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DEFTECH-SCAN

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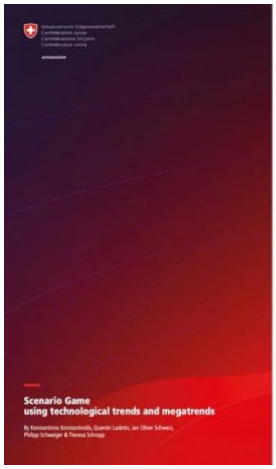
Dear Reader,

This is already the last deftech.scan of 2024 and we thank you for your interest ! As you for sure experience during the year, what was an idea yesterday is becoming a prototype and then a product at an amazing speed.

In order to stay ahead of the curve, we've developed and share these two products to anticipate situations, learn about different trends while playing and having fun. We are strong believers that doing serious stuff in a pleasant mode is an important ingredient towards success.



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Between two games and to feed your thoughts, here are some latest news in the following areas:

We wish you an interesting read.

Foresightly Yours,

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1. Applications of AI and data

1.1	**Leveraging Llama: accelerating use of generative AI for national defence** Meta's Llama AI model was the subject of a flurry of reporting and developments in early November, including reporting that China's People's Liberation Army (PLA) had repurposed the model to develop a military chatbot and that the company was making the model available to the United States defence and national security community. (source, source, source, source) *Assessment:* On 1 November, reporting emerged that the PLA used an early version of Meta's Llama and used a dataset of around 100,000 military dialogues to create a tool called ChatBit. The tool will be used for intelligence gathering, operational decision making, and military dialogue simulations, according to *Medium*. Despite the relatively small dataset ChatBit reportedly has almost 90% of the capabilities of more advanced and trained models such as OpenAI's GPT-4. Reuters first reported on ChatBit's development after reviewing a scientific paper from researchers associated with the PLA. The paper revealed that ChatBit development is continuing, saying that "in the future, through technological refinement, ChatBit will not only be applied to intelligence analysis but also ... strategic planning, simulation training and command decision-making will be explored." On 4 November, Meta announced that it would now allow U.S. government agencies and contractors to use its open-source Llama model for national security applications, such as to "streamline complicated logistics and planning, track terrorist finances, or strengthen our cyber defences." The company said that Oracle has already started building on Llama to "synthesize maintenance documents to help aircraft technicians make reports while Lockheed Martin is using the model to generate code and analyse data.". Also on 4 November, Scale AI unveiled its "Defense Llama" tool, a large language model (LLM) the company configured and developed over the last year from Meta's Llama 3 LLM. The company said that the tool is being experimented with to support missions such as combat planning and intelligence operations.

1.2	**Bullfrog a potential leap forward for autonomous weapons systems** The U.S. Army tested an AI-enabled robotic gun system that can autonomously target and engage drones at a pace and with accuracy that greatly exceeds that of human operators. (source) *Assessment:* Reporting from *Wired* magazine revealed that the DoD tested the Bullfrog system—made by Allen Control Systems—in August during the Technology Readiness Experimentation (T-Rex) event in August. The system consists of a 7.62—mm M240 machine gun mounted on a specially designed rotating turret outfitted with an electro-optical sensor, proprietary AI, and computer vision software. It is designed to deliver small arms fire on small, fast-moving drones, especially swarms of small drones, many of which will be able to move much more quickly and with greater agility than human operators can track. According to company President Steve Simoni, an autonomous solution is required "in order to solve this problem of hitting a fast drone that's accelerated at five Gs at a couple hundred yards . . A DJI drone is a little bit bigger than my hand, and our system can down one at 200 yards with two shots." Despite its potential in the increasingly important and complicated counter-drone mission, there are concerns about the potential use of Bullfrog as a completely autonomous weapons system. The company maintains that the Bullfrog is designed to keep a human "in the loop" in order to avoid a potential "unauthorized engagement", meaning that the gun will identify and track targets but will not fire unless commanded by a human operator. Nonetheless, company representatives also indicated that the weapon can operate completely autonomously if the U.S. military were to require that capability in the future. Simoni also noted that the system's algorithms can be easily upgraded, enabling new capabilities, telling *Wired* that "Eventually, the system will consist of different guns, reaching out across longer ranges, engaging drones that are moving in different acceleration patterns—that's' all based on updates to our AI model."

