

Impact of India's ISR Capabilities on South Asian Security Dynamics

Amjad Mahmood* and Adil Sultan**

Abstract

Intelligence, Surveillance and Reconnaissance (ISR) capabilities have grown exponentially over the past two decades. Almost all major powers are building their ISR potential for commercial and military purposes which has provided incentive for the other emerging powers such as India to follow suit and develop its own cross-domain ISR network. This is likely to adversely impact South Asian security environment where India and Pakistan, the two nuclear armed states, remain embroiled in a military competition and have experienced several serious military crises over the past many years. Acquisition of new ISR technologies could also provide incentive to India to exploit its apparent conventional military advantage against Pakistan and venture into a limited armed conflict in pursuit of its political objectives under a nuclear overhang. Owing to a long history of distrust such an attempt could quickly escalate conflict with the possibility of an all-out war including the potential for a nuclear exchange. This paper aims to discuss India's ambitious plan to upgrade its ISR capabilities in all the four domains of warfare, i.e. space, land, sea and air; the evolving India-US cooperation in sharing of data and its implications for Pakistan.

Keywords: Intelligence, Surveillance, Reconnaissance, India, Pakistan, Strategic Environment.

Introduction

The Intelligence, Surveillance and Reconnaissance (ISR)¹ capabilities have become an essential component of 'Informationised' warfare where these

*The author is a serving officer in Pakistan Air Force and is currently pursuing his PhD from National Defence University, Islamabad. Email: machzone@gmail.com

**The author is a Acting Dean/ HoD, Faculty of Aerospace and Strategic Studies, Air University Islamabad. Email: adilsultan66@gmail.com

technologies form the basis for developing national security plan. Real-time (RT) or near-real-time (NRT) information acquired through ISR platforms plays an important role in the formulation of military strategy, planning and conducting operations besides identifying adversary's strategic, operational and tactical centres of gravity.² Almost all militaries around the world are engaged in modernising their ISR capabilities that are considered vital for optimal utilisation of military assets to achieve the overall political objectives.

In South Asia due to a long history of disputes and conflicts, and the fact that a crisis between the two nuclear armed neighbours could quickly escalate to an all-out war with the possibility of nuclear exchange, the induction of new ISR technologies could have both stabilising and destabilising effect. On one hand, it could incentivise an aggressor state to launch a limited military offensive or a preemptive conventional or nuclear strike, while at the same time this could lead to wrong signalling, especially if the other side is not able to clearly interpret the information gleaned from the ISR platforms.

In South Asia, India with large size of its economy and significant military capability, retains its influence over its smaller neighbours such as Nepal, Bhutan, Maldives, Bangladesh, Sri Lanka and Myanmar, while Pakistan continues to challenge India's desire to become a regional hegemon. Both countries have longstanding disputes over Kashmir, water and other territorial issues that continue to keep the region under stress. The border clashes over the past few years between India-Pakistan and India-China, have exposed India's limitations in the ISR domain,³ forcing its military and political leadership to overcome these shortfalls by acquiring new technologies and signing information sharing agreements with the US and other western countries.

¹ In military terminology, ISR was coined in the 1990s (mainly by the US Department of Defence) and gained momentum as an enabler for ideas such as Revolution in Military Affairs.

² DOD Dictionary of Military and Associated Terms, <https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf>

³ Brookings India Think Tank Panel Discussion on "20 Years After Kargil: Military Operations, Perceptions, and Decision-Making," <https://www.brookings.edu/events/20-years-after-kargil-military-operations-perceptions-and-decision-making-2/>. Also see SumitGanguly and Frank O'Dennell, "China is Taking Advantage of India's Intelligence Failures," Foreign Policy, <https://foreignpolicy.com/2020/08/27/india-china-galwan-intelligence-failure/>

China's rise as a major competitor to the US and India's willingness to play a leading role in the US-led China containment strategy has encouraged several western powers to assist India in its military modernisation plans, including the ISR capabilities that could have direct bearing on strategic stability in South Asia. It is, therefore, important to critically analyse India's ISR capabilities in space, land, air, and maritime domains and what are the emerging trends and how it could impact Pakistan's security interests in the near to long term.

India's Evolving ISR Network

India has emerged as a major economic and military power in South Asia.⁴ Apart from being the second largest weapon importer in the world, it is also developing indigenous weapon systems of various types. India is now in the process of transforming its ISR force structure into a modern and robust strategic warning system which consists of information gathering satellites, an expanding fleet of airborne platforms, and ground-based sensors.⁵ Over the last two decades, the Indian Space Research Organization (ISRO) has achieved noteworthy progress in the development of space systems with Space Situational Awareness (SSA) and Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) as its main pillars. India is also preparing to upgrade its satellite building capacity from intermediate/medium class to heavier class satellites.⁶ All these advancements in satellite technology have enabled India to progress towards dedicated military satellite networks, such as an ELINT (Electronic Intelligence) cluster,⁷ satellite applications for Geo-

⁴ "The World's Top 5 Largest Economies in 2024," *Focus Economics*,

<https://www.focus-economics.com/blog/the-largest-economies-in-the-world>

⁵ Muhammad Jawad Hashmi and Sultan Mubariz Khan "Emerging Network Centric Warfare Capabilities of Indian Military: Challenges for Pakistan's Security,"

Margalla Papers, vol. XXIII, issue no. 2 (2019),

https://ndu.edu.pk/issra/issra_pub/articles/margallapaper/margallapapers2019issueii/04-Emerging-Network.pdf

⁶ Venkatesan Sundararajan "Economic & Performance Analysis of Indian Space Transportation System," Aerospace Research Central (ARC), June 26, 2012,

<https://arc.aiaa.org/doi/10.2514/6.2010-8708>

⁷ Rajesh Uppal, "Countries Advancing Satellite ELINT/COMINT Constellations,"

