



Commercial Space-Based Intelligence, Surveillance and Reconnaissance and Australia's National Security

**Geospatial Intelligence Pty Ltd - White Paper
December 2021**



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@ info@geoint.com.au  geoint.com.au  +61 1800 436 468  PO Box 5354 Kingston ACT, 2604 Australia





PREFACE

This document represents Geospatial Intelligence Pty Ltd's inaugural White Paper. Geospatial Intelligence Pty Ltd (GI) was founded in Canberra in 2002 and has since built the highest concentration of geospatial intelligence (GEOINT) talent in a wholly Australian owned and operated company, and formed strong links with the Department of Defence and the National Intelligence Community. We have relationships with many of the world's leading commercial Earth observation satellite providers and have developed our own artificial intelligence and machine learning intellectual property that allows us to transform Earth observation, geospatial and open-source data, into meaningful, valuable intelligence.

Since 2002 the commercial space-based Earth observation market has become more sophisticated and competitive, the Australian space industry has expanded, and the strategic environment in the Indo-Pacific has become more complex. As a leading non-government GEOINT organisation in Australia, with strong partnerships with government and private industry globally, we believe that we are well-placed to provide thought leadership on this developing landscape.

White Papers provide an excellent avenue to share our ideas on emerging issues with our peers; so to complement our internet and social media presence, we are now also committing our thoughts to such documents. The aim of our White Papers is to produce documents of substance which will apprise time-poor readers – whether in government or industry – of complex geospatial intelligence related issues and problems – and provide a view on possible solutions to the issues identified. These potential solutions may be drawn from a range of sources including our own experience and ideas, the experience and ideas of published leading-edge thinkers, and other industry experts (including from defence,

government, intelligence, and academic backgrounds).

The examples given in this White Paper are intended only to provide examples of what is possible from a commercial company like Geospatial Intelligence Pty Ltd and its associates, with their available products and service offerings.

I commend our first White Paper to you.

Robert Coorey

Chief Executive Officer
Geospatial Intelligence Pty Ltd

+61 1800 436 468

PO Box 5354 Kingston ACT 2604 Australia
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Defence Business
of the Year



Executive
of the Year

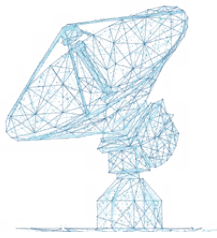


Innovator of the
Year - Company

**Australian Space
Award Winners
2021**

EXECUTIVE SUMMARY

From the early days of being exclusively the domain of governments, space-based Intelligence, Surveillance and Reconnaissance (ISR) capabilities are now also available from commercial providers. Due to the wide range of satellites now in operation, space-based commercial ISR now has greater coverage, and because of their business focus, their analytical 'back-end' operations can be very agile and innovative. Commercial GEOINT has been joined by commercial SIGINT, and both in the context of OSINT, now provide a broad range of intelligence solutions to national security partners.



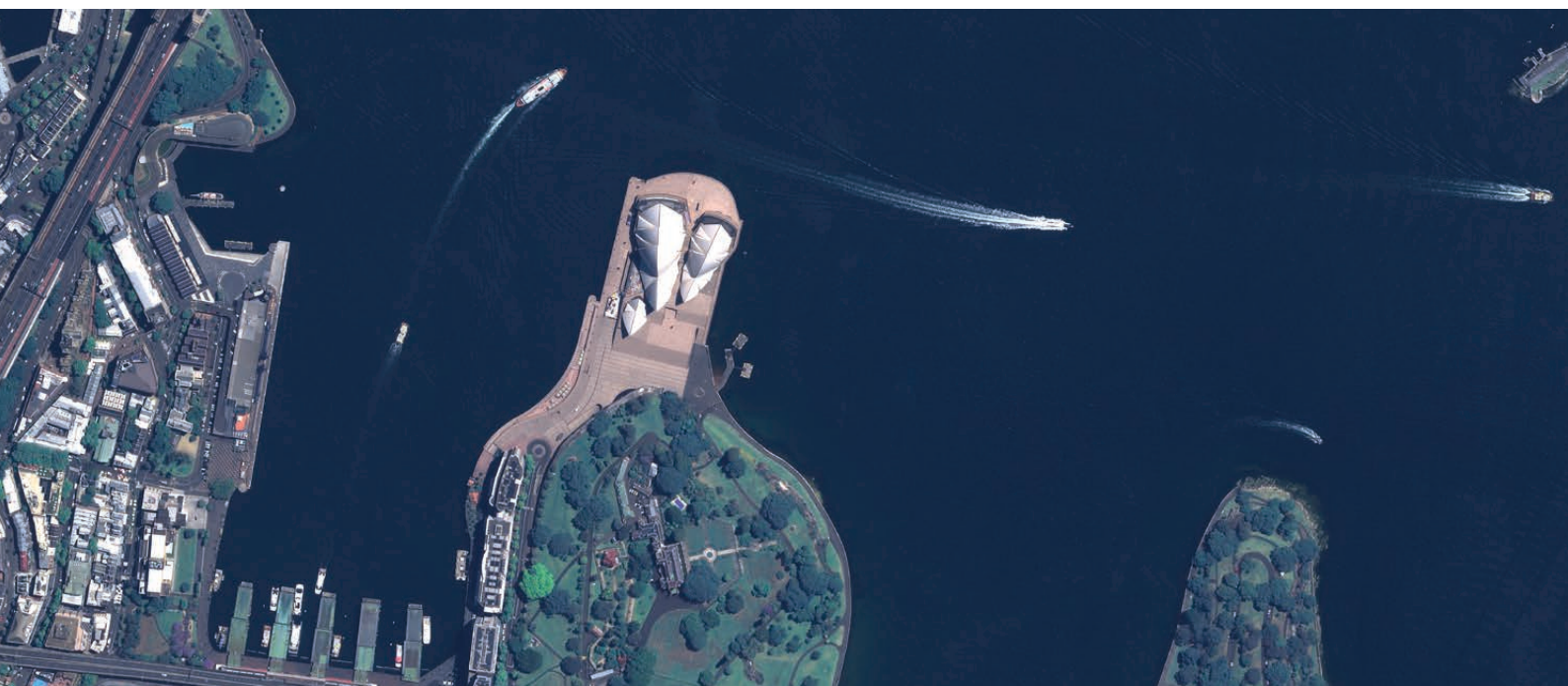
COMMERCIAL IMAGERY AND DATA CAN COMPLEMENT CLASSIFIED SOURCES AND METHODS BY INCREASING ISR MASS AND BY TAKING ADVANTAGE OF THE EVER-INCREASING NUMBER OF COMMERCIAL SATELLITE CAPABILITIES

