The Flight Department's manual for selecting private jet Wi-Fi

Global connectivity for your aircraft

Viasat™

For private aviation passengers who travel around the world, staying connected in transit is paramount to business – and life – continuity. And while it's generally recognized that in-flight connectivity is a must especially for business jets, sifting through all the available connectivity options can be overwhelming.

Viasat knows the importance of keeping you connected, so in the following pages we'll walk you through the basics of in-flight connectivity for private jets, from the available technologies to what to consider when choosing a connectivity provider.

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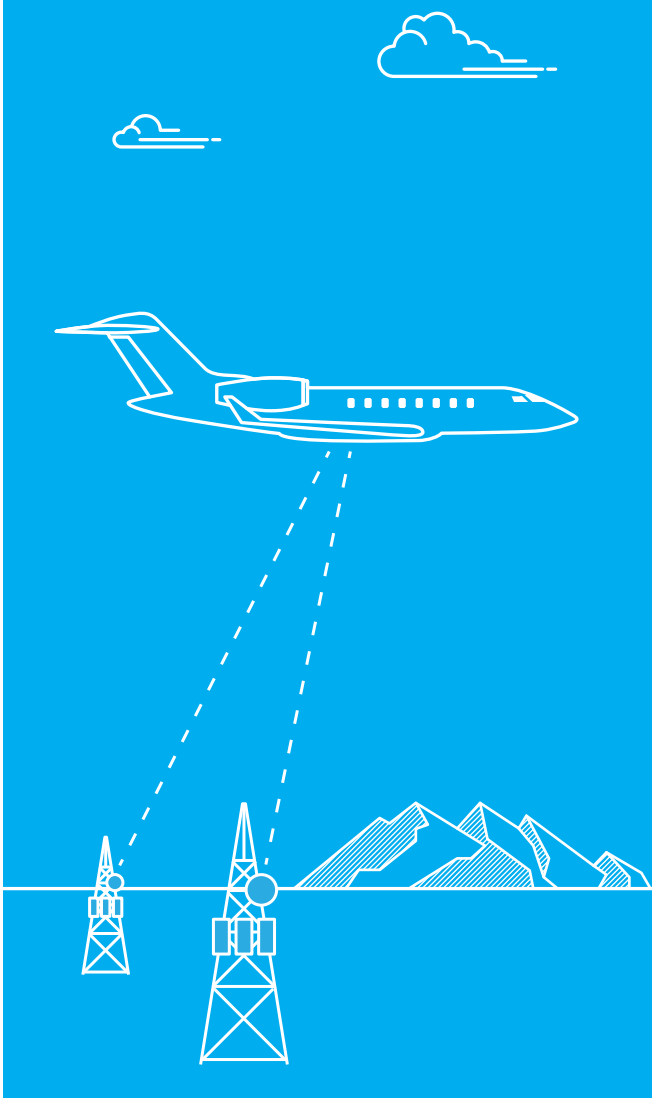
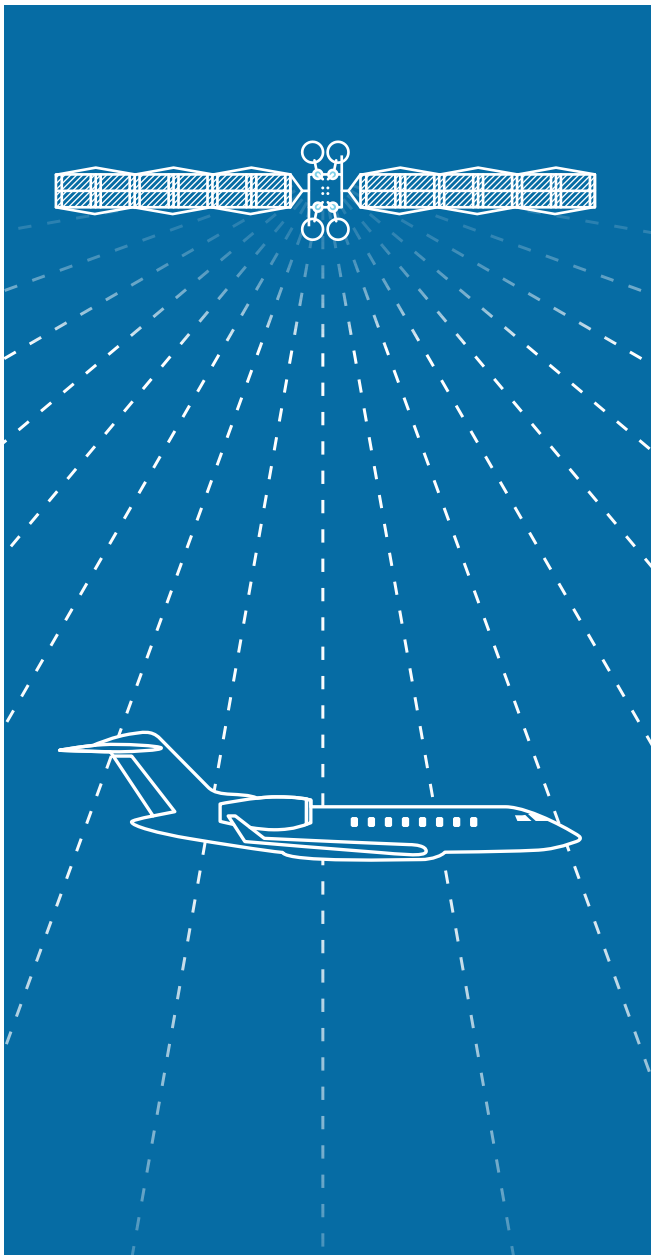
In-flight connectivity basics

