Ground Control

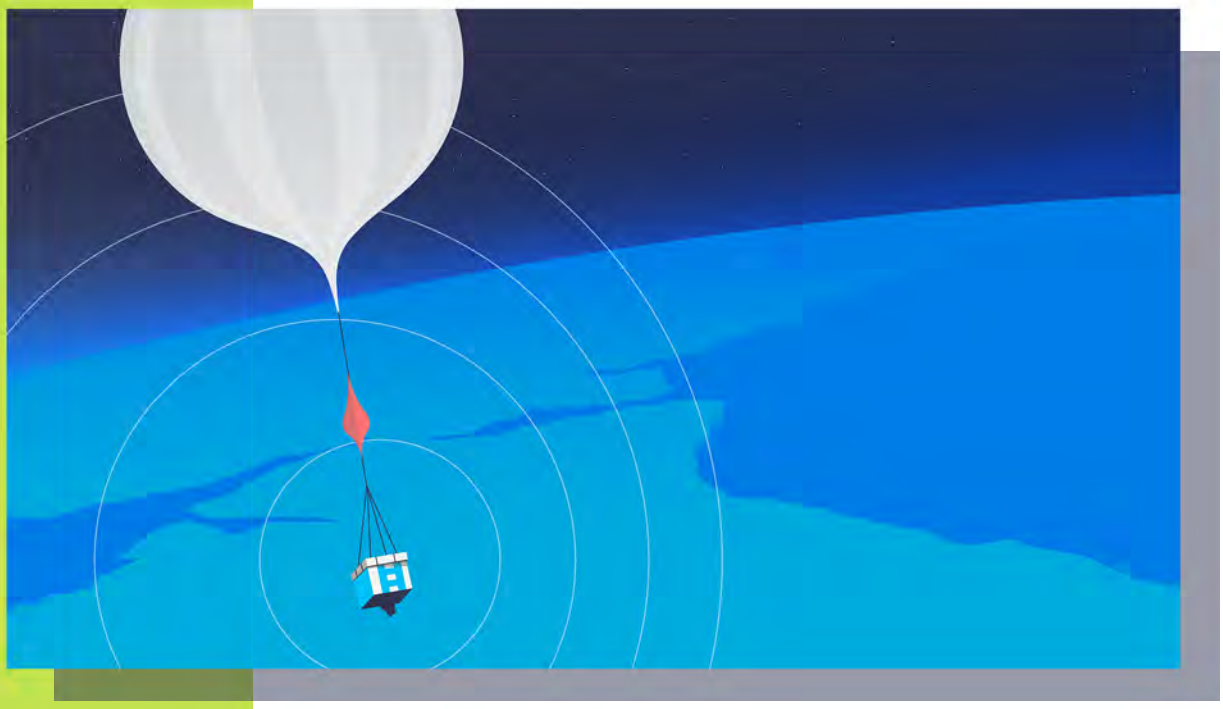
Could your business achieve more with better connectivity?

What's in this eBook

Ground Control has specialised in satellite and cellular connectivity for remote, critical communications for over 20 years. In that time we've seen huge changes in how satellite connectivity is delivered and charged for, which has really opened up this channel for IoT / M2M applications. Which is timely, because the number of IoT connected devices has exploded in recent years, while terrestrial networks still only cover 15% of the earth's surface.

In this eBook we'll explore the changing landscape of satellite connectivity, and take a look at the projections by industry for future growth; we'll take a deep dive into some of the ways improved connectivity is transforming outcomes, from disaster recovery to transport telematics.

Finally, we've included an FAQs section, so if you want to cut to the chase, head to page 15.

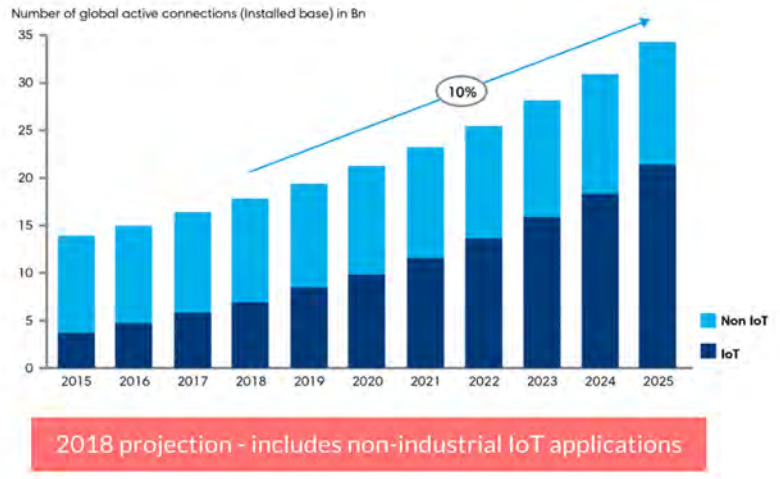


An Overview of Satellite IoT

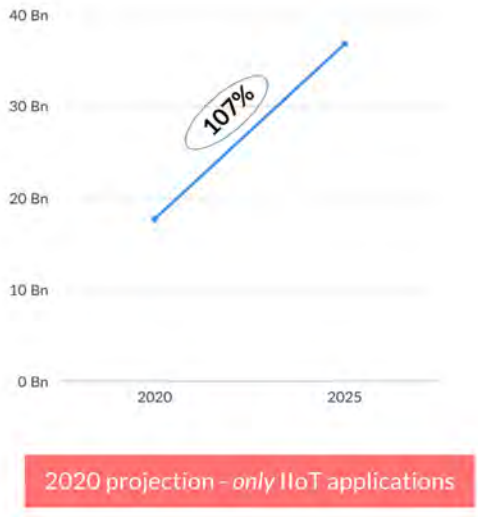
Active Device Connections Worldwide

These two charts tell a story: the first projection was made in 2018, and suggested that there would be approximately 20 billion IoT devices by 2025.

