (ATM) System. The Load Emulator synthesizes interference in the forward and return radio link in different traffic loading scenarios. Together with a simulator of the telecommunication payload to be carried on the ATM satellite and the Satellite Channel Emulator of Ku-band & L-band links, all the components were integrated to a so called Verification Test Bench and used to evaluate and improve performance of the future ATM system.

Test Controller

Another challenge for esc Aerospace is to develop Test Controller of the ATM Verification Test Bench (VTB). The Test Controller provides remote monitoring and control of all VTB elements from a centralized user position. There are 21 partners involved in the development of the VTB.

Our delivery consisted of a SW module, host platform HW, documentation and integration of additional components like GUI or Result Processor provided by other subcontractors in the Iris/ ANTARES project.

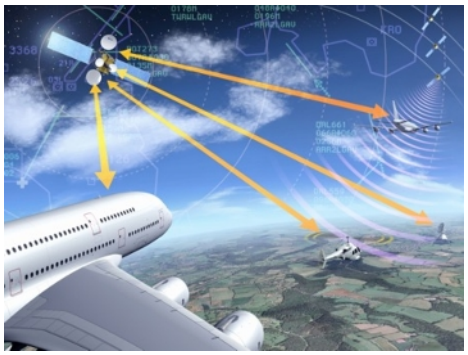


nmarsat-5 F4 (I-5 F4) © inmarsat

RPAS (WP Leader) – IRIS Service Evolution

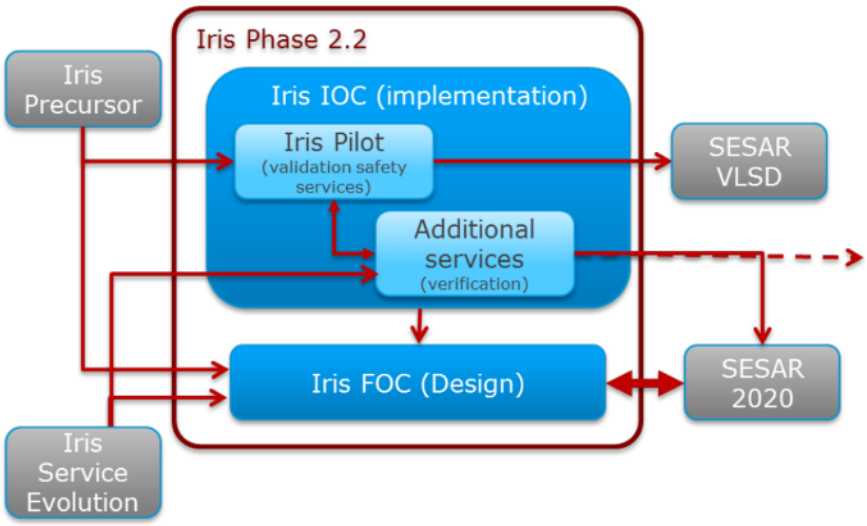
Within Iris Service Evolution study/phase, the objectives of the work package were:

- To analyse RPAS integration into Iris Service Evolution to support the RPAS operation into non-segregated airspace (i.e. within the ATM environment)
- To characterise the RPAS ATM traffic to operate safely into the ATM environment
- To generate requirements for the Iris Service Evolution to support the integration of the RPAS into the ATM environment
- To propose an RPAS demonstrator for assessing the use of Iris Service Evolution in the RPAS environment and to identify potential pre-developments



Iris: Satellite communications for ATM © ESA

The scope of this WP is on the RPAS integration into the ATM environment relying on Iris Service Evolution; thus, the main focus of this project is the ATM data link between the ATC controller and the RPAS. The objective is not to analyse the C2 data link (i.e. data link between the RPA and the RPIL). In case that this link is necessary, some assumptions will be taken.



Iris Infrastracture © ESA

esc Aerospace was participating on the FLPP3 project Demise Observation Capsule.

Mission Background

The DOC shall be carried on-board the host vehicle (in this concept the reference mission is the VEGA launcher) by means of physical fixations, and shall be capable to autonomously perform its mission, including the safe separation from the host vehicle following the critical re-entry phase, and the transfer of the collected data to ground without the need of the DOC to be recovered.

Features

The on-board software is considered to be a fully automated system, which will carry out its mission with no intervention from ground operators during any part of a mission.

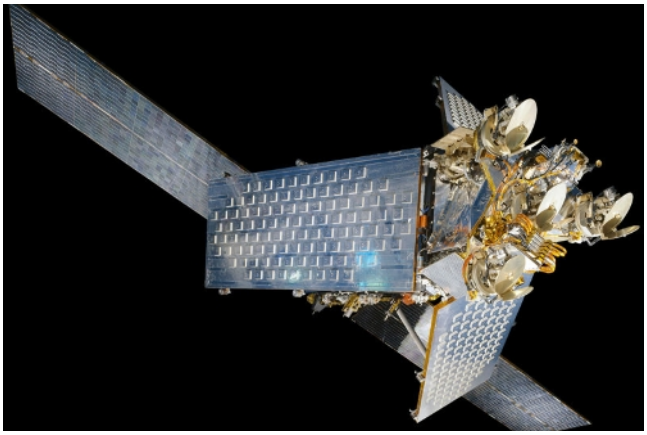
The concept behind the FSW (Flight SW) is a linear sequence of modes (from stand-by/launch mode to atmospheric free-fall mode), with predefined triggers controlling the transitions between the modes. In-flight data is transferred via a commercially available global telecommunication system (Iridium).

esc Aerospace designed and implemented a communication protocol - Iridium optimized.

esc Aerospace designed, developed and qualified the OBC SW, including and EGSE SW and HW:

- Real-time operating system (FreeRTOS). SW Engineering;C language including SW unit testing;
- Embedded Technology: AVR32, GOMSPACE A3200;
- Ground support and test equipment SW: Linux, Qt 4, C/C++.

Vega © ESA



Iridium © Iridium

LVICE2

Mission Background

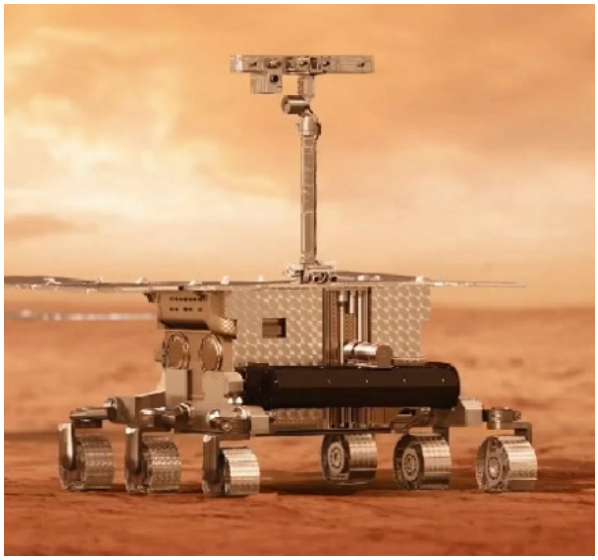
esc Aerospace joined with a group of Czech academic institutions and companies with a heritage of space-proven scientific instruments. Together, we proposed a unique mission set to study the yet unexplored dust clouds at Earth-Moon Lagrange points L4/L5 and the solar wind turbulence in the Lunar wake.

With this mission, esc Aerospace aims to develop and demonstrate the capability to completely integrate a spacecraft. The platform can be reused with small adaptations to fit other missions. It has an active attitude and orbit control and is capable of large orbital manoeuvres within cis-lunar space. If the mission concept is selected for funding, it would be the first Czech probe with an active propulsion system going to deep space.

EXOMARS

Mission Background

The goal of the ExoMars Rover and Surface Platform mission is to deliver a European ExoMars Rover to the surface of Mars. The primary objective is to land the rover at a site with high potential for finding well-preserved organic material, particularly from the very early history of the planet.



The ExoMars Rover is to be delivered to Mars surface using ExoMars descent module. Propulsion, power, and communications to the descent module during cruise to Mars are provided by ExoMars carrier module. The descent module will deliver the rover and platform safely to the surface while the carrier module will burn up in the atmosphere.

Features

esc Aerospace is responsible for additional SW verification and validation of the application SW for carrier module and descent module.

The responsibilities include manual and tool-assisted review of the application SW, verification of correct implementation of SW requirements, validation of GNC algorithms, and testing of SW behavior on the spacecraft simulator.

