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OVERVIEW OF THE GLOBAL MARKET FOR SATELLITE BROADBAND ACCESS SYSTEMS

Broadband Internet access is becoming an integral part of the daily life of an increasing number of people on Earth. Currently, about 60% of the world's population has access to the network. At the same time, about 3 billion people around the world still remain outside the World Wide Web. Broadband access technologies are various. While in Europe, the USA, and Russia it is mainly a cable, developing regions of the world, for example, Africa, use mobile connections. And if in developed countries, “broadband” is considered to be a connection at a speed of at least 10-20 Mbit/s, for the developing it is much lower, about 1-2 Mbit/s.

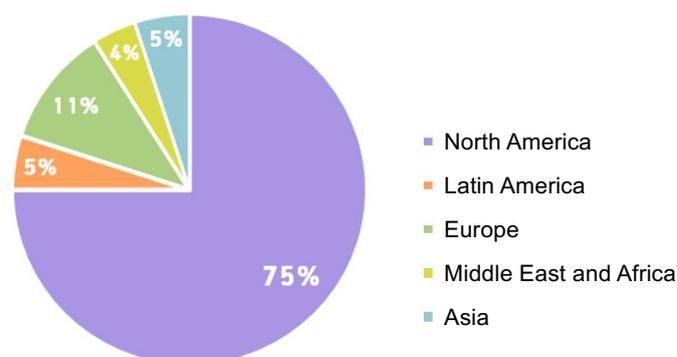
Connecting individual broadband access subscribers via satellite is a rather rare phenomenon on the scale of global access channels to the global network, however satellite is often the only possible physical or economic way to connect remote Internet users located in hard-to-reach and remote places, or in an area where there is no stable broadband connection. This article provides an overview of the global satellite broadband market in different regions of the world.

Satellite broadband is an access channel organized by an Internet service provider via satellite for individual users or a group of users, as well as for a household or small office. The main criterion for satellite broadband access is to provide the service on the conditions of the same level of access to the resource to all users, without creating dedicated networks with defined SLAs.

All statistical and analytical data, unless otherwise indicated, are as of the beginning of 2019. Currently, all subscribers work through geostationary communication systems. For the operation of broadband access systems, VSAT equipment is used, which operates mainly in the Ka-frequency band (19-20 / 28-29 GHz).

Overview of the global market. So, there are about 2.7 million subscribers of satellite broadband access in the world. $\frac{3}{4}$ of them are located in North America (Figure 1).

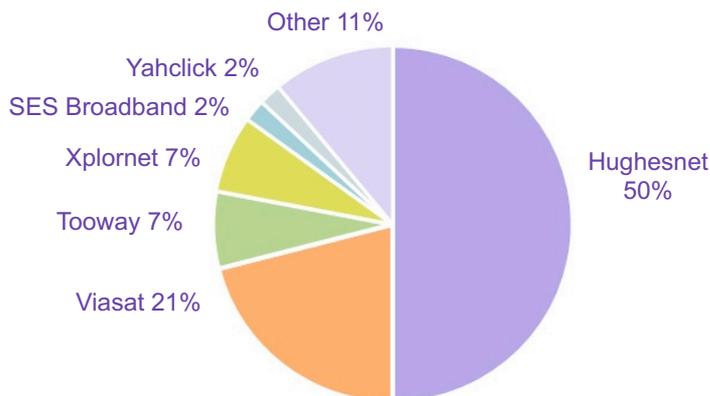
Fig. 1. Distribution of satellite broadband subscribers by regions of the world.



The market for two-way satellite broadband for end users in its current configuration was originally born in the United States in 2010. Therefore, the leader in the number of connected subscribers is the American service providers HughesNet and Viasat (Fig. 2). At the same time, HughesNet is the undisputed leader with more than 1.3 million

subscribers in the USA, Mexico, Brazil, Colombia, Peru, Chile and Ecuador. The Canadian operator Xplornet and the European network Tooway (Eutelsat) are in third place.

