Work Package 2
Early Analysis & Guidelines

Deliverable 4:

Early report on Satellite Broadband as an option for Regions, including non-technological roadblocks and potential for demand aggregation

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SABER (Satellite Broadband for European Regions) is a CIP ICT PSP co-funded Thematic Network

For more info see: http://www.project-saber.eu/

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1. Executive Summary

Fast, reliable broadband internet access has political and social implications. It is essential for homes throughout the EU to benefit from online services, and for businesses to compete globally. Some areas have access to faster broadband speeds than others, with many rural areas receiving far lower speeds than cities and urban areas. Broadband penetration remains far below the EU target fixed by the Digital Agenda for 2013: basic broadband for 100% of Europeans citizens.

There are different reasons for the remaining broadband gaps, despite public aid measures that have provided grants for the deployment of fibre-based backhaul networks in un-served areas, including:

- Topography (e.g. mountainous areas)
- Low density of population
- Sparse demand

These factors, among others reasons, result in inadequate short or long-term return on investment for telecommunications operators, limiting private investment such that even public funding is unable to fill the gap.

Many regions, including those which are partners in the SABER project, have expressed the urgent need to tackle the remaining digital divide and serve the percentage of population without broadband access.

Satellite broadband is a complementary technology, ideally suited to providing instant infrastructure for broadband. Terminals can be installed in the most rugged and remote terrains within a matter of days, allowing new users to immediately take advantage of broadband services. Satellite broadband can be used to deliver broadband access to everyone in the EU with peak speeds from 2 Mb/s up to 20 Mb/s. Satellite is a viable option for the most remote users and for those in some other not-spots. While the cost of deploying fibre increases incrementally for the final percentage of premises to be connected, the cost of a satellite solution remains constant.

However satellite broadband to the general public is a new and developing service on the market, and as such there is a general lack of awareness amongst the public sector (as well as amongst final users): the section 3 on techno-economic analysis is intended to improve this awareness and demonstrate the advantages of including satellites in the mix of technology supported by public interventions to bridge the digital divide.

A state-of-art review of the retail offers of satellite-based consumer broadband internet in the countries represented in the SABER project is provided both as neutral reference and as a potential input of the preliminary market analysis for Public Authorities aiming to address broadband gaps in their territory. It is the intention of the SABER project to maintain and regularly update this table of retail offers along the lifetime of the project, as well as to identify a solution in order for this table to be maintained and regularly updated beyond the lifetime of the project.

Satellite using the Ka band can offer high data rate services to large numbers of customers at an acceptable price level. Today's satellite solutions fall behind fibre and wireless technologies in terms of latency, mass throughput, and cost per bit delivered, but they are advanced in terms of reliability, speed of deployment, and security.

So far, most European governments have been extensively investing in fibre optic broadband, even where in some cases satellite broadband might better serve broadband not-spots. Few European countries have considered effective implementation measures based on satellite broadband in their national broadband plans.

Current State aid guidelines tend to favour wired solutions, which partly explains why governments have focused on fibre, even though this is sometimes a more expensive or less effective option.

Section 5 of this deliverable analyses a number of issues that have prevented satellite broadband being considered in past public interventions and even ruled out from some public tenders (sometimes because of the different architecture of terrestrial and satellite networks, despite both

being able to deliver the same service), and proposes suitable solutions.

The political push of EC bodies towards terrestrial solutions to bridge the digital divide, coupled with the lack of awareness, has generated a situation in which policy makers have so far been reluctant to provide support to satellite in their broadband deployment plans, despite the large investments in new, high-capacity systems by the satellite operators.

More recently, however, it has become clear that some European regions prefer to implement alternative and quick solutions for basic broadband to close the present digital divide before considering future superfast broadband links, which may be costly and take a long time to deploy, leaving many people without broadband access to the internet for several years.

Among these European regions are the early stream regions of the SABER project, which have reached an advanced stage in addressing their broadband gaps and not-spots to achieve 100% basic broadband coverage and are ready to integrate satellite solutions into their broadband plans.

These authorities need to find how to deploy satellite broadband in the most efficient and effective way possible. Section 4 of this deliverable is devoted to a preliminary analysis of potential cases for demand aggregation.

2. General Introduction To The Deliverable

This deliverable presents intelligence gathered on satellite broadband in general, and as an option for regions to achieve the objective of 100% broadband coverage in particular. This document makes available to regions in need and other stakeholders across Europe:

- An initial techno-economic analysis highlighting the risks of relying on terrestrial technologies only to meet the DAE targets of achieving 100% broadband coverage, and the benefits afforded by satellite broadband in this context.
- A synthesis of the technical characteristics of satellite broadband service provision.
- A review of current satellite broadband service offers, in terms of service models, quality of service (QoS) and tariffs.
- A review of non-technological roadblocks at European level towards satellite broadband deployment and recommended solutions.
- A preliminary review of the potential impact of demand aggregation schemes in Europe.

3. Initial Review Of Techno-Economic Analysis Highlighting The Benefits Afforded By Satellite Broadband To Meet The Dae Targets Of Achieving 100% Broadband Coverage

3.1 Introduction

It is not the role of the SABER project to recall the importance of broadband deployment to promote social inclusion and competitiveness in the EU.

It is nevertheless clear that having access to a fast and reliable internet service is essential in a modern society as social and economic development relies on communication means (see Figure **1** Correlation between penetration of fixed broadband and competitiveness). "The widespread use of broadband – high speed, always on internet access - is vital to achieving productivity gains in the European economy and maximising the gains to society from eHealth, eGovernment and more."[1]

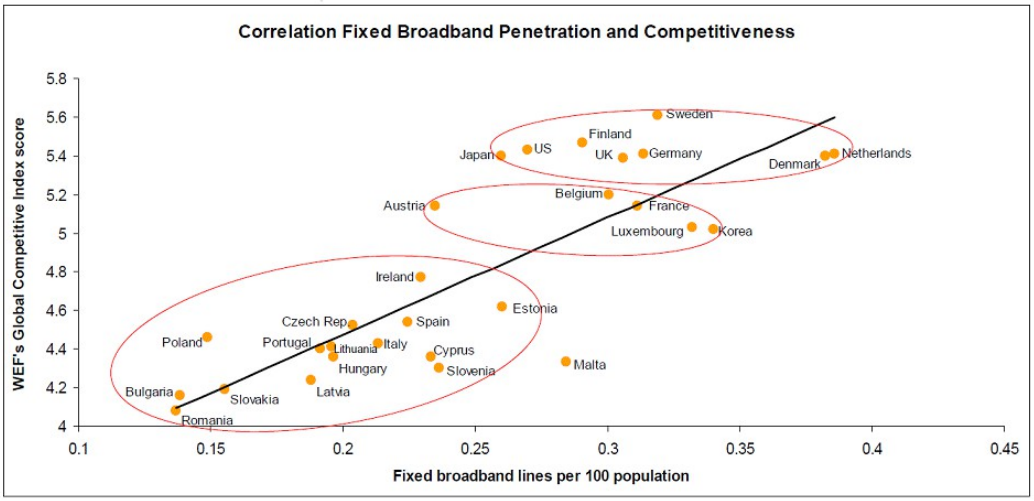


Figure 1: Correlation between penetration of fixed broadband and competitiveness

[1] Digital Agenda for Europe Scoreboard 2012, European Commission, DG CONNECT, page 46

It is however known that broadband penetration is far below the EU target fixed by the Digital Agenda for 2013: basic broadband for 100% of the Europeans citizens,

Satellite communications remain a natural complementary solution to terrestrial solutions to quickly bridge the digital divide in the EU and achieve the 2013 Digital Agenda objective.

The last evolutions in satellite technology (high-throughput satellites, HTS) which have led to the new satellite broadband offering have contributed to consolidate the specific role satellites have in providing fairly fast broadband in areas (such as rural and remote areas) that will never be economical to deliver through fixed lines, and also in offering a very strong interim solution to other areas where faster fixed broadband will take longer to rollout.

With satellite technology it is now possible to provide more than the average DSL speed anywhere in Europe.

This section is intended to present the state-of-the-art satellite internet connectivity from a technical and economic point of view. The aim is to aid understanding of the maturity of satellite technology to complement or even replace terrestrial links where user experience, profitability, sustainability and affordability indicate so.

3.2 Broadband Status In EU

The Europe 2020 Strategy, in underlying the importance of accessibility and affordability of broadband for all, has restated the objectives:

- The entire EU to be covered by broadband by 2013.
- All Europeans to have access to much higher internet speeds of above 30Mbps by 2020
- 50% or more of European households will be subscribing to internet connections above 100 Mbps by 2020.

In this respect, “a balance” needs to be found in public policy “between the provision of very high speed infrastructure in urban areas and the need to avoid a new digital divide in rural areas”[2]

3.2.1. Penetration

According to the Digital Agenda for Europe Scoreboard, ahead of the performance target of the entire EU to be covered by broadband by 2013, the actual coverage of fixed broadband networks

[2] Source: Draft EU Guidelines for the application of state aid rules in relation to the rapid deployment of broadband networks, 2012

in 2011 was around 95 % of the European population: 5% i.e. 9.4 million of citizens remains uncovered in spite of many State aid measures to support fibre-based backhaul network for unconnected citizens.

Lack of coverage is by far more important in rural areas; 70% (6.6 million households) of the unconnected households are in rural areas. This situation is even worse in the new EU countries.

As the still unconnected persons are the hardest to reach, it is unlikely that the target of full broadband coverage of the EU by 2013 is achieved, unless particularly cost- and time-effective, alternative measures are taken.

Also, looking at the latest data published in the EU's Digital Agenda Scoreboard for 2012 (see Figure 2), it can be observed that at the end of 2011, only 48.4% of all fixed lines in the EU27 is able to provide speeds in excess of 10 Mbps. In that respect it can be observed that in many EU countries speeds between 144 kbps and 2 Mbps are still observed Yet a more detailed analysis reveals that even countries such as Germany and France show a significant delay in upgrading their telecommunication infrastructure with 11% and 18%, respectively, of the entire fixed lines still providing speeds below 2 Mbps.

[3]

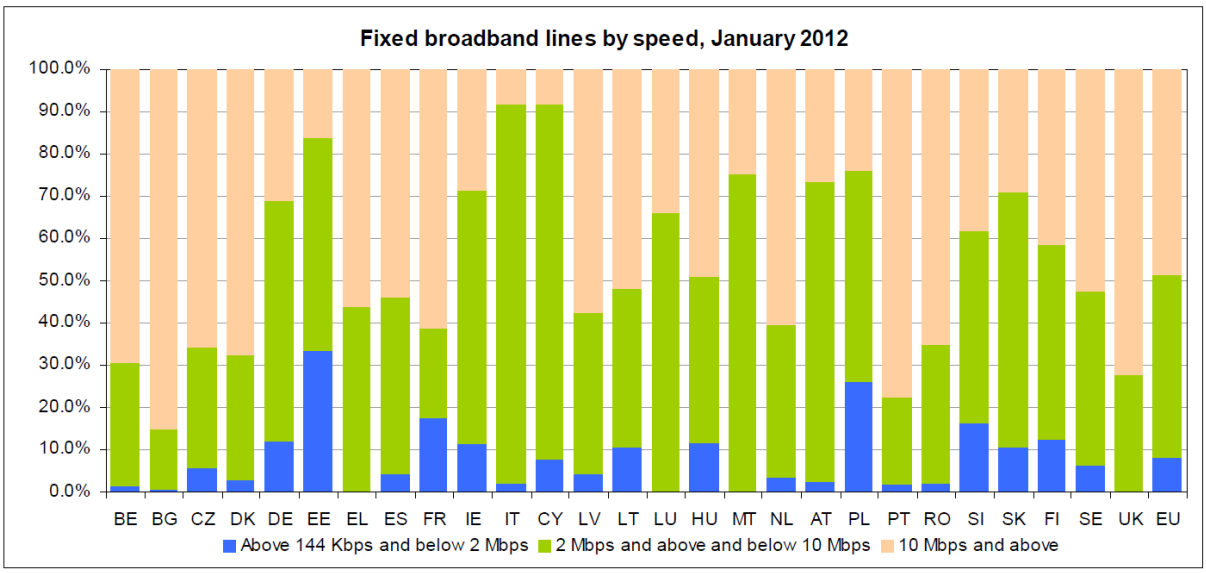


Figure 2: Fixed broadband lines in the EU Member States by speed

[3] Source: Digital Scoreboard 2012, Broadband take-up in Europe

3.3 Relying On Broadband Terrestrial Solution Only?

The EU traditionally promotes a policy which assumes that only fibre connections can deliver the type of connectivity (in terms of speed, symmetry, etc.) which meets domestic user demands, and that mobile or other wireless solutions including satellite will fill in the void where fibre is not available.

The incremental cost of terrestrial infrastructures is driven by civil engineering costs, (which can be as high as 80%), pushing any return on terrestrial infrastructures (fibre based) investments to a horizon of over 25 years even under an optimistic evaluation.

[4]

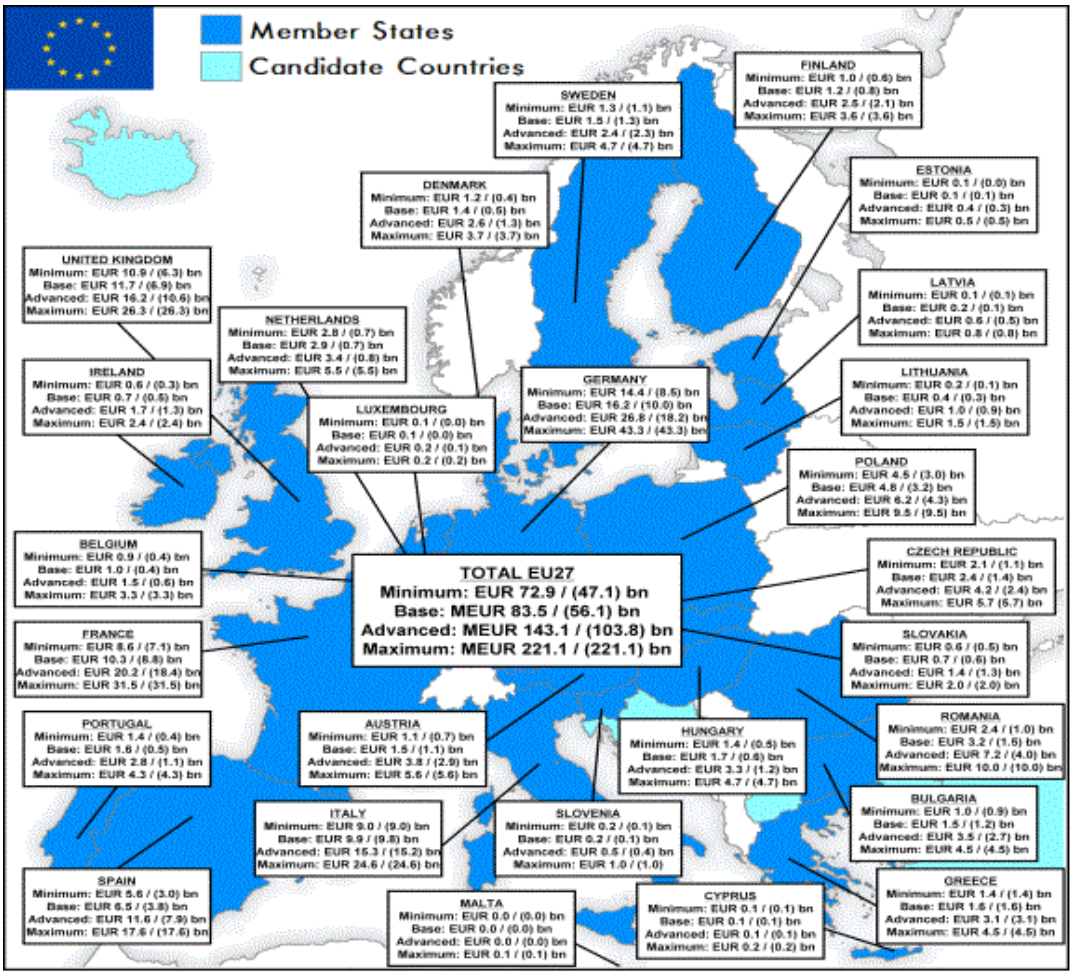


Figure 3: Cost per country to reach EU Digital Agenda targets

[4] "An assessment on the total investment requirement to reach the Digital Agenda broadband targets" P.Koutroumpis, EIB, 2011

The cost of rolling-out fibre increases when the population density decreases. More in general, the average price per connection varies enormously from country to country, from region to region, from area to area as a function of geo-morphological conditions, population density, etc. (see Figure 4)

Location	Funding (EUR million)	Number of households	Cost per household (EUR)
South Yorkshire Digital Region	105	546 000	183
East Peak (UK)	0.50	1502	346
Krško (Slovenia)	6.03	2811	2144
Mozirje (Slovenia)	6.03	2000	3015
Nuenen (the Netherlands)	6.2	7500	1300
Asturias (Spain)	47	51 000	921

Figure 4: Projects in the EU; cost per households

A contribution of the SABER partner RD horizon indicates that, following two Open Calls for a total value 84 M€ in Slovenia, 17 projects were selected to serve 44 municipalities to enable almost 30,000 connections, out of which 9.500 were realised by 31 December 2012.

The average price per connection (enabled) is 2863 €. This amount, paid on public funds, is particularly high, as it is the case in other EU regions.

In order to guarantee 100% coverage in Europe with terrestrial solutions only, namely through the rollout of backhaul broadband infrastructure in optical fibre to all local exchanges, a high level of capital investment would be necessary.

The fact that broadband penetration is far below the EU targets is mainly due the economic sustainability of existing terrestrial technologies by population density at target Average Return Per User (ARPU).

The business case for these investments is still uncertain, posing the threat that, in spite of

[5] Analysys-Mason "The socio-economic impact of bandwidth" EC DG INFSO workshop, 21/02/2012

considerable efforts from the Institutions, the un-served or under-served markets remain significant.

In fact, governments have been often investing public funds for fibre optic backhaul broadband infrastructure in rural areas – also due to the European legal guidelines which tended to favour 'wired' networks – but this remains a very expensive option especially for the last few despite the fact that ERDF and EAFRD 2007-2013 for broadband infrastructure are still available in some EU countries / regions.

In addition, the approach to support the offer of ADSL through the rollout of backhaul broadband infrastructure has also reached in many cases its technical limits due to the speed limitation imposed by the existing access component (copper pairs too long and twisty, network concentrators between the local exchange and the user premises, etc.).

