



# Digitalisation in Defence: Command, Control and Situational Awareness (C2SA)

*60 Years of Growth, Innovation and Leadership*

F R O S T & S U L L I V A N

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## EXECUTIVE SUMMARY

The COVID-19 pandemic has had a destabilising impact on geopolitics, which has increased both focus and spending on national defence. Global defence spending in 2020 reached just under \$ 2 trillion, an increase of 2.6% year-on-year from 2019, despite the global gross domestic product (GDP) decline of 3.4%<sup>1</sup>. Moreover, the pandemic accelerated digitalisation in the military domain, as it did in the commercial sector, which is evident from the many military organizations currently considering or adopting digital technologies exponentially. This trend is compounded by rising geopolitical threats from state and non-state actors that can only be countered by the strategic and financial advantages digitalisation offers in the combat zone. The main area of technology application is to reduce the time taken from detecting the threat to taking action to neutralise the same, i.e. reducing the observe, orient, decide, act (OODA) loop by tapping the power of connecting air, land, maritime, and space-based assets as part of enhanced and effective C4ISR and C2SA networks.<sup>2</sup>

Space has come to the fore in providing a fourth element for networked operations as global militaries have been increasing the adoption of space-based assets as part of their overall digitalisation and as an element of C4ISR/ C2SA networks. The surge in launch of low Earth orbit (LEO) satellite constellations, such as those provided by Iridium, Starlink, and OneWeb, has increased the uptake of space-based assets. For example, the UK government has acquired a stake in OneWeb as part of its larger commercial and military digitalisation.

C2SA solutions such as TITAN BY NORTAC that use short burst data (SBD) for global connectivity are seeing increased adoption worldwide. SBD solutions offer enhanced strategic and financial advantages that fit the purposes of advanced and emerging countries alike. The strategic advantages are beyond-line-of-sight (BLOS) uninterrupted situational awareness (SA), dispersed operations, strong encryption protocol, and low probability of detection. The financial advantages accrue from the low volume of data required and the declining cost curve of satellite data services. TITAN BY NORTAC, in particular, has a flexible and modular architecture that enables its incorporation into existing battlefield management systems (BMSs) to provide redundancy and enhanced functionality. The flexible architecture also provides users an option to either choose the existing Iridium satellite network or transport the solution on their own satellites.

A Frost & Sullivan study conducted in May 2021 for Nortac Defence suggests that the total market across twenty selected countries for solutions like TITAN BY NORTAC is \$ 1.39 billion for the period 2021 to 2026, with the total accessible market specifically for TITAN BY NORTAC estimated at \$278 million for the same period.<sup>3</sup>



<sup>1</sup> "Press Release: World Military Spending", SIPRI, <https://www.sipri.org/media/press-release/2021/world-military-spending-rises-almost-2-trillion-2020> (accessed December 15, 2021)

<sup>2</sup> C4ISR – Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance  
C2SA – Command, Control, and Situational Awareness

<sup>3</sup> The twenty countries were selected on parameters based on their geopolitical situation/ threat criteria, existing solutions, need for TITAN BY NORTAC-like solutions, defence budget, and the size of Special Forces.



**Global defence spending is expected to reach \$2,274 billion in 2025, increasing at a compounded rate of 2.6% due to increased geopolitical tension and economic rebound.**



## **PART 1: GLOBAL DEFENCE AND SPACE TRENDS**

### **Global Defence Spending**

The economic impact of COVID-19 has not affected global defence spending, primarily due to the increased geopolitical uncertainty which accompanied the pandemic. Mounting antagonism against China that has heightened tension in the Indo-Pacific region, exposure of ethnic and social fault lines in Europe and Russia's attempt to exploit the fissure, and the United States' withdrawal from Afghanistan that allowed the re-emergence of the Taliban have, among other factors, contributed to the increased threat scenario. For example, a face-off between India and China in 2020 at the northern borders of India led to casualties on both sides, a first since 1975.<sup>4</sup> Globally, the expansion of defence budgets from most top spenders reflects the effect of rising tensions. For instance, Australian Prime Minister Scott Morrison committed AUD270 billion for defence spending in the next ten years as he regards Indo-Pacific as the epicentre of strategic competition. PM Morrison stated that Australia must prepare for a poorer, more dangerous, and disorderly post-COVID-19 world. The focus of a more aggressive defence strategy is to counter the increasing threat of a rising and belligerent China.<sup>5</sup>

As a result of geopolitical decline, global defence spending in 2020 was recorded at \$1,981 billion, which is an increase of 2.6% over 2019 (Source: SIPRI) The higher defence spending, even when the global GDP faced a contraction of negative 3.4%, is an indicator of increased defence posturing in uncertain times. With a global economic rebound of 3-4% expected in the medium term<sup>6</sup> and assuming continued geopolitical tension, defence spending will increase at a compound annual growth rate (CAGR) of 2.8% to reach approximately \$2,274 billion in 2025 (see Figure 1).<sup>7</sup>

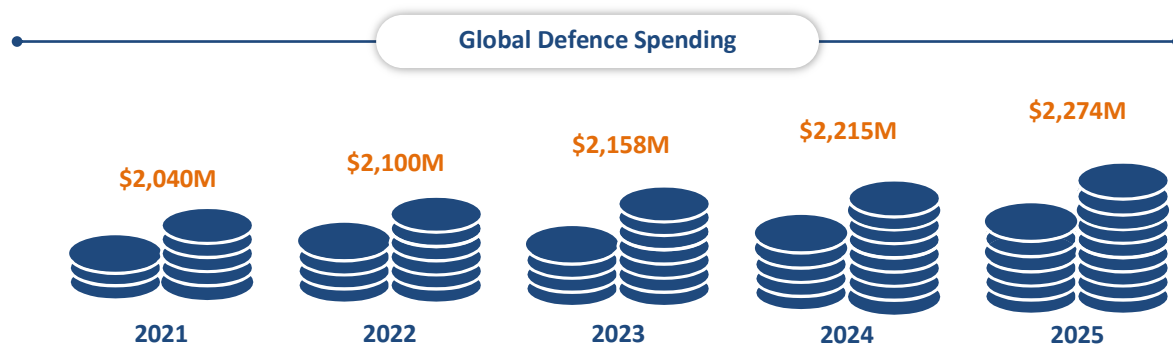
<sup>4</sup> "India-China dispute: The border row explained in 400 words," BBC News, <https://www.bbc.com/news/world-asia-3062484> (accessed December 15, 2021)

<sup>5</sup> "Australia to spend \$270b building larger military to prepare for 'poorer, more dangerous' world and rise of China" ABC News, <https://www.abc.net.au/news/2020-06-30/australia-unveils-10-year-defence-strategy/12408232> (accessed December 15, 2021).