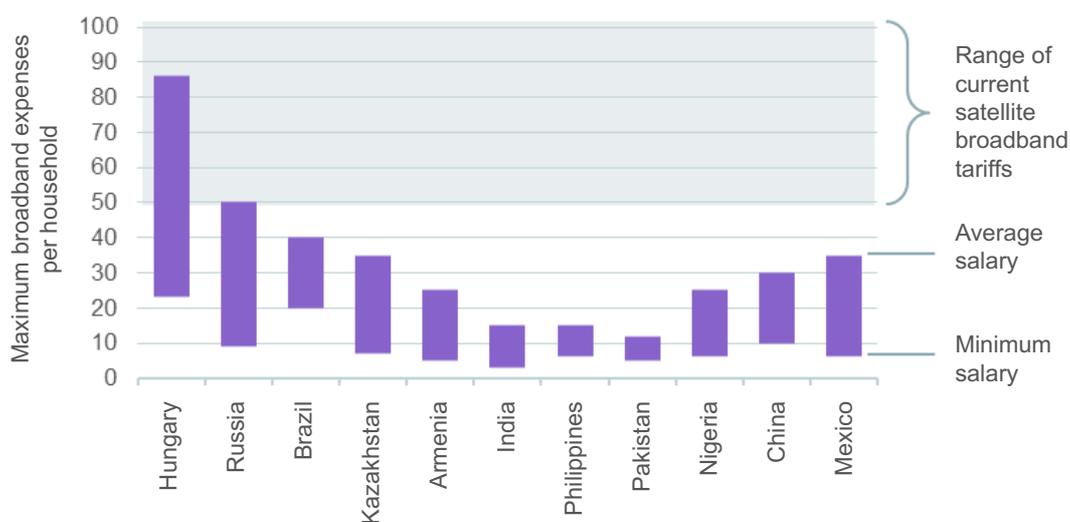
Fig. 2. Distribution of subscribers by satellite broadband systems.



Most satellite broadband subscribers are located in developed countries: in North America, Western Europe and Australia, where the successful implementation of this service is often the result of government support through growth packages. For example, in 2009 the USA the government allocated \$ 100 million for the development of satellite broadband. Many countries include satellite broadband in national broadband development programs or universal communications services, as, for example, Australia, where NBN, the state-owned satellite broadband operator was created.

The current tariffs does not yet allow us to talk about the massive commercial implementation of satellite broadband in most developing countries. The cost of the service is still above the level of the mass market. Figure 3 shows the ranges of the maximum possible spending of average residents of various countries on broadband access in the average and minimum segments of remuneration. According to studies of the European Commission, the maximum costs of broadband access in developing countries cannot exceed 5% of the monthly family income (Fig. 3).

Fig. 3. Maximum household expenses on broadband access in the middle and low wage segments in selected countries (US dollars per month).



High prices for equipment and services are an obstacle to expanding the satellite broadband subscriber base worldwide. The cost of attracting a subscriber can reach up to 700 US dollars, plus the cost of equipment and its installation. Many countries at the state level, as part of special programs, are trying to provide users with subsidies aimed at reducing the cost of initial payments when connecting to the service (Fig. 4). In France, the amount of 300 to



400 Euros is compensated for the acquisition of satellite kits. As a result, these subsidies allowed the country to increase the largest subscriber base in Europe. The UK government grants about £ 350 for radio-frequency equipment and installation. In Spain it is 400 Euro.

Fig. 4. Payment for services, installation fees and subsidies for satellite broadband

Country	Provider	Monthly payment	Installation fee	Equipment fee	Governmental subsidies
USA	Viasat/Hughes	\$50-150	Free-\$100	\$300-450	None
France	Eutelsat	\$15-115	\$115-290	\$395-465	\$350-465
UK	Tooway	\$75-110	\$450-500		\$460
Spain	Quantis (Europa)	\$25-135	Free	\$465-525	\$465
Australia	NBN (Sky Master)	\$22-141	Free	Free	None

In the future, subscriber growth in developed countries (USA and Western Europe) will continue, but the largest potential for growth of the satellite broadband market is in developing countries. Markets with a large rural population distributed over large territories (Brazil, some regions of Africa and Asia) are potentially ideal for developing the service, since connecting subscribers by cable or wireless terrestrial radio technology in such regions is not cost-effective. According to a study by the American analytical agency NorthernSkyResearch (NSR), the potential satellite broadband market in the world has about 450 million users (Fig. 5). Asia has the greatest potential, but even in North America, which is now the leader in the subscriber base, the penetration rate of satellite broadband access is only 15%.