A more balanced and pragmatic approach, which would be much more realistic and cost effective includes the use of other technologies (such as existing satellites) in an infrastructure mix to economically deliver the necessary bandwidth to those users who are not currently within easy reach of wired terrestrial solutions. This results in a more prudent management of supply and demand for broadband and drives service availability immediately and everywhere, a factor which is more critical than the applied technology.

Considering LTE, it may provide fixed broadband infrastructures in rural areas and very high per user speeds can be achieved when each base station is backhauled by a fibre network.

Some numbers can help shed light on the relative strengths and weaknesses of this solution. The total download bandwidth is 60 MHz in Europe. The LTE cell size can be vary, from tens of kilometres down to few hundreds of metres. That means that capacity can be concentrated to specific city neighbourhoods or villages, or small regions with LTE. This flexibility represents a great advantage whenever population is concentrated in specific and differentiated areas. On the other hand, connecting the very last isolated households scattered over an entire region may be very tricky using LTE because signal attenuation increases with the square of the cell radius, and because precious dedicated bandwidth needs to be reserved for these “isolated households”.

Moreover, in view of the limited total download bandwidth and of volume limitations of contracts, the delivery of linear TV and other streaming of high definition video through LTE is unlikely[6], and knowing that all forms of video will continue to be approximately 90 percent of global

[6] “No TV via LTE in Germany?” Broadband TV News – 12 February 2013

consumer traffic by 2015[7] this represents a non negligible limitation to the widespread use of LTE as fixed broadband access in rural areas.

Finally, one should not forget that LTE is first and foremost an outstanding and effective technique for mobile broadband communications, with high ROI for telecom operators especially in densely populated areas. Using it in an extensive manner as a replacement to fixed communication in rural areas is somehow a technical and economic challenge.

In view of the above considerations, it is obvious that satellites have a specific role in providing fairly fast broadband in areas that it will never be economic to deliver through fixed lines and also offer a very strong interim solution to other areas where faster fixed broadband will take longer to rollout.

In fact, considering the high investment needed to deploy and upgrading terrestrial infrastructures, satellite broadband remain a natural complementary solution, namely a quick and attractive solution for rural areas.

In particular, currently available satellite broadband services offer speeds by far larger than the ones of the so-called "light" ADSL services, limited by their distance from / to the exchange.

3.4 Satellite Broadband In Europe: Technical Features

This section will give an overview of satellite broadband technology evolution in time as well as a perspective of the value chain of the technology. We will then, based on the experiences gathered by the industrial partners and the regions of SABER address in a neutral fashion, the strengths and the weaknesses of the technology.

3.4.1. Satellite Broadband Product And Service Evolution In Time

In Europe Internet access service based on satellites exists for more than 10 years. At the early stages it consisted of a unidirectional link in which the forward path was assured by a satellite connection and the return path by a terrestrial dial-up connection (analogue with a standard 56K modem). The cost of the service was however high (about 2-3 times higher than a standard

[7] http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html

terrestrial connection) and the performance somehow limited.

With the introduction in 2001 of the bidirectional satellite service, this technology became fully independent from terrestrial links including the upload path. However at that time satellites had a total band capacity of few Gbit/s which made a mass adoption difficult because of the consequently high subscription fees, and, in parallel, terminals equipment still costly in spite of the type approval (e.g. subscription at 300-600 €/m for 2 Mbit/s, with a terminal cost of a few thousands of euro). Therefore acquisition, installation and operational costs were prohibitive for the consumer market.

3.4.2. Satellite Broadband Today

Today, with specific service offerings for the residential market in multiple frequency bands (mainly Ka and Ku-bands) and more efficient modulation schemes such as Adaptive Coding and Modulation (ACM)., satellite operators such as Eutelsat and SES serve a larger population of subscribers. They have larger geographical scope and reach a higher number of subscribers and supply connectivity in all covered areas with performance similar or even higher to terrestrial ADSL at a comparable price.

In the last three years the two-way satellite broadband access service has largely improved its capability data rates. In 2010 the high-end SLA allowed downloading speeds up to 5 Mbps and uploading speed up to 1 Mbps. While from 2012, with the introduction of services in Ka band, the performances have jumped up to 20 Mbps in download and up to 6 Mbps in upload, which translates into a better end-user experience.

There are a number of reasons for the move toward the use of Ka band in satellite broadband in Europe – indeed consumer broadband is at present the main target market for Ka-band satellites.

First of all, the Ku band, the most widely used band over Europe, is in high demand for professional services namely TV broadcasting and became almost saturated. As a result, further expansion is limited. On the contrary, the capacity available in Ka band is larger than in other bands and it is largely unused today.

Figure 5 shows the main characteristics of the frequency bands more frequently used for

geostationary satellite communications.

Looking at the typical coverage of satellites working in each band, it is understandable that the large coverage in C band is particularly suited for establishing intercontinental communications while the regional coverage in Ku band is particularly suited for TV distribution (note also that lower frequencies are less subject to atmospheric fade, which impacts service availability).
The size of a Ka-band spot of a satellite beam, of the order of 250-500 km, allows for multiple spot-beam coverage with frequency reuse among non-adjacent spots.

The combined effects of a larger spectrum allowance and of the frequency reuse is that Ka-band satellites offer more capacity at lower cost: powerful Ka-band multi-spot satellites provide throughput few tenths times higher than traditional satellites. The higher capacity per satellite translates in a lower cost per bit to the final user.

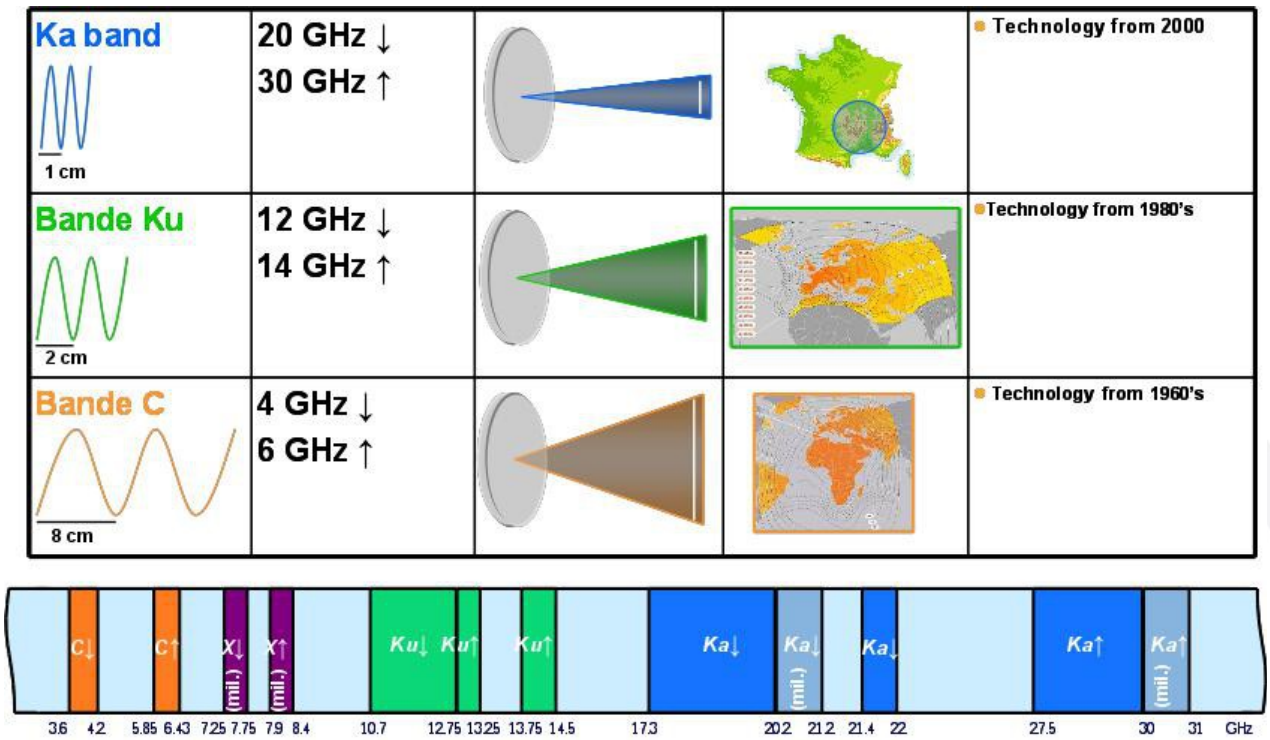


Image 5: Frequency bands used for geostationary satellite communications

3.4.3. How Does Satellite Internet Work?

Satellite Internet is based on the ability to transmit and receive data from a relatively small satellite dish on Earth and communicate with an orbiting geostationary[8] satellite 35786 kilometres above Earth's equator.

Due to the large coverage of satellites, satellite-based internet network can provide fast and reliable internet access almost anywhere.

As showed in Figure 6, a satellite link operates in a very simple way despite its high level of technology included in the development, in the deployment and in the maintenance of the component in space. The main components of a satellite system comprises of the following (see figure):

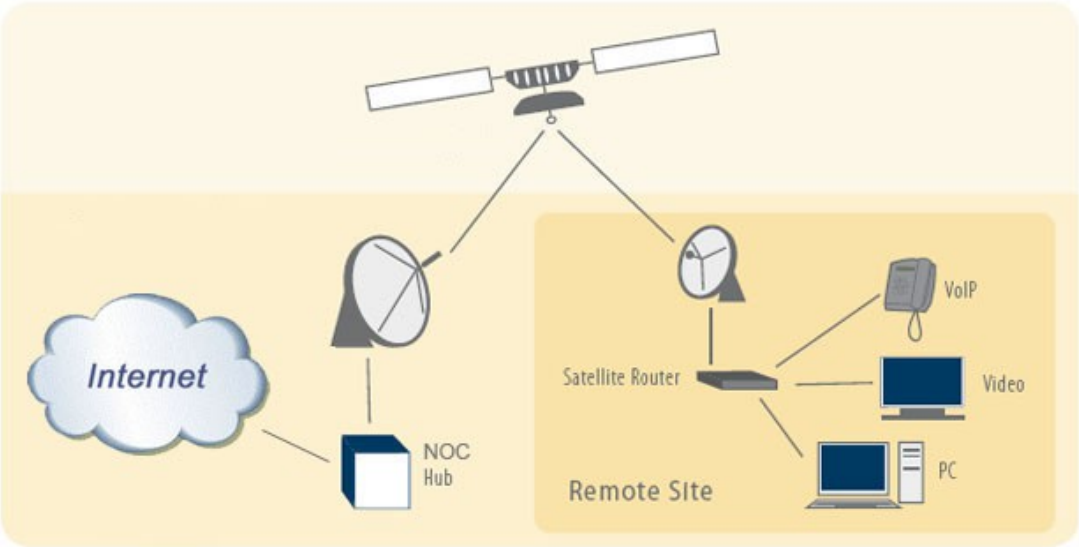


Figure 6: Typical satellite connection diagram

[8] Geostationary means a location in space where you can place a satellite in orbit so that from the ground, the satellite appears stationary. What is happening is that the satellite is actually orbiting the Earth at the same speed the Earth is rotating. The satellite makes a complete orbit around the Earth in 24 hours, or exactly one day. Geostationary satellites are only located at 35786 kilometres directly above the Earth's equator and nowhere else. They are used for a variety of purposes like TV broadcasting and telecommunications.

1. The Satellite itself
2. The ground-based stations
    a. At the end-users' premises (see Figure 7):

    The indoor modem: a satellite modem manages data transfers using a communications satellite as a relay. It is connected to the external dish by a coaxial cable carrying the data traffic and powering the external transmission/reception block.

    The outdoor unit: mounted on a rooftop pole either directly to an external wall, it is comprised of a parabolic dish (typically ranging from 70 to 120 cm in diameter, depending on application and location) with the two-way transmission/reception block mounted in the focus. The transmitted power is irradiated only towards the satellite and it is limited (1-3 watts), on the basis of the maximum allowable Effective Isotropic Radiated Power (EIRP) of a satellite terminal in order to remain within the type-approval regime (see below), and.

    In fact the installation of user ground-based stations, also referred as Consumer Premises Equipment (CPE) is exempted from individual licensing, as it fulfils the size and power requirements of the applicable Decision of the European Conference of Postal and Telecommunications Administrations (ECC Decision 06/03) which comprises the policy makers and regulators from 48 countries across Europe.

    The typical cost of the CPE is of the order of a few hundred euros.

Figure 7: Example of end-user ground equipment

b. The Network Operator's Teleport

The teleport is the central earth station that controls communications across the space link; its Network Operations Center (NOC) manages the connections to/from remote satellite equipment at end-users' premises interconnecting them to the Internet. The NOC monitors and appropriately adjust power levels and satellite signal performances, manages the network configurations and ensures prompt proactive and reactive central troubleshooting where needed.

The teleport is connected to the Internet Backbone with high-speed links.

Figure 8: Example of antennas in a teleport

2. Five steps to understand the process:
    - End-user computer is connected to the network, which in turn is connected to the Internet. End user computer sends a request for a transfer of data (for instance by opening a web browser and typing a web address).
    - The request is sent from the end user PC, through the home network if present, to the indoor satellite modem which modulates the signal and passes it to the satellite dish. The transmission/reception block of the dish converts this signal to an RF signal and sends it at the speed of light to the satellite located in the geostationary orbit.
    - The satellite in the geo-stationary orbit receives this signal and sends it to the teleport. This illustrates the fact that although the packets of information travel tremendous distances via the space segment, the packets hop fewer networks (compared with other

technologies) due to the large reduction in the number of inter-domain and intra-domain routers, giving an opportunity to minimise latency.

- The request then goes to the NOC, which retrieves the requested website from the web server, across the backbone.
- The whole cycle is then reversed and the requested data is available to the user.

Note that the traffic going from the end-user terminal to the backbone is defined as data upload, and the traffic going to the end-user terminal from the Internet backbone is defined as data download

In a nutshell, the satellite operator, with its satellite fleet and its ground infrastructures (teleports) enables broadband internet for all end users connected to the services with simple equipment composed by an antenna and a satellite modem. It is also possible to add digital television and telephone line so as to benefit of a Triple-Play service.

Satellites can also be integrated with terrestrial wired and wireless access technologies.

In this case, the satellite link acts as backhaul for a local DSLAM, CMTS or a Wi-Fi access point, and the two-way satellite broadband serves a community, such as an entire village, by means of a single satellite dish.

The final objective is enabling access to internet for all end users connected to the aggregation point regardless of the last mile technology. In this case, users don't have to install an individual satellite antenna.

3.4.4. Strengths And Weaknesses Of Broadband Satellite Solutions

Satellite broadband services have some inherent strength due to the position of geostationary satellites:

- Ubiquity: universal service regardless of geographic location. Satellite communications offer a predictable and stable quality of service everywhere, independent of the distance from the ground infrastructure to the end-user premises[9].
- Cost-effectiveness: the deployment cost is independent of terrain characteristics, population sparsity or right-of-way regulation, etc., hence cost per user is fixed everywhere. It is commonly accepted that satellite technology is the most cost-efficient solution for broadband in areas with a population density of typically <150 inhabitants/km^2.
- Quick and immediate coverage: deployment of satellite broadband services is simple and quick; the only requirement is to install the user terminal equipment – no need for additional networks infrastructure (the satellites and the teleports are already in operation).
- Independence and resilience to earth/ground events (for instance natural or man-made disaster or social and political events).
- Reliability and security: the satellite suffers from very limited downtimes and service disruptions during its lifespan (typically 15 years for GEO satellites).

Conversely, the satellite-based broadband services have some inherent challenges mainly linked to the physics of satellite communications:

- Latency: Due to the distance of the geostationary orbit to Earth, the propagation delay of a signal sent from Earth to a satellite and vice versa is of 119.35 milliseconds, and the so-called round-trip delay (teleport->satellite->user terminal and vice versa of almost 240 milliseconds.

[9] Also, satellite communications need power at the end user, hence power failure at the end user will affect communications (but this is the case for terrestrial NGA technologies, such as fibre, xDSL, Coax cable; only twisted pair telephony is designed to withstand power failures at the end user) unless back-up power sources are used.

- Apart from a potential impact on interactive voice and video services, which is however less and less noticeable thanks to the improvement in the quality of the signal itself, the more relevant effect is on data, namely on the ping time[10] which could be of the order of 800 ms. This has a regrettable impact on some data services using the Transmission Control Protocol (TCP), as the TCP/IP exhibits poor efficiency over paths that have a large bandwidth x round-trip delay product (due to the mechanism of the window for flow control). While services such as huge file transfers are not sensitive to large propagation delay, calling web pages may sometimes be slow (due to TCP which generates a waste of bandwidth when a link is empty and the transmitter is temporarily stalled while awaiting an acknowledgement). In a nutshell, in some cases TCP/IP prevents to fully benefit from the fast download and upload speeds made available by a broadband satellite connection, giving the false impression of a slow connection.
- With the aim to diminish its impact the satellite industry has introduced and continues further developing mechanisms such as pre-fetching content and TCP/IP acceleration.
- Fading Space telecommunication may suffer severe signal weakening due from rain and gas when crossing the atmosphere. However modern technologies such as ACM (Adaptive Coding and Modulation) regularly applied to satellite broadband have mitigated and overcome this effect.
- Bandwidth sharing limitation: spot size (250-500 km diameter) is determined by the carrier wavelength alone and cannot be reduced to increase the bandwidth per user like in terrestrial wireless. On the basis of the overall bandwidth available on a satellite, a trade-off is found in satellite broadband internet between capacity per user, coverage and subscription price.
- Volume limitation: sometime called the Fair Access Policy (FAP) or Fair Usage Policy (FUP), it means that your ISP will put limits on how much you can download over periods of time – which could be a few hours and / or a week. If you exceed that, they will temporarily slow your speed down.

[10] The time it takes the router to get a call back from an internet server.

It has to be noted that all the broadband technologies are implicitly or explicitly confronted by volume limitations. Mobile data subscriptions are generally limited to 1-5 GB and require charging for additional usage. This is not the case with satellite: once the cap is reached, speed decreases but the connection is still on. Volume limitation also terrestrial technology concerns more and more, where unlimited internet is progressively being removed from commercial offers [11].