Figure 1: The Bullfrog weapons system. Source: Allen Control Systems via Wired

2. Robotics and Autonomous Systems

2.1	**Filling the personnel gap: Uncrewed systems on display at KADEX '24** The Korean Army International Defence Industry Exhibition was held in early October in Gyeryong, South Korea. Uncrewed systems featured heavily during the show as South Korean companies seek to help the military manage troop shortages driven by low birth rates and recruitment levels. (source, source, source, source). *Assessment:* Several novel uncrewed systems were displayed during the exhibition. South Korean company Hanwha Ocean presented a model of the Ghost Commander uncrewed command and control ship similar to an aircraft carrier. The ship could operate autonomously and is designed to carry uncrewed aerial systems (UASs) and uncrewed underwater vehicles (UUVs). Ghost Commander was originally unveiled in October 2023. Korea Aerospace Industries (KAI) and Korean Air's Aerospace Division both provided more details on their respective collaborative combat aircraft (CCA) designs. KAI unveiled a scaled down version of its AAP-150 design. The company seeks to fly a prototype AAP-150 in 2025 and demonstrate technology for the FA-50 light fighter to control the AAP-150 in 2027. Korean Air's Aerospace Division showcased a new expendable CCA known as the KUS-RP—with RP short for "replicator." The system will be launched from an aircraft and be equipped with an aircraft connection interface and folding wings. The company is also developing the KUS-LW reusable loyal wingman uncrewed combat aerial vehicle (UCAV). Perhaps most interestingly, Hanwha Aerospace unveiled an uncrewed multi-rocket launcher system designed for amphibious operations. The system is designed to provide advanced fire support capabilities during maritime approach phases and after landing. According to *Defence Post,* the system will be used to deliver precise fire support with minimal manpower and to enable deployment of rocket artillery in previously unreachable areas, particularly during distributed operations. One of the key features of the system is its compatibility with existing Chunmoo MRLS PODs, which allows the system to fire both traditional and newly developed missiles..

2.2	**Successful test for first UK autonomous XL submarine** BAE Systems successfully tested its Extra Large Autonomous Underwater Vessel (XLAUV), known as the Herne. The modular, highly configurable vessel can host a wide range of mission-specific payloads that can be configured to meet various mission profiles while keeping humans further away from dangerous missions. (source, source) *Assessment:* The system is designed to operate as an off-board sensor that can inspect undersea infrastructure, support anti-submarine warfare, and deliver subsea surveillance in order to "remove reliance and risk to large platforms and critical resources whilst providing a range of new mission capability." During testing, the Herne conducted a pre-programmed intelligence, surveillance and reconnaissance mission. BAE's platform-agnostic autonomous military control system known as Nautomate is responsible for enabling the XLAUV's autonomy. Nautomate was trialled on a surface vessel earlier in 2024 and now has proven its ability to control an undersea vehicle. While Nautomate is being built into the under-development Herne, it can also be retrofitted to existing vessels, allowing navies to rapidly increase their autonomous vessel capability to meet operational requirements without relying on or endangering more expensive crewed systems or putting humans at risk. Saab unveiled a similar autonomous mission control system called Autonomous Ocean Core at the Euronaval exhibition in early November in Paris. Saab claims the system is capable of turning any vessel smaller than 50 meters into an autonomous ship. Saab executive Lars Brannstrom stressed the importance of autonomy on the modern battlefield and thus the value of the Autonomous Ocean Core system during the Exhibition. Brannstrom observed that: "if we are able to autonomously operate different kinds of vessels, on the surface and underwater, it lets us provide navies with something that would previously have involved human beings in either boring or dangerous tasks. If we can sacrifice a machine instead of a human, that's worth doing for its own sake, and it also plays into the rising trend of lean crewing."

