



**ESA SECURE SATELLITE COMMUNICATIONS SUPPORT TO ESA LONG TERM PLAN
ANNOUNCEMENT OF OPPORTUNITY IN THE FRAMEWORK OF ESA
SECURE SYSTEMS FOR SAFETY & SECURITY (4S)
TECHNOLOGIES, PRODUCTS, SYSTEMS AND
END-TO-END INFRASTRUCTURES DEVELOPMENTS
FOR SECURE COMMUNICATIONS**

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1. ACRONYMS

AO	Announcement of Opportunity
ARTES	Advanced Research in Telecommunications Systems
ATM	Air Traffic Management
BC	Business Case
BP	Business Plan
CC	Core Competitiveness
C&G	Competitiveness and Growth
CEO	Chief Executive Officer
CTO	Chief Technology Officer, Chief Technical Officer
EC	European Commission
EDA	European Defence Agency
ESA	European Space Agency
EU	European Union
FIFO	First in first out
FP	Full Proposal
GaaS	Ground as a Service
GEO	Geostationary Earth Orbit
GOVSATCOM	ESA programme on governmental satellite communications
GPL	Generic Programme Line
GS	Ground Segment
IoT	Internet of Things
IPS	In-Principle Support
JCB	ESA Joint Board on Communication Satellite Programmes
LEO	Low Earth Orbit
MOC	Mission Operations Centre
MS	ESA Member States
M2M	Machine to Machine
NoI	Notification of Intent
NG	Next Generation
NGSO	Non-Geostationary Earth Orbit
OP	Outline Proposal
QKD	Quantum Key Distribution
PP	Pitch Proposal
PPP	Public-Private Partnership
RF	Radio Frequency
RPAS	Remotely Piloted Aerial System
SCC	Spacecraft Control Centre
S/C	Spacecraft
SEI	Socio-Economic Impact
SPACE19+	ESA Ministerial Council 2019
SPL	Strategic Programme Line
SOTM	Satcom On-The-Move
SOTP	Satcom On-The-Pause
TBC	To Be Confirmed
TBD	To Be Defined
UAV	Unmanned Aeronautical Vehicle
VHTS	Very High Throughput Satellite(s)
4S	Secure Satcom for Safety and Security
5G	Fifth generation technology standard for broadband cellular networks

2. OVERVIEW

This document presents the **Announcement of Opportunity for technologies, products, systems and end-to end infrastructure developments for secure communications** initiated in the frame of the ESA ARTES Space Systems for Safety and Security (4S) Strategic Programme Line.

The document consists of:

- Background and Rationale
- Scope of the Announcement
- Objectives of the Opportunity
- Industrial Focus
- Process and Schedule
- Guidelines
- Annex A

3. BACKGROUND AND RATIONALE

3.1. State of Play

Our society, economy, security and sovereignty are increasingly dependent on the digital infrastructure and more specifically on communication networks: any lack of coverage in some areas or loss of availability due to accidental or intentional disruption may have widespread impact and very negative consequences.

Hence, specific governmental attention is granted to those “4S-related” communication services and networks that are required for essential governmental or institutional services (at national, regional or local levels) or support operations that are deemed critical in fields as various as transport, finance, health, energy production and distribution, etc.; security and appropriate control of their design, manufacturing and operations are indeed key requirements in support to resilience and sovereignty.

Governmental actions include setting pro-active public policies, imposing strict regulations on these services and the infrastructure that support them and carefully checking their application through various mechanisms such as service certification or operational oversight by dedicated governmental bodies or agencies. When necessary, they may also include direct procurement of infrastructure responding to their specific requirements, or support for instance through co-investment to public private partnerships in charge of deploying these infrastructures and providing the expected services. Today, our communications rely mostly on terrestrial network solutions that tend to be more and more integrated (IP, 5G, ...), which may strongly increase the impact of any disruption. At the same time, as the overall presence of Europe and Canada in the design and manufacturing of these terrestrial network solutions tends to decrease, this can only negatively impact our actual level of control of this essential infrastructure and have serious implication on European and Canadian safety, security and sovereignty. In that context, it is growingly perceived that adding appropriately tailored secure Next Generation SatCom components to our telecommunication infrastructure may greatly help to increase its overall resilience to any kind of disruption, bring additional capacity and ensure its global coverage while

providing a stand-alone highly secure space-based capacity to channel the most sensitive and critical communications services.