<sup>6</sup> "Global recovery continues, but the momentum has weakened and uncertainty has increased", International Monetary Fund, <https://www.imf.org/en/Publications/WEO/Issues/2021/10/12/world-economic-outlook-october-2021> (accessed December 15, 2021)

<sup>7</sup> Frost & Sullivan modelling based on economic, geopolitical, and threat scenarios

**Figure 1: Defence Spending Forecast, Global, 2021–2025**



Source: Frost & Sullivan

*Note: Forecasted defence spending for 2021–2025 is based on Frost & Sullivan modelling and is subject to maintenance of the current geopolitical situation. A significant upside risk to the estimates is probable if the geopolitical situation deteriorates further. Figures are rounded off to the nearest million.*

### Increased Uptake of Digitalisation and Joint Structures in Defence Forces



Joint operations are the key to unlocking the full power of defence air, land, and naval elements, but this strategy can only be achieved by employing digitalisation in inter-operable systems and joint command structures. In the past, however, internal challenges have hampered the adoption of digitalisation and joint structures; data security, data sharing concerns, the lack of concept of operations, and an overt platform-centric approach all compounded the adoption issue. While internal challenges are unlikely to disappear overnight, stakeholders have taken positive moves to ease the process of adopting digital solutions. Specific initiatives have included the use of joint operations networks, a shift from data silos to centralised models, and modification of acquisition procedures for software services to promote greater ease of integrating connected structures. The focus of applying digitalisation is to reduce the OODA loop and thus improve commanders' C2SA at both headquarters (HQ) and at the tactical edge.

An exemplary digitalisation initiative is the JADC2 concept, which is the US Department of Defense's (DOD's) program to connect sensors across all military services—Air Force, Army, Marine Corps, Navy, and Space Force—into a single network.<sup>8</sup> This is a departure from the past when each service branch developed its own tactical networks that were incompatible with those of other service branches. The aim of JADC2 is to reduce the OODA loop so that commanders have access to near real-time information from a multitude of joint sensors transmitted through different communication channels. The data is processed by using artificial intelligence (AI) and algorithms to identify targets and then recommend the optimal kinetic or non-kinetic (e.g., cybersecurity) solution to the commander for faster decision making.

