INTELSAT

Unmanned Aerial Systems
**Current Challenges and Future Opportunities
for Governments Around the World**

Overview

The requirements and opportunities for the use of Unmanned Aerial Systems (UAS) utilizing satellite technology are appreciably varied among regions of the world, let alone the sovereign states in each region. There are many factors creating these differences, from market maturity to geography, to political forces, to the availability of funds and resources.

Importantly, the uses of UAS are starting to stretch beyond the long-understood framework of intelligence, surveillance, and reconnaissance (ISR) as has been defined by military practices.

Crucially, there is no one-size-fits-all approach to cover all global regions, or all countries within a region. There are now more opportunities to address national and regional needs in a way that not only addresses current realities but helps build a framework for future requirements as well. This includes more than purely military operations, including inter-governmental opportunities and joint civil-military requirements.

As technologies continually develop, UAS can be used more strategically for environmental and societal benefits beyond purely military uses, using infrastructure that is already in place and operational.

Additionally, no matter where an organization is located, access to stable and safe high throughput telecommunications remains a common focus, and will only increase over time. Top priorities for users include communications technologies that are platform-agnostic, high-performing, and offer secure connectivity when and where it's needed with seamless integration across space and terrestrial networks.

In 2019, the European Parliament circulated a briefing paper, Civil and military drones: Navigating a disruptive and dynamic technological ecosystem, that spoke – in part – to at least some of the challenges and opportunities UAVs represent, starting with the sentence:

> ❝Often labeled as one of today's main disruptive technologies, 'drones' have indeed earned this label by prompting a fundamental rethinking of business models, existing laws, safety and security standards, the future of transport, and modern warfare.❞
>
> The market has only become more complex in the past few years, with no easing in the rate of change or diversity in potential applications.

Why UAS Are Important

It has long been understood that UAS have offered a nation's military infrastructure many benefits, including:

- Reduction in the risk to human life
- Economic savings in low-cost platforms with onboard sensors
- Accessibility in remote and hard to reach areas with no terrestrial infrastructure
- Real-time overview of the area of interest
- Data acquisition with high temporal and spatial resolution
- Controllable from distant command centres

With all of these benefits, UAS have become the norm for applications such as maritime patrolling, allowing manned missions to be dedicated to more mission-specific tasks.

As the technology has developed offering more ISR capabilities such as full motion-video, improvements in satellite communications are also delivering more opportunities. The need for reliable, high throughput communications has driven the development of smaller, mobility-friendly terminals that support new bandwidth-hungry and time-critical applications.

> The demand for comprehensive, end-to-end security that keeps the data safe is also increasing.

A network needs to deliver the highest level of network uptime and enable users to avoid disruptions in data collection. This enables operators to track movements in real time, decrease downtime, take advantage of predictable maintenance, and improve operational efficiencies throughout the system. The effective and efficient use of UAS is no different.

Security can be enhanced by using both software encryption – that can be incorporated into terminals – and bespoke national hardware encryption – that can be added at the back of any terminal – to create a secure national channel.

Importantly, UAS can be used to leverage military logistics for work with joint agency teams delivering humanitarian aid with immediate access to reliable communications linking advance teams to information and services essential for their mission.

The development of medium-altitude long-endurance (MALE) and high-altitude, long-endurance (HALE) UAS has meant that they are now used for strategic and tactical missions. Flying above 10,000 feet (9,000+ metres) and up to 70,000 feet (21,000+ metres) and for more than 24 hours at a time, the beyond-line-of-sight (BLOS) capable UAS offer applications with wide-reaching benefits.

As is often the case, as technologies develop, so too do opportunities for applications to address concerns that can now be handled in more efficient and effective ways.

Many of the UAS available can carry multiple sensor payloads, allowing for a combination of communications intelligence and electronic intelligence (COMINT and ELINT), communications relay and radar systems. The unmanned vehicle uses a direct line of sight data link or a beyond-line-of-sight (BLOS) link utilizing satellite connectivity to communicate with the ground control station. This multi-mode capability allows for wide area searches and identification of targets that might not be visible with other technologies and can provide direct support to manned patrol craft.

Satellite communications (satcom) has been supporting mission-critical communications including ISR, as well as search and rescue, border management, and several other applications for more than 20 years.

As stated earlier, for many sovereign nations, the current and future developments in UAS offer opportunities for development and growth of their nation that are beyond purely military applications.