As illustrations among many others, some ongoing trends and objectives of growing importance:

- Enhancing and creating cybersecurity frameworks;
- Evolving regulatory context and start design of solutions for Railway Traffic Management, Air Traffic Management, UAV/RPAS, etc.;
- Developing solutions addressing the emergence of a growing governmental users' appetite for low latency communication services such as non-geostationary (NGSO) solutions, etc.;
- Upgrading and expanding availability of the appropriate technologies and products in Europe and Canada both to support our industry competitiveness and to address specific needs for sovereign and independent technologies, products and systems at national and EU level, with the 2025-2030 deployment timeframe in mind.

3.2. Rationale

In 2019, ESA Member States decided to focus their efforts in this domain by the creation of a Strategic Programme Line named "Space Systems for Safety and Security (4S)" under ESA Telecommunication Programme ARTES (Advanced Research in Telecommunications Systems).

Last 2 years confirmed expectations for growth of worldwide demand in this domain, and prospects for large opportunities triggered or reinforced by public initiative in the European and Canadian area. ARTES 4S Member States hence decided to increase and accelerate their efforts in this domain, both in support to our industry to timely and competitively deliver the most advanced solutions and in support to these European or Canadian public initiatives. More precisely, 4S efforts have been moved from the exploratory to the preparatory stage by the adoption of a 4S Next Generation SATCOM Work Plan whose complementary actions aim to cope with prospects for these opportunities to reach the full scale implementation stage in early 2025 and the need for our industry to have further consolidated their proposals.

As part of this 4S Work Plan, the present Announcement of Opportunity aims to boost the European and Canadian industry's innovation, competitiveness and ability to timely deliver the most advanced technologies, products, systems and end-to-end solutions in response to 4S-related demands and opportunities on the market worldwide, and in particular from dedicated actions from public and private organisations in the ARTES MS perimeter and at EU level.

The availability of such solutions will not only unlock the implementation of strategic secure initiatives at national and EU level but also result in commercial return for Industry due the number of opportunities in this 4S domain worldwide. These solutions can also enable new products which can spin-off into the commercial market and thus increase ESA Member States' competitiveness and share.

It is key for ESA Member States' Industry to start as fast as possible the developments critical to capture those opportunities and prepare the industrial base for emerging secure services and solutions. This AO will therefore be implemented in a fast-track mode with industry. Proposals will be assessed and possibly implemented in a first in first out (FIFO) mode by ESA team.

A set of critical developments have been already identified in the framework of the ARTES 4S Next Generation satcom system studies as well as by Industry and Operators in the frame of ongoing 4S-related activities. They include critical technologies, products and systems as well as the gaps to be

filled by ESA Member States' Industry to gain competitiveness in the satcom secure market and their timely availability to address near-term opportunities. Those are presented in Chapter 4.

NOTE : Any proposal submitted after the deadline indicated in section 8.1 will automatically revert to the technology and product permanent open Call for Proposals 'ARTES 4.0 Technologies and Product for C&G, Scylight, 4S and 5G' (AO 10285).

4. SCOPE OF THE ANNOUNCEMENT

The 4S Strategic Programme Line objective is to support the development of Next Generation Satcom Systems aimed at providing secure and safe communications for governmental/institutional and public regulated services and ensuring resilience to society's critical digital infrastructures. Broadband connectivity as well as low data rate (ADS-B, AIS/VDES, IoT...) applications are considered. These entails the following applications areas (non-exhaustive list):



Support to transportation	Public Safety, Law enforcement and other Governmental use cases	Protection of key infrastructures
<p>Improve safety and security of air, rail, land and maritime transportation and traffic management</p> <p>Ensure safe and secure operations of connected and unmanned vehicles</p>		<p>Secure remote management of utilities (energy, water, telecom, digital) networks, "smart grids"</p> <p>Fast and secure links for financial institutions, healthcare, etc.</p>
	<p>Bring capabilities and improve connectivity for civil protection, public safety, humanitarian aid, and security forces (police, coast guards, etc.)</p> <p>Connect key institutional infrastructures globally (e.g. embassies)</p>	<p>Monitoring of key physical infrastructures (e.g. bridges)</p> 
	<p>Enable remote border control and maritime surveillance (IoT, RPAS/UAV)</p> <p>Ensure global communication coverage including over the poles</p> <p>Provide communications services to other space systems. i.e. Galileo (augmentation), Copernicus (data relay)</p>	

The present Announcement of Opportunity aims to foster the development of 4S technologies, products, sub-systems, systems, end-to-end infrastructure solutions, upon which these Next Generation Satcom Systems will rely.

The following sections provide an outlook for the critical 4S technologies, products, sub-systems, systems and end-to-end infrastructures. The list is not exhaustive, and the call opens to additional and complementary developments to the ones here below provided.

