Countries planning unified space-based ballistic missile warning system to counter ICBM threat and for strategic deterrence

The warning bells has ringed in US, as Kim has finally succeeded in developing an ICBM operational capability through which it can deliver a nuclear weapon anywhere in the United States, according to analysis based on Images released by North Korea. North Korea released dozens of photos and a video after 29 Nov launch of the new Hwasong-15 missile, and leader Kim Jong Un declared the country had “finally realized the great historic cause of completing the state nuclear force”. North Korea said the missile soared to an altitude of about 4,475 km (2,780 miles), more than 10 times the height of the International Space Station, and flew 950 km (590 miles) during its 53-minute flight before landing in the sea near Japan.

In response, US is strengthening its Ballistic Missile Defence capabilities including the Redesigned Kill Vehicle, the Multi-Object Kill Vehicle, the Configuration-3 booster, a space-based sensor layer, boost phase sensor and kill technologies and additional ground-based interceptors.”

Critical to missile defence is capability of well-organized missile warning system structure that allows commanders to maximize detection and warning of inbound ballistic missiles, thereby ensuring effective passive defense, active defense, and attack operations. Missile warning systems process raw sensor data into missile warning reports and disseminate the information to users globally. Missile warning consists of

multiple ground and space-based systems located worldwide.

The American missile warning mission uses a mix of space-based and terrestrial sensors. US's Space-based Infrared System (SBIRS) is a constellation of integrated satellites in geosynchronous orbit (GEO) and high elliptical orbit (HEO) and ground-based data processing and command and control centers.This system is designed to provide early missile warning, cue missile defenses, deliver technical intelligence (TECHINT), and support battlespace awareness. These satellites are equipped with IR sensors that track the hot plumes of the launches.

The National Defence Authorisation Act, a year-end policy bill also hinted that US will seek to use advanced technology to defeat both small-scale and large-scale nuclear attacks through "research, development, test and evaluation" of space-based systems for missile defence. The US exchanges missile detection and warning information with its multinational partners.

Russia and China are also pursuing space based missile defence solutions.

Space based missile warning

U.S. Missile Defense Agency must have a space-based sensor layer as part of its long-term plans to track ballistic missiles that could threaten the United States using a sensor in medium earth orbit, said Navy Vice Adm. James Syring, the head of the MDA, said the organization. "From a missile defense perspective, we have to develop a future operational space layer," Syring said. "Given where the threat is going with hypersonics and more ICBMs and so forth this persistent tracking and discrimination capability from space is a must."

Traditionally Ballistic Missile launches were detected by GSO . More recent US responses to ballistic missile threats,

involve creating capabilities to intercept and deal with the threat during the boost and mid-course phases of the missile trajectory. To perform these functions US is looking at a constellation of satellites in LEO and maybe in MEO to perform the mid-course and boost phase detection as early as possible after the missile is launched.

Space-sensors increase the lethality and effectiveness of Ground Based Interceptors (GBIs), "but also adds to the lethality and effectiveness of every other element of the BMDS" such as the Patriot missile defense system, the Terminal High Altitude Area Defense system and the Aegis system, Tom Karako, a missile defense analyst at the Center for Strategic and International Studies, said.

In 2013, an Aegis Standard Missile-3 Block IIB fired on the basis of tracking from space, using a satellite, "and as a result dramatically increased its defended area because the defended area is a function of the radars and where we are right now is the radars, the missile basically has longer legs than the radars do," Karako said. "Our defended area is held back not by the missile but by the sensors.

However space base missile defence face many challenges including discrimination of the warhead from the decoys and their continued tracking is a crucial requirement. Clouds, the sunlight and the moon are other sources of radiation that could corrupt the signal. The US Mid-Course Space Experiment collected signatures of various Re-entry Vehicles to build a data bank for the designing of suitable algorithms that help identify the RV from clutter, backgrounds and chaff.

The appropriations measure states that the US Missile Defence Agency would have the job of producing "a highly reliable and cost-effective" sensor architecture capable of "precision tracking of threat missiles," "discrimination of warheads" and "effective kill assessments".

Russia and China are also pursuing space based missile defence solutions.

Russia is pursuing unified space-based ballistic missile warning system, as was announced by Russian Defense Minister Sergei Shoigu. The system will help Russia detect moving targets at medium and high altitudes. Russia is fast tracking the deployment of such ballistic missile systems in response to the U.S.' aggressive rearmament program of its cruise missile.