Types of technology

Air-to-Ground (ATG) works with a network of ground-based towers and doesn't provide internet service to aircraft flying over water or parked on the ramp because ATG communicates with cell towers and base stations that are on land.

If you need a global solution and/or the fastest speeds to the aircraft, ATG isn't the right technology.





Satellite solutions work virtually everywhere the plane flies, including over oceans because the internet signal from the aircraft communicates with satellites that sit thousands of miles above the earth's atmosphere. State-of-the-art satellite solutions offer the fastest speeds to the aircraft.

Frequency bands

The two main communication bands in operation today by satellites are Ka and Ku-band. In the simplest terms, the bands refer to the frequency range of the signal.

Ka-band
Ka, or 'above K' band, operates in the frequency range between 26.5-40 GHz. Since there is more spectrum available, up to 7 times more than Ku, it enables more capacity, bandwidth and increased user speeds. However, Ka-band is not as widely available as Ku-band as it's a newer technology.

Ku-band
Ku, or 'under K' band, operates in the 12-18GHz frequency range and depending on the in-flight Wi-Fi solution and service provider, you can still receive similar speeds to Ka-band. Email, text, browsing, business data applications and streaming can be conducted within the amount of spectrum available in this frequency.

Satellite orbits[1]

The orbit that a satellite takes around the world has an effect not only on the area of signal coverage it can offer, but also on the speed of the connection.

There are four different categories of orbits that satellites use, although two of those categories are split into two sub-categories.

LEO
LEO stands for low earth orbit. As the name suggests, LEO is the lowest orbit around the earth that a satellite can take.

The main advantage of LEO satellites is that a signal takes the shortest amount of time to reach an aircraft from the satellite. The major disadvantage is that because the satellites are in such a low orbit, many of them are needed to achieve global coverage. For aviation users, switching between satellites would be frequent, with potential drops in service during the transitions. The satellites are also subjected to much harsher atmospheric conditions, so generally their lifespans are much shorter than those located in a higher orbit.

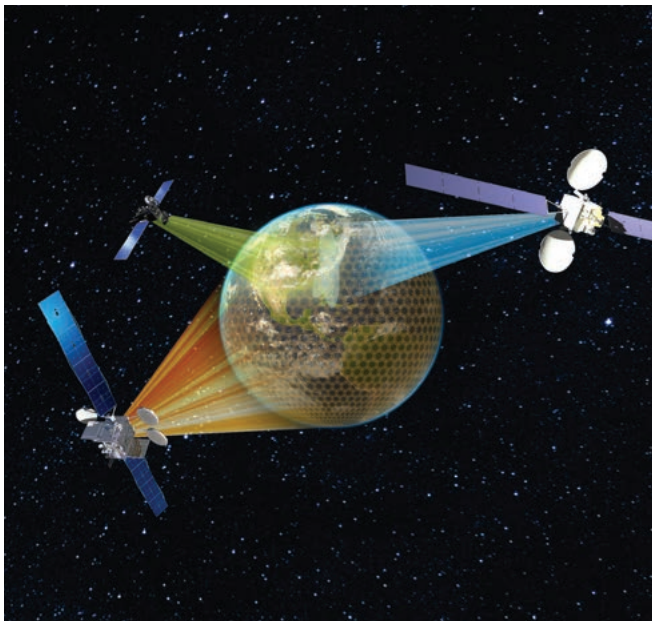
MEO
MEO, or medium earth orbit, sits between LEO and GEO orbits, with an average height of 12,550 miles above sea level. The actual space defined as MEO is the widest of all categories, stretching from 1,240 miles to 22,236 miles.