Note: Pooling & Sharing solutions are excluded from this AO as specifically covered in other frameworks.

4.1. Ground Segment

The Ground Segment (GS) has become a key enabler of any emerging satcom system in particular for constellations. The availability of low-cost user terminals, a self-scanning antenna and automated and scalable Ground Segment architecture are examples of fundamental items required for the success of any satcom service and system deployment, for instance related to VHTS, M2M/IoT, constellation, SOTM etc. The Ground Segment Architecture is required to be:

- Secure;
- Scalable and flexible;
- Autonomous;
- Integrated with terrestrial;
- Virtualised;
- With data and processing in the cloud;
- Multi-mission/service;
- Orbit agnostic;
- With high availability and reliability.

At user segment level, developments in the following domains are required:

- Low-cost flat antenna;
- Orbit agnostic;
- Multi band;
- Wearable Antennas;
- Next Generation of SOTP;
- Self-powered IoT;
- Miniaturisation, adaptations to user constraints (SWAP), ruggedization
- Low-cost terminal/antenna,

At traffic segment level (i.e. Gateway), developments in the following domains are required:

- Secured GaaS concept;
- Cyber-secured Cloudification and Virtualisation;
- Digitalisation (e.g. RF chains);
- Seamless interface with Terrestrial (e.g.5G).

4.2. System

- Solutions for end-to-end orchestration of Resources for Secure & Reliable services:
 - Dynamic Resource Allocation;
 - Antenna Diversity solutions;
 - RF and Network Orchestration;
 - Service Redundancy (maintaining connectivity to more than one satellite);
- Solutions Service Orchestration for System of Systems:
 - Managing services across several space assets in different orbits, especially NGSO;

- Onboarding new assets/new users to the system;
 - Managing service provision and service priorities in case of contention;
- Solutions for end-to-end performance optimisation/routing optimisation.

4.3. Space Segment

Innovation is anticipated in the following areas to support 4S applications:

- Inter-satellite links, including links between constellations in different orbits in a “system of systems” scenario;
- High-speed, secure and partitioned command and control links and subsystems;
- Cryptographic processing and secure key distribution/management;
- On-board interference management subsystems, including interference, localisation and mitigation;
- Dense functional integration, modularity, scalability, genericity and high in-orbit payload flexibility;
- Rapid service reconfiguration to place capacity in different geographical areas according to need (e.g. disaster recovery);
- Autonomous or semi-autonomous in-orbit operations (e.g. exploiting artificial intelligence techniques);
- Digitisation, including reconfigurable and regenerative signal processing, packet routing and beam hopping capabilities;
- Active antennas;
- Photonic, microwave photonic and laser communication subsystems;
- Interference management.

4.4. End-to-End System Infrastructures

This section addresses the (emerging) end-to-end safety critical applications (e.g. for Aero, Maritime, Railway, connected land vehicles, utilities management, emergency, etc.)

Related activities will target the definition, development and demonstration of end-to-end infrastructure (space, ground and user segments). The infrastructure might adopt a set of technology innovations as described but not limited to the ones identified in the above sections.

Demonstration activities will include the demonstration of the innovative elements of the end-to-end infrastructure in the relevant operational environment to show to the end users the benefits of the proposed solutions.

4.5. Security

Security is a major element of Next Generation Satcom Systems. Innovation is anticipated in the following areas:

- Technologies and standards for secure communications and networks
- Technologies and standards for secure space systems operations
- Secure Cyber-secure Cloudification/Virtualisation
- Institutional and commercial traffic secure virtual separation architecture
- Cryptographic processing (quantum and non quantum) and key distribution/management.
- Intentional and non-intentional interference localisation and management

5. OBJECTIVES OF THE OPPORTUNITY

The objective of this AO is to support developments proposed by ESA Member States' Industry in the areas of ground, space, sub-system, system, security and end-to-end infrastructures addressing the market of secure communications. This market can be related to dedicated actions from public and private organisations in the ARTES MS perimeter and at EU level, or can target worldwide opportunities.

The AO is open to Industry within ESA Member States participating in the 4S Strategic Programme Line.

This announcement presents the opportunity for industry to enter into a partnership with ESA on development of innovative technologies / systems / services as addressed by 4S.

In such partnership ESA shall typically cover, through co-funding, the technology and market risk associated to innovative developments. Note that the level of co-funding may depend on the technology maturity and risks addressed in the proposed activities. Co-funding levels are available in Annex B - Pitch Proposal Template.

In return the Partner(s) shall:

- provide the respective private co-funding; and
- develop innovative technologies / systems / products and end-to-end infrastructure.