Another potential limitation is due to the CPE cost: In satellite broadband, the major investment (the satellites and the related terrestrial segment) have been entirely borne on private funds. The only missing component to supply the user access to internet is the user terminal (antenna + modem). The total costs of the end-user equipment, including installation and activation fees, which is of the order of 500 euro TVA included, might be an obstacle for a large development of satellite-based Internet especially in areas with low purchasing power.
In this respect, the uptake in Australia or in the U.S. where satellite connectivity is highly popular has partially relied on subsidy schemes[12] from local governments for consumer broadband satellite terminals.

These subsidies establish a level playing field among different broadband solutions: in terrestrial technologies, the user access to broadband internet is enabled throughout the support of the deployment of backhaul infrastructure, in satellite technologies throughout the support to the ground equipment.

This subject is developed in Deliverable 2.3 “Regional / national satellite broadband implementation case studies” and Deliverable 2.4 “Early Guidelines on Satellite Services Procurement”.

[11] “Deutsche Telekom said that soaring data traffic, which is expected to quadruple by 2016, would force it to impose limits that had been applied only to mobile users. Under a new pricing plan, Deutsche Telekom would slow landline Internet customers to a rate of 384 kilobits a second, once the download limit is reached, which for many consumers would be at 75 gigabytes of downloads per month” Limiting Data Use in Germany, May 12th 2013, New York Times

[12] In Australia the NBN Co. (National Broadband Network) and in USA thought the Department of Agriculture’s Rural Utilities Service (RUS). This will be further developed during the Work Package 3 of the SABER project (end 2013).

More in general, informing and educating the customers beforehand about expected performance of the satellite service (especially about the potential differences with the one of fibre-like services) is important to make them understand how a satellite service will be able to fulfil their connectivity need. Obviously real time applications on which the delay requirements are very stringent, like on-line gaming, it is not always feasible to use a satellite connection considering the long round-trip delay. For all other applications with non stringent delay requirements the satellite service can cover very well all the specifications of a very good quality service.

In a nutshell, the permanent technology development has helped to mitigate and overcome the challenges related to satellite communication and to improve the user experience of satellite broadband. Recent independent tests reported hereafter confirm the positive experience in terms of quality of service perceived by the end-users.

Official Tested Performances, U.K., March 2013

Review of a satellite broadband system in the U.K., March 2013[13]

a) *Is satellite broadband any good?*

The argument for satellite broadband is a compelling one: any building can have fast broadband, so long as you can position a satellite dish so that it can see the sky. And the {system-1} *package takes price out of the equation: you can get up to 20 Mbit/s broadband for just £29 a month. Bearing in mind that you don't need a phone line for satellite broadband, that total cost compares well with traditional or fibre broadband.*
So with satellite anyone can get broadband. But is satellite broadband any good? We took up a subscription with 20Mbit/s downloads, 6Mpbs uploads and a 10GBytes a month data limit for £29 a month from {satellite ISP-1} *via* {system-1} *to find out.*

[13] [PC Advisor, 19-03-2013 http://www.pcadvisor.co.uk/reviews/broadband/3435765/tooway-satellite-broadband-review-is-satellite-broadband-any-good/?olo=rss&tab=verdictTab#top

b) Setup

The first thing you need to know: you need a satellite dish. The dish is bigger than the dish usually provided as part of a Sky TV subscription.
Installation takes a couple of hours, and the installer needs to pass a thick black cable from the dish and into the house. […]
You need both satellite modem and broadband router - we were given a router for free, but customers usually have to pay for one or use an existing broadband router.
Setup is part of the package, and couldn't be simpler. Once everything is up and running you need only to connect to the satellite broadband router in exactly the same way as you would any connection.

c) Speed tests

We tested our connection using an independent Speedtest.net.
For comparison we tested our existing Sky Broadband ADSL broadband. Both connections are nominally 'up to 20Mbit/s', but our ADSL line has always been slow - our house is a long way from the exchange.
We tested both connections using the same fast Lenovo Ultrabook, an iPhone 5 and a Nexus 7.
In all cases we carried out tests next to the router being tested, and ran each test several times.
Our Sky Broadband is slow. The house is a long way from the exchange. Speedtest.net measured average download speeds of 3.51Mbit/s, and upload speeds of 0.67Mbit/s. The ping was measured at an average of 38ms - this is important, as we will see.
{system-1} *smashed Sky in all but the ping test. Average download speeds were a square 8Mbit/s, uploads 3.08Mbit/s. But the ping time - the time it takes the router to get a call back from the internet server - was 797ms.*

d) *Real-world tests*

What this means in practice is that downloading and uploading files is unrecognisably better when using the satellite connection. Pulling down a file for work is so much faster.
But web surfing feels about the same - that slow ping response time means a certain lag when calling web pages that negates some of the benefits of the much faster down - and upload speeds.
So if mobile media streaming or online gaming is your thing, satellite broadband may not be for you.

e) *Is it good value?*

Those caveats notwithstanding, we think {system-1} is good value. Most ADSL broadband packages require you to pay BT for a phone line, remember, and the data allowance is generous if you use multiple devices in your home. It's not a cheap option, but it is reasonably priced when compared to other options.

f) *Who is it* for*?*

Our experience is that satellite broadband is not as good as a fast fibre or ADSL connection, in most circumstances. Increasingly we are using the web for media streaming, online gaming, video calling and so on. Satellite is not as good as fixed line broadband for these purposes. But that misses the point. If you need internet connectivity and can't get ADSL or fibre broadband, you should look at satellite. If you can see the sky, you can get online. And it won't break the bank.
It's not cheap, but is reasonably priced. And setup is simple. Most importantly performance is okay. If you can't get online by any other means satellite is a viable option.

Official Tested Performances, Germany, November 2009

Comparison between satellite broadband systems and mobile Internet in Germany, November 2009[14]

Stiftung Warentest made substantial comparative tests between satellite broadband systems (in Ku band at that time) and mobile Internet which significantly helped shifting the Figure of satellite broadband.

Satellite and mobile Internet access have been tested with the following scoring methods: excellent (0.5-1.5), good (1.6-2.5), satisfactory (2.6-3.5), sufficient (3.6-4.5), deficient (4.6-5.5).

The results by category for satellite internet were the following:[15]

- Internet connectivity: very good (1.4)
- Handling: good (2.3)
- Installation: good (2.3)
- Versatility: good (2.5)
- Deficiencies in the general terms and conditions: marginal

In this particular test, Stiftung Warentest, has awarded the service with a global grade of GOOD (1.8). Among the tested parameters it shall be highlighted that the quality of the internet connectivity was awarded with a grade of VERY GOOD (1.4).

[14] Stiftung Warentest, November 2009 edition, (http://www.test.de/Internet-per-Satellit-und-Mobilfunk-Noch-nicht-optimal-1816231-0/)

[15] Satellite SLA tested was 2048 kbit/s from German ISPs Filiago and StarDSL

Stiftung Warentest

test

GUT (1,8)

Im Test: Internet per Satellit
Ausgabe 11/2009

Satellite Internet		
test Quality Assessment	100%	GOOD (1.8)
INTERNET CONNECTIONS	60%	very good (1.4)
Transmission speed		+
Regularity of transmission speed		++
Stability of connections		++
HANDLING	15%	good (2.3)
Printed directions		++
Electronic directions		++
Daily use		O
INSTALLATION	15%	good (2.3)
Ordering process		O
Installation on site		+
VERSATILITY	10%	good (2.5)
DEFFICIENCIES IN GTC	0%	minor

Figure 9: Satellite Internet test result

The key point of the test was to compare the quality of the internet wireless connections (satellite and mobile internet) in order to better understand an alternative way to an ADSL connection where this kind of service is not offered.

In that respect, and according to the criteria set for the test, the satellite service presented the best performance to overcome the lack of ADSL connectivity: the test showed an equally good performance of internet speed connectivity and a very good web browsing experience (see Figure 10)

Mobile Internet				
Evaluation	T-Mobile we-b'n'walk Connect L	O2 Active Data with Internet Pack L	Vodafone Mobile Connect Flat	E-Plus Base Lap-top Internet Flat [4]
test Quality Assessment 100%	GOOD (2.3)	SATISFACTORY (2.6)	SATISFACTORY (2.8)	SUFFICIENT (3.7)
INTERNET CONNECTIONS 60%	satisfactory (2.8)	satisfactory (2.8)	satisfactory (2.6)	satisfactory (3.4)
Transmission speed	+	+	+	O
Regularity of transmission speed	O	O	O	O
Stability of connections	O	O	O	O
Mobile use	O	O	O	Θ
HANDLING 30%	very good (1.4)	good (1.9)	very good (1.4)	very good (1.5)
Printed directions	++	+	+	++
Electronic directions	+	Omitted	O	+
First installation	+	+	++	++
Daily use	++	+	++	++
VERSATILITY 10%	good (2.0)	satisfactory (3.0)	satisfactory (3.0)	good (2.0)
DEFFICIENCIES IN GTC [3] 0%	very minor	none	notable *)	very notable *)

Figure 10: Mobile internet test results

It is important to highlight that from 2009, the price of satellite-based internet services has substantially dropped and also that the performance at that time was lower than the one currently possible. Consequently, a better result/test score would be expected with the current offers.

The results of the official test corroborate that the new developments have been key to overcome the myths associated with satellite communications such as low speeds or hefty installation.

3.5 Satellite Broadband In Europe: Commercial Features

3.5.1. Approach Of European Satellite Operators To Consumer Broadband

In this section, some information is given on the way the two satellite operators partners in SABER, Eutelsat and SES, has approached the consumer broadband services market. The strategies of Eutelsat and the one of SES are indeed very different from each other.

Eutelsat has made an overall investment exceeding 300 million euro in KA-SAT, a powerful new platform delivering high-bandwidth services.

SES' approach to Ka-band differs from its competitors in the way the capacity is brought into the market. SES did not invest in an "all Ka-band" satellite, such as Eutelsat.
The strategy of SES is to gradually increase the capacity of its Ka-band satellites as and when required. The gradual introduction of Ka payloads will allow SES to accommodate smooth growth and increase network resiliency following market demand.

Eutelsat Ka-Sat, A Satellite Dedicated To High-Speed Internet

KA-SAT is the first European multi-beam, fully Ka band High-Throughput Satellite (HTS). Weighing a little over 6 tons and a wingspan of almost 40 meters with solar panels, satellite embarks four large antennas with a diameter of 2.60 meters each with 20 feed horns.
Ordered from(?) EADS / Astrium in 2008, the KA-SAT satellite was launched by an ILS Proton launcher in December 2010 before being formally put into operation in March 2011. It is positioned in geostationary orbit at 9 degrees East.
It covers Europe, North Africa, and Middle East.
Unlike other satellites designed to cover a large area with a single beam, KA-SAT uses an innovative architecture to target the whole of Europe with 82 spot beams (each spot being connected to an operational transponders).of 250 kilometres in diameter.

Each country is served by several spot beams. France is well covered by 10 beams, 9 Italy, Germany 7, 5 for the UK and Ireland and another 10 for Spain and Portugal.

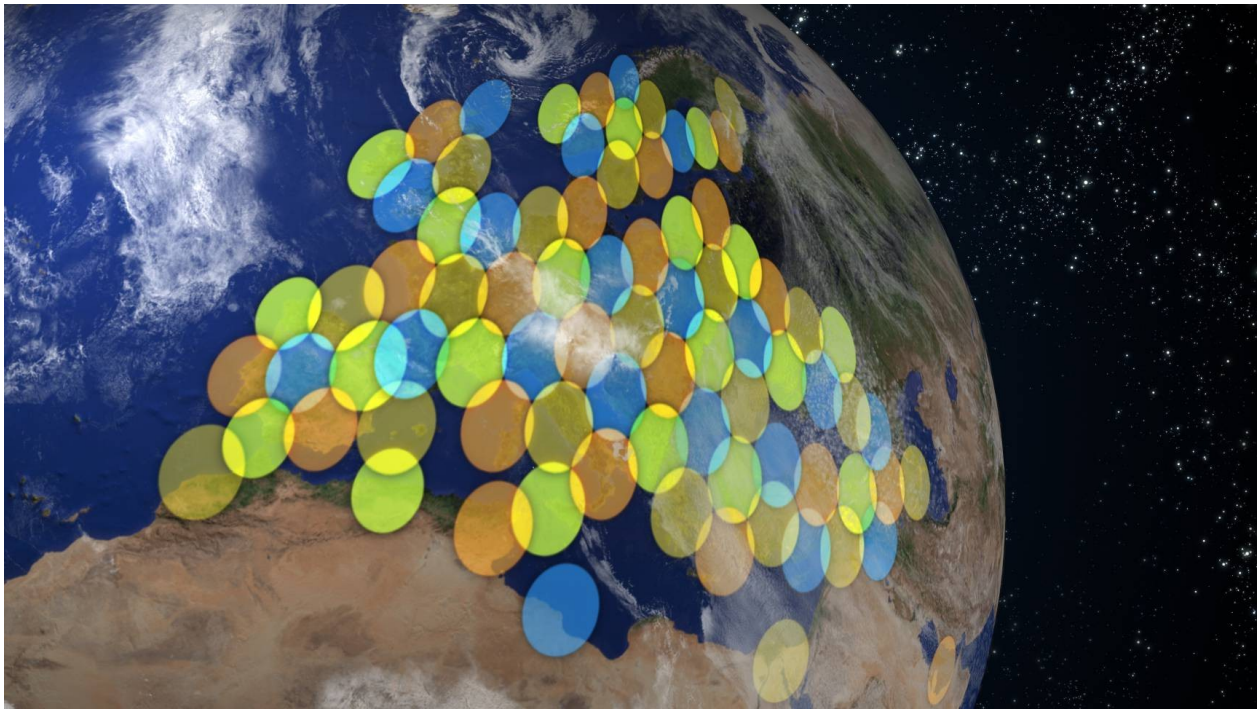


Figure 11: KA-SAT European Coverage

The use of different frequency bands allows overlapping spots for continuous coverage. The frequency reuse factor multiplies the available bandwidth.

The high frequency re-use through multiple spots allows total throughput in excess of 90 Gbps, shared between the downlink and uplink paths, which can be increased further depending upon modulation coding schemes used.

The 82 Ka-band spot beams are connected to a network of ten ground stations (Gateways) scattered throughout Europe.

Each Gateway, equipped with a parable of 9 meters in diameter, manages 10 spots. The ten Gateways, placed in Athens (EL), Berlin (DE), Helsinki (FI), Larnaca (CY), Udine (IT), Madrid, Scanzano (IT), Cork (IE), Turin (IT) and Rambouillet (FR), are interconnected among them and with to the main control centre in Turin, Italy, through a 20 Gbit/s fibre optic network. The

network is connected to major European POPs.

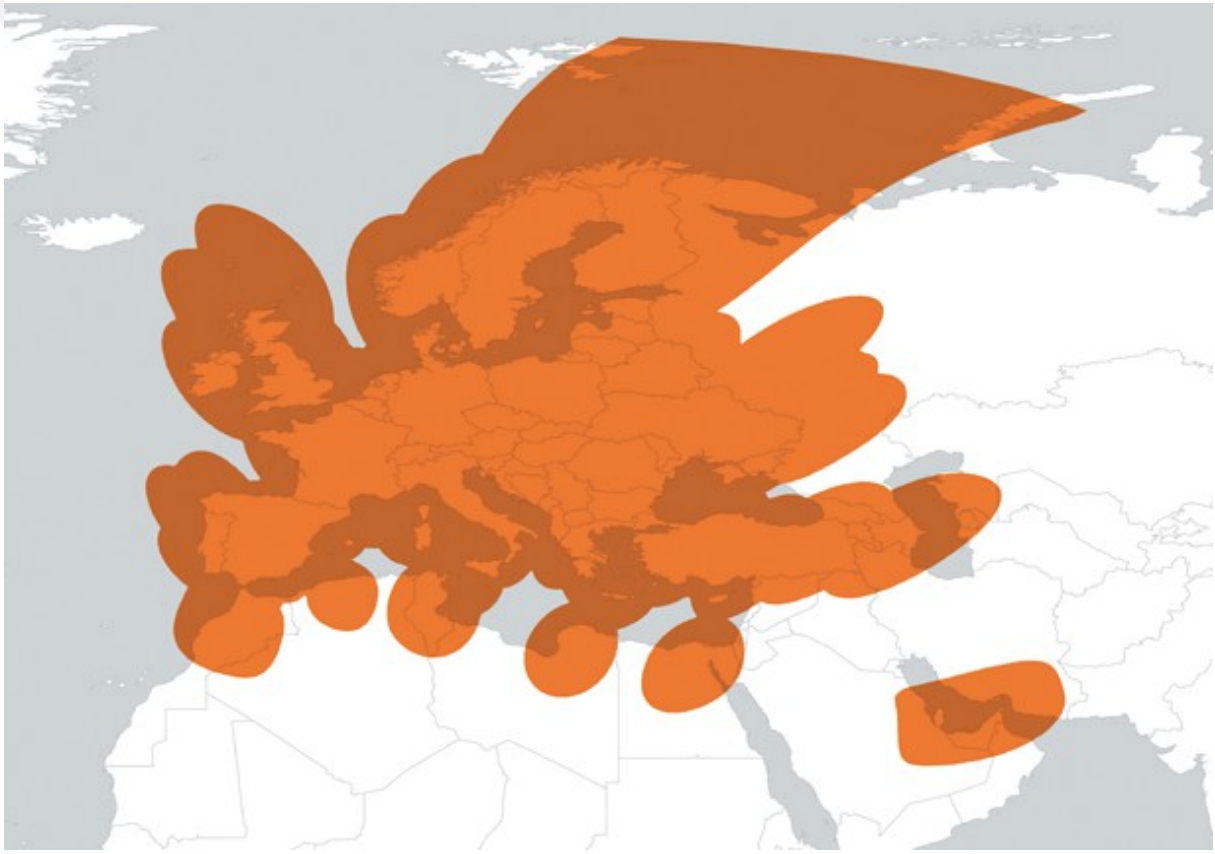


Figure 12: KA-SAT - combined service downlink

SES satellites providing high-speed Internet

The SES broadband service (formerly known as "ASTRA2Connect") was launched in 2007 and is offered in Ku and since early in 2013 also in Ka band1. The service is currently powered by satellites located at the 5°, 23.5° and 28.2° East orbital positions.