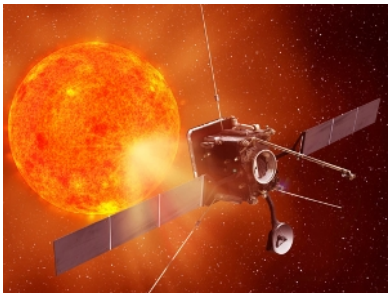
SPACE QUALIFIED SOFTWARE - STIX

esc Aerospace is a leader in the field of Space On-board Software in Europe.

esc Aerospace engineers have broad experience from earlier non-ESA Space projects and recently completed ESA projects. The On-board SW development is compliant to the current ECSS standardization.

STIX Instrument On-board Software (PRODEX)

Mission Background



Solar Orbiter Mission © ESA

The Solar Orbiter is one of the Cosmic vision M-Class ESA missions. Goal of the mission is to understand (and even predict) how the Sun creates and controls the Heliosphere. STIX is one of the Solar Orbiter's on-board remote sensing instruments. STIX provides imaging spectroscopy of solar thermal and non-thermal X-ray emissions from approx. 4 to 150 keV, with unprecedented sensitivity and spatial resolution. esc Aerospace designed, developed and qualified the On-Board SW, including:

- StartUp SW – Mission critical SW (stored in PROM)
- Application SW (stored in FLASH memory)

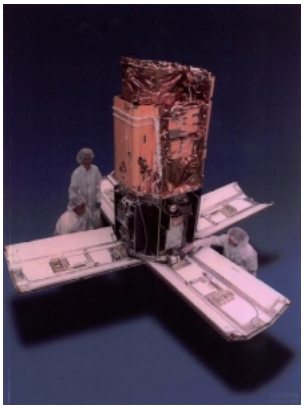
Features

- Control of the instrument and interface to the spacecraft
- SpaceWire link interface, using ESA PUS TC/TM interface
- Housekeeping data acquisition and reporting
- FDIR (Failure detection, isolation and recovery)
- Science data acquisition and storage
- Autonomous On-board data processing
- SW developed in C language
- Embedded Technology: Leon 3FT IP core in FPGA

HXRS (Solar Hard X-Ray Spectrometer)

Mission background

Czech Solar Hard X-Ray Spectrometer aboard the NASA & U.S. Department of Defense & U.S. Department of Energy – Multispectral Thermal Imager satellite (MTI). Launched on March 12th, 2000 on a Taurus vehicle from VAFB, CA, USA, successful 18 month mission.



Czech Solar Hard X-Ray Spectrometer © NASA

Features

esc Aerospace designed, developed and qualified:

- Technology: On-board SW: 80C166 CPU
  Assembly; Ground support and test equipment SW: C++,
  Windows

SWARM ACCELEROMETER

Mission background

The SWARM mission objective is to provide the best survey ever of the geomagnetic field and the first global representation of its variations on time scales from an hour to several years. SWARM, a constellation mission
(3 identical satellites), simultaneously obtains a space-time characterisation of both the internal field sources in the Earth and the ionospheric-magnetospheric current systems.

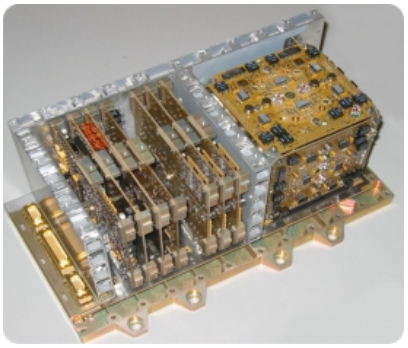
SWARM satellites © ESA

esc Aerospace designed, developed and qualified the Accelerometer Instrument On-Board SW, including:

- StartUp SW – Mission critical SW (stored in PROM)
- Application SW (stored in FLASH memory)

Features

- Science and Housekeeping data acquisition using multiple AD converters, time-stamped with accuracy better than 1 millisecond
- ESA Packet Utilization Standard (PUS) TC/TM interface
- SW developed in C language, time critical routines in Assembly
- HW target was a significant performance constraint for the SW – x51 family 8-bit microcontroller (Space qualified 80C32E at 12 MHz with only 268 Dhrystones / 0.153 VAX MIPS)
- Priority scheduler for optimal utilization of limited CPU performance



Accelerometer © VZLÚ

MIMOSA (Czech Microsatellite)

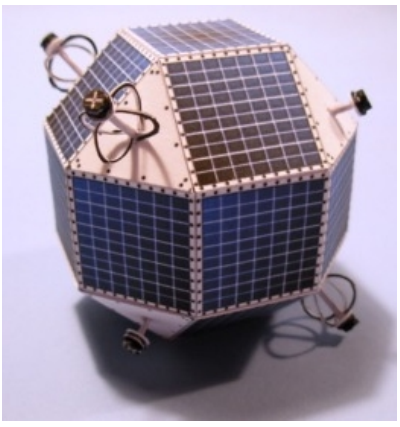
Mission background

MIMOSA (Microaccelerometric Measurements of Satellite Accelerations) was a Czech microsatellite, principal investigator of the project was Astronomical Institute of Academy of Sciences (ASU CAS) Ondřejov, Czech Republic (Czech national funding). Launched on June 30th, 2003 on Rockot KS / Breeze (Eurockot) from Plesetsk in northern Russia.

Features

esc Aerospace designed, developed and qualified the OBC On-board SW, including:

- Main instrument (Microaccelerometer MAC-03)
- Embedded technology: 80C166 CPU, Assembly;
- Ground support and test equipment SW: Linux, RTLinux, C/C++

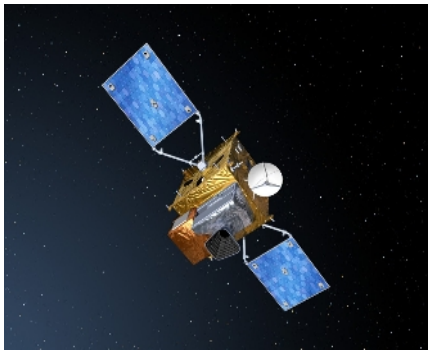


Mimosa microsatellite © ASÚ

Meteosat Third Generation (MTG)

Mission Background

The MTG series will comprise four imaging and two sounding satellites. The MTG-I imaging satellites will carry the Flexible Combined Imager (FCI) and the Lightning Imager. The MTG-S sounding satellites – a first for Meteosat – will carry an Infrared Sounder (IRS) and an Ultraviolet Visible Near-Infrared spectrometer, which will be provided by ESA as the Copernicus Sentinel-4 mission. On the MTG-I satellites, FCI will scan the full Earth disc every 10 minutes using 16 spectral channels at very high spatial resolutions, from 2 km to 0.5 km. In fast imagery mode it will be capable of a repeat cycle of 2.5 minutes over a quarter of the disc. On the MTG-S satellites, IRS will provide detailed vertical profiles of atmospheric temperature and humidity at a high spatial resolution of 4 km. These data will feed into advanced regional Numerical Weather Prediction models that are expected to be used in the future for nowcasting and very short-range weather forecasting.



MTG imaging satellite © ESA

esc Aerospace has supported this mission in:

- Engineering support during projects phases B2 and C/D
- Modelling of Data Collection System & GEO Search and Rescue (DCS & GEOSAR) payload
- Performance simulation and analysis of payload's behaviour

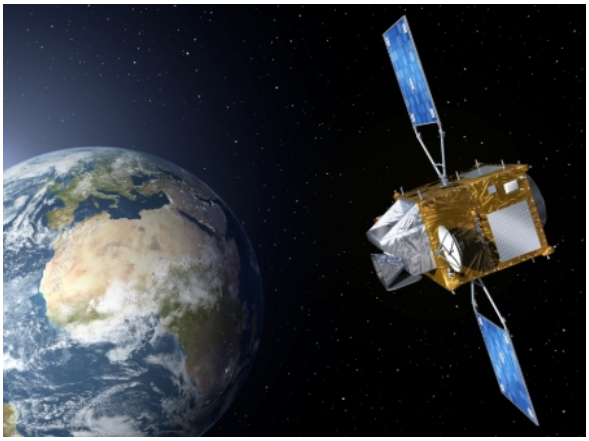
Features

- Receive UHF band SAR distress messages and DCP beacons messages from on ground beacons
- Downlink of SAR beacons from MTG-I satellites to COSPAS-SARSAT ground segment via D&G Downlink Antenna (L-Band)
- Digitalize DCP beacons messages and interface the Payload Data Downlink function to ground segment via Ka-Band downlink
- Produce TM messages in response to TC messages and to monitor the status of the payload

Sentinel-4

Mission background

Sentinel-4 is a payload that will be embarked upon a Meteosat Third Generation-Sounder (MTG-S) satellite in geostationary orbit scheduled to launch in 2019. Sentinel-4 is dedicated to atmospheric monitoring. The Dual spectrometers will provide first ever continuous observation of the atmosphere from a geostationary orbit. The MTG Satellite platforms will hold position at an altitude of 36,000 kilometres and will allow seamless observations of Europe and North Africa to be taken hourly. The system (constellation of satellites) will include 6 satellites, of which 2 are designated as Sounding satellites. They are a part of the Copernicus Programme.