IDST, August 2, 2019, <https://idstch.com/space/countries-advancing-elint-comint-satellite-constellations-counteracting-adversary-military-radars-communications/>

spatial Intelligence (GEOINT),⁸ Communication, Early Warning, Navigation, Search & Rescue, Space Control, some of which could be useful for its ambition to build a robust Ballistic Missile Defence (BMD) system. These developments combined together may have led to strategic imbalance between Pakistan and India while adversely affecting former's security⁹ and could even encourage India to contemplate launching preemptive strikes against Pakistan's nuclear installations and delivery systems with catastrophic consequences.¹⁰

India is rapidly modernising its military. Since 2000, its defence budget has increased exponentially from US\$ 8.26 Billion to US\$64.1 Billion for the year 2020-21.¹¹ On the other hand, Pakistan's military spending for 2019-20 stands at US\$7.6 Billion.¹² India is also the world's second-largest buyer of conventional weapons with plans to spend US\$130 billion on the modernisation of its defence forces over the next five years.¹³ India is also buying weapons and acquiring technology from countries like France, US, Russia and Israel, to augment its military's Intelligence, Surveillance & Reconnaissance (ISR), precision-strike, and command and control capabilities which are cornerstone of Revolution in Military Affairs (RMA).¹⁴ For this purpose, it has made huge investments in satellites, unmanned aerial vehicles (UAVs), radars, airborne early warning systems, Electronic Warfare (EW) and other ISR sensors which reflects India's desire to dominate the ISR spectrum.¹⁵

⁸ As per US Code, Geospatial intelligence (GEOINT) is about the human activity on earth derived from the exploitation and analysis of imagery and geospatial information.

⁹ Malcom Davis "South Asia and Space Security," *Taylor & Francis*, February 12, 2019, <https://www.tandfonline.com/doi/abs/10.1080/14777622.2019.1578935>

¹⁰ Christopher Clary and Vipin Narang, "India's New Nuclear Thinking: Counterforce, Crises, and Consequences," Belfer Centre, May 24, 2019, <https://www.belfercenter.org/publication/indias-new-nuclear-thinking-counterforce-crises-and-consequences>

¹¹ "SIPRI Military Expenditure Database," <https://www.sipri.org/databases/milex>

¹² "SIPRI Military Expenditure Database," <https://www.sipri.org/databases/milex>

¹³ "SIPRI Military Expenditure Database," <https://www.sipri.org/databases/milex>

¹⁴ As per US DoD, RMA is a hypothesis in military theory about the future of warfare often connected to technological and organisational recommendations for military reform.

¹⁵ Christopher Clary and Vipin Narang, "India's New Nuclear Thinking: Counterforce, Crises, and Consequences," Belfer Center, May 24, 2019,

Table No. 1
Indian Defence Budget (2020-21)

Indian Def Budget ¹⁶	2000	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
USD (in Billion)	26	49	51	51	56	58	57.9	60.8	64.1

Source: *Military Balance, The International Institute for Strategic Studies & SIPRI Military Expenditure Database*

India's Space Based Capability

India's space strategy or architecture can be fairly estimated through various publications by Indian military think tanks apart from Indian space ventures. From some of the published literature it appears that India is pursuing ambitious yet workable space strategy¹⁷ which includes development of space-based C4ISR¹⁸ assets complemented by ground-based Space Situational Awareness (SSA) components.¹⁹ India's space architecture comprises of the following components:²⁰

<https://www.belfercenter.org/publication/indias-new-nuclear-thinking-counterforce-crises-and-consequences>

¹⁶ "The Military Balance 2021," *The International Institute for Strategic Studies* (IISS) London,

<https://hostnezt.com/cssfiles/currentaffairs/The%20Military%20Balance%202021.pdf>

¹⁷ S. Chandrashekar, "Space, War & Security — A Strategy for India," December 2015, International Strategic & Security Studies Program (ISSSP) National Institute of Advanced Studies Bengaluru, http://issp.in/wp-content/uploads/2016/03/Space-War-and-Security-_A-Strategy-for-India.pdf

¹⁸ C4ISR is an acronym used by the US Department of Defence, US intelligence agencies and the defence community.

¹⁹ As per John A Kennewell, Space Situational Awareness (SSA) refers to a knowledge of our near-space environment including both natural and man-made components. A wide variety of SSA sensors, data fusion techniques, data display methods etc. are required.

²⁰ S. Chandrashekar, "Space, War & Security — A Strategy for India," December 2015, International Strategic & Security Studies Program (ISSSP), National Institute of Advanced Studies Bengaluru, 95, <http://issp.in/wp-content/uploads/2016/03/Space-War-and-Security-A-Strategy-for-India.pdf>

- i. Advanced communications satellites in Geostationary Orbit (GSO) for carrying out vital C4 (Command, Control, Communications, & Computers) functions by four satellites.
- ii. Electro-optical (EO) and Synthetic Aperture Radar (SAR) satellites in appropriate Sun-Synchronous Orbits (SSO) for meeting ISR needs. It will be provided by a constellation of 12 satellites.
- iii. Electronic Intelligence (ELINT) functions by three clusters of 03 satellites.
- iv. Military Internet providing satellites in Low Earth Orbit (LEO) with a constellation of 40 satellites.
- v. Small satellites in Low Earth Orbit (LEO) for meeting ISR needs during times of crisis. It will be provided by a constellation of 24 satellites.
- vi. Three Tracking & Data Relay Satellite (TDRSS) satellites in Geostationary Orbit GSO for performing tracking and data relay functions needed for a C4ISR capability.
- vii. Two satellites in Geostationary Orbit (GSO) along with 3 satellites in Sun-Synchronous Orbits (SSO) for fulfilling operational weather needs.
- viii. Seven satellites in Geostationary and Geosynchronous Orbits for navigation applications. Also extending the Indian Regional Navigation Satellite System (IRNSS) scheme to 24 satellite constellation in Medium Earth Orbit (MEO) for providing an indigenous navigation solution.
- ix. The integration of the various Space Situational Awareness (SSA) and C4ISR capabilities into a seamless network would be the key.