These include economic stability, safety and security, technological advancement, research and development, as well as expanding joint civil/military operations, support for NGO work, and the ability to provide strong real-time results.
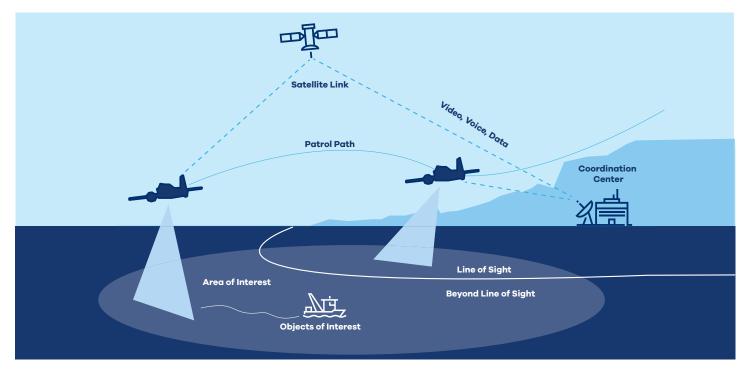

Figure 1: BLOS Offers Greater Use of UAS Infrastructure

Snapshot: State of the Defence Market for UAS

UAS have become a key part of the armed forces across the world, as they are being extensively deployed in war zones, counter-terrorism operations, and for functions such as border patrol, maritime surveillance, and search & rescue as force multipliers. Furthermore, UAS can lead the way into high threat environments by reducing risks for manned aircraft while challenging next-generation air defence systems.

While it is clear that there are regional partnerships for the development and delivery of hardware and technologies, there is no doubt the UAS market is truly global. As such, this paper offers an indication, with highlights by region, of use cases for UAS identified over the past few years.

Across all three regions there are some common challenges, with changeable dynamics over time and location:

- **Globalization** requiring national governments and regional intergovernmental agencies to efficiently track movements, secure identity and automate decision-making.

- **Porous long borders** that require advanced technology such as surveillance drones, infra-red cameras, ground and subterranean sensors, border patrol vehicles, digital fencing and more.

- **Economic growth challenges** often leading to an increase in localized or regional crime, such as the smuggling of illicit goods, drugs, and people.

- **Terrorism and espionage** which requires the careful and timely coordination between government agencies, with external sources of information to develop a common operating picture of movements within and beyond borders.

Asia Pacific

With a wide range of economic maturity across the region, one key regional issue is funding for new technologies, despite the benefits they might bring.

An additional – and connected – challenge is the perception of funding versus potential benefits, and the opportunities to leverage the technologies to deliver benefits beyond purely military outcomes.

MENA

With a number of key players, the Middle East and North African nations have a wide range of economic maturity across the region. There is also a growing need for UAS springing from the modernization of not only the military but also all sort of services and advancements in both the public and private sectors

There is a growing R&D landscape, serving both national and affiliated nations across multiple regions that can also benefit from ISR connectivity.

Europe

The European Union (EU) market holds a much more advanced position in the UAS arena – both strategically and tactically. However, there have been a number of key challenges raised that are currently being reviewed by the United Nations and the European Commission.

The EU has a diverse and well-funded R&D landscape and a lower TRL (technology readiness level) investment approach that continues to deliver individual hardware or standalone software innovation but does not readily translate into a wider system-of-systems implementation or recognize that most real-world implementations are iterative and continuous – not programmatic or stand-alone.

A strong regulatory structure that includes governmental and industry stakeholders is periodically reviewed and updated, providing a framework for safe operation of UAS in European skies, adopting a risk-based approach.

The EU paper, Strategic Research and Innovation Agenda for EU-funded Space Research Supporting Competitiveness, reflects this need for an integrated approach, with acknowledgment of the need for end-to-send systems, ground segment, as well as the 'space' component, and should be reflected in the upcoming Action Plan.

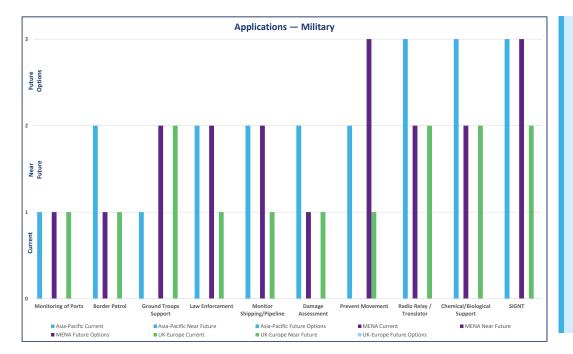# Civil, Military/Civil Applications and the Benefits of UAS

As with current uses of UAS, applications are being rolled out at different rates in different regions of the globe for civil applications. While unmanned aircraft are not a new technology to the military, it is already clear that non-military UAS are making a difference around the globe and will continue as these technologies advance.

