



● ● The Sea-based, X-band Radar (SBX 1) is seen as it transits the waters of Joint Base Pearl Harbour-Hickam, Hawaii, US. Credit Daniel Barker/US Navy/Handout via REUTERS

## Transmit, reflect, detect ● ●

Radar is a highly-effective system that has been providing data for military, defence, aviation and meteorological applications, among others, for more than 50 years now. While more refined and more accurate systems have been developed over the years, the fundamental concept remains largely unchanged. Here, we take a look at how radar is being used for defence applications today, and the latest application developments in the field.

**Radar was developed for military applications before** and during World War II, as an object-detection system that uses radio waves to determine the angle, range and velocity of objects. Radar can be used to detect spacecraft, guided missiles, motor vehicles, aircraft, weather formations and terrain, among others.

Radar systems include a transmitter that produces electromagnetic waves in the radio or microwave spectrum, transmitting and receiving antennas, a receiver, and a processor. Pulsed or continuous waves from the transmitter reflect off the object and return to the receiver to provide information about the object's speed and location.

Radar, like satellite, is one of those technologies that has truly lasted the test of time, and provides enough value across different applications that the market is still growing today. According to ReportsnReports' *'The Global Military Radar Market 2016-2026'* report, the global military radar market, valued at US\$15.5 billion in 2016, is expected to grow at a compound annual growth rate (CAGR) of 1.84 percent until 2026 to reach US\$18.6 billion. The market is expected to be dominated by airborne radar systems, accounting for 28 percent of the market share; ground-based (25 percent), naval (20 percent), sonar (15 percent), and space-based (11 percent) systems comprise the remaining five market segments. During the forecast period, North America is expected to remain the dominant market region with a 36 percent share, followed by Asia-Pacific and Europe, with 26 percent and 23 percent shares respectively. Demand through to 2026 is expected to be driven primarily by the growth in unmanned platforms and modernisation of existing radar systems.

### Providing vital intelligence

Intelligence provides the fundamental basis for every military operation. With it, decision-makers can devise plans based on

a solid understanding of potential threats and opportunities in the world around them. Intelligence comes from many sources, including publicly-available information like population data, newspapers, commercial weapons data, through to more proprietary information, such as high resolution imagery, private documents and covert eavesdropping. Radar, too, can provide a great deal of intelligence information, including accurate environmental data of surrounding terrain and enemy weapon systems. Most governments today include radar as a vital source of intelligence.

In January 2017, it emerged that the Pentagon had deployed a high-tech military radar to look out for possible North Korean intercontinental ballistic missile (ICBM) test launches. The sea-based X-band radar (SBX) can track long-range missile launches, and was deployed to a location some 2,000 miles Northwest of Hawaii. The radar can only be deployed for limited periods, requiring decision-makers to calculate the optimal times for use.

"The SBX's current deployment is not based on any credible threat; however, we cannot discuss specifics for this particular mission while it is underway," said Commander Gary Ross, spokesperson for the Pentagon. Defence Secretary Ash Carter has stated that while threatening missiles will be intercepted, non-threatening missiles will likely be observed to gather intelligence from the flight, saving interceptor inventory and providing data.

Russia is another major user of radar for military and defence purposes. The country established a new radar facility called Sopka-2 on Wrangel Island in the Arctic to bolster Russia's land and air borders at the end of 2016. The Russian military established a base there in 2014, manufactured from modules complete with everything required for long-term habitation.

