Space Systems for Safety and Security | 4S

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Applications for Safety and Security Webinar

30th November 2020

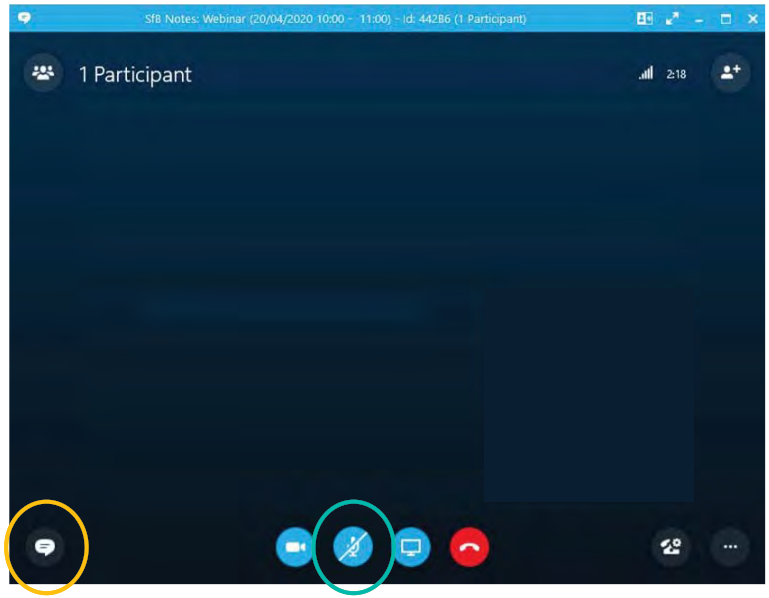
Laurence Duquerroy European Space Agency

WELCOME TO THE WEBINAR!

Before we start…

- Due to the number of attendees, please **keep your microphones muted** at all times and switch off the webcam function

- You can use the **conversation function** anytime to submit your questions. They will be addressed during the Q&A at the end of the webinar



AGENDA

- **About ESA and ESA Space solutions**
- **Space Systems for Safety and Security (4S) initiative**
- **4S Announcement of Opportunity "Applications for Safety and Security "**
  - Objectives
  - Areas of application
  - Activities
  - Funding
- **Guest speakers**
  - Ricardo Mendes – TEKEVER (RAPSODY demo project)
  - Gerhard Heindl – IABG (TT-GSAT demo project)
- **4S "Applications for Safety and Security ": How to apply ?**
- **4S Technology & Product Development**
- **Open Questions & Answers session**

About ESA & ESA Space solutions

THE EUROPEAN SPACE AGENCY

Purpose of ESA

To provide for and promote, for exclusively peaceful purposes, cooperation among European states in space research and technology and their space applications.

Facts and figures

- Over 50 years of experience
- 22 Member States
- 8 sites across Europe and a spaceport in French Guiana
- Over 80 satellites designed, tested and operated in flight

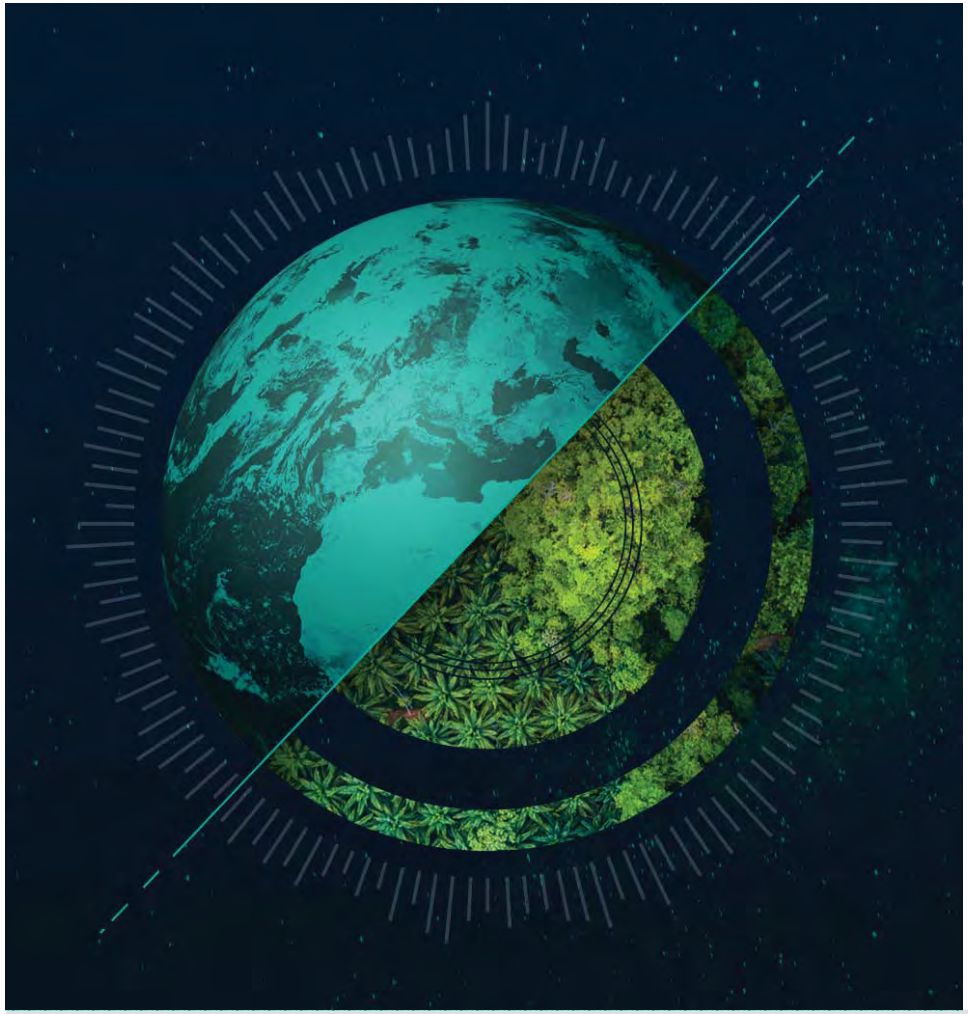

space transportation
science
human spaceflight
earth observation
telecommunications and applications
navigation
exploration
operations
technology

→ ESA SPACE SOLUTIONS

esa space solutions

The largest space innovation network in the world

- The go-to place for business involving space to improve everyday life.
- Supporting European start-ups and SMEs to develop businesses using space technology and data.
- Offering funding, business and technical support to help to generate successful business and create jobs.



