Work Package 4

Consensus Building & Validation

Deliverable 5:

Report on future roadmap for satellite technology

Version 1.0

31 May 2014

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1 Context and objectives

The need for informing the public stakeholders about future satellite broadband technologies has been identified within the SABER Thematic Network.

Beyond awareness raising and guidelines for today's satellite solutions procurement and deployment, it turned out fundamental to provide reliable information to the Public Authorities about satellite technologies sustainability and evolution and to describe and assess the European satellite technology evolution roadmap enabling satellites broadband services to serve the DAE 2020 targets with a viable economical model.

The challenge is twofold

Technology: need to evolve ground, platform and payload technologies to reduce cost of bit-per-second while increasing throughput (competition outside Europe is already progressing)

Market: market environment and public frameworks must encourage operators investment

There is a need for European public support and accompanying measures on both fronts, as done outside Europe

Target calendar of on-going European R&D roadmaps aiming at allowing competitive consumers offers:

- 50 Mbps in ~2017/18 (pro offers already exist)
- 100 Mbps offer ~2020/22

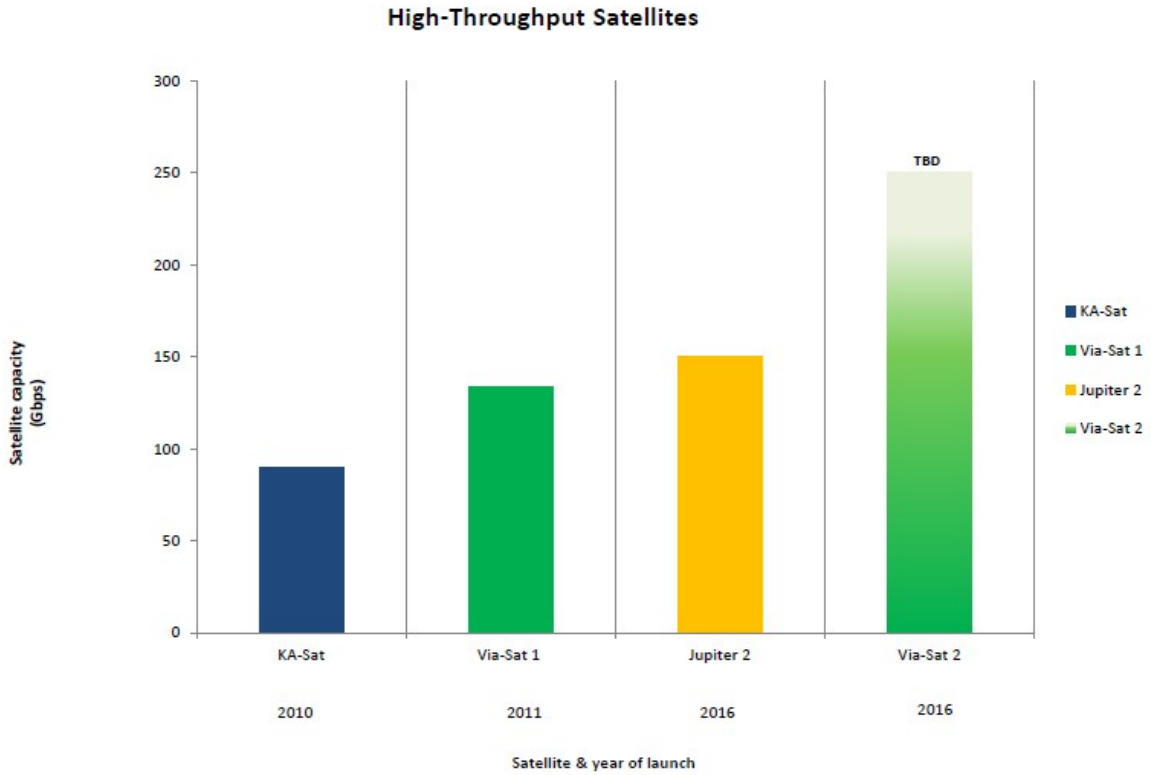
2 Where do we start

2.1 The recent (r)evolution

Drastic performance evolution in the last years thanks to multi-beams payload and frequency re-use technique: High Throughput Satellites (HTS).