When considering the different regions, priorities and past opportunities have directed current applications, with military applications leading the way.

However, there are new applications being considered by military, civil, and joint military-civil authorities as technology evolves, partnerships are formed, and national and regional needs change.

The following graphs indicate some of the key applications by region for: current use, under consideration, and opportunities that might be considered for the future.

As can be seen in Figure 2, while all three regions use UAS for military monitoring of ports and inland activity as part of national security, other applications differ across regions. This includes border patrol and monitoring, guardian angel for ground troops and law enforcement. These are country-specific applications.

The need to use technologies strategically – including working across an increasing range of applications – while staying inside resource controls with the many levels of safety and security required makes UAS a benefits-focused opportunity.

Figure 2: Identified Applications for Military Use of UAS, by Region and Anticipated Priority

Expanding Opportunities and Benefits

It is important to emphasize that while some UAS applications are considered standard in some countries they are not yet being implemented in others. With the use of Satcom to boost the coverage, quality, reliability and security of data streams, the opportunities for additional/expanded national and regional applications is growing.

- **Infrastructure and construction surveys** — Safety inspections of pipelines and long-distance rail

- **Environmental and biodiversity ISR and reporting for Environmental, Social and Governance (ESG)** — As ESG targets become more common, governments will be able to take advantage of communications technologies to not only track their targets, but also demonstrate they are meeting or exceeding them.

- **Wildlife monitoring, protection** — UAS imagery is a natural "bridge" between fine scale field measurements and spatially expansive coarse-scale satellite remote sensing, which is very useful for wildlife monitoring. This is particularly relevant for fisheries protection in Asia Pacific and MENA. The use of satellite communications to deliver real-time support to conservation groups is already underway in remote regions, as scientists track different species' resilience to changing habitats and climatic situations.

- **Geo-science applications including environmental, ecological, and biosphere mapping as partners with researchers** — A recent literature review of 137 peer-reviewed articles of UAV & satellite synergies for optical remote sensing applications noted, "...it seems that the potential of the UAV/Satellite synergy is currently not fully exploited: several scientific fields do not take enough advantage of this synergy, the capacities of the different earth observation systems are under-exploited, and stronger synergies are less used.

"Ecology and agriculture scientific fields have been mainly involved in the exploitation of UAV/satellite complementarities, unlike other earth observation fields (geosciences, disaster, archaeology, water resource or city monitoring) that generally require less important resolutions. **There were three key conclusions:**

- Ecology was the main application area that used this synergy and used mostly the "model calibration" strategy, using an iterative process of comparing the model with the real system.

- Remote Sensing UAVs can replace in-situ surveys for basic applications.

- UAV capabilities offered greater potential than what was currently used."

Figures 3 and 4 highlight more opportunities for Civil and Joint Military/Civil applications. A few are currently in use in different countries or regions, with a growing number of applications possible in the near future.
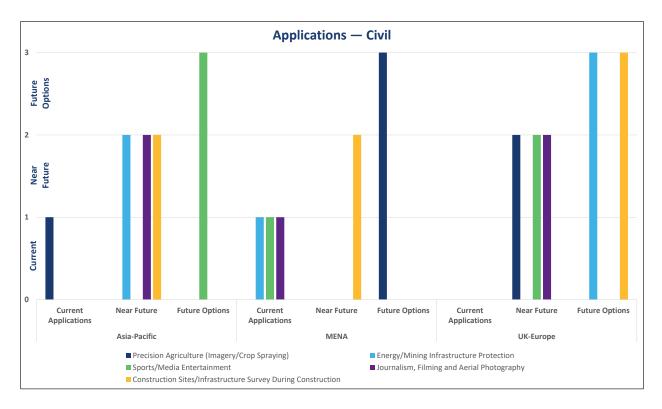