The second projection, made in 2020, only covers industrial IoT devices, but it puts the number at 36.8 billion devices by 2025 - a 107% increase over the known 2020 figure.



Source: IoT Analytics Research 2018



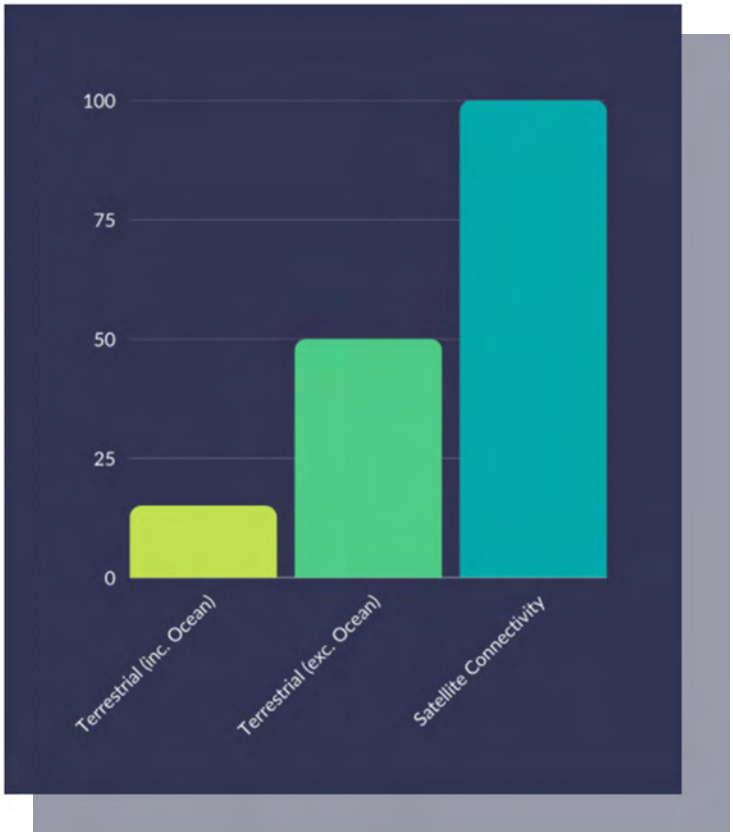
Source: Juniper Research Industrial IoT: Future Market Outlook 2020-2025 Report

The use of industrial IoT devices has far exceeded projections made just two years earlier, accelerated to some degree by COVID-19, as businesses tackled digital transformation projects with unprecedented urgency.

Connectivity Challenges

It is, of course, mission critical that industrial IoT devices can communicate with their base of operations. There's a clear challenge for devices that are either in remote areas, or travelling in and out of cellular coverage - terrestrial networks only cover 15% of the Earth's surface (albeit 50% of the landmass), and focus on populated areas.

This leaves a number of businesses unable to reach their assets remotely due to insufficient coverage or prohibitively expensive solutions, and having instead to resort to manpower - with the time delays and additional costs presented by that solution.



When your assets are mobile - land, sea or air - or located in remote areas like deserts, forests and mountainous regions, satellite is the only viable option for secure, guaranteed and - as we will see, increasingly cost-effective connectivity.

One further area that's worth noting, is that the number one challenge The IoT Magazine stated that IoT faced was cybersecurity, and the risk of hacking. Satellite has a huge advantage over cellular here, as, if needed, an entirely private network can be created with no reliance on, or exposure to, public infrastructure at all.

Satellite is now competing with cellular

From 2016 to 2018, there was a 60% wholesale price drop across high-throughput satellite verticals, most prominently for backhaul and consumer broadband. New entrants into the satellite communications market such as SpaceX's Starlink, Swarm, Telesat's Lightspeed and Amazon's Kuiper will further increase competition, and drive consumer pricing down.

Existing players such as Inmarsat and Iridium have diversified their offerings, with IoT / tracking services at one end of the spectrum, and high throughput broadband at the other.

> *"The data market is striving to achieve the holy grail of telecom pricing through capacity supply acceleration, led by players like ViaSat, Hughes, SES and upcoming LEOs, among others."*
>
> Northern Sky Research