→ ESA SPACE SOLUTIONS OFFERS

esa space solutions

- Zero-equity funding (from €50k to €2M+ per activity)
- A personalised ESA consultant
- Technical support and commercial guidance
- Tailored project management support
- Access to our international network of ESA and partners
- Access to our network of investors
- Credibility of the ESA brand

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Space Systems for Safety and Security (4S)

European Space Agency

A new Strategic Programme Line

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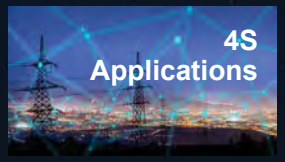
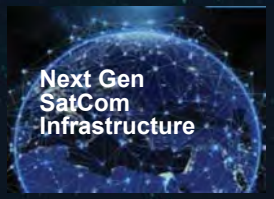
ARTES 4.0 Space Systems for Safety and Security (4S)

- Next Generation 4S solutions to **enable a safe and secure digitization**
  - ⇒ Complementary to terrestrial networks
  - ⇒ Additional capacity, full coverage
  - ⇒ Resilience, Security
  - ⇒ Sovereignty

- ESA/ARTES/4S to boost **European private and public Connectivity ambitions** via innovation programs and quick in orbit system validation
  - ⇒ boost innovation for industry competitiveness and endeavours worldwide, including in Europe
  - ⇒ trigger and support public initiatives in Europe





Announcement of Opportunity "Applications for Safety and Security "(4S)

via AO 10494

Objectives:

support the development of **innovative and sustainable applications** enabled by **space technologies**

contributing to the **safe and secure operations of services** that are deemed **critical for institutions, society and economy**

in fields as various as transport, finance, health, energy production and distribution, public safety, etc.

Primary **focus** is on the **use of secure Satellite communications** available today or over the next decade (Next Generation Satcom infrastructure),

- This also includes SAT-AIS/VDES, satellite-based ADS-B and other RF signals collected from space.

Integration with other space assets such as **Satellite Navigation and Satellite Earth Observation** as well other non-space innovative technologies (e.g. ML/AI) is also of interest

AREAS OF APPLICATION

Ensure Safe and Secure Transportation

- aviation
- maritime
- road/land
- rail
- manned
- unmanned

- Utilities (Energy, water, telecom)
- Finance
- Health
- Infrastructures monitoring
- Logistics

Protection of Critical infrastructures & Essential services

Support Public Safety & Law enforcement

- Emergency Services
- Civil protection
- Maritime surveillance
- Border surveillance

And others…

ACTIVITIES

DEMONSTRATION PROJECT

- implement and perform a pilot/pre-operational demonstration of the services with the involvement of relevant users
- validate the business case and undertake business development activities to ensure successful service roll-out
- deliver a minimum viable service after the conclusion of the demo project

FEASIBILITY STUDY

Preparatory framework to assess and define new potentially sustainable applications and services

- assess the technical feasibility and commercial viability of service(s) able to meet the needs and conditions of relevant user community(ies),
- prepare the implementation of the service(s) on the targeted market and consolidate the business strategy
- secure the buy-in and involvement of important customers/users for the further implementation and market roll-out,
- reduce technical and commercial risks
- prepare a potential follow-on demonstration project

USER-DRIVEN ACTIVITIES
involvement of user communities and relevant stakeholders

FUNDING

	Non-SME*	SME*	Universities & Research Institutes**
Feasibility Study	Up to 50%	Up to 80%	Up to 100%
Demo Project	Up to 50%	Up to 80%	Up to 80%

*SME's are fulfilling the criteria defined in the European Commission Recommendation of 6 May 2003 (2003/361/EC) or as updated

** with no commercial interest in product/service. The funding of Universities or Research Institutes shall not exceed 30% of the total allowable cost

ESA will bear up to the above defined percentage of the acceptable project cost, and the remainder has to be financed by industry, institutions and users participating in the activity, and may be in cash or in-kind.

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Guest speaker

Ricardo Mendes – TEKEVER

TEKEVER

4S Applications Webinar
PROJECT RAPSODY

Ricardo Mendes
Founder & CEO

Who we are.

TEKEVER is **the leading** UAS manufacturer and service provider in Europe, delivering services to the **EMSA** and the **UK Home Office**, and exporting systems worldwide

Highly skilled and passionate team

250+

- Portugal
  - Lisbon
  - Caldas
  - Ponte De Sor
  - Porto
- UK
  - Southampton

COMPLETE SYSTEMS DEVELOPMENT AND MANUFACTURING CAPABILITY

Airframe design and aerodynamics

Tekever's engineering team is capable of designing and producing diverse airframes, suited for specific missions.

Bespoke aircraft designs

We design and customize our systems based on specific mission requirements.

In-house systems software development

All our system software (UAV+GCS) is produced in-house by our developers

Proprietary C2

Our proprietary C2 system is compatible with all our UAVs, and is NATO compatible.

Electronics and PCB

All the system electronics and PCB designs are custom-designed and manufactured by Tekever

Proprietary Payloads

Tekever has strong expertise in advanced payload design and integration.

