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Deftech Scan

January 2021



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Dear Reader,

Out of the blue, we are coming back in red !

Don't look for any special reason, we just like to keep it alive. The structure of the 2020 documents still applies, but we'll look at changes happening worldwide with the lenses of innovation, resilience and robustness. Why ? Because these are the main topics of the event planned for February 2nd 2022 !

Book the day !



We wish you an nice reading..... as well as a great 2021 (yes, we are still on time)!

Foresightly Yours,


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Introduction and Executive Summary

This Deftech Scan reports on and assesses occurrences in military technology and capability development taking place from late November 2020 through to mid-to-late January 2021 with some additional references to actions that predates the reporting period. It contains reporting on recent activities and announcements in the United States, South Korea, North Korea, China, India, Russia, France, Sweden, Japan, the United Kingdom, Germany, NATO, and the European Union.

The following key themes emerged in the research supporting this Deftech Scan:

The “New” Domains of Conflict: This volume has a strong emphasis on current developments and emerging requirements related to three domains that the Defence of Japan 2020 White Paper released in July of last year referred to as the “new domains” of conflict: space, the electromagnetic spectrum, and the cyber-domain. Of course, militaries of all sizes have been operating in these domains for years. However, small, medium, and large-sized militaries are concentrating research and development efforts on and organising around the iterative competitions in these domains. Some relevant examples from this report:

- Among the main improvements in the Tejas Mark-1A jet procured by India in January is an AESA radar and advanced electronic warfare equipment that can help jam adversary aircraft.
- The **Cyber and C4ISR** section describes a NATO cyber exercise that sought to prepare allied and partner militaries for a rapidly evolving and complex threat environment. The exercise took place only three weeks before the U.S. government announced the sophisticated and massive SolarWinds cyber-attack against. Three days after the announcement of SolarWinds, *Reuters* released an exclusive report detailing China’s alleged hacking of the African Union headquarters (not explicitly covered in this report) that siphoned off security video footage from throughout the headquarters facility,¹ once again demonstrating that geopolitically motivated cyber-threats are not limited to large states and great powers.
- Russia tested *another* counterspace weapon in December—at least its third test during 2020. Tests of anti-satellite weapons and other, more subtle, counterspace weapons such as co-orbital satellites have been a regular focus of Deftech Scans. Growing counterspace capabilities in combination with the presence of more militaries in space—including small and medium-sized militaries—has led to real innovation in both operational concepts and new capabilities designed to build resilience in space by both commercial organizations and defence and security communities as evidenced by the January debut of Aevum’s Ravn X uncrewed, reusable small satellite space launch system.

Harsh Environments and Evolving Requirements: The report also highlights the ways in which militaries throughout the world are responding to several indicative emerging requirements. Notably, commentary in the first two sections of the report—**Energy, Power, and Design** and **Human Performance Enhancement and Protection**—examine how both defence industry and militaries are working to optimize performance in harsh environments such as extreme heat or high-elevation environments. Defence communities are also investing in new capabilities to meet a broader range of threats and missions—including more efficiently coping with the “low and slow” asymmetric threat stemming from proliferated uncrewed systems—and how incorporation of new weapons systems and sensors are affecting platform design.

Industry Dynamics: Several stories demonstrate the development—or attempted development—of domestic industry in countries such as South Korea, India, France, Russia, the United Kingdom, and Germany. At the same time, the report also includes examples of the need to balance a desire to build domestic industry with budgetary and operational and strategic realities rightly could encourage collaboration.

¹ Raphael Satter, “Exclusive: Suspected Chinese Hackers Stole Camera Footage from African Union, memo”, *Reuters*, December 16, 2020, [Exclusive-Suspected Chinese hackers stole camera footage from African Union - memo | Reuters](#)

Energy, Power, and Design

Key Insights:

- For small and large militaries, the need to meet an expanding range of threats, carry new weapons and payloads, and operate in harsh environments has real implications for platform energy and power requirements.
- Among the many novel solutions to providing more power to crewed and uncrewed platforms is the development of Lithium-Ion batteries, which provide more reliable power as well as more durability over extended periods of time than lead acid batteries.
- The growing demand for energy and durability in harsh environments will also have potentially profound effects on the design of platforms. The U.S. Navy, for example, is rethinking the hull design of future vessels in order to better accommodate the need for power necessary to operate the sensors and weapons of the future.

A New Lithium-Ion Battery and Energy Generation Concerns: U.S.-based company Galvion announced it will begin low-rate initial production (LRIP) of its Symbasys SwitchPack i6T Lithium-Ion (Li-Ion) vehicle battery, which is designed to support crewed and uncrewed vehicles operating in harsh environments.



Figure 1: A list of operational advantages Galvion claims its new battery possesses relative to traditional lead acid alternatives. Source: Galvion

According to a company press-release, “what makes Galvion’s solution both unique and ground-breaking is the use of a blended lithium chemistry that has been tailored to match the specific needs of military vehicle power . . . High purity materials combined with quality separators and laser welded electrodes minimize losses and unwanted chemical side-reactions which extends cycle life and environmental performance.”²

The company also stresses the importance of its smart internal battery management system that “includes self-shutdown and self-balancing protocols in unsafe conditions. The BMS has been bespoke designed to effectively operate in the harsh conditions and environments experienced on military operations.”³

In a white paper released in late 2020 entitled “Military Vehicle Power Storage—One Size Does Not Fit All”, Galvion describes many of the challenges related “to one of the weakest area [s] of military vehicles, the battery.” The paper highlights the need for flexible battery solutions to meet the expanding requirements for power on land vehicles, particularly the need to supply power for reconnaissance and

² “GALVION ENTERS ‘LOW RATE INITIAL PRODUCTION’ WITH UNIQUE SYMBASYS SWITCHPACK™ i6T LI-ION VEHICLE BATTERY”, Galvion website, Press Room, November 26, 2020, [Galvion Launches Symbasys SWitchPack™ i6T Li-ion vehicle battery](#)

³ Ibid.

surveillance—which requires the “highest possible storage capacity”—electric propulsion, and to use directed energy weapons.⁴

Concern over the growing requirement for energy production and storage—especially to power increasingly prominent directed energy weapons—is shared by militaries throughout the world and is not limited to the land domain.