Because satellites are in a higher orbit than those in a low earth orbit, the signal that they transmit is visible in one location for a longer period. Therefore, fewer satellites are needed for global coverage than those in LEO.

GEO
GEO covers two distinct types of orbits: geostationary and geosynchronous.

While both orbits involve the satellite moving around the earth as it turns, the main difference is that geostationary satellites move at the same rate as the position of the ground they are orbiting, so they appear fixed in the sky.

Geostationary and geosynchronous satellites are both launched high into the atmosphere, at an average height of 22,236 miles above sea level, with the advantage being that as they are so high they can cover more of the earth. It is because of this that Viasat only needs three GEO satellites to cover the entire planet.



[1] Viasat Intelligence and Corporate Jet Investor

Why more capacity means more speed

Capacity is the engine behind high-speed internet bandwidth.

Everything done online, from email to streaming video, takes the form of data bits. Capacity is the maximum number of data bits the in-flight connectivity network can accommodate and send to all users of the service over a given period.

Speed is the velocity at which data can be sent through the network directly to the user's device.

One way to think of capacity and speed is as similar to the number of lanes on an urban highway or interstate freeway. The more lanes, the more vehicles can be accommodated. The number of lanes may be adequate to allow smooth traffic flow — at least at times of the day when it is relatively light. But during heavy traffic periods, such as the morning or evening commute hours, the volume of cars coming onto the road constrains total lane capacity, cutting vehicular speed to a crawl or standstill.

Bandwidth is a major factor in determining capacity. As with a build-up of motor vehicles taxing the capacity of highway lanes, heavy usage can also impact internet speed, significantly slowing the transmission of data bits. The more users on a network without enough capacity, the more the service degrades, which is why capacity is so important. If the capacity is substantially large, more data bits can flow through the satellite network, even during high internet traffic periods, resulting in a faster, higher quality connectivity experience per individual user.

The most capacity

Our ViaSat-1 satellite earned a Guinness World Records® title as the highest-capacity communications satellite in the world. At the time of its launch, ViaSat-1 had more capacity than all the other communication satellites covering North America combined. This means we provide the most total throughput capacity over the U.S. and Canada — **100 times the capacity of a typical Ku-band satellite and 10 times the throughput of any Ka-band satellite launched prior to ViaSat-1.** Combined with the company's innovative ground system, the new system is transforming the economics and quality of service offered by satellite Internet service.

With our unrivaled capacity we can deliver higher connection speeds to all passengers on your aircraft – at the same time. Viasat's satellite fleet will soon provide more than twice the total combined network capacity of the commercial communications satellites in space today. Network flexibility means Viasat can concentrate capacity in highly congested air corridors or hubs so the connectivity experience remains consistent for each passenger.

In a nutshell, the more capacity in the network, the more bandwidth for each user, and the better — and faster — the internet experience will be.

The ROI of private jet in-flight connectivity

Determining the true total ROI on fast, reliable in-flight connectivity is a complex equation. Some of the factors private aviation customers should take into consideration to determine value include:

- Business jet travelers demand it
- Loyalty for charter/fractional companies, and repeat bookings
- Forward compatibility of technology
- Increased resale value of plane

For the latter, when choosing what features to add to a private jet when customizing, it's important to know that only a select few impact ROI and increase resale value.

In-flight Wi-fi is one of the most recommended private jet upgrades with a relatively high ROI.

Top 5 private jet upgrades:

1. In-flight Wi-Fi

Cost: starting at $350,000 w/installation, depending on system

Sourcing a global in-flight internet system that offers high speeds and forward-compatibility will protect your investment and bring up to 80% ROI.

2. ADS-B

Cost: $6,000-$8,000

The FAA mandated this navigation system be installed by 2020, and for a private jet, the under $10,000 price tag is a small price to pay for compliance.

There are hundreds of ways to customize a private jet, but only a few that will increase resale value.

3. Carpets & upholstery

Cost: $100,000-$300,000

New seat covers and carpet are easy interior upgrades with fast installation times. Neutral colors and minimalist designs bring the highest resale value.

4. Winglets

Cost: $400,000-$750,000

Winglets can reduce fuel consumption by 5-7% and flight time by 5-10 minutes. Less fuel and fewer hours equal lower operating costs and a higher resale value.