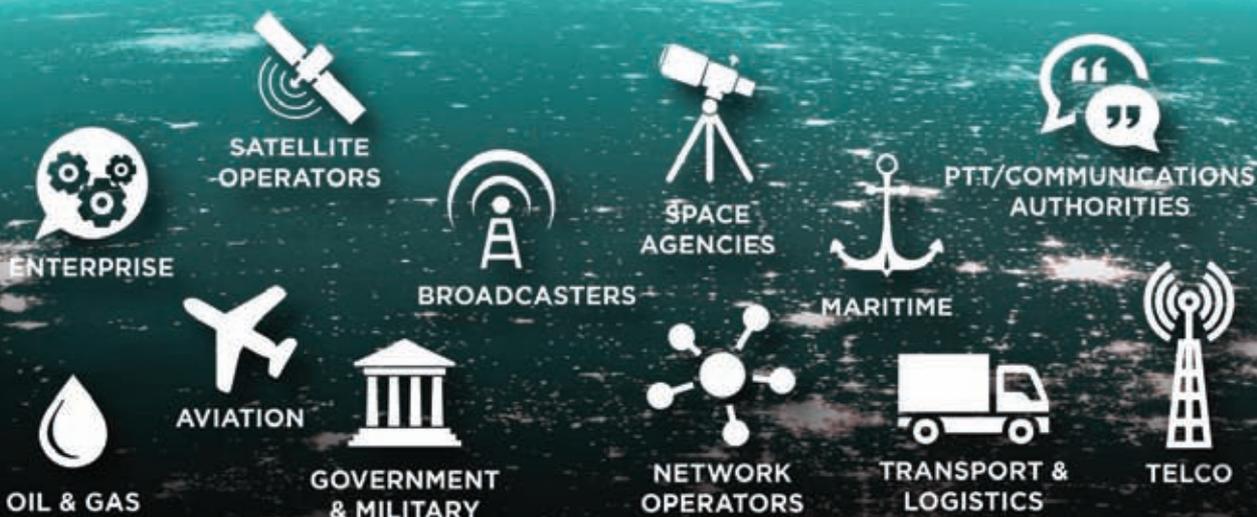
"A new radar array complex, Sopka-2, entered service on

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Wrangel Island in 2016. The main mission of the radar is acquiring, generalising and analysing of aerial situation in the Arctic region,” said Alexander Gordeev, Eastern Military District’s spokesperson.

Equipped with a protective cupola, Sopka-2 can operate in the harshest weather conditions, including sub-zero temperatures as low as -40 degrees C. The radar system can control civilian air traffic, monitor aerospace for potentially hostile targets, and provide meteorological data.

The base and its new radar facility are part of a major plan to cover Russia’s northern borders with a network of military bases, airfields, radar stations and command and control sites, and explore the Arctic region.

### Investing in stealth

Stealth has played a key role in military and governmental programmes for as long as they have existed. As the years, have gone by, stealth technologies have become increasingly advanced, making it harder than ever before for the enemy to target our aircraft, maritime vessels and stationary assets.

In January 2017, Bell Helicopter announced plans to explore innovative ways to reduce the radar signature of its next-generation V-280 Valor tilt-rotor aircraft, which is expected to be operational by the 2030s. The project is not being described as a stealth aircraft, although stealthy characteristics are a major focus. These include IR heat suppressing systems for the engines and exhaust, reducing the need to use jamming technologies to confuse enemy radar, as well as fuselage contour constructions that will make the V-280 less targetable.

“We will definitely employ some passive measures in terms of how we shape the aircraft, to make it invisible. The key is not to be able to target it and reduce the signature passively so radar sweeps do not see anything. In the end, you do not want to get detected or engaged,” Vince Tobin, Vice President of Advanced Tiltrotor Systems at Bell Helicopter, told local media.

The new V-280 Valor is part of the Army’s Joint Multi-Role Technology Demonstrator programme that will establish requirements and pave the way towards a new Future Vertical

Lift aircraft designed to meet new requirements. A demonstrator aircraft is expected to perform test flights in November 2017, with many more developments expected before the official launch in the 2030s.

### Adding new dimensions

One step ahead of traditional radar, 3D radar systems provide coverage in three dimensions, ideal for air defence, surveillance and weather monitoring applications. Within the military sector, 3D radar delivers great value in providing the perfect intercept point.

In January 2016, BAE Systems completed three years of sea-based trials of its Artisan 3D radar system on the Royal Navy’s Type 23 Frigates, proving its capabilities in an operational environment. Artisan 3D can monitor more than 800 objects simultaneously from 200-200,000m away, cutting through interference equal to 10,000 mobile phone signals.