India's space programme is managed by the Indian Space Research Organization (ISRO). Major programs of space systems include the Indian

National Satellite System (INSAT),²¹ Indian Remote Sensing satellites (IRS),²² Radar Imaging Satellites (RISAT),²³ Meteorological Satellites, Commercial Satellites, GAGAN Satellite Navigation System and ISRO Nano Satellites (INS). To-date India has launched 122 satellites so far²⁴ of many types since 1975. Important satellites of military significance are shown in the tables below.

Table No. 2
Radar Imaging/ Remote Sensing Satellite Programme (in operation)

Satellite	Type	Sensor	Resolution	Purpose	Origin	Band	Coverage
RISAT-2B	Radar Imaging	Active SAR	1 meter	Military surveillance	Israeli Origin TECSAR-1 system	X Band	-
RISAT-2BR1	-"-	-"-	0.3 meter	-"-	Israeli Origin TECSAR-1 system	X Band	-
RISAT 2A (Future)	-"-	-"-	0.25 m to 13.5 m	-"-	Indian	X Band	450 Km

Source: eoPortal Directory (Sharing Earth Observation Resources), Radar Imaging / Remote Sensing Satellite Program (in operation)²⁵

²¹ INSAT is a series of multipurpose geostationary satellites for the telecommunications, broadcasting, meteorology and surveillance. INSAT is the largest domestic communication system in the Asia-Pacific Region.

²² IRS is a series of earth observation satellites.

²³ Synthetic Aperture Radar payload.

²⁴ Department of Space, Indian Space Research Organization, <https://www.isro.gov.in/list-of-spacecrafts>

²⁵ Department of Space, Indian Space Research Organization.

Table No.3
Cartosat Series Remote Sensing Satellites (in operation)

Satellite	Type	Sensor	Resolution	Purpose / Features
Cartosat-1	Remote sensing	PAN Cameras	2.5 meter	Stereoscopic Earth observation Generates 3D Maps
Cartosat-2	-"-	-"-	Less than 01 m	Scene specific spot imagery
Cartosat-2A	-"-	-"-	0.8 meter	Dedicated for military use Highly agile 45 deg steering
Cartosat-2B	-"-	-"-	Less than 01 m 9.6 Km swath	Scene specific spot imagery 26 deg steerable
Cartosat-2 C,D,E&F	-"-	Multispectral camera	0.6 meter (Cartosat-2D)	Better resolution Highly agile 45 deg steering
Cartosat-3	-"-	PAN, Multispectral &Hyperspectral	0.25 m with a 16 Km swath	World's highest resolution Highly Agile/dual gimble High rate data handling & transmission

*Source: eoPortal Directory (Sharing Earth Observation Resources), Cartosat Series Remote Sensing Satellites (in operation)*²⁶

Resource Series Satellites (Remote Sensing)

Resource satellites are used for earth observation and they provide continued remote sensing data services for integrated land and water resources management. India's ResourceSat-1 carries three cameras, a resolution of 5.8 meters, and swath coverage of 23 km, whereas ResourceSat-2 is an improved version with swath coverage of 70 km and three-tier imaging capability.²⁷ ResourceSat-2A is a follow on version for continuity of data. ResourceSat-3 series are high-resolution satellites that would follow the 2A series in the future.²⁸

²⁶ Department of Space, Indian Space Research Organisation.

²⁷ Department of Space, Indian Space Research Organisation.

²⁸ Department of Space, Indian Space Research Organisation.

Communication Satellites Program

- a) *Communication-Centric Intelligence Satellite (CCI-Sat)*: India revealed the CCI-Sat project in February 2010.²⁹ It is claimed that this spy satellite will incorporate smart sensors to intercept communications and conversations across the borders. The satellite was scheduled for launch in 2020.³⁰
- b) *GSAT Series*: India is operating GSAT-8,12,10,7,14,16,6, 15,18,19,17,29,11,7A&31 satellites (in the order of launch).³¹ These satellites are used for a variety of communication and navigational purposes. GSAT-7 is a dedicated naval satellite which facilitates naval communication and network-centric warfare.³² GSAT-7A is dedicated to Indian Air Force and Army, meant to inter-link different radar stations, airbase, aerial platforms (AWACS, UAVs, other aircraft), and real-time control systems.³³ The satellite will enhance the network-centric capability of the Indian Air Force and Army.
- c) *INSAT Series*: **INSAT-2E** is a multi-purpose satellite for telecom, TV broadcasting, and meteorological services. It features a Very High-Resolution Radiometer (VHRR) and Charge Coupled Device (CCD) camera with a 1 km resolution. INSAT-3C is intended to continue the services of INSAT-2DT and INSAT-2C which are retired. INSAT-3D is a meteorological satellite and only contain SAR payload. **INSAT-4 A, B & C** are dedicated to telecom with 12 Ku band and 12 C-band transponders each. Their coverage zone is the Indian sub-continent.³⁴

²⁹ "India to Build Intelligent Satellite," *Nation*, February 10, 2010, <https://nation.com.pk/10-Feb-2010/india-to-build-intelligent-satellite>

³⁰ "India to Build Intelligent Satellite."