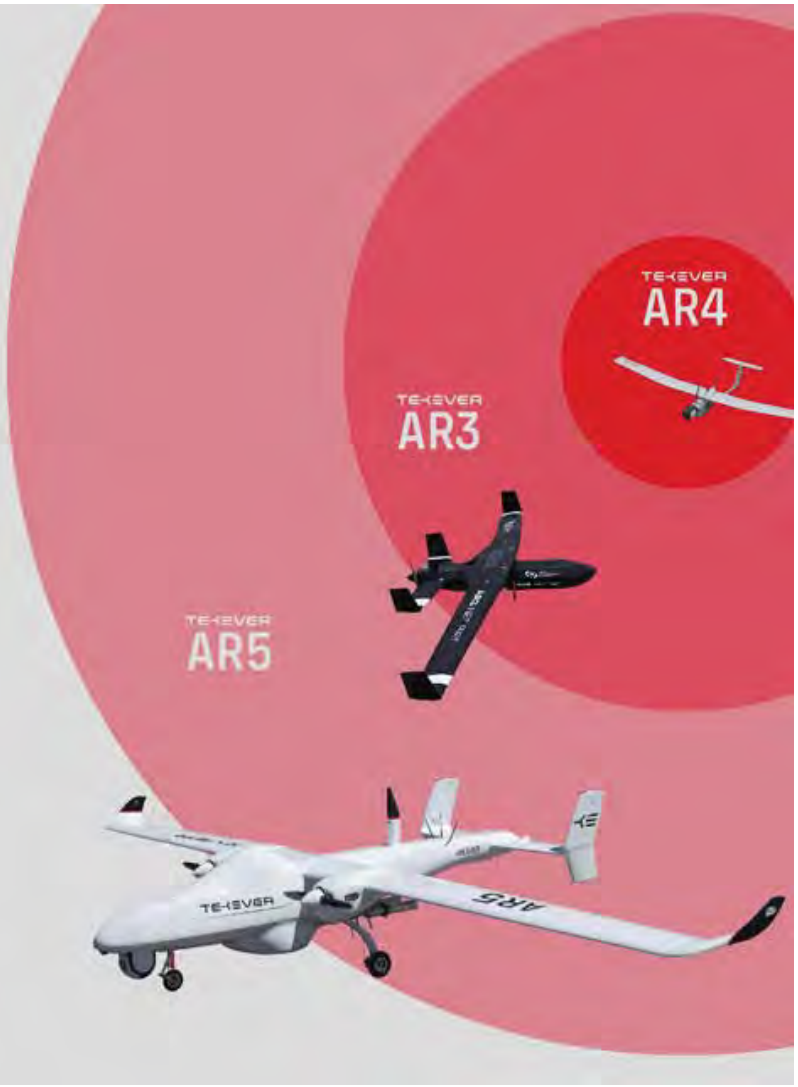
Quick Prototyping Capabilities

Tekever's manufacturing facilities and interoperable subsystems allow us to test aircraft prototypes in extremely short timeframes

Proprietary Autopilot

Tekever's Advanced Autopilot was fully developed internally, and is compatible with all our platforms

TEKEVER	AR4	AR3	AR5
Dimensions	2.1 x 1.35 m	3.5 x 1.7 m	7.3 x 4.0 m
Cruise Speed	54 km/h	85 km/h	100 km/h
Comms Range	20 km	100 km	unlimited
MTOW	5 kg	22 kg	180 kg
Payload Capacity	1 kg	6 kg	60 kg
Endurance	2 h	13 h	20 h
Recovery	Parachute or Belly	parachute	Unprepared Airstrip
Launch	Hand Launched	catapult	Unprepared Airstrip



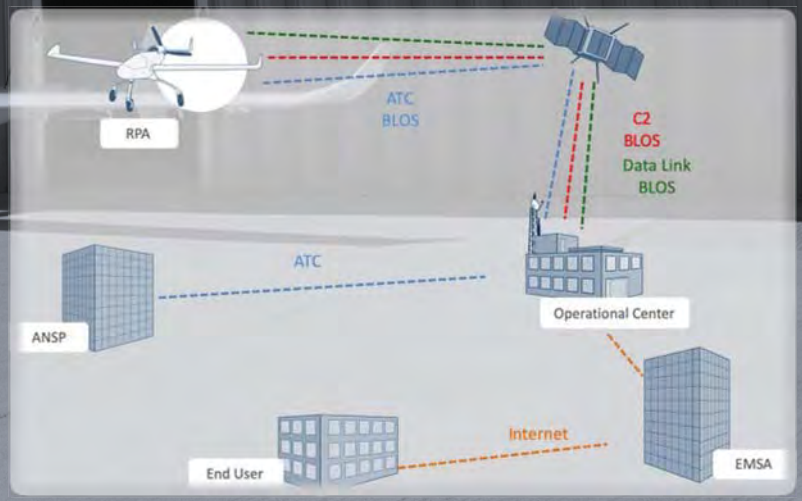

For the TEKEVER AR5, the journey began with
PROJECT RAPSODY

Project RAPSODY

GOAL: Demonstrate the use of RPAS in a maritime context by developing two maritime services:

A) Oil spill detection & Pollution Monitoring

B) Search & Rescue



New technological approach:

1. Low mass payloads, integrated into a single full capability maritime surveillance solution

2. Exploit Satellite communications capability to operate RPAS BLoS

3. Develop on-board and ground data reduction and processing algorithms to improve operational performance

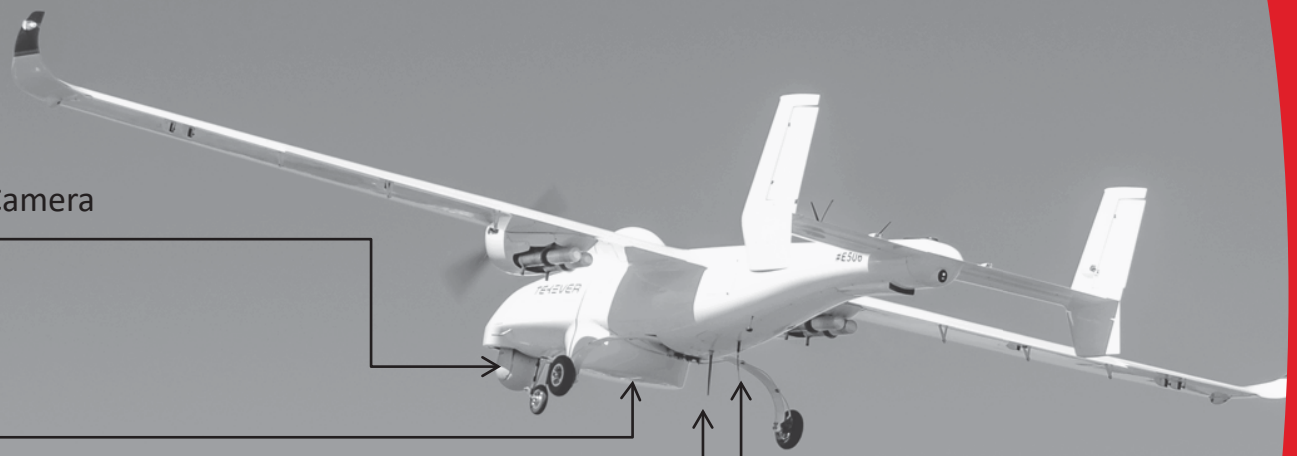
4. Use realistic demonstration scenarios

Fast Forward to TODAY…

Meet the new TEKEVER AR5

- 180kg MTOW
- Up to 12 Hours operational endurance
- Equipped with SATCOM to provide an unlimited comms range

TEKEVER AR5 - Maritime Configuration



Gimbal

- EO Sensor
- Multiple IR Sensors
- High Resolution Stills Camera
- Laser Illuminator

Maritime radar

- Solid-State Doppler Radar
- Real-Time Hazard Identification
- Tracking Algorithms
- Up to 40nm Detections

EPIRB receiver

- Decodes Emergency Broadcasts

AIS Receiver

- Real-Time Tracking and Identification of Maritime Traffic

Compliment manned assets.