Sentinel-4 instrument on the MTG-S satellite © ESA

Capsule on a Vega rocket

Mission background

With the growing number of operating satellites (e.g. constellations) and space debris, and with the setting up of de-orbitation requirements, a better understanding and mastering of atmospheric re-entry has now become of utmost importance. It is essential for the success of the mission (regarding to limiting in-orbit risks and returning spacecraft to be retrieved), for public safety (population on ground exposed to collision and toxic risks), and for technology enhancement.

Capsule on a Vega rocket © ESA

Demise Observation Capsule © ESA

Features

Capsule capabilities

- Independent re-entry capsule qualified to 'rideshare' with no impact on launcher payloads or operation
- Robust, modular design for the 3rd / 4th stages of a multitude of launch vehicles
- Miniaturised sensors and electronics in a versatile and extendable sensor suite
- Full nano-satellite capabilities
- Observation cameras on host vehicle and capsule
- Onboard software for autonomous mission performance and in-flight data transfer
- Safe and controlled stage separation after passivation
- ITAR-free equipment

Mission background

All of the following activities were developed within the SAVOIR framework. **S**pace **AV**ionics **O**pen a**R**chitecture is an initiative to federate the space avionics community and to work together in order to improve the way that the European Space community builds avionics sub-systems.

OBCP-BB

Requirements and I/F definition for future OBCP Building Block (GSTP)

OBCP-BB (Requirements and Interface Definition for Future OBCP Building Block) aimed at the assessment of current OBCP implementations and definition of the On-Board Control Procedures Building Block together with the implementation of an OBCP BB prototype.

Prototype implementation and demonstration – The On-Board Control Procedure Service (OBCP-S) is modelled as a pseudo-component within the Execution Platform of the On-board SW Reference Architecture (OBSW-RA). The implementation was done in Java. C and Lua programming languages were selected as an interpreter for the OBCPs.

OSRAc

On-board Software Reference Architecture Consolidation (GSTP)

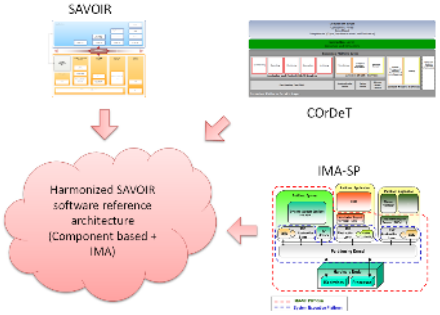
The objective of the OSRAc project was to identify all building blocks and interfaces of the core on-board software reference architecture and to verify and consolidate the software architectural concepts developed in the COrDeT2 working group defining future modular and reusable on- board SW architecture with a goal to reuse the On-board software in a systematic manner. The main performed activities to achieve the objectives are:

- Functional chains analysis of the core on-board software
- Mapping of the identified functional chains onto the software architectural concepts of the software reference architecture
- Verification of the mapping to ensure software architectural concepts.

OSRAp

On-board Software Reference Architecture for Payloads (GSTP)

OSRAp project is the continuation of several previous studies in the field of computer science, aiming to consolidate and harmonize different methods of software design. The aim of the study is to promote a more universal and generic approach to flight and system software, which is typically monolithic and developed from scratch with little re-use. OSRAp is aiming for a working plug-and-play type of interface between software elements, thus leading to shorter development times and significant cost reductions by maximizing reuse of software. Another results of the study wa also product a Payload Catalogue of recently launched or in-development payloads, from which one or more payloads were eventually demonstrated to be hosted on a more universal platform.



On-board SW Reference Architecture for Payloads

Integrated Modular Avionics – IMA-SP

Mission backgroud

In a system built around the IMA paradigm, a number of different applications are integrated onto the same hardware each executing in their own partition. They are kept separated by the separation kernel in compliance with ARINC 653. The strict separation of applications provides a range of benefits from the viewpoint of software development. ARINC 653 specifies an software operating layer which abstracts the underlying hardware resources and provides a standardised interface for application software. This operating layer also ensures separation between applications by providing proper partitioning of the abstracted resources.
Aim is to demonstrate how the flight software of a small spacecraft can be partitioned. At the same time, demonstrate and assess off-line integration of different applications in a partitioned execution environment. Lastly, the project also serves to demonstrate and assess software development process and roles across different software teams.

Features

esc Aerospace adapted STIX payload (Solar Orbiter launched in 2020) SW to IMA-SP and did a process assessment to ESA, that can be applied in the future ESA missions!

PUS-C

Mission backgroud

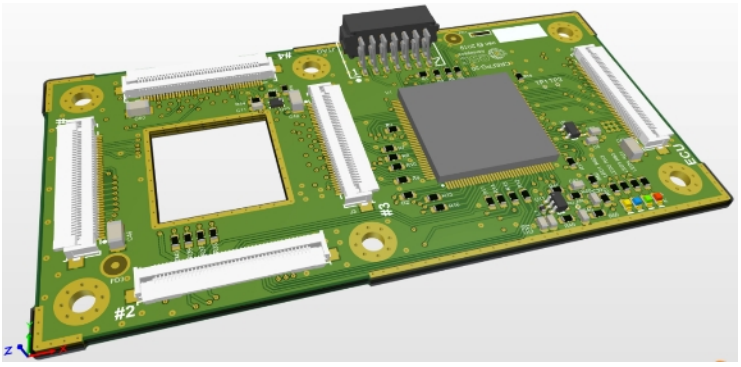
The version A of the PUS standard (Telemetry and Telecommand Packet Utilization standard) was published in January 2003. Over the last 10 years, the PUS standard has been widely used in Europe. A new version of that standard (version C) was released in 2016.

Mission of the project comprises implementation of the PUS-C standard both into a workable, human interactive database of rules and relationships, resulting in actual C code, as well as auto-generated documentation for the space community and future users of this ECSS standard. The text of the standard shall be brought further to completion by adding computer generated charts and diagrams, based on well established ASN.1/ACN ,standards.

Features

esc Aerospace presented PUS-C Population GUI Tool (SW) in 2019 at ESTEC.

SDL (Specification and Description Language) charts.MSC (Message Sequence Chart).



SVF (Software Verification Framework for Microsatellites

Mission Background

The Triton-X multi-mission microsatellite platform is intended to serve worldwide customers with an industrial product enabling affordable regional and global microsatellite constellations.

Features

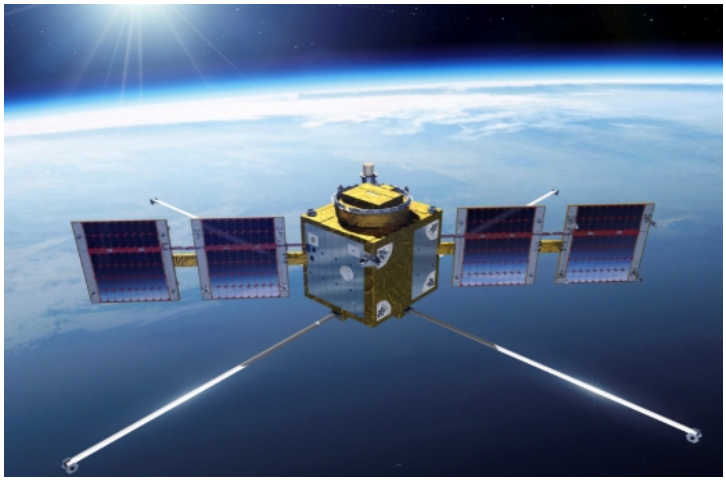
Satellite onboard software and EGSE testers

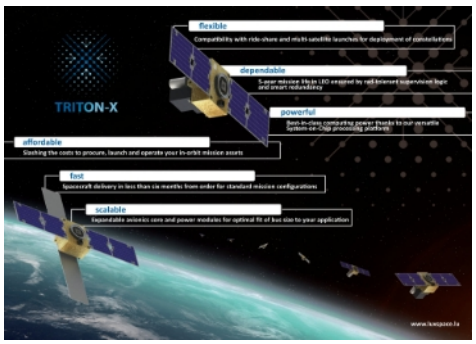
esc Aerospace will be the strongest flight software company in the Czech Republic and the surrounding area after the completion of the project for OHB LuxSpace.