The new generation satellites will ensure much quicker identification of ballistic missile launches by detecting their engines' exhaust plume in infrared light. The EKS-1 – the first such satellite of the unified space-based ballistic missile warning system was launched late 2015 by the Russian Aerospace Defense Forces.

China's super-secretive Communications Engineering Test Satellite -1 (TXJSSY-1) that was launched by from the Xichang Satellite Launch Center on 12 September 2015 was speculated for early warning of ballistic missiles. Rumors initially suggested that this launch involved the first Great Wall (Changcheng) satellite – a new series of Chinese satellites dedicated to early warning similar to the American Space Based Infra-Red Sensor satellites.

China Shijian 11 satellites, the first of them was launched in 2009 followed by three launches in 2011. Expert analysis of the pattern of coverage suggested a possible near continuous monitoring of Northern Canada and Alaska. A large field of view sensor (or a combination of smaller field of view overlapping sensors) may provide the desired large area coverage for detecting missile launches.

In December 2015 China also launched the Gaofen 4 satellite

into GSO (106 E) officially a civilian satellite used for the detection of hot spots in tropical storms. However given its reported stop and stare optical and IR sensors it could be the precursor for China's GSO based "Early Warning" satellite.

Japan's Kyodo News reported that China was building a missile defense system to detect a ballistic missile attack. The Kyodo News report was based on Chinese military documents that referred the development of an experimental early warning satellite program. Additionally the report pointed out that China had started the development of an X-band radar system as part of a ground-based interceptor system.

USA space sensor system

American space-based sensors, such as Defense Support Program and space-based infrared system, usually provide the first level of immediate missile detection. Some satellite sensors also accomplish nuclear detonation detection. Ground-based radars provide follow-on information on launches and confirmation of strategic attack. The majority of their day-to- day mission is space surveillance; however, the radars are always scanning the horizon for incoming missiles.

Once it detects significant activity, that information is transmitted to Air Force Space Command in Colorado and subsequently to North American Aerospace Defense Command (NORAD) and other relevant parts of the military who will decide whether the launch threatens the United States or its interests. Missile warning includes the notification to national leaders of a missile attack against North America, as well as attacks against multinational partners. It also includes notification to multinational partners and forward deployed personnel of missile attack.

The SBIRS architecture includes a resilient mix of satellites

in geosynchronous earth orbit (GEO), hosted payloads in HEO orbit, and ground hardware and software. The integrated system supports multiple missions simultaneously, while providing robust performance with global, persistent coverage.

The SBIRS program delivers timely, reliable and accurate missile warning and infrared surveillance information to key decision makers. The system enhances global missile launch detection capability, supports the nation’s ballistic missile defense system, expands the country’s technical intelligence gathering capacity and bolsters situational awareness for warfighters on the battlefield.

The constellation has a continuous view of all of the earth’s surface, which it images every 10 seconds while searching for infrared (IR) activity indicating heat signatures. SBIRS is able to detect missile launches faster than any other system and can identify the missile’s type, burnout velocity, trajectory, and point of impact.

Though the system was designed primarily for missile defense purposes, its short- and mid-wave IR sensors can detect any significant infrared event on the globe, including explosions, fires, and plane crashes.

This system is intended to replace the aging DSP system of satellites.SBIRS satellites are able to scan large swaths of territory to detect missile activity and can also hone in on areas of interest for lower-scale activities, including launches of tactical ballistic missiles. These sensors are independently tasked, meaning the satellite can both scan a wide territory and fixate on a particular area of concern simultaneously.

The first satellite, SBIRS GEO-1, launched in May 2011 and was followed in March 2013 by the SBIRS GEO-2 satellite.2 In July 2015, the Air Force delivered its third satellite, though it plans to store it and launch the fourth satellite first, which

is slated for an October 2016 launch.3 In addition to the dedicated satellites in GEO, the system also includes two missile warning sensors hosted on classified satellites in HEO that were launched in November 2006 and June 2008.

Defense Support Program satellites use an infrared sensor to detect heat from missile or booster plumes against the relatively cool background of the Earth's surface. These geosynchronous satellites that were designed to detect strategic ballistic missiles in the early stage of launch of their flights, have provided uninterrupted warning since the early 1970s.

Spacebased Kill Assessment, which would use sensors hosted onboard nondedicated commercial vehicles

The MDA is requesting $22 million next year for the Spacebased Kill Assessment experiment. The Spacebased Kill Assessment , the experimental network of space-based sensors that will fly into commercially hosted payloads that will verify whether incoming missiles have been destroyed by defensive interceptors and no longer pose a threat.