One example of this concern is seen in the comments of U.S. Navy Rear Admiral Paul Schlise during a virtual conference in January 2021. Schlise noted that the service needs to build new ships capable of generating “enough power to drive more sophisticated radars, electronic warfare systems and directed energy weapons.”⁵

And while the Navy is seeking new power generation solutions it is first focusing on developing a new hull design that can accommodate the solutions required to safely and reliably generate power for all the tasks many of its ships are being asked to perform. According to Schlise “we are looking at a new hull form with a new propulsion plant and the ability to incorporate . . . an integrated power system that has the ability to power up the weapons and sensors of the future.” The new vessel will be dubbed the DDG-X and is set to replace the Navy’s existing fleet of 22 Ticonderoga-class Aegis cruisers, which will reach the end of their service lives over the next 17 years.⁶

Human Performance Enhancement and Protection

Key Insights:

- Developments in materials science are making new forms of sophisticated camouflage possible for militaries throughout the world. A South Korean research team has demonstrated the potential of an ‘artificial skin’ inspired by the “intriguing cloaking properties of cephalopods.” The skin can mimic either visible colors or thermal characteristics of a physical environment increasing survivability in multiple contexts.
- The People’s Liberation Army (PLA) is deploying new technology-enabled equipment designed to enhance human performance in the harsh physical environments of the Himalayan mountains in order to relieve not only the physical burden associated with operations at high-altitude, but also to enhance communications and blue-force tracking in the difficult mountainous terrain. The PLA reportedly has deployed both new exoskeletons and individual information systems in support of ground forces operating in Tibet.

‘Artificial Skin’ May Make Troops Invisible: A paper from a research team at Seoul National University describes a cloaking skin inspired by the “intriguing cloaking properties of cephalopods.” The artificial skin is composed of bendable patches that use active heating and cooling to mimic either visible colors or thermal characteristics of the environment enhancing the flexibility of camouflage and survivability of individual troops. The paper was originally published on-line in the *Advanced Functional Materials* journal in July 2020 but received extensive media attention in early December 2020.⁷

⁴ “Military Vehicle Power Storage”, Galvion, Galvion website, [Microsoft Word - Military Vehicle Power Storage - One Size Does Not Fit All \(shopify.com\)](#)

⁵ Jared Keller, “The Navy is eyeing a brand new destroyer bristling with lasers and hypersonic weapons”, *Task and Purpose*, January 14, 2021, [Navy eyeing lasers and hypersonic missiles for next-generation destroyer \(taskandpurpose.com\)](#)

⁶ Ibid.

⁷ Jinwoo Lee et al., “Thermally Controlled, Active Imperceptible Artificial Skin in Visible-to-Infrared Range”, *Advanced Functional Materials*, Volume 30, Issue 36, September 3, 2020, [Thermally Controlled, Active Imperceptible Artificial Skin in Visible-to-Infrared Range \(govexec.com\)](#)

The patches are built of pixels containing thermochromic liquid crystals that change color depending on temperature, “allowing the generation of a diverse number of colors by controlling temperature. The cloaking in the visible range is therefore achieved separately by matching the ambient color.”⁸

Another interesting component is that the skin can switch from mimicking visible colors to mimicking thermal characteristics of the environment within about five seconds, meaning that the wearer can camouflage in the daytime and also be difficult to detect on thermal cameras at night.⁹

Technical challenges to developing a fully functional capability remain, including developing a more efficient power source to enable the development of larger versions of the capability and ensuring that the artificial skin is not undermined by extreme hot or cold.¹⁰

“The skin-like cloaking platform not only translates fundamental camouflage features of cephalopods, but it also exhibits high practicality for the direct usage on the human skin unlike previous literature . . . We believe that the unprecedented properties of [the system], which provides a complete multi-spectral cloaking ability with a single device, would make a significant contribution to wearable military covert applications and can also serve to be a step forward to complete invisibility shortly.” –

Jinwoo Lee et al. “Thermally Controlled Active Imperceptible Artificial Skin in Visible-to-Infrared Range”

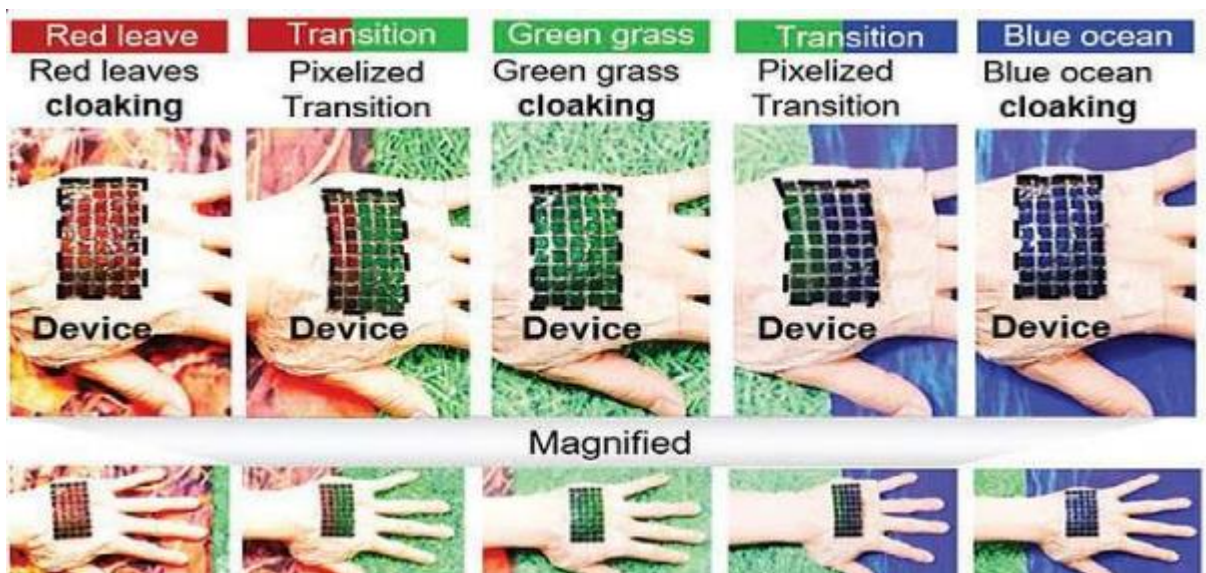


Figure 2: According to the paper, “Multispectral cloaking in the visible and IR regimes on the virtual map, in which the device worn on the hand moves across different visible and thermal backgrounds. The background in the visible spectrum consists of red maple leaves, green grass, and deep blue ocean, and the IR backgrounds with different temperature includes 10 and 50 °C. Note that each device pixel can autonomously express different colors/ temperatures based on its relative positions as the hand moves across various backgrounds owing to the pixelization of the device.” Source: “Thermally Controlled Active Imperceptible Artificial Skin in Visible-to-Infrared Range.”