### Digitalisation Adoption Varies Significantly around the Globe

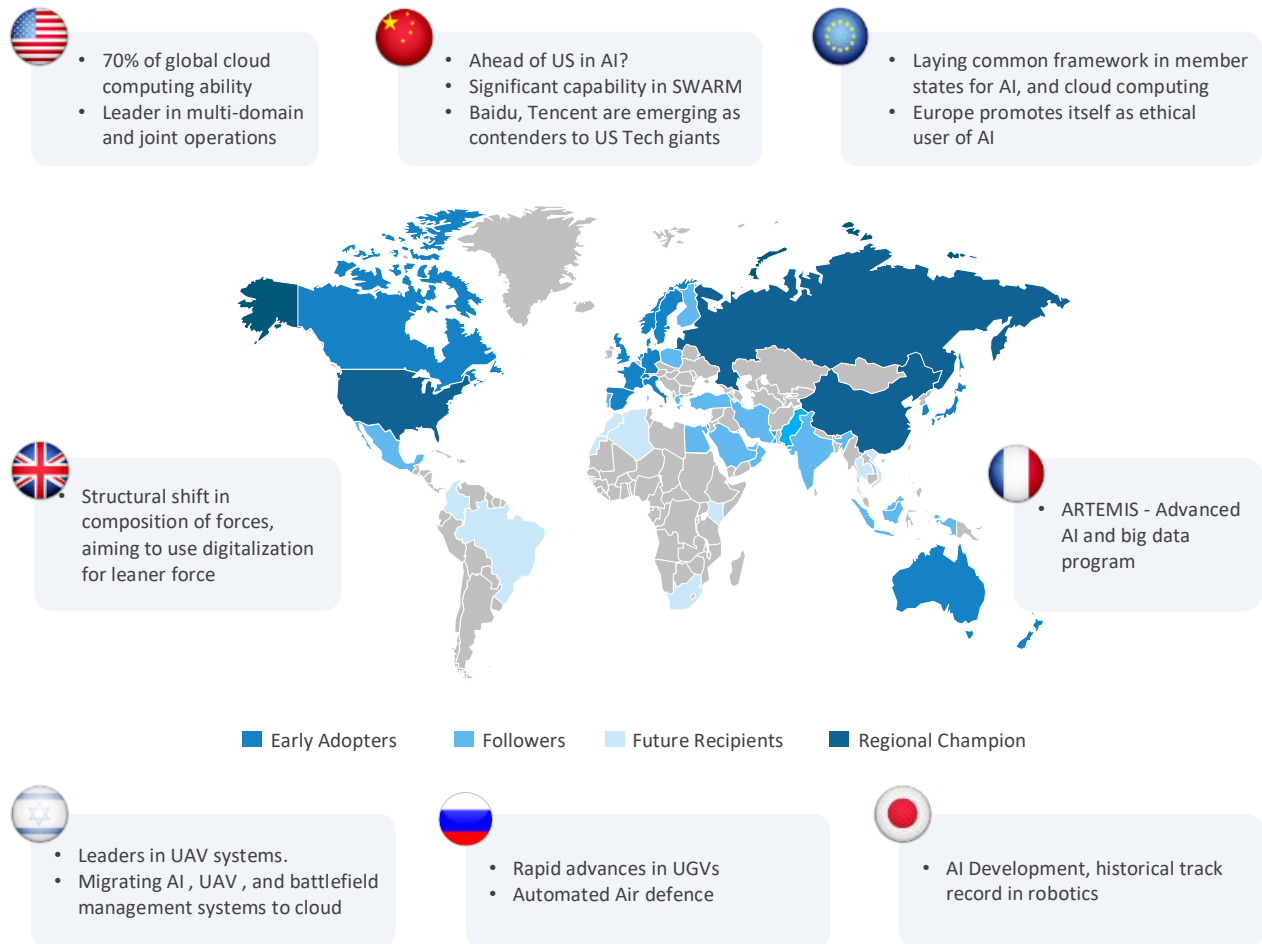


The US and Chinese defence forces are the leaders in adoption of both defence technology and digitalisation. Europe is a distant second in technology adoption. Notably, the United Kingdom, France, Japan, Israel, Australia, and South Korea have instituted national-level defence technology programs while countries in the Middle East, Asia-Pacific (APAC), South Asia, and South America are future adopters currently characterised by legacy equipment, low force equipment levels, and lower budgetary spend. However, most countries, irrespective of their current technology status, recognise the need for digitalisation and are taking steps to incorporate C4ISR and C2SA solutions into their larger digital transformation programs.

<sup>8</sup> "Joint All-Domain Command and Control (JADC2)", Congressional Research Service, <https://crsreports.congress.gov/product/pdf/IF/IF11493> (accessed December 15, 2021)



Figure 2: Defence Digitalisation Adoption Map, Global, 2022

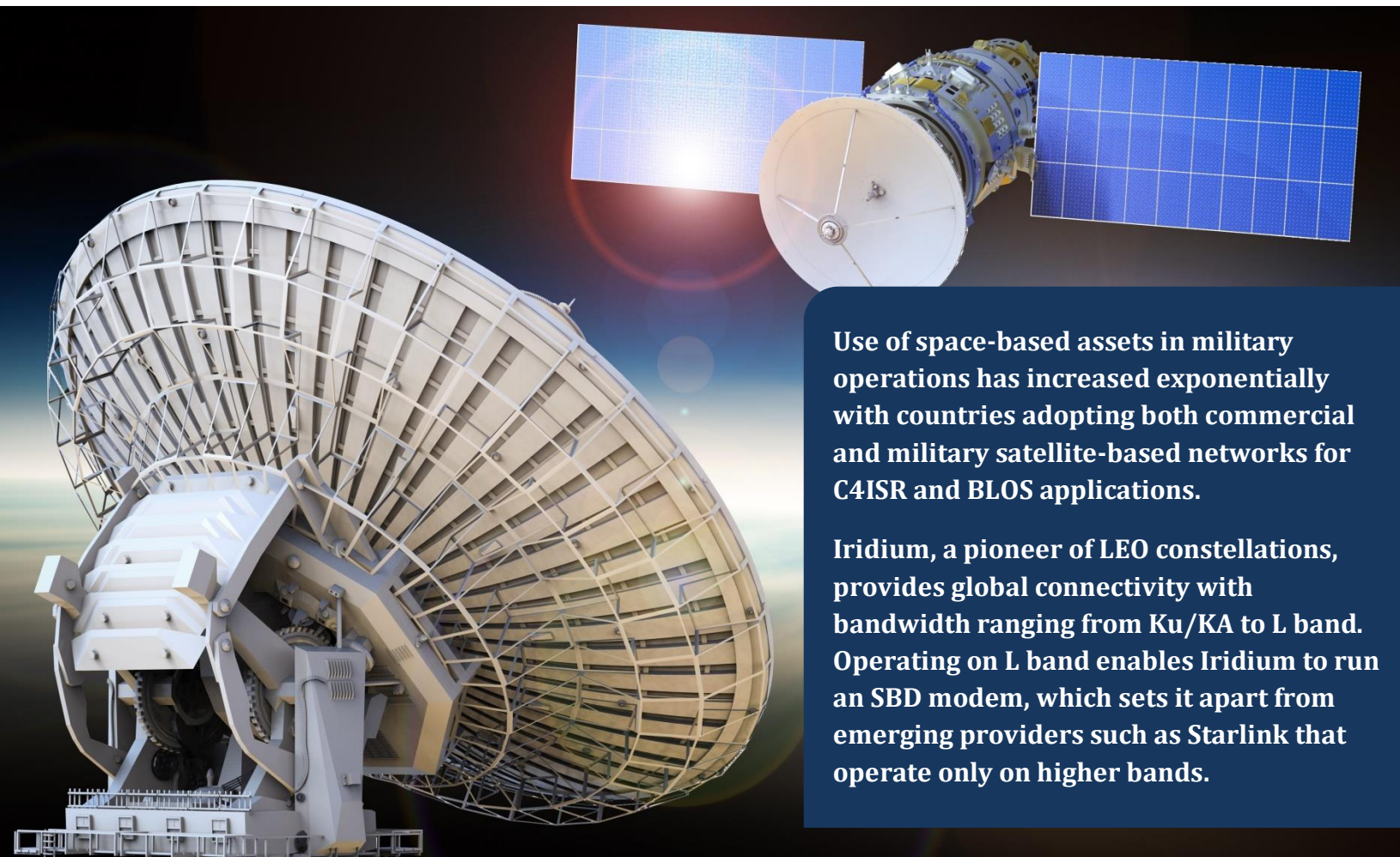


Source: Frost & Sullivan

What varies from nation to nation is the nature of programs being adopted. While the United States is adopting complex programs like JADC2, Thailand, the Philippines, and Malaysia have instituted C4ISR and C2SA programs as first steps in the digital transformation journey. The difference in the nature of national programs may be gauged by reviewing the specific C2SA solutions adopted. C2SA solutions typically involve blue force tracking (BFT) and communication by line-of-sight (LOS) networks, such as towers, or beyond LOS (BLOS) networks, such as satellites. In leading countries, these critical abilities are incorporated as part of larger programs, as seen in the Leonardo DRS Mounted Family of Computer Systems (MFOCS). MFOCS II integrates existing Force XXI Battle Command Brigade and Below (FBCB2) and future Joint Battle Command-Platform (JBC-P) capability in a modular and flexible architecture to extend networking reach to the tactical edge. In emerging countries, however, these applications—especially BLOS—are used to supplement their legacy communication equipment, which have a limited LOS range, lower power, and no SA ability.