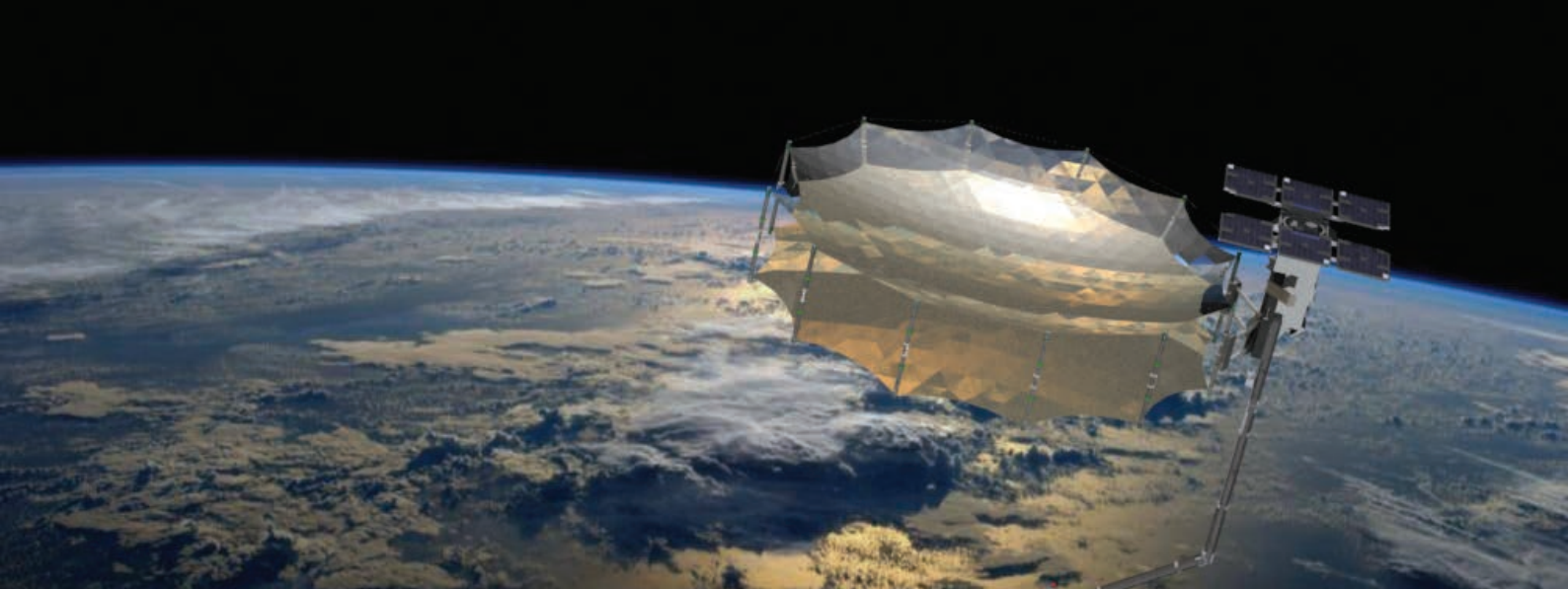
Space-based ISR is comprised of more than electro-optical (EO) imagery. Various Earth observation satellites now carry infra-red (IR), multi-spectral imaging (MSI), hyper-spectral imaging (HSI), and synthetic aperture radar (SAR) imaging sensors to provide 24 hours a day, 7 days a week, every day of the year (24/7/365) coverage in all weather and against all target types. Some satellites also carry Automatic Identification System (AIS) and radiofrequency (RF) sensors. Full motion video imagery from space is also now a reality.

This White Paper will explore four themes where space-based commercial ISR can be operationalised and synchronised with classified sources and methods, to provide a partnered and fused intelligence picture to the national security and intelligence communities.

Space-based commercial ISR is an intelligence source of choice because it can be used to enable foundational intelligence; indications and warning; joint intelligence preparation of the operational environment; operational intelligence; common operating picture management; target development and assessment; technical intelligence; and intelligence mission data. Commercial imagery and data can complement classified sources and methods by increasing ISR mass and by taking advantage of the ever-increasing number of commercial satellite capabilities, alongside government ones, to allow greater optimisation of sensors to targets based on capability and capacity.

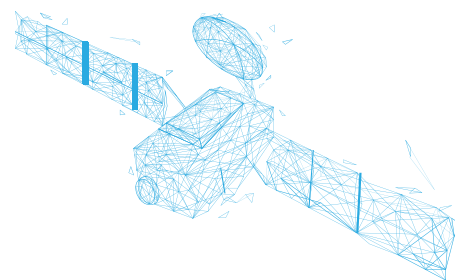
Sydney Opera House and Circular Quay
Image Pléiades Neo ©Airbus DS, 2021.





Capella Space SAR Satellite (Courtesy Capella Space)

COMMERCIAL SPACE-BASED ISR PROVIDERS HAVE A KEY ROLE TO PLAY IN ASSISTING THE DEPARTMENT OF DEFENCE AND THE NIC IN PROTECTING AUSTRALIA AND ITS INTERESTS



Space-based commercial ISR also enables Maritime Domain Awareness as it has unique capabilities to image large swathes of the ocean and complex littoral environments using a mix of EO, IR, and SAR imaging sensors – fused with AIS and RF data. This array of capabilities can assist in locating, tracking, and identifying *Dark Ships* that have turned off their communications, radar systems and AIS, are mis-characterising their identities on AIS, have physically changed their identities, are lurking in busy shipping lanes, or are hugging the littoral.

One of the most obvious characteristics of commercial space-based ISR data and information is that it is unclassified. It therefore provides many more options to governments who may want or need to share valuable insights or evidence, that may have previously only been known through classified sources. These unclassified products can more readily be shared with a broader array of organisations.

Commercial imagery or RF data overlaid on geospatial data, using appropriate intelligence tradecraft, can also provide compelling evidence to inform audiences and influence opinions. This type of intelligence also has applicability in equipping Australia to respond to ‘Grey Zone’, or information warfare, threats using media, economic, or other means, as part of an orchestrated operation of disinformation. Intelligence can assist in disproving propaganda and understanding the sources, means and motives for its dissemination.

In an environment of increasing uncertainty, Australia needs to maximise what is available to it in terms of data, information, and intelligence to develop the knowledge and understanding required to ensure its national security. Commercial space-based ISR providers have a key role to play in assisting the Department of Defence and the National Intelligence Community in protecting Australia and its interests.

INTRODUCTION

This White Paper will highlight the two sides of Intelligence, Surveillance and Reconnaissance (ISR) – government and commercial – and how they can, and indeed do, operate effectively and cooperatively as part of the same national security and intelligence undertaking; with each operating in distinct areas but where the advantages of one can mitigate the constraints of the other. For example, the commercialisation of Earth observation satellites, and their wide-ranging capabilities, can be used to assist national security organisations by complementing their own classified ones.

This White Paper will illustrate how the fusion of commercial space-based satellite data, geospatial intelligence, signals intelligence, and open-source intelligence, can revolutionise the direction, collection, analysis, dissemination, and utilisation of intelligence for a multitude of national security and intelligence stakeholders across multiple themes.

The collection and use of commercial and open-source data and information, as with classified sources, must be directed, planned, synchronised, coordinated, analysed, fused, and transformed into intelligence that provides real knowledge and understanding; and appropriately disseminated to build a holistic picture of the strategic, operational, and tactical environments. This will be of paramount importance to the Australian national security architecture, the National Intelligence Community and the Australian Defence Force, including in combined operations with other friendly nations.

Australia has been relatively slow, compared to many other nations, in developing its own sovereign space-based ISR capability, but with the establishment of the Australian Space Agency and the introduction of various space initiatives, the landscape is changing. The 2016 Defence White Paper, for example, stated that Australia would acquire its own satellite imagery capability, and Defence Project 799 (DEF799) was initiated to deliver this capability. The aim of Phase 1 of DEF799 was to provide Defence with direct access to space-based commercial satellite imagery. Phase 2 may acquire a more robust space-based GEOINT capability.¹ In November 2020, the Office of National Intelligence also orbited a satellite as 'a technology demonstrator ... [to enable] the Australian National Intelligence Community to experiment with emerging commercial satellite technologies.'²

Sydney, Australia
Imagery Pléiades Neo ©Airbus DS, 2021.