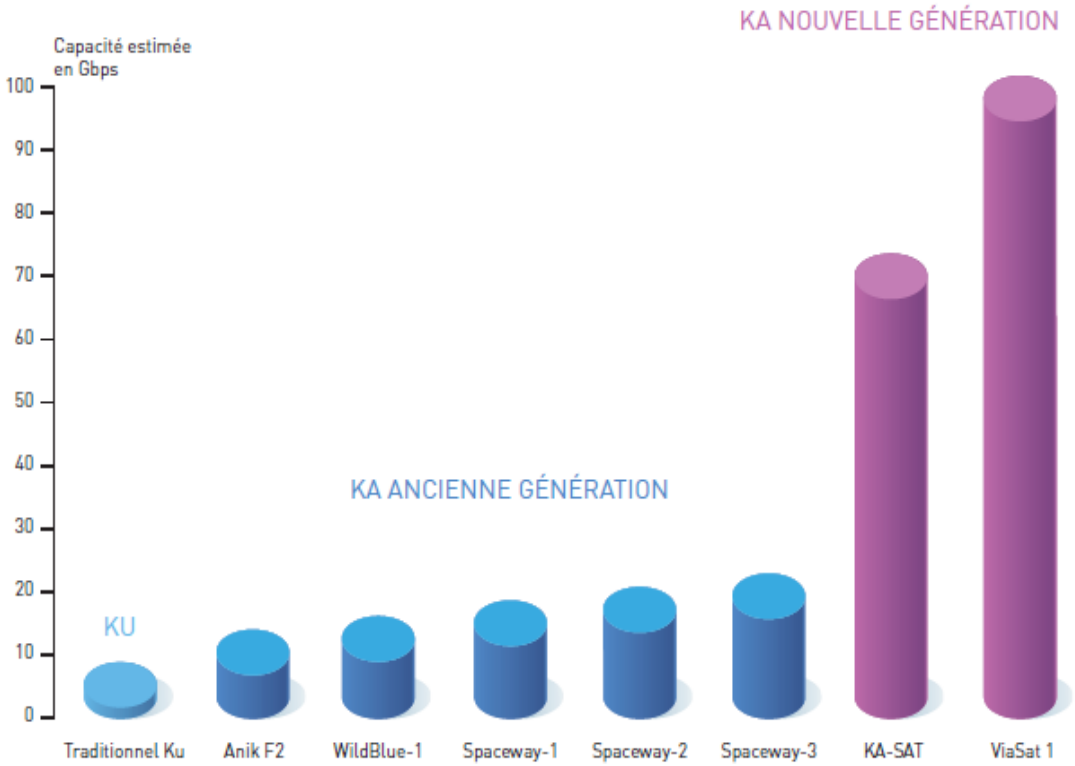
Operators decide whether to embark broadband specific payloads or to fully dedicate the satellite to broadband services (business plan).