5. Galley improvements

Cost: $200-$2,000

Easily the lowest-priced upgrades, an espresso machine or in-flight oven bring the most gains for long-range private jets carrying passengers who eat multiple meals in the air.

The importance of forward compatibility

In-flight connectivity is an investment. So how can aircraft owners ensure that the in-flight connectivity systems they install today will remain useful five to ten years down the road, as connection speeds and data throughput continue to expand exponentially?

This expected increase in internet demand means that in-flight systems must deliver quality of internet connectivity not just today, but in the years to come. This is why business aircraft owners need to future-proof their systems to keep up with increases in internet connection speeds and bandwidth.

Even in the newest aircraft, an in-flight connectivity solution can quickly become yesterday's news. This is why a connectivity solution that can adapt to technology changes can help keep costs and downtime to a minimum. When it comes to connecting an aircraft to a broadband network, it makes sense to buy a system that will work with the network provider's technology of tomorrow.

To ensure an in-flight connectivity solution is future proofed, ask your provider whether you'll have to swap out hardware or radomes to enable faster speeds and increased capacity, and if the solution will be able to attain faster speeds as data needs increase.

Will your in-flight connectivity support tomorrow's technology?

The future is now. Viasat keeps you ahead of connectivity demands for today and tomorrow's business jet travelers.

Watch the video at https://youtu.be/sCWZ0RUb1sg

Hardware considerations: SWaP (size, weight, and power)

When evaluating the type of hardware to install for in-flight connectivity, using size, weight, and power (SWaP) criteria offers guidance on which solution is best for your aircraft.

Size

The footprint of the line replaceable units (LRUs), which make up the Wi-Fi solution, needs to be taken into consideration. The lower the number of LRUs means the less space it will take onboard. You'll also want to consider if the equipment needs to be installed within the pressurized cabin.

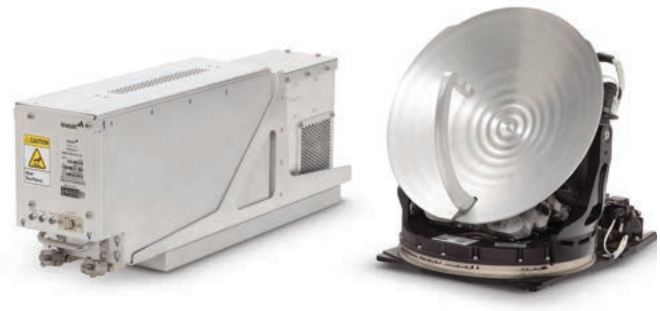
An operator should carefully evaluate the technology footprint, and the tradeoff against valuable avionics or baggage space. If the equipment can live outside the pressurized cabin and not take up precious luggage space, that's a win.

Weight

It probably goes without saying but the weight of the in-flight solution equipment is important as every pound impacts fuel efficiency. For each pound of weight added to the aircraft, the incremental additional fuel burn rate per flight hour is 0.007 gallons[2]. A rule of thumb is that a reduction in fuel consumption of about 0.75% results from each 1% reduction in weight[3].

Power

An aircraft's electrical components operate on many different voltages both AC and DC. Be sure to investigate what kind of power the in-flight Wi-Fi connectivity system supports. Some solutions, like Viasat's, support both.



Viasat Global Aero Terminal 5510

WEIGHT	
Antenna	26.4 lb.
Antenna power supply (not pictured)	10 lb.
Modem	17 lb.
Total weight	53.4 lb.

FUEL SAVINGS	
Weight	**Fuel burned per flight hour[1]**
100 lb.	0.70 gal.
53.4 lb.	0.37 gal.
Total fuel savings per flight hour	0.33 gal.

[2] https://www.faa.gov/regulations_policies/policy_guidance/benefit_cost/media/econ-value-section-6-perf-factors.pdf
[3] Barney L. Capehart, 2007: *Encyclopedia of Energy Engineering and Technology*

What to consider when selecting a service provider

The best service provider will have the flexibility to handle your in-flight needs over time.

Because capacity leads to speed, which impacts customer experience, satellite network design is an important consideration when you're choosing technology providers. Satellite capacity varies across operators by a factor of over 100, so when choosing a network operator for in-flight connectivity, important questions to ask include if the provider's satellite capacity is over 100 Gbps. Also, can the power in the satellite automatically shift to support natural daily capacity surges, such as Monday mornings at business aviation airports or during major sporting events like the Super Bowl or World Cup — or does the satellite require a manual steerable beam — and if so, who determines which markets can use the steerable beams?

