



# ISICOM

## “Integrated Space Infrastructure for Global Communications”

### *Executive Summary*

*December 15<sup>th</sup>, 2010*

## 1 Foreword

**Europe needs a global, secure and resilient telecommunication infrastructure** with state of the art broadband and handheld services capabilities **to serve its political ambition and help assure its sovereignty**. ISICOM will extend the use of this infrastructure to users without terrestrial connections allowing broadband services under shortest notice to targeted ground, air and naval users where needed worldwide, through network instead of point to point connections. This future SatCom network will help to interconnect institutional users from different European organizations where each terminal of the network will be addressable and capable of generating, processing or routing information.

The foundation of this specific and ambitious European Satellite Telecommunication Initiative (encompassing R&D, infrastructure and services) **targeting the institutional demand in the domain of security, transport and energy**, will

- **enable the development of innovative technologies, products and services up to in-orbit validation** and large scale pre operational experimentations in order to maintain the technological edge, international competitiveness and market share of the European strategic satellite communication industry and consequently enhancing the capabilities and sustainability of the whole European satellite industry;
- **improve where needed, Europe’s existing and planned capacity, to prevent and respond to crisis or disaster situations** wherever they may occur with effective means of surveillance, coordination and control with the development and deployment of an efficient, global, secured and resilient end-to-end system.

This document provides an overview of ISICOM, a long term Initiative proposed by ISI to provide EU with satellite communications (“SatCom”) capacity to fulfil its objectives. It would also enable to leverage on existing and planned assets in a first phase.



## 2 Objective and rationale

ISICOM aims at providing global, flexible, secure and resilient SatCom services able to operate worldwide to ensure routine operations and support crisis management. ISICOM features are:

- High-speed broadband seamless services to and from fixed and mobile terminals with low operational constraints, either directly or backhaul through several hops
- High Quality of Service
- Adequate data security (encryption, access control, ...)
- Minimum response time
- Fast deployment and mission re-configuration
- Seamless interoperability with terrestrial systems / networks
- Integration with satellite based earth observation and navigation systems. (data-relay services for raw data collect and geo-spatial product dissemination, geo-localization based services, )
- Integration of the SatCom infrastructure and its related services into overall crisis management tools
- Resilient and flexible network architecture
- Services to unmanned platforms such as UAVs or HAPS (such as HD video transfer in real time)
- Sharing of the satellite capacity amongst many users, terminals, and services

All these features will provide a real and tangible benefit to Public Safety related missions allowing more efficient coordination of operations and the planning of the necessary logistics based on evolving situation assessment. Targeted end-users of ISICOM are institutional organisations such as civil protection, police, customs and coast guards, Non Governmental Organizations and, potentially, defence institutions, which need to support at least 6 types of security related missions:

- Crisis management in case of natural or man made disasters or complex emergency situations with casualties, that cannot be handled at national level
- External security actions like peace keeping missions
- Border and maritime surveillance aimed at understanding of all activities carried out at sea or at land borders that could impact the security, safety, economy, or environment of the European Union and its Member States
- Critical infrastructure surveillance and protection (Power, Water, Oil & Gas utility network, etc.)
- Transport security
- Security of citizens

These missions can be carried out within the EU territory, but abroad actions can also be considered to support the EU external missions whenever Europe shall intervene to relief action after a natural disaster for instance.

Aggregating the telecommunication demand associated to these institutional missions will allow improving and speeding up the support of these critical missions by

- reducing the necessary investment
- reducing operational cost among user organisations distributed over Europe by mutualisation of the demand;
- developing dedicated satellite resources;
- ensuring the required integration with terrestrial networks;

In addition, it is a unique opportunity to support the development in Europe of strategic space technologies (on board and on ground) for next generation SatCom solutions also benefiting other satellite applications. This will contribute to maintain the competitiveness of European SatCom industry.