Fig. 5. Potential subscribers of satellite broadband

Regions	Potentially active subscribers	Market share	Penetration rate (2018)
North America	12 983 471	3.0%	15.82%
Latin America	25 635 817	5.9%	0.57%
Europe	39 123 957	9.0%	0.74%
Middle East and Africa	121 796 748	28.1%	0.08%
Asia	234 169 691	54.0%	0.06%
Total	433 709 684	100.0%	0.63%

The main reasons for the low penetration of satellite broadband access worldwide are the low geographical and economic service availability, inefficient sales channels, lack of Internet skills, and lack of required content.

Issues of service affordability were discussed above. Choosing an effective service distribution scheme is also a great issue. High-throughput satellite systems (HTS) and the deployment of services based on them revolutionized the business models of satellite operators. Since the capacity of narrow beams can be limited to several thousand subscribers, and potential users are scattered throughout the country, the choice of the right sales channels and service distributors is a determining factor for success. Currently, there are four business models for the sale of satellite broadband in the world.

1. Direct sales. This business model is successfully applied by Hughes and Viasat as part of a fully integrated service providing chain - from satellite ordering to terminal production. Direct sales allow you to attract new customers as part of targeted marketing campaigns. However, such a model requires a seriously built-up service distribution network and is absolutely unique for the American market, since its volume and the homogeneous structure of potential users within one country allow for save on scale and logistics. Both operators also began to export this model to the markets of Latin America and Europe with varying degrees of success. The advantages of this model are strict focusing on marketing activities, full control over the process of providing services to the end user and a higher ARPU. However, this model is associated with increased risk, requires large capital costs and has a high cost of attracting a subscriber (about 700-800 US dollars).

2. Sale through specialized service providers. Other satellite operators such as Eutelsat, SES, Yahsat have limited their vertical integration at the network operation level (traffic management), since the integration of a service



and its sale is less productive within the cultural, linguistic, territorial and regulatory features of various target markets. In Russia, with its enormous distances and time zones, RSCC works according to this model and GSS plans to operate the same way. Within this business model, the satellite operator manages the service at the top level, while specialized distributors sell Internet access packages directly to subscribers. Usually they already have experience with VSAT installations, knowledge of the local market and can only focus on satellite solutions. However, this approach limits marketing resources and sales opportunities; the subscriber base is growing more slowly and brings lower ARPU.

3. Sale through telecom and Internet service providers. In this case, the seller of the service is a large regional or national telecom or Internet service provider. Such providers usually have a large customer base in terrestrial networks, great financial opportunities and a sales service, as well as serious experience in the segment of providing services to individuals. At the same time, the advantages of such operators are also their disadvantages: satellite Internet is not the main type of business for such providers, therefore there is competition within the company with the main type of business, sellers still prefer standard ground-based solutions. In addition, such operators there may not be enough experience installing satellite systems. Thaicom (IPStar), Eutelsat, Hispasat, Avanti use this model.

4. Implementation through Satellite Direct TV platform. This is a very expected cooperation, when a satellite TV subscriber is offered an additional satellite Internet access term. This model is widely used by ViaSat, Hughes, Xplornet, Telefonica (Movistar), Eutelsat (OTE). In Russia, Eutelsat Network works on this model in conjunction with Tricolor. The advantages are obvious: a huge customer base of satellite service, experience in installing satellite equipment and sales to individuals, a large distribution network in the regions. However, here, Internet access is not the main business for such a provider, in addition, most Satellite Direct TV platforms already have agreements with terrestrial Internet operators.

Next, we offer a more detailed look at each of the regions of the world.

North America. This regional market is the ancestor and the most successful example of the satellite broadband access development. Over the past ten years, the two largest providers Hughes and Viasat have increased their customer base to 1.3 million and 600 thousand subscribers, respectively. Operators are not going to stop there and in 2021 they are planning to launch new-generation satellites Jupiter-3 and Viasat-3, respectively, with a total bandwidth of 500 Gbit/s and 1 Tbit/s, respectively. The market is characterized by the highest ARPU - about \$75. The main success factors for the development of the American satellite broadband access market are: vertical integration, government support (vouchers), the size and homogeneity of the US market, whose population is 320 million people and especially its rural part (60 million), high purchasing power of the population, and also the high cost of ground solutions.