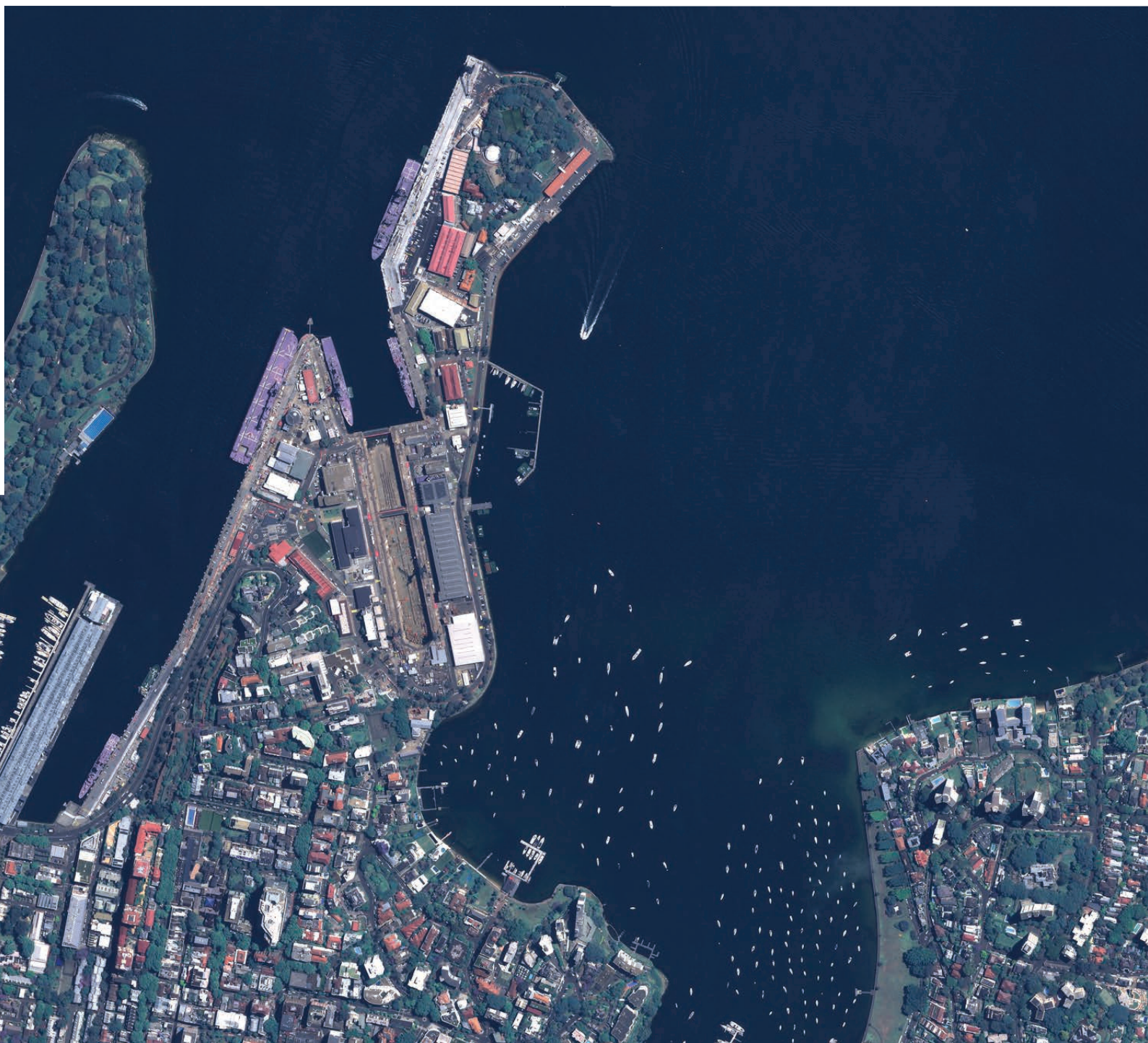
These are welcome developments, but it is unlikely that Defence or National Intelligence Community owned capabilities could immediately replicate the vast range of capabilities commercially available now and possibly into the near future. While they may have more 'exquisite' sensors and would not be required to compete with others for tasking priority, they are unlikely to provide the coverage and flexibility required for the desired type, range, and level of operational ISR and foundational intelligence tasking. It is much more likely, both in terms of efficiency and effectiveness, that government and commercial capabilities will operate in partnership utilising each one's strengths to create a more complete intelligence picture.

Structure

In addition to providing relevant background, this White Paper will discuss four themes where space-based commercial ISR can be operationalised and synchronised with classified sources and methods to provide a partnered and fused intelligence picture. The themes are:

1. An intelligence source of choice
2. Maritime Domain Awareness
3. To share information and establish trust
4. To dispel misinformation

Sydney, Australia
Imagery Pléiades Neo ©Airbus DS, 2021.



BACKGROUND

Humankind has always sought higher and higher vantage points from which to observe threats or adversaries – whether real, potential, or imagined. Initially, an elevated position on higher ground was sought, then kites and balloons were used, then powered flight was employed, and today space is increasingly becoming the domain of choice from which to conduct observation of the Earth. Space is the ultimate high ground.

Traditionally, we have called this observation *reconnaissance*, if we looked at the target for a short time, *surveillance* if we looked in a more systematic way over a longer period of time, or *intelligence* if we employed dedicated intelligence collection methods or organisations, to gather relevant information. As the three kinds of collection are increasingly integrated and the boundaries between them have become less clear and relevant, we now refer to them collectively as *Intelligence, Surveillance and Reconnaissance (ISR)*.

ISR can be defined as an activity that synchronises and integrates the direction, planning and operation of collection capabilities and processing, exploitation and dissemination (PED) systems. ISR thus connects requirements and collection management, collection by all collection types and means, and PED, into a coherent whole. ISR is not limited to a single level of command, but rather it spans the tactical to the strategic – literally from ground to space.

ISR is critical in the collection of data that can be transformed into information and further into intelligence. ISR is made up of different intelligence disciplines, including but not limited to, geospatial intelligence (GEOINT), signals intelligence (SIGINT), and open-source intelligence (OSINT).

In terms of Earth observation, GEOINT is the best known and most ubiquitous of the intelligence disciplines. The Australian Geospatial-Intelligence Organisation (AGO) defines GEOINT as the 'collection, analysis, and dissemination of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities in the air, land, maritime, and space domains.'³

While GEOINT is not only collected from space, there is little doubt that space is the increasingly preferred domain from which to collect it. Indeed, Earth observation from space has been a key aspect of intelligence collection since 1960.

SIGINT comprises communications intelligence (COMINT) concerning voice and data transmissions, and electronic intelligence (ELINT) targeting non-voice communications and radar systems.

OSINT includes data and information that is either publicly available (PAI) or commercially available (CAI). PAI is mostly free content available on the internet. CAI includes pay wall subscription services and commercially owned Earth observation satellite provided imagery and data.

OSINT is increasingly a collection source and analytical method of choice. Indeed, open sources have always constituted most of the data and information used by governments as part of their intelligence efforts.⁴ However, what was once incidentally collected is now the subject of targeted and requirements-driven collection activity.

Early Earth observation from space

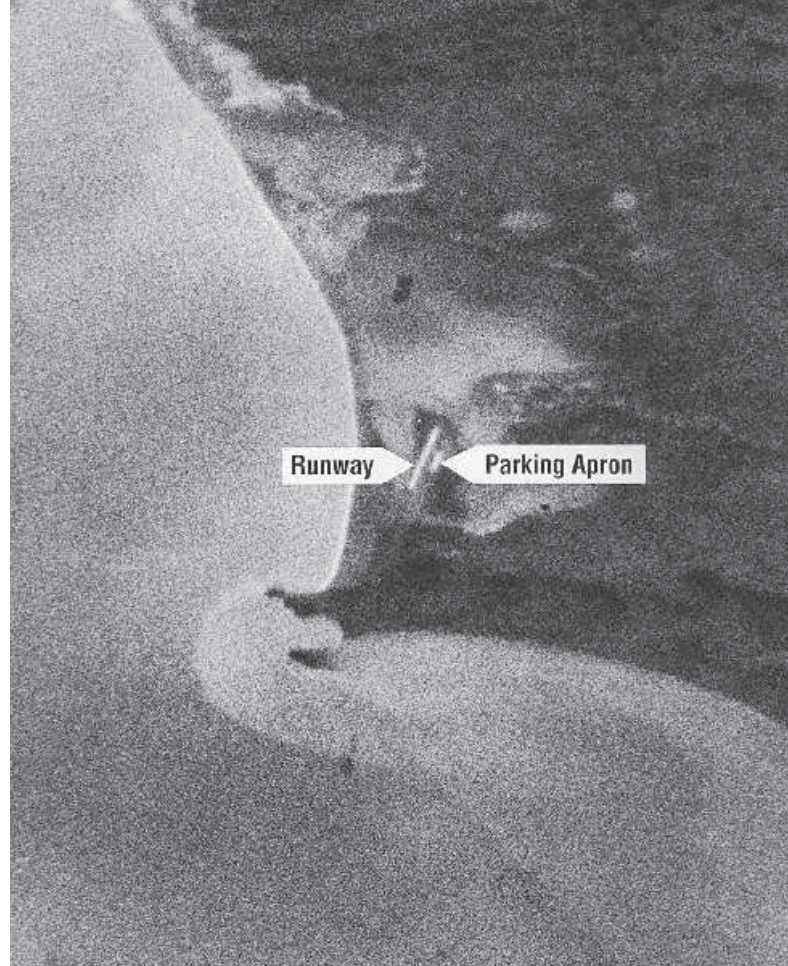
In August 1960, the United States successfully orbited a KH-1 CORONA Earth observation satellite and imaged Mys Shmidta – a Russian Airfield located in the Arctic – with a resolution of approximately 9m.⁵ The KH-1 used an optical camera and released film canisters containing the negatives which were retrieved in flight by specially modified aircraft. These negatives were then processed, exploited, and disseminated by the Central Intelligence Agency in what was a very sensitive process.⁶