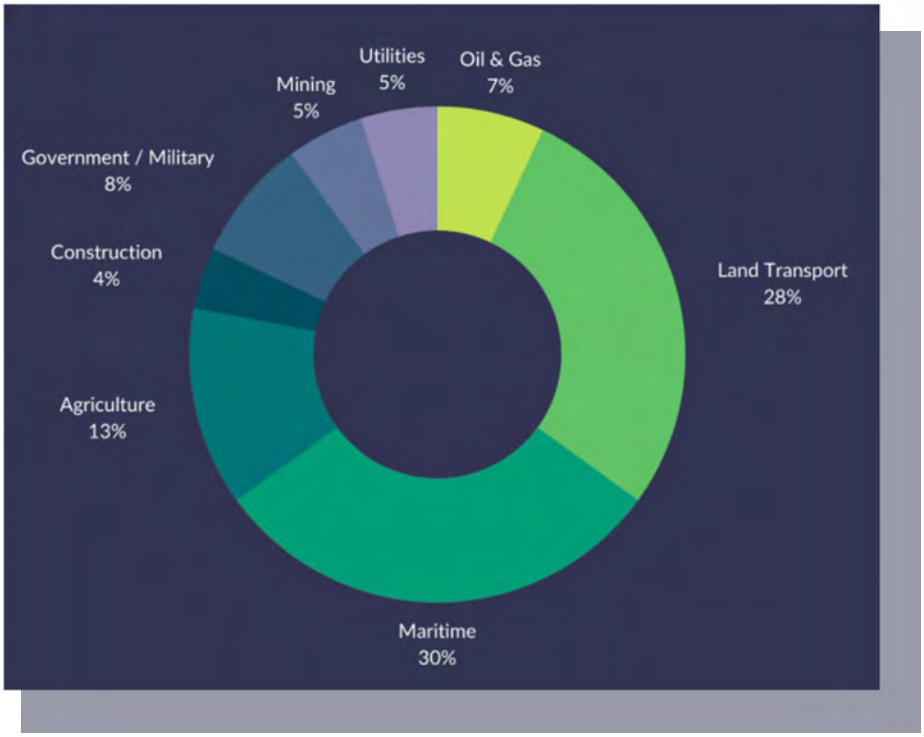
So here's the critical point: satellite is not as low cost as cellular, but it is most definitely moving in the right direction.

Greater competition, better technology, and diversification of offerings has seen the wholesale price of high-throughput satellite tumble in recent years, and it's our view that this will continue to decline, as the established players - Inmarsat and Iridium, for example - come up against well funded new entrants.

Projected usage of IoT

That said, it's improbable that satellite will replace cellular, as it is likely to always remain a little more expensive; so the applications for satellite IoT are, not unexpectedly, those where cellular networks are unavailable, such as ocean bound vessels or remote farms, or where the asset is moving in and out of terrestrial connectivity - such as transport and cargo.

As the chart shows, the projection for 2027 is that maritime, agriculture and land transport will be the power users of satellite connectivity.

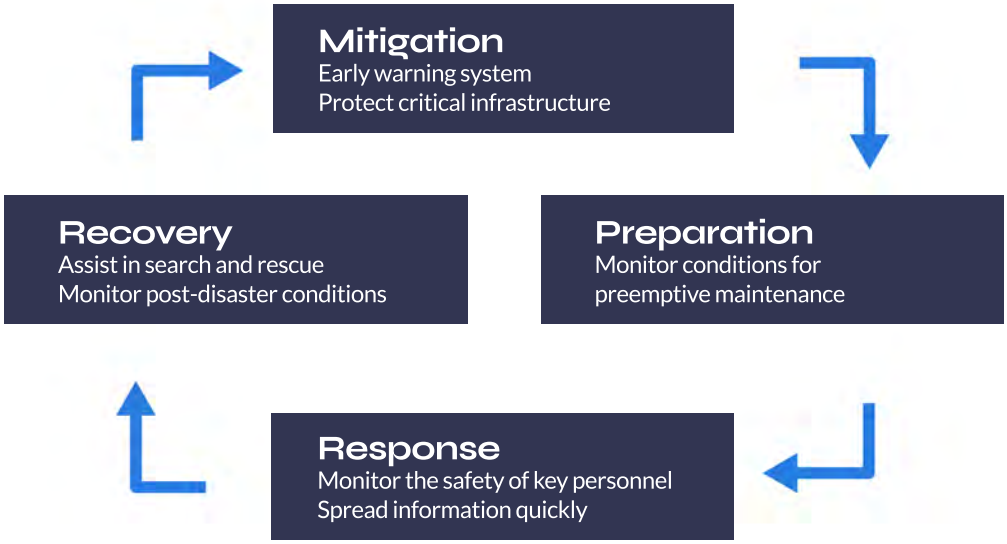


Source: Satellite Markets & Research, September 2021

Case Studies

Disaster Recovery

According to FEMA, there are four stages of emergency management:



IoT can help at every point in this process. At the mitigation stage, IoT can act as an early warning system - ground movement acceleration sensors for example, or sensors attached to trees to record temperature, humidity and CO2 - all parameters that change when there is a forest fire. Early detection can lead to early warnings, ensuring that machinery can be powered down and secured, and transport systems halted - all of which can also be actioned by IoT devices.

At the preparation stage, IoT devices can monitor the condition of emergency equipment to ensure that it's in full working order when needed, and even order spare parts should something reach the end of its life.

In the response stage, IoT devices can monitor the movement and even the health of key personnel, and help coordinate efforts. Messages can also be distributed to spread information quickly.

In the recovery stage, the tracking capabilities of IoT devices help to guide rescuers to victims, and can monitor post-disaster conditions to provide an early warning system.