³¹ Department of Space, Indian Space Research Organization, <https://www.isro.gov.in/list-of-spacecrafts>

³² Kartik Bommakanti, "Strengthening the C4ISR Capabilities of India's Armed Forces: The Role of Small Satellites," *Observer Research Foundation (ORF)*, June 15, 2020, <https://www.orfonline.org/research/strengthening-the-c4isr-capabilities-of-indias-armed-forces-the-role-of-small-satellites-67842/>

³³ Bommakanti, "Strengthening the C4ISR Capabilities of India's Armed Forces."

³⁴ Bommakanti, "Strengthening the C4ISR Capabilities of India's Armed Forces."

Navigation Satellite Programme

India is developing her own Satellite-Based Regional GPS Augmentation System. The system is known as GAGAN (GPS Aided GEO Augmented Navigation). The GAGAN navigation payload has been launched through seven Indian Region Navigation Satellite System (IRNSS) series satellites starting from early 2013. IRNSS-1A being first in the row was launched in the same year. Later IRNSS-1B, C, D, E, F, G & I were successfully launched from 2014 to 2018. The system will be used for secure navigation and weapon guidance in addition to commercial use.³⁵

Electronic Intelligence Satellites EMISAT: EMISAT is an Indian reconnaissance satellite which is meant to provide space-based electronic intelligence to enhance the SA of the Indian military forces by identifying and locating enemy radars.³⁶ It carries “*Kautilya*”³⁷ (an ELINT package) instrumentation to detect, locate and characterise electromagnetic signals.

Indian Air Force ISR Capabilities: Indian Air Force (IAF) appears to be emulating the United States (US) to operate ISR forces at every altitude. IAF started ISR activities right from its birth with Canberra PR-57 reconnaissance aircraft. Now, India is indigenising and acquiring airframes of various sizes to carry ISR systems. Key features of IAF’s ISR capability include:

- a) The IAF at present has two types of Airborne Early Warning Systems (AWACS / AEW&C).³⁸ AWACS systems. First, the Phalcon Airborne Warning and Control Systems (AWACS)

³⁵ Mrinal Goswami, RowdraGhatak, Anindya Bose, “Global Navigation Satellite Systems and Indian Defence Research — A Review,” *IEEE Xplore*, February 2019, <https://ieeexplore.ieee.org/document/9069614>

³⁶ “EMISAT (Electromagnetic Intelligence-gathering Satellite),” *eoPortal Directory*, <https://directory.eoportal.org/web/eoportal/satellite-missions/content/-/article/emisat>

³⁷ As per Indian MoD’s annual report of 2013-14, *Kautilya* is a space borne ELINT System project that involves the development of Electronic Intelligence payload for integration on an indigenous mini satellite.

³⁸ Airborne Early Warning & Control System (AEW&C), is a force multiplier system of systems for detecting & tracking of enemy/hostile aircrafts/ UAVs etc. It also enables operators onboard and on ground to identify, assess the threat and take actions to guide our interceptors to those for neutralizing those threats, <https://www.drdo.gov.in/airborne-early-warning-and-control-awec>

acquired from Israel and installed on Russian IL-76 aircraft. It is the core thrust of India's ISR capability.³⁹ The system can perform aerial surveillance up to 500 km along with electronic and communications intelligence. India has three such aircraft while another two are on order. Secondly, IAF also operates an indigenous AWCAS system mounted on a Brazilian Embraer-145 aircraft.⁴⁰ It has a phased array system with a range of 200-250 Km and 240 degrees scanning capability.⁴¹ IAF has commissioned two such systems whereas one more is under production.

- b) India plans to include development of indigenous Next-Generation AWACS and the acquisition of "special mission" jets; possibly Embraer or Beechcraft,⁴² outfitted with microprocessor-based high-performance aerial survey cameras, cyber and EW technologies. Next-Generation AWACS would be installed on Airbus A-330 with a 360-degree scan AESA⁴³ radar. It would also be utilised in a dual role as an air-to-air refueller. The system is expected to be effective against aerial threats (aircraft, UAVs, cruise missiles) with a range of 400-450 Km.⁴⁴
- c) Integrated Air Command and Control System (IACCS). The IAF is developing a network-centric warfare system known as the Integrated Air Command and Control System (IACCS) by state-owned Bharat Electronics Ltd (BEL).⁴⁵ The system would integrate data from a variety of radars, mobile observers, Air

³⁹ Chris Dougherty, "Force Development Options for India by 2030," *Centre for New American Security*, October 23, 2019, <https://www.cnas.org/publications/reports/force-development-options-for-india-by-2030>

⁴⁰ Dougherty, "Force Development Options for India by 2030."

⁴¹ Dougherty, "Force Development Options for India by 2030."

⁴² Kiran Moodley, "Small Planes, Big Fight: Beechcraft vs Brazil's Embraer," *CNBC*, June 24, 2013, <https://www.cnn.com/id/100830777>

⁴³ "Active Electronically Scanned Array," https://en.wikipedia.org/wiki/Active_electronically_scanned_array

⁴⁴ Dougherty, "Force Development Options for India by 2030," <https://www.cnas.org/publications/reports/force-development-options-for-india-by-2030>

⁴⁵ Hashmi and Khan "Emerging Network Centric Warfare Capabilities of Indian Military: Challenges for Pakistan's Security."