The AO addresses the full life cycle of activities relating to 4S including:

- definition, technology and product developments, demonstration in a pre-operational environment.

The activities can cover one or multiple phases of the full cycle.

Furthermore, proposals are encouraged to identify any value that the proposed activity may bring for reducing the dependency of institutional safety & security solutions on non-EU actors or actors outside ESA Member States, such as:

- ownership of asset, location of operations facility (e.g. S/C; SCC; MOC);
- security of technology supply, manufacturing know-how; and
- security certification.

6. INDUSTRIAL FOCUS

ESA does not intend to prioritise any particular element of the above 4S activities and expects industry to define its own priorities (for instance in line with its business plans). For the same reason, ESA does not intend to prioritise particular domains of innovation in technology, product and service development. Consequently, the AO provides the opportunity for industry to propose an implementation in response to its own priorities regarding the different activity areas and the theme as a whole. These priorities can be further consolidated during the dialogue phase defined under section 8 below.

7. PROCESS AND SCHEDULE

7.1. Timeline and procedure

Following a first issue of this opportunity from June to November 2021, a second issue of this AO will open in December 2021 till May 2022.

Pitches can be submitted within two batches (time-windows):

- First batch lasting from December 2021 till 28 February 2022
- Second batch lasting from 02 March 2022 to 31 May 2022

If the Industry wishes to expedite the procedure, they are encouraged to submit their proposals ahead of the deadline indicated for each batch. ESA will endeavour to assess pitch and outline proposals within 10 working days following reception.

For each batch, the announcement procedure will be organised in three steps and with the following schedule:

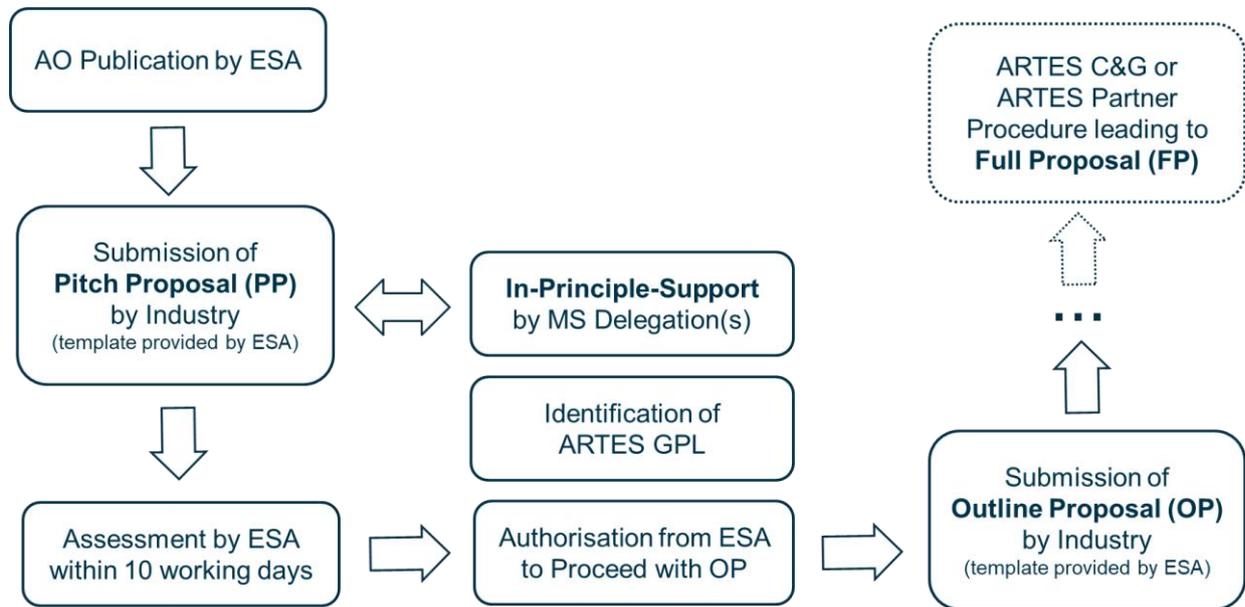


Figure 1: Illustrative Timeline

Step 1: Pitch Proposal

Following the issuing of this Announcement, interested potential partners are requested to submit their proposal(s) in the form of Pitch Proposal(s) based on the template provided by ESA. Multiple Pitch Proposals can be submitted. The Pitch Proposals shall be approved and signed at higher company management level, ideally at executive level e.g. CTO/CEO, and indicating their firm commitment to the proposed activity. The Pitch Proposal shall as a minimum provide a first set of information as defined below:

- Outline of intended scope of the proposed 4S activity or activities;
- Description of considered innovative elements;
- Indication on the nature of the activity or activities within the development life cycle (e.g. definition, technology de-risk, product development, pre-operational demonstration);
- Commercial viability (preliminary business case);
- Future level of investment required related to the development life cycle.