Coincidentally, 1960 was also the year that Gary Powers' U-2 high altitude ISR aircraft was shot down over Russia. Therefore, a gap of only several months existed between the last manned ISR mission over Russia and the first unmanned satellite one. Satellite based ISR addressed many key issues of strategic and political risk associated with aircraft overflight; as well as greater ubiquity, persistence, penetration, and survivability.

Additionally, from 1976, with the launch of the KH-11 Earth observation satellite, capabilities transitioned from ejecting 'hard copy' film capsules retrieved in flight, to 'soft copy' transmission of electro-optical (EO) imagery via datalink.⁷ Image resolution has also vastly improved.

Over the ensuing decades, in addition to optical and EO sensors, Earth observation satellites were developed, deployed, and launched which carried various infra-red (IR), multi-spectral imaging (MSI), hyper-spectral imaging (HSI), and synthetic aperture radar (SAR) sensors. Not only did the United States field this wide array of Earth observation satellites and sensors, but so too did many other nations.

Landsat-1 image courtesy of the U.S. Geological Survey



Mys Shmidta Airfield, Russia, 18 August 1960
(Source: Wikipedia)

1976 LANDSAT 1 CALIFORNIAN COASTLINE



Earth observation goes commercial

In July 1972, the defence-only domain of space-based ISR ended with the launch by the U.S. Geological Survey of LANDSAT-1 with a resolution of 60m. The French company, SPOT Image (now Airbus Defence and Space), followed in 1986 with the launch of SPOT-1 with 10m resolution. In 1999, the situation vastly changed when the US company, Space Imaging (which then became GeoEye, then DigitalGlobe and now Maxar), launched IKONOS with 0.82m resolution EO imagery for commercial sale.

Now, commercially sourced EO imagery from providers such as ImageSat International (ISI), Maxar, and Airbus Defence and Space, is available down to 30cm or less. Some commercial providers such as Planet and BlackSky place greater emphasis on coverage than resolution.

While resolution is important, so is coverage, and they can often be mutually two exclusive characteristics. Coverage has increased in recent years with the addition of larger numbers of smaller satellites (such as SmallSats and CubeSats), which cannot carry the large and 'exquisite' sensors favoured by governments or the large, established very high-resolution commercial satellite companies, but instead focus on numbers and hence larger coverage, or a more frequent target re-visit rate.

Commercial SAR imagery is now also available from companies such as Airbus Defence and Space, Capella Space, e-GEOS, and ICEYE, at resolutions lower than 1m. Space-based full motion video (FMV) imagery is also likely to be commercially available in the near future.

Since 2008, the Automatic Identification System (AIS), a radio frequency identification signal carried by international voyaging ships and receivers, has operated from satellites. AIS is often overlaid on geospatial datasets by companies such as exactEarth and used with other space-based sensors to develop a fuller maritime ISR picture.

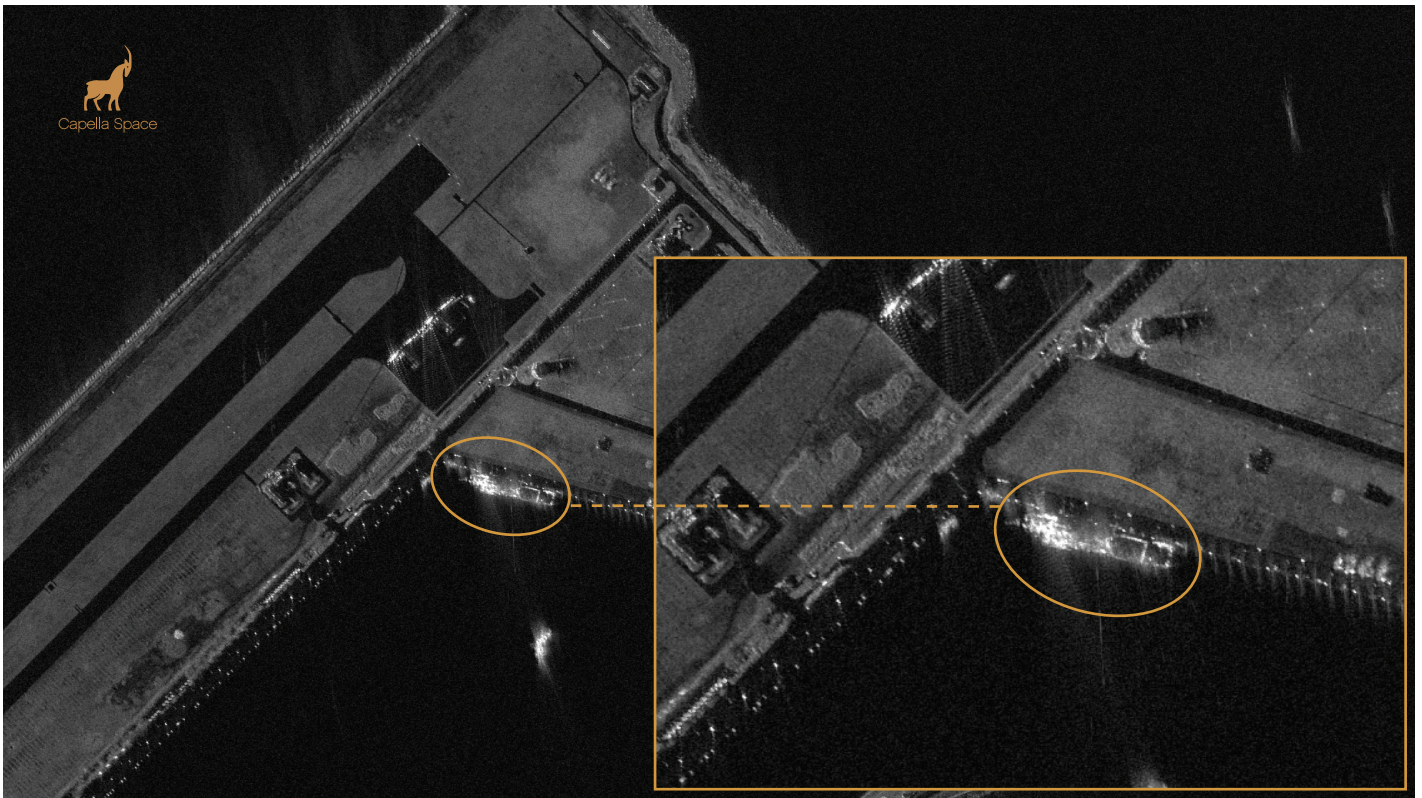
More recently, commercial SIGINT capable satellites are being launched. HawkEye 360, unseenlabs, and Kleos are leading the way with their radiofrequency (RF) detecting satellites increasing in constellation size and capability. These capabilities are increasingly utilised to collect data on 'non-cooperative' vessels not using AIS.