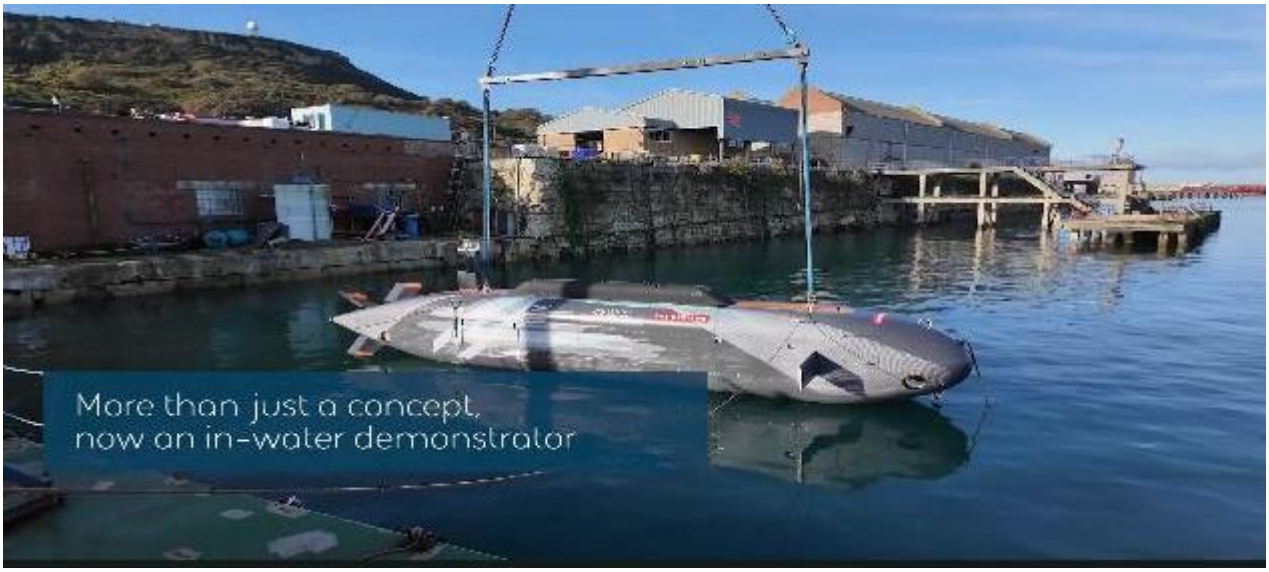

Figure 2: A screenshot of the Herne entering the water during recent in-water testing near Portsmouth, England. Source: BAE promotional video from the Herne product page on the BAE website.

2.3	**British researchers test a nervous system for drones** Researchers at the University of Southampton in the UK are developing a UAS that uses advanced optical fires to communicate real-time data about the drones operating system via light rather than electric signals. (source and source) *Assessment*: The new system—likened to a "nervous system" for the drone—increases the efficiency and reliability of the drone by constantly checking their structure and health. A key benefit of the system cited by the research leads is that it significantly decreases the frequency of inspections required for maintenance, saving time and resources, but also increasing the safety and reliability of the aircraft operations. The system employs an optical speckle technique that produces specific images influence by the optical fibre nervous system signals. Optical fibres allow for the transmission of real-time drone system data via light rather than electrical signals, ensuring the transmission avoids the interference from radio frequencies that electronic systems have. It also uses AI algorithms to process the data, allowing for real-time monitoring of the stresses on the aircraft. The system is being developed to increase efficiency and reduce maintenance for commercial cargo and medical supply delivery drones, both of which require regular manual safety checks, limiting availability and increasing costs. However, the technology could be applicable to other industries as well as to defence and security communities, which are increasingly seeking to enhance readiness and simplify logistics and sustainment operations.