People’s Liberation Army Deploys New Kit to Tibet: A report from China Central Television (CCTV) on December 9 revealed that a People’s Liberation Army Ground Forces (PLAGF) border patrol unit in Tibet was equipped with a new indigenously developed exoskeleton system.

⁸ Ibid.

⁹ Patrick Tucker, “‘Artificial Skin’ May One Day Make Troops Invisible, Even to Heat Sensors”, *Defense One*, December 5, 2020, [‘Artificial Skin’ May One Day Make Troops Invisible, Even to Heat Sensors - Defense One](#)

¹⁰ Ibid.



Figure 3: TOP: A still from CCTV footage showing members of a PLAGF unit putting on recently delivered exoskeleton systems. BOTTOM: A still from CCTV footage released on 29 December showing a soldier under the PLAGF's Tibet Military District operating a tablet-like handheld computer. Source: CCTV via Janes

The unit is operating in the Ngari Prefecture at altitudes of 5,000 meters above sea level and using the unnamed system to carry out tasks more efficiently in “harsh, high-altitude environments.” As *Janes* points out, the use of exoskeleton in Tibet is part of a broader effort by the PLA to develop and deploy a range of new exoskeleton technologies designed to reduce soldier burden in high altitudes where objects are heavier to carry and human endurance and performance suffer.¹¹

PLAGF forces operating in Tibet are also being supplied with “new tablet-like, handheld computers for use as part of a broader tactical information system” known as the Chinese Individual Information Combat System.

The systems are designed to “boost overall combat capabilities, especially in the cold mountainous regions in Tibet”, according to *Janes* citing a CCTV report published in late December 2020.

The CCTV report also noted that by monitoring the new tactical information system carried by each soldier, the command centre was able to track the soldiers’ movements, understand whole dynamics on the battlefield, and give instructions to the soldiers in real time about their current mission.¹²

¹¹ Gabriel Dominguez, “PLA border patrol unit in Tibet using new exoskeleton system”, *Janes*, December 11, 2020, [PLA border patrol unit in Tibet using new exoskeleton system \(janes.com\)](https://www.janes.com/article/75442/pla-border-patrol-unit-in-tibet-using-new-exoskeleton-system)

¹² Gabriel Dominguez and Amaal Kotlarski, “China equipping soldiers in Tibet with personal electronic equipment to boost combat efficiency”, *Janes.com*, January 5, 2021, [China equipping soldiers in Tibet with personal electronic equipment to boost combat efficiency \(janes.com\)](https://www.janes.com/article/75442/china-equipping-soldiers-in-tibet-with-personal-electronic-equipment-to-boost-combat-efficiency)

Cyber and C4ISR

Key Insights:

- The seemingly inevitable march of the integration of AI technologies and applications into military systems continued over the last two months. In December, both the United States Air Force and European defence contractor MBDA revealed impressive developments of AI capable of autonomously detect targets. The U.S. Air Force successfully put an AI agent in control of select systems on a U-2 Dragon Lady spy plane to detect enemy launchers during a real-world test flight in California. MBDA released information about its 2ACI program, which involves an AI agent embedded into ground vehicle systems autonomously detecting and identifying vehicles.
- The last two-plus months provided stark examples of how societies, governments, militaries, and national security communities around the world continue to be vulnerable to a growing range of complex and disruptive threats in the cyber and information domain, especially in an era of intensifying geopolitical competition and uncertainty.
- The SolarWinds hack of approximately 250 U.S. government agencies and high-tech companies demonstrates some of the vulnerabilities associated with the software supply chain that can be relatively easily exploited by savvy and well-funded actors.
- But the threats in the information domain go well-beyond cyber-espionage, data theft, or network disruption. Comments from European Union (EU) military personnel to a sub-committee on security and defence in November revealed how the use of social media to spread disinformation and misinformation is undermining EU military operations throughout the globe.

Steps Forward for Military AI: On December 16, the United States Air Force announced it had allowed an intelligence (AI) algorithm to control sensor and navigation systems on a U-2 Dragon Lady spy plane during an exercise at Beale Air Force Base in California that simulated a missile strike. The algorithm was tasked with searching for enemy launchers while the pilot searched for threatening aircraft. Both used the U-2's radar.¹³

The test was the first time an AI agent has controlled a United States military system and may be the first instance globally. Eric Schmidt, the former Google chief executive believed that the test was “the first time . . . that you have a military system integrating AI, probably in any military.”¹⁴

The AI agent is known as ARTUμ-- a reference to the droid R2D2 in the *Star Wars* movies that serves as an automated assistant on board Luke Skywalker's X-Wing fighter. It is based on the publicly accessible algorithm μZero, which is known for being applied to win strategy games like chess. While ARTUμ did have complete control over certain on-board systems, the human pilot was in control of the plane's movements throughout the test.¹⁵

In an article published on December 16 in *Popular Mechanics* announcing the successful test, Dr. Will Roper, the Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics, described the three-year process of developing the ARTUμ code—a process that included over one million tests before being demonstrated in the December test.¹⁶

The milestone reflects the prominent role AI is playing for many defence and security communities as they contemplate how best to manage the cognitive demands on human operators in complex environments marked by pervasive sensors and information flows.

¹³ Aaron Gregg, “In a first, Air Force uses artificial intelligence aboard military jet”, *Washington Post*, December 16, 2020, [Air Force uses artificial intelligence on U-2 Dragon Lady spy plane - The Washington Post](https://www.washingtonpost.com/air-force-uses-artificial-intelligence-on-u-2-dragon-lady-spy-plane-the-washington-post/2020/12/16/)

¹⁴ Ibid.