Force bases, and other agencies to create a real-time comprehensive picture. It will also provide automation for the planning and execution of air operations

- d) Ground-based Radars/Airborne Radars /ISR Pods. IAF also operates numerous high, medium and low-level radars including balloon hoisted Aerostat low-level radars. Moreover, fighter aircraft such as Rafale, SU-30MKI, Mig-29, Mirage 2000, Teja, Mig-21 and Jaguar with their airborne radars and ISR pods can also perform the surveillance of air space and reconnaissance of ground objects at varying degrees and levels. By the end of 2020, India will also operationalise the S-400 Missile system. Its radar is capable of targeting and detection up to 400 Km.⁴⁶

Indian Army ISR Capabilities

In the Indian Army's modernisation plans, ISR has been placed as an integral part of the Command and Control structure with the network-centric capability and secure communication networks⁴⁷. At the operational level, the Indian Army ISR structure includes the concept of Force Multiplier Command Post (FMCP).⁴⁸ It receives and processes information acquired through different sensors at Corps HQ and then disseminates it to the lower formation HQs. Corps HQs have also established the Defence Image Processing and Analysis Centre (DIPAC)⁴⁹ for satellite imageries. Additionally, Battlefield Surveillance System (BSS)⁵⁰ is under development for data fusion through different sensors. Presently, the Indian Army uses a variety of sensors and EW equipment such as LORROS (Long-range rece

⁴⁶ Dougherty, "Force Development Options for India by 2030," Centre for New American Security, October 23, 2019, <https://www.cnas.org/publications/reports/force-development-options-for-india-by-2030>

⁴⁷ Masood Ur Rehman, "Indian Military Modernisation: Implications for Pakistan," *Strategic Studies*, vol. 39, no. 1 (Spring 2019): 20-40, Institute of Strategic Studies Islamabad.

⁴⁸ Rehman, "Indian Military Modernisation: Implications for Pakistan."

⁴⁹ Ajey Lele "First Step to Credible Space Warfare Capability," *IDI* (Indian Defence Industries), June 16, 2019, <https://indiandefenceindustries.in/first-step-space-warfare>

⁵⁰ Dougherty, "Force Development Options for India by 2030."

& observation system),⁵¹ Battlefield surveillance radars, *Samyukta*⁵² Electronic warfare system, etc.

India's Maritime ISR

Indian Navy (IN) has a desire of acquiring overlapping capabilities of sea control in the Indian Ocean and power projection beyond the Indian Ocean in the Pacific.⁵³ Consequently, IN has set up a Maritime Domain Awareness (MDA) system,⁵⁴ by an integrated network of sensors. IN has plans to expand MDA by including the surface, subsurface, air, and cyber realms.⁵⁵ This multi-domain awareness would include networks of fixed and mobile sensors that provide surveillance of areas of interest, and incorporates the ability to fuse, integrate, and distribute the resulting operational information.⁵⁶ A multi-domain common operational picture (COP) would also be part of the ongoing innovation. India has also developed "Indian Maritime Situational Awareness System (IMSAS)"⁵⁷ that aims at providing a comprehensive situational picture to commanders at the shore, fleet as well as platform levels.⁵⁸ Maritime ISR capabilities have undergone a quantum jump. Main ISR aerial platforms held by IN include US origin P-8Is equipped with multiple sensors to perform long-range maritime reconnaissance and anti-submarine warfare, IL-38SD MPA, and anti-submarine warfare aircraft, Dornier 228 MPA and *Tupolev Tu-142MKE*

⁵¹ Dougherty, "Force Development Options for India by 2030."

⁵² As per Indian DARDO, *Samyukta* is a mobile integrated electronic warfare system developed jointly by DRDO, Bharat Electronics Limited, Electronics Corporation of India Limited and Corps of Signals of Indian Army.

⁵³ Ben Dolven and Bruce Vaughn "Indo-Pacific Strategies of US Allies and Partners: Issue for Congress," *Congressional Research Service*, January 30, 2020, https://www.everycrsreport.com/files/20200130_R46217_770a61c4856a9a5aed99d6699f3423b6240ff1c3.pdf

⁵⁴ David Brewster, "India and China at Sea: Competition for Naval Dominance in the Indian Ocean," *Oxford Scholarship Online*, May 2018, <https://oxford.universitypressscholarship.com/view/10.1093/oso/9780199479337.001.0001/oso-9780199479337>

⁵⁵ Aman Thakker, "A Rising India in the Indian Ocean Needs a Strong Navy," *Center of Strategic and International Studies (CSIS)*, June 2016, <https://www.csis.org/npfp/rising-india-indian-ocean-needs-strong-navy>

⁵⁶ Thakker, "A Rising India in the Indian Ocean Needs a Strong Navy."

⁵⁷ Defence Research and Development Organization (DRDO), <https://www.drdo.gov.in/technology-cluster/about-us/med-and-computational-systems>

⁵⁸ Defence Research and Development Organization (DRDO).

reconnaissance aircraft. Other Indian Navy ISR sensors include Super Vision-2000/XV-2004 airborne 3D naval surveillance radar (to be fitted to the Advanced Light Helicopter, Navy's Do-228's, Ka-25's and light transport aircraft with detection range over 100 nautical miles), *Revathi* 3D Central Acquisition Radar with a range of more than 180 km, Underwater maritime patrol and reconnaissance vehicles (under development), etc.⁵⁹

Unmanned Aerial Systems

Indian military realised the need for Unmanned Aerial Vehicle (UAV) based ISR to bridge the gaps in effective aerial surveillance and real-time ISR.⁶⁰ Indian defence forces have finalised a plan to procure more than 5,000 UAVs over the next 10 years for about US \$3 billion.⁶¹ With this planning, the Indian Army will field Unmanned Aerial Systems (UAS) units supporting every battalion of the Mountain Strike Corps. Indian Navy will expand its inventory to enhance maritime ISR, search and coastal security and the Indian Air Force is also expected to expand on the use of UAS carrying heavier payloads for long missions.⁶² The Aeronautical Development Establishment (ADE) in Defence Research and Development Organisation (DRDO) is developing indigenous unmanned systems capabilities including *Nishant*,⁶³ *Rustom-I/II*,⁶⁴ and *Netra*.⁶⁵ The Indian armed forces have also initiated the procurement of Israeli unmanned

⁵⁹ Abhijit Singh "Unmanned and Autonomous Vehicles and Future Maritime Operations in Littoral Asia", *Observer Research Foundation*(ORF), Jul 28, 2016, <https://www.orfonline.org/research/unmanned-and-autonomous-vehicles-and-future-maritime-operations-in-littoral-asia/>

⁶⁰ Aditi Malhotra and Rammohan Viswesh, "Taking to the Skies – China and India's Quest for UAVs," *Journal of the Indian Ocean Region*, vol.10, issue no. 2 (2014), <https://www.tandfonline.com/doi/abs/10.1080/19480881.2014.957082>

⁶¹ Vivek Raghuvanshi, "India Finalises US\$3B Blueprint for UAV Fleets," *Defence News*, March 20, 2016, <https://www.defensenews.com/air/2016/03/20/india-finalizes-3b-blueprint-for-uav-fleets/>

⁶² Malhotra and Viswesh, "Taking to the Skies – China and India's Quest for UAVs."