The strategy of SES is to gradually increase the capacity of its Ka-band satellites. Instead of launching a broadband-dedicated High Throughput Satellite (HTS), SES decided to embark Ka payloads onboard several satellites (ASTRA 2F, already launched, and ASTRA 2E and 2G, scheduled for launch on Q3-2013 and on Q1-2014 respectively). The objective is to complement the current pan-European Ku broadband coverage with incremental Ka capacity over selected areas.

Once the ground-based gateway stations necessary for the Ka-band service will be deployed, SES will have the possibility to provide more than 6Gbit/s of capacity.

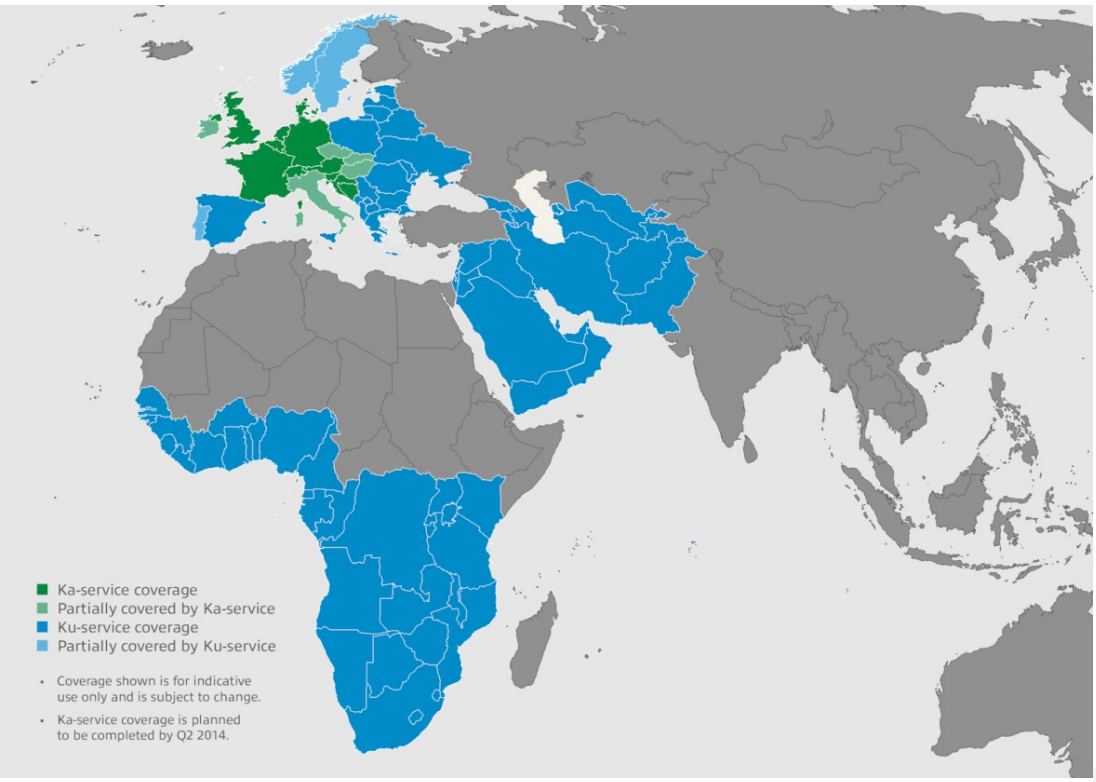


Figure 13: SES Broadband service coverage Ku / Ka bands

3.6 Satellite Broadband Services Currently Available Throughout The Eu: Performance And Prices

3.6.1. Satellite Broadband Value Chain

The satellite broadband value chain is somehow long and complex. Streamlining it, for example by vertical integration such as merging wholesale and retail activities as it happened in the U.S.A. with ViaSat and Wild Blue, is hardly achievable in Europe. Indeed, there is no Digital Single

Market in the EU, Therefore satellite operators have to find local distributors in each of the 27 EU countries' markets, which have their own specific rules and dynamics.

In the satellite broadband value chain, satellite network operators shape and manage the prioritisation of the traffic according to the congestion and the channel condition while the satellite ISPs (Internet Service Providers) manage the end-user, providing the service and related activities as installation and first level of assistance. With reference to Figure 14, the six main actors of the Satellite Broadband value chain and their respective roles are the:

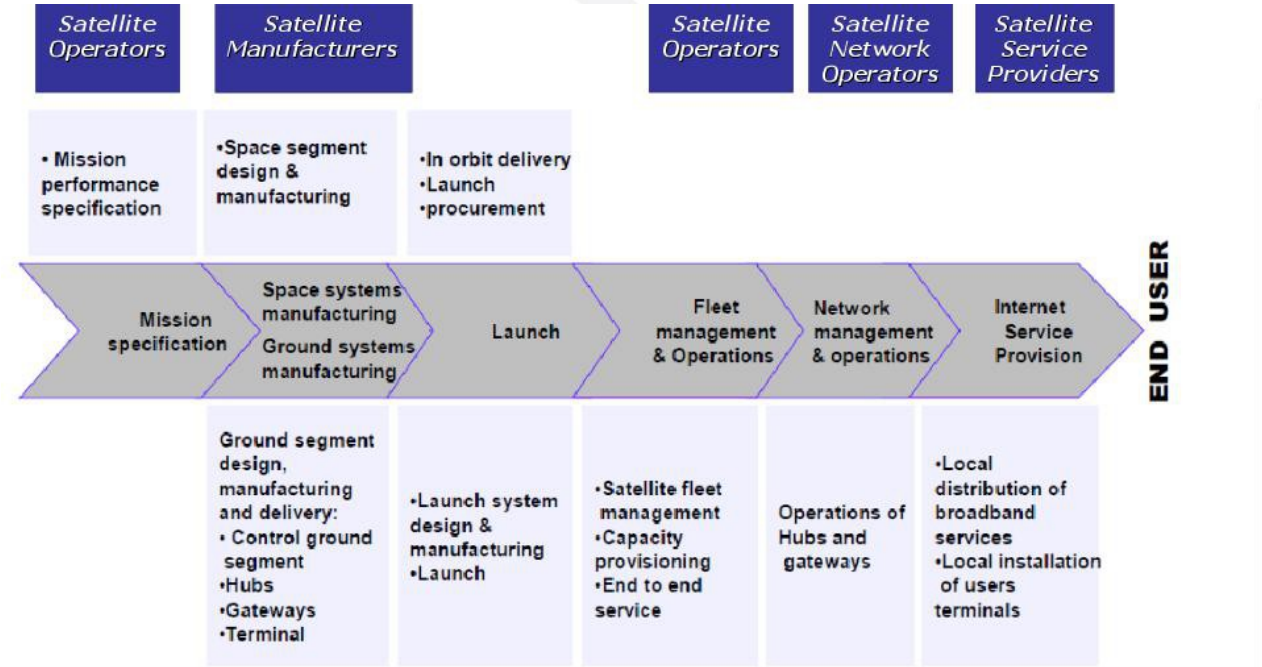


Figure 14: Satellite Broadband Value Chain

1. Satellite manufacturers (e.g. Astrium) build satellites, following the demand of their clients, the satellite operators.
2. Satellite Operators: (e.g. SES and Eutelsat) finance, own and operate the satellite(s) in geostationary orbit.
3. Satellite Network Operators (e.g Skylogic and SBBS) operate the ground stations (antennas and hubs) with terrestrial internet connectivity and provide network services.
4. Satellite Internet Service Providers (ISPs): buy either wholesale capacity or off-the-shelf

packages from the satellite network operators, set user charges and service levels (SLA) and sell retail service packages to end-users. ISPs own the user relationship: they are responsible for providing the service to end-users, including the equipment, for ensuring first-level customer support and for billing.

5. Customer-Premises Equipment (CPE) manufacturers (e.g Viasat, Newtec, Gilat): build and provide ISPs with the end-users equipment which consists of a 74cm – 120cm dish depending on the satellite, the geographical location of the end-user and on the service deployed with radio equipment and the satellite modem. The price of the CPE varies between € 250-600 depending on the service provider.
6. End-Users (e.g. Residential, SMEs, Business, Administration).

As stated in the non-technological roadblocks chapter, satellite operators are NOT present in the retail market, and NO vertical integration exists between the ISPs and the operators (owners of the infrastructures). In the case of satellite, open access, a pro-competitive solution, is guaranteed via bitstream, the sole wholesale access product that complies with satellite specific architecture. Satellite operators do not give any exclusive rights to one ISP. Besides, there is no restriction on the ISPs market, each ISP offering its own value-added services to the customers.

A notable result of the value chain is the economic sustainability at local level; in fact, the necessity of having a critical mass of knowledgeable person able to sell and install satellite broadband equipment has positive consequences on the creation of new job.

3.6.2. Overview Of The Existing Offer

In this part we will present an initial review of the retail offers of satellite-based consumer broadband internet, in terms of capabilities (e.g. peak speed and performance), service models and tariffing. The benchmark analysis relies on public data from different satellite broadband service providers operating in the European market. The main source of information has been the websites of the ISP resellers mentioned above.

This study led to the production of a database on the actual satellite ISPs offers in the countries represented in the SABER project (UK, Ireland, Germany, Austria, Switzerland, France, Italy, Poland, Romania, Slovenia, Hungary, Greece, Sweden, Norway and Spain) and can be found in

Annex I

This database lists every Internet Service Providers by country, and includes approximately 250 broadband retail offers (rows) organized around 6 parameters (columns) - download speed, upload speed, data volume, monthly subscription fees, price of CPE, satellite operators (Eutelsat and SES, members of the SABER project, plus Avanti, Hellas-Sat and Hispasat).

These parameters are essential to understand the quality of service (QoS) and the value for money of the various satellite broadband commercial offers, namely the impact of speeds and volume on pricing. In fact the cost structure of satellite broadband services is somehow different from the one of terrestrial broadband services.

In particular, the use of the available satellite resources (bandwidth and power) depends more on the volume of exchanged data than on the peak download / upload bitrates. That is why caps are put on the volume of data that can downloaded and uploaded over periods of time – a few hours and / or a week – and when these limits are exceed, the connection is temporarily slowed down.

As far as bitrates are concerned, the limiting factor resides mainly in the upload, as the speed is determined by the maximum allowable Effective Isotropic Radiated Power (EIRP) of a satellite terminal in order to remain within the type-approval regime.

Thanks to the extensive database provided by SABER, broadband offers in Europe are listed in a unique document which can be used as a neutral reference both for public stakeholders and private customers – and in particular for each regional SABER partners in its activity to bridge the digital divide.

The database confirms that the launch of service in Ka-band is driving the prices down while increasing the speeds thus fostering the affordability and the acceptability for the end-user. This breaks the myth that satellite broadband is expensive and speeds are slow.
France, Germany and also UK, present the most attractive and affordable offering, mainly because of the intensive competition among several ISPs resellers on the market.

However, the European satellite broadband market remains still negligible if compared with other regions of the world. Indeed it represents less than 10% (~120 K subscribers) of the worldwide global base of satellite broadband access subscribers which was estimated at 1.4 million terminals in 2011. The scattering of the potential users in the European territory and the absence of a single digital market (see 4 - Demand aggregation) partly justifies the fact that satellite broadband is a niche market in Europe.

Western Europe represents the larger part of subscribers, in Central and Eastern Europe the monthly services fees and the most especially the CPE cost and installation remains a barrier. More in general, there is no doubt that the addressable market of both un-served and underserved households and business in Central and Eastern Europe is important. However, the cost of service combined with the distribution challenge in the market makes that this part of Europe market remains challenging for growth of satellite broadband access services.

The widespread introduction of funding schemes, such as the one available in a few regions of Europe (see Deliverable 2.3 – Regional/National satellite broadband implementation case studies), could reduce this barrier, then contributing to mitigate the digital divide and promote the uptake of broadband in un-served or underserved regions.

3.7 Satellite Broadband In Support Of Digital Agenda Goals

Basic broadband penetration in Europe is far below the target fixed by the EU Digital Agenda for Europe (DAE) for 2013: basic broadband for 100% of Europeans citizens.

As a conclusion to this chapter, we submit that it is not only recommended but also necessary that satellite broadband is fully included in the EU broadband strategy, particularly to achieve the 2013 DAE objective.

The information provided in this chapter confirms that satellite-based technology is an affordable,

complementary solution to terrestrial broadband technology to quickly bridge the digital divide in Europe and bring Internet connectivity to the remaining 5%–10% of the European population which is still unserved or underserved – by and large rural and isolated – and which is, by definition, the most difficult and expensive to cover.

Deploying a satellite-based broadband solution may result not only in immediate service provision but also in large savings in terms of infrastructure cost in certain rural and scarcely populated areas.

The performance of satellite-based broadband services in terms of users' experience, cost efficiency, speeds, reliability and security is now comparable to that offered by many basic terrestrial broadband services.

The offer made available to the different European markets by satellite operators, such as Eutelsat and SES, are designed for different classes of users: individual households as well as entire villages, SMEs, and the public sector.

In order to fully exploit the contribution of satellite broadband to 100% EU broadband coverage, there is the need to develop a close partnership between European public institutions and the private satellite industry.

This partnership should target improvements in awareness amongst stakeholders through the dissemination across Europe of updated and comprehensive information about satellite broadband (such as that provided in this document), and also propose plausible solutions to fully include satellite solutions in public procurements and minimise the effects of the obstacles that were identified in European, national and regional rules and regulations (see 5). Finally, the establishment of common approaches towards the procurement of satellite solutions across European regions constitutes a de facto demand aggregation scheme (see 4) for the possible use of EU funds.

4. Demand aggregation

This chapter analyses the applicability of demand aggregation for satellite broadband in Europe.

The satellite broadband market has some specific features which challenges the implementation of large and genuine demand aggregation schemes within the current EU context.
The EU, unlike the U.S.A. or Australia, has currently neither centralised fund for broadband nor central authority managing the implementation of measures to fight against the Digital Divide.
The responsibility for broadband implementation strategies is often decentralised and therefore held at both national and regional levels. This leads to the absence of common methodologies, rules and tools and to an inhomogeneous demand.
As a consequence, the only way to benefit from the typical advantage of large-scale demand-aggregation schemes i.e. the emergence of a more convenient and competitive offer for the final users, is to achieve a harmonisation of the demand throughout Europe.
To help overcome this challenge the EC should therefore improve public authorities' awareness of satellite technologies, foster a shared understanding of the situations in which satellite solutions are best suited for reducing the digital divide, and disseminate common methodologies, rules and tools to European Member States and regions in need.
For the future, the EC should consider introducing a new, centralised budget devoted to a pan-European deployment of satellite broadband to bridge the digital divide.

4.1 Potential Case For Demand Aggregation Schemes In Europe

4.1.1. Introduction

As explained in the chapter 3, the remaining un-served or under-served population in Europe is scattered across the territories, and mostly in rural, mountainous or isolated areas, with a low population density.
Satellite broadband appears as the ideal solution to address this sparse demand. However, serving local demand requires dedicated market and commercial efforts which are not justified by the size of each individual market.

Demand aggregation could potentially favour broadband satellite solutions to effectively address the fragmented market generated by the broadband coverage gaps.
Demand aggregation refers to mechanisms aimed at pooling the demand for a given service over a specific region, country, and continent or even across continents.

The implementation of demand aggregation schemes for satellite broadband public procurement would therefore present the following advantages:

- creating a consistent single market from a sparse demand;
- allowing public authorities to ensure true public services continuity (e-government, e-education and e-health) across their low density areas;
- realising savings of public money
- making the broadband market more attractive for investors.

In order to be fully applicable and valid in an institutional context, demand aggregation requires:

- a central level to purchase;
- a centralised public fund;
- a central authority managing the funds.

Successful examples of demand aggregation for satellite broadband can be found outside Europe, typically in large and rural countries such as Australia, New Zealand, U.S.A. and Canada[16]. where policymakers have centrally defined a dedicated budget and have implemented the measures to provide broadband for all.
Demand aggregation was successful in these countries as a result of undertaking a mapping of the territory and a cost-benefit analysis of the available technologies, which led to pre-identifying some rural areas where satellite broadband was found to be the most cost-effective solution.
A pragmatic approach was taken to developing the strategies recognising the complementarity of terrestrial and satellites solutions.

[16] These international case study examples will be analysed in more depth in Work Package 3 of the SABER project.

4.1.2. Applicability Of Satellite Demand Aggregation Scheme In Europe

The satellite broadband market in Europe is characterised by low-density areas, disparate geography and consequently sparse demand.

In order to be successful, a pan-European satellite broadband provision needs to:

- Be available in all European countries, thus encompassing a very large network of committed ISPs.
- Be compatible with the laws of each country.
- Ensure rapid availability of the hardware, thus requiring advanced procurement of thousands of Customer Premises Equipment.
- Ensure a certain level of centralised activities is available including; training, management, hot line (in many different languages), billing systems, and Europe-wide communication/marketing campaigns to ensure market take-up etc.

These activities require a high level of marketing and commercial overheads that are generally not required for terrestrial operators which are focused on addressing each national or regional market individually.

Without demand aggregation, satellite broadband is not likely to become a mass market in Europe. However, the contribution of satellite broadband systems to help achieve the basic broadband for all 2013 Digital Agenda for Europe target, could be facilitated and accelerated through demand aggregation, based on models of cooperation among different public authorities on a Pan-European basis.

The current absence of a centralised public fund at an EU level and managed by the EC makes this exercise more challenging. In this respect, the authors have noted the CEF (Connecting Europe Facility) 2014-2020 centralised budget devoted to ICT, which could have been in line with the requirement for developing a European Demand Aggregation Scheme, has undergone a dramatic cut and is therefore unavailable for this purpose.

Demand aggregation at a national level, is similarly difficult because the implementation of the broadband strategy uses, in the majority of cases, EU funds (ERDF and EARDF) that are usually managed by regions. Even when a dedicated national budget exists, it is sometimes delegated to a local authority level at which decisions on solution to be implemented are taken.

Should a national budget exist, the difficulty is to achieve alignment of central and local policymakers to obtain a national aggregation scheme.

Therefore, in the current EU context, the regional level, whilst representing a small market, appears to be the highest possible level for a genuine and practical consideration of demand aggregation.

Today, many regions have implemented a specific procurement process for satellite broadband, each defining a specific quality of service, very often because of a lack of awareness and understanding of the most recent satellite technologies. This multiplicity of different requests for what is in reality the same quality of service generates extra costs for the satellite operators and the satellite ISPs, which is reflected in the subscription prices.

Therefore a way to benefit from the advantages of a larger-scale demand-aggregation scheme is to achieve a harmonisation of the demand at a European level.