¹⁵ Ibid.

¹⁶ Dr. Will Roper, “Exclusive: AI Just Controlled a Military Plan for the First Time Ever”, *Popular Mechanics*, December 16, 2020, [Air Force Flies AI Copilot on U-2 Spy Plane: Exclusive Details \(popularmechanics.com\)](https://www.popularmechanics.com/technology/aerospace/ai-just-controlled-a-military-plan-for-the-first-time-ever/)

For example, also in December, European defence contractor MBDA in conjunction with French high-tech startup Kalray announced it has developed and demonstrated a capacity for automatic object recognition and acquisition by imagery using AI in support of France's Directorate General for Armaments (DGA).¹⁷



Figure 4: A screenshot of a 2ACI detecting and identifying vehicles taken from the MBDA YouTube announcement. The system was installed in the turret sights of a French Army AMX10RCR tank. Source: MBDA

The 2ACI program trained AI on computer-generated images before being integrated into an embedded system. The system uses the AI to access and analyse this database to detect, recognize, and identify vehicles using infrared imaging.

According to a December 16 MBDA YouTube video, the system can be applied to any tactical context—day or night, poor weather conditions, fixed or mobile vehicles, or single or multiple vehicles. MBDA

also believes 2ACI will be suitable for air and naval contexts as well.¹⁸ The technology is expected to be integrated into the French Army's Scorpion combat system as well as the MMP (man-portable anti-tank guided missile) firing unit.¹⁹

NATO's 'Cyber Coalition 2020' Exercise & SolarWinds Attack: NATO held its Cyber Coalition 2020 exercise from November 16 – 20 to better prepare NATO militaries as well as several other partner militaries to better manage a shifting and increasingly challenging cyber threat environment.

The exercise was held virtually due to Covid-19 and involved about 1,000 officials and experts from across NATO as well as Finland, Ireland, Sweden, Switzerland, and the European Union. According to NATO, the event stressed the ability of the alliance to handle modern cyber threats by injecting scenarios that reflect current and emerging threats in the cyber domain such as attempts to breach classified networks, disruption of communications systems in critical infrastructure, and espionage through smartphone applications.

Indeed, a real-world example of the pervasiveness and complexity of the cyber threat was revealed only weeks after the NATO exercise. On December 13, the U.S. government revealed a massive cyber-espionage attack (commonly referred to as "SolarWinds") against the supply chain associated with the U.S. software and cyber-security industry support government operations. While the full scope of the "SolarWinds" attack is not fully understood even over a month later, the *New York Times* reported in early January that approximately 250 government agencies—including many in the U.S. national security

¹⁷ Artificial Intelligence: 2ACI, MBDA YouTube channel, December 16, 2020, [Artificial Intelligence - 2ACI - YouTube](#)

¹⁸ Artificial Intelligence: 2ACI, MBDA YouTube channel, December 16, 2020, [Artificial Intelligence - 2ACI - YouTube](#)

¹⁹ "French Army will get system to identify enemy vehicles", *The Defence Post*, December 23, 2020, [French Army to Get AI System to Identify Enemy Vehicles \(thedefensepost.com\)](#)

community—and private sector companies had been compromised.²⁰ The U.S. government blamed the Russian hacking group APT29 and tied the group to the Russian intelligence services, the SVP.²¹

The attack was launched using backdoors inserted into an update of the “ubiquitous” SolarWinds Orion network monitoring software. The software is used by over 18,000 customers, including throughout much of the U.S. government.²²

Disinformation and Military Operations

Closely related to the threats of cyber espionage, data theft, and network disruption or denial is the growing challenge of the use of social media to spread misinformation and disinformation to undermine military operations.

During a meeting of the European Union’s sub-committee on security and defence on November 16, Admiral Herve Blejeau reported that social media-based disinformation campaigns targeting EU civil security and training missions in Africa and elsewhere are becoming more frequent and effective. According to Blejeau, “The simple fact is all our missions are being targeted by disinformation.”

Admiral Blejeau cited Russia’s efforts to undermine the EU’s military training mission in the Central African Republic (CAR) as being of particular concern and also asserted Russia’s aim was to replace the EU in running the training mission. He noted that the “EU head of mission in Bangui is constantly bombarded by it: unscrupulous and low-quality disinformation fed to the local media that attempts to portray [the] EU as a poor partner,”

Source: Brooks Tigner, “Social media disinformation disrupts EU missions worldwide”, *Janes.com*, November 20, 2020, [Social media disinformation disrupts EU missions worldwide \(janes.com\)](https://www.janes.com/news/social-media-disinformation-disrupts-eu-missions-worldwide)

The Austin, Texas-based SolarWinds has confirmed that the attack began in September 2019²³, allowing the SVP over a year to exfiltrate data from across the United States government and software companies such as Microsoft and Amazon. The U.S. government announced the hack on December 13, though it was first discovered by private sector cyber-security firm FireEye on December 8.²⁴

While the main vector of the attack has been determined, several components of and circumstances around the attack indicate that this was a highly sophisticated operation that exploited various layers of vulnerability to not only insert the malware but also avoid detection for so long.

Notably, the attack also focused on Microsoft and the software

supply chain, especially Microsoft resellers who have “broad access to Microsoft customers’ networks.”²⁵ Additionally, some of the Solar Winds Orion software is engineered in the Czech Republic, Poland, and Belarus, places in which “Russian intelligence operatives are deeply rooted.”²⁶ While there is currently no evidence that the attack originated from within SolarWinds, it has become an angle of the on-going investigation into the attack. Regardless, as Glenn Chisholm, a founder of Obsidian Security, the attackers “targeted the weakest points in the supply chain and through our most trusted relationships.”²⁷

²⁰ David E. Sanger, Nicole Perloth, and Julian E. Barnes, “As Understanding of Russian Hacking Grows, So Does Alarm”, *The New York Times*, Published January 2, 2021, updated January 5, 2021, [As Understanding of Russian Hacking Grows, So Does Alarm - The New York Times \(nytimes.com\)](https://www.nytimes.com/2021/01/02/us/politics/russian-hacking-solarwinds.html)

²¹ Ben Jensen and Mark Montgomery, “The Strategic Implications of SolarWinds”, *Lawfare*, December 18, 2020, [The Strategic Implications of SolarWinds - Lawfare \(lawfareblog.com\)](https://www.lawfareblog.com/the-strategic-implications-of-solarwinds)

²² Ibid.