## 3 ISICOM concept overview

The ISICOM Initiative aims at serving the European Institutional SatCom demand and supporting the European SatCom industry in the development of breakthrough technologies for advanced features and performances.



The ISICOM initiative is targeting the development and deployment of an innovative SatCom system infrastructure:

- Providing a short notice dependable and trusted satellite based network, delivering mobile and broadband interactive services while being integrated with terrestrial networks
- Leveraging on existing and planned SatCom systems to form a seamless global common space infrastructure
- Increasing the available bandwidth with innovative spectrum management, radio transmission and protocol techniques
- Reducing the costs of ground and space segments with standardised design
- Improving the interoperability of the different communication features of the Public Safety users
- Proposing a scalable and modular design well fitted to incremental deployment in coverage and capacity by accommodating additional satellite resources and upgrading the ground component
- Allowing to share the system and its capacity by many organizations, through intelligent capacity allocation schemes
- Defining a progressive implementation plan

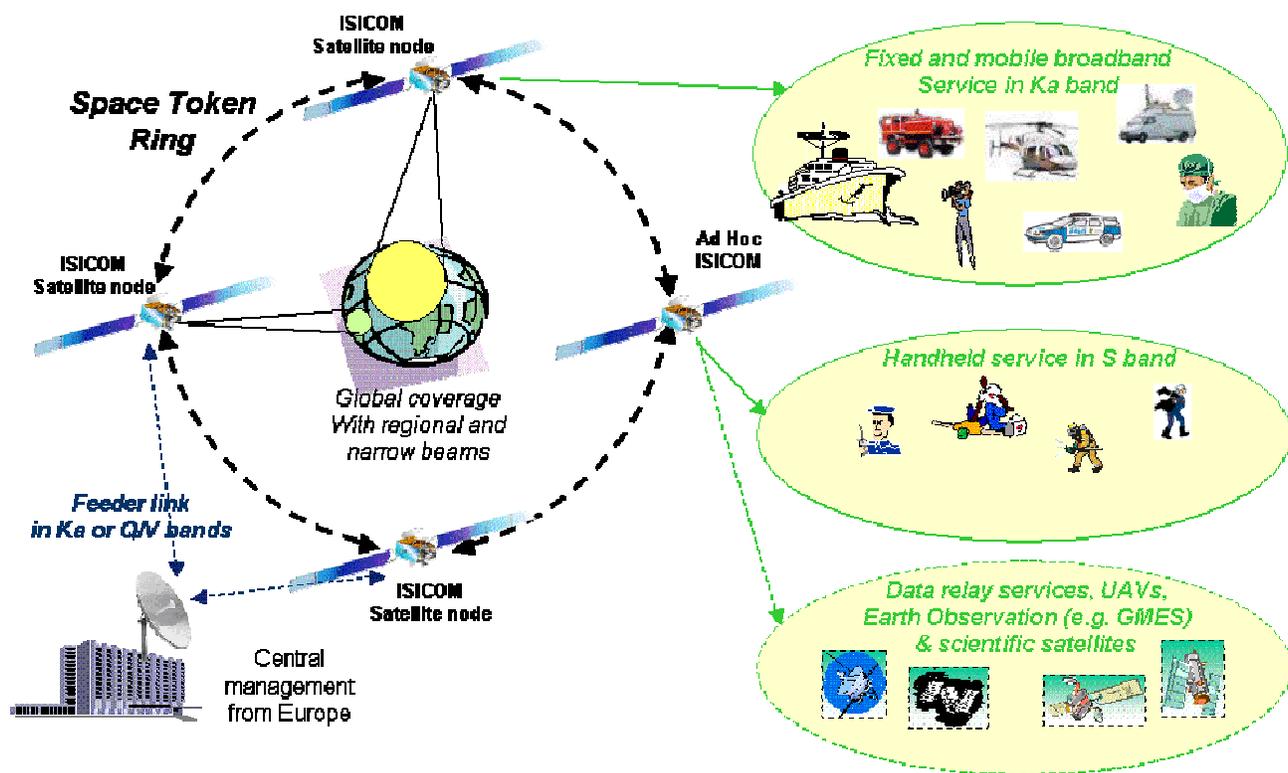


Figure 1 : ISICOM infrastructure concept

ISICOM benefits for the European citizens including relevant users:

- Faster response time in the crisis management
- Provision of permanent, secure and resilient communications

ISICOM benefits for the European Union:

- Improvement of its efficiency in handling crisis situations
- European autonomy on the key assets supporting EU security policy



- Cost optimisation associated to resilient telecommunication services for security
- Harmonised infrastructure to support the pan-European civil protection organisation
- Cost sharing between many organizations, while providing each of them “always-on” connectivity
- As a tool to provide capacity that would considerably help to serve TLC needs of Developing Countries when appropriate

ISICOM benefits for the Europe SatCom industry

- Contribution to the set-up of a coherent European Space Industrial policy
- Efficient cross-fertilization and technology transfer between space and non space sectors
- Development and deployment of innovative SatCom program able to federate public and private R&D effort
- Development of breakthrough technologies
- Development of innovative satellite enabled services addressing security, emergency and societal challenges
- Further strengthening (at global level) of European universities and research centres on SatCom

## 4 High level system requirements and architecture

The ISICOM system infrastructure is characterised by

- Very high-speed broadband internet class services to fixed, transportable and mobile terminals including UAVs
- Voice, video, messaging and data services to hand-held services;
- Backbone connectivity services to remote terrestrial local area networks (e.g. Public Safety);
- Inter-Orbit Link with Earth Observation satellites for data relay services
- Inter-Satellite Link (ISL) to connect all satellites of the ISICOM architecture, avoiding double satellite hops via costly ground infrastructure in case of far range communications around the Earth and allowing new classes of services.

Furthermore ISICOM will activate synergies/interoperability with commercial and even defence satellite communication systems. The integration can take place at ground level or even directly in the space via the ISLs and on board routing .

The approach is to leverage on existing or planned satellite assets owned by Institutions of European Member States, European commercial entities, or that can be accessed via European controlled gateways, operating in different frequency bands.

It shall develop progressively additional space and ground segment resources allowing to provide:

- global coverage to serve users anywhere and anytime thanks to a constellation of interconnected geo-stationary satellites ;
- very high access rate capability of several tens of Mbps to support upcoming very high speed broadband internet services;
- large throughput of tens of Gbps to accommodate the global trends in broadband traffic evolution;
- mesh network capability for single hop communication between any terminals or gateways in the system whether they are under the same or different beams, the same or different satellites;
- mobility management with the support of various types of terminals including handheld, transportable, land mobile, vessel or aeronautical mounted devices able to roam or hand-over between beams and/or satellites while ensuring reinforced end to end security to meet the institutional users requirements;
- integration with terrestrial network to extend the service coverage in urban as well as indoor environment.
- immediately usable backup to terrestrial connections
- fast network set up and deployment

ISICOM satellite resources may require geo-stationary and/or non geo-stationary satellites. They can represent full or a piggy back payloads.



In the appendix, a table summarises the added value of ISICOM with respect to a set of existing and planned systems.

## 5 Enablers

### 5.1 Technologies

Particular emphasis will be put to ensure that the developed technologies, products and services at ground and space segment level can be re-used in future satellite systems of other SatCom markets and maximise the European industry competitiveness.

ISICOM will also capitalise on technologies and services successfully demonstrated with proof of concepts.

Here below are listed potential technologies to be developed within ISICOM.