4.1.3. Satellite Demand Aggregation In The ESA BB-MED Report[17]

BB-MED is a study on the "Evaluation of the Satellite Solution for the Development of a Broadband Service for the Union for the Mediterranean" developed by a consortium led by Avanti Communications and supported by Point Topic and HellasSat under a contract of the European Space Agency (ESA).

[17] *Disclaimer: The ESA BB-MED report was explicitly mentioned in the CIP call for proposal as one of the major reference documents for this chapter was expected to have been available at the beginning of the SABER project. As a consequence of the current unavailability of this report this section contains only a preliminary analysis on the way the ESA BB-MED report has developed the Demand Aggregation topic.*

BB-MED provides an assessment of a possible satellite broadband internet service that could be deployed across the Union for the Mediterranean (UfM) countries, in order to reduce the digital divide.

A set of specific Demand Aggregation cases were studied within BB-MED through models of cooperation, related to geographic, socio-economic and sector criteria, organised around five scenarios:

- 100% of schools in FEMIP countries unable to get broadband (2013)
- 100% of Farms, SMEs and consumers in Eastern European countries unable to get broadband (2013)
- 100% European + FEMIP take-up across all user categories i.e. Consumers, Schools, Hospitals, SMEs, and Farms unable to get broadband (2015)
- 100% European + FEMIP take-up across all user categories i.e. Consumers, Schools, Hospitals, SMEs, and Farms unable to get broadband (2020)
- 100% of Schools & Hospitals in Libya unable to get broadband (2013)

In general, the BB-MED project evokes demand aggregation as a means:

- For the users, to negotiate a wholesale rate and long-term contract with the providers and define Service Level Agreements (SLA), and
- For the providers, to create a flow of revenues that eases the economic pressure on the business case;

through the coordination of the demand from homogeneous groups of broadband users such as government administrations, public services, local schools, health care facilities, etc.;

4.1.4. Preliminary Recommendations For Satellite Demand Aggregation Within The EU

The above analysis tends to show that the European satellite broadband market has some specific features which make difficult the implementation of genuine demand aggregation within the current EU context.

A way to benefit from the typical advantages of large-scale demand-aggregation schemes in the

framework of the current public procurements, in which funds are managed at a regional (or sometimes even more local) level, is to achieve a harmonisation of the demand throughout Europe, which will in turn favour the emergence of a more convenient and competitive offer for the final users.

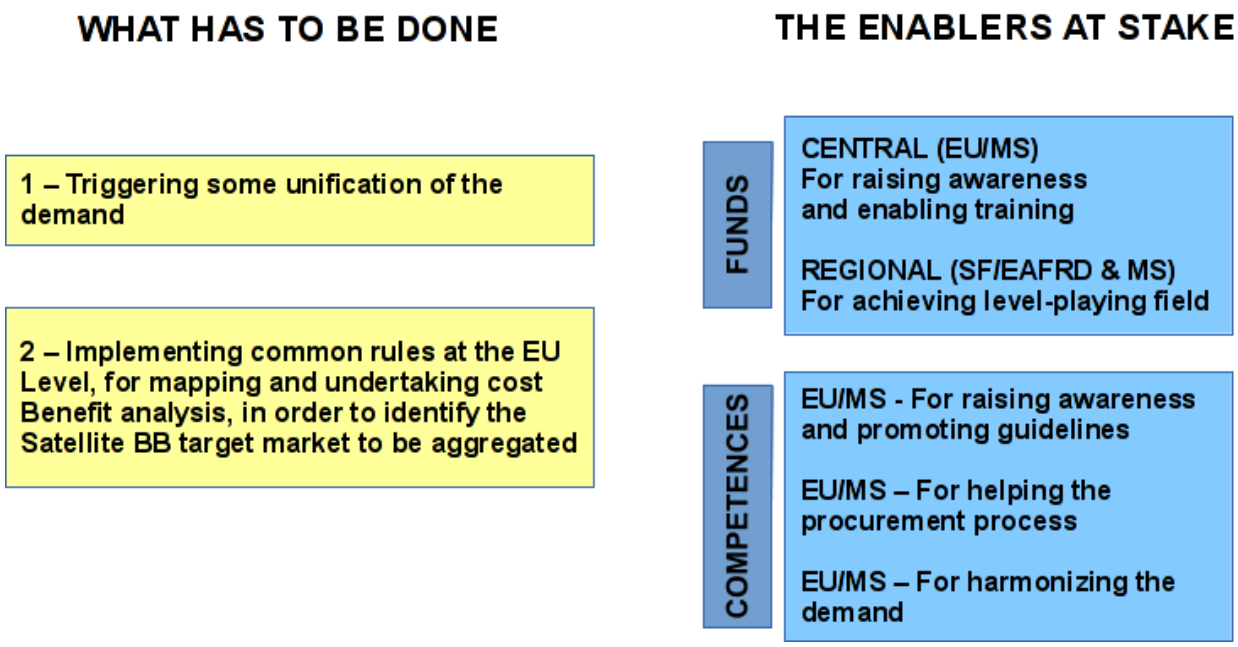


Figure 15: How to obtain some demand-aggregation benefits in the present European institutional context

A widely shared understanding of the technical and commercial features of satellite technologies, and the environment (e.g. geography, timely deployment, etc.) in which satellite solutions are cost effective and particularly suited to reducing the digital divide, should lead to a more homogeneous demand from regions.

Therefore, as shown in figure 15 the EU institutions should concretely support the awareness raising of satellite broadband – among others, by endorsing and disseminating the information provided by the SABER project.

In addition, common methodologies, rules and tools that will be developed by SABER can equally support the objective of a harmonised approach to the procurement of satellite solutions in the various European regions in need.

In the medium term, it would be ideal if the EC could introduce a new, centralized budget devoted to strategic and focused demand aggregation interventions on a pan-European scale (namely those related to the deployment of satellite broadband to complement terrestrial infrastructures) to respond to the challenges imposed by the digital divide.

5. Initial Review Of Non-Technological Roadblocks And Obstacles Towards Satellite Broadband Deployment In The Eu

This Chapter is the result of the active collaboration of all SABER partners. The information, analysis and recommendations included in the following paragraphs are the outcome of SABER partners' intelligence gathering. Specifically:

- Research and review of EU State Aid Broadband Guidelines and State aid Broadband EU Decisions.
- Research and review of ERDF Operational Programs and EARDF Rural Development Plans
- Research and review of calls for tenders
- Specific discussion on the deliverable subjects in two Workshop (Cork and Brussels) to iteratively review, and validate the network's findings and good practice case studies.

The final review of the chapter was carried out on the basis of partners' comments, analysis and discussion.

5.1 Introduction

Satellite broadband is a complementary technology for fast, reliable broadband internet access, ideally suited to providing instant solutions for broadband, especially for the most remote and rural users and for those in other not-spots.

As explained in the section 3.5.1, the satellite operators have been investing over the last few years in new, innovative satellites and their related ground segment in order to be able to provide high-performance, yet affordable, consumer broadband services. Via the satellites launched by different European operators, Internet broadband services are now provided throughout the EU with download speeds up to 20 Mbps and upload speeds up to 6 Mbps.

Therefore, currently available satellite-based solutions for broadband connectivity are in line with the 2013 targets of the Digital Agenda for Europe (100% connectivity to basic broadband).

In this context it is important to underline that the core network infrastructure necessary to supply satellite broadband services, i.e. the satellites with their related ground segment, as a result of significant private investment by satellite operators , is already in place, as recognised by the Scoreboard 2012 of the Digital Agenda for Europe.

This wide coverage means that while the cost of deploying terrestrial infrastructures (e.g. fibre backhaul) may increase incrementally for the final percentage of premises to be connected, the cost of providing a broadband satellite connection remains constant and not dependent on the geographic location of the user or their distance from nearby infrastructure.
In areas with scattered un-served users, satellite is often the most cost-effective solution, as the only missing network element needed in order to establish a broadband connection is the customer premise equipment.
The installation and activation at the user premises, even in the most rugged and remote terrains, can be undertaken in just a matter of days. Thus new users, irrespective of their location, can immediately take advantage of broadband services.

In this respect satellite broadband can complement terrestrial solutions in achieving the Digital Agenda for Europe 2013 target.

Providing broadband services over satellite to the general public is a new and developing market sector. Hence the new satellite broadband solutions, need to be better known (as observed in the DAE Scoreboard 2012) in order to be fully exploited.
Often, decision-makers at national and regional level may not be aware that satellite solutions exist, or that they are efficient, accessible and affordable. The satellite industry is a small industry, with limited marketing reach when compared to major telecoms operators and manufacturers. However the industry does work hard to inform decision makers of the developments taking place in the industry and their relevance to narrowing the digital divide.

Governments have been extensively investing in optical fibre in the backhaul; satellite broadband can offer an effective solution to address broadband not-spots not reached by the optical fibre

investment.

Some EU Member States have considered satellite broadband implementation measures in the context of their national broadband plans (for more information see deliverable 2.3 Regional / national satellite broadband implementation case studies)

The decisional practice shows that some of the past State Aid schemes approved by the European Commission (see examples in the next section 5.2.1) were based on the assumption that satellite technology was not sufficiently appropriate to fulfil the deployment objectives.

In addition, current legal State Aid Broadband guidelines[18] tend to implicitly encourage the deployment of 'wired' infrastructures, which might explain why governments have decided to go down this route, even though it can be an expensive option.

In some cases, satellite broadband has not been given due consideration in public interventions to enable a faster rate of broadband penetration.

In the past some recurrent, non-technological roadblocks have prevented the submission of satellite-based solutions to some public tenders (sometimes because of the different architecture of terrestrial and satellite networks, despite both being able to deliver the same service).

The political focus of the EC towards terrestrial wireless and wired solutions to bridge the Digital Divide has generated situations in which it is very hard for satellite operators to take business decisions to further support the marketing and commercial investments needed to deliver broadband services in the EU.

More recently, however, it has become clear that some regions would prefer medium-speed broadband immediately rather than interminably awaiting for future superfast broadband links.

In this context, the SABER partners have come together to raise awareness about satellite broadband, analyse the non technological roadblocks towards satellite communication deployment, provide recommended solutions and disseminate information throughout European regions on the benefits of satellite based solutions.

[18] EU Guidelines for the application of state aid rules in relation to the rapid deployment of broadband networks

The main obstacles to satellite broadband deployment identified in public broadband strategies and presented in this Chapter are predominantly as a result of:

- Lack of awareness at a Public Authority level.
- Inadequate / not technologically neutral treatment of satellite broadband solutions within rules and regulations, calls for tender (perception of non-level playing field with other technologies).

5.2 Non-Technological Roadblocks And Obstacles

5.2.1. Lack Of Awareness At Public Authority Level

The lack of awareness about the new developments in satellite broadband solutions makes it difficult for Public Authorities to include satellite based solutions in their broadband schemes. One of the major reasons is that satellite solutions suffer from a negative image derived from old generations of Internet via satellite (services too expensive, performance perceived as not satisfying needs and limited competition).
Unfortunately, even in very recent studies, this image is perpetuated despite the fact that current services are efficient, accessible and affordable, as demonstrated in section 3.6.2.

In the recent past, this misperception has regrettably often, had a negative impact on EU State Aid decisions on broadband deployment. The decisional practice shows that some of the past State Aid schemes approved by the European Commission were based on the assumption that the satellite technology was not sufficiently capable to fulfil the deployment objectives.

As illustrated in the following section, some of the statements submitted by national authorities in the context of the State Aid notification were incorrect, misleading or out-of-date (e.g. about the prices and speeds of satellite broadband). The EC assessment and approval of such State Aid schemes was therefore based on erroneous facts as to the capabilities of satellite technologies.
This has led to the exclusion of satellite-based solutions in broadband deployment plans, in spite of the fact that “in order to reach the ambitious objectives of the DAE, it is necessary to develop a

comprehensive policy, based on a mix of technologies", and in contradiction with the principle of cost-effective use of public funds[19].

Some typical examples of such misperceptions are provided below. The statements contained in these examples are reviewed in this section and the misperceptions highlighted.

The WIK report, 2011

One of the most recent examples is the "Study on the Implementation of the existing Broadband Guidelines[20]: commissioned by the European Commission Directorate-General for Competition (DG Comp) to WIK Consult GmbH in order to prepare the latest revision of the "EU Guidelines for the application of state aid rules in relation to the rapid deployment of broadband networks". (hereinafter referred as the "State Aid Guidelines for Broadband").

This study was presented to representatives of the Member States, the European Commission and BEREC in November 2011, during the multilateral meeting "Revision of the State Aid Broadband Guidelines" in Brussels.

Published in December 2011, the WIK study draws conclusions using old data on satellite broadband and without considering the most recent developments in satellite technologies. European Satellite Operators were not given the opportunity to input to the study.

The study also reports incorrect assumptions on satellite broadband made by public authorities without challenging them.

A few excerpts from the WIK report are reported below to illustrate some misperceptions:

- "The provision of broadband services in rural areas in Baden-Wuerttemberg (or parts of these communities) that do not have affordable access to this kind of telecommunications services apart from expensive satellite or leased line broadband solutions"
- Technology neutrality posed a problem as the subsidised solution should guarantee a

[19] COM/2010/0472 final EC Communication- European Broadband: investing in digitally driven growth, 20 September 2010

[20] WIK-Consult: COMP/2011/006 Study on the Implementation of the existing Broadband Guidelines, - Final Report, 7 December 2011

reliable, fast and secure network. Therefore, broadband satellite technologies were treated in a special way as from the perspective of the Lombard authorities these services are still lacking the necessary speed and other performance criteria in order to fulfil the broadband requirements set by the authorities. Download and upload speed via satellite are not perceived to be satisfying. Note that "the main objective of the project is to expand the existing ADSL broadband coverage with a minimum of 2 Mbps to 99.7% of the population in Lombardy."

- Ensuring technology neutrality might cause a challenge for the public authorities. Depending on the intended type of broadband access to be provided there may be technological solutions which are in principal not suitable to deliver the requested performance. Against this background the Italian authorities for example limited the role of satellite technology in the Lombard case to a niche contribution to broadband coverage.
- Satellite broadband offerings in all likelihood are considerably higher-priced as regular broadband services.
- Furthermore, broadband satellite equipment requires sometimes substantial infrastructure installations and costs (satellite dish) at the consumer premises.
- The end-user has to buy specific hardware for satellite based internet access which may cost up to several hundred Euros.
- It is also assumed that broadband satellite technologies tend to establish de-facto monopolistic structures and to limit open access.

The House of Commons Report - Wales - 2012[21]

"Satellite transmissions may be affected by weather conditions or local obstructions including foliage and trees, and the cost of installing and running satellite broadband could be expensive compared with other types of broadband."

State Aid to rural broadband - Sweden - 2010[22]

"Broadband through the fixed telephone network dominates in rural areas. However, this network is being partly eliminated as old and obsolete parts of it result in excessive operating costs by which approximately 50000 households will be affected until 2015. The vast majority will be able to obtain wireless or satellite services through the market, but there is a risk that the number of businesses and households lacking access to high-capacity broadband may increase." "According to the Swedish authorities, currently satellite broadband offers do not provide adequate services on these areas for several main reasons:

- due to Sweden's geographical location, the overall satellite coverage is not optimal in all rural areas;
- as with other radio based solutions, deep forests and valleys make it difficult to achieve good coverage in all areas,
- the price plans are not commercial attractive, some 4,5 € per Mb consumed traffic or 1 € per minute connected,
- bandwidth does not reach requirements for decent broadband (2 Mbps),
- asymmetric connections make uplink slow and create long response time, i.e. limit available services."

[21] Broadband services in Wales, First report of session 2012-2013, Welsh Affairs Committee, September 2012}

[22] State aid to broadband within the framework of the rural development program - 25/03/2010 C (2010)1916 State aid N 30/2010 – Sweden

State Aid to rural broadband – Asturias, Spain – 2009[23]

"The Spanish authorities state that the persisting lack of broadband availability in the rural areas of Asturias is due to the geographical characteristics of the region which have caused private investments to be insufficient. In particular, due to the mountainous nature of the territory, even when the telecommunication infrastructure exists, its distance from the users' premises is so large that adequate service cannot be ensured. As for mobile connectivity, the Spanish authorities identified certain rural areas in which coverage does not go above 25%. State subsidised satellite access has been made available only in some of the localities targeted by the measure (based on current market prices, satellite broadband is not considered as an affordable option, as the very low take up rate proves.), but the performance level is deemed unsatisfactory by the Spanish authorities (due in particular to the maximum download speed not going above 512 kbps)."

Broadband Network Development Strategy, Slovenia, 2008[24] (still in force)

"Satellite connections disadvantages:

- High costs for the end user.
- Low transmission speed in the direction from the user"

5.2.2. Inadequate / Not Technologically Neutral Treatment Of Satellites (NO Level Playing Field With Other Technologies)

The Framework Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services sets the principles of technology and service neutrality as a rule. Exceptions are possible where properly justified, or to promote social, regional or territorial cohesion or avoid inefficient use of spectrum (for service neutrality).

[23] Excerpt from Broadband in Rural Areas of Asturias - 14/12/2009 C (2009)10259 State aid N 323/2009

[24] Broadband Network Development Strategy in the Republic of Slovenia, 2008, Government of the Republic of Slovenia

In this respect, Commissioner Kroes more recently confirmed "The EC takes a technologically neutral approach to promote innovation and competition […] keeping a close eye on state aid practices to ensure that certain wireless technologies do not suffer undue discrimination"1

However, some countries have occasionally put aside, without any justification of exceptions, the technological neutrality principle in their race to the deployment of optical fibre, even in rural and remote areas.

Indeed, this ex ante predetermination of a specific technology, might comprise the achievement of the 2013 DAE targets. Any reference to unnecessary and/or discriminatory technical requirements that, by disadvantaging satellite, might lead to the non-respect of the principle of the cost-effective use of the public funds, i.e. might eventually contribute to a misspending of public funds.

Broadband Calls For Tender: Cases Of Satellites Exclusion

Another major non-technological roadblock for satellite broadband is the way the Calls for Tender /Proposal for the procurement of broadband internet solutions and services are drawn up.

Many Calls for Tender/Proposal are conceived without taking into consideration the characteristics and features of satellite broadband, thus excluding *a priori* the opportunity for satellite ISPs to participate in the procurement process.