²³ Sudhakar Ramakrishna, “New Findings From Our Investigation of SUNBURST”, *SolarWinds*, January 11, 2021, [New Findings From Our Investigation of SUNBURST - Orange Matter \(solarwinds.com\)](https://solarwinds.com/news/new-findings-from-our-investigation-of-sunburst)

²⁴ David E. Sanger, Nicole Perloth, and Julian E. Barnes, “As Understanding of Russian Hacking Grows, So Does Alarm”, *The New York Times*, Published January 2, 2021, updated January 5, 2021, [As Understanding of Russian Hacking Grows, So Does Alarm - The New York Times \(nytimes.com\)](https://www.nytimes.com/2021/01/02/us/politics/russian-hacking-solarwinds.html)

²⁵ Ibid.

²⁶ Ibid.

²⁷ Ibid.

Manned Platforms

Key Insights:

- The Indian government approved the procurement of 83 Tejas Light Combat Aircraft in what is the largest procurement of indigenously developed military equipment in India's history. The deal will help India redress its 'fighter gap' with respect to the combined threat of China and Pakistan.
- The deal is also notable for its focus on building India's domestic defence industry, which has been a long-standing priority for a country routinely among global leaders in defense imports. In conjunction with other developments during the reporting period, the Tejas deal—and an Indian government decision only days later to procure dozens more Russian fighters—reveals the tension between the desire of many states around the world to support and build domestic defence industry while also balancing with strategic and operational realities.
- The United Kingdom's continuing discussions with France and Germany to join the Future Main Combat Ground System program as an observer offers another interesting case study of how both governments and industry are managing these competing objectives and forces—towards indigenization on one hand and collaboration or even consolidation on the other. .

Tejas' Long and Windy Road: On January 12, the Indian Minister of Defence Rajnath Singh confirmed that the country's Cabinet Committee on Security (CCS) had approved the procurement of a total of 83 fourth generation supersonic Tejas Light Combat Aircraft (LCA) for a total of 46,898 crore rupees (approximately \$6.68 billion). The deal is the largest indigenous defence procurement in India's history and involves Hindustan Aeronautics Limited delivering 73 'improved' Mark-1A Tejas fighters as well as 10 trainer aircraft.²⁸

The Indian Air Force had previously ordered 40 Tejas Mark 1-A aircraft, though full delivery of these aircraft has been delayed due to slow production rates. The Mark 1-A version of the Tejas ordered in January will be the most advanced version of the aircraft developed so far and will reportedly have 43 "improvements" over previously ordered version. These improvements reflect trends in demand military capabilities:²⁹

| Improvement | Requirement |
|---|---|
| AESA radars to replace existing mechanically steered radars | AESA radars offer an enhanced degree of protection against electronic warfare threats, reduce detectability by increasingly prevalent advanced radar systems, and enable multi-mode capabilities that allow a single platform to perform a range of missions |
| Air-to-air re-fuelling | Persistence and endurance of both crewed and uncrewed platforms enhances their operational utility, provides more flexibility to respond to fast-moving contingencies, and extends the range of platforms, all of which are highly relevant in the Indo-Pacific context |
| Astra beyond visual range missiles | Long-range stand-off strike is becoming more important in air-combat in order to reduce risk of detection by more advanced radar and anti-access / area denial capabilities and to offer more time to respond to increasingly high-speed missiles |
| Advanced electronic warfare equipment to jam enemy radars and missiles | To better compete in electromagnetic warfare (EW) as advanced EW attack and defence capabilities proliferate across the region, especially in China, which is increasingly organizing around EW |

Table 1: An overview of improvements in the most recently procured Tejas Mark 1-A and an explanation of what current or emerging operational requirement the improvement is designed to meet. Source: Tate Nurkin, with information derived from other open sources

²⁸ Rajat Pandit, "CCS clears Rs 47,000 crore deal for 83 indigenous Tejas fighters", *Times of India*, January 13, 2021, [Tejas fighter jet: CCS clears Rs 47,000 crore deal for 83 indigenous Tejas fighters | India News - Times of India \(indiatimes.com\)](https://timesofindia.indiatimes.com/india/CCS-clears-Rs-47-000-crore-deal-for-83-indigenous-Tejas-fighters/articleshow/81111111.cms)

²⁹ Ibid.

The deal will help fill a perceived fighter gap within the Indian military. India currently has only 30 fighter squadrons of 16 – 18 jets, well below the 42 the military believes are required to deter both China and Pakistan.³⁰

Filling this gap in an affordable way is another concern. India has procured 36 Rafale fighters from Dassault, which are more advanced and durable than the lightweight Tejas. They are also significantly more expensive. In addition, only days after the approval of the acquisition of the more modern Tejas, the government announced that it will urgently procure 21 MiG-29 and 12 Su-30 aircraft from Russia to arrest the decline of India's air combat capability.³¹ According to *Times of India* commentary on the Tejas deal, acquiring even more Tejas jets will become essential as "India simply cannot afford to keep on buying expensive foreign fighters."³²

The deal will also serve as a boost to India's efforts to more fully indigenize its defence industry, a longstanding goal of the Indian Ministry of Defence and broader civilian government. HAL is expected to work with approximately 500 Indian companies to scale up production. According to Defence Minister Singh, "this deal will be a game changer for self-reliance in Indian defence manufacturing. It would act as a catalyst for transforming the domestic aerospace ecosystem." Singh expects that indigenously developed content will move from 50% to 60% by the time the production run is scheduled to end at the conclusion of 2028.³³

The approval of the deal is also a big moment for the Tejas, which has had a spotted development history that dates to 1983. The plane first flew in January 2001 but did not enter service until 2016 and only received final operational clearance (FOC) in 2019. At the time the LCA received FOC, Defence Research and Development Organisation (DRDO) Chief Dr. G Satheesh Reddy noted that India is one of an only a few countries that has designed and built its own fighter jet even if "it has taken about three decades of struggle."³⁴

Post-Brexit Collaboration in Europe: The United Kingdom is in discussions with France and Germany to become an observer on the French-German Next General Main Ground Combat System program, according to reporting from January.³⁵