SVF is used to test SC-SW satellites of TRITON-X

esc Aerospace has experience from previous projects in this field (EGSE, SVF, OBSW), eg IHPA / IMA (In-flight Hosting of Prototype Applications / Integrated Modular Avionics), Deployment of the PUS-C Standard, SOLAR ORBITER STIX, MetOp -SG instrument bootloaders, Demise Observation Capsule (DOC) ASW (FLPP), ...

The aim of using SVF is to validate the entire software of the TRITON-X satellite in the range of 120 communication commands and their answers. The target product, of course, is satellite software.





List of SVF products:

- Testbench HW (T-HW) test environment hardware used to verify the SC-SW version when operating in the target environment.
- HW (T-HW) test environment hardware used to verify the SC-SW version when operating in the target environment.
- HW (T-HW) test environment hardware used to verify the SC-SW version when operating in the target environment
- Needle tester device and its software developed by esc Aerospace enabling the imposition of error signals into the CMB EM.
- Needle tester device and its software developed by esc Aerospace enabling the imposition of error signals into the CMB EM.
  - Testbench SW (T-SW) test environment software running on a PC used to verify the SC-SW version in the operation of the target environment.
  - Tool (based on AI) for automatic processing of test cases into activity diagrams.

QKDSat / OPTICAL

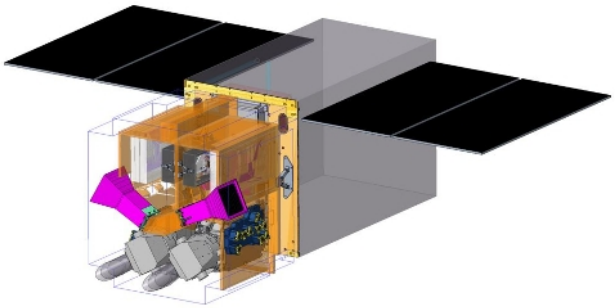
Mission background

D/TIA partners develop first Quantum Encryption Satellite

On 31st August 2018, the European Space Agency via its Directorate of Telecommunication and Integrated Applications signed a contract to develop the first European Quantum Key Distribution Satellite (**QKDSat**).

QKDSat is a highly innovative project, the first of its kind, which will validate Quantum Key Distribution via satellite technologies.

The contract covers the development of service delivery through a pre-operational deployment, prior to a full global commercial service via multiple satellites in the near future.



esc Aerospace and other D/TIA partners with UK-based ArQit to develop first Quantum Encryption Satellite

The installation of Ground Optical Communications Terminals to support the projected market needs

The contract will enable the industry of ESA Member States to take the lead in an important, new and growing field of secure communications.

Secure Connectivity

The EU constellation's first purpose is to serve the needs of all European users and citizens with both Institutional and commercial services. One of its key principles is to be fully implemented by European stakeholders, public and private, from the space and non-space sector. European major space industrialists and operators will lead EU's endeavor for the constellation, welcoming new entrants and start up that can bring value to the project. Innovation shall be at the core of the project, bringing state-of-the-art services to Europe, while placing EU at the forefront of the space and digital revolutions.

- Technical concept, System architecture and Satellite, Ground segment, Users, design and trade-off
- Key technologies to be developed,
- Security, and QKD/QCI,
- Business Public/Private/partnerships

SPACE PROGRAMS CONTRIBUTIONS

24 years of experience in Space!

SOLAR ORBITER STIX FSW 2016	**MICRO-LAUNCHER** GNC/OBC 2016	**SENTINEL 4 UVN** IQT PAT SW 2016	**DEMISE CAPSULE** FSW 2016	**MetOp-SG** FSW 2016
OSRAp IMA-IHPA GSTP 2015	**MTG** DCS & GEOSAR SIM 2015	**OSRAc** GSTP 2013	**SWARM** ACC FSW 2013	**OBCP-BB** GSTP 2011
IRIS ANTARES ATM 2011	**CORONAS-PHOTON** SphinX DP 2009	**CZCUBE** CAMERA FSW 2006	**MIMOSA** ACC&S/C FSW 2003	**MTI** HXRS FSW 2000

Space Programs Table Legend:

- Name of the mission/Program
- Type of activity:
  - DP – Data Processing
  - FSW – Space Qualified On-board Software
  - SIM - Simulator
- Launch year

Space Program Customers:

TESTBEDS & TESTERS / EGSES & SCOES

24 years of experience in certified test systems!

MICRO-LAUNCHER HWIL/SWIL 2016	**SENTINEL 4 UVN** IQT PAT SW 2016	**CNT Avionics** Avionics Testbed 2016	**DEMISE CAPSULE** EGSE 2016	**HAES Payload** Payload Testbed 2014
D&A Payload UAS Testbed 2013	**RPAS/UAS COMM** Comm. EGSE 2013	**Radiation Payload** Payload Testbed 2013	**SWARM** ACC EGSE 3 pcs 2011	**JET Engine** Engine Testbed 2011
IRIS ANTARES SL Emulator 2011	**HAES Avionics** Avionics Testbed 2009	**CUBESAT** EGSE/SCOE 2006	**MIMOSA** S/C SCOE 2003	**MTI** HXRS EGSE 2000

esc Aerospace's testbed systems, EGSEs & SCOEs, have been used in space and defence programs!

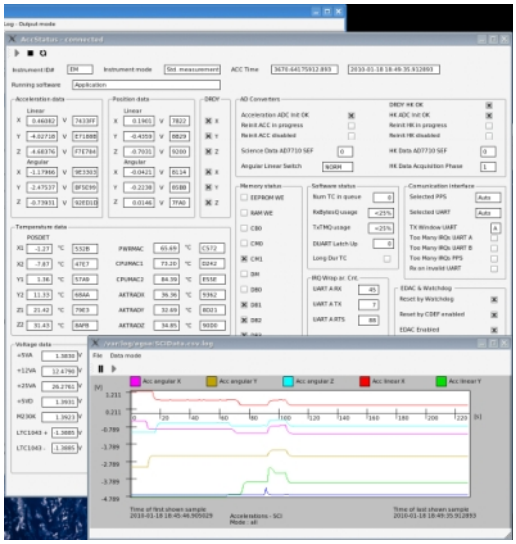
EGSE / SCOE - SWARM

esc Aerospace provided EGSE (Electrical Ground Support Equipment) Software for the following missions:

SWARM ACC Instrument EGSE

Mission background:

The EGSE GUI provides on-line view (tabular and graphical) of the instrument status and control of the instrument operation. Used during instrument development, verification/validation testing on instrument level, Spacecraft integration.



SWARM ACC Insrument EGSE screenshot Coronas-Photon spacecraft

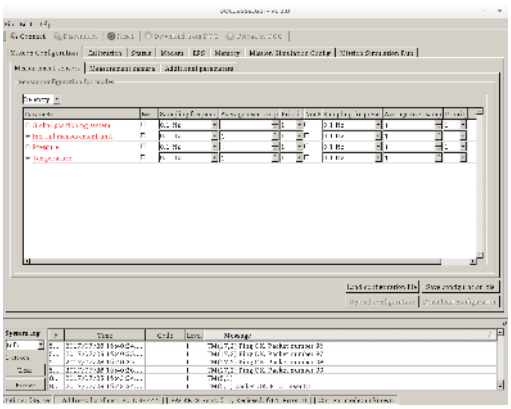
Features

- Communication front-end for generating, handling a receiving TC / TM packets, according to the appropriate ESA standards (ECSS-E-70-41)
- Load and dump SW (including EEPROM patching)
- Simulation of the spacecraft OBC (On-board computer) functionality
- Generates all TC packets for the ACC instrument
- Open architecture allows the user to write own test scripts in the well known PHP scripting language
- Automatic Data parsing
- Packet Analyser, including Housekeeping and Science
- Test front-end for testing of ACC HW, both digital and analogue part with specific test of HW
- Control of EGSE HW modules, all digital I/O interfaces and remote-controlled power supply.