## Increasing Use of Space-based Assets in Military Operations



**Use of space-based assets in military operations has increased exponentially with countries adopting both commercial and military satellite-based networks for C4ISR and BLOS applications.**

**Iridium, a pioneer of LEO constellations, provides global connectivity with bandwidth ranging from Ku/KA to L band. Operating on L band enables Iridium to run an SBD modem, which sets it apart from emerging providers such as Starlink that operate only on higher bands.**

Space-based assets have long been an integral part of military operations. The objective of using space-based assets as defined by 'Joint Pub 3-14, Space Operations' is to create the "effective employment of space capabilities in support of land, sea, and air operations to gain and maintain a combat advantage throughout the operational continuum and across the three levels of war."<sup>9</sup>

Within the framework of digitalisation and joint operations, the use of space-based assets has seen an exponential increase, not only with the launch of military satellites but also with commercially launched LEO satellites.

For instance, the UK government has funded and acquired a portion of the OneWeb satellite constellation along with the commercial entity Bharti Airtel. It is widely believed that in addition to the main business model of using the constellation to beam the internet, the UK government will perhaps build a space-based positioning, navigation, and timing (PNT) service. In the new Defence, Security and Policy review, the UK Ministry of Defence (MoD) has announced its intention of cutting the overall strength of its army and inducting new capabilities in advanced space, cyber, and AI platforms. The acquisition of OneWeb could well be a part of the UK military's overall digitalisation profile, which includes exploitation of space-based capabilities for enhanced operational capability. It is worth mentioning here that among other applications, OneWeb lists peacekeeping and military C2SA among its use cases.

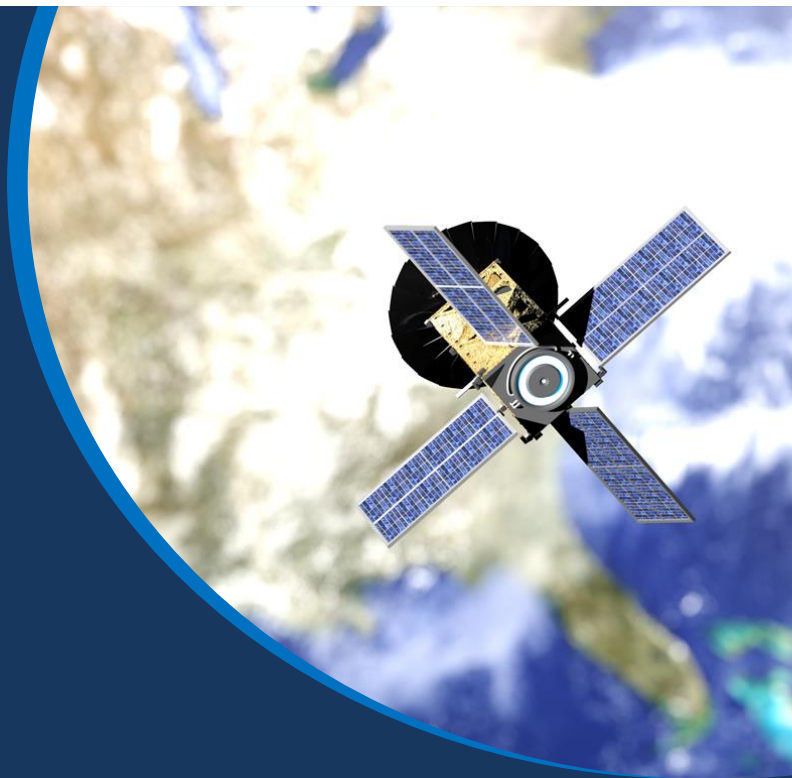
<sup>9</sup> Space Operations Joint Force Development, [https://www.ics.mil/Portals/36/Documents/Doctrine/pubs/jp3\\_14ch1.pdf?ver=qmkgYPyKBvslZyrnswSMCG%3D%3D](https://www.ics.mil/Portals/36/Documents/Doctrine/pubs/jp3_14ch1.pdf?ver=qmkgYPyKBvslZyrnswSMCG%3D%3D)



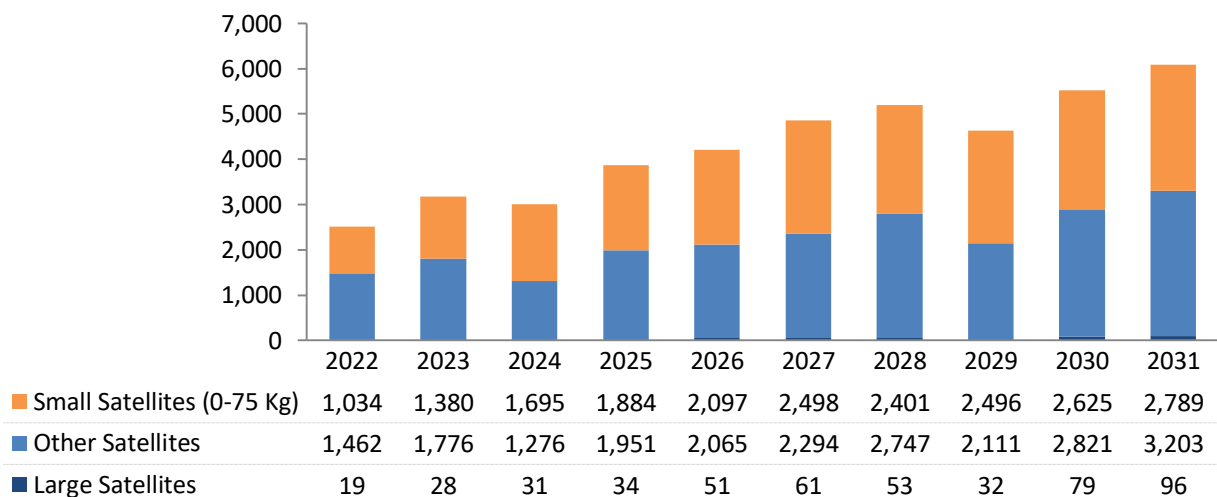
Frost & Sullivan estimates that end users will launch **43,000** satellites from 2022 to 2031 .