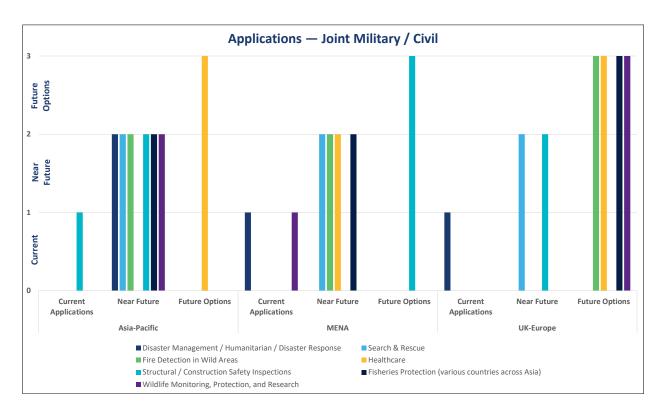Figure 3: Identified Applications for Civil Use of UAS, by Region and Anticipated Priority

Figure 4: Identified Applications for Joint Military-Civil Use of UAS, by Region and Anticipated Priority

Social and Societal Benefits

Many social and societal benefits result from using commercial satellite-based UAS, however, each demonstrates varying levels of opportunities that could be upscaled to serve a wider audience.

Assessing Disaster Areas

UAS are a relatively fast and inexpensive way to obtain images of natural disasters so that emergency responders are aware of the situation and well-equipped to act accordingly and in a timely manner.

Fighting Wildfires

In recent years, **California has used drones to assist firefighters from the sky, as a safer way to evaluate the fire front**. Unmanned aircraft are safer for firefighters, can operate for long stretches of time, and are not limited by weather and visibility conditions as much as helicopters and planes are.

Transporting Medicine and Medical Equipment

Often faster than helicopters and other traditional methods, **UAS are being used for a number of medical applications**. These include carrying blood, vaccines, and small medical equipment.

UAVs are currently used by the **U.K. Defense Medical Sources** to deliver blood to remote military locations in Afghanistan, and defibrillators to those that need them in the USA and Sweden.

Norway has begun using drones to quickly bring defibrillators to the scene of emergencies. In medicine, time is of the essence, and quick delivery can save lives.

In 2019 it was reported that the **South African National Blood Service** (SANBS) planned to use drones to deliver blood to rural areas for blood transfusions. That work was already underway in Zambia and Ghana.

In 2018, **Vanuatu** was the first country to use a drone to transport vaccines to rural areas.

Different companies have used UAS of different sizes to **deliver PPE** throughout the Covid-19 pandemic.

Challenges Governments are Facing As They Look to Using UAS

As governments look at how to improve their national security, telecommunications, and tackle challenges such as environmental targets, UAS offer many opportunities, but also raise questions including cost, operations, licensing and clearances.

> There are a number of misunderstandings surrounding the inclusion of UAS in a national plan.

One of the most common is the overall perception that UAS are "only for the military to blow things up". Another is that "satellite time is a more expensive option" than some nations want to use. With new higher-powered satellites and end-to-end managed services, pricing per unit of capacity has been dramatically reduced.

This paper seeks to highlight that there are more applications available today than previously perceived, as Figures 2-4 show. More applications are being considered by government and commercial users, as technology develops and familiarity with the technologies increases. Still, there are two challenges that should be addressed as listed below.

Funding

Across both Asia Pacific and MENA, one of the greater challenges is the economic diversity across nations in each region. While not the sole source of difference, for less robust economies, the disparity causes many financial challenges, which can be both a real and a perceived issue.

The significant developments in technology over time now mean that access to Satcom for UAS offers greater returns on investment that reach beyond traditional military ISR applications.

While the real financial challenges faced by some sovereign states are not without significant consequences, there are also opportunities for partnerships to address accessing the potential of UAS.

Civilian Concerns

As with other technology developments, **the use of UAS in military operations has raised civilian concerns around civilian safety, human rights abuses, and moral rights.**

In 2014, the UN started to discuss the use of UAS, particularly in battle situations. While there is a sound understanding that UAS allow for fewer troops on a battlefield – which could save lives – there is great concern around the misuse and unintended consequences from using remote unmanned devices.

Some of the civilian concerns stem from pop culture, while some have been shown to stem from past realities. The UN is currently working towards a draft treaty that will help address these civilian concerns.

The Intelsat Network

Intelsat partners with government ministries around the world to help their civil and defence agencies connect to programs, resources, and to each other. They rely on our secure, cost-efficient, high-performance satellite network to power mobility applications in the air, on sea and on the ground that range from border security and remote military operations to disaster preparedness and recovery.