The TEKEVER AR5 is the first to operate alongside manned assets

In 2020 the TEKEVER AR5 became the **first UAV** commercial service **ever** to operate alongside **manned assets.**

Questions?

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Guest speaker

Gerhard Heindl – IABG

Multi Media
Crew Communication

Ad-hoc
Aerial Image Processing

Secure
Localisation and Navigation

Decision Support and
Operational Picture

TEST AND TRIAL CENTRE FOR GEO-INFORMATION AND SATELLITE BASED RESCUE & EMERGENCY SERVICES (TT-GSAT)

Overview

CONTENT


Project Information


System Overview


Demonstration Use Cases


Pilot Demonstration

OBJECTIVE

Piloting a test and trial environment for authorities and organisations with security responsibilities where it is possible to touch, try out and play with real building blocks in order to creatively find and implement new solutions.
These building blocks can be individually combined with each other in order to try out and test the interaction of different equipment in different deployment scenarios.

In close cooperation with users and manufacturers from the targeted business.

Europe's gateway to space	*digital.secure.networked.*	*We realize innovations for mobile people and goods*	*The experts for spatial data*

CUSTOMER SEGMENTS AND SUPPORT FROM THE USER GROUPS

Customer segments

- Emergency services
- Fire departments
- Police authorities
- Disaster protection
- Other public authorities and politics
- Industry and service providers
- Public and private institutes & innovation / competence centres

Support from the user groups

- Participation in interviews, meetings and workshops
- Review of documents
- Support in finding, developing and defining use cases
- Participation in demonstrations
- Participation in ESA's System Acceptance Test milestone
- Provision of personnel and/or equipment (e.g. connection to IT systems, server, drones, telephones, robots, vehicles), provision of buildings, rooms, real estate

SUBJECT AREAS

Multi Media Crew Communication

Ad-hoc mesh communication network between mission vehicles, staff, sensors and robots

Reconnaissance with cameras and sensors mounted on robots

Ad-hoc Aerial Image Processing

Earth Observation with satellites

Earth Observation with drones

Secure Localization and Navigation

Navigation Testbed (GPS, Galileo, Galileo PRS)

Jamming and Spoofing Detection

Indoor Navigation

Decision Support and Operational Picture

Visualisation

Augmented Reality

Virtual Reality

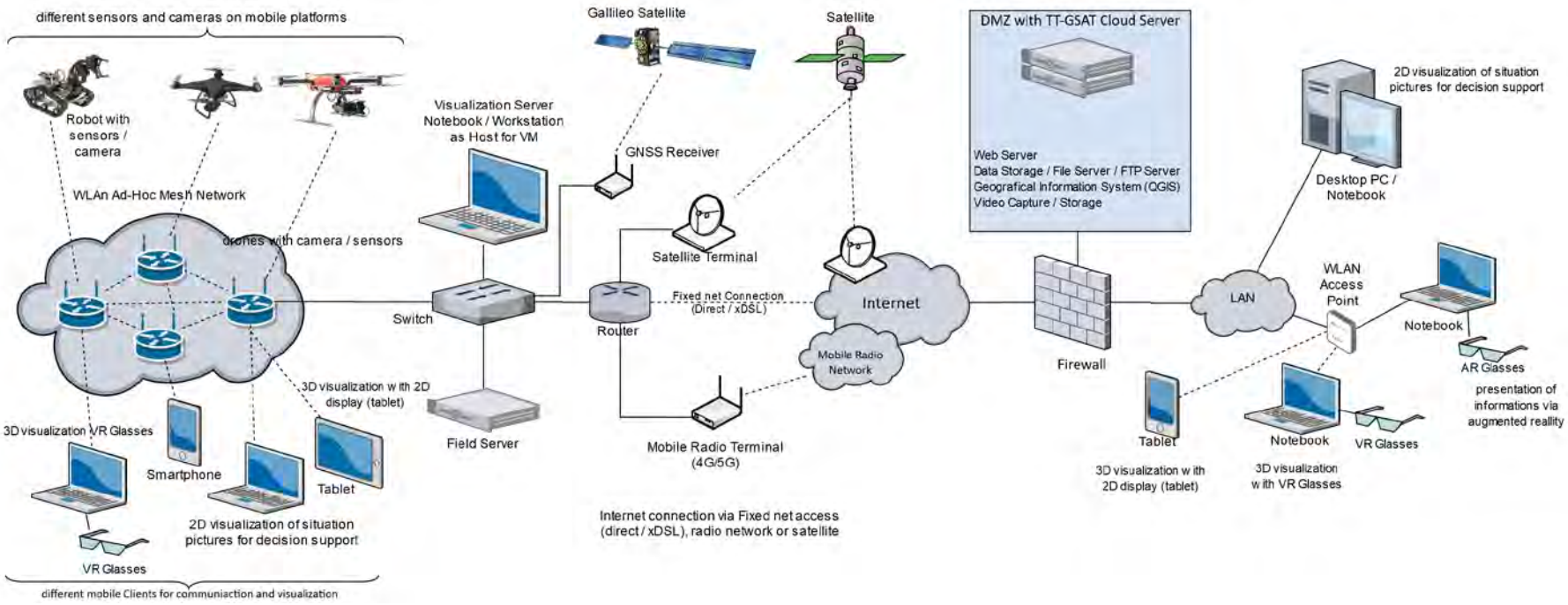
Artificial Intelligence

SPACE ASSETS

Satellite Communications	✓
Satellite Navigation	✓
Earth Observation	✓

- Satellite communication systems in combination with terrestrial communication systems like professional radio networks, commercial radio networks, terrestrial fibre networks for unreached availability in mission areas where the communication infrastructure is not available, overloaded or destroyed. What is more, local stand-alone ad-hoc networks can be connected with satellite network systems.
- Satellite navigation services for secure satellite-based positioning, navigation, tracking and synchronization, for example Galileo Public Regulated Service, Galileo Open Service, GPS.
- Earth observation services to deliver aerial photographs of high precision and actuality to obtain up-to-date information on the relevant mission or crisis event, its geographical extension, its temporal development, damages, etc.