Figure 3: An image of the drone on which the optical speckle system has been tested. The pictured drone was developed by students at the University of Northampton. Source: University of Southampton, via BBC

3. Energy, Power, and Propulsion

3.1	**Hyundai unveils vision for hydrogen powered stealthy tank** Hyundai subsidiary Rotem reviewed its vision for the Republic of Korea's (RoK) next generation of K-series main battle tanks (MBT) that will incorporate several novel technologies including hydrogen fuel cells. (source) *Assessment:* On 28 October, Rotem unveiled its vision for the K-3 MBT, which will replace the diesel engines that currently power the K-series MBT with hydrogen fuel cells. The design has been developed in collaboration with the RoK's Agency for Defence Development and other national technology research institutions. The tank is expected to enter production by 2040. The incorporation of hydrogen propulsion will be carried out in stages with the first K-3 prototype featuring hybrid hydrogen and diesel propulsion. The move to hydrogen will make the MBT more sustainable, of course, but it will also bring operational benefits such as reducing the vehicle's heat signature and reducing the noise the tank makes when operating. Hydrogen fuel cells should also provide greater acceleration and mobility, significantly better fuel efficiency, lower maintenance costs due to having fewer moving parts, and better handling in steep and rugged terrains. In addition to the use of hydrogen fuel cells, the new MBT will include several other new technologies and capabilities to increase its firepower, capability for human-machine teaming, and survivability.

Figure 4: An artist's rendering of the K-3 MBT. Source: Hyundai website product page

3.2	**Raytheon to develop power beaming capabilities for U.S. Army** The contract to develop directed energy wireless power beaming capabilities is part of the Department of Defense's Operational Energy Strategy. (source) *Assessment:* On 14 November, Raytheon announced it had been awarded a contract to develop advanced wireless power transmitter and receiver technologies to enable a long-range demonstration of power beaming capabilities. Wireless power beaming allows for power to be beamed over distances to deployed forces in the field, reducing the need for troops to carry additional fuel and batteries. It also reduces reliance on fixed fuel depots or power stations that would be priority targets in combat. This technology is especially important in light of the electrification of the battlefield, a trend in which the increased use of power-hungry systems such as sensors, uncrewed systems, active protection systems for vehicles, and electric vehicles are increasing requirements for electric power and batteries. Reliance on power sources wirelessly beamed from a distance enables facilitates operational resilience and removes a significant component of the logistics tether that can create significant operational constraints and vulnerabilities.

