The Integral Satcom Initiative

Evolution of SatCom Ground Segment

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The ISI European Technology Platform has more than 170 Member Organisations, covering 29 Countries and representing all the Stakeholders of the European Satellite Communications sector.

ISI defines and implements the Strategic Research Agenda for Satellite Communications. The ISI SRA implementation permits European Industry and Academia to develop all capabilities required to design, develop, launch and operate the Satellite Communication Systems of the Future.

ISI has elaborated innovative ideas and initiated to develop its SRA through internally funded coordinated activities: unfortunately it has not been possible so far to implement the SRA through FP 7, since no R&D satellite communications projects have been funded yet.
Satellite Communications represent a fundamental part of the Space industry and, in particular, are essential to allow for GMES and Galileo applications to be distributed in real-time to all of the European citizens.

Satellite Communications importance for the Space sector can be clearly appreciated by mentioning that 20 out of 21 satellites placed in orbit by Ariane 5 and Soyuz in the last year are Telecommunications Satellites; furthermore more than 50% of the turnover of the European Satellite Industry derives from Telecommunications Satellites.

The evolution of the technology and market scenario is moving towards interoperability of satellite communications systems with the terrestrial communications networks: without satellite communications there could be no successful development of the Global Communications Networks of the Future.
The Role of SatCom within the Communication Networks of the Future

New advanced paradigms and models, together with the need of communicating anywhere and within a plurality of very different contexts, require innovative architectural approaches, adding a further layer of network intelligence and depicting hybrid end-to-end telecommunication networks, fully exploiting the main added-value features of satellites.

Satellites are key elements of the Future Internet scenario, represent an essential part of broadband and broadcast infrastructures and provide innovative mobile services to the transport community (e.g. trains).

In addition to commercial applications, the unique coverage and flexibility advantages of satellite systems position them as key players in the frame of security and crisis management applications for institutional, government, security and defence purposes.
The European Scenario and the Global Challenges

Security threats
- European countries committed to dealing peacefully with disputes and to co-operating through common initiatives
- However, Europe still faces security threats and challenges, inside and outside its boundaries
- Continuous cooperation between European security forces is essential to maintain global peace and stability

Disaster management
- Climate changes seem to accelerate the number of natural catastrophes worldwide, resulting in high losses of lives and massive damages, also affecting the availability of vital natural resources
- It is the role and the responsibility of Europe to define and support the deployment of the most appropriate solutions guaranteeing the safety of EU citizens and internationally cooperating to disaster prevention and mitigation

Ubiquitous access to ICT infrastructures and services
- Telecommunications infrastructures have become a foundation of the modern Society
- Still, the digital gap remains a reality for several millions of European citizens located in areas underserved by terrestrial network infrastructures
Space-based communication systems help facing Global Challenges (1)

- Central enabling agents in building the Future Information Society:
  - Global Connectivity
  - Seamless continuity of service

- Space-based systems open up many capabilities complementary to ground systems:
  - Ubiquitous access to information for all of the citizens
  - Enhanced mobility
  - Interoperability capabilities
  - Cost-effective and economically competitive broadcasting and multicasting of video, voice and data
  - Improved disaster protection and security management
  - Quick set-up and infrastructure restoration capabilities of satellite-based systems in emergency situations
  - Monitoring of emerging threats and crisis management

- Based on these key added values of satellite, Europe has made research in the areas of space, security and monitoring of environment a priority for the coming years
Europe is aiming to play the role of a Global Player, in particular in vital sectors like security and emergency management: to this aim a European global communication capability should be put in place.

In support to this European role and on the basis of capabilities of Satellite Communications, the ISI European Technology Platform has recently conceived the innovative ISICOM system concept.

ISICOM (Integrated Space Infrastructure for global Communications) is intended to be the ISI proposal for an advanced European Satellite Communications System fully integrated with the Global Communications Network of the Future and able to complement Galileo and GMES by adding important value and functionalities.

The ISICOM global communication capability will provide the necessary connectivity network for real time monitoring, threat anticipation, crisis management and on-field operation worldwide, to support the implementation of related European Policies (like the ESDP).
ISICOM: main features

• **ISICOM must be regarded both as:**
  - a self-standing solution
  - and a space-based element of an integrated communication network, to which the satellite component adds innovative features and performance

• **Use of a mix of high-capacity RF and optical technologies in space**
  - To support data rates up to tens Mbps and laser communication user data rates in the Gbps range
  - To ensure global and safe end-to-end connectivity
  - Direct connectivity among LEO and GEO satellites, as well as with terminals located anywhere within the coverage either onboard aircrafts, ships, on-ground fixed or handheld

• **Use of Internet Protocol routing to enable the connection of thousands of users through networks**
ISICOM Innovation priorities

Some basic technological building blocks are already available, but a number of more advanced key technologies, permitting the full development of the entire ISICOM system, are still to be developed through an innovation and R&D path.