Satellites weighing less than 75 Kg form about 50% of the total demand, while 98.99% is contributed by satellites weighing less than 500 Kg.

This mass class (less than 75Kg) covers all key user segments, including university, commercial, military, and civil government customers.

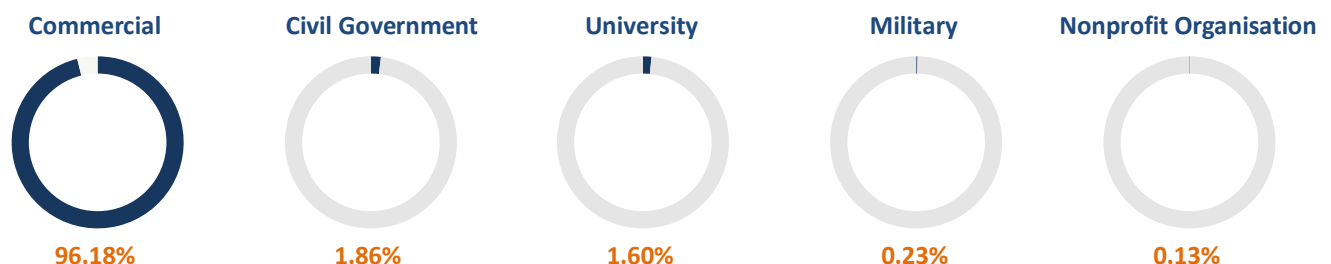


**Figure 3: Global Satellite Manufacturing Market Share by User Segment for Mass Class (less than 75Kg), 2022–2031**



Source: Frost & Sullivan

**Figure 4: Small Satellite Launch Market: High-Scenario Demand Forecast by User Segment, Global, 2022–2031**



Source: Frost & Sullivan

The greatest demand falls in the low weight, LEO, and communication satellites. Commercial satellites in the LEO class are increasingly being used by defence forces for C2SA solutions. The major commercial satellite providers for communication and networking are Iridium, Starlink, Amazon, and OneWeb. Iridium, an industry pioneer, is the longest-running provider of LEO satellites. Iridium's constellation architecture makes it the only network that covers 100% of the planet wherein its satellites are cross-linked to provide reliable, low-latency, weather-resilient connections that enable communication anywhere in the world.<sup>10</sup> Among other services, such as handsets, Wi-Fi hotspots, and stand-alone trans-receiver units, Iridium provides SBD modems on L band. This is a unique value proposition as newer providers, such as Starlink, operate only on Ku/Ka band.

## PART II: GLOBAL DEFENCE TECHNOLOGY TRENDS

### Defence Digitalisation Technologies

Frost & Sullivan has grouped defence digitalisation technologies into four clusters: AI, everywhere computing, human-machine interface (HMI), and connectivity. The industry regards AI and connectivity solutions (C4ISR and C2SA) as the frontier technologies that are expected to have the greatest impact on military operations.

Beyond designating the four main clusters, Frost & Sullivan classified the technologies as evolutionary, emerging, and disruptive according to their technology readiness level, adoption timeline, and impact on military operations:

- **Evolutionary:** The technology is well understood and is widely developed in operational and training systems, and it will continue to evolve independently and in conjunction with other clusters.
- **Emerging:** With a low technology readiness level, these solutions will take a few years to mature and impact military operations.
- **Disruptive:** A technology classified as disruptive will change the way battles are fought and necessitate new strategies and operational concepts.

Figure 5 outlines the timeline for the adoption of digitalisation technologies and the impact they will have on military operations.



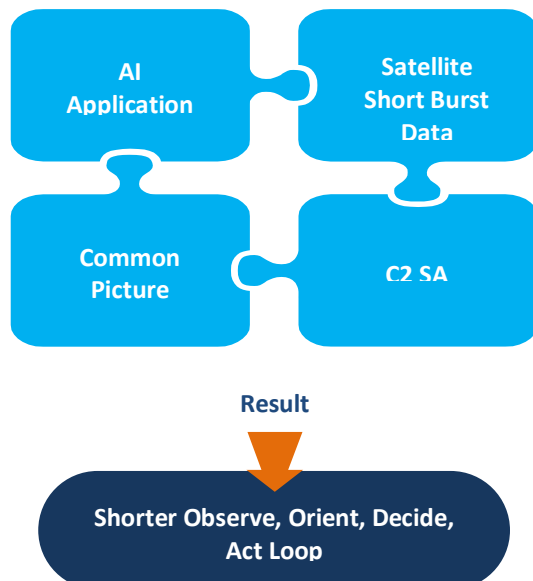
<sup>10</sup> "Iridium Communications", Iridium, <https://www.iridium.com/>

**Figure 5: Defence Digitalisation Technologies, Impact on Military Operations and Adoption Timeline, Global, 2022**



Source: Frost & Sullivan

**Figure 6: Collective Application of Digitalisation Technologies, OODA Loop, Global, 2022**



While some technologies may lead the digitalisation movement, the collective exploitation is the road to exponential gain, as illustrated in the figure, using the examples of SBD, C2SA, and AI harnessed to reduce the OODA loop.



Globally, end users are adopting satellite-based C2SA solutions to provide strategic and financial advantages, aided by the commercial and military LEO satellite networks.








### Increasing Adoption of Satellite-based C2SA Solutions

Countries are progressively and exponentially employing BFT and C2SA solutions in BMSs, soldier systems, aerial platforms, and tactical unmanned aerial vehicles. Most tactical systems are based on radio/tower networks and can suffer from connectivity issues due to impeding terrain or unavailable ground infrastructure. Both advanced and emerging countries face this problem as radio networks are limited by LOS, while the required infrastructure for tower networks may not be available in all operating locations. As a solution, users can employ satellite broadband for voice and video in such situations; however, it tends to be extremely costly due to very high data usage. Also, satellite broadband may not provide instant SA between all elements of the combat force, such as HQ, aerial/land platforms, and dismounted soldiers.

Table 1 offers examples of the increased and wider adoption of satellite-based C2SA for soldiers and a wider system-of-systems approach.