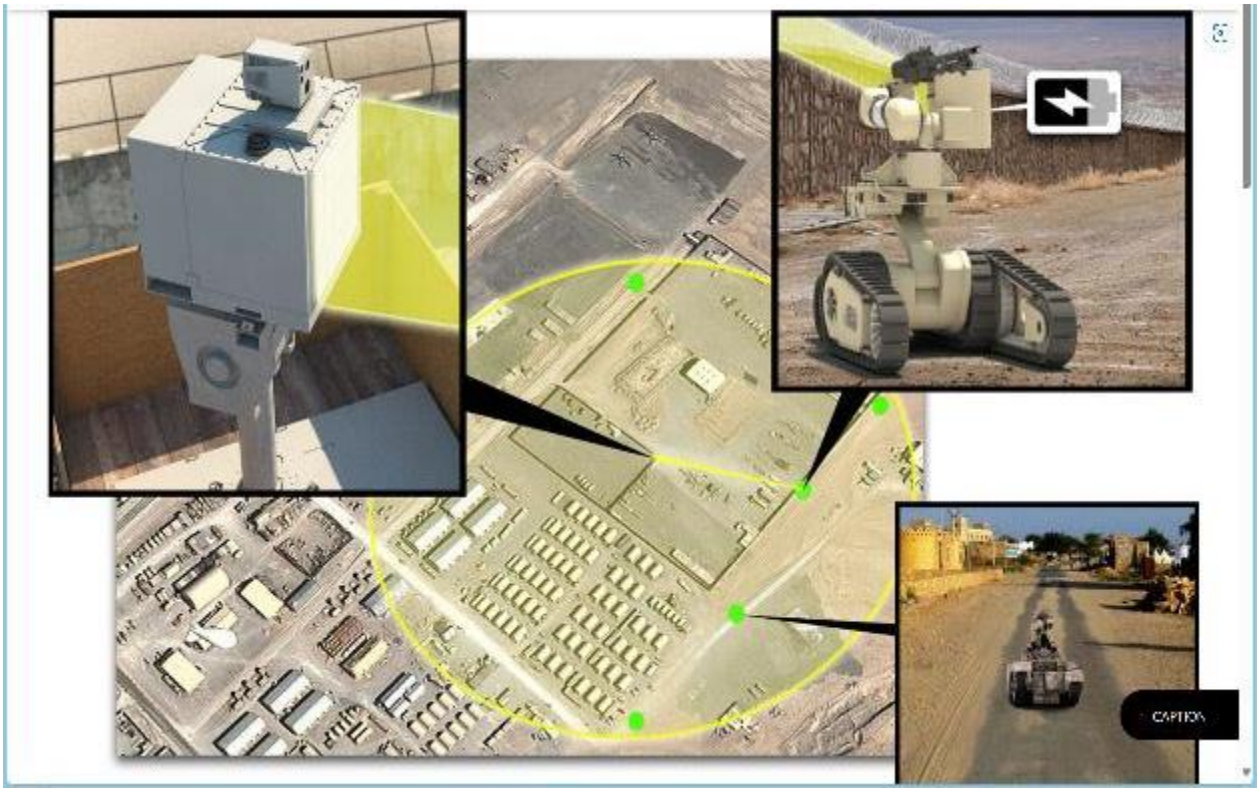

Figure 5: An image Raytheon's website that shows the functionality of wireless power beaming. According to the image's caption: " From perimeter security to advanced robotics, wireless power energy delivers operational need for the DoD.' Source: RTX press release

4. Sensors

4.2	**Making counter-stealth accessible: Chinese scientists claim new, simpler, and cheaper means of detecting stealthy aircraft** In a peer-reviewed paper, a team of Chinese scientists claim to have developed a new means for detecting and tracking F-22 stealth fighters using signals from China's BeiDou navigation satellite system. The new approach could significantly reduce costs of counter-stealth technology. (source—firewalled) *Assessment:* The detection system uses China's BeiDou global navigation satellite system (GNSS) to detect stealth aircraft. When BeiDou signals encounter a stealth aircraft, they are refracted, creating unique echoes that scientists can analyse to make a "fairly accurate guess as to the type of target and its position", according to *South China Morning Post.* However, the signals generated by stealth aircraft are extremely weak by the time they reach the ground and are also prone to environmental interference. To date, to detect stealthy objects, passive radars have used a dedicated set of antennae pointing directly at a given satellite to obtain a stronger signal that can be compared to signals received by other antennae in order to discern if the satellite has detected a stealth aircraft. This method increases cost and complexity and requires a high degree of compute to carry out the processing of the range of signals detected. To get around these challenges, the Chinese research team proposed a "blind detection" method using a single channel to identify stealth aircraft, eliminating the need for a reference antenna. A crucial component of the radar development effort was the use and refinement of an algorithm developed in 1991 by Goran Zivanovic, a computer scientist then-based in Belgrade that enabled the detection of hidden cyclic frequencies in electromagnetic signals. Little cited in the West, Zivanovic's work has been applied to radar research in China. In simulation tests, the system successfully distinguished the distance, direction, and speed of the three stealth targets from "radio noise." The research team used an image of a U.S. F-22 Raptor stealth fighter to illustrate the new radar system's hypothetical target. The research was led by Wen Yuanyuan, a senior engineer with the National Key Laboratory of Space Microwave Communication in Xian. Her team's paper was published in the October volume of the Journal of National University of Defence Technology.