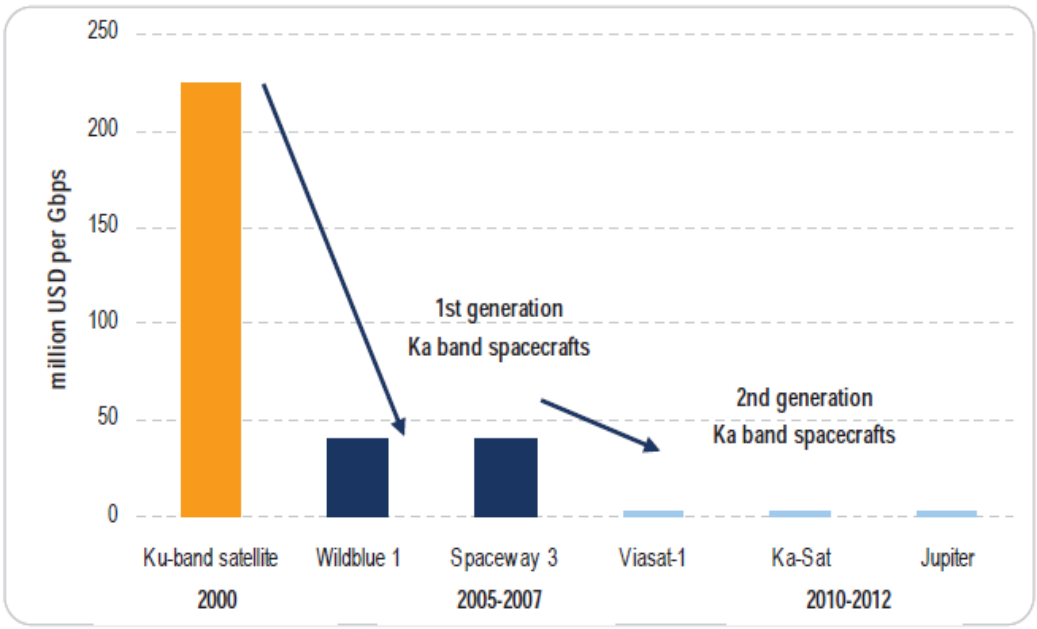
To meet the Digital Agenda 2020 objectives: necessary to investigate next generation HTS systems providing a further order of magnitude improvement (Terabit/s satellite capacity) at viable economical conditions.



Source : Idate, *Satellite : perspectives de quelques marchés clés*
M13304IN1F – Insight n°1 – Juin 2013

No communication yet on the capacity of Via-Sat 2, only this: « *ViaSat-2 is designed to double the bandwidth economics of ViaSat-1 and provide seven times the coverage area* ».