Space-based commercial GEOINT and SIGINT is also no longer solely available to the financially well-resourced. Space technology has steadily reduced in cost while increasing in capability and capacity. Space-based commercial ISR has therefore become successfully democratised with increasingly competitive products and pricing.⁸ It is now effectively one of the technical intelligence arms of OSINT alongside social media analysis (SOCMED).

The capability, resolution, coverage, and capacity of commercial space-based ISR capabilities may differ to those operated by governments, however, their capability and flexibility have strong and discrete advantages of their own.

HawkEye 360 RF satellite constellation (Courtesy Hawkeye 360)





Capella Space SAR imagery of a vessel berthed alongside a wharf (© 2021 Capella Space. all Rights Reserved)



ISI EO imagery of the same berthed vessel (Courtesy ISI)



THEME 1

AN INTELLIGENCE SOURCE OF CHOICE

GEOINT has always been an intelligence source of choice. Since 1960 Space-based Earth observation sensors have provided imagery from across the electromagnetic spectrum which has high resolution, is highly repeatable, has low strategic and political risk, and is available 24/7/365 in most weather conditions.

Space-based Earth observation products and services are used to enable foundational intelligence; indications and warning; joint intelligence preparation of the operational environment; operational intelligence; common operating picture management; target development and assessment; technical intelligence; and intelligence mission data.

While EO sensors are useful for technical intelligence, targeting, and mapping, they are limited by cloud and sunlight hours. IR imagery is available 24/7/365, and is useful to discern activity through energy being emitted by a target object. MSI is often used in resource management and for change detection. HSI has uses in detecting chemicals and pollutants. SAR imagery is 24/7/365, is comparatively unimpacted by weather, can penetrate some materials, and can provide insights that other forms of imagery may not.

Collectively, space-based EO, IR, MSI, HSI, and SAR sensors can provide global, 24/7/365, all weather coverage against a variety of target types, stationary or in motion, seen and unseen. This layering of collection capabilities is fundamental to effective collection management to answer questions and provide insight, but imagery needs to be analysed and contextualised.

Analytical tools such as Esri's *ArcGIS*, BAE's *Socet GXP* and *Centrifuge* by Centrifuge Analytics enable the analysis of big data problems with a geospatial element, by providing visual display, link-analysis, research, and product development capabilities. Commercial OSINT organisations also provide customers with timely, verified, validated, unbiased and relevant current and foundational OSINT to understand, identify and connect data on people, things, and events.

BLACK|SKY

Change Detection on 5 & 6 August 2021 - © BlackSky 2021



Space-based commercial ISR sources can, when correctly employed, complement a government's classified sources and methods as part of the regular Defence and National Intelligence Community effort. This can be done by increasing the effective mass of ISR capabilities available for tasking by taking advantage of the large number of commercial capabilities and allowing greater optimisation of sensors to targets based on their capabilities and fitness of purpose. Space-based commercial ISR sources can be applied to the less-urgent, less-sensitive, more routine, or larger foundational aspects of intelligence work, allowing government owned 'exquisite' classified capabilities to focus on more challenging, urgent, or important priorities.⁹

Intelligence Mission Data

Intelligence Mission Data (IMD) is structured all-source foundational intelligence intended to feed fifth-generation platforms, weapons, sensors, and command and control systems. This data is required to develop and maintain superior situational awareness and understanding of threats and targets. Increasingly it is this data that is decisive – not the platforms themselves. IMD consists of five categories: characteristics and performance data; electronic warfare data; order of battle data; GEOINT data; and signature data.¹¹

GEOINT, whether government or commercially provided, is not limited to just one IMD category, but is key to all five. This applicability might be more obvious for the order of battle and GEOINT categories, but perhaps not so clear for the other three. By way of example: characteristics and performance data benefits from GEOINT because of the ability to discern characteristics like antenna height or dish orientation; and electronic warfare and signature data benefit from the ability to identify equipment and key componentry or features on equipment.

Open-source intelligence

Alongside space-based commercial ISR, OSINT through publicly or commercially available information, is now a widespread intelligence discipline. The fusion of space-based commercial GEOINT imagery with high quality, open-source data allows intelligence analysts to produce OSINT based products of a similar look and feel to traditional National Intelligence Community all-source products.¹⁰ OSINT may still be verified by classified intelligence sources and methods to ensure accuracy but is then available for a wide variety of uses.

Artificial intelligence and machine learning

The amount of data that is now being collected of Earth from space means that it is simply beyond the ability of humans to process, exploit and disseminate it all. Artificial intelligence (AI) and machine learning (ML) are therefore game changers for GEOINT – and indeed GEOINT's focus on physical characterisation and location are what AI and ML are best at. However, there are limits to how well AI and ML can be fully integrated into intelligence work. Algorithms need to be trained so they know what they are looking at so AI and ML '...can help with tasks related to collection, processing, and analysis...but will struggle with tasks related to intelligence planning, dissemination, and evaluation.'¹²

Security

Security is critical to all intelligence operations. Confidentiality of tasking is important, as information on what is tasked by a government could provide insights into a nation's intelligence priorities and knowledge gaps. It is therefore important that commercial providers strictly adhere to security regulations.

OUTPOSTS IN THE SPRATLY ISLANDS

The South China Sea is a heavily contested and congested body of water that lies on the main trade routes between East Asia, and the Middle East and Europe. Resources such as oil, natural gas, and fish abound in the South China Sea - but its most favourable characteristic is its location. To the North is China and Taiwan, to the south is Indonesia, to the East is the Philippines, Brunei, and Malaysia, and to the West is Vietnam.

All these nations claim either some or all this area. Within the South China Sea, the two main island groups are the Paracel Islands and the Spratly Islands. There are also other assorted reefs and shoals. While the Paracels are held entirely by China, the Spratlys are claimed in full by China because the group falls within its Nine Dash Line claim, and in part by Taiwan, the Philippines, Brunei and Malaysia, and Vietnam.

While nearly all claimants have military forces and bases on their claims, China has substantially increased its infrastructure in the region. In the last decade China, on the seven occupied Spratly Islands, has constructed three major airfields on Fiery Cross Reef, Mischief Reef, and Subi Reef, and four major command, control and ISR nodes on Gaven Reef, Hughes Reef, Johnson South Reef and Cuarteron Reef. The three airfields have runways of 10,000 feet or longer and include hangars, fuel and ammunition storage, communications facilities, and personnel accommodation.

The associated construction work by China on the seven occupied Spratly Islands has been intensely followed by defence forces, intelligence agencies, think tanks and the news media. Because of the location of the features, the primary tool of choice has been commercial space-based Earth observation satellite imagery, as well as AIS and RF data. This body of water is likely to be one of the most imaged in the world.¹³



Time series showing expansion at Fiery Cross Reef in the South China Sea from 2013 to 2017. Satellite imagery ©2021 Maxar Technologies.



Marine Reserve monitoring to detect unauthorised fishing and vessel traffic
Image © CNES (2018) Distribution Airbus DS



AIS tracks of fishing and passenger vessels viewed on exactEarth® ShipView
in the Coral Sea Marine Reserve (Courtesy exactEarth)

THEME 2

MARITIME DOMAIN AWARENESS

Maritime Domain Awareness (MDA) describes a capability to know and understand what is happening in the maritime environment which might affect national security, economic wellbeing, or the safety of life at sea. Even in the 21st century it is possible for large vessels to blend into the vastness of an ocean.

Vessels that do not want to be tracked have several options to reduce their chances of detection. They can turn off their communications and radar systems, turn off their AIS, mis-characterise their identity or intentions on AIS, physically change their identity, lurk in busy shipping lanes, or hug the littoral. Vessels that do this are commonly referred to as *Dark Ships*.