**Table 1: Representative Satellite-based BFT and SA Programs, Global, 2021**

	End User	OEM	Program
	US Army	Leonardo	Family of Mounted Computer System
	Norwegian Armed Forces	Telepan Globe	FACNAV solution incorporating BFT, SA, and messaging
	Israeli Army	Elbit	SmarTrac as part of Dominator soldier system
	Polish Army	Teledat	JASMINE C3IS solution incorporating BFT and SA
	German Army	Rheinmetall	Gladius 2.0 with BFT, mini-drone, and voice radio with flexible architecture



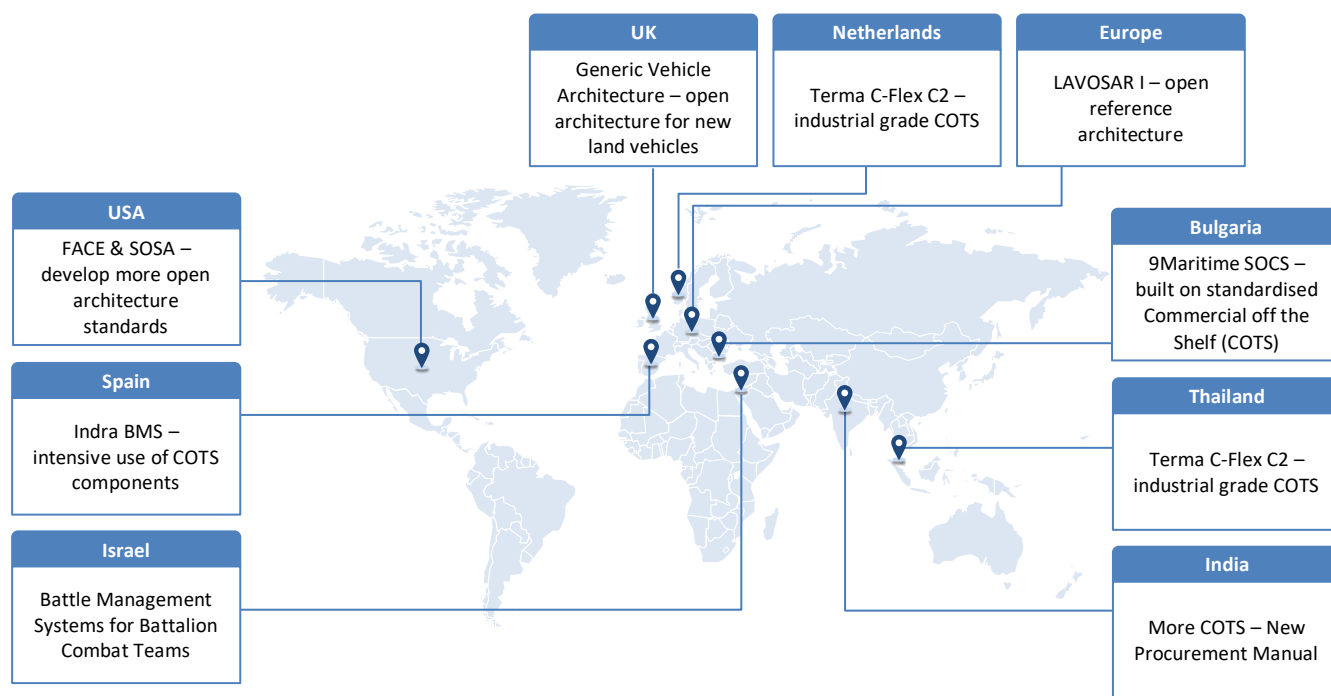
**COTS components are fast becoming the building blocks of defence equipment, replacing bespoke components.**

**Globally, major powers are recognizing the advantages of faster upgrades, plug-and-play readiness, and lower costs due to COTS use.**

### Commercial Off the Shelf (COTS) Products as the New Norm

Economic pressures are driving many commercial and governmental operators within the military to purchase COTS products (see figure 7). These products have a favourable cost-to-performance ratio. Militaries are finding it difficult to improve the capability of their existing systems by relying solely on evolutionary upgrades achieved through standard practices, for which they were not designed. Advances in COTS hardware are thus enabling new opportunities for a hardware support model that facilitates continuous deployment of war-fighting capabilities.

**Figure 7: Representative Programs with Adoption of COTS in Military Equipment, Global, 2022**



Source: Frost & Sullivan

## PART III: TITAN BY NORTAC



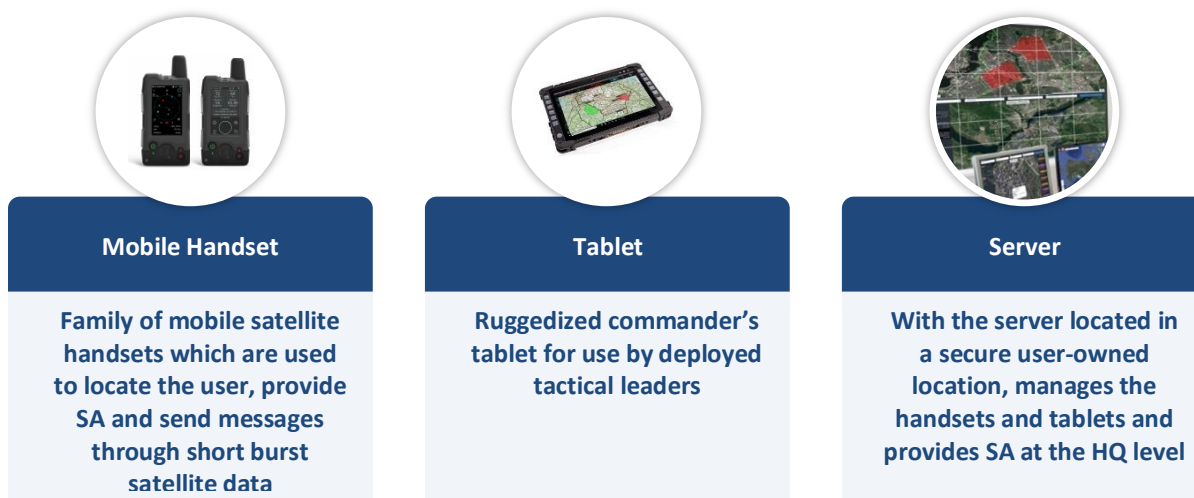
**TITAN BY NORTAC, a satellite-based SBD C2SA solution, provides constant C2SA to commanders and the ground/ air/ naval combat elements.**

**It bridges the gap between a traditional BMS and the need for connected operations in an increasingly hostile environment, besides providing significant strategic and financial advantages.**

### TITAN BY NORTAC—The Solution

Irrespective of the scale or nature of operations, networking and SA are essential requirements for gaining and maintaining strategic advantages. Most BMS are based on radio networks/GSM, but these can suffer from degradation due to either the terrain (only LOS) or lack of tower infrastructure. All countries face this limitation regardless of the equipment they possess because terrain is a universal factor and forward-operating areas may lack the required infrastructure.