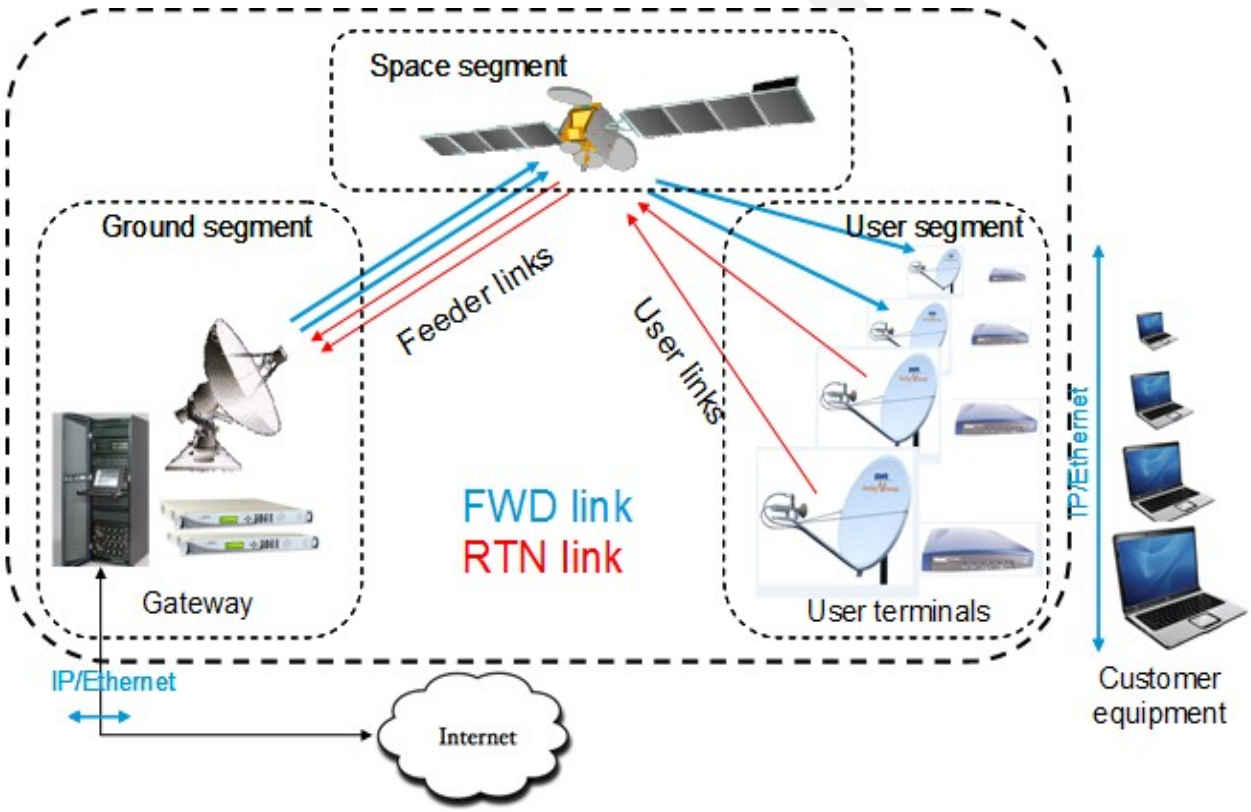


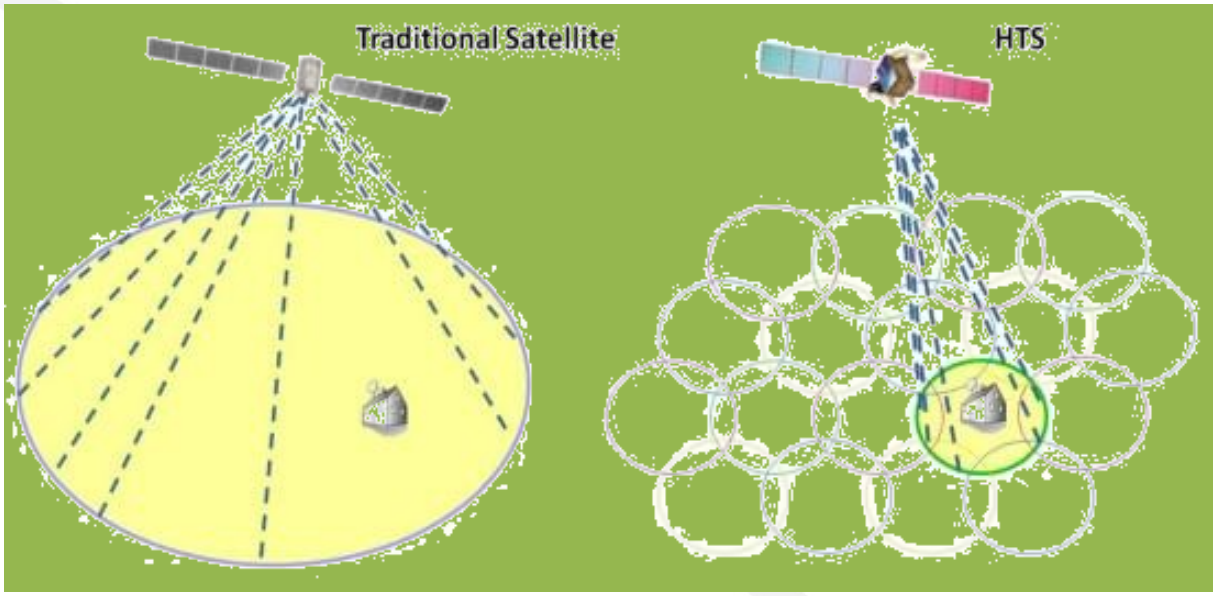


Source: IDATE

2.2 The principle of an HTS satellite

- Access to Internet backbone requires:
  - two-way connectivity terminals
  - a few gateways which are connected to the Internet backbone.
    - one gateway serves several spot beams
- Use of maximum available spectrum and increased performance:
  - Maximised frequency reuse thanks to a set of narrow spot beams
  - Increased power per beam and isolation and increased spectral efficiency





2.3 Killing a myth: satellite can already deliver 30 Mbps

Killing a myth: satellite services already do more than 20 Mbps!