SYSTEM AND SERVICE ARCHITECTURE: SCENARIO OVERVIEW



Field **Transmittance** **Centre**

USE CASE MULTIMEDIA CREW COMMUNICATION

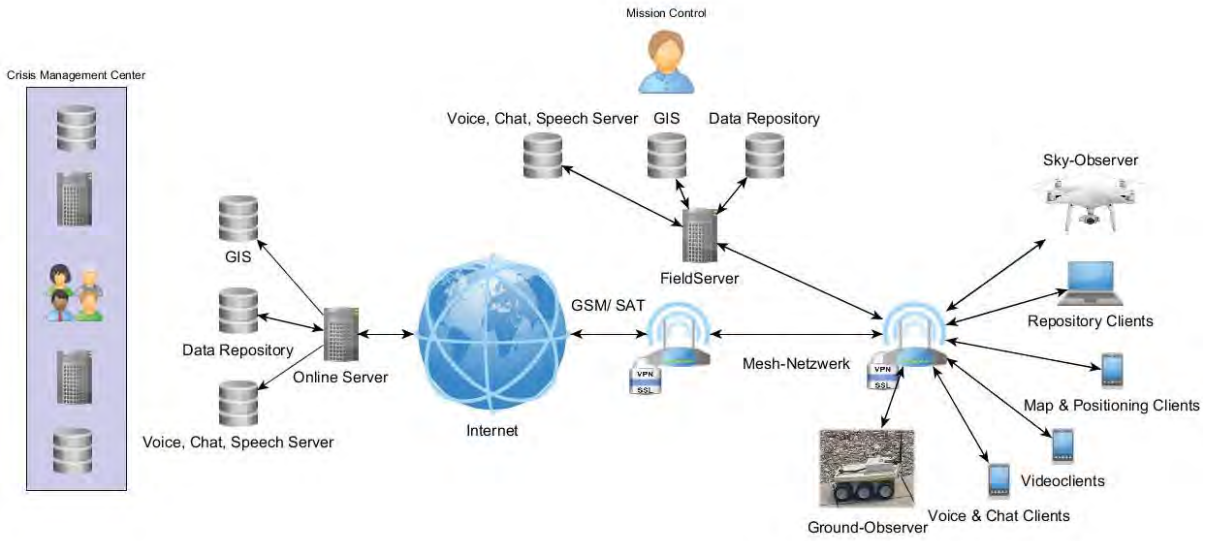
OBJECTIVE:

- Demonstration of resilient and reliable communication and internet-like services based on open source software.
- Even under special conditions like wide area disaster events, bad radio coverage or cyberattacks giving a strategic independency to be operational under all circumstances.

SOLUTION:

A building set of components and services for:

- Communication networks based on mesh nodes
- Data Repository
- Voice and video communication
- Messaging services
- Position and map visualization
- Sensoric surveys
- With/without connection to crisis management centre



EXAMPLE: USE CASE EARTH OBSERVATION DATA (SENTINEL/PLANET)

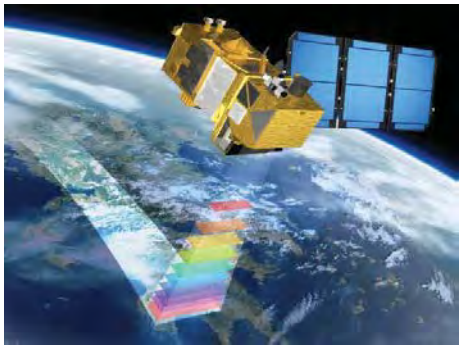


Image acquisition

- Sentinel-2, PlanetScope optical earth observation satellites
- Archive search based on area of interest
- Image selection
- Download and pre-processing (atmospheric correction)

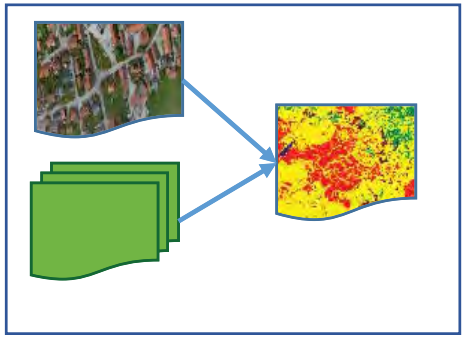
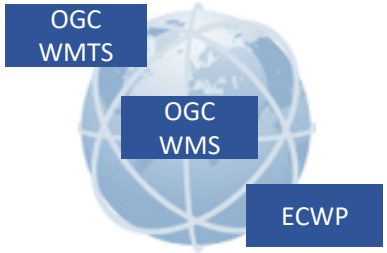


Image processing

- Provide metadata
- Analyse time series of imagery
- Detect objects and/or change
- Catalogue images, metadata and results of analyses in ERDAS APOLLO



Web Services

Image dissemination

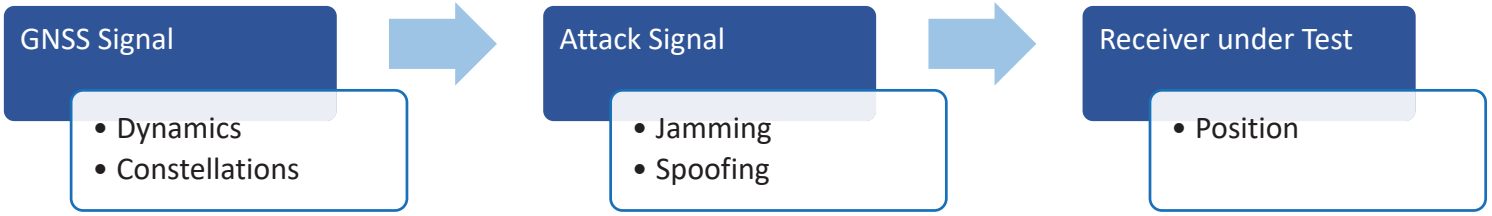
- as Web Services using ERDAS APOLLO
- OGC-conform standards WMTS, WMS
- Efficient image compression using ECWP
- Fast access

TTGSat

EXAMPLE: GNSS RECEIVER TESTING – LAB ENVIRONMENT

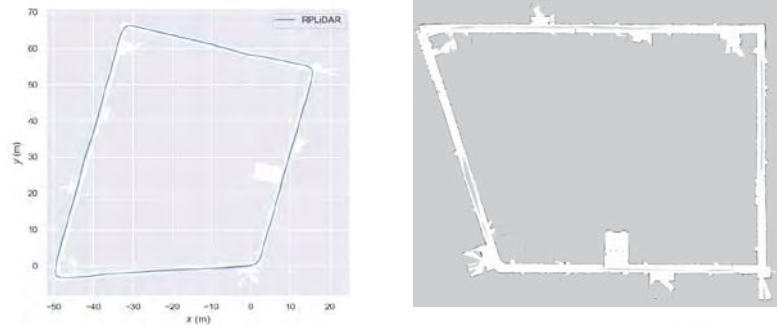
- Testing of different GNSS receivers in a laboratory environment
  - Recorded & replayed live GNSS signals
  - Simulated signals
- Comparison of different COTS-receivers and Galileo Public Regulated Service (PRS) receivers under
  - Nominal and
  - GNSS denied conditions
- Assessment of the influence of interferences (jamming and spoofing)
- Live-Demonstration of the enhanced anti-jamming and anti-spoofing capabilities of Galileo PRS receivers