5. Industry and Manufacturing

5.1	**Coping with brain drain: France seeks to establish defence industrial reserves** The effort is part of broader effort to scale production of munitions and defence equipment during a time of growing threats to French and European security (source)
	Assessment: French armament agency DGA signed contracts with armoured-vehicle manufacturers KNDS and Arquus in November to join a defence industrial reserve program through which retiring industry veterans can be activated to train new hires on how to design and build modern military equipment. The initiative aims to build a pool of skilled experts, from welders to designers and engineers, that can be activated to support manufacturing or train others in high-value skills at their former employer or other French companies. DGA head Emmanuel Chiva stressed the urgency of the need to build scaled resilience across the French defence industry based on a realistic assessment of the intensifying threats to French and European security. Chiva told *Defense News* that France is "not at war, but on the other hand we must not be naïve. We're preparing for a rise in strength, if only for the sake of our credibility, and so today we're going to look for the skills where we can find them." Members of the defence industrial reserve program will be asked to commit to 10 days of training per year to maintain and refresh skills. Reservist members will enter as non-commissioned officers or officers with renumeration at the same level as active-duty military at the same rank. The target is to build a defence industrial reserve force of 3,000 by 2030. In addition to targeting defence industry retirees, DGA is also looking at adjacent industries, such as the automotive industry, where technical, engineering, and manufacturing expertise could be leveraged to scale production of defence related items in a time of crisis or conflict. The program is an innovative means of building resilience in France's defence industrial base and ensuring that the knowledge base that has been created in France's defence industry is not lost as experienced professionals retire. A government report published in 2023 estimated that across all French industries nearly 1 million industrial workers are expected to retire by 2030. Of course, this challenge is not unique to France. Most modern militaries and defence industrial bases are struggling with the need to manufacture the scale of defence materiel to either deter or, if necessary, win conflict, especially munitions., Retaining workers and expertise required to build this equipment is crucial. Indeed, in July of 2023, U.S. defence contractor Raytheon called in retirees to teach its workers how to build Stinger missiles—which the U.S. military no longer procures and has not been in production for nearly 20 years—to be provided to Ukraine.

6. Platforms and Weapons Systems

6.1	**If you win all your wargames, you will lose all your wars: UK wargames expose potential aircraft carrier vulnerabilities and value of wargames** Reporting from *The Times* details findings from a series of UK wargames in which the UK's two carriers are sunk in future conflict scenarios by advanced missile threats. (source) *Assessment: The Times* article provides a useful framing of the debate within the UK MoD and elsewhere about the utility and value for cost that aircraft carriers provide in a future fight. It is built around an assessment from a UK military source that "in most [UK] wargames, the carriers get sunk." It also highlights the potential vulnerability of the very expensive platforms—the UK's two carriers cost £6.2 billion each—in a future fight that includes highly capable and long-range anti-ship weapons, such as manoeuvrable hypersonic weapons and anti-ship ballistic missiles. The piece was published as the UK MoD continues its extensive defence review in hopes of building a more lethal and lean force while finding cost savings. The prospect of cutting one of the UK's two carriers has apparently already been discussed as a means of achieving these savings and freeing "up people and running costs" which could be "reinvested in the running costs of the rest of the fleet and easing the stresses on personnel", according to Lord Lee of Trafford, a former defence minister. Despite these cost challenges and potential operational vulnerabilities, there remains staunch support for carriers within the UK MoD and throughout the world. As Lord West of Spithead, a former First Sea Lord, observed, "if carriers are so useless, why are the Chinese, Americans, and Indians desperately building up their carrier forces." The United States has 11 operational carriers while China has three with a fourth being developed. Several other nations operate two or fewer carriers. Part of this support is rooted in a sense that carriers are more survivable than what is modeled in many wargame exercises, both due to the presence of air defence ships in a carrier strike group and other emerging non-kinetic / electronic warfare measures that can be used for both active and passive defence. The prevailing perspective on the issue is summed up by UK shadow defence secretary James Cartlidge, who noted that carriers still provide "extraordinary capability" but that they should be updated to incorporate and defend against emerging technologies to include developing more advanced air and missile defenses and to be able to carry more low cost uncrewed systems. In addition to outlining the contours of an important debate within military circles throughout the world, the *Times* piece also provides insight into the utility of wargames in understanding and addressing vulnerabilities. That carriers are sunk in wargames is not necessarily a bad outcome for the UK MoD. The best and most useful wargames are those that are designed to test, rather than merely validate, capabilities and concepts and, as a result, to identify vulnerabilities. A Royal Navy spokesperson highlighted this point by telling *The Times* that the wargame scenarios "are worst case fictitious scenarios that push our capabilities to the very limits—they are not forecasts of what is most likely to happen. This ensures we remain fully prepared for all future potential threats."