A team of Krauss-Maffei Wegmann (KMW), Nexter, and Rheinmetall are currently working on a design for a vehicle to replace Germany's Leopard 2 and France's Leclerc around 2035. At the same time, the UK Ministry of Defence is beginning to develop requirements for its own Future Ground Combat Systems program, which would replace the UK's likely to be upgraded Challenger 2 also in the 2035 to 2040 timeframe.³⁶

The so-called 'Eurotank' program envisions a team of vehicles that may involve both crewed and uncrewed ground vehicles as well as uncrewed aerial vehicles requiring increased collaborative combat capability and a "drastic update of current operational concepts."³⁷ Development is proceeding in five successive stages: 1) requirements analysis; 2) concepts study; 3) technology development and demonstration; 4) system development; and 5) system production. The first two stages have reportedly

³⁰ The left column of the chart includes the improvements included in the most recently procured Tejas. This information is sourced to Rajat Pandit, "CCS clears Rs 47,000 crore deal for 83 indigenous Tejas fighters", *Times of India*, January 13, 2021, [Tejas fighter jet: CCS clears Rs 47,000 crore deal for 83 indigenous Tejas fighters | India News - Times of India \(indiatimes.com\)](https://timesofindia.indiatimes.com/Tejas-fighter-jet-CCS-clears-Rs-47,000-crore-deal-for-83-indigenous-Tejas-fighters/articleshow/82444447.cms)

³¹ "After Tejas, India set to procure more MiG-20 and Sukhoi fighter jets", *BusinessToday India*, January 18, 2021, [After Tejas, India set to procure more MiG-29 and Sukhoi fighter jets \(businesstoday.in\)](https://www.businesstoday.in/After-Tejas-India-set-to-procure-more-MiG-29-and-Sukhoi-fighter-jets/article/10000000)

³² Ibid.

³³ Ibid.

³⁴ Pradip R Sagar, "20 years since LCA Tejas's first flight: What's next for India's indigenous fighter programme?", *The Week*, January 5, 2021, [20 years since LCA Tejas's first flight: What's next for India's indigenous fighter programme? - The Week](https://www.theweek.in/news/india/2021/01/05/20-years-since-lca-tejas-first-flight-what-s-next-for-india-s-indigenous-fighter-programme.html)

³⁵ Andrew Chuter and Sebastian Sprenger, "British military looks to the 'Eurotank' as it weighs its hardware options", *Defense News*, January 11, 2021, [British military looks to the 'Eurotank' as it weighs its hardware options \(defensenews.com\)](https://www.defensenews.com/eurotank/2021/01/11/british-military-looks-to-the-eurotank-as-it-weighs-its-hardware-options/)

³⁶ Ibid.

³⁷ "MCGS: Main Ground Combat System", ISL-French-German Research Institute of Saint Louis, [MCGS.indd \(isl.eu\)](https://www.isl.eu/mcgs)

been completed with requirements analysis taking place in 2013 and 2014 and concepts studies taking place between 2015 and 2018.³⁸

It is not clear exactly what level of access observer status would entail. The German Ministry of Defence confirmed discussions are taking place and that other partners and potential partners were welcome. A spokeswoman with the Defence Ministry noted that “bringing new members on board with MCGS is in line with Germany’s aspirations to push consolidation in the European defence industry.” Some observers see the MGCS as having “all the markers of a test case for pursuing large-scale joint programs in a post-Brexit Europe.”³⁹

Missile Systems and Munitions

Key Insights:

- Both North Korea and South Korea made announcements concerning the development of submarine launched ballistic missiles in January once again driving concern about North Korea’s advancing missile and nuclear programs and the potential for a dangerous and destabilizing arms race in the region. Many states are concerned by statements from North Korea that suggest the weapons are designed to pre-emptively defeat adversaries.
- Russia tested a direct-ascent anti-satellite weapon in December. This is at least the third Russian counterspace weapon test or demonstration in the last year further underscoring the intensity of the space – counterspace competition.
- The development of these counterspace weapons (not just by Russia) is also inspiring impressive innovation in capabilities to build resilience of threatened space architecture such as Aevum’s Ravn X uncrewed small satellite launch vehicle, which was revealed in December.
- This iterative competition is of interest not just to large militaries, but to most military and security communities throughout the world, given the increasing importance of space for C3ISR operations and the growing number of militaries that have active space operations.

Missile Developments on the Korean Peninsula: North Korea and South Korea made announcements in January concerning the development of submarine launched ballistic missiles (SLBMs), driving increased concern about North Korea’s advancing missile and nuclear programs and the potential for provocation and escalation in the region.

On January 14, 2021, North Korea displayed new currently under development SLBMs as part of a military parade through Kim Il Sung Square in Pyongyang. The parade was a celebration of the ending of the eight-day Worker’s Party Congress during which Kim Jung Un announced his intention to build a nuclear-powered submarine and develop a strategic weapon that can be launched from a submarine.

³⁸ “Research and Technology for the Future Main Ground Combat System”, *European Security and Defence*, August 15, 2020, [Research and Technology for the Future Main Ground Combat System - European Security & Defence \(euro-sd.com\)](https://euro-sd.com/research-and-technology-for-the-future-main-ground-combat-system/)

³⁹ Ibid.



Figure 5: A close-up photo of the Pukguksong-5 from the January 14, 2021 North Korean military parade: Source: Korean Central News Agency via The Drive

The new solid-fuel SLBM is called the Pukguksong-5 and appears to be longer and possess a different warhead section than the Pukguksong-3 tested by North Korea in 2019 and the Pukguksong-4 SLBM displayed during a larger military parade held in October 2020.⁴⁰

Some observers believed that the missiles on display could be engineering mock-ups while most analysts believe much more work needs to be done to develop and demonstrate the capability to launch a SLBM⁴¹, including developing a submarine

capable of launching such a large missile.⁴² Nonetheless, North Korea's efforts to produce a workable SLBM has created unease in the region. Japanese Chief Cabinet Secretary Katsunobu Kato noted after the parade that Japan is monitoring North Korea's missile developments with "great concern."⁴³

The day before the North Korean parade, South Korea announced it had tested its own SLBM at the Agency for Defense Development's Anheung test site. The SLBM was launched from a ground platform, and underwater tests are scheduled for March 2021. North Korea responded in a predictably dismissive and aggressive manner to news of the South Korean test. Kim Yo Jong, referred to as the Vice Department Director of the Central Committee of the Korean Worker's Party for the first time, issued a statement calling South Korea "the idiot" and asserting that Seoul tops "the world's list in misbehaviour."⁴⁴

A Direct Ascent ASAT Weapon Test and the Space – Counterspace Competition: On December 16, Russia reportedly tested a direct ascent anti-satellite weapon (ASAT) capable of destroying satellites in low earth orbit. It was Russia's third test of a counter-space weapon this year,⁴⁵ including testing a co-orbital satellite in July 2020.