⁶³ Nishant is a tactical UAV with EO/IR payload / 4.5 hours endurance, <https://www.globalsecurity.org/military/world/india/nishant.htm>

⁶⁴ Rustom I/II will be medium altitude long range (MALE) UAV with multiple sensors / 14 hours endurance, <https://www.airforce-technology.com/projects/rustom-ii-male-unmanned-aerial-vehicle-uav/>

⁶⁵ Netra is a tactical UAV with Optical/TV sensors, <https://www.ideaforge.co.in/drones/netra-v-series-uav/>

systems of different types including *Searcher I/II*,⁶⁶ *Heron I*,⁶⁷ etc. India is also considering the *Super Heron* and *Heron TP* from Israel.⁶⁸ These UAVs can carry electro-optical payloads and data links supporting new high definition standards in the visual and infrared bands.⁶⁹ Other payloads would include signals intelligence, synthetic aperture and surface search maritime radars for maritime surveillance.⁷⁰ Indian UVAs fall in Medium Altitude Long Endurance (MALE) and tactical UAVs categories. India also has plans to develop High Altitude Long Endurance (HALE) class UAVs.⁷¹

Emerging Trends

Data fusion, integration of various sensors, AI-based prioritising, and command and control are emerging trends in the Indian ISR efforts. In this regard, a meaningful effort was initiated through the National Battle space Awareness project-72 meant to enable seamless sharing of all national ISR data to ensure unified coverage of the areas of interest. After its inception in the early 2000s, it is expected that India has made worthwhile progress to integrate ISR networks. Such integration would ensure the flow of information well beyond the platforms, sensors and crews conducting these missions. However, despite the presence of such systems, well-trained analysts will still be required for the interpretation of useful intelligence. India is also developing a tri-system radar fingerprinting system which would provide India much needed jointness in the electronic realm. The three services are also building an overarching defence communication

⁶⁶ Searcher I/II is a MALE UAV with modern sensors to be used for ELINT/SIGINT, <https://www.israeli-weapons.com/weapons/aircraft/uav/searcher2/Searcher2.html>

⁶⁷ Heron-I is a MALE UAV with multiple sensors / 1000 Km range, <https://theprint.in/defence/heron-searcher-sea-guardian-switch-the-many-uavs-that-make-up-indias-drone-arsenal/709670/>

⁶⁸ Super Heron and Heron TP are Israeli origin MALE UAVs with multiple sensors / weapon payload, <https://www.timesofisrael.com/israeli-company-unveils-new-super-heron-drone/>

⁶⁹ Malhotra and Viswesh, "Taking to the Skies – China and India's Quest for UAVs."

⁷⁰ Malhotra and Viswesh, "Taking to the Skies – China and India's quest for UAVs."

⁷¹ "HAL to Make Advanced Armed UAVs with Israeli Co," *Economic Times*, February 3, 2020.

⁷² "Indian Army Doctrine," First Edition (2004), <https://www.files.ethz.ch/isn/157030/India%202004.pdf>

network (DCN)⁷³ which will enable simultaneous conduct of real-time networked operations from multiple sites; hence providing redundancy against contingencies.

After realising the hefty cost and need for secrecy associated with the ISR systems, India has decided to follow indigenisation and to use modern technology in the form of miniaturised smart antennas with shared aperture systems and quasi-optical radiators. India is also stepping into Micro-electromechanical systems (MEMS) that are extremely efficient and produce high power output per given volume. With their compact design, lighter weight, lower power requirements, and longer ranges these systems would be ideally suited for airborne and space-based platforms and revolutionising the ISR technology.

Communications Compatibility and Security Agreement

India and the US signed the Communications Compatibility and Security Agreement (COMCASA) which was signed on September 6, 2018 during the maiden 2+2 ministerial meeting between India and the US. It is pertinent to mention here that COMCASA deals with secure military communication.⁷⁴ COMCASA is one of the foundational agreements that the US signs with its close allies to facilitate interoperability between militaries and the provision of high-end technologies. The US and India signed this in 2018 allowing both sides to operate same communication systems. India now has access to sensitive communication equipment and real-time operational information from the US space-based assets, some of which is also installed on US aircraft such as C-17, C-130, P-8Is, etc. This would help India in improved battlefield situation awareness through sharing of intelligence and real-time imagery.

⁷³ DCN is satellite based secure network to ensure network centricity across the three services, Integrated Defence Staff (IDS) and the Strategic Forces Command (SFC), <https://www.gktoday.in/topic/indias-integrated-defence-communication-network-dcn/>

⁷⁴ Adil Sultan, "India-US Basic Exchange and Cooperation Agreement (BECA)," STRAFASIA, October 28, 2020, <https://strafasia.com/india-us-basic-exchange-and-cooperation-agreement-beca/>

Basic Exchange and Cooperation Agreement (BECA)

Basic Exchange and Cooperation Agreement (BECA) was signed between the US and India on October 27, 2020 which along with earlier signed agreements of the Logistic Exchange Memorandum of Agreement (LEMOA) and COMCASA furthered the deep-rooted military cooperation between the two states. BECA will enable the partners to share high-end military technology, satellite data and critical information. It will help India get real-time access to the US geospatial intelligence that will enhance the accuracy of automated systems and weapons like missiles including the newly acquired S-400 surface to air missile defense system, and armed drones.