Latin America. In contrast to North America, where the development of the satellite broadband networks market is mainly related to the growth of traffic to the station, in Latin America this is due to the growth of the subscriber base. Over the past couple of years, it has grown rapidly to 200 thousand subscribers, while in 2018, the growth of new subscribers amounted to 75%. This is due to the launch of a number of HTS satellites in the Ka-band, as well as the successful export of Hughes's business model of the American market to Brazil, Colombia, Chile, Ecuador and Peru. As a result, Hughes occupies 60% of the Latin American market with 150 thousand users. The rapid growth of satellite connections is associated with huge pent-up demand, since in Brazil more than 70 thousand subscribers were connected in the first year by the Hughes network alone. Also, another American provider, Viasat, began working in the Brazilian market in partnership with Brazil's state-owned telecom provider Telebrasil. In both cases, providers had to move away from a fully vertically integrated model, and they leased satellite capacity from other satellite providers. Since Hughes and Viasat are trying to keep ARPU at a high level, this strategy is paying off so far by skimming, but the subscriber base growth rate is gradually slowing. Therefore, in future all players on the market will focus their services not only on private users, but also on collective access, that is WiFi access points.

Europe. This is the second largest broadband satellite market in the world (265 thousand). Here, more than half of the market is occupied by the satellite operator Eutelsat with a service based on the Ka-Sat spacecraft (144 thousand). Further growth of subscribers number in this network is limited to 100% coverage in the main national markets (France, Great Britain and Ireland), however, the situation should improve in 2021 with the launch of the new Konnekt satellite with a total capacity of 500 Gbit/s. The second and third places are SES (whose main customers are in Germany, France and England) and Avanti (Great Britain and Ireland). The subscriber base is 50 thousand users each. The potential for



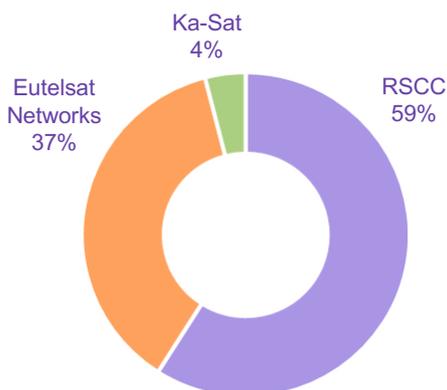
the development of satellite broadband in Europe still exists, since 4% of households in the EU have a broadband access of less than 4 Mbit/s, and 21% have less than 30 Mbit/s. The relatively low level of satellite use in Europe is explained by high competition with terrestrial networks, high prices for satellite capacity and a large number of heterogeneous national markets. The main growth of new subscribers is expected in Eastern Europe.

Middle East and Africa. This region the emerging market of satellite communications in general, however, the B2C sector is growing slower than B2B. The current market size is only 55 thousand subscribers. The market leader is the satellite operator Yahsat (UAE), which occupies about 40% of the market. Next are Eutelsat (20%) and Avanti (10%). All three operators ordered new HTS satellites with advanced capabilities, so the market growth is expected to be quite high - about 20% per year. The potential market is 121 million non-Internet households. However, nowadays, this market is the most difficult for satellite broadband providers for the following reasons. The slowdown in the economies of natural resource suppliers has led to a significant decrease in purchasing power. Sophisticated logistics, especially in Africa, as well as a large number of countries, languages and cultures, leads to a slower development of sales channels. Collecting and withdrawing money is also very difficult. The low level of digital skills, the lack of sufficient local content, the minimum number of premium country markets - all these issues make providers to focus mainly on serving small and medium businesses, as well as WiFi access points in partnership with Facebook, Google, Coca-Cola and others.