Demise Observation Capsule EGSE

Mission background

The EGSE GUI provides an on-line view of the entire Capsule, including status and control of avionics operations, mode and mission management.



Demise Observation Capsule EGSE

Features

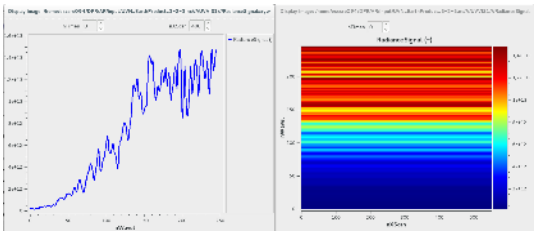
- Communication per (ECSS-E-70-41)
- Load and dump SW (including EEPROM patching)
- Simulation of the spacecraft mission types
- Control of EGSE HW modules: and all digital I/O interfaces and remote-controlled power supply
- Parameter control
- Mode management and mission simulation
- GPS and communications modem controls

esc Aerospace is a leader in the field of Ground-segment data processing SW in Europe having vast experience with ESA projects.

Performance Assessment Tool (PAT)

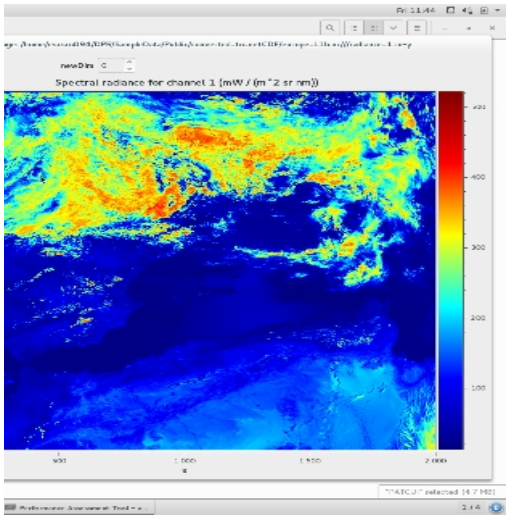
Mission backgroud

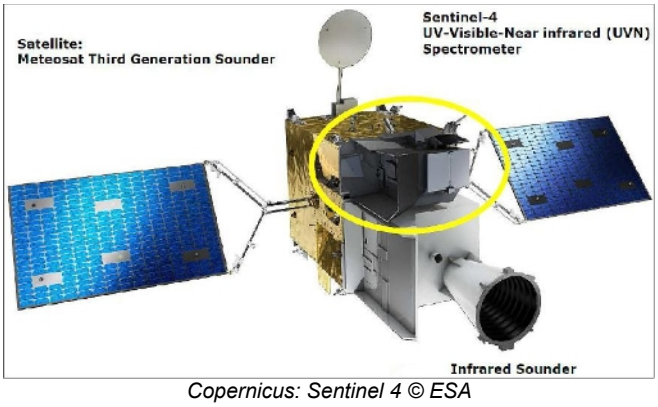
The Performance Assessment Tool (PAT) is part of the Sentinel-4 UVN Instrument Quality Tool, which generates Quality Reports of the Sentinel-4 UVN Data Products.



Features

- Fully user driven, intuitive GUI
- Processing large data input (10 GB+) at a time
- Scalable performance based on HW platform
- Network based data-acquisition and storage, local operations available on demand
- Multiple/Generic 3rd party database import & support
- Supports integration into openSF; allows also flexible scientific functions addition
- Preview style operation available to generate sessions for full data processing, including automation of large sessions
- Graphical manipulation of data and scientific report generation
- Output to common file types (PDF, doc)





Copernicus: Sentinel 4 © ESA

DATA PROCESSING SOFTWARE - CORONAS

Data processing is a highly customized section of any project, providing the interface to conversion of large amounts of instrument data into useful scientific results.

esc Aerospace engineers have experience from space projects – from successful implementation of the data processing for satellite payloads (spectrometers & accelerometers). Below are selected some of the projects where esc Aerospace delivered data processing software:

SphinX (CORONAS-PHOTON)

Fast Soft X-ray Spectrophotometer flyed aboard of CORONAS-PHOTON spacecraft.

Data Processing Ground Segment software for SphinX for the Russian CORONAS (Complex Orbital Observations Near-Earth of Activity of the Sun) Solar Mission in cooperation with Astronomical Institute, Academy of Sciences of the CR.

- Technology: Ground segment SW: Linux, C, C++, Shell scripts, IDL, NASA Solarsoft packages, SQL, JAVA, PHP, Firebird

Coronas-Photon spacecraft in orbit
© Roskosmos

Sphinx Data processing SW features

- The purpose of software is to analyze and process incoming data dumps, downloaded from the Spacecraft operational centre; The inputs for the processing are SphinX spectrometer science (X-ray) data and auxiliary data-housekeeping / technological data and S/C position/orientation data
- Processed data is accessible locally using the interactive visualization tool and a web server (data catalogue and visualization)
- Properties: Two synchronized Linux Servers, Creating of FITS files from telemetry dumps, Measurements stored in a Firebird database, IDL Thick-Client for interactive data visualisation, Web-Server with a catalogue, PDF generator

Coronas-Photon spacecraft @ Roskosmos

CORONAS-PHOTON was been launched on January 30th, 2009 on Tsyklon-3 from LC-32, Plesetsk, Russia.

Mission background

CORONAS is a Russian program for study of the Sun and solar-terrestrial connections physics by series of spacecrafts, which provides launching of three solar-oriented satellites onto the near-Earth orbit. CORONAS-PHOTON is the third satellite in this series. Two previous missions of the project were "CORONAS-I" (launched on March 2, 1994) and "CORONAS-F" (launched on July 31, 2001). Data Processing Ground Segment software for SphinX – a fast Soft X-ray Spectrophotometer for the Russian CORONAS Solar Mission – was developed in cooperation with Astronomical Institute, Academy of Sciences of the CR. The end customer was Space Research Centre of the Polish Academy of Sciences.

Management System (MSS)

The Real-Time MMS is based on esc Aerospace years of experience in development of UAS avionics/flight controls. The MMS is based on previously developed product and is enhanced for power consumption optimization while taking into account factors in load (sensors, gimble, etc.), environmental conditions (wind, altitude, etc.) and operational factors.

UAS flight simulator © esc Aerospace

Avionics © esc Aerospace

The development setup includes an ability to integrate with a small UAS flight simulator. Developing an MMS is easier when the flight tests are done in a simulator. This is called Hardware in the Loop (HIL). The MMS hardware is fed with flight data generated by the simulator (lat/long, altitude, velocity, power consumption, etc.) The MMS computes the new control values (i.e. servo positions) which are sent back to the simulator. The MMS also calculates estimated flight time utilizing load information (sensors, gimble, etc.), and environmental conditions (wind, altitude, etc.). This information is made available to the operator. The simulated aircraft performs the flight as commanded by the autopilot, closing the loop. The mission planned in the Ground Control Station is executed by the simulator and the MMS.

UAS Platform Subsystem

VTOL UAS is inexpensive and easily customizable. This platform can be modified, as needed, to enable integration with our enhanced MMS and power subsystems.

UAS flight simulator © esc Aerospace

The UAS platform is also modified, as needed, to meet the requirements of the challenge:

- Autonomous and human controlled flight;
- Vertical take-off and landing (VTOL) UAS with the ability to hover in place;
- Free flying, no tethers;
- Provide an interchangeable payload adapter (per specification to be provided);
- Allow for the different weight payloads
  - 10 inch x 10 inch plate with 8020 aluminum extrusion rails attached to two opposite sides
  - of the plate to attach the payload.
  - at least four points of connection to the 8020 rails
  - T-Slotted Aluminum Extrusions 10 inch long, with a 1 inch x 1 inch cross-section
  - support payload volume will be approximately 8 x 8 x 6 inches.

Entire prototype UAS will fit within the specified 6 ft. x 4ft. x3 ft., and weigh no more than 55 pounds (UAS + payload.