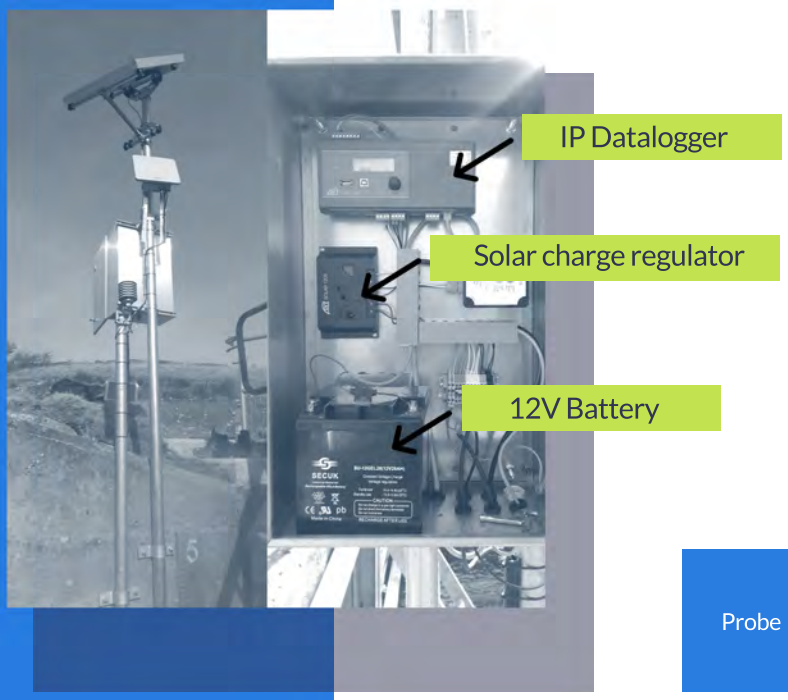
Asset Management

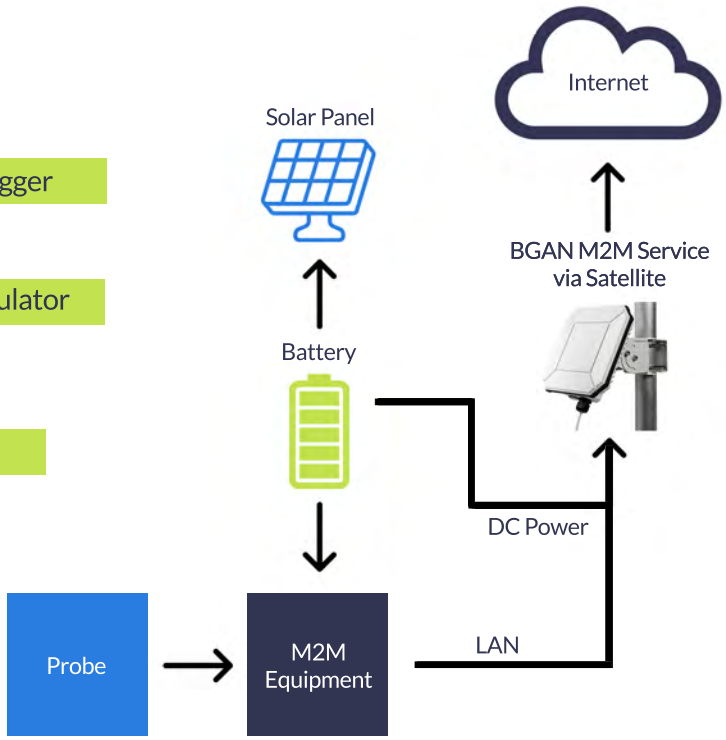
Asset monitoring and optimisation is probably the most popular and recognisable application of IoT, and we could spend the entire eBook talking about it.

Instead we'll focus on a single use case here: an IP solution featuring a low-power, directional small terminal. This one is on a hydroelectric scheme monitoring river levels in a remote area of Scotland, UK, that's not served by terrestrial networks.

The data logger is collecting rainfall data, temperature, humidity and water level. It's got a bit of intelligence built in so it can alarm on exception or increase sampling based on trigger levels on the level sensors.

It collects data every 15 minutes and powers up the terminal to send that data every hour, or on exception (i.e. if the readings are outside of a set of parameters). This minimises the power consumption and keeps costs down. The terminal can be solar powered and has a 12V battery. The data is coming off an IP connection and going to an FTP site where it's picked up.