The template for the Pitch Proposal is provided in Annex A.

The completed Pitch Proposal shall be submitted by e-mail to

ARTES-4S@esa.int

Step 2a: In-Principle Support from ESA Member States

The Pitch Proposals received will be assessed by ESA. In parallel the interested potential partners shall contact and engage with the relevant ESA Member States Delegates to verify their interest and in principle support. The coordinates of the National Delegates can be found here: <https://artes.esa.int/national-delegation>

It is recognised that some interactions with potential partners may be required and ESA may therefore offer support in providing further clarifications, aimed at better shaping the Outline Proposals (Step 3).

Dialogue sessions may be organised individually with potential partners prior to Step 3. Requests for such sessions should be sent by email to ARTES-4S@esa.int

At the end of the dialogue phase, if the submitted Pitch Proposal has been positively reviewed by ESA and supported in-principle by the relevant ESA Member State(s), the interested potential partners shall be authorised by ESA to provide an Outline Proposal.

Step 2b: Identification of the ARTES Implementing Rules for the Activity Implementation

The Pitch Proposals that are positively evaluated and supported by the relevant ESA Member State Delegations, may be implemented under either ARTES C&G or ARTES Partner Generic Programme Line (GPL) Implementation Rules, depending on their nature and scope and in coordination with National Delegations.

The ESA support will be based on a co-funding scheme where the funding levels depend on the maturity and the risk involved as well as on the relevant Delegation's decision.

Subject to a positive evaluation and support, the interested potential partner will be notified about the applicable Programmatic tool and co-funding scheme, as part of an invitation by ESA to submit an Outline Proposal (see Step 3).

Step 3: Outline Proposal (OP)

The Outline Proposal is expanding the Pitch Proposal with a more extensive level of details, in accordance with the identified ARTES GPL (see Step 2b).

The detailed scope expected from the Outline Proposal will be provided to all parties that have submitted a Pitch Proposal, that has been positively evaluated by ESA and is supported by the relevant Member States. A template will be provided by ESA, covering as minimum the following aspects:

- Outline of the proposed 4S activity or activities;

- Description of innovative technology elements;
- Design & Development Plan, IOT/IOV Approach, Demo Plan as applicable;
- Business Perspective on global market and/or European institutional opportunities;
- Industrial Organisation and Programme of Work;
- Link to relevant national and/or EU initiatives as applicable;
- Funding Plan and cost estimates.

Subsequent Steps

Following the submission of the OP, in case of a positive assessment from ESA, the Industry will be invited to submit a Full Proposal (**Step 4**) with the Authorisation of Funding (AoF) from the relevant National Delegation(s), and in line with the selected Generic Programme Line procurement process. Following a positive assessment by ESA the proposed activity will be approved for implementation.

7.2. Evaluation Criteria

The evaluation process is non-competitive, as each proposal will be assessed individually on its own merits.

For any Outline Proposal to be considered as an adequate basis for further consideration, the following evaluation criteria will be used:

1. Consortium experience in 4S-related product and system development;
2. Proposed management organisation, including management of risks;
3. Adequacy of cost and funding;
4. Potential for future evolution towards an operational 4S solution on a global market and/or towards European institutional opportunities and associated return on investment; and
5. Level of European non-dependence (where applicable for the European institutional market).

8. ANNOUNCEMENT GUIDELINES

8.1. General conditions

The submissions and all correspondence relating to it shall be in English.

The tender shall not contain any Classified Information, whether in the Pitch, in the Outline Proposal or in the Full Proposal.

To avoid any confusion with Classified security markings, the unclassified protective marking used by the Tenderer in the proposal shall not contain the terms: "Restricted", "Confidential", or "Secret".



However, should the Tenderer consider necessary to include Classified Information in the tender, the Tenderer shall inform beforehand the Agency.

The Tenderers are informed that Classified Information can be shared with ESA only in compliance with the Project Security Instruction (PSI) duly established by the Agency beforehand and subject to the approval by the ESA Member States.

The Agency will treat commercially sensitive or proprietary information confidentially and solely for the purpose of the assessment of the response.

Expenses incurred in the preparation and dispatch of the response to the announcement will not be reimbursed. This includes any expenses connected with a potential dialogue phase.

The announcement does not bind the Agency in any way to place a contract. The Agency reserves the right to issue amendments to the announcement.



ANNEX A : Template for Pitch Proposal

The template is provided separately.