“Artisan 3D is a ground-breaking radar system that delivers real capability to the Royal Navy with its supreme accuracy and uncompromising tracking. Its world-leading electronic protection measure ensures that even complex jammers will not reduce its effectiveness,” said Les Gregory, Director for Products and Training Services at BAE Systems. “Artisan 3D has now been extensively tested, demonstrating high performance with significant flexibility to meet current and future threats. It provides air and surface surveillance and target tracking to support platform and weapon system requirements on a wide range of platforms. BAE Systems is proud to continue its record of providing the most advanced radar capabilities to the Royal Navy.”

Under a £105 million contract, BAE Systems will develop, manufacture and provide support for 19 of the radars for the Royal Navy until 2022. All 19 Artisan 3D systems will be delivered to the Ministry of Defence (MoD) by the middle of 2017. On top of the 11 frigates so far, Artisan 3D has also been installed on HMS Queen Elizabeth, a new aircraft carrier due into Portsmouth later in 2017. It will also be fitted on a second new aircraft carrier, HMS Prince of Wales, two more frigates, and a landing platform



Manufacturer’s photo of Sopka-2 facility at an unidentified location. Credit [lemz.ru](http://lemz.ru)



● ● BAE Systems' Artisan 3D radar system has successfully completed three years of sea-based trials on the Royal Navy's Type 23 frigates.

dock assault ship. Further trials will take place before each of the Artisan 3D systems goes into service.

"Artisan is a highly capable radar, providing record breaking track detection ranges against complex and demanding threats. This contract demonstrates how DE&S, industry and the Royal Navy are working collaboratively to deliver cutting-edge equipment, vital in supporting and protecting our Armed Forces," said Jonathan Barratt, Head of the Complex Weapons Team at the MOD's Defence Equipment and Support.

The US Coast Guard also sees the value in 3D radar systems. Airbus Defence and Space and Airbus DS Electronics and Border Security GmbH (EBS) are currently under contract to provide the TRS-3D Baseline D multi-mode radar (MMR) for the US Coast Guard's ninth National Security Cutter (NSC). The TRS-3D Baseline D, designated AN/SPS-75, uses Gallium Nitride (GaN) technology to deliver robust performance while improving reliability and options for future development.

"The AN/SPS-75 is the right choice to meet Coast Guard requirements for a multi-mode radar," said Mike Cosentino, President of Airbus Defence and Space. "It is currently meeting operational requirements and is consistent with Coast Guard investments in training infrastructure ashore, as well as with their existing sustainment programme."

The TRS-3D delivers three-dimensional multi-mode naval radar for air and surface surveillance, target acquisition, self-defence, aircraft control and gunfire support. It automatically detects and tracks all types of air and sea targets. The AN/SPS-75's solid state system design reduces maintenance costs and increases reliability, rendering it an affordable solution.

### Overcoming interference challenges

One of the pitfalls of relying on radar is the detection of interfering objects. Windfarms, for example, provide a promising solution

for green energy projects, but the massive turbines are visible to radar systems, meaning they can only be constructed in a limited number of locations.

In January 2017, QinetiQ announced the construction of stealth wind turbines, which have a minimal radar presence, for an energy company. EDF was initially refused permission to build a windfarm near Perpignan, France, because the towers and rotating blades interfere with radar systems used for weather forecasts. The company turned to QinetiQ for a solution, which duly designed and constructed a windfarm with 35 x 400ft turbines which appear as only 4ft high on radar systems.

"We first started looking at this more than a decade ago because UK onshore windfarms were getting turned down on planning applications because of worries about turbines affecting air defence radars," said David Moore, Director of Research Services at QinetiQ. "We had experience in making other things look smaller to radar for the military, so we thought we could use it in other areas."

Wind turbine blades cause a major challenge since they can't be significantly altered without losing efficiency, while a coating would significantly increase the weight of the blades. As such, QinetiQ designed blades made of composite materials that absorb radar waves, transforming them into heat, while a cladding was built around the towers and generators to make them invisible to radar. The structures were produced by wind turbine manufacturer Vestas.

QinetiQ is now looking at the broader market for other potential commercial applications that could benefit from stealth, including air traffic control and computer data centres. "Stealth is all about channelling energy and there many other potential uses," said Moore. "One of these is protecting computer data centres and communications to stop people eavesdropping on them."

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