The development of more and more sophisticated counterspace weapons not just by Russia but also other states such as India and China indicates the importance of the space domain for a range of C3ISR activities for militaries of all sizes. As the Royal Thai Air Force's February 2020 White Paper notes, "space observation, space surveillance and space capability development are necessary for national security."⁴⁶

The combination of the increased demand for resilience of space-based assets and infrastructure in response to the development of new counterspace weapons and a need to get satellites into space quickly, either to replenish degraded assets or respond to a fast-moving crisis has led to impressive development and demonstration of new launch capabilities.

Notably, on December 3, air launch company Aevum debuted the Ravn X space launch aircraft. The Ravn X combines an uncrewed horizontal take-off and landing design with a secondary stage that deploys

⁴⁰ Mike Yeo and Kim Tong-Hyung, "See the weapons at North Korea's latest military parade", *Army Times*, January 15, 2021, [See the weapons at North Korea's latest military parade \(armytimes.com\)](https://www.armytimes.com/news/see-the-weapons-at-north-korea-s-latest-military-parade)

⁴¹ Ibid.

⁴² Thomas Newdick, "North Korea's New Submarine-Launched Ballistic Missile Is Its Biggest Yet", *The Drive*, January 15, 2021, [North Korea's New Submarine-Launched Ballistic Missile Is Its Biggest Yet \(thedrive.com\)](https://thedrive.com/news/north-korea-s-new-submarine-launched-ballistic-missile-is-its-biggest-yet)

⁴³ Mike Yeo and Kim Tong-Hyung, "See the weapons at North Korea's latest military parade", *Army Times*, January 15, 2021, [See the weapons at North Korea's latest military parade \(armytimes.com\)](https://www.armytimes.com/news/see-the-weapons-at-north-korea-s-latest-military-parade)

⁴⁴ Thomas Newdick, "North Korea's New Submarine-Launched Ballistic Missile Is Its Biggest Yet", *The Drive*, January 15, 2021, [North Korea's New Submarine-Launched Ballistic Missile Is Its Biggest Yet \(thedrive.com\)](https://thedrive.com/news/north-korea-s-new-submarine-launched-ballistic-missile-is-its-biggest-yet)

⁴⁵ Hanneke Weitering, "Russia has launched an anti-satellite missile test, US Space Command says", *Space.com*, December 16, 2020, [Russia has launched an anti-satellite missile test, US Space Command says | Space](https://www.space.com/58888-russia-launches-anti-satellite-missile-test)

⁴⁶ "Royal Thai Air Force White Paper 2020", [Thailand RTAF White Paper 2020 ENG complete text.pdf \(mzv.cz\)](https://www.rtaf.mil.th/Portals/0/White%20Paper%202020%20ENG%20complete%20text.pdf)

at high-altitude and can take small payloads to space.⁴⁷ The system will be able to get between 100 and 500 kilograms of small satellites into orbit very quickly⁴⁸—in as little as 180 minutes—and is largely reusable, driving down costs.⁴⁹ Aevum CEO Jay Skylus estimates that Ravn X will be ready for operations within the next 18 months.

Robotics and Uncrewed Systems

Key Insights:

- Interest in autonomous uncrewed aircraft to either carry out or support combat operations has increased over the last year as Australia, the United States, and Russia have all achieved important milestone in the development of “loyal wingman” type capabilities. Japan, which had previously expressed interest in the concept in 2016, announced its plans to develop an autonomous fighter capable of teaming with crewed fighters by 2035.
- Ethical concerns are among the constraints around uncrewed combat aircraft—whether they are autonomous or not. In December, the German government rejected a request from the Bundeswehr to field armed drones out of fears that the aircraft could be deployed in unlawful or unethical missions.
- Small and medium sized militaries continue to invest in uncrewed systems as a means not only of covering potential resources and personnel deficits, but also because they are able to carry out the dirty, dull, difficult, and dangerous missions involved in modern conflict such as maritime countermining missions and also dealing with the ‘low and slow’ threat stemming from the proliferation of uncrewed offensive systems.
- Militaries throughout the world are putting into practice lessons gained from deploying and operating against uncrewed systems in combat zones in the broader Middle East and Eurasia. Russia, for example, has frequently used the Syria conflict as a test-bed for many of its new military equipment and is now reportedly developing a long-range radar helicopter uncrewed aerial system (UAS) to carry out counter-UAS missions based on observations of the effectiveness of UASs in the recent Azerbaijan-Armenia conflict.

Autonomous Fighters and Loyal Wingmen:⁵⁰ On January 1, *Nikkei Asian Review* reported that Japan is seeking to domestically develop and deploy advanced uncrewed fighter jets by 2035 in order to meet the growing challenge posed by the size and increasing capability of China’s People’s Liberation Army Air Force (PLAAF). The *Nikkei* report notes that China possesses more than 1,000 fourth-generation fighter jets, which is about three times more than Japan, and is now deploying the fifth generation J-20.

The development program will proceed in three stages. Stage one will focus on research and development into remote controlled uncrewed aircraft followed by a second stage that will advance “teaming” operations in which a crewed aircraft would control several uncrewed aircraft similar to the several loyal wingman programs being pursued by countries throughout the world. The final stage would be the development of a domestically built and fully autonomous uncrewed aircraft. The Japanese Ministry of Defence (MoD) expects the second stage to be completed by 2035.