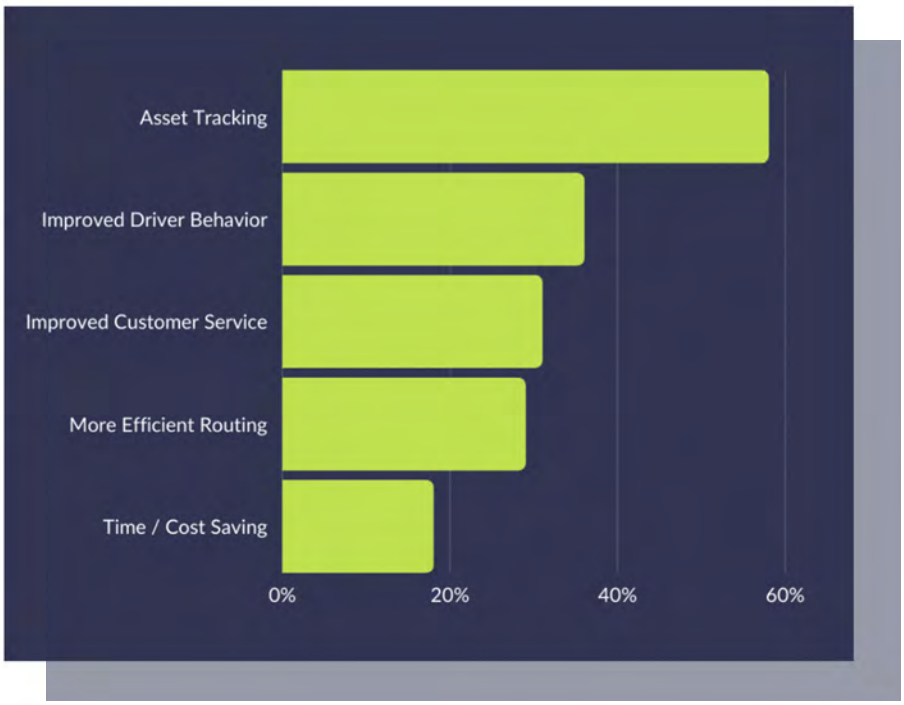


Transport Telematics

The chart below is from a 2019 survey of transport and cargo companies using telematics, to understand the main benefits they were realising from their investment. The first was the simple peace of mind of knowing where their assets - on land, air or sea - were, at any given time.

Improved driver behaviour is likely a knock-on effect of knowing they're being tracked. Customers - businesses or consumers - benefit from having more realistic delivery schedules, and fleet managers are able to reduce fuel costs and time by routing their drivers away from congestion or bad weather affected areas.

As most fleets are moving in and out of cellular connectivity, a device that automatically switches to satellite when cellular isn't available is the most cost effective means of ensuring global connectivity, and there are multiple devices that now offer automatic lowest-cost routing.



Source: Teletrac Navman 2019 Telematics Benchmark Report

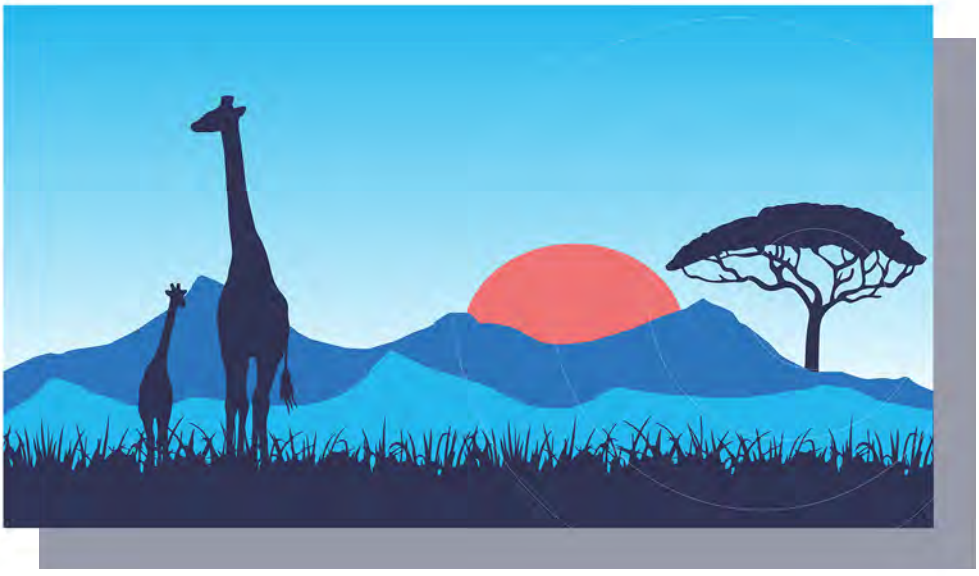
Environmental Protection

There are dozens of examples of how satellite connectivity has helped charities, NGOs and wildlife services reduce poaching, but the award winning 'Instant Detect' is an example of which we're particularly proud, because of the innovation shown by all parties.

It's common practice to set up motion capture cameras around areas where poachers frequent, but the data these devices report often comes too late to save the lives of the animals. That's because traditional wildlife monitoring systems rely on SD cards or mobile cellular networks to save or upload images and data. These systems suffer due to lack of real-time imagery, or simply won't work if cellular connectivity isn't available

The Zoological Society of London worked with Ground Control, Seven Technologies Group, and Iridium to set up a network of low power sensors, camera traps and acoustic sensors that are clever enough to distinguish between a human, and a human carrying a metallic item, such as a rifle.

The network sends data back to the interested parties in close to real time, with photographic proof, which allows the wildlife services to potentially intervene and make arrests before animals are killed or maimed. The latency of the Iridium satellite network is less than one second, so we really are able to make life-saving decisions with this accessibility of data.



Smart Farming

The case for smart farming is iron-clad: IBM Research estimates that 90% of yield losses are due to weather conditions. Sensors can gather data to support more accurate models of changing weather patterns, which, when combined with precision agriculture techniques, could cut yield losses by 25% (source: IDATE).

Further, IoT enabled equipment can report the number of crops gathered per acre, and the spacing between them, and the amount of fertilizer used; it can record wear and tear so that the farmer doesn't even need to place an order for a replacement part, it will arrive when the machine needs it. IoT also enables farmers to monitor the health of their livestock and optimize yield here, too.

But a huge barrier to wider adoption of this technology is the ability to get that data from the field to the farmer, given that by their very nature, farms are in rural, and often poorly connected, areas. Satellite connectivity overcomes this problem, and price is no longer the hurdle to smart farming connectivity that it might have been five years ago.

"A very large (and significant) percentage of farmers are not 'connected', added to which network coverage in rural areas tends to be poor."