Indeed the low level of participation of satellite ISP in past public Calls for Tender / Proposal was observed also by the European Commission that stated: "Based on the feedback that we receive from the Member States, we understand that satellite operators rarely participate in broadband tender procedures"[25]

The most frequent recurrent non-technological roadblocks that make ISPs unable to apply for public calls are:

a) Satellite network architecture not taken into account.
b) Bundling service objectives with unnecessary infrastructure requirements.
c) Non-observance of the Technology Neutrality principle.
d) Supposed lack of open access in satellite broadband

[25] DG COMP / DG INFSO - HT.3095 - Revision of the State aid Broadband Guidelines – Reply to ESOA letter dated 26/03/2012 on concerns and recommendations in the context of the EC revision of the broadband guidelines, 26/03/2012. Eutelsat is a full member of ESOA (the European Satellite Operators' Association)

Each of the four non-technological roadblocks are discussed in more detail below:

a) Satellite network architecture not taken into account

The following statements are commonly included in calls for tender:

- The technology neutrality is guaranteed in this tender.
- The performance provided by broadband infrastructure will be taken into consideration regardless of the adopted technology.
- A model of technology-neutral network (see example in figure 16) is defined, in order to identify the key points of the network relevant to the assessment of the proposed architecture.
- The definition of a network model that respects the neutrality of technology makes it possible to identify points of logical evaluation of the sizing and performance measurement.

Figure 16: A model of supposedly technology-neutral reference network

However calls for tender designed in this way are unable to make a comparative performance assessment of satellite-based solutions, thus implicitly excluding them from bidding. In fact, with reference to figure 8, it should be noted that:

In satellite networks, there is no architectural separation into backhaul and last mile

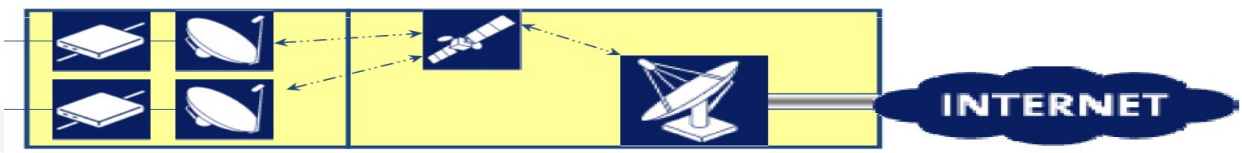


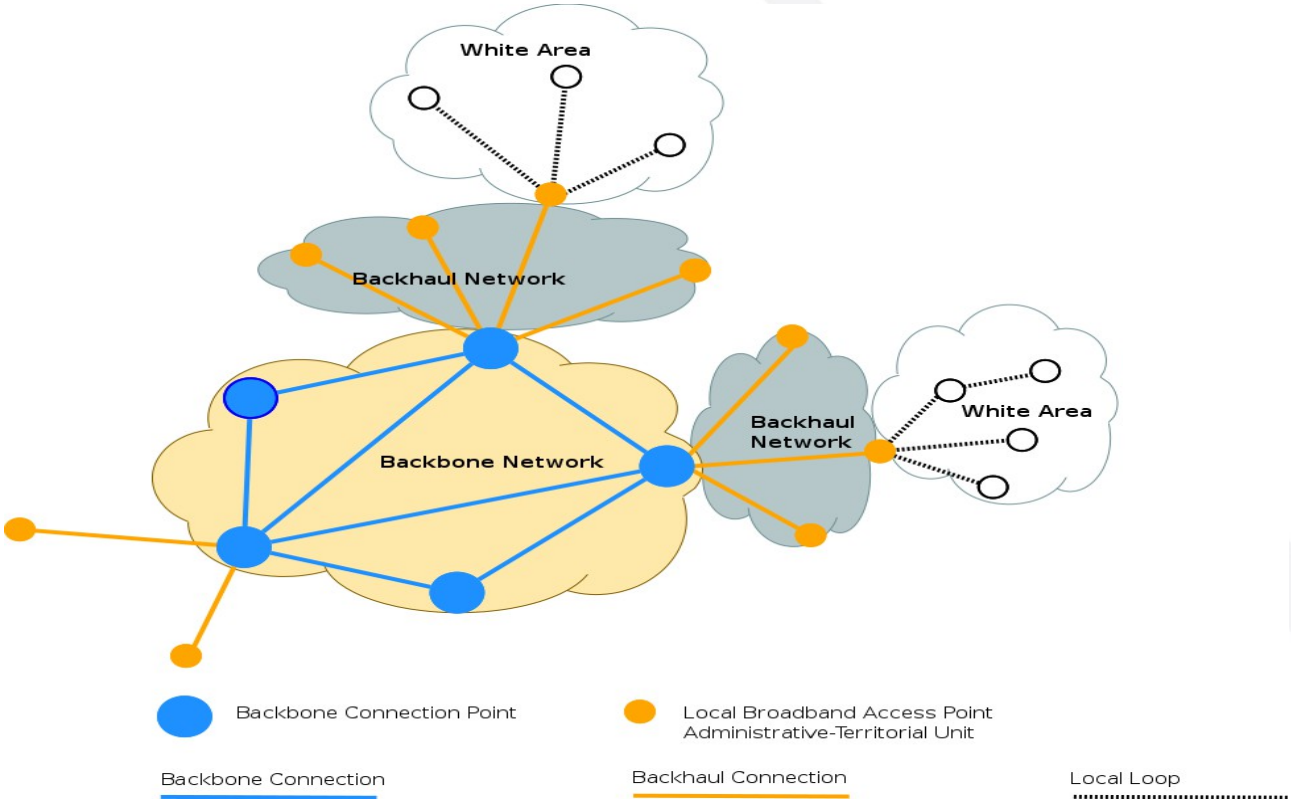
Figure 17: Satellite broadband network reference architecture

Therefore procedures that ignore the satellite network architecture, are usually not consistent with the principle of technology neutrality.

Unfortunately this issue was not addressed and consequently not resolved by the revision of State Aid Broadband Guidelines published in January 2013. Therefore the risk that future grants or procurement processes for broadband are not based on genuine technology neutrality (to the detriment of satellite solution) is still present.

One significant example of this non technological roadblock is the State Aid Memorandum – Support for setting up broadband networks in the underserved areas. - Romania – May 2011[26]

In spite of the claim of technology neutrality, the "indicative broadband infrastructure model" (see figure 18) proposed is not applicable to satellite networks for the reason explained above.



[26] Concept Paper of the Ministry of Communications and Information Society - Intermediate Body for the Promotion of the Information Society - Romania - State aid Memorandum - Priority Axis 3 - ICT for Private and Public Sectors - Support for setting up broadband networks in the underserved areas. May 2011

"Backbone" means the main high capacity, high reliability, low latency data routes between large, strategically interconnected networks and core routers in the Internet;
"Backbone connection point" means the connection point between the backbone and the backhaul;
"Local Broadband Access Points" (LBAPs) will comprise of the buildings and related physical structures, as well as the telecommunications equipment housed within. It is likely that every administrative-territorial unit will have a LBAP;
"Backhaul network (distribution)" is defined as the intermediate network links between the backbone and the access sections of the network, consisting in connections of the individual LBAPs to backbone, via broadband links. In the area of the intervention of this project, the backhaul consists of the intermediate links extending from the existing backbone network to the newly constructed LBAPs or among the newly constructed LBAPs, including the equipment in the LBAP and equipment for the backbone insertion points;
"Local loop (last mile)" means the physical circuit connecting the customer premises to a distribution frame or equivalent facility/aggregation point (LBAP)"

Figure 18: Indicative broadband infrastructure model

b) Bundling service objectives with unnecessary infrastructure requirements

Another typical non-technological roadblock for satellite broadband is somehow related to the principle of territoriality foreseen in the regional (ERDF) and agricultural (EARDF) funds.
In fact, depending on its interpretation, this principle can restrict the technology solutions eligible to grants to terrestrial wired and wireless ones only.
The most significant example is the Polish Operational Programme Innovative Economy (OPIE) 2007-2013, January 2009, measure 8.4. The text on the objective: "Ensuring Internet access at the 'last mile' level", includes the following requirements:

- "[…]. creating a possibility of direct provision of access to Internet service at the so called 'last mile' […]."
- "projects based on co-financing construction of a dedicated teleinformation infrastructure between the nearest or most effective point of Internet distribution and target group(s)"

However, restriction of technical solutions to 'construction' and 'nearest point of Internet distribution' is adding unnecessary infrastructural constraints to the service requirement and the actual objective of bids, and is also in contradiction with the EU principle of "Use of existing infrastructure" applicable to State Aids.
As a result, projects submitted by ISPs that proposed satellite broadband access were rejected on pretext of "Satellite networks do not contribute to the creation of a public terrestrial infrastructure" and "Connection must be established between the nearest or most effective point of Internet distribution and the end user".

c) Non-observance of the Technology Neutrality principle

In spite of the commonly-accepted principle of technology neutrality in public procurements. there have been instances where a different treatment was given to different technologies within calls for tender.

The most significant example is again the Polish OPIE mentioned above. Some reviewed technical criteria for the call, published in October 2012, included the following award criterion: "The various technologies are assigned the following maximum number of points:"

Network implemented in fibre optic technology (FTTH)	*35*
Network implemented in fibre optic and copper technology (FTTC, FTTB)	*30*
Cable television networks made of coaxial cables	*25*
Networks implemented in copper technology	*20*
Radio systems in protected band	*7*
Radio systems in unprotected band	*5*
Data network on Power Line, or satellite systems	*5*

This award criterion contrary to the principles of technology neutrality as it scores the technology rather than the capability of the solutions provided. As a result, no satellite bid was selected among the various proposals – although broadband internet service in line with the objective of the call (direct provision of access to broadband Internet service at the so called "last mile" level) – can be provided also via satellite in an effective way in Poland.

d) Supposed lack of open access in satellite broadband

The lack of knowledge and understanding of the value chain for satellite broadband, namely of the difference between wholesale and retail, is at the origin of another non-technological roadblock based on the pro-competitive concept of open access, that has to be applied in broadband procurement in compliance with the Telecom Package Directives and the State Aid Guidelines for

Broadband.

For instance, in this regard, the previously mentioned WIK report states that: "It seems that one of the reasons why satellite operators do not usually participate in such tenders is that aid beneficiaries have to provide open access to the subsidized network, and satellite operators are not ready to do that by disclosing the existing access protocols".

However, as explained in the section 3.6.1:

Satellite operators are not present in the retail market, and no vertical integration exists in the European satellite market between the service providers and the operators (owners of the infrastructures)

This alleged lack of open access is sometimes used to exclude satellite broadband from the eligible solutions in State Aid decisions and Call for Tenders / Proposals.

In reality, open access in the satellite service provision is guaranteed via 'bitstream', the sole wholesale access product that complies with the specific network architecture of the satellite solutions[27].

Bitstream refers to the provision of transmission capacity to service providers which offer their own value-added services to their customers. Therefore "satellite ensures open access via an active infrastructure" [28].

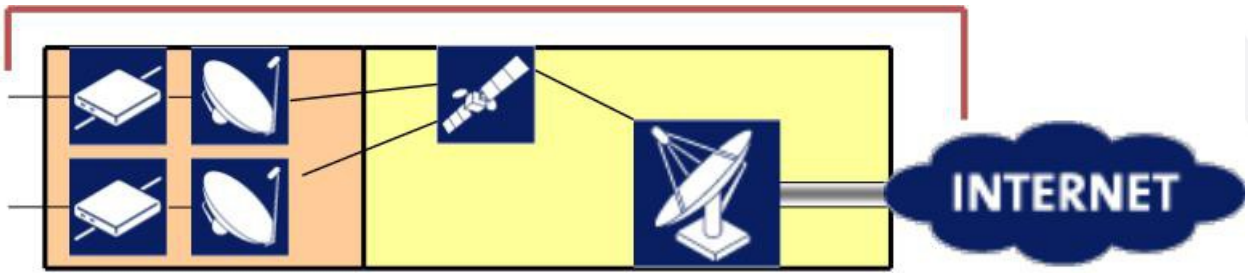


Figure 19: Bitstream service model

[27] Draft EU Guidelines for the application of state aid rules in relation to the rapid deployment of broadband networks, 2012

[28] Guide to broadband investment, Analysys Mason, September 2011

In addition, measures supporting the deployment of broadband satellite solutions introduce less competition distortion than the measures supporting terrestrial networks: the aid, if any, is provided for customer premise equipment (satellite ground equipment / terminals), and the beneficiaries are the end users (households, SMEs and Public Authorities) and not the satellite operators. Indirect beneficiaries are the satellite ISPs which sell, install and maintain the CPEs.

Finally, the information provided in 37 shows that competition exists in every EU country among the satellite operators (at different orbital positions) as well as among satellite ISPs working at the same orbital position.

5.3 Recommended Solutions

The preliminary analysis developed in this chapter has identified non-technological roadblocks towards satellite broadband deployment, even in the European areas that have no prospect of being efficiently and cost-effectively served with terrestrial solutions.

These roadblocks often prevent the use of EU funds and public funds in calls for tender / calls for proposal or other public procurement schemes for satellite based solutions in some countries.

The introduction of plausible adaptations and improvements – intended to better include satellite-based solutions among the ones supported by EU funds for the achievement of 100% EU broadband coverage – to this current, anti-competitive situation, require the pro-active assistance and support of the EC.

There is a need to clarify and improve, ideally through a minimum set of common, clear guidelines to be drawn up by the EC for the attention of the various public stakeholders in EU Member States and Regions, many of the existing rules which are often designed with terrestrial infrastructures in mind. In particular:

- The principle of technology neutrality (level playing field between the various technologies) should be genuinely implemented.
- An *ex-ante* cost-benefit analysis of the various solutions for broadband connectivity should be mandatory, as the competitive tender procedure alone does not guarantee the choice of the most efficient and cost-effective solution
- A proper consideration should be given to the specificities of the satellite network architecture (e.g. no separation between backhaul and access).
- Satellites should be explicitly recognised as existing infrastructure, and as such potentially able to significantly reduce the investments costs in certain areas.
- The clear eligibility of the satellite equipment to public funding should be re-stated.

- Due consideration should be given by the EC to update the various broadband and State Aid guidelines to reflect the observations outlined in this deliverable.

6. Acronyms

ACM	Adaptive Coding And Modulation
ADSL	Asymmetric Digital Subscriber Line
ARPU	Average Revenue per User
CMTS	Cable Modem Termination System
COCOM	Coordinating Committee on Multilateral Export Controls
CPE	Customer Premise Equipment
DAE	Digital Agenda for Europe
DSL	Asymmetric Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
DVB	Digital Video Broadcasting
DIY	Do it Yourself
EARDF	European Agricultural Regional Development Fund
EC	European Commission
ERDF	European Regional Development Fund
EU	European Union
FFTH	Fibre-to-the-home
FTTC	Fibre-to-the-cub
GDP	Gross Domestic Product
GEO sat	Geostationary Satellite
GPS	Global Positioning System
HD	High Definition
HDTV	High Definition Television
HFC	Hybrid-fibre-cable
HTS	High-Throughput Satellite
ISP	Internet Service Providers
IT	Information Technology
LTE	Long Term Evolution
M2M	Machine To Machine

NBN Co.	(National Broadband Network)
NGA	Next Generation Access
NOC	Network Operation Center
NSN	Nokia Siemens Network
NSR	Northern Sky Research
P2P	Peer-to-Peer
QoS	Quality of Service
RoI	Return on Investment
RUS	Department of Agriculture's Rural Utilities Service
SLA	Service Level Agreement
SMEs	Small Medium Enterprises
SoHo	Small Office Home Office
TelCos	Telecommunication Companies
TCP	Transmission Control Procedure
U.S.	United States
UK	United Kingdom
VNI	Virtual Networking Index
VoD	Video On Demand
VoIP	Voice over Internet Protocol
WEF	World Economic Forum

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8. Annex I - Satellite Internet Access: Retail Offer Database[29]

The present Annex collects an extensive database of retail offers of satellite-based consumer broadband internet in the countries represented in the SABER project (UK, Ireland, Germany, Austria, Switzerland, France, Italy, Poland, Romania, Slovenia, Hungary, Greece, Sweden, Norway and Spain), provided both as general reference and as a potential input of the preliminary market analysis for Public Authorities aiming to address broadband gaps in their territory.

The document includes the offers currently available to consumers through different ISPs, that were identified or validated by the two satellite operators members of the SABER project (Eutelsat and SES), and by Hellas Sat. Therefore, the ISPs list was built with a neutral and comprehensive approach.

Regarding the retail offers, the main source of information has been the websites of the satellite ISP mentioned above; each record shows the ISP website link where the offer is published and can be independently checked at any time. This factual methodology is also aimed to provide a tool to enable periodical maintenance of the database itself.

The database is organized by country, and includes approximately 250 broadband retail offers (rows) organized around the main parameters (columns) essential to understand the quality of service (QoS) and the value for money - download speed, upload speed, monthly data volume where applicable, monthly subscription fees including local VAT, and price of CPE. For each retail offer the offering ISP, the satellite operator and the link to web offer are also provided.

The database shows a wide range of performances and of commercial conditions; this patterns confirms that this niche market, addressed in Europe only since 2007, is still evolving and competition is taking place at all levels of the value chain – among satellite operators on the technical ground, and among all actors (satellite operators, local ISPs and installers networks) on

[29] Disclaimer
"The present data have been validated by Eutelsat, Hellas Sat and SES on a voluntary basis. Avanti and Hispasat validation are still pending. The data have been extracted from publicly available sources and are subject to modification upon operators request"

the commercial ground. As an evidence, the most dynamic markets (f.i. France, Germany, UK, Spain, Italy) already show the most attractive and affordable offerings; a desirable target for all involved stakeholders would be to encourage a similar development in the other countries of the EU.