Through this agreement, information sharing on maps and satellite images as well as availability of military grade coordinates to India will be possible. In essence, this information will be quite useful to accurately direct missiles and air-launched weapons at locations in neighbouring countries. Given the geopolitical situation, BECA would be relevant for both western and northern borders of India, providing Indian military systems with a high-quality GPS to navigate missiles with real-time intelligence to precisely target the adversary.

Implications for Pakistan

Impact of India's Space Programme.

The Indian space programme has made a big gateway since its inception. With the deployment of 104 satellites in a single launch, India set a world record in 2017.⁷⁵ India's significant advantage in the space domain allows it to employ it for ISR in the shape of dual-purpose civil-military satellites as well as dedicated military ELINT satellites cluster. Indian space program can be analysed as follows:

- a) Indian Defence Imagery Processing and Analysis Centers (DIPAC) are established in Corps HQs and control Indian Satellite-based image acquisition. DIPAC would augment

⁷⁵ Samantha Mathewson, "India Launches Record-Breaking 104 Satellites on Single Rocket," *Space.com*, February 15, 2017, <https://www.space.com/35709-india-rocket-launches-record-104-satellites.html>

Indian geospatial intelligence (GEOINT) and improve the responsiveness of Indian military forces. Integration of satellite applications with Indian military operations would enable critical functions of early warning, operational environment awareness, mission planning, command and control, target intelligence, navigation, communication, search and rescue, space control, and ballistic missile defence (BMD).

- b) With satellite-based sensors, India has round the clock coverage of Pakistan's conventional and strategic installations, disposition of forces, real-time ISR and secure communication to disseminate data and command to cruise missiles. This dynamic space program has created a strategic imbalance between Pakistan and India in South Asia and brought higher risks to Pakistan's security. After the commissioning of a fully matured space-based ISR system, the Indian military would be more confident to consider the launching of preemptive strikes against Pakistan's nuclear installations and delivery systems. Consequently, Pakistan's surface to surface Missiles (SSMs) launching sites and other nuclear delivery systems will be vulnerable to constant detection and monitoring. Similarly, with the extension of the space program and collaboration with the US, Israel, and France space technologies, India would further expand its ISR capabilities.
- c) The naval satellite (GSAT-7) will significantly improve India's maritime security, communication, and intelligence gathering in a wide swathe on the eastern and western flanks of the Indian Ocean region; posing a constant threat to Pakistan's maritime assets. The dedicated Air Force and Army satellite (GSAT-7A) will supplement Indian Air Force operations by linking up with the AWACS and other ground and air-based sensors. Its data could also be used for applications in the Land Information System (LIS) and Geographical Information System (GIS) for military use. India's dedicated meteorological satellites in geosynchronous orbit (GSO) are also capable of military use by supporting C4ISR operations.

- d) Indian remote sensing satellites mostly carry SAR & optical payloads that can provide sufficient geographical observation; however, for precise target identification and subsequent engagement, multispectral or integrated sensors are mandatory which is lacking in India's inventory and this deficiency has to be addressed by the employment of UAVs and other aerial platforms.

Early Warning and Force Multipliers

The Indian Air Force with a variety of ISR platforms and early warning capability has emerged as the leader for strategic and operational ISR requirements. The airborne early warning provided by AWACS is essential for air defence and situational awareness. The AWACS will not only prevent nasty surprises but also act as a force multiplier to support the IAF offensive operations across borders and improve the survivability of forces participating in operations.

India's UAVs have provided the economic solution to ISR requirements, owing to comparatively low cost, long loiter time and ability to conduct ISR over enemy territory without any risk of loss of life. India has also embarked on adding satellite communications in UAVs to extend its operating range deeper into Pakistan. A large fleet of UAVs will supplement ISR activities by providing strategic ISR, update the order of battle, and locate or fix the targets for the surface to surface missiles, especially *Prithvi* SSM.⁷⁶ Moreover, UAVs will fill the gaps in mountainous areas where radar coverage remains limited. India's future HALE UAVs (similar to the US Global Hawk) could have implications for the whole region, whereas tactical UAVs will provide real-time battlefield reconnaissance for the precise application of ground forces. Improved payloads and data links also mean that video, thermal, and radar imagery would be delivered at a higher fidelity and enhanced real-time intelligence to support Indian military operations.

⁷⁶ *Prithvi* is a tactical surface-to-surface short-range ballistic missile (SRBM) developed by Indian Defence Research and Development Organization, <https://missilethreat.csis.org/missile/prithvi/>

Implications of Maritime ISR

A large part of the world's economy depends heavily on trade through the Indian Ocean. About half of all container traffic transits through it including two-thirds of global oil shipments. Almost 90 per cent of Pakistani trade comes from the sea including critical energy imports.⁷⁷ Similarly, India also relies heavily on trade through the Indian Ocean, with its 70 per cent of oil imports dependent upon it. With the full functioning of CPEC this trade volume is likely to further surge mainly benefitting China, Pakistan and other connected countries. Hence sea control and maritime security in the Indian Ocean carry crucial importance. The impact of Indian maritime ISR can be briefly summarised as follows:

- a) India is persistently growing its maritime ISR footprint through Satellite-based surveillance, maritime domain awareness (MDA) networks, P-8I LRMPAs, Carrier Battle Groups and UAVs. When achieved, such superiority in the maritime domain would keep Pakistan's maritime economic interests under constant risk of Indian targeting of its maritime assets. Indian maritime ISR capability will render, Pakistan's Sea Lines of Communications (SLOCs), exclusive economic zones and naval assets vulnerable to coercive threats.
- b) Growing Indian cooperation with the US and Australia whose assets are already deployed in the Indian Ocean to keep a watch over the whole region add to the complexities. The combined operation of P-8Is by India, Australia, and the US through QUAD,⁷⁸ BECA, LEMOA, COMCASA agreements would enable India to be part of the shared maritime domain awareness in the region.
- c) The superiority of Indian maritime ISR can offset Pakistan Navy's offensive capability as PN submarines would be under potent threat of being located and identification allowing a greater degree of freedom to Indian Naval forces to retain sea control.