Technologies left to be developed are included in the areas of

- Inter-satellite optical communications,
- Advanced on-board IP routing, fast packet switching, bulk and packet encryption/decryption,
- Advanced multi-beam or steerable communication antennas,
- Radiation hardened on-board components,
- Software defined radio, dynamic bandwidth and resource allocation techniques, protected bandwidth efficient modulation.
- Complementary Ground Component
- Smooth integration with all IP global telecom infrastructure
Satellite Communications Ground Segment

- SatCom Ground Segment context next 5 – 10 years

- Required Developments
SatCom Ground Segment context next 5 – 10 years

- Available standards:
  - DVB-S, DVB-S2
  - DVB-RCS, DVB-RCSmobile
  - DVB-SH, future DVB-NGH
  - ETSI VSAT series
  - SATMODE CENELEC
  - ETSI BSM
  - ETSI SatEC
  - ETSI GMR
  - ETSI MSS (former S-UMTS) series

- Many frequency bands require site clearance (lower European implementation of new HEST and LEST ECC Decisions).
- Interference mitigation techniques required. Rely on exclusive bands will be less “acceptable”.
- Many and frequent changes to operational transponders within a single satellite system moving services to one satellite to another
ISI Vision of Network of the Future (I)

Commonly accepted trends in the evolution of today communications networks are:

- the constant increase of the required data rate
- the request for ubiquitous connectivity
- the support of higher mobility and thus the convergence of fixed, mobile and broadcast services
- the availability of multi-purpose end-user devices, offering an increasingly variety of different services and supporting an increasingly large number of different access technologies

Considering the above trends, ISI vision about the network of the future is that of a “network of networks”, where user terminals can seamlessly roam across heterogeneous domains and access technologies thanks to a set of common and standardised transport and network layer protocols.
ISI Vision of Network of the Future (II)

This vision entails four different levels of convergence and integration, namely at:

- application level (one device fits all),
- at service level (convergence of traditional fixed, mobile and broadcast services as well as service personalisation with location based and context aware functionalities),
- at transport and network level thanks to the aforementioned common and standardised set of protocols,
- at access layer thanks to the harmonic coexistence of different access technologies, with remarkably different characteristics in terms of available data rate, coverage, availability, performance, employed frequency band, etc…
Satellite Communications Ground Segment

ISI Vision of Network of the Future (III)

- **heterogeneous**, since it will include a large variety of globally interconnected access networks such as wired and wireless terrestrial, including MANET, High Altitude Platforms (HAPs) and Unmanned Aerial Vehicles (UAVs), GEO/HEO/LEO/MEO satellite networks, deep space and interplanetary networks and sensor networks;

- **ubiquitous** to meet the challenge of achieving truly global connectivity anywhere at anytime. This means also connectivity while on the move, in remote areas and in emergency and disaster scenarios;

- **pervasive and dependable**, since our society will depend on it for virtually all transactions;

- **secure and trustable**, since all transactions must be secure, and people must trust the network under all environmental conditions.
Satellite Communications Ground Segment

Required Developments (I)

- Combined satellite and ground segment technologies, techniques and system designs that improve radio transmission efficiency and spectrum utilisation to maximise the exploitation of the available spectrum. Develop the concept of “Operable SatCom frequency band” where SatCom systems can work in exclusive or on shared basis.

- Flexible allocation of operational carriers as per interference on site situation

- Push for ground segment solutions capable to be license exempted throughout Europe.

- Update licensing regulatory conditions for systems operating with few carriers but capable to change operating carriers instantaneously.

- Advocate for harmonized licensing conditions throughout Europe. Currently, there are:
  - Individual license to each earth station
  - Individual license to each satellite network
  - General license to a satellite network but requirement for registration
  - General authorization to a satellite network without any requirement for registration
  - License fees for a typical VSAT network ranging from few hundred €/year to 10.000 €/year.
Needed Developments (II)

- Better spatial discrimination to reject interference from terrestrial systems sharing the band
- Cost and performance of antennas; new antenna technologies allowing an easier installation
- Optimal use of transponder bandwidth. Better planning of transponder usage with users spread throughout enlarged coverage areas. Different satellite antenna beams feeding the same transponder chain.
- Techniques to limit the transmission power hence the cost of small terminals.
Needless to say, but here re-stated

ISI would love to closely work with ESA to jointly push for the developments of the ISICOM vision and the whole SatCom required technology solutions
Many thanks

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