8.1 UK and Ireland

Speed		Volume	CPE purchase	End User pricing (incl. VAT)	Satellite operator	Local service provider (ISP)	Website	Update
Download (kbit/s)	Upload (kbit/s)	(GByte/month incl.)	EUR	(EUR/month)				
2048	1024	2	180	20,4	SES Broadband	Beyondsl	http://www.satelliteinternet.co.uk/packages?pkg=2	
8192	1024	8	156	36,0	SES Broadband	Beyondsl	http://www.satelliteinternet.co.uk/packages?pkg=3	
10240	1024	10	120	48,0	SES Broadband	Beyondsl	http://www.satelliteinternet.co.uk/packages?pkg=4	29/05/2013
20480	1024	20	0	60,0	SES Broadband	Beyondsl		
16384	1024	32	0	120,0	SES Broadband	Beyondsl	http://www.satelliteinternet.co.uk/packages?pkg=5	
20480	1024	50	0	168,0	SES Broadband	Beyondsl	http://www.satelliteinternet.co.uk/packages?pkg=6	
2048	256	2	348	15,6	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
6144	256	2	348	19,8	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
6144	256	4	348	27,6	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
6144	256	6	348	33,6	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
6144	256	8	348	39,6	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
10240	256	10	348	57,6	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	29/05/2013
2048	256	2	348	21,6	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
6144	256	4	348	38,4	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
6144	256	6	348	45,6	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
6144	256	8	348	54,0	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
10240	256	10	348	79,2	SES Broadband	Apogee	http://www.apogeeinternet.co.uk/	
20480	6144	10	TBC	28,7	Eutelsat Broadband	Bentley-Walker	www.bentley-walker.com/tooway/	
20480	6144	20/UNL	TBC	40,4	Eutelsat Broadband	Bentley-Walker	www.bentley-walker.com/tooway/	29/05/2013
20480	6144	30/UNL	TBC	52,1	Eutelsat Broadband	Bentley-Walker	www.bentley-walker.com/tooway/	
20480	6144	UNL	TBC	75,5	Eutelsat Broadband	Bentley-Walker	www.bentley-walker.com/tooway/	
2048	1024	2	TBC	27,9	Eutelsat Broadband	TowayDirect	http://www.toowaydirect.com/purchase/	
20480	6144	10	TBC	37,9	Eutelsat Broadband	TowayDirect	http://www.toowaydirect.com/purchase/	
20480	6144	20/UNL	TBC	47,9	Eutelsat Broadband	TowayDirect	http://www.toowaydirect.com/purchase/	29/05/2013
20480	6144	30/UNL	TBC	57,9	Eutelsat Broadband	TowayDirect	http://www.toowaydirect.com/purchase/	
20480	6144	UNL	TBC	79,9	Eutelsat Broadband	TowayDirect	http://www.toowaydirect.com/purchase/	
20480	6144	10	350	35,1	Eutelsat Broadband	BB Whereve	http://www.broadbandwherever.net/products/tooway.aspx	
20480	6144	20/UNL	350	46,8	Eutelsat Broadband	BB Whereve	http://www.broadbandwherever.net/products/tooway.aspx	29/05/2013
20480	6144	30/UNL	350	64,4	Eutelsat Broadband	BB Whereve	http://www.broadbandwherever.net/products/tooway.aspx	
20480	6144	UNL	350	87,8	Eutelsat Broadband	BB Whereve	http://www.broadbandwherever.net/products/tooway.aspx	
20480	6144	10/UNL	TBC	40,0	Eutelsat Broadband	DigiWeb	http://www.digiweb.ie/home/broadband/satellite	
20480	6144	20/UNL	TBC	59,0	Eutelsat Broadband	DigiWeb	http://www.digiweb.ie/home/broadband/satellite	29/05/2013
20480	6144	30/UNL	TBC	77,0	Eutelsat Broadband	DigiWeb	http://www.digiweb.ie/home/broadband/satellite	
20480	6144	UNL	TBC	112,0	Eutelsat Broadband	DigiWeb	http://www.digiweb.ie/home/broadband/satellite	
2048	1024	2	TBC	19,8	Eutelsat Broadband	Avonline	http://www.avonlinebroadband.co.uk/packages/	
20480	6144	10	TBC	30,0	Eutelsat Broadband	Avonline	http://www.avonlinebroadband.co.uk/packages/	
20480	6144	20/UNL	TBC	40,0	Eutelsat Broadband	Avonline	http://www.avonlinebroadband.co.uk/packages/	29/05/2013
20480	6144	30/UNL	TBC	50,0	Eutelsat Broadband	Avonline	http://www.avonlinebroadband.co.uk/packages/	
20480	6144	UNL	TBC	80,0	Eutelsat Broadband	Avonline	http://www.avonlinebroadband.co.uk/packages/	
20480	6144	10	TBC	40,0	Eutelsat Broadband	Onwave	http://www.onwave.ie/packages/broadband	
20480	6144	20/UNL	TBC	55,0	Eutelsat Broadband	Onwave	http://www.onwave.ie/packages/broadband	29/05/2013
20480	6144	30/UNL	TBC	70,0	Eutelsat Broadband	Onwave	http://www.onwave.ie/packages/broadband	
20480	6144	UNL	TBC	95,0	Eutelsat Broadband	Onwave	http://www.onwave.ie/packages/broadband	
512	128	3	599	15,6	Avanti	KryptonTV	http://www.kryptontv.co.uk/packages.php	
1024	256	5	599	24,0	Avanti	KryptonTV	http://www.kryptontv.co.uk/packages.php	
2048	516	6	599	32,4	Avanti	KryptonTV	http://www.kryptontv.co.uk/packages.php	
4096	1024	8	599	42,0	Avanti	KryptonTV	http://www.kryptontv.co.uk/packages.php	
8192	2048	10	599	51,6	Avanti	KryptonTV	http://www.kryptontv.co.uk/packages.php	
10240	2048	16	599	60,0	Avanti	KryptonTV	http://www.kryptontv.co.uk/packages.php	
1024	516	1	689	24,5	Avanti	Ethnetuk	http://ethnetuk.com/index.php?pageid=153	
2048	1024	2	689	27,4	Avanti	Ethnetuk	http://ethnetuk.com/index.php?pageid=154	
4096	1024	3	689	36,0	Avanti	Ethnetuk	http://ethnetuk.com/index.php?pageid=155	
6144	1536	4	689	41,8	Avanti	Ethnetuk	http://ethnetuk.com/index.php?pageid=156	
8192	1536	6	689	50,4	Avanti	Ethnetuk	http://ethnetuk.com/index.php?pageid=157	
10240	2048	8	689	85,0	Avanti	Ethnetuk	http://ethnetuk.com/index.php?pageid=158	
8192	2048	3	534	23,0	Avanti	Prime Sat	http://www.primesatellitebroadband.com/satellitebroadband.htm	
8192	2048	6	534	30,0	Avanti	Prime Sat	http://www.primesatellitebroadband.com/satellitebroadband.htm	
8192	2048	12	479	60,0	Avanti	Prime Sat	http://www.primesatellitebroadband.com/satellitebroadband.htm	
8192	2048	8	479	64,8	Avanti	Prime Sat	http://www.primesatellitebroadband.com/satellitebroadband.htm	

8.2 France

Speed Download (kbit/s)	Speed Upload (kbit/s)	Volume (GByte/month incl.)	CPE purchase EUR	End User pricing (incl. VAT) (EUR/month)	Satellite operator	Local service provider (ISP)	Website	Update
20480	2048	5	249	29,9	SES Broadband	Auvea	http://www.viveole.fr	29/05/2013
20480	2048	15	249	39,9	SES Broadband	Auvea	http://www.viveole.fr	
20480	2048	UNL	249	49,9	SES Broadband	Auvea	http://www.viveole.fr	
TBC	TBC	TBC	TBC	TBC	SES Broadband	Wibox	http://www.wibox.fr/contact/	29/05/2013
20480	2048	10	399	29,9	SES Broadband	Nordnet	http://www.nordnet.com/offres/internet-satellite/tarifs.php	29/05/2013
20480	6144	10	349	29,9	Eutelsat Broadband	Ozone	http://www.ozone.net	29/05/2013
20480	6144	20/UNL	349	39,9	Eutelsat Broadband	Ozone	http://www.ozone.net	
20480	6144	30/UNL	349	49,9	Eutelsat Broadband	Ozone	http://www.ozone.net	
20480	6144	UNL	349	71,9	Eutelsat Broadband	Ozone	http://www.ozone.net	
20480	6144	20/UNL	399	44,9	Eutelsat Broadband	Nordnet	http://www.nordnet.com/offres/internet-satellite-pro/notre-offre.php	29/05/2013
20480	6144	30/UNL	399	54,9	Eutelsat Broadband	Nordnet	http://www.nordnet.com/offres/internet-satellite-pro/notre-offre.php	
20480	6144	UNL	399	79,9	Eutelsat Broadband	Nordnet	http://www.nordnet.com/offres/internet-satellite-pro/notre-offre.php	
2048	1024	2	399	19,9	Eutelsat Broadband	Sat2Way	http://www.sat2way.fr	29/05/2013
20480	6144	10	399	29,9	Eutelsat Broadband	Sat2Way	http://www.sat2way.fr	
20480	6144	20/UNL	399	39,9	Eutelsat Broadband	Sat2Way	http://www.sat2way.fr	
20480	6144	30/UNL	399	49,9	Eutelsat Broadband	Sat2Way	http://www.sat2way.fr	
20480	6144	UNL	399	74,9	Eutelsat Broadband	Sat2Way	http://www.sat2way.fr	
2048	1024	2	Only for rental	19,9	Eutelsat Broadband	Connexion Verte	http://www.connexion-verte.fr	29/05/2013
20480	6144	10	Only for rental	29,9	Eutelsat Broadband	Connexion Verte	http://www.connexion-verte.fr	
20480	6144	20/UNL	Only for rental	39,9	Eutelsat Broadband	Connexion Verte	http://www.connexion-verte.fr	
20480	6144	30/UNL	Only for rental	49,9	Eutelsat Broadband	Connexion Verte	http://www.connexion-verte.fr	
20480	6144	UNL	Only for rental	74,9	Eutelsat Broadband	Connexion Verte	http://www.connexion-verte.fr	
20480	6144	10	350	29,9	Eutelsat Broadband	Alsatis	http://www.alsatis.com	29/05/2013
20480	6144	20/UNL	350	39,9	Eutelsat Broadband	Alsatis	http://www.alsatis.com	
20480	6144	30/UNL	350	49,9	Eutelsat Broadband	Alsatis	http://www.alsatis.com	
20480	6144	UNL	350	74,9	Eutelsat Broadband	Alsatis	http://www.alsatis.com	
20480	6144	10	TBC	29,9	Eutelsat Broadband	IDHD Net/ Universat	http://www.universat.fr/internet-par-satellite.php	29/05/2013
20480	6144	20/UNL	TBC	39,9	Eutelsat Broadband	IDHD Net/ Universat	http://www.universat.fr/internet-par-satellite.php	
20480	6144	30/UNL	TBC	49,9	Eutelsat Broadband	IDHD Net/ Universat	http://www.universat.fr/internet-par-satellite.php	
20480	6144	UNL	TBC	74,9	Eutelsat Broadband	IDHD Net/ Universat	http://www.universat.fr/internet-par-satellite.php	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.3 Germany

Speed Download (kbit/s)	Speed Upload (kbit/s)	Volume (GByte/month incl.)	CPE purchase EUR	End User pricing (incl. VAT) (EUR/month)	Satellite operator	Local service provider (ISP)	Website	Update
10240	256	UNL	TBC	30,0	SES Broadband	Filiago	https://www.filiago.org/produkte/bestellen/306/index.aspx	29/05/2013
2048	256	UNL	TBC	TBC	SES Broadband	Deutsche Telekom	http://www.telekom.de/is-bin/INTERSHOP.enfinity/WFS/EKI-GK-Site/de_DE/-/EUR/ViewError-NotFound;	29/05/2013
20480	6144	10	399	29,95	Eutelsat Broadband	Toowaysat	http://en.toowaysat.com/	29/05/2013
20480	6144	20/UNL	399	45,95	Eutelsat Broadband	Toowaysat	http://en.toowaysat.com/	
20480	6144	30/UNL	399	49,95	Eutelsat Broadband	Toowaysat	http://en.toowaysat.com/	
20480	6144	UNL	399	79,95	Eutelsat Broadband	Toowaysat	http://en.toowaysat.com/	
6144	1024	UNL	399	19,9	Eutelsat Broadband	SkyDSL	https://de.skydsl.eu/index.php?c=tariff&s=skydsl2p&cs=sky2pt9#	29/05/2013
12288	4096	UNL	399	29,9	Eutelsat Broadband	SkyDSL	https://de.skydsl.eu/index.php?c=tariff&s=skydsl2p&cs=sky2pt6	
20480	6144	UNL	399	49,9	Eutelsat Broadband	SkyDSL	https://de.skydsl.eu/index.php?c=tariff&s=skydsl2p&cs=sky2pt8	
2048	1024	2	TBC	19,9	Eutelsat Broadband	StarDSL	http://www.stardsl.de	29/05/2013
20480	6144	10	TBC	39,9	Eutelsat Broadband	StarDSL	http://www.stardsl.de	
20480	6144	20/UNL	TBC	49,9	Eutelsat Broadband	StarDSL	http://www.stardsl.de	
20480	6144	30/UNL	TBC	59,9	Eutelsat Broadband	StarDSL	http://www.stardsl.de	
20480	6144	UNL	TBC	99,9	Eutelsat Broadband	StarDSL	http://www.stardsl.de	
2048	1024	2	TBC	19,9	Eutelsat Broadband	Getnternet	http://www.getinternet.de/tarife-satelliten-dsl/	29/05/2013
20480	6144	10	TBC	29,9	Eutelsat Broadband	Getnternet	http://www.getinternet.de/tarife-satelliten-dsl/	
20480	6144	20/UNL	TBC	49,9	Eutelsat Broadband	Getnternet	http://www.getinternet.de/tarife-satelliten-dsl/	
20480	6144	30/UNL	TBC	59,9	Eutelsat Broadband	Getnternet	http://www.getinternet.de/tarife-satelliten-dsl/	
20480	6144	UNL	TBC	79,9	Eutelsat Broadband	Getnternet	http://www.getinternet.de/tarife-satelliten-dsl/	
6144	1024	UNL	500	30,0	Avanti	Filiago	https://www.filiago.org/produkte/bestellen/289/index.aspx	
10240	1024	UNL	500	40,0	Avanti	Filiago	https://www.filiago.org/produkte/bestellen/315/index.aspx	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.4 Italy

Speed Download (kbit/s)	Speed Upload (kbit/s)	Volume (GByte/month incl.)	CPE purchase EUR	End User pricing (incl. VAT) (EUR/month)	Satellite operator	Local service provider (ISP)	Website	Update
10240	1024	10	0	74,7	SES Broadband	Digitaria	http://store.digitaria.it/it/prodotti/websat	29/05/2013
16384	2048	16	0	98,3	SES Broadband	Digitaria	http://store.digitaria.it/it/prodotti/websat	
20480	2048	20	0	122,9	SES Broadband	Digitaria	http://store.digitaria.it/it/prodotti/websat	
20480	6144	10	349	24.90 then 31.90	Eutelsat Broadband	OpenSky	http://www.open-sky.it	29/05/2013
20480	6144	20/UNL	349	41,9	Eutelsat Broadband	OpenSky	http://www.open-sky.it	
20480	6144	30/UNL	349	51,9	Eutelsat Broadband	OpenSky	http://www.open-sky.it	
20480	6144	UNL	349	74,9	Eutelsat Broadband	Opensky	http://www.open-sky.it	
8192	2024	8	TBC	19.90 then 24	Eutelsat Broadband	Sitmar	http://www.sitmar.it	29/05/2013
12288	4096	16	TBC	30 then 35	Eutelsat Broadband	Sitmar	http://www.sitmar.it	
18432	6144	26	TBC	42 then 49	Eutelsat Broadband	Sitmar	http://www.sitmar.it	
18432	6144	50	TBC	80 then 89	Eutelsat Broadband	Sitmar	http://www.sitmar.it	
18432	6144	75	TBC	145 then 159	Eutelsat Broadband	Sitmar	http://www.sitmar.it	
8192	2024	8	TBC	19.90 then 24	Eutelsat Broadband	Magellano	http://www.magellanosat.it/tooway/	29/05/2013
12288	4096	16	TBC	34,9	Eutelsat Broadband	Magellano	http://www.magellanosat.it/tooway/	
18432	6144	26	TBC	53,9	Eutelsat Broadband	Magellano	http://www.magellanosat.it/tooway/	
18432	6144	50	TBC	89,9	Eutelsat Broadband	Magellano	http://www.magellanosat.it/tooway/	
8192	2024	UNL	360	29,0	Eutelsat Broadband	BroadSat	http://www.broadsat.com	29/05/2013
12288	4096	UNL	360	45,0	Eutelsat Broadband	BroadSat	http://www.broadsat.com	
18432	6144	UNL	360	59,9	Eutelsat Broadband	BroadSat	http://www.broadsat.com	
18432	6144	UNL	360	109,0	Eutelsat Broadband	BroadSat	http://www.broadsat.com	
6144	1024	UNL	399	29.90 then 19.90	Eutelsat Broadband	skyDSL	http://www.skydsl.eu	29/05/2013
12288	4096	UNL	399	39.90 then 29.90	Eutelsat Broadband	skyDSL	http://www.skydsl.eu	
20480	6144	UNL	399	69.90 then 59.90	Eutelsat Broadband	skyDSL	http://www.skydsl.eu	
20480	6144	10	323	26,9	Eutelsat Broadband	NoiSat	http://www.noisat.it/home.asp	29/05/2013
20480	6144	20/UNL	323	36,9	Eutelsat Broadband	NoiSat	http://www.noisat.it/home.asp	
20480	6144	30/UNL	323	46,9	Eutelsat Broadband	NoiSat	http://www.noisat.it/home.asp	
20480	6144	UNL	323	69,9	Eutelsat Broadband	NoiSat	http://www.noisat.it/home.asp	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.5 Spain