IDATE

Smart Metering

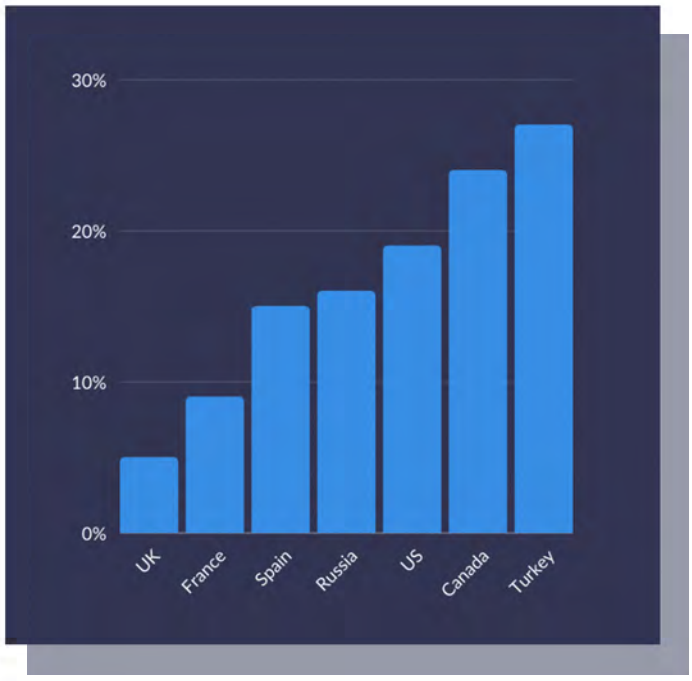
From the edge of cities to remote farms, there are hundreds of millions of people worldwide who live in areas with no fiber or cable connections. Even in a small, densely populated country like the UK, there are still 5% of households that have no access to terrestrial communication networks. It's not surprising to see this percentage increase in huge countries like Russia, the US and Canada.

There is, around the world, a push towards smart grids for electricity supply, and so understanding demand is critical for utilities providers. This has triggered the rollout of smart meters to as many homes as possible. But if you're missing data from almost a third of your customers, you can't make accurate predictions about energy consumption.

Additionally, some smart electricity and gas meters need frequent firmware updates, which would usually be delivered by terrestrial networks; in the absence of these, this would require an engineer visit.

Enabling your smart meters with a satellite transceiver overcomes this problem, as it ensures both that the data can be transmitted to the utility company, and also, that firmware upgrades can be delivered remotely, without having to visit these remote households.

Percentage of homes without access to terrestrial communication networks



Source: Deloitte Mobile Home Internet Report, 2018

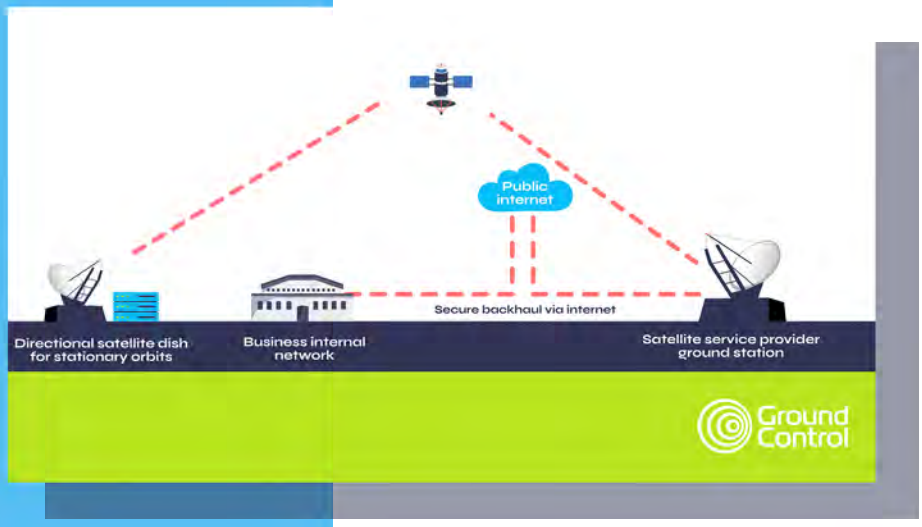
Frequently Asked Questions

What are the Costs Relative to Cellular?

The cost of sending data via satellite has materially lowered; in 2016 to 2018, for example, the wholesale pricing for high throughput connectivity dropped by 60%. It is not, and is unlikely to ever be, as low cost as cellular, but there are plenty of ways in which you can optimise your devices to ensure that the cost is as low as possible. For example, can you report on exception rather than routinely, and power down the terminal when not in active use?