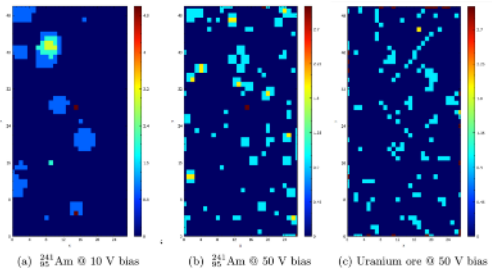
Mission Background

The SpacePix® is a revolutionary ASIC designed for a wide range of space radiation measurements. It can be employed as a highly miniaturized radiation detector with radiation identification capability for advanced radiation detection and early warning systems. A second generation of the detector SpacePix2® is now available and ready for in-flight validation on aboard of VZLUSAT2 satellite.

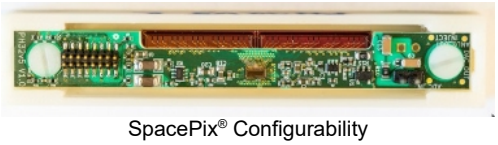
Features

The key features are:

- Directly sensitive to galactic cosmic rays, solar wind and trapped radiation electrons and protons
- Proton energy detection threshold of 1 MeV
- Electron energy detection threshold of 60 keV
- Particle identification capability by analysis of the detector hit signature
- With a neutron conversion layer, it can be made sensitive to fast neutrons
- A high degree of SEU tolerance thanks to the separate sensor and electronics parts
- 1.8 V voltage levels for low power consumption (100 mW)
- Depleted layer thickness 10 to 30 µm, depending on bias voltage and application
- 4096 channels arranged in a matrix of 64×64 pixels
- 10 bit ADC resolution
- Each pixel has dedicated electronics for hit counting and energy measurement
- Hit global capability – allows particle hit signalling to avoid periodic readout for constant monitoring
- Internal temperature sensors
- Impact energy and threshold calibration
- Self-test change injection capability
- LVDS maximum frequency of 500 MHz
- Maximum communication speed of of SPI is 50 MHz
- Chip select capability for multi-ASIC configuration via single SPI bus



SpacePix® - Revolutionary ASIC



SpacePix® Configurability

Configurability

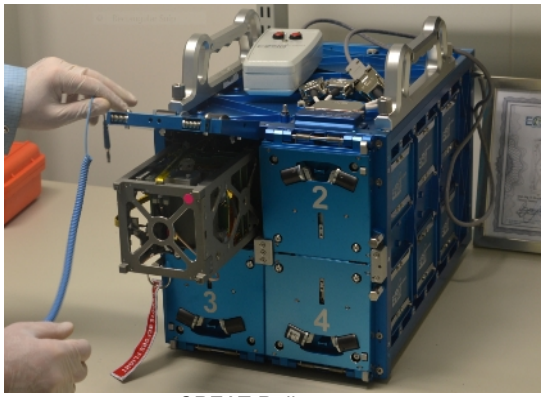
- Each pixel can be configured to work in a hit counting mode or energy deposition mode
- Internal DACs for setting working point of every channel
- Possibility of ASIC stacking
- It is possible to build a beam telescope with multiple SpacePix® ASIC
- Fully custom design with no IP liabilities
- Comprehensive IO / Payload Support

SPACEPIX ON SOCRAT-R / VZLUSAT2

Mission Background

esc Aerospace has developed new SpacePix® Detectors® for the study of a cosmic weather. The detector was sent on-board of the satellite Socrat-R to the orbit around the Earth with Soyuz 2.1 b/Fregat carrier on Friday 5th July 2019.

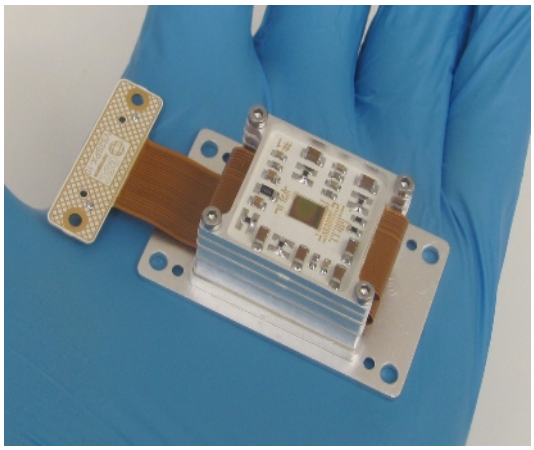
The primary mission has been to monitor the cosmic weather and the radiation field around Earth. To perform this task will be used unique monolithic pixel detectors developed at the Faculty of Nuclear and physical engineering CTU supplemented with PIN diode open-source dosimeter developed at the Institute of Nuclear Physics ASCR.



CREAT-R dispenser

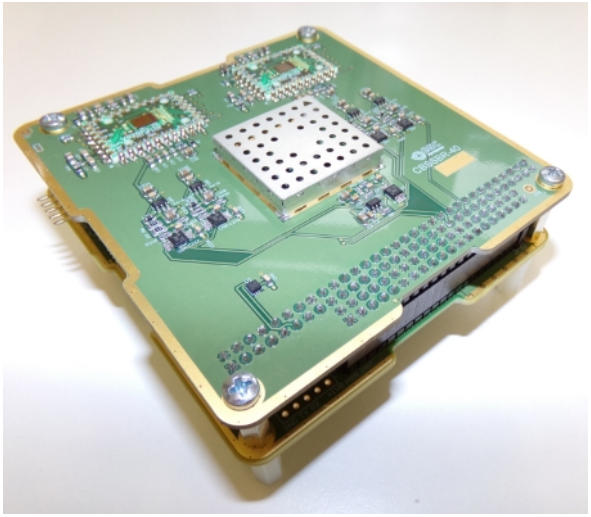
The Czech part of the satellite apparatus was designed within the consortium of FJFI CTU, esc Aerospace s.r.o. and ÚJF AVČR.

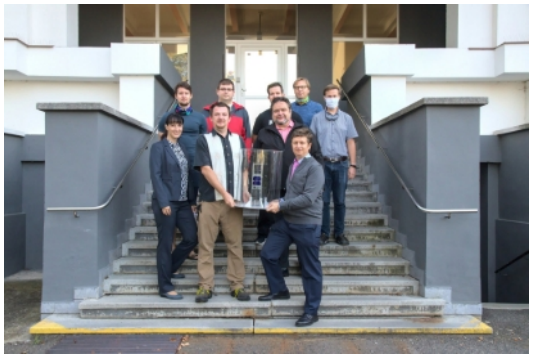
The construction and production of the whole instrument was ensured by the Czech company esc Aerospace with the contribution of FJFI CTU in Prague, ÚJF and Universal Scientific Technologies s.r.o.



The radiation-resistant new generation detectors were developed in the Czech Republic at FJFI in the framework of the TAČR and the MPO grants.

These projects are a spin-off project of the Czech Competence Centre TE01020069. The PIN-diode dosimeter was developed as a part of the CRREAT project.





IN ORBIT VALIDATION / IN ORBIT DEMONSTRATION

IOV / IOD

Mission background

Deployment to an orbit is essential to devices used for radiation measurement in the space environment. The durability of the technology and the instrument (including its electronics) will be tested throughout a set of qualification tests which are described in section 1.10 Detailed description of the experiment and interface. Environment, especially for long term measurements, are difficult to test in the Earth conditions. The CERNEU high energy Reference Field facility is known, and SXRM will be tested at this facility during the qualification campaign. Therefore, the IOD/IOV is essential step for ESC to offer a component with novel capabilities, thus very modern, with a space heritage.

BION

Mission background

The scientific goal of the unmanned BION missions is to study how the microgravity and radiation of the space environment affects living organisms.
The Bion-M2 spacecraft is expected to be launched using the Soyuz-2.1b carrier rocket in 2023. The duration of the mission will be 30 days.The spacecraft will orbit at an altitude of 800-1,000 kilometers, which is within the inner Van Allen Belt. The living organisms in the biological capsule are expected to receive a dose of space radiation similar to a three year flight onboard the International Space Station.

SPACE RIDER

Mission background

The Space RIDER (Space Reusable Integrated Demonstrator for Europe Return) is a planned orbital uncrewed aiming to provide the European Space Agency (ESA) with affordable and routine access to space. It is an uncrewed robotic laboratory about the size of two minivans. After launch on Vega-C it will stay in low orbit for about two months. Experiments inside its cargo bay will allow technology demonstration and benefit research in pharmaceutics, biomedicine, biology and physical science. At the end of its mission, Space Rider will return to Earth with its payloads and land on a runway to be unloaded and refurbished for another flight.