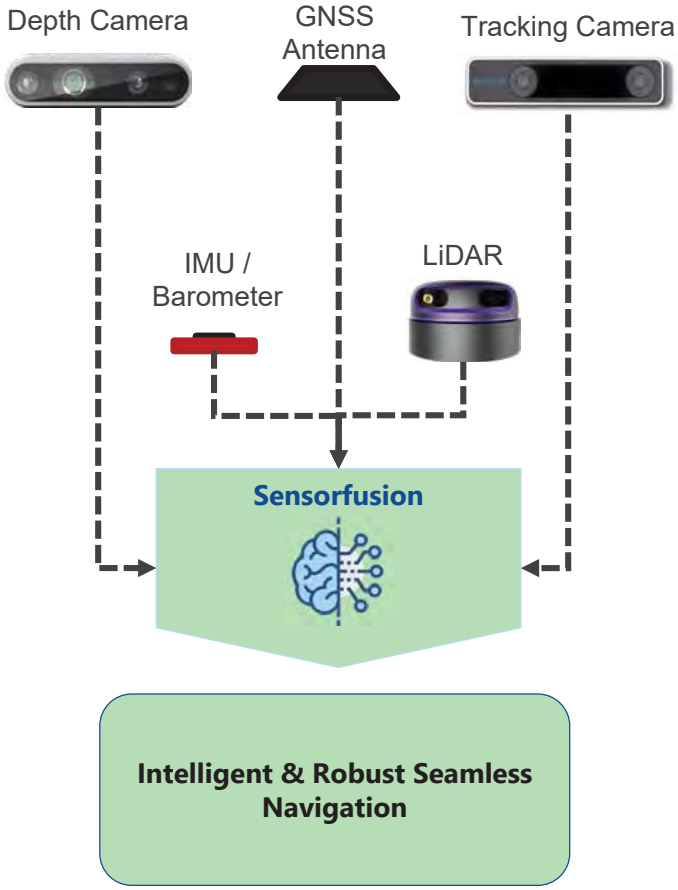
Components of the Jammer-Trap-Unit



EXAMPLE: SEAMLESS NAVIGATION

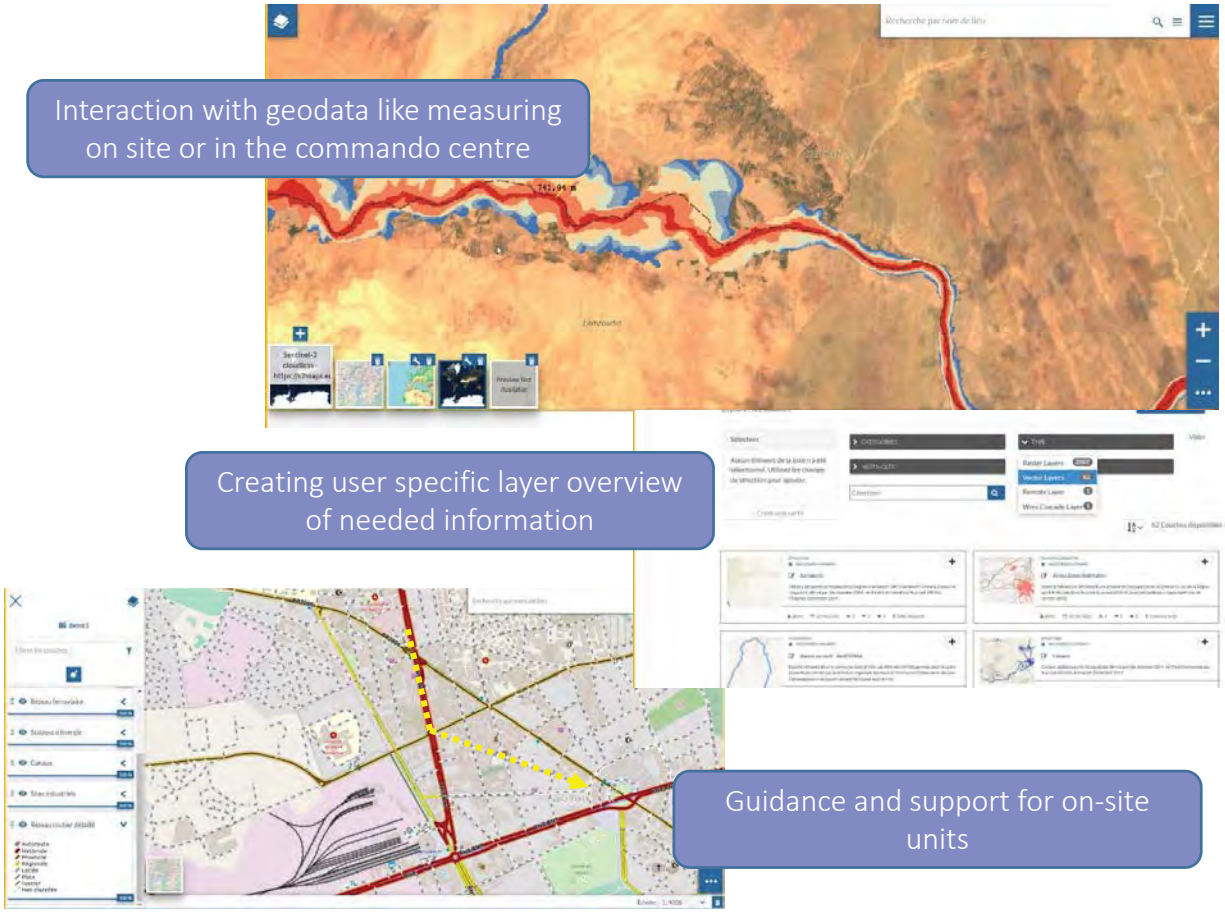
- Prepare a robust and high accurate position in the transition of outdoor and indoor environments
- Strengthen GNSS position with optical Sensors based on:
  - Computer vision
  - Sensor fusion
- Possibility to map, localize and detect unknown environments