Other questions include if future satellites are to be launched, can the current aircraft hardware take advantage of those advances or does it require a chipset swap? And, is the aircraft's current tail radome compatible with new satellites?

Below are the most important provider considerations at a glance:

1

Capacity: More capacity means more bandwidth available for each user.

2

Speed: Make sure you have the speed to stay connected and do all that you want in-flight from streaming video and music, browsing the web, email, and teleconferencing.

3

Coverage: The solution that is best for you can vary based on where you frequently fly. Do you predominantly fly domestically? Globally? Overseas? Choose a service provider that offers connectivity wherever you fly.

4

Forward compatibility: Choose equipment and a provider that will work with tomorrow's technologies and increasing speed and data needs.

5

Reputable network provider: Look for providers with a strong track record in developing connectivity solutions.

The Viasat difference

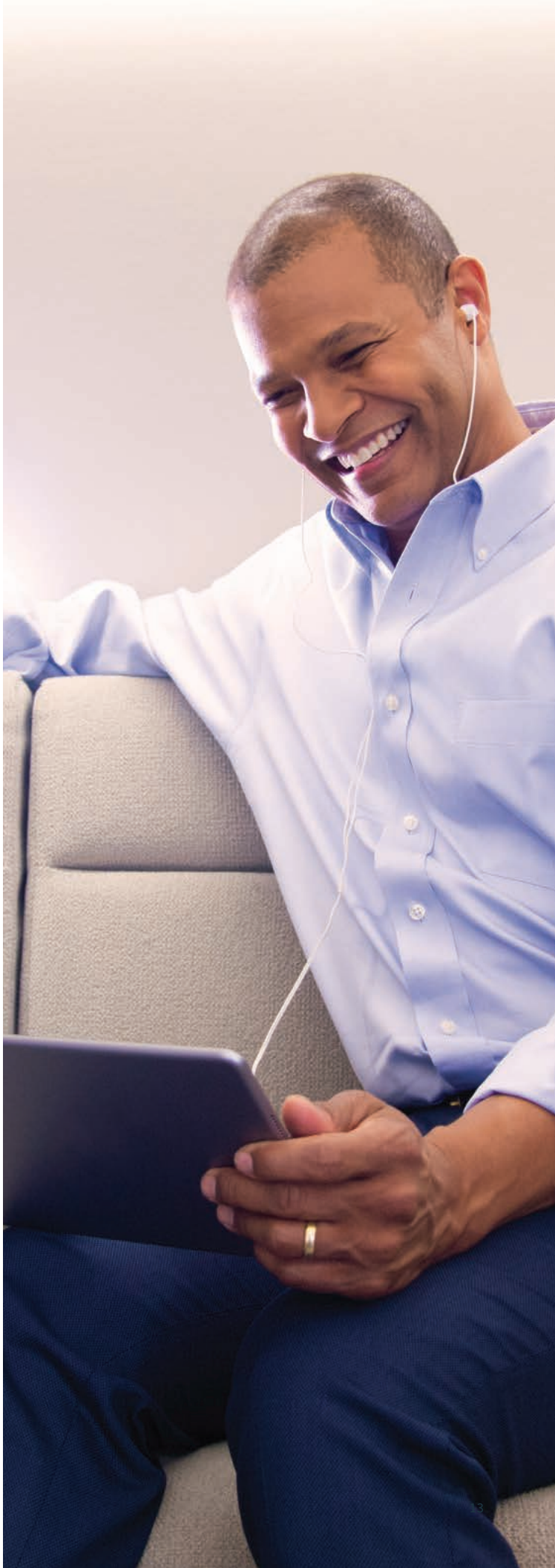
Viasat is an industry leader with vast experience building and managing satellite systems. Our products and services connect hundreds of commercial airlines, business jets, and government senior leader aircraft.

We have transformed the in-flight experience by offering unprecedented Wi-Fi speeds and performance through advanced satellite technology. Our unrivaled capacity keeps you connected to everything you need to stay productive, entertained and accessible in the air.

12.1 million
devices connected per month

160,000
flights connected per month

1,700
business and commercial aircraft connected



We invite you to elevate in-flight connectivity with the best Wi-Fi in the sky **and experience the Viasat difference.**

Global headquarters
6155 El Camino Real, Carlsbad, CA 92009-1699, USA

WEB viasat.com/business-aviation

TEL 888 842 7281 (US toll free)
+1 760 476 4755

EMAIL business-aviation@viasat.com

939539-190906-003