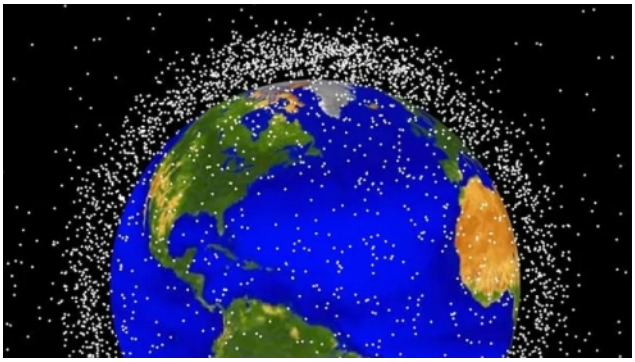
Mission possibilities

- Experiments in microgravity
- In-orbit validation/demonstrations in:
- - Robotic exploration
- - Earth observation
- - Science, telecommunication
- Satellites inspection

SPACE DEBRIS DEFLECTION BY SPACE-BASED LASER

Mission background

The activity supports the future activities in ESA's proposal for a space safety programme addressing laser-induced collision avoidance manoeuvres through technology studies for photon pressure based momentum transfer and a derived ground-based prototype system for laser-based environment remediation. Based on the findings of the study and the progress in the first period of the space safety programme, space-based applications might be considered for subsequent programme periods.



Business Benefits: Space-based laser tracking will generate several benefits:

- Precise orbit information,
- support collision avoidance
- and debris removal.

Laser technology is a promising candidate for space debris remediation and removal.

Features

esc Aerospace is responsible for **Testing of individual components of the optical system (detectors of individual photons and laser components) for the protection of satellite systems.**

Functional sample of a passively mode-locked fiber laser with an output wavelength in the range of 1520 - 1590 nm for space debris monitoring based on Eb-doped active fiber.

Functional sample of a passively mode-locked fiber laser with an output wavelength in the range of 1900 - 2050 nm for space debris monitoring based on Tm-doped active fiber.

For many applications, the need to use lasers for satellites or probes will increase. Examples include

- "orbital litter cleaning"
- more accurate monitoring of motion near the planet
- data transfers or the application of very accurate measurements.

For these purposes, one of the very suitable candidates are **fiber lasers**

The basic elements of a laser or amplifier are the active environment, pumping and positive feedback.

In the case of fiber lasers and amplifiers, the optical medium is mainly doped optical elements doped with rare earth elements such as Nd, Yb, Eb, Tm or Ho, where Yb and Eb are the most common dopants.

The active optical fiber consists of a doped core, a cladding and a polymer coating. Unlike optical fibers, where the functional layers are only the core and cladding, all three layers are functional for active fibers. It is the polymeric materials used for the sheath that may be most susceptible to ionizing radiation.

The active medium is then pumped in the case of said fiber lasers by semiconductor laser diodes, where 40% to 90% of the absorbed power is converted to coherent radiation or amplification.

Structurally, it is an assembly of lasers and amplifiers, where a metal foil with encapsulated active fiber, a pump diode and passive optical + optomechanical components will be attached to the thermoelectric cell.

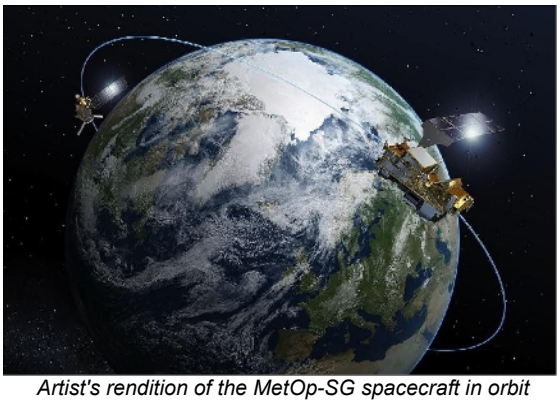
METOP-SG

Mission background

MetOp-SG (Meteorological Operational Satellite – Second Generation) is a series of six meteorological satellites developed by European Space Agency and EUMETSAT to be launched from 2023 to 2037.

MetOp-SG satellites will be built in two series: A, carrying visible, infrared, and microwave imagers and sounders; and B, carrying microwave imagers and radars.

The first A-series satellite will be launched in 2022, while the first B-series satellite will be launched in 2023



Artist's rendition of the MetOp-SG spacecraft in orbit (image credit: ESA)

MetOp-SG encompasses the objective of obtaining consistent, long-term collection of remotely sensed data of uniform quality for operational services for meteorology and climate monitoring state analysis, forecasting and operational service provision, in the context of the EUMETSAT's EPS-SG system.

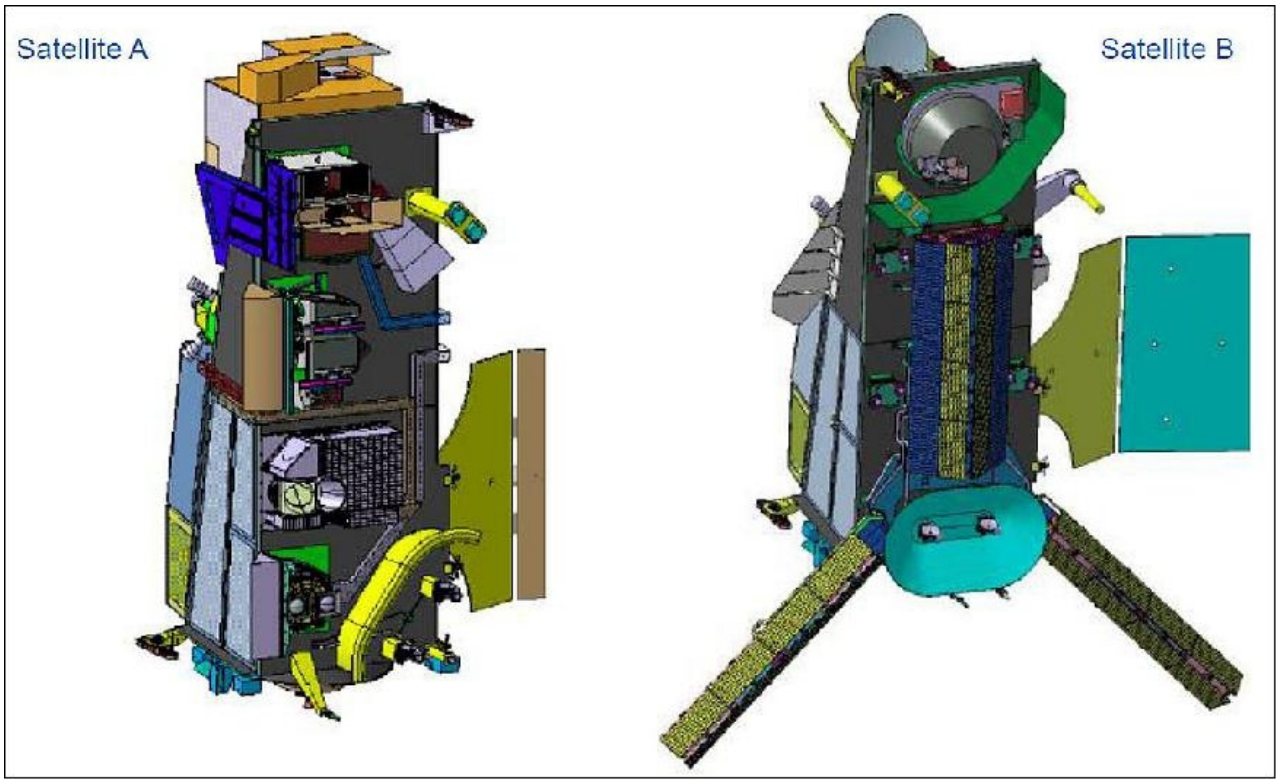


Illustration of the MetOp-SG satellites

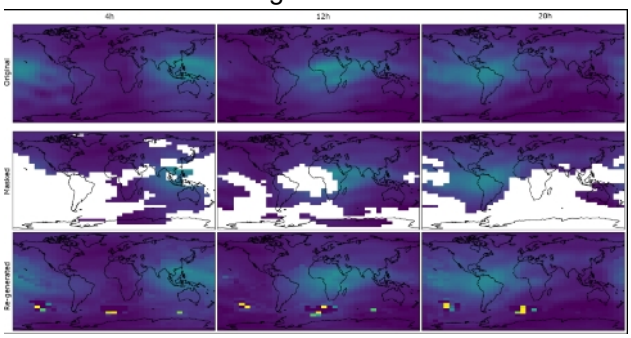
ARTIFICAL INTELLIGENCE / NEURAL NETWORKS

Mission background

The project **Generative Artificial Intelligence for high performing inversions models (GERANIIUM)** researches possibilities of application of artificial intelligence (AI) in satellite/airborne data processing. Its main scope is use of the generative methods of AI to extend input datasets or fill missing data. In the next step use of AI to model relations between ground and satellite/airborne data.