The Spacebased Kill Assessment consists of "a network of sensors, each mated to a different satellite; and the total number of sensors and where they are placed in the network are specifically tailored for the kill assessment mission," the MDA budget documents said.

The individual sensors house three infrared detectors used to collect the energy signature of the impact between a threat ballistic missile and an interceptor of the Ballistic Missile Defense System. The SKA experiment is currently in the satellite integration and testing phase and is expected to be on orbit in 2018.

Each sensor would weigh about 10 kilograms. John Hopkins University's Applied Physics Lab is developing the entire experiment.

Budget documents said the experiment follows a "precedent established by a United States Air Force experiment using a commercial satellite program as the platform host for a Department of Defense payload; thus taking full advantage of a multi-billion dollar space and ground system that already exists."The budget documents did not identify any host satellites, saying only that integration of the first sensors would begin in fiscal year 2016.

The Fiscal Year 2014 National Defense Authorization Act directed the Missile Defense Agency to address hit and kill assessment for the Ballistic Missile Defense System. An internal study on space highlighted strategies that could provide sensor capabilities at lower price points.

The first experimental missile-warning sensor, known as the Commercially Hosted Infrared Payload, or CHIRP, was launched aboard the SES-2 telecommunications satellite owned by fleet operator SES of Luxembourg. The program is widely viewed among government and industry officials as validation of the hosted payload concept.

Russia planning unified space-based ballistic missile warning system for strategic deterrence by 2020

Russia has started to develop a line of defense systems similar to the United States' Terminal High Altitude Area Defense (THAAD) and Ground-based Midcourse Defense (GMD) systems, local media reports announced. It is also planning to put in place an improved early warning system in space for detecting ballistic missile launches by 2020, a chief engineer

from the Russian defense corporation Almaz Antey said recently.

Russia had lost its last Oko-1 geostationary satellite of its missile attack warning system (MAWS) last year, which had impacted the capability of the country's strategic defense system, of which outer space segment was a critical part. To be fully operational, Oko-1 system needs four 73D6 satellites in placed in a highly elliptical orbit, dubbed 'Molnya' (lightning) orbit, to provide full-time coverage of the area of interest, and an additional backup satellite in a 71X6 geosynchronous orbit.

"MAWS are still fully operational, despite the fact that the geostationary satellites have been lost, as the Cosmos-2422 and Cosmos-2446 satellites, which operate in high orbits, are still running", according to Igor Lisov of trade magazine Cosmonautics News. According to Lisov, geostationary satellites and high-orbit satellites can typically compensate for one another.

The current early warning system can detect any launches from any direction from south or north or any other. It is impossible to commit any act of aggression without us finding out," Chief of Staff of the Main Centre for Missile Warning of the Russian Aerospace Forces, Colonel Viktor Tymoshenko said in an interview with radio RSN. According to him, the early warning system is constructed in such a way that it is 'multi-channeled' and can function on mass launches of dozens of ballistic missiles.

The first generation MAWS system was launched in 1982, when the first of four generations of 74D6 (US-K or Oko) satellites for high orbits was placed on alert. Experts believed that Russia's early warning system, unlike that of the United States, did not provide global coverage. Russian early warning satellites have traditionally monitored only U.S. territory.The second second-generation system, placed in 1991

of the Oko-1 (US-KMO) and 71X6 geostationary satellites was also able to record sea-based missile launches and determine their flight trajectory. According to Soviet officials its early warning satellites could detect missile launches within 20 seconds of lift-off.

The first satellite of it's new warning system, Known as 'product 14F142' is to be launched by a Soyuz-2.1b rocket and a Fregat third stage to a Tundra orbit – a highly elliptical orbit similar to Molnya, but with twice its period.

According to an RBTH source close to the Ministry of Defense, the lack of geostationary satellites is being compensated for by new horizon radar systems known as Voronezh-M and Voronezh-DM. Located in the Kaliningrad, Leningrad, Irkutsk, and Krasnodar regions, these stations operate in two frequency ranges: the meter range (Voronezh-M) and the decimeter range (Voronezh-DM). They create a radar field, which makes it possible to easily detect space objects and effectively prevent missile attacks.

The first early warning ground-based station for the new network has been built in the Altay region and it has passed state trial.The Russian Aerospace Forces are engaged in the centralized management of the air forces, air defense and missile defense, operation and supervision of spacecraft of the Russian orbital grouping. It is also responsible for the space control and early warning of missile attacks.

The Russian Defence Ministry considers the continuous and stable functioning of missile attack warning systems to be a crucial element of strategic deterrence.

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