System features	Technology enablers
Global coverage	Constellation, smart antenna systems, ISL, GEO fixed and mobile satellites
Large access rate	Large reflector antenna, high power satellite platform, protocol optimization
Throughput	Multi beam antenna for spectrum re-use, exploitation of Q/V bands; channels adaptation / pre-distortion, optimised fade mitigation techniques as Adaptive Coding and Modulation scheme, routing, new transport protocols and cross layer techniques;
Security	New encryption techniques, authentication, confidentiality
Resilient	Mesh topology, auto-configurable, alternative paths.
Direct access and mesh networking	On board Processor, Inter Satellite Links Ground level: low cost terminals, flexible gateways; cognitive radio and interference mitigation techniques. Mesh networks with automatic traffic routing
Low cost terminals	Small form factor terminals, regenerative processors, SDR-based terminals, low profile tracking antennas
Mobility management and integration with terrestrial networks	Mobility management including hand-over, NGN, delay-tolerant and opportunistic networking to cope with intermittent connectivity in mobile environment.

### 5.2 Regulatory and standardisation aspects

The deployment of such system requires a harmonised regulatory and legislative framework together with the availability and protection of the required spectrum resources allowing the targeted services globally.

The current plan for the ISICOM system development foresees the use of Ka Band (for Fixed and Mobile Satellite Services) and S Bands (for Mobile Satellite Services). In addition, use of portions of the Q and V frequency bands could be envisaged for the feeder links. Approach to spectrum management authorities is envisaged in order to develop spectrum policies at International, European and Member States to facilitate certainty for the SatCom operations free of harmful interference.

ISI recommends that the end to end system architecture be defined also in coherence with the work of standardisation organisations (e.g. ETSI) to meet the need of harmonisation at pan-European level enabling certification procedures and interoperability between equipments of sub-systems from several vendors. ISI also recommends to leverage on European developed Satellite Radio Interface (e.g. DVB-S2, DVB-RCS2) as well as other networking technologies developed for terrestrial networks.



### 5.3 Economical enablers

Several economical enablers are needed for successful development of the system:

- Assessment of pan-European institutional demand for SatCom services, involving end-users to best understand their needs
- Aggregation of the institutional demand to serve the European institutional users at optimised cost
- Pre-procurement and long term leasing of capacity by the European Union Institutions
- Set-up of an ambitious and coherent European R&D Work program financially supported by the European Commission, ESA and national agencies
- Preparation of a consistent overall business model for the operational phase

## 6 Development plan and way forward

For the development and operational phase, ISI proposes to consider the following possible cooperation model with separation of tasks. According to this model:

The European Commission would

- capture the European institutional needs and aggregate the institutional demand to serve the targeted European institutional user organisations;
- prime the infrastructure development and deployment until full operational status. This includes satellite procurement under EU rules;
- mobilise adequate instruments and budgets under an EU operational programme

The European Space Agency supported by National Space Agencies would

- support the technology R&D and validation phase;
- manage the operational and full deployment phases until the operational transfer to the selected operator.

The satellite service provider(s) would be responsible for

- the system design with the support of the industry;
- the ISICOM system operations and development of service portfolio;
- the sharing of the satellite resources by the different European institutional user organisations according to EC defined rules.

The European industrial consortium would be responsible for the system development and deployment.

These possible roles have to be discussed and elaborated both with EU relevant directorates on the one hand, and with ESA and national space agency in the other hand.



## 7 Appendix

### 7.1 ISICOM's positioning versus existing or planned Institutional and Commercial systems operated by European based organisations