Our network is comprised of the world's largest integrated satellite and terrestrial network, offering multiple-layered, redundant coverage, and seamless secure connectivity.

Intelsat's open architecture network is technology-agnostic, providing "plug and play access" for our customers, and ensuring seamless connectivity. Our services and select partners, together with world-class support, open standards and security credentials, make integrating our services secure and efficient.

We provide easy to deploy, end-to-end services across technologies and infrastructures or, alternately, our engineers can help you design a custom-tailored network solution.

We offer a superior user experience with:

- Industry leading Service Level Agreements (SLAs)
- Robust and scalable cyber-secure network
- Simple and fast access to the network
- Powerful, simple, and cost-effective user terminals
- Provisioning in hours; not weeks
- Commissioning in minutes; not hours
- Protection of information from malicious attacks

Security of the Network

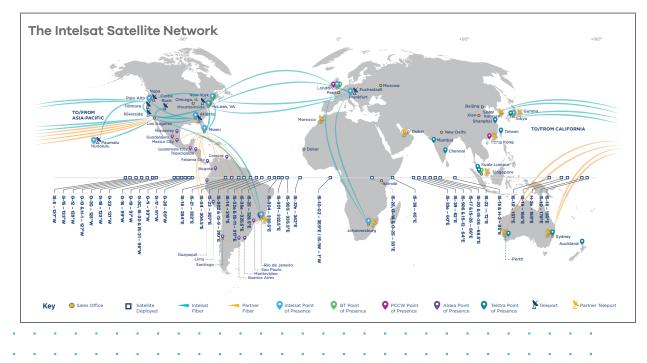Comprehensive, end-to-end security is woven into the fabric of our network and procedures. With a network hardened at every point, we leverage the latest innovations to keep our network, and yours, safe. Intelsat is also the only commercial satellite operator with an independent third-party Service Organization Control 3 (SOC 3) accreditation.
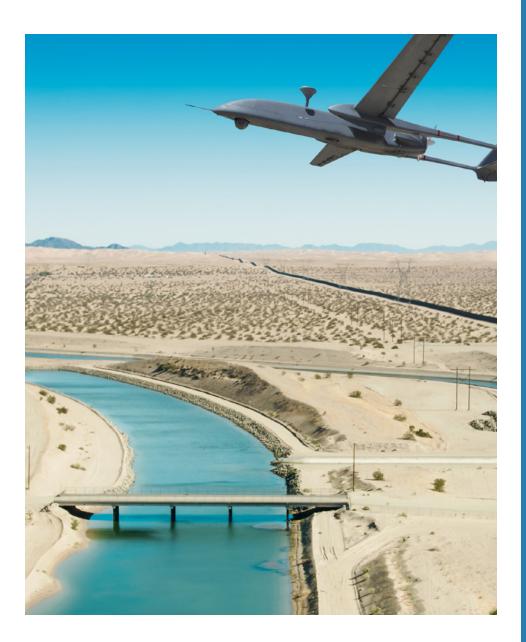
Our people are passionate and dedicated experts who deliver fully managed and supported solutions, guaranteed service quality and world-class support

We Offer:

- A fully integrated high-throughput (HTS) and wide-beam satellite fleet and global terrestrial network that is aligned to region- and application-specific requirements.

- High-data rates using a range of mobility terminals. The Intelsat HTS architecture is enterprise- grade, open architecture and vendor-agnostic, which allows access to bandwidth-efficient, high-data rate connectivity via a wide variety of user-chosen waveforms, modems and antennas.

- An ecosystem of partners to provide value-added applications and technical expertise for specific missions

The Intelsat Satellite Network

Antennas Available for UAS

There are a variety of antenna manufacturers that sell terminals for UAS platforms. As satellite technology has advanced creating more powerful satellites, the SWaP (Size, Weight and Power) of antennas has come down, reducing the price of the antennas as well as the real-estate required on the UAS.

Intelsat works with the world's leading manufacturers to help ensure that their terminals are compatible with the Intelsat network.

In the Near Future

Our Unified Network will be comprised of new software-defined satellites that concentrate and allocate bandwidth on-the-fly. They fundamentally change the game, delivering services when and where they are most needed, and dynamically steering band-width as needs change. With the ability to be reprogrammed in orbit, they can respond immediately to changing demands for a superior user experience.

INTELSAT