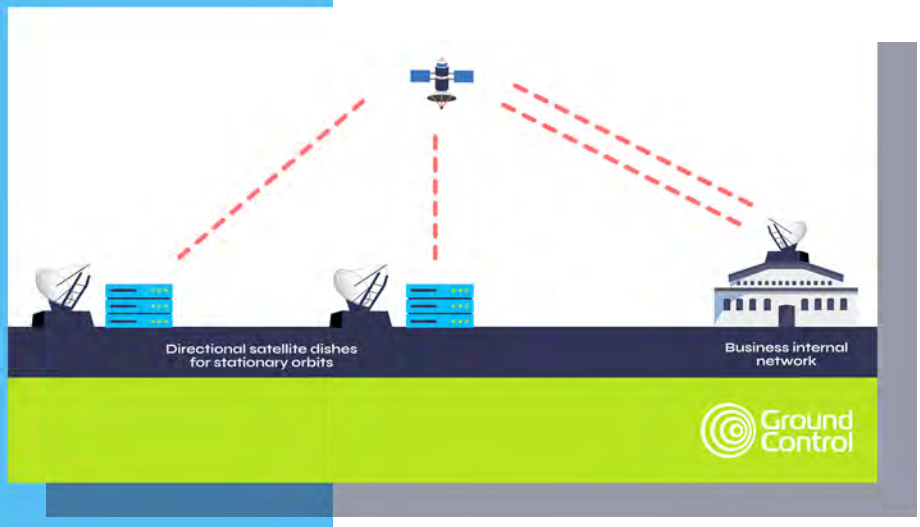
Edge computing will further reduce the cost of satellite connectivity, as it will enable more processing to take place at the sensor location, so less data will be needed to be sent over satellite. This emerging technology is gathering pace and is likely to feature in most new IoT installations in remote areas.

Is Satellite Secure?



Transmitting your data from your sensors to the satellite, and back to a ground station on Earth, is very secure. What typically happens next is that the ground station sends your data via the internet - protected via a VPN - to your base of operations. This is the most popular choice because it's cost-effective and very secure.

Another option for securing your data backhaul is a dedicated circuit.



The most secure option is a private satellite network, where your data is sent to your own ground station, rather than shared facilities. As you might expect, this option is more expensive, but a popular choice for businesses like Utilities and Oil and Gas, on whom a huge amount of the economy relies, and so for whom data security is absolutely paramount.

Is the Hardware Robust?

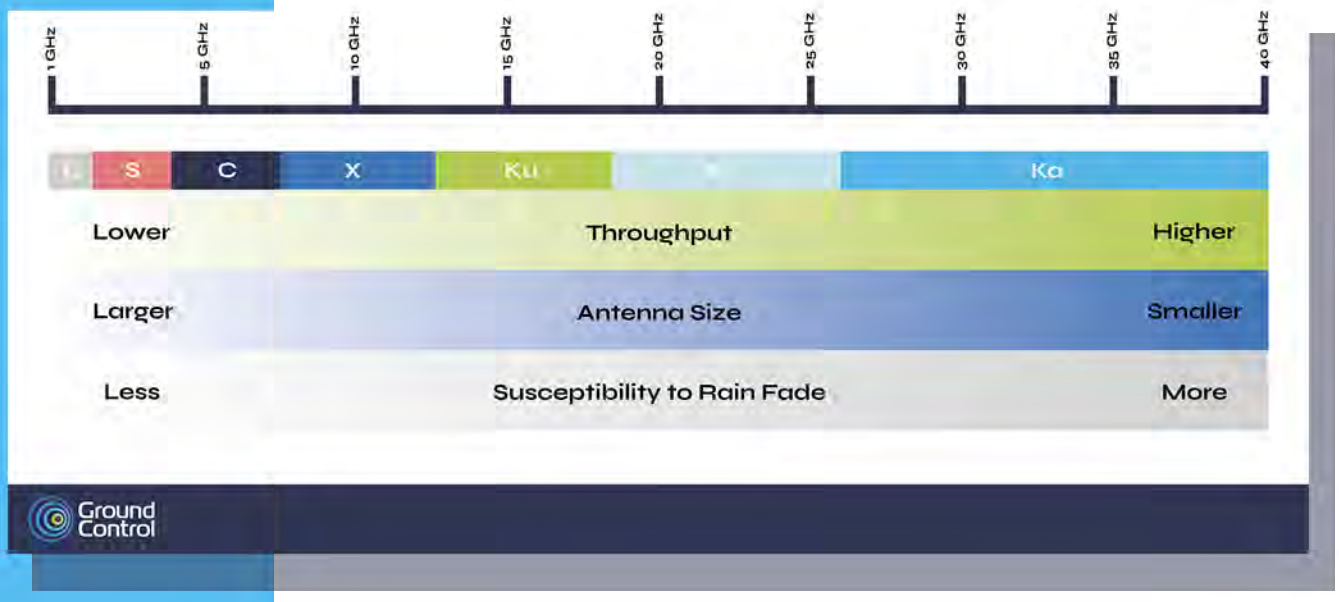
There is a huge variety of terminals and antennas available now, and you will be able to easily locate a highly ruggedised device, if that's what you need. Look for an IP68 rating, which means that the device is completely waterproof and dustproof, and suitable for being left outside in extreme weather conditions.

The operating temperatures are generally -40C to +70C (-40F to +158F), which covers most requirements.

As the technology has progressed, the devices have become smaller, and are now increasingly discreet and easy to conceal. Some local authorities will insist upon this if you're locating devices in protected areas, for example, National Parks; it also means the devices are less likely to be stolen or vandalised.

Can Weather Interrupt the Signal?

That depends on the frequency you're using to connect with the satellite. The L-Band frequency is not impacted by what's known as 'rain fade', whereas some frequencies are. It's important to choose a frequency that's fit for your purpose - and Ground Control can help you in this selection.



Are the Devices Power-Hungry?

Devices designed for IoT / M2M applications are, by design, not power hungry. That's because they may be located not just out of terrestrial communication networks; they may also be positioned in areas unconnected to the energy grid.

So you will find many devices that operate on solar power and/or battery; others are mains operated and will need a connection to the energy grid. Battery-powered animal tracking collars can last for three years!