6.2	**The Empire Strikes Back? Chinese scientists claim to have developed a "Death Star"-type directed energy weapon** The counter-space weapon focuses several electromagnetic waves on a single target, similar to the weapon featured in the Star Wars films. Scientists with the Xian Navigation Technology Research Institute at the China Electronics Technology Group Corporation claim to overcome challenges associated with synchronization and precision that have hampered previous attempts to combine electromagnetic beams. (source) *Assessment:* Trials have begun in China on a new weapon system that consists of multiple microwave-transmitting vehicles deployed to different locations. They then emit microwaves that can then merge into a powerful energy beam to strike a single target. While science fiction writers have toyed with the idea, it has been extremely difficult to bring it to life in the real world, given that it requires different beams from different platforms to arrive at the same location at the same time and in the same form. To achieve this, each vehicle needs to be deployed with a positional error reduced to millimetres, and the time synchronization between the different platforms cannot exceed 170 picoseconds, a degree of precision that exceeds atomic clocks on GPS satellites. Researchers connected the timing devices on the transmitting platforms with optical fibres to achieve "ultra-high time precision synchronization" and also installed laser ranging auxiliary positioning devices on each transmitting vehicle to obtain millimetre-level coordinates.. Reporting from *South China Morning Post* indicates that the weapon is being design and tested to serve as an Earth-based counter-space weapon capable of damaging Global Navigation Satellite Systems, such as GPS, or other satellites in low-earth orbit (LEO)

6.3	**India joins the hypersonic weapons club** India successfully tested a long-range hypersonic missile, joining a small group of nations that have achieved this milestone. While additional testing and development are required to mature the program to an operational capability, the test constitutes an important and impressive step forward in India's military capability and technology development. (source, source, and source) *Assessment:* On 16 November, India's Defence Research and Development Organisation (DRDO) conducted a successful flight trial of the country's first long-range hypersonic missile. The weapon system travelled at Mach 6 during the test, and the DRDO press release relayed that "flight data from down range ship stations confirmed the successful terminal manoeuvres and impact with a high degree of accuracy." India began its hypersonic development program in 2017. Defence Minister Rajnath Singh called the test "a historic moment and significant achievement" that has "put our country in the group of select nations" capable of developing advanced military technology. Most notably, China and Russia have developed operational hypersonic missiles while the United States, which has at times struggled to scale its hypersonic programs, has successfully tested hypersonic weapons as well. Several other nations, including France, Germany, the United Kingdom, Australia, Japan, Iran, and Israel have hypersonic weapon development programs as well. Hypersonic weapons systems come in two types: hypersonic cruise missiles (HCMs) and hypersonic glide vehicles (HGVs). HGVs are launched on a rocket into the stratosphere where the HGV separates from the rocket and glides at extremely high speeds to its target on earth, be it a ship or fixed ground target. Both HCMs and HGVs share two prominent attributes that are driving the global interest in hypersonic weapons systems. First, hypersonic missiles travel at speeds exceeding Mach 5, much faster than cruise missiles that typically travel at subsonic or low supersonic speeds. Second, they are manoeuvrable in flight. While nearly all ballistic missiles do reach hypersonic speeds during flight, their trajectory is fixed making them easier to target. Most modern air defence systems are not equipped to reliably deal with this combination of speed and manoeuvrability, driving global interest in both HCMs and HGVs as a means of overcoming increasingly robust missile defence systems. Analysis of the significance of the test from India's Center for Air Power Studies (CAPS) think tank highlights the strategic and operational importance of India developing a hypersonic weapon systems capability that would serve as a "powerful tool for strategic deterrence, as potential adversaries would need to consider the devastating consequences of such a weapon." However, it also notes the importance of the test for India's regional positioning, global prestige, and validation and promotion of the country's "Make in India" initiative that prioritizes indigenous development of advanced technologies and military capabilities.