Pacific Rim. Such densely populated countries as China, India, and Indonesia belong to this region. However, the current market volume totals only 155 thousand subscribers of satellite broadband access. The leader is Australia (61%). Australia's leadership is explained by the fact that only this country in the region has a full-fledged market for satellite broadband access. This national market was fully formed by the state-owned operator NBN, created by the Australian government to connect 7% of the country's population not covered by landline networks. The state fully covers the expenses of the subscriber for equipment, and he pays only for traffic. The average ARPU of NBN is around \$45. The second major satellite broadband access system is IPStar, the world's first HTS launched by the Thai satellite operator Thaicom more than 15 years ago. A feature of this system is the Ku-band operation on the line between the subscriber station and the satellite. The project is successful, but over 15 years the subscriber base has amounted to only about 30 thousand subscribers. Despite the potential market for 235 million households, the satellite broadband penetration rate remains low. The reason is that most densely populated countries have their own national C/Ku band systems, and the development of their national broadband access programs is tightly related to national satellite systems. So, in 2018, India launched the HTS Ku-band GSAT-11 with a capacity of 11 Gb/s and is planning to launch another HTS in the Ka-band. In 2018, China launched the Chinasat-16 experimental satellite in the Ka-band (20 Gb/s) and is planning to launch VHTS, i.e. an ultra-high bandwidth satellite, for the domestic market in 2021. In Indonesia, in 2023 the HTS-band (150 Gb/s) is planned as part of the Satria state project, which provides for the connection of more than 150 thousand subscribers. Considering these projects, the growth of satellite broadband subscribers in this region is expected to be the highest - up to 35% per year.

Russia. At the end of 2019, the current Russian market is estimated at 27 thousand satellite broadband subscribers (Figure 6).

Fig. 6 Market shares of satellite broadband operators in the Russian market by the number of subscribers (November 2019).



RSCC is a leader in the number of connected subscribers is (about 16 thousand). The second major player is Eutelsat Networks, a subsidiary of Eutelsat (about 10 thousand subscribers according to expert estimates). The third potentially major market participant is GSS that completed the test of the new HTS Yamal-601 (30 Gb/s) at the end of 2019. The Russian market is one of the most dynamic in the world - 85% growth in 2018 and another 35% in 2019. The key to accelerating growth in the last two years is the final formation of the satellite broadband market in Russia and, as a result, more active sales of services of the recently launched HTS Express-AM5.6 and AMU-1. At the same time, the third player (Yamal-601) will continue the growth in 2020.

Forecasts. According to the forecasts of the American analytical agency NSR, which specializes in the space industry, by 2028 the global market for satellite broadband access can reach from 12 million (pessimistic forecast) to 18 million (optimistic forecast) subscribers. At the same time, North America will remain the largest market and Asia may become the leader if its national state programs are implemented. By 2028 the total turnover of the global satellite broadband market will reach \$ 126 billion. We will also see an exponential increase in supply, since the providers from all over the world are planning to launch a large number of HTS. The total bandwidth of all broadband satellite networks will be 43 Gbit/s.

In North America, ARPU will continue its growth due to increased traffic volumes with a primary focus on the premium segment. In Latin America, growth will continue through the introduction of entry-level service plans. In Europe, subscriber growth will be driven by lower satellite capacity tariffs. In Africa and the Middle East, providers will continue to focus on premium plans and segments (small and medium business). In Asia, the lowest cost of satellite traffic is expected due to state broadband development programs.

The issue of reducing the cost of subscriber equipment, that cannot be lower than \$ 300 per set without providers' subsidies, is particularly acute. This price is very high for most markets, not only developing, but also for many developed countries. And subsidizing terminals requires extensive measures and lots of money from the provider.

Undoubtedly, the development of the broadband access market in the next decade may be significantly affected by non-geostationary groups. However, their full implementation is planned not earlier than 2024-2025. Therefore, it is too early to speak not only about their commercial success, the price of traffic, the distribution system, business models and the cost of the terminal, but also about the possible work on the broadband access market in general. These systems, despite the initially declared focus on the broadband access market, then ultimately go to more marginal and highly profitable segments, such as trunk lines for Internet providers and mobile operators, communications on mobile facilities, networks for law enforcement agencies and corporations. Such a fate befell the system in the middle O3B orbits. OneWeb also seems to follow this way, focusing its marketing efforts in the same markets.

In general, the cornerstone of the successful development of satellite broadband is government support of national programs for the development of communications and digitalization of the economy, as well as reducing the cost of terminals or stabilizing the economic situation in developing countries.

p.s. In the preparation of this article, we used open data about the participants of the international satellite communications market, analytical studies of NSR and Euroconsult consulting companies, as well as RSCC own data.