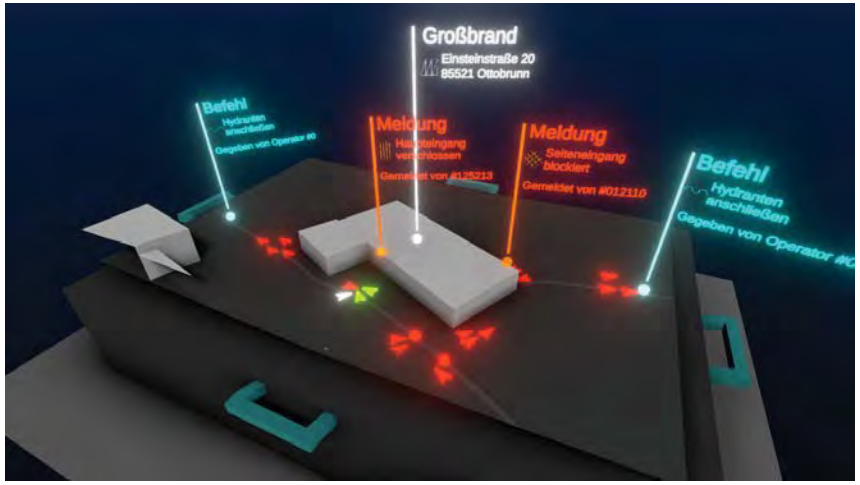


EXAMPLE: VISUALISATION

- Presentation of site by different aerial imaging and informational mapping solutions
- Presentation of real time and near real time information of staff, vehicles, equipment, sensors and objects
- Visualization of additional data provided by other TT-GSAT scenarios
- Real time geodata processing on site and in the field of application

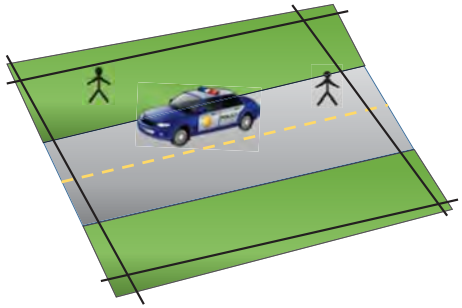


EXAMPLE: VIRTUAL AND AUGMENTED REALITY



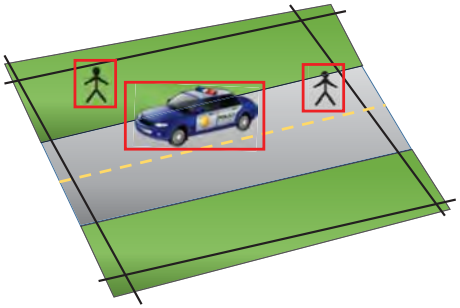
- Event identification from live streams or video feeds displayed in the virtual environment
- Manual placement of event occurrence or augmentation with meta data e.g. to alert or hazard indication
- Event notification in connected virtual environments (AR/VR glasses)
- Interactive change of directional or meta data information as instruction of the remote units
- Change of group members or change of mission task to be displayed and communicated via AR Glasses
- Insertion of tactic commands as highlighted text in the virtual remote units

EXAMPLE: ARTIFICIAL INTELLIGENCE BASED OBJECT RECOGNITION



INPUT

- georeferenced aerial pictures
- georeferenced video streams
- drone, satellite, …
- transmission via
  - radio (dynamic)
  - SD-Card (static)



PROCESSING

- AI-based object recognition
  - individuals
  - cars
  - bicycles
  - houses
  - ….
- tracking of elements in motion

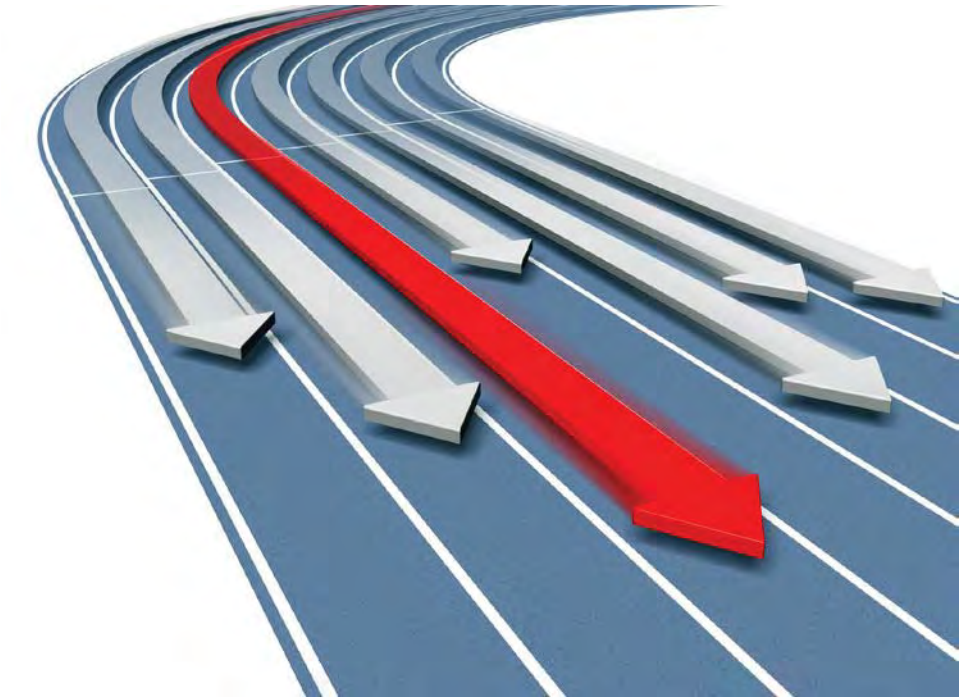
```
...
{‘date‘ : ‘2020-11-24 12:03:35 GMT+0‘,
 ‘file‘ : ‘drone_001256.jpg‘
 ‘1‘:{type: ‘person‘, position:
‘48.049707685620184, 11.660353816264347‘},
 ‘2‘ : {type: ‘person‘,position:
‘48.049611328527924, 11.662857339025688‘},
 ‘3‘ :{type: ‘car‘, position:
‘48.0497888282949, 11.661393157531936‘}}
...
```

OUTPUT

- element types
- associated geo positions
- input for visualization with
  - Web-GIS
  - VR glasses
  - AR glasses
- provision of an OGC service

PILOT OBJECTIVES

- Validate the implementation of the system together with selected users
- Validate the scenario requirements as a Proof-of-Concept (PoC) or testing campaign
- deepening the knowledge of user behaviour and user expectations
- Comparison with the business plan and derivation of new business opportunities



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4S Applications for Safety and Security

How to apply

Application process

Proposal for 4S application demonstration projects and feasibility studies have to be submitted via the **permanently Open Call (Direct Negotiation)**

A0 10494 - CALL FOR PROPOSALS FOR DOWNSTREAM APPLICATIONS IN ARTES 4.0 (UNDER BASS, 4S OR 5G PROGRAMME LINES)

ELIGIBILITY

Funded participation to 4S Strategic Programme Line is open to any company and/or organisation residing in the following Member States:

Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Spain, Switzerland, and the **United Kingdom**

ACCESS TO TENDER DOCUMENTATION

1. **Register** (minimum 'light registration') by completing online questionnaire on ESA-STAR Registration (esastar-emr.sso.esa.int)
2. **Download** the official tender **documentation** (Invitation to Tender) on EMITS : emits.esa.int.