7. Space

7.1	**Japan, UK building military space architecture** The reporting period saw Japan and the UK make announcements reflecting increased importance of space-based communication and remote sensing to military operations. (source and source) *Assessment:* On 4 November, Japan successfully launched the Kirameki No.3 defence satellite into orbit. The satellite was carried into space on the domestically built H3 No. 4 rocket. The Kirameki No. 3 is an X-band communications satellite that will join two earlier Kirameki X-band satellites at undisclosed orbits. Once the No. 3 satellite begins operations at the end of March, the three X-band communication satellites will enable high-speed, large-capacity data transmission and communication across Japan's Ground, Maritime, and Air Self-Defence Forces, as well as with units deployed overseas on peacekeeping missions or exercises. The launch comes as Japan seeks to improve its overall defence capability and increase its defence spending in response to growing tensions with China and a challenging security environment in the Indo-Pacific. Also on 4 November, the UK Ministry of Defence announced a £40 million project with Surrey Satellite Technology Ltd to build a new Juno remote sensing satellite that will be able to capture daytime images of the Earth's surface, strengthening the UK's space-based intelligence, surveillance, and reconnaissance (ISR) capabilities. Remote sensing satellites form a crucial component of military ISR and early warning systems, as they offer a high-endurance capability that can monitor adversary activities or positions, detect change over time, map terrains, and provide real-time imagery of rapidly unfolding crises or natural disasters. Juno is expected to launch in 2027.

7.2	**Not so fast: Australia cancels $5 billion military satellite communication project as technology and threat environment advance** The decision reflects an emerging trend in which some militaries prioritize LEO constellations of small satellites over individual, large—and more vulnerable—satellites in higher orbits. (source)

Assessment: The Australian Department of Defence's decision to cancel the JP9102 military satellite program in early November demonstrates the disruptive effects of the use of proliferated small satellite constellations in LEO by both commercial and government organizations.

The $5 billion JP9102, or Defence Joint Project 9102, was launched in 2021 with the aim of developing three to five satellites in geostationary orbit (GEO) as well as associated ground stations. Lockheed Martin was selected to lead the consortium of companies to build the satellites, which would constitute Australia's first sovereign military satellite communications capability.

However, in a 4 November statement the Australian Department of Defence announced the cancellation of the project, citing a changed threat environment in space. Specifically, the statement observed that "with the acceleration in space technologies and evolving threats in space since the project's commencement, Defence has assessed that single orbit GEO-based satellite communications system would not meet strategic priorities."

The advancement and diffusion of advanced counter-space capabilities—including non-kinetic capabilities—has made space-based communications and ISR assets considerably more vulnerable to disruption and disablement. Single, high-value, and expensive assets placed at higher-orbits typically provide sophisticated capabilities but once these assets are disabled, the capable they provide is lost.

To be sure, the use of satellites in GEO is not ending, especially for remote sensing satellites as GEO orbits allow near constant coverage of a target areas. But there has been increased government and commercial interest in using large constellations of small satellites in LEO to deliver a more resilient capability. The loss of one or even several constellation satellites will not lead to a loss of the overall constellation's capability. LEO satellites also have the added benefit of being able to transmit data to ground stations more quickly because they operate at lower altitudes.

SpaceX's StarLink satellite communications network has demonstrated the utility of LEO satellite communications constellations in commercial settings as well as during the war in Ukraine and government organizations around the world are embracing the LEO constellation model. For example, the U.S. DoD is building the "National Defense Space Architecture", a seven layer proliferated constellation of hundreds of remote sensing and communications satellites in LEO based on the assumption that "former approaches of developing a small amount of large satellites, along with large monolithic ground systems taking many years to develop, can no longer be the norm." Additionally, China has announced two efforts to build mega constellations of commercial communication satellites in LEO to compete with StarLink and also support government activities.

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