Speed Download (kbit/s)	Speed Upload (kbit/s)	Volume (GByte/month incl.)	CPE purchase EUR	End User pricing (incl. VAT) (EUR/month)	Satellite operator	Local service provider (ISP)	Website	Update
2048	256	UNL	TBC	TBC	SES Broadband	Quantis	http://www.quantis.es/spa/products/#	29/05/2013
1024	128	UNL	TBC	TBC	SES Broadband	Telecable	http://web.telecable.es/portal.do?IDM=9&NM=1	29/05/2013
20480	6144	10	299	29,9	Eutelsat Broadband	EuronaSAT	http://www.eurona.net/particulares/internet-satelite/	29/05/2013
20480	6144	20/UNL	299	39,9	Eutelsat Broadband	EuronaSAT	http://www.eurona.net/particulares/internet-satelite/	
20480	6144	UNL	299	69,9	Eutelsat Broadband	EuronaSAT	http://www.eurona.net/particulares/internet-satelite/	
2048	1024	2	300	17,9	Eutelsat Broadband	Mira Novas	http://www.internetrural.eu/intranet/Formulario	29/05/2013
20480	6144	10	300	25,9	Eutelsat Broadband	Mira Novas	http://www.internetrural.eu/intranet/Formulario	
20480	6144	20/UNL	300	33,9	Eutelsat Broadband	Mira Novas	http://www.internetrural.eu/intranet/Formulario	
20480	6144	30/UNL	300	42,9	Eutelsat Broadband	Mira Novas	http://www.internetrural.eu/intranet/Formulario	
20480	6144	UNL	300	60,9	Eutelsat Broadband	Mira Novas	http://www.internetrural.eu/intranet/Formulario	
2048	1024	2	TBC	19,9	Eutelsat Broadband	StarDSL	https://ssl.stardsl.es/	29/05/2013
20480	6144	10	TBC	39,9	Eutelsat Broadband	StarDSL	https://ssl.stardsl.es/	
20480	6144	20/UNL	TBC	49,9	Eutelsat Broadband	StarDSL	https://ssl.stardsl.es/	
20480	6144	30/UNL	TBC	59,9	Eutelsat Broadband	StarDSL	https://ssl.stardsl.es/	
20480	6144	UNL	TBC	99,9	Eutelsat Broadband	StarDSL	https://ssl.stardsl.es/	
20480	6144	10	399	29,9	Eutelsat Broadband	Broadband Algarve	http://www.broadbandalgarve.co.uk/21378/broadband-algarve-products/tooway-broadband-rental-for-home/	29/05/2013
20480	6144	20/UNL	399	39,9	Eutelsat Broadband	Broadband Algarve	http://www.broadbandalgarve.co.uk/21378/broadband-algarve-products/tooway-broadband-rental-for-home/	
20480	6144	30/UNL	399	59,9	Eutelsat Broadband	Broadband Algarve	http://www.broadbandalgarve.co.uk/21378/broadband-algarve-products/tooway-broadband-rental-for-home/	
20480	6144	UNL	399	69,9	Eutelsat Broadband	Broadband Algarve	http://www.broadbandalgarve.co.uk/21378/broadband-algarve-products/tooway-broadband-rental-for-home/	
1024	256	5	360	22,1	Avanti	algarve	http://www.broadbandalgarve.co.uk/20869/broadband-algarve-products/broadband-for-home/	
2048	516	6	360	32,9	Avanti	algarve	http://www.broadbandalgarve.co.uk/20869/broadband-algarve-products/broadband-for-home/	
4096	1024	8	360	41,5	Avanti	algarve	http://www.broadbandalgarve.co.uk/20869/broadband-algarve-products/broadband-for-home/	
8192	2048	10	360	55,4	Avanti	algarve	http://www.broadbandalgarve.co.uk/20869/broadband-algarve-products/broadband-for-home/	
10240	2048	16	360	77,5	Avanti	algarve	http://www.broadbandalgarve.co.uk/20869/broadband-algarve-products/broadband-for-home/	
512	128	3	714	24,0	Avanti	GlobaTel	http://globatel.net/residential/broadband-internet-via-satellite?lang=en	
1024	256	5	714	39,6	Avanti	GlobaTel	http://globatel.net/residential/broadband-internet-via-satellite?lang=en	
2048	516	6	714	57,6	Avanti	GlobaTel	http://globatel.net/residential/broadband-internet-via-satellite?lang=en	
4096	1024	8	594	74,4	Avanti	GlobaTel	http://globatel.net/residential/broadband-internet-via-satellite?lang=en	
8192	2048	10	594	99,6	Avanti	GlobaTel	http://globatel.net/residential/broadband-internet-via-satellite?lang=en	
1024	TBC	UNL	TBC	48,3	HispaSat	Quantis	http://www.quantis.es/spa/products/quantisduo	
2048	TBC	UNL	TBC	72,5	HispaSat	Quantis	http://www.quantis.es/spa/products/quantisduo	
4096	TBC	UNL	TBC	108,8	HispaSat	Quantis	http://www.quantis.es/spa/products/quantisduo	
8192	TBC	UNL	TBC	145,1	HispaSat	Quantis	http://www.quantis.es/spa/products/quantisduo	
8192	TBC	2	TBC	36,2	HispaSat	Quantis	http://www.quantis.es/spa/products/quantismax	
8192	TBC	5	TBC	54,3	HispaSat	Quantis	http://www.quantis.es/spa/products/quantismax	
8192	TBC	11	TBC	90,6	HispaSat	Quantis	http://www.quantis.es/spa/products/quantismax	
8192	TBC	15	TBC	120,9	HispaSat	Quantis	http://www.quantis.es/spa/products/quantismax	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.6 Poland

Speed Download (kbit/s)	Speed Upload (kbit/s)	Volume (GByte/month incl.)	CPE purchase EUR	End User pricing (incl. VAT) (EUR/month)	Satellite operator	Local service provider (ISP)	Website	Update
2048	256	UNL	TBC	TBC	SES Broadband	Orange	http://www.orange.pl/esupport_b2c_contact.phtml?footerlink=true	29/05/2013
2048	256	UNL	TBC	TBC	SES Broadband	Nask	http://www.nask.pl/run/n/kontakt	29/05/2013
2048	1024	2	TBC	21,7	Eutelsat Broadband	Avctrade	http://www.avctrade.com.pl/dladomu.htm	29/05/2013
10240	2048	10	TBC	28,1	Eutelsat Broadband	Avctrade	http://www.avctrade.com.pl/dladomu.htm	
10240	2048	16	TBC	39,9	Eutelsat Broadband	Avctrade	http://www.avctrade.com.pl/dladomu.htm	
20480	6144	20/UNL	TBC	47,0	Eutelsat Broadband	Avctrade	http://www.avctrade.com.pl/dladomu.htm	
20480	6144	30/UNL	TBC	56,5	Eutelsat Broadband	Avctrade	http://www.avctrade.com.pl/dladomu.htm	
20480	6144	UNL	TBC	80,1	Eutelsat Broadband	Avctrade	http://www.avctrade.com.pl/dladomu.htm	
8192	2048	8	362	28,1	Eutelsat Broadband	Hetan	http://www.hetan.pl/internet_satelitarny/internet_dla_domu	29/05/2013
12288	4096	16	362	47,0	Eutelsat Broadband	Hetan	http://www.hetan.pl/internet_satelitarny/internet_dla_domu	
18432	6144	26	362	56,5	Eutelsat Broadband	Hetan	http://www.hetan.pl/internet_satelitarny/internet_dla_domu	
18432	6144	50	362	94,3	Eutelsat Broadband	Hetan	http://www.hetan.pl/internet_satelitarny/internet_dla_domu	
8192	2048	8	352	23,4	Eutelsat Broadband	Infratel	http://www.infratel.pl/site,tooway,49.html	29/05/2013
12288	4096	16	352	42,3	Eutelsat Broadband	Infratel	http://www.infratel.pl/site,tooway,49.html	
18432	6144	26	352	61,2	Eutelsat Broadband	Infratel	http://www.infratel.pl/site,tooway,49.html	
18432	6144	50	352	103,8	Eutelsat Broadband	Infratel	http://www.infratel.pl/site,tooway,49.html	
2048	1024	2	354	21,0	Eutelsat Broadband	Kempa	http://www.kempa-satellite.com	29/05/2013
8192	2048	8	354	28,1	Eutelsat Broadband	Kempa	http://www.kempa-satellite.com	
12288	4096	16	354	42,3	Eutelsat Broadband	Kempa	http://www.kempa-satellite.com	
18432	6144	26	354	56,5	Eutelsat Broadband	Kempa	http://www.kempa-satellite.com	
18432	6144	50	354	94,3	Eutelsat Broadband	Kempa	http://www.kempa-satellite.com	
2048	1028	2	TBC	24,6	Eutelsat Broadband	StarDSL	https://ssl.stardsl.pl/	29/05/2013
10240	2048	10	TBC	29,3	Eutelsat Broadband	StarDSL	https://ssl.stardsl.pl/	
20480	6144	10	TBC	41,1	Eutelsat Broadband	StarDSL	https://ssl.stardsl.pl/	
20480	6144	20	TBC	50,6	Eutelsat Broadband	StarDSL	https://ssl.stardsl.pl/	
20480	6144	30	TBC	60,0	Eutelsat Broadband	StarDSL	https://ssl.stardsl.pl/	
2048	1024	2	388	21,6	Eutelsat Broadband	Wachowiak	http://www.internetsatelitarny.pl/tooway-dla-domu.html	30/03/2013
8192	2048	8	388	28,9	Eutelsat Broadband	Wachowiak	http://www.internetsatelitarny.pl/tooway-dla-domu.html	
12288	4096	16	388	43,5	Eutelsat Broadband	Wachowiak	http://www.internetsatelitarny.pl/tooway-dla-domu.html	
18432	6144	26	388	58,1	Eutelsat Broadband	Wachowiak	http://www.internetsatelitarny.pl/tooway-dla-domu.html	
18432	6144	50	388	96,9	Eutelsat Broadband	Wachowiak	http://www.internetsatelitarny.pl/tooway-dla-domu.html	

8.7 Romania

Speed Download (kbit/s)	Speed Upload (kbit/s)	Volume (GByte/month incl.)	CPE purchase EUR	End User pricing (incl. VAT) (EUR/month)	Satellite operator	Local service provider (ISP)	Website	Update
3072	256	3	TBC	TBC	SES Broadband	E-Sourcing	http://www.e-sourcing.ro/contact/	29/05/2013
2048	1024	2	TBC	25,0	Eutelsat Broadband	ToowaySat	http://www.toowaysat.ro/intrebari-frecvente_2-70-0	29/05/2013
8192	2048	8	TBC	35,0	Eutelsat Broadband	ToowaySat	http://www.toowaysat.ro/index.php?page=new_order_form	
12288	4096	16	TBC	45,0	Eutelsat Broadband	ToowaySat	http://www.toowaysat.ro/index.php?page=new_order_form	
18432	6144	26	TBC	60,0	Eutelsat Broadband	ToowaysSat	http://www.toowaysat.ro/index.php?page=new_order_form	
18432	6144	50	TBC	95,0	Eutelsat Broadband	ToowaySat	http://www.toowaysat.ro/index.php?page=new_order_form	
2048	1024	2	349,0	17,0	Eutelsat Broadband	Mediasat	http://www.mediasat.ro/tooway-abonamente.html	29/05/2013
8192	2048	8	349,0	21,0	Eutelsat Broadband	Mediasat	http://www.mediasat.ro/tooway-abonamente.html	
12288	4096	16	349,0	35,0	Eutelsat Broadband	Mediasat	http://www.mediasat.ro/tooway-abonamente.html	
18432	6144	26	349,0	51,0	Eutelsat Broadband	Mediasat	http://www.mediasat.ro/tooway-abonamente.html	
18432	6144	50	349,0	87,0	Eutelsat Broadband	Mediasat	http://www.mediasat.ro/tooway-abonamente.html	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.8 Slovenia

Speed Download (kbit/s)	Speed Upload (kbit/s)	Volume (GByte/month incl.)	CPE purchase EUR	End User pricing (incl. VAT) (EUR/month)	Satellite operator	Local service provider (ISP)	Website	Update
4096	256	4	420	30,0	SES Broadband	Elsat	http://www.elsat.si	29/05/2013
6144	256	5	420	40,0	SES Broadband	Elsat	http://www.elsat.si	
512	96	UNL	420	20,0	SES Broadband	Elsat	http://www.elsat.si	
1024	128	UNL	420	30,0	SES Broadband	Elsat	http://www.elsat.si	
2048	256	UNL	420	40,0	SES Broadband	Elsat	http://www.elsat.si	
8192	2048	8	TBC	33,0	Eutelsat Broadband	satelitski-internet	http://satelitski-internet.si/	29/05/2013
12288	4096	16	TBC	47,0	Eutelsat Broadband	satelitski-internet	http://satelitski-internet.si/	
18432	6144	26	TBC	63,0	Eutelsat Broadband	satelitski-internet	http://satelitski-internet.si/	
18432	6144	50	TBC	99,0	Eutelsat Broadband	satelitski-internet	http://satelitski-internet.si/	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.9 Hungary

Speed Download (kbit/s)	Speed Upload (kbit/s)	Volume (GByte/month incl.)	CPE purchase EUR	End User pricing (incl. VAT) (EUR/month)	Satellite operator	Local service provider (ISP)	Website	Update
3072	256	3	TBC	TBC	SES Broadband	VanNet	http://vannet.hu/contact	29/05/2013
20480	6144	10	275	40,0	Eutelsat Broadband	SatDSL	http://internet.mediaservices.hu/en/products/tooway-satdsl	29/05/2013
20480	6144	20	275	53,0	Eutelsat Broadband	SatDSL	http://internet.mediaservices.hu/en/products/tooway-satdsl	
20480	6144	30	275	66,0	Eutelsat Broadband	SatDSL	http://internet.mediaservices.hu/en/products/tooway-satdsl	
20480	6144	UNL	275	125,0	Eutelsat Broadband	SatDSL	http://internet.mediaservices.hu/en/products/tooway-satdsl	
8192	2048	8	TBC	24,4	Eutelsat Broadband	VanNet	http://www.btel.hu/lakossagi/muholdas_internet	29/05/2013
12288	4096	16	TBC	62,1	Eutelsat Broadband	VanNet	http://www.btel.hu/lakossagi/muholdas_internet	
18432	6144	25	TBC	96,8	Eutelsat Broadband	VanNet	http://www.btel.hu/lakossagi/muholdas_internet	
18432	6144	50	TBC	173,1	Eutelsat Broadband	VanNet	http://www.btel.hu/lakossagi/muholdas_internet	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.10 Cyprus

Speed		Volume	CPE purchase	End User pricing (incl. VAT)	Satellite operator	Local service provider (ISP)	Website	Update
Download (kbit/s)	Upload (kbit/s)	(GByte/month incl.)	EUR	(EUR/month)				
512	96	UNL	412	41,0	HellasSat	Hellas Sat	http://www.hellas-sat.net/en/home_500.html	29/05/2013
1024	128	UNL	412	51,3	HellasSat	Hellas Sat	http://www.hellas-sat.net/en/home_1000.html	
512	256	UNL	1488,3	146,38	HellasSat	Hellas Sat	http://www.hellas-sat.net/gr/business_500.html	29/05/2013
1024	256	UNL	1488,3	244,78	HellasSat	Hellas Sat	http://www.hellas-sat.net/gr/business_1000.html	29/05/2013
1024	512	UNL	1488,3	367,78	HellasSat	Hellas Sat	http://www.hellas-sat.net/gr/business_1000_plus.html	29/05/2013
2048	512	UNL	1488,3	675,28	HellasSat	Hellas Sat	http://www.hellas-sat.net/gr/business_2000.html	29/05/2013

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.11 Greece

Speed		Volume	CPE purchase	End User pricing (incl. VAT)	Satellite operator	Local service provider (ISP)	Website	Update
Download (kbit/s)	Upload (kbit/s)	(GByte/month incl.)	EUR	(EUR/month)				
512	96	UNL	412	41,0	HellasSat	Hellas Sat	http://www.hellas-sat.net/en/home_500.html	29/05/2013
1024	128	UNL	412	51,3	HellasSat	Hellas Sat	http://www.hellas-sat.net/en/home_1000.html	
512	256	UNL	1488,3	146,38	HellasSat	Hellas Sat	http://www.hellas-sat.net/gr/business_500.html	
1024	256	UNL	1488,3	244,78	HellasSat	Hellas Sat	http://www.hellas-sat.net/gr/business_1000.html	
1024	512	UNL	1488,3	367,78	HellasSat	Hellas Sat	http://www.hellas-sat.net/gr/business_1000_plus.html	
2048	512	UNL	1488,3	675,28	HellasSat	Hellas Sat	http://www.hellas-sat.net/gr/business_2000.html	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.12 Sweden

Speed		Volume	CPE purchase	End User pricing (incl. VAT)	Satellite operator	Local service provider (ISP)	Website	Update
Download (kbit/s)	Upload (kbit/s)	(GByte/month incl.)	EUR	(EUR/month)				
2048	1024	2	TBC	22,7	Eutelsat Broadband	RBcom	http://www.rbcom.se/tooway-prislista/	
20480	6144	10	TBC	34,3	Eutelsat Broadband	RBcom	http://www.rbcom.se/tooway-prislista/	
20480	6144	20/UNL	TBC	45,9	Eutelsat Broadband	RBcom	http://www.rbcom.se/tooway-prislista/	29/05/2013
20480	6144	30/UNL	TBC	57,5	Eutelsat Broadband	RBcom	http://www.rbcom.se/tooway-prislista/	
20480	6144	UNL	TBC	92,4	Eutelsat Broadband	RBcom	http://www.rbcom.se/tooway-prislista/	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.

8.13 Norway

Speed		Volume	CPE purchase	End User pricing (incl. VAT)	Satellite operator	Local service provider (ISP)	Website	Update
Download (kbit/s)	Upload (kbit/s)	(GByte/month incl.)	EUR	(EUR/month)				
8192	2048	8	631	53,12	Eutelsat Broadband	Radio Link	https://www.radio-link.no/privat.html	30/03/2013
12288	4096	16	631	66,44	Eutelsat Broadband	Radio Link	https://www.radio-link.no/privat.html	
18432	6144	26	631	79,75	Eutelsat Broadband	Radio Link	https://www.radio-link.no/privat.html	
18432	6144	50	631	119,7	Eutelsat Broadband	Radio Link	https://www.radio-link.no/privat.html	
2048	1024	2	TBC	52,51	Eutelsat Broadband	Direct Connect	http://www.directconnect.no/privat/produktoversikt/satellittbredbaand/	29/05/2013
20480	6144	10	TBC	65,67	Eutelsat Broadband	Direct Connect	http://www.directconnect.no/privat/produktoversikt/satellittbredbaand/	
20480	6144	20	TBC	78,83	Eutelsat Broadband	Direct Connect	http://www.directconnect.no/privat/produktoversikt/satellittbredbaand/	
20480	6144	30	TBC	91,99	Eutelsat Broadband	Direct Connect	http://www.directconnect.no/privat/produktoversikt/satellittbredbaand/	
20480	6144	UNL	TBC	105,14	Eutelsat Broadband	Direct Connect	http://www.directconnect.no/privat/produktoversikt/satellittbredbaand/	

Note: activation and/or logistics fees and minimum contract commitment not included in this analysis and to be checked with the local ISP.