Again, it's important to pick the right device for your needs.

Do you Need to Point Antennas at the Satellite?

In some cases, yes; the devices make this very easy by giving you LEDs and beeping sounds that increase in intensity when you're approaching the most optimal angle.

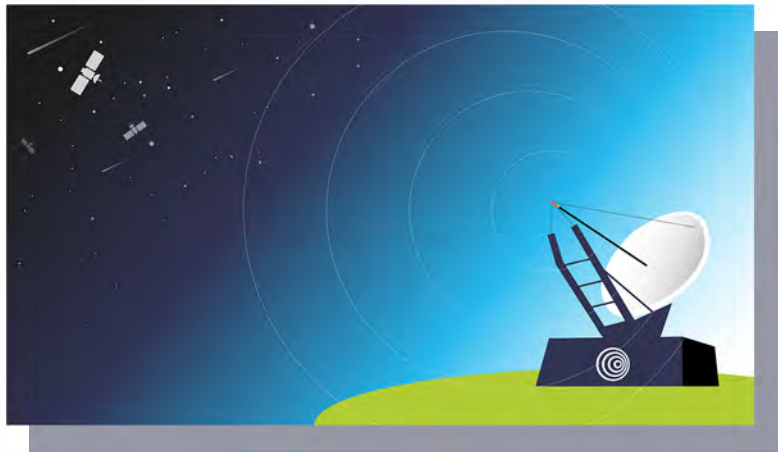
Other devices will auto-point at a geostationary satellite (we'd recommend reading our blog post on satellite orbit heights for more information, if this term is unfamiliar).

Many IoT applications are using low-earth orbit satellite constellations in which multiple satellites form a constantly in-motion 'net' overhead. In this case you don't need to point your signal at all, as it will always be received by one of the satellites in the network.

The Ground Control team will be able to advise on the best orbit height to meet your particular needs, as there are benefits to each.

How Difficult are SatComms Devices to Install?

Most are very easy to install and need no specialist advice. Some larger, fixed dish installations - not usually seen for IoT applications - benefit from specialist knowledge. If you're unsure, speak to the Ground Control team, and we'll be able to advise.



Is my Data Guaranteed to Arrive?

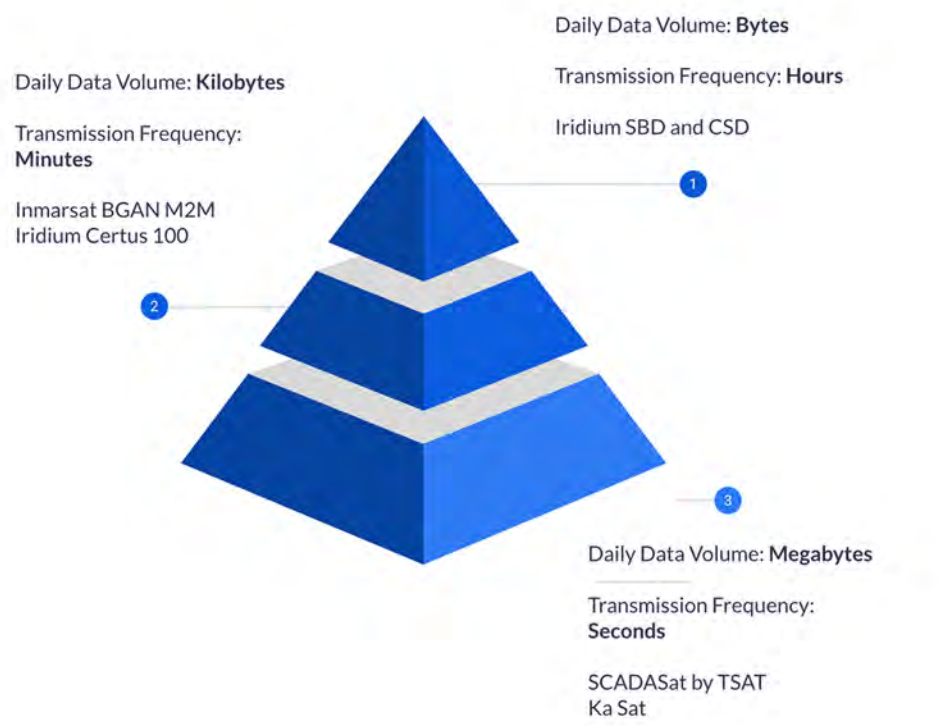
Satellite connectivity is extremely reliable. Inmarsat, for example, quotes 99.9% uptime. As described earlier, you need to backhaul your data from the ground station. This secure internet backhaul is also extremely reliable; it's a managed service, with 24/7 monitoring, and failover contingency built in.

Private satellite networks remove the need for any public infrastructure, so if you want complete peace of mind, it's worthwhile exploring this option.

Not all satellites are the same...

If there's one message that's important to take away from this eBook, it's that satellite connectivity is not a one-size-fits-all solution.

And that is to your benefit, because it allows you to buy only what you need for your application.



If you can answer the following questions, you'll be far closer to identifying the best solution for your needs.

Are you trying to move data hourly, daily, or monthly?
How much data do you need to move?
What are your power requirements?
Is the asset moving or stationary?

Ultimately, the Ground Control team are here to help. We work with the best providers of satellite connectivity available, and multiple manufacturing partners, to ensure you get the service you need.

Thanks for reading!

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