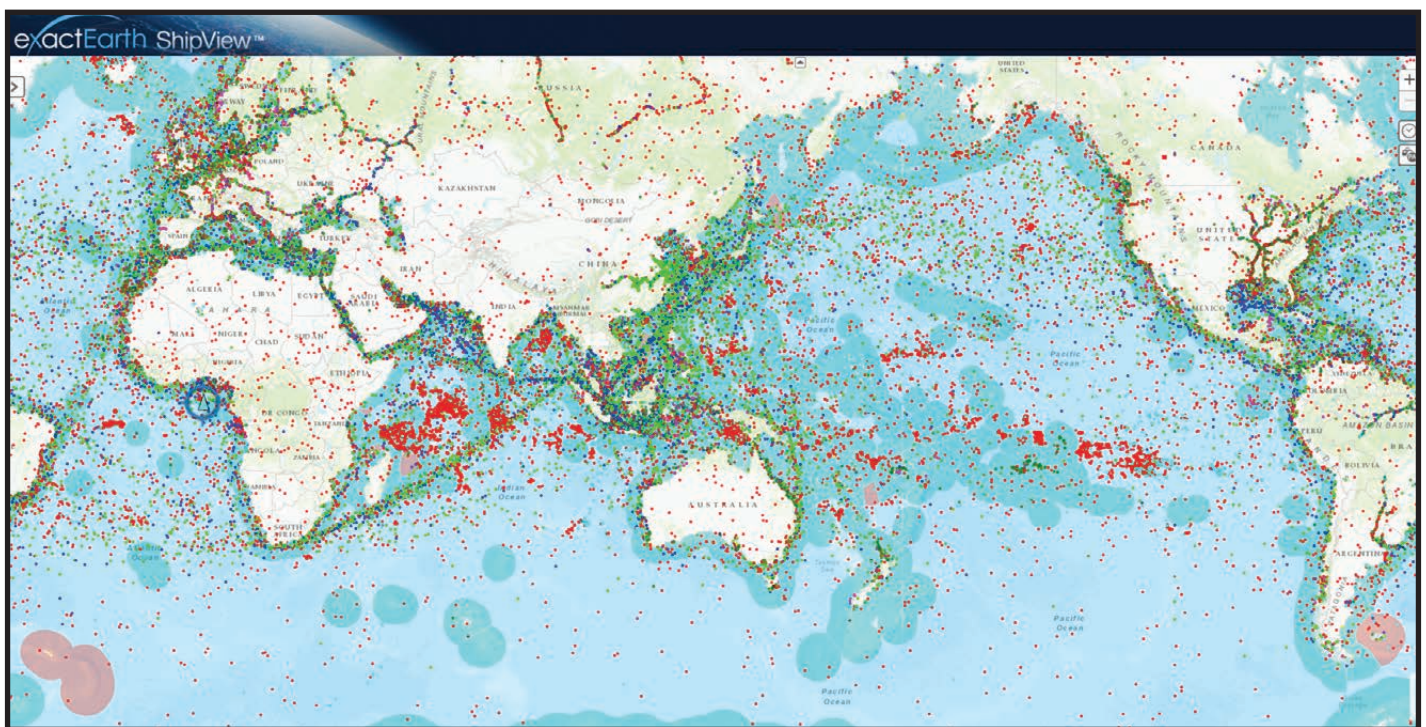
MDA usually involves a Common Operating Picture (COP) on which all operational and all-source data, information and intelligence is layered in a format that provides situational awareness for decision makers. Fundamentally, COPs rely on GEOINT to provide the essential base layers, often sourced from commercial GEOINT providers, upon which other data is superimposed.¹⁴

MDA is enhanced by space-based Earth observation as it has unique capabilities to image large swathes of the ocean and complex littoral environments using a mix of EO, IR and SAR imaging sensors – fused with AIS – and increasingly assisted by RF sensors. The latter assistance provided by RF sensors is especially useful in cases where a vessel has not enabled its AIS or has deliberately mis-characterised itself. RF sensors may provide enough of a clue to tip and cue an all-weather SAR capability or a good weather/daylight hours EO capability to classify or identify the vessel.

The use of more novel sensors can also prove valuable in MDA. For example, the Visible Infrared Imaging Radiometer Suite (VIIRS) is a sensor on board the Suomi National Polar-Orbiting Partnership (Suomi NPP) and United States National Oceanic and Atmospheric Administration (NOAA) NOAA-20 weather satellites. The sensor has the capability to detect lights on vessels at sea that are often used to attract fish.¹⁵

Commercial space-based ISR data is unclassified, has high resolution, and is capable of 24/7/365 availability across the gamut of EO, IR, SAR, AIS and RF. It is therefore of great value to nations such as Australia in its efforts to facilitate the MDA of developing nations because it will generally have fewer constraints on its use.

Because MDA is an international issue that transcends national borders and spans issues of national security through to economic interests, information sharing is often fundamental to its success. No nation can sustain 24/7/365 full situational awareness of the oceans in isolation, so the most efficient way to achieve the desired level of knowledge is to share information with partner nations. Indeed, counterintuitively, national sovereignty frequently depends on the sharing of data, information, and intelligence between like-minded nations to achieve MDA.



Every AIS transmitting vessel viewed on exactEarth® ShipView with the different coloured icons indicating different vessel types (Courtesy exactEarth)

TRACKING 'DARK SHIPS'

The International Maritime Organization (IMO) mandates that all voyaging ships use AIS to provide information to other vessels and to coastal authorities about the vessel and associated characteristics. Unscrupulous ship operators or those with ill-intent, often turn AIS off to disguise their true location or activities. Without AIS, other sources of data may be required to maintain MDA. In the past, the default option was airborne ISR capabilities and/or space-based EO imagery.

In more recent years, companies such as Airbus Defence and Space, MDA, Capella Space, ICEYE and e-Geos, have fielded active all-weather space-based SAR systems capable of imaging day or night in poor weather and in some instances, against moving targets. More recently again, providers such as HawkEye 360, unseenlabs and Kleos have fielded SmallSats with RF sensors. SAR and RF sensors can now provide a multi-intelligence capability to detect, track, and in some cases identify non-cooperative targets.

EO remains the highest resolution sensor type and is highly valuable when a ship is in a known location such as a patrol area, anchorage, or port. Some EO imagery such as VIIRS can also be used at night to detect vessels if they have their lights on. Additionally, when RF data is overlaid on EO imagery a more complete representation of the actual situation can be discerned. SAR imagery can also detect vessels at night, in poor weather, or which are deliberately being obscured by other materials. It can also be used to inform directed EO imagery collection on vessels of interest during sunlight hours and at high resolution.

The types of 'Dark Ships' that have been successfully tracked and identified using 24/7/365 space-based Earth observation capabilities in recent years include: Iranian crude oil tankers sailing to Syria in defiance of sanctions from the United States; North Korean vessels delivering coal to China in violation of United Nations Security Council Resolutions; and foreign fishing vessels which are illegally fishing within national exclusive economic zones.¹⁶



AIS and RF used in combination in the South China Sea
(Courtesy Hawkeye 360)