Features	Globalstar/LEO	IridiumNext/LEO	Inmarsat-4/BGAN/GEO	AthenaFidus/GEO	Inmarsat-5/Global Xpress/GEO <sup>1</sup>	ISICOM/GEO
<b>Spectrum</b>	Monoband. Limited frequency re-use	Monoband. Limited frequency re-use	Monoband. Limited frequency re-use	Monoband. Spectrum optimization by frequency reuse	Monoband. Spectrum optimization by frequency reuse	Multiband. Spectrum optimization by frequency reuse
<b>Satellites</b>	48	66	3	1	3	3 + 1
<b>Coverage</b>	Worldwide but no full coverage	Global including polar regions	Global excluding polar regions	Regional (Europe/Africa)	Global excluding polar regions	Global excluding polar regions
<b>Max access rate (Fwd/Rtn)</b>	1 Mbps/tens of kbps	1 Mbps/tens of kbps	500 kbps/500 kbps	Tens Mbps / Several Mbps	< Tens Mbps / Hundreds of kbps	< Tens of Mbps / Several Mbps
<b>Through put</b>	Hundreds Mbps for the constellation	Hundreds Mbps for the constellation	Hundreds Mbps per satellite	Several Gbps	Several Gbps per satellite	Tens of Gbps per satellite
<b>Connectivity</b>	Star	Mesh (on board) including ISL	Star	Star	Star	Star and Mesh (on board) including ISLs
<b>Addressable terminals</b>	Hand-held terminals Vessel, aircraft mounted devices	Hand-held terminals Vessel, aircraft mounted devices	Hand-held, Transportable, Mobile as vessel, aircraft, train mounted devices	Fixed terminal (60 cm dish) Mobile terminal , UAV	Fixed terminals Transportable (20-60 cm), vessel, aircraft, train mounted devices	Hand-held, fixed terminals, vessel, aircraft, train mounted devices, Transportable (20-60 cm)
<b>Security</b>	Communication security (layer 2)	Communication security (layer 2)	Communication security (layer 2)	Communication security (layer 2), Protected TM/TC	Communication security (layer 2)	Cross layer communication security, Protected TM/TC
<b>Integration with other satellite systems</b>	No	No	Yes Inmarsat/Global Xpress	No	Yes Inmarsat/BGAN	Yes GMES, Galileo

<sup>1</sup> Source : Inmarsat press release, August 2010



## 7.2 Document history

Document history		
Version	Date	Comment
0.1	21/06/2010	Telespazio: Preparation of initial draft (v0.1) based on the ISICOM overview presented at the ISI general assembly in Toulouse on 7 <sup>th</sup> April
0.2	06/07/2010	Telespazio Re structuring of the document using the template agreed upon at the ISICOM Task Force 2 <sup>nd</sup> phase kick off conf call on 29 <sup>th</sup> April 2010 (v0.2)
0.2_1	13/07/2010	Astrium: Review of the foreword, proposal to delete some paragraphs. Motte Mc Donald: Reordering of ISICOM concept and rational chapters SES: add the need for protection of spectrum Gilat: adding Backhaul service to terrestrial network
0.2_2	13/09/2010	TAS (in the frame of EC FP7 ICT FISl project n°257118): Substantial changes on the content of chapters. Further clarification of the ISICOM objectives, concept, Identification of technology, regulatory and economical enablers. Proposed development/operation scheme.
0.2_3	16/09/2010	Astrium (in the frame of EC FP7 ICT FISl project n°257118): review of the document
0.2_4	05/10/2010	Additional inputs from ROSE and further review of the editorials
0.2_5	05/10/2010	Additional inputs from ISDEFE
0.2_6	05/10/2010	Additional inputs from CNIT-University of Florence
0.2_7	06/10/2010	Additional inputs from Gilat
0.2_8	07/10/2010	Additional inputs from CNIT-University of Reggio Calabria
0.2_9	22/10/2010	SES Input
0.2_10	08/11/2010	Review comments and harmonize : Telespazio, Astrium and TAS
0.3	10/11/2010	Telespazio: Production and circulation of v03
0.4	29/11/2010	Univ. Salzburg: editorial improvements

## 7.3 Abbreviations

BGAN	Broadband Global Area Network
ESA	European Space Agency
HAPS	High Altitude Platform Systems
HD	High Definition
ISICOM	Integrated Space Infrastructure for Global Communications
ISL	Inter Satellite Links
NGN	Next Generation Networks
SDR	Software Defined Radio
TAS	Thales Alenia Space
UAV	Unmanned Air Vehicle