⁷⁷ "Review of Maritime Transport 2019,"

UNCTAD, <https://unctad.org/webflyer/review-maritime-transport-2019>

⁷⁸ Quadrilateral Security Dialogue – an informal strategic dialogue between the US, Japan, Australia and India aimed to curtail growing Chinese influence in Asian Pacific Region, <https://www.cfr.org/in-brief/quad-indo-pacific-what-know>

- d) With such superior maritime ISR capability, India would gain substantial confidence to exercise sea control, employ maritime diplomacy, and influence maritime trade.

Implications on Ground Operations

There has been a paradigm shift in Indian military employment; wherein the Indian Army is focusing on blending satellite imagery, UAVs, helicopter-based sensors, and ground-based sensors in operational and tactical scenarios.⁷⁹ In all recent major exercises, the Indian Army demonstrated employment of real-time intelligence from multiple ISR sensors including LORROS and FMCP systems. Such ISR technologies will assist field commanders in battlefield precision and rapid execution of operations through quick decision-making. Such visibility would impact Pakistan's land forces' ability for achieving effective surprise in the planning and execution of operations.

India's ISR Employment Options

Presently, the Indian ISR systems are challenged by the inter-linking of all sensors effectively to yield a comprehensive intelligence picture. However, given the focus of its IT technologies, the Indian ISR network carries the potential to transform into a well informationised and net-centric entity. India's ISR system intends to fuse all sensors' data for a comprehensive digital picture of the battle space thereby enabling optimum utilisation of its forces. One such example could be a satellite photograph by remote sensing satellite such as RISAT, melded with an ELINT (electronic intelligence collected by Phalcon or special mission EW aircraft) further blended with a multi-spectral picture/video by UAV, put on top of a SAR (Synthetic Aperture Radar) picture to determine the true nature of object on the ground. India is developing its ISR structure in line with the US system of sensor-shooter combination. It might not, therefore, be out of place to assume that in all probability, the Indian employment strategy may be emulating USAF's "Wolfpack ISR" strategy.⁸⁰ It symbolises the process where a lot of wolves (akin to ISR platforms) would be hounding the target. The shooter

⁷⁹ Dougherty, "Force development options for India by 2030."

⁸⁰ John A. Tirpak, "Find, Fix, Track, Target, Engage, Assess," *Air Force Magazine*, July 1, 2000, <https://www.airforcemag.com/article/0700find/>

platform (alpha wolf) would go in to make the kill while working collaboratively with all other wolves of the gang (platforms).

Challenges for India's ISR

Data Handling

Indian ISR network design would also be challenged by the huge volume of data supplied by different sensors and platforms. Data handling issues would surface in both the communication and processing of the big data. The diversified inventory of Indian sensors means diversified demands on communications links and data-analysis systems including data rate and peak processing power. Moreover, without the presence of an appropriate AI tool in the ISR network, the extraction of relevant data from a huge amount of raw data would be a challenge. Similarly, due to the limitation of data-rate, the Indian ISR network would face the challenge of tasking appropriate sensors and platforms to maximize the value/quality of the ISR information.

A synergised ISR force structure, comprising space, airborne and ground-based technologies can provide a comprehensive picture for detecting activity in the respective domains for eventual decision making with confidence. On the other hand, a variety of ISR platforms can allow redundancies as there will be options available to substitute, where appropriate, manned platforms with unmanned ones to reduce the crew burden. Such a layered structure can limit response options to deny Indian ISR. This notwithstanding, for round the clock coverage, the Indian ISR network would have to accept trade-offs between the precision of the airborne platforms versus the persistence of the satellite-based networks.

Conclusion

Contemporary ISR is multi-dimensional, involving space, cyber, airborne and surface/sub-surface based technologies to fulfill the entire continuum of ISR requirements. Indian military intends to dominate all dimensions of the ISR to constantly evaluate the military capabilities of Pakistan and China.

Hence, Indian ISR capability is growing exponentially which not only accentuates Pakistan's security dilemma but also affects the regional security dynamics. While Pakistan would have an obvious security concern regarding the evolving Indian capability, the India-US nexus raises significant alarm for China as well. Moreover, greater Indian visibility (through modern ISR systems) into Pakistan's and Chinese military forces' dispositions can boost Indian over-confidence to a somewhat reckless level encouraging it to adopt coercive measures to settle its disputes with its neighbours. Needless to emphasise that such trends in the region and beyond lead to a trajectory of conflict and remain a recipe for disaster.

Arguably, this growing asymmetry between Pakistan and India, especially in the space domain has created a strategic imbalance in the region. All the important national assets, military locations, installations, disposition of forces, defences and strategic assets of Pakistan are within the coverage of Indian ISR. The situation entails a comprehensive counter ISR strategy to ensure effective national security. The strategy may include a mix of passive measures as well as kinetic and non-kinetic measures. However, counter-ISR options cannot be acquired easily, given the sensitivity of technology and expansive price tag. While regional strategic collaboration with China to counter the common threat can be one option, Pakistani leadership will have to divert serious efforts and concerns to find a workable solution against this potent threat.