- Published under "Open Invitations
- Look for ITT number: **A0 10494**

First Step

Tell us more about your idea and how you plan to implement it by preparing and sending an

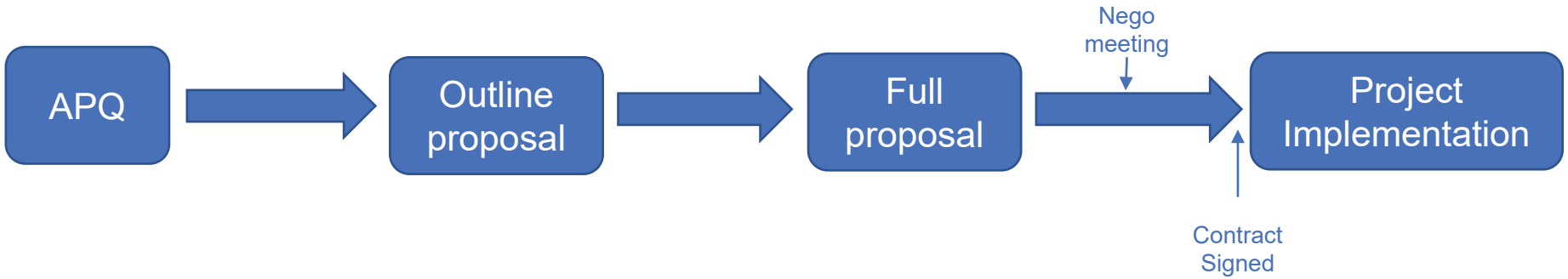
Activity Pitch Questionnaire (APQ)

to business@esa.int (please mention 4S in the title of your activity)

For more information on application process and templates, please visit :
https://business.esa.int/funding/direct-negotiation-call-for-proposals/call-for-proposals

Full Process

After the assessment of the APQ, an ESA Technical Officer will be assigned to you and she/he will guide you in the preparation of the **Outline** and **Full proposals**.



- For more information and templates, please visit :
https://business.esa.int/funding/direct-negotiation-call-for-proposals/call-for-proposals

National Delegations

- The applicable funding level of the individual prime- or subcontractors is subject to authorisation by the involved National Delegation(s).
- Therefore bidding teams are requested to obtain a **Letter of Authorisation** from all their national delegations before submitting a Full Proposal.
- For contact details of your National Delegation(s), please visit:

https://artes.esa.int/national-delegations

Ambassador Platforms

- Ambassadors can help you in the early stages of your proposal submission (APQ preparation) and provide independent advice

- https://business.esa.int/ambassador-platforms

4S – Technology and Product developments

4S – Technology and Product developments

For upstream elements (i.e. satellite telecommunications ground and space components)

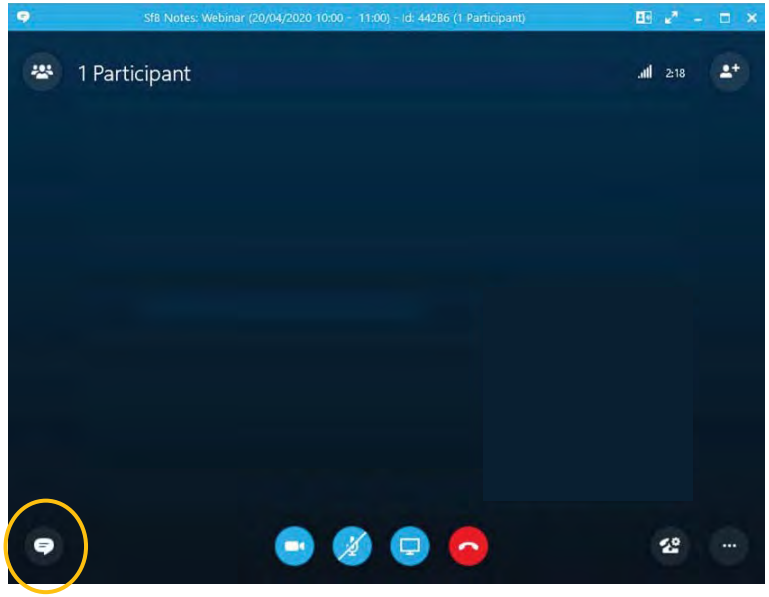
- Industry-initiated activities (Direct Negotiation)
  - Techno & Product development for 4S : open call for proposals (**AO10285**)
- ESA-initiated activities
  - 4S Workplan (updated at September JCB)
  - Activities defined by ESA, to address identified Technology Developments
  - Up to 100% funded and submitted in Open Competition
  - A set of projects to be started in 2021

4S – Technology and Product developments

4S ESA-initiated activities workplan (to be released in Q1-Q2 2021):

Activity Ref.	Title	Cost (k€)	Funding Level	Planned for
3A.136 (4S.006)	Integration of satellite and terrestrial railway control networks	800	Up to 100%	Q2 2021
Objective : develop and test the control and management protocol stacks of railway control communication via satellite, necessary also for the integration of satellite and terrestrial railway control networks.				
3C.025 (4S.007)	System simulator for UAV terminal development	400	Up to 100%	Q1 2021
Objective : develop and test an end-to-end system simulator that provides performance indicators which are key for the development of UAV satellite terminals. The simulator will support both command and control and payload data communication				
3D.006 (4S.008)	Over the air cryptographic keys exchange for secure governmental satellite communications	600	Up to 100%	Q1 2021
Objective : to develop and demonstrate a security keys exchange protocol to support confidentiality and integrity protection of the control and user planes at the data link layer				
6B.085 (4S.009)	Techniques for intelligent jamming detection and mitigation of satellite IoT gateways	750	Up to 100%	Q1 2021
Objective : develop jamming detection and mitigation techniques for satellite Internet of Things (IoT) gateways as a counter-measure against security threats.				

OPEN QUESTIONS & ANSWERS SESSION



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→ THANK YOU!

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