THEME 3

TO SHARE INFORMATION AND ESTABLISH TRUST

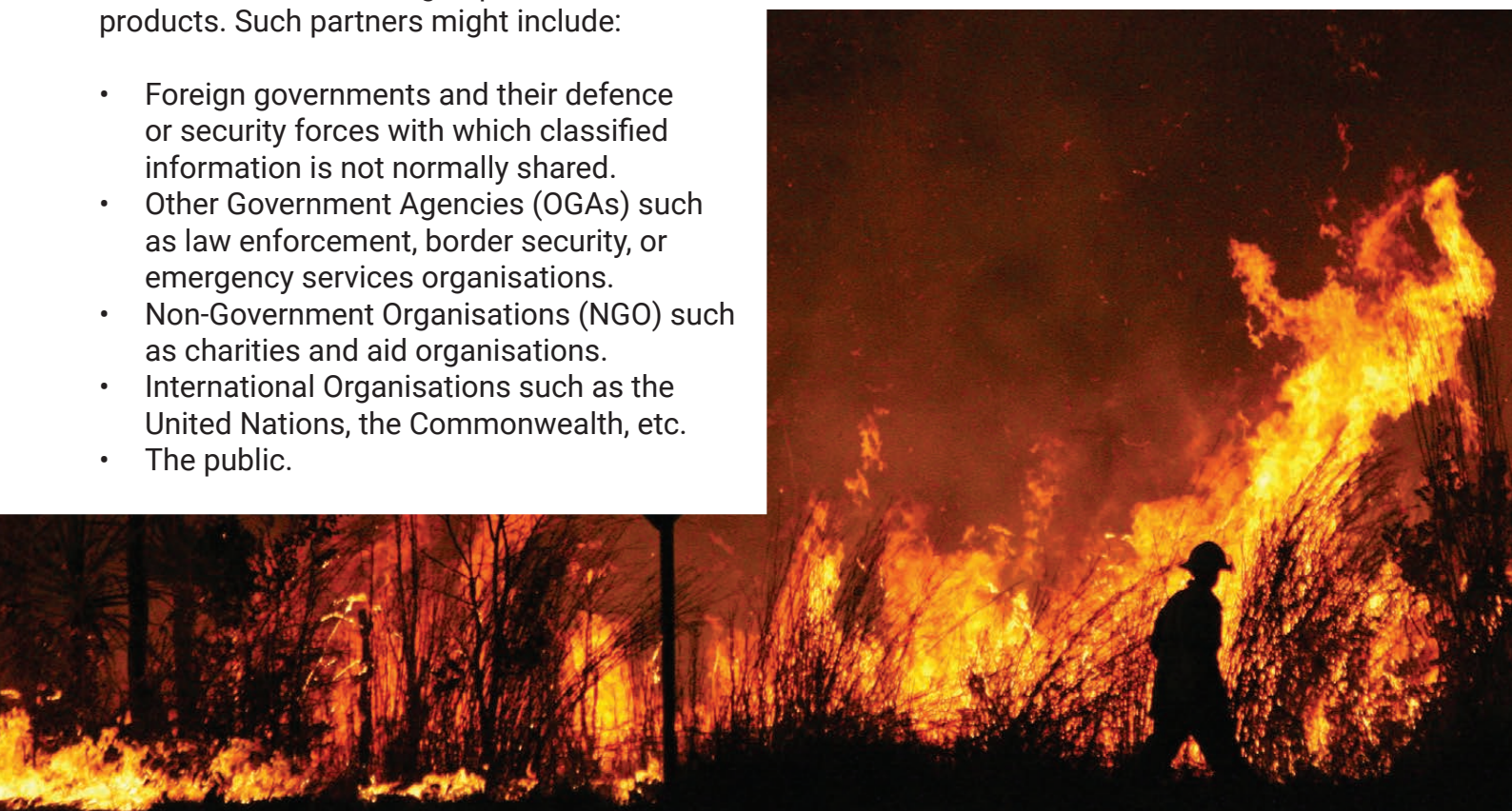
One of the most significant characteristics of commercial space-based ISR data and information is that it is unclassified. It therefore provides many more options to governments who may want or need to share valuable insights or evidence, some which may have previously only been known through access to classified sources and methods. This non-classified data and products have fewer constraints and can therefore be more readily shared.

Commercial space-based ISR data is now widely accessible and while most high resolution imagery and data can be purchased, some 'foundational' imagery, such as that available through the Google Earth platform and from other providers, is often free of charge.

Commercial space-based ISR data is now more readily available for use in the creation of purpose designed products, using intelligence tradecraft, for sharing with partners with whom governments have previously been either unable or unwilling to provide classified products. Such partners might include:

- Foreign governments and their defence or security forces with which classified information is not normally shared.
- Other Government Agencies (OGAs) such as law enforcement, border security, or emergency services organisations.
- Non-Government Organisations (NGO) such as charities and aid organisations.
- International Organisations such as the United Nations, the Commonwealth, etc.
- The public.

Examples of instances where commercial space-based ISR data may be preferred over classified sources include but are not limited to: sharing data indicating, or as evidence of, illegal foreign fishing or resource exploitation; overseas humanitarian and disaster relief (HADR) operations (such as regional cyclones and other disasters); and, Defence Aid to the Civil Community (DACC) and Defence Aid to the Civil Power (DACP) activities in Australia (such as cyclones, bushfires, floods, storms, and pandemics).¹⁷



HUMANITARIAN AND DISASTER RELIEF

The Australian Government has an excellent track record of providing HADR support to regional nations when tropical cyclones, tsunamis, Earthquakes, floods, landslides, and volcanos strike. Damage assessment is critical during HADR operations to ensure the full scope of damage is understood, where the most in- need populations are located, what critical infrastructure has been damaged and must be repaired, and what airfields, ports and other lines of communications are still functional to transport the required aid and personnel.

A critical issue for HADR operations is that imagery of affected areas needs to be made available at an unclassified level to the afflicted country's government and official agencies, as

well as NGOs and International Organisations. It is also important for the imagery to be both timely and in usable formats so that inexperienced users can maximise its benefits.

In April 2020, Tropical Cyclone Harold struck the Solomon Islands, Vanuatu, Fiji, and Tonga. Hundreds of thousands of people were affected. Lives and livelihoods were lost. Housing, schools, and utilities were destroyed, and fishing fleets affected.

The Australian Defence Force delivered over 224 tonnes of materiel to aid the recovery effort. This included 74 tonnes for the UN, Red Cross, and other NGO partners.¹⁸

Staff at the Nadi International Airport, Fiji, commence the offloading of Australian humanitarian aid stores from a RAAF C-17A aircraft on 18 April 2020. (Courtesy Australian Defence Force)



Maxar satellite imagery of damage from Cyclone Harold in Vanuatu, taken 10 April 2020 with WorldView-2. Satellite imagery ©2021 Maxar Technologies.

PANDEMIC EARLY WARNING SYSTEM (PEWS)

COVID-19 has raised awareness surrounding the threat of zoonotic diseases, which are defined by the World Health Organisation (WHO) as 'those diseases and infections, which are naturally transmitted between vertebrate animals and man, and infections that are shared between vertebrates and man.'

WHO has also defined zoonotic diseases in South Asia as being endemic, re-emerging, or emerging diseases with epidemic potential. Due to this potential threat, and lessons learnt from the COVID-19 pandemic, it is imperative that possible disease outbreaks be identified, monitored, and ranked to provide early warning to authorities and help stop epidemics from becoming pandemics.

The Pandemic Early Warning System (PEWS), provided by Spatial Apps Pty Ltd, uses AI to transform multiple data sources, including local news reports, social media, commercial satellite imagery, locations of high-risk areas, and other geospatial data into the detection of early warning signs of disease.

PEWS is an Analysis Toolkit that quickly identifies, interprets, and ranks millions of data sources that would otherwise require hours of manual analysis.

PEWS allows different sources of information such as social media and local news reports to be correlated and linked to specific locations. Using AI technology, web-scraping and sentiment analysis techniques, PEWS can monitor and detect when diseases, symptoms or illnesses are mentioned in social media or traditional media reporting.

This information is then consolidated and linked to a range of other location-based data before being integrated according to the risk profiles. The highly ranked areas can then be investigated further to identify possible transport vectors that could lead to a global spread of the disease, as well as the key potential entry points of the disease into other countries.





THEME 4

TO DISPEL MISINFORMATION

The term 'Grey Zone' has become increasingly common in recent times to describe a form of information warfare, often using media, economic, or other means. The 2020 Defence Strategic Update highlighted that the term:

*'Grey zone' is ... used to describe activities designed to coerce countries in ways that seek to avoid military conflict. Examples include using para-military forces, militarisation of disputed features, exploiting influence, interference operations and the coercive use of trade and economic levers. These tactics are not new. But they are now being used in our immediate region against shared interests in security and stability. They are facilitated by technological developments including cyber warfare.*²²

The 2020 Defence Strategic Update also made the point that Grey Zone activities include disinformation operations and that 'Defence must be better prepared to respond to these activities, including by working more closely with other elements of Australia's national power.'¹⁹

Intelligence is a key element in equipping Australia to respond to Grey Zone activities because it can provide insights into who may be undertaking the activities of concern, why they are undertaking them, and what they hope to achieve. Intelligence can also illuminate what is actually happening, or disprove incorrect or misleading assertions by a nation or organisation.