The MoD will invest 2.5 billion yen (\$24.3 million) into remote and flight technology and another 200 million yen into AI technologies with the goal of conducting a flight test with a small prototype in fiscal year 2024. Subaru has been selected to lead developing remote and flight control capabilities while

⁴⁷ Darrell Etherington, “Space startup Aevum debuts world’s first fully autonomous orbital rocket launching drone”, *TechCrunch*, December 3, 2020, [Space startup Aevum debuts world’s first fully autonomous orbital rocket launching drone – TechCrunch](#)

⁴⁸ Sandra Erwin, “Aevum unveils smallsat-launching drone aircraft”, *Space News*, December 3, 2020, [Aevum unveils smallsat-launching drone aircraft – SpaceNews](#)

⁴⁹ Darrell Etherington, “Space startup Aevum debuts world’s first fully autonomous orbital rocket launching drone”, *TechCrunch*, December 3, 2020, [Space startup Aevum debuts world’s first fully autonomous orbital rocket launching drone – TechCrunch](#)

⁵⁰ Junnosuke Kobara, “Japan aims to deploy unmanned fighter jets in 2035”, *Nikkei Asian Review*, January 1, 2021, [Japan aims to deploy unmanned fighter jets in 2035 – Nikkei Asia](#)

Mitsubishi Heavy Industries and Mitsubishi Electric will develop the secure communications and information sharing systems connecting multiple crewed and uncrewed aircraft.

Ethics and Uncrewed Combat Aircraft: Ethical concerns are a critical constraint associated with uncrewed combat aircraft—whether they are autonomous or not. And while the discussion of fully autonomous weapons that operate absent human intervention may be relatively straight forward, the broader discussion around ethics and uncrewed combat systems can be layered and nuanced. For example, in December, the German government rejected a request from the Bundeswehr to field armed drones out of fears that the aircraft could be deployed in unlawful or unethical missions.

However, as Elizabeth Braw points out in commentary that appeared in *Defense One* on December 22, this decision does produce its own ethical and strategic consequences and questions. Most notably, not providing equipment that could help protect soldiers deployed to combat zones could place German and allied personnel at increased risk and may undermine Germany’s reliability as a military partner.⁵¹

Devising means and methods of weighing competing ethical considerations will become a more important consideration and priority for defence communities of all sizes as AI, autonomy, and swarming technologies are increasingly incorporated into even more prevalent uncrewed systems.

Uncrewed Mine-Detection: On December 9, South Korea’s Defense Acquisition Program Administration (DAPA) announced it will commence indigenous development of an autonomous uncrewed underwater vehicle (UUV) optimised for mine detection.

Defence contractor LIG Nex1 was awarded an \$11 million contract to develop an autonomous UUV capable of performing precise navigation and collision avoidance to improve South Korea’s mine



Figure 6: An artists' rendering of Saab's MuMNS system inspecting a maritime mine. Source: SAAB, [MuMNS | Saab](#)

countermeasure capabilities and reduce risk to personnel in conducting these typically dangerous and time-consuming missions. The new vehicle is expected to be developed by 2023.⁵²

Previous DEFTECH SCAN reports have highlighted the growing number of UUV programs in support of improving mine and MCM operation, including the joint French-British Maritime Mine Countermeasure (MMCM) program being managed by Thales.

As part of this program Swedish defence contractor Saab announced in January 2021 that it received a contract worth 300 million Swedish krona (\$36 million) to provide its Multi-Shot Mine Neutralization System (MuMNS) to Thales in support of MMCM. MuMNS includes a remote-controlled vehicle capable of inspecting all manner of mines and attaching explosive charges to them. Each vehicle can carry three explosive loads enabling them to be able to address multiple mines in one sortie.⁵³ According to SAAB’s press release announcing the award, the system provides “unparalleled operational capability with greater flexibility that significantly improves operational tempo, and reduces the cost of

⁵¹ Elizabeth Braw, “Why German Troops Will Not Get Armed Drones”, *Defense One*, December 22, 2020, [Why German Troops Won't Get Armed Drones - Defense One](#)

⁵² Dae Young Kim, “South Korea launches indigenous mine detection AUV development”, *Janes*, December 14, 2020, [South Korea launches indigenous mine detection AUV development \(janes.com\)](#)

⁵³ Sebastian Sprenger, “Saab to build underwater robots for French-British naval counter-mine program”, *Defense News*, January 8, 2021, [Saab to build underwater robots for French-British naval counter-mine program \(defensenews.com\)](#)

Mine Countermeasures operations and risk to personnel. Deliveries of the first systems are expected to take place in 2022.⁵⁴

Drones to Deal With the ‘Low and Slow’ Threat from Other Drones: Russian state-run news agency RIA Novosti reported in early December that an uncrewed long-range radar surveillance helicopter that will serve in counter-uncrewed aerial systems operations (C-UAS) has been in development since November.⁵⁵

The system will track small and low-speed enemy uncrewed aerial vehicles (UAVs) at low and extremely low altitudes at which it can be difficult to detect aerial threats. The development seems to have been inspired by the recent Azeri-Armenian conflict in which Turkish-made drones were used by Azerbaijani forces to break Armenian defences.⁵⁶ According to a RIA Novosti source, the program was “initiative on the basis of analysis of experience in recent local conflicts, which shows the increased role of combat drones.”⁵⁷

⁵⁴ “Saab signs contract on MuMNS for Franco-British Maritime Mine Counter Measures (MMCM) programme”, Saab website pressroom, January 8, 2021, [Saab signs contract on MuMNS for Franco-British Maritime Mine Counter Measures \(MMCM\) programme](#)

⁵⁵ Leonid Nersisyan, “Russia plans airborne surveillance radar on rotary-wing UAV”, *Shephard Media*, December 30, 2020, [PREMIUM: Russia plans airborne surveillance radar on rotary-wing UAV - Unmanned Vehicles - Shephard Media](#)

⁵⁶ Alexander Bratersky, “Russia is developing a helicopter drone to destroy other drones”, *Defense News*, December 17, 2020, [Russia is developing a helicopter drone to destroy other drones \(defensenews.com\)](#)

⁵⁷ Leonid Nersisyan, “Russia plans airborne surveillance radar on rotary-wing UAV”, *Shephard Media*, December 30, 2020, [PREMIUM: Russia plans airborne surveillance radar on rotary-wing UAV - Unmanned Vehicles - Shephard Media](#)



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