Thermal-infrared inversion

The project **Generative Artificial Intelligence for high performing inversions models (GERANIIUM)** researches possibilities of application of artificial intelligence (AI) in satellite/airborne data processing. Its main scope is use of the generative methods of AI to extend input datasets or fill missing data. In the next step use of AI to model relations between ground and satellite/airborne data.

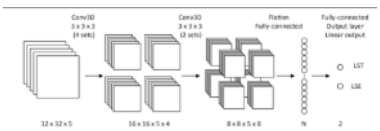


Thermal-infrared inversion

First part regards thermal-infrared inversion for the retrieval of Land Surface Temperature and Emissivity from an initial set of features, mainly simulated brightness temperatures, airborne acquisitions and ground measurements. The main criticality here is the production of labelled data sets for the training of the inversion models. The goal is to assess how Generative Models can simplify the production of data, augment the variability of features and assess the quality of the augmented data sets. The augmented data sets are tested using inversion retrieval models, where two different models are used. In first case state of the art model is used and in second model which uses deep learning techniques is developed.

Total Electron Content

Second part of the project regards the computation of vertical Total Electron Content. This is done by use of Generative adversarial inputational networks which fills gaps in available data in both temporal and spatial manner. Furthermore neural networks are used to detect significant anomalies caused by geomagnetic storms and to make predictions of Total Electron Content.



Features

esc Aerospace is responsible for the data preparation, assessment of used AI techniques and assessment of the results. Furthermore it leads technical discussions regarding satellite data and atmospheric effects.

QUANTUM KEY DISTRIBUTION - NEXT GENERATION QKD-SECURED CLOUD

Applicable Standards

- Common Criteria (ISO 15408) Evaluation,
- ISO 27001
- ISO 31000
- IEC 62443
- FIPS 140-2
- FIDO certification in Authenticator Certification Level 2

Features

- Creating CI/CD pipelines, application catalogs for containerized applications to Kubernetes environments and managing different cloud platforms;
- Integration with vCloud Director and vSphere (possibility to deploy all components mentioned above to these environments);
- Integration with Software-Defined Storage, utilization of its features such as triplication of data, erasure coding;
- Integration of QKD security ecosystem (starting with true random key generator, secured communication and processes);
- Deployment and testing of a cloud tool, hardware scalability, software-defined storage.

Deployment

- individual virtual machines,
- entire virtualized infrastructure,
- Kubernetes clusters,
- complete IT solutions:
  - whole development stacks,
  - CSM tools,
  - BIG DATA solution.

esc QCloud VM 21

- 21x VMware ready virtual machine with maintenance support
- administrator has no data access to the user data
- world-wide technical support: USA, EUROPE
- VM category list
  - 802.1X Radius Server
  - Quantum Key Housekeeping
  - Confidential Document Storage
  - VPN Server
  - iSCSI Storage
  - Encrypted Data Storage
  - BigFile Transfer
  - Office Attendance Record System

Quantum Key Distribution - Hardware Items

Common Features

- Managed by esc Software Criticality C (ECSS-Q-ST-80C)
- MACsec IEEE 802.1AE, GCM-AES-256
- IEEE 802.1X
- Standard ports: 100BASE-TX, 1000BASE-T
- Optional fiber ports: 100BASE-FX, 1000BASE-X
- Dual Power Supply
- 19" Rack Solution

esc QKey Storage 1400, 1430, 1455

- secure erase - content always erased with random data
- optional GNSS time and position protection
- environment housekeeping including optional x-ray detection

esc QSwitch Distribution 2140

- 2x 1000BASE-T ports
- 2x 1000BASE-X SFP-based ports
- 1-4095 VLANs
- Only encryption connections

esc QData Storage

- confidential data storage
- encrypted with quantum key
- decryption possible only with quantum distributed key
- world-wide technical support: USA, EUROPE

esc QCloud VM 21

- 21x VMware ready virtual machine with maintenance support
- administrator has no data access to the user data
- world-wide technical support: USA, EUROPE
- VM category list
  - 802.1X Radius Server
  - Quantum Key Housekeeping
  - Confidential Document Storage
  - VPN Server
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  - Encrypted Data Storage
  - BigFile Transfer
  - Office Attendance Record System

MEET ESC AEROSPACE

esc Aerospace is a Czech MOD Authorised and Contracted Expert for EDA JIP RPAS WG (European Defence Agency Joint Investment Programme on Remotely Piloted Aircraft Systems working group). esc Aerospace is involved in utilizing legislative documents for RPAS/UAS public operations in the Czech Republic and other European countries together with its sister companies in Germany, Poland and Austria. Further, esc Aerospace is an active member of DSIA's section for Autonomous systems and robotics. You can also meet the esc Aerospace Management at the world largest trade fairs.

esc Aerospace regularly attends leading industry events, such as the AUSA 2013 and 2014 Annual Meeting and Exposition (Association of the U.S. Army) held in Washington D.C. AUSA is the largest land power exposition and professional development forum in North America. We were also at IDET 2015 and 2017 in Brno.

In 2016 esc Aerospace attended the ILA in Berlin, Eurosatory in Paris and ISD in ESTEC, Noordwijk.

In 2021 we are exhibiting at IDET in Brno and in 2022 we will be at Eurosatory in Paris. We look forward to meeting you there.

Come and see us at our stand!

IDET 2017

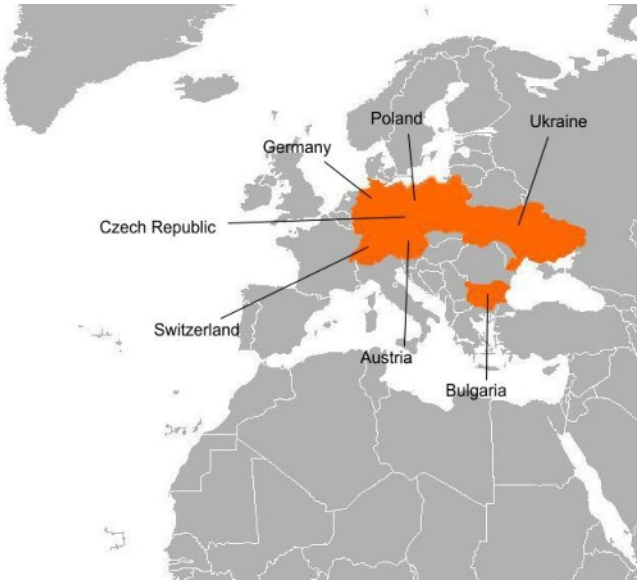
ESC AEROSPACE LOCATIONS

esc Aerospace

founded 1999
HQ in Munich, Prague and Orlando.

esc Aerospace - Certificates

- Quality management system ISO 9001:2015
- Czech MOD Authorized and Contracted Expert for EDA RPAS/UAS WG
- Security Clearance level Confidential



esc Aerospace - Space activities

- Flight software programming for various satellites
- On-board instruments, OBC, GNC
- Software References Architectures
- OBCP Building Block
- Space Qualified Hardware Design
- Modelling & Analysis of payloads
- Performance simulations & Load emulators
- EGSE (Electrical Ground Support Equipment) SW/HW, SCOE
- Data Processing software

DNV

MANAGEMENT SYSTEM CERTIFICATE

This is to certify that the centrally implemented management system for

esc Aerospace s.r.o.
Československé armády 14, 160 00 Praha 6, Czech Republic

has been found to conform to the Quality Management System standard:
ISO 9001:2015

This certificate is valid for the following site scope:
Development, production, trade and services in the field of space, seamless, autonomous and healthcare systems

Defence activities

See Defence Catalogue.

Medical activities

See Medical Catalogue

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