As a satellite-based SBD C2SA solution, TITAN BY NORTAC provides commanders the ability to maintain constant C2SA, irrespective of terrain and infrastructure.<sup>11</sup> It consists of three main components: mobile handset, tablet, and server.

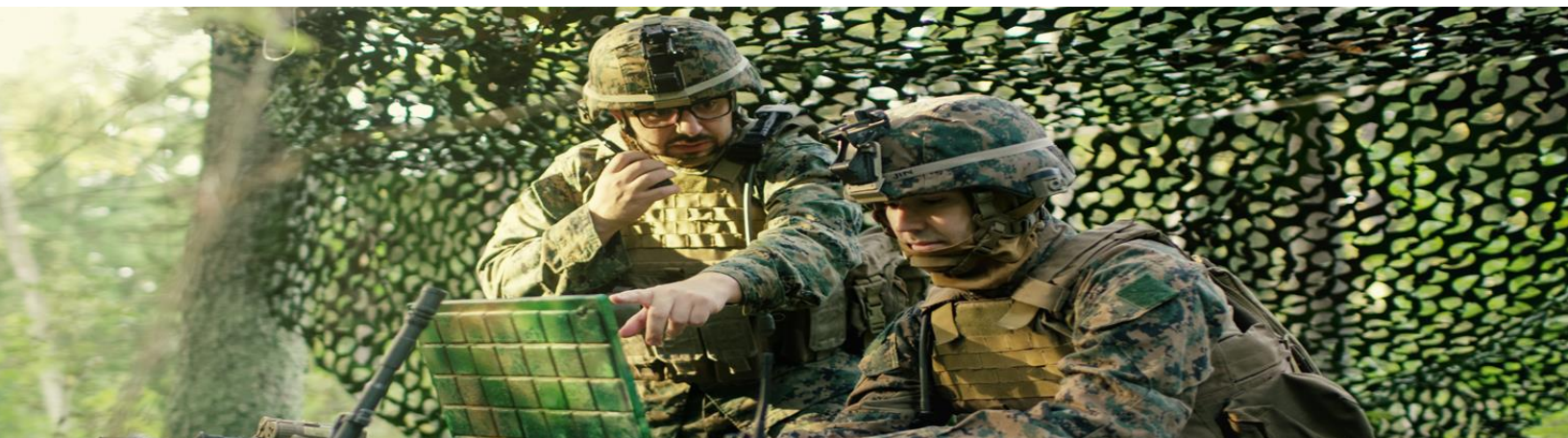


The solution not only provides SA from HQ to each combat element through means of BFT, but also enables quick updates and reports using SBD. The strategic advantages are maintenance of SA under all operating conditions, dispersed operations, low probability of detection (LPD) due to low power, and financial advantages due to the low amount of data being used. Moreover, costs are expected to decrease further as more and more LEO satellite constellations take to space, leading to economies of scale and a larger user base. Some leading countries have launched or are planning to launch their own satellite networks, and TITAN BY NORTAC, which has a flexible and

<sup>11</sup> <https://www.nortacdefence.com>



modular architecture, can be hosted on private satellites as required by the user. Further, users can integrate the solution into traditional BMS using radio/ GSM/GPRS/ LTE, providing both redundancy and improved SA.



### Salient Features of TITAN BY NORTAC

**Space-based:** The solution uses SBD from a network of 66 Iridium NEXT satellites, which provide global coverage. The solution is well positioned to capture growth in use of space by militaries around the world, especially the LEO satellite constellations.

**Negotiates Terrain and Poor Infrastructure:** The solution provides uninterrupted C2SA regardless of the operational terrain and requires no existing ground infrastructure. This is a significant strategic advantage for users and blends well with the rising penetration of military digitalisation and importance of network-centric and joint operations.

**Stand-alone Solution that Supplements Existing BMS:** TITAN BY NORTAC can act as a stand-alone solution for dispersed operations and supplements existing BMS using radio. NORTAC has developed a solution, Hermes, to provide agnostic high frequency (HF) radio integration into an existing BMS. The addition of a space-based network and GSM/ GPRS/ LTE adds critical strategic capability to a nation's BMS to uphold the importance of always maintaining situational awareness.

**COTS:** NORTAC Defence designed its solution using COTS equipment, which results in lower hardware costs. Militaries today are using COTS components in most weapons systems to lower costs and shorten the product development, maintenance, and upgrade schedule timelines. TITAN BY NORTAC is well placed to benefit from the trend.

**Flexible Architecture:** TITAN BY NORTAC has a flexible architecture, so users can obtain the source codes for integration into their own satellite network. Users can also integrate the solution into other commercial LEO satellite constellations as they desire.

**Financial Advantage:** Using SBD is much more economical than using satellite broadband, as the data requirement is lower. Financial advantages accrued from using COTS components and SBD make the solution highly attractive, especially to emerging countries that can upgrade their networking capability at a lower cost while adhering to budgetary constraints.

**Ease of Training and Deployment:** The training and time required to operate TITAN BY NORTAC is uncomplicated and minimal for combatants to start using it effectively. Further, TITAN BY NORTAC is easy and efficient to deploy and integrate into the tactical environment. The combined effect is that users can add and exploit the capabilities almost instantaneously.