- 50 Mbps subscriptions are already offered to professional users
- Current technology even allows more: so why only a 20 Mbps consumer offer today?

It all depends on the economical equation around « data rate/monthly volume »

- A spot beam has a given volume (and a certain cost for the operator) which can be shared among a certain numbers of users
- The volume sharing granularity is thus a major driver of the subscription fees
- Within the monthly volume allowance, the offered speed is adapted so as:
  - to enable the service use over a month: downloading 1 movie in 1 second is not worth if no other service is available for the rest of the month!
  - to run the service with affordable personal equipement.

A bigger spot beam capacity means:

- Highly monthly allowance for the same number of users or
- Lower monthly fee with more users and the same monthly allowance

The right balance has to be found between the monthly allowance and the data rate to allow reasonable subscription fees while permitting a sustainable economical model for the operator: the price of the Space-to-ground Mbps must be taken down to allow higher performance consumer offers.

3 Improving broadband satellite services performances while reducing the Mbps price

3.1 A combination of paths towards the DAE 2020 targets

To set the scene, it is important to recall that satellite services rely on a value chain involving many competencies and actors.

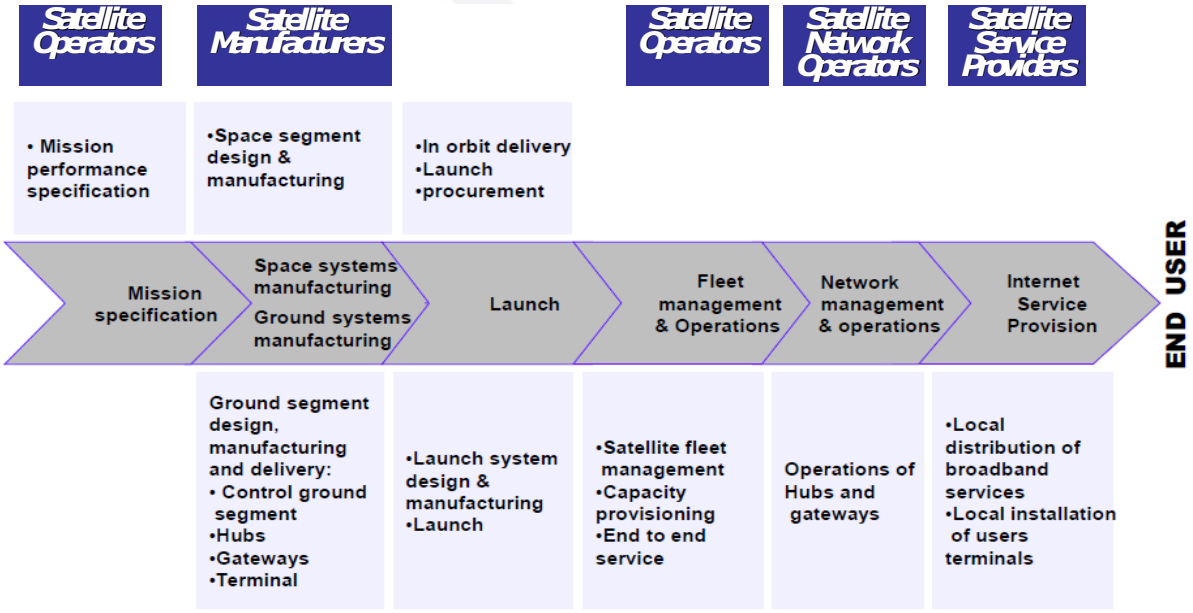


Figure 3.1/A: The satellite services value chain

Improving the performance of satellite broadband services can stem from each building block of the value chain. All the stakeholders can act independently or concurrently:

- Satellite operators are considering deploying hybrid ecosystems supporting converged broadband and broadcast services to consumers equipped with smart CPE devices across the EU. This can been done using the already flying satellites..
- Ground infrastructure manufacturer constantly enhance the performance of the gateways and the personal equipment level.
- Space infrastructure manufacturers run a continuous R&D effort to further increase the throughput delivered by the satellite while reducing the overall cost of the mission (satellite and launcher) to keep the economic model viable.

As an overarching starting requirement: need to secure spectrum!

3.2 Innovative and/or integrated operational approaches

Some examples:

- Possibly re-use of AV Convergence position paper (E.g: smart use of a mix broadcast/Broadband infrastructures to provide connected TV in an hybrid network configuration.)
- Deploying hybrid ecosystems: using Ka/Ku/C band satellites/payload for delivery of next generation converged broadband and broadcast services to consumers equipped with smart CPE devices across the EU.
- Satellite IP networks architectures
- Etc.

3.3 Improving the user segment performance (ground infrastructure)

For example, more efficient signal modulation, error corrections, filtering etc

3.4 Increasing on-board payload performance and throughput

Non exhaustive insight of the technology improvement possibilities.

Larger antennas to increase throughput per beam

Beyond 3 meters

Flexibility capabilities to optimize use of bandwidth and power

Feeder link equipment and antennas in higher wavelength

- Q/V and Optical feeder technologies
- Broadband satellite end-to-end solutions for Diversity management techniques

3.5 Acting at overall mission performance level

Reducing the overall cost of the mission (satellite and launcher):

Non exhaustive insight of the technology improvement possibilities.

- Satellite mass reduction lowering the launch cost e.g. thanks to
  - Lighter materials
  - electric propulsion
- Spacecraft volume reduction to increase services scope while remaining compliant with the launcher constraints.

4 Hts: actual technology & system design roadmap

Research work along those tracks has started some years ago using industry and public (national and ESA) funds. For what concerns the specify support provided by the EU research programme:

- FP7
- H2020 Space call perspectives: 2014 call disappointing in this field although an EU societal challenge is at stake.
- H2020 ICT

4.1 Innovative and integrated operational approaches

Some service-oriented and user-centric research has started ran through FP7 ICT lines (no technology development)

- E.g the project BATS studies the integration of next generation satellite systems with established terrestrial infrastructure to supply communications to 'unserved/underserved' regions and improve the communication availability at urban areas all across Europe.

H2020 Space would be well suited to pursue work on future satellite Broadband end-to-end solutions through studies and pilot projects on topics like:

- Satellite IP networks architectures
- etc.

Currently, user-centric satellite research is eligible to two areas of the H2020 ICT work programme: Future Internet and 5G.

4.2 Improving the user segment performance (ground infrastructure)

As for the Space component, much research is undertaken by or through the European Space Agency to support the evolution of the ground-segment.

H2020 SPACE could however be an excellent complementary tool to support low TRL focused research, for example the area of the optical feeder link (ground-station and diversity management).

4.3 Increasing on-board payload throughput

Larger antennas to increase throughput per beam

- Up to ~5 m antenna reflectors: addressed by PIA THD-SAT (France) and addressable by ESA
- Reflectors beyond 5 m: H2020 Space would be well suited

Equipments and antennas in higher wavelength

- Q/V: addressed by ESA ARTES and PIA THD-SAT (France)
- Optical feeder technologies and End to end Diversity management techniques: H2020 Space would be well suited

Flexibility capabilities to optimize use of bandwidth and power

4.4 Acting at overall mission cost level

- Lighter materials
- Electric propulsion: ESA, CNES and H2020
- Compact payload
- Miniaturisation