The key is that at least some of the intelligence must be able to be publicly released to support the counter-narrative. Indeed, this is not just an Australian issue – but a broader one. In April 2021 in the United States, it was reported that in 2020 'a group of four-star military commanders sent a rare and urgent plea asking for help in the information war against Russia and China', and that as a result, 'America's top spies...are looking for ways to declassify and release more intelligence about adversaries' bad behaviour.'²⁰

The United States commanders further stated that they need this assistance 'to better enable the US, and by extension its allies and partners, to win without fighting, to fight now in so-called grey zones, and to supply ammunition in the ongoing war of narratives' and that they 'continue to miss opportunities to clarify truth, counter distortions, puncture false narratives, and influence events in time to make a difference.'²¹

This is where commercially sourced ISR can be of fundamental importance in a counter-Grey Zone designed information warfare operation, action, or activity. Commercial imagery, or RF data overlaid on geospatial data, using appropriate intelligence tradecraft and graphic annotations to assist untrained audiences, can provide compelling evidence to inform the public and influence opinion on what is occurring, its relevance to Australia's national security, and what the true nature of the threat is. Space-based commercial imagery or RF data may provide vital credibility and aid in comprehension.

Simply put, a picture is worth a thousand words, and complex geo-strategic matters can be given real meaning with the targeted use of commercial ISR information in support of the strategic narrative.

MALAYSIA AIRLINES FLIGHT 17

On 17 July 2014 at 1620 hrs local time, Malaysia Airlines Flight 17 (MH-17) was shot down over the Ukraine, killing all 298 passengers and crew. The perpetrators were believed to be pro-Russian separatists equipped with an SA-11 BUK surface to air missile system.

Within hours of the aircraft's destruction, the open-source investigative company, Bellingcat, analysed imagery of a SA-11 BUK surface to air missile system in the area. This imagery was sourced from Twitter, Facebook, and YouTube and was posted by eyewitnesses. This imagery was then geo-located using commercial space-based imagery available on Google Earth to prove location. Bellingcat later connected the launcher to the Russian 52nd Anti-Aircraft Missile Brigade, normally located near Kursk, Russia.^{23,24}

After the attack on the aircraft, and in the face of international outrage, the Russian Government maintained that it was not Russia, nor Russian-backed separatists, at fault, but the Ukraine. These claims were contrary to the information gathered by Bellingcat using OSINT and geo-location techniques.

Several aircraft safety and criminal investigations have been conducted since the events of July 2014, with their reports generally concurring with Bellingcat's findings. As of August 2021, the Netherlands is currently in the process of taking Russia to the European Court of Human Rights for its part in the shoot-down.



Positions of Russian separatist vehicles from social media and Google Earth/DigitalGlobe (now Maxar) satellite imagery dated 17 July 2014 but released in July 2016. (Courtesy Bellingcat)

CONCLUSION

From its classified early days in 1960, space-based ISR has come a long way. Now, commercially available sensor resolution is very high, coverage is extremely broad, and periodicity is frequent. Commercial GEOINT has been joined by commercial SIGINT, and in the context of the ever-expanding field of OSINT, can provide a broad range of intelligence solutions to national security problems.

This White Paper has illustrated how the two sides of ISR – government and commercial – can, and indeed do, operate effectively and co-operatively as part of the same overall national security and intelligence enterprise. As noted in this White Paper, one's advantages can balance the constraints of the other.

This White Paper has also discussed four themes where space-based commercial ISR can be operationalised and synchronised with classified sources and methods to provide a partnered and fused intelligence picture: as an intelligence source of choice; to enable Maritime Domain Awareness; to share information and establish trust; and, to dispel misinformation.

In late 2020, the Australian Government released its Defence Strategic Update. At its launch, Prime Minister Scott Morrison noted the level of strategic uncertainty that Australia now faces.

Australia therefore needs to maximise what is available to it in terms of data, information, and intelligence to create the knowledge and understanding required to ensure its national security. Commercial space-based ISR providers could provide valuable assistance as key partners of the Department of Defence, the Australian Defence Force, and the National Intelligence Community in the protection of Australia and its interests.

To find out more about commercial space-based ISR and how it can be used as part of Australia's national security efforts, **Geospatial Intelligence Pty Ltd is available to assist.**

COMPANY PROFILE

Founded in 2002, headquartered in Canberra, and 100 percent Australian owned and staffed; Geospatial Intelligence Pty Ltd is a specialist provider of geospatial data, analysis, and analytics.

Geospatial Intelligence Pty Ltd is the leading Australian re-seller of very high resolution electro-optical, infrared, multi-spectral, and synthetic aperture radar satellite imagery, and Automatic Identification System data. GI is also a provider of open-source intelligence, and training services.

We directly task some satellite providers, and request targeted data from others, to capture the imagery and data that best meets our customers' needs. We deliver this imagery and data in either a ready-to-use format, or fuse it with other data sources and analysis, to deliver value-added products.

We excel in the use of open-source intelligence. We use structured and unstructured location-based data combined with our custom algorithms, to efficiently collect, process and analyse open-source intelligence to understand context, relationships, patterns, and trends.

Our highly qualified team of experts will work with you to understand your geospatial needs and challenges, and will dedicate themselves to:

- sourcing the best available data
- creatively applying their skills and leading analysis tools to turning that data into meaningful information and intelligence
- providing you with a tailored solution.

Our products and services allow our clients to understand context, relationships, patterns, and trends. This valuable information can be applied in:

- enhancing their domain awareness and knowledge
- supporting informed decision making
- creating strategic, operational, or competitive advantage.

Our track record has built us a strong reputation for delivering innovative, responsive, and effective geospatial solutions that consistently exceed our clients' expectations. The key to our business success is a combination of our:

- client-focus
- quality service
- specialist expertise
- relationships
- reputation for creativity and reliability.

Please refer to our website for information on our products and services



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Author

Air Commodore Richard (Rick) Keir, AM, CSC (Retired) is the Strategic Advisor for National Security and Intelligence to Geospatial Intelligence Pty Ltd. Rick has over 30 years' experience as a Royal Australian Air Force Intelligence Officer and his last military appointment was as the Director-General Intelligence (J2) at Headquarters Joint Operations Command where he was responsible for global intelligence support to the Australian Defence Force. Rick now provides strategic advisory and consulting services to the national security, intelligence, and defence communities, and industry that engages, or wants to engage, with these communities.

Abbreviations

ADF	Australian Defence Force
AGO	Australian Geospatial-Intelligence Organisation
AI	Artificial Intelligence
AIS	Automatic Identification Service
CAI	Commercially Available Information
COMINT	Communications Intelligence
COP	Common Operating Picture
ELINT	Electronic Intelligence
EO	Electro-Optical
FMV	Full Motion Video
GEOINT	Geospatial Intelligence
HADR	Humanitarian and Disaster Relief
HSI	Hyper Spectral Imagery
IMD	Intelligence Mission Data
IR	Infra-red
ISR	Intelligence, Surveillance and Reconnaissance
MDA	Maritime Domain Awareness
ML	Machine Learning
MSI	Multi Spectral Imagery
NIC	National Intelligence Community
OSINT	Open-Source Intelligence
PAI	Publicly Available Information
PEWS	Pandemic Early Warning System
RF	Radiofrequency
SAR	Synthetic Aperture Radar
SIGINT	Signals Intelligence
VIIRS	Visible Infrared Imaging Radiometer Suite

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GEOSPATIAL INTELLIGENCE PTY LTD

@ info@geoint.com.au

🌐 geoint.com.au

☎ +61 1800 436 468