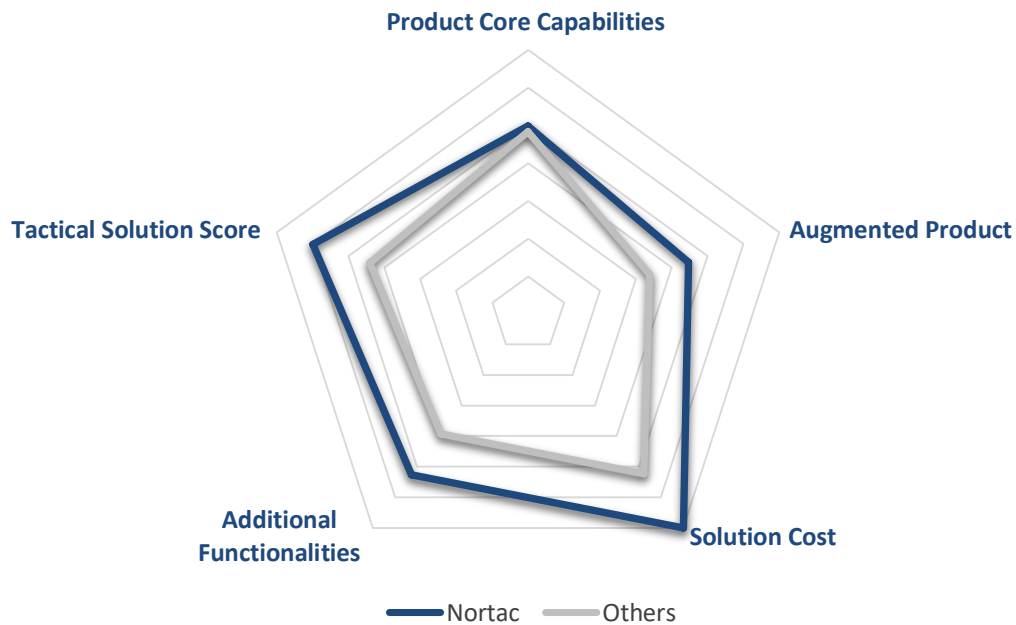
**Mature Solution:** TITAN BY NORTAC is a mature solution and has proved its battlefield capability across dismounts and land/naval/aerial platforms. Globally, it is already being used by military forces and federal agencies.

## Product Benchmarking

In a Frost & Sullivan survey, TITAN BY NORTAC emerged as the best-in-class C2SA solution when compared to similar products available in the market.

In May 2021, Frost & Sullivan benchmarked TITAN BY NORTAC against similar products being offered by defence OEMs. The study compared the product against ten competing solutions that were selected on the basis of similarities in operational functionality and deployment. The benchmarking factored in four main attributes: product core capabilities, augmented product, additional functionalities, and solution cost. Benchmarking results reveal that TITAN BY NORTAC is the best-in-class solution, as depicted in Figure 8.

**Figure 8: TITAN BY NORTAC Benchmarking against Competing Solutions, Global, 2021**



*Note: An average score was computed based on evaluating all the other competitor products to Titan*



## Part IV: NORTAC DEFENCE

### Background

NORTAC Defence, the developer of TITAN BY NORTAC, is headquartered in Ottawa, Canada. The idea for TITAN BY NORTAC was inspired during conflicts in Iraq where the US military successfully introduced FBCB2. The US military first deployed the Northrop Grumman Force XX1 FBCB2 during Operation Iraqi Freedom in 2003. FBCB2 provided a satellite-based digital communications and situational awareness layer on top of traditional radio-based military communications. The benefits were outstanding. It became clear that this digital overlay would become standard for all militaries around the world as it represents a major step change in command-and-control capabilities.

However, a capability that not only works but is affordable and can be sold to most countries without restrictions such as International Trade in Arms Regulations (ITAR) was required. NORTAC Defence was founded to develop a cost-effective, COTS, non-ITAR-restricted capability with the essential benefits of FBCB2.

TITAN BY NORTAC resulted from a combination of special forces' tactical insights and experience with the technical delivery of SBD C2SA capability over satellites for air assets in Iraq and Afghanistan.

### Current Customers

NORTAC won the Canadian Shared Services Canada contract for the first time in 2011, and thereafter in 2017 and 2020 when the contract was retendered. The contract enables the company to sell SBD C2SA products to 52 federal agencies, including the Canadian Department of National Defence (DND). Additionally, NORTAC Defence counts various military forces across the globe as current customers.

### Total Accessible Market

A study carried out by Frost & Sullivan in May 2021 finds the total market across twenty selected countries for TITAN BY NORTAC-like solutions is an estimated \$1.39 billion for the period of 2021 to 2026. Based on the NORTAC sales reach and competitive scenario, the total accessible market (TAM) for NORTAC is forecast at \$278 million. The forecast is based on the assumption of NORTAC Defence activating business development channels in the twenty selected countries and the user countries integrating the solution in their Special Forces. The estimate has significant upside potential, should TITAN BY NORTAC be integrated by a major OEM into its existing radio/GPRS-based BMS for product development or selected by a country for wider adoption in its C4ISR network.

**The Total Market for TITAN like solutions is estimated to be \$1.39 billion for the period of 2021 to 2026 while the Total Addressable Market for TITAN is estimated at \$278 million**

### Future Business Potential

To address expected demand, NORTAC Defence has established distributor channels in Southeast Asia, the Middle East, and Africa. The company's strategy of expanding its footprint has paid rich dividends wherein the probability of a win has increased manifold due to both its expanded sales reach and strength of the solution. The company has a significant expected sales pipeline up to 2024.

Further, NORTAC has shortlisted pairing up with a partner as one of the key tenets for future business potential. The combination of demand for improved and continuous SA, digitalisation, integration of space-based assets in C4ISR/ C2SA, and TITAN BY NORTAC's positioning is likely to stand out as an attractive proposition for potential partners.



## CONCLUSION

The major trends Frost & Sullivan has identified across the geopolitical, economic, networked operations, and technology fronts will become significant drivers for adoption of C4ISR and C2SA solutions in the coming decade. Solutions like TITAN BY NORTAC will prove essential to meet the rising need of networked operations and SA across advanced and emerging economies, as space-based assets come to the fore in military operations in the race towards digitalisation.

