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EMISAT: A Force Multiplier

Brig **Akhelesh Bhargava**, an Army Air Defence officer, was commissioned in Jun 1983. He has tenanted various command and staff appointments. He has done B Tech (EL), LGSC (O), DSSC and MBA (Fin). Presently he is CI PROMEX, CLAWS.

The Electromagnetic Intelligence (ELINT) Satellite or EMISAT, is India's first dedicated electronic surveillance satellite, and will act as a force multiplier for the Armed Forces. In an operation like Uri or Balakot, it is important to detect and identify the various air force and army air defence surveillance and tracking radars that were operating at the time of operation.

ELINT. ELINT is information, which is the product of activities in the collection and processing for subsequent intelligence purposes of potentially hostile communication and non-communication Electronic Magnetic (EM) radiations (other than nuclear or radioactive sources). During peacetime, the quest for knowing enemy electronic order of battle is high on priority so that during hostilities, own forces are able to decipher the electronic signatures timely. The process used to obtain tactical and technical parameters are as below:

- **Search.** It is concerned with the examination of the frequency spectrum to identify hostile electronic emissions. The effectiveness

Key Points

1. EMISAT, India's first dedicated electronic surveillance satellite, is a force multiplier for the Armed Forces.
2. ELINT is information, which is the product of activities in the collection and processing for subsequent intelligence purposes.
3. EMISAT placed in elliptical sun-synchronous orbit, with tilt to ensure enough dwell time for picking up signals.
4. EMISAT covers virtually the entire spectrum of non-communication equipment, held with our adversary.
5. Artificial Intelligence (AI) is needed to sort, sift, analyse, record and disseminate intelligence.
6. EMISAT and AI together will go a long way to make operations like Uri and Balakot a sure success.

EMISAT ...

of search depends on the sensitivity of the search receiver, power of hostile emission and ground conditions. The various problems encountered during search include frequency congestion, enemy using microwave frequencies, low emission power, frequency resolution, modulation technique, mode of working and low probability of interception.

- **Intercept.** This is the process of listening and recording enemy's electronic emission. It is carried out after the target is detected by search. The intercept system is required to obtain information of hostile emission to include time, type and purpose of transmission and radiation characteristics.
- **Location.** Once the source of emission has been established, the position coordinates of the emitter are obtained by various methods, e.g., triangulation, etc. The accuracy of Direction Finding (DF) depends on the characteristics of the Electronic Support Measures (ESM) receiver used.
- **Analysis and Evaluation.** The role of analysis is to scrutinise the intercepts and derive technical and tactical intelligence. It involves sighting of all types of intelligence obtained from search and intercepts, photo reconnaissance reports, intelligence summaries and interrogation summaries, etc.
- **Recording and Updating.** The technical and tactical intelligence is correctly recorded and the available data is updated, so that the same is readily available during hostilities.

Intelligence on Enemy Radars. Radar equipment transmits Radio Frequency (RF) using variety of antennas depending on its role (surveillance—both air and battlefield—tactical control, tracking, fire-control, etc.). Most of the radars are pulse emitter type, while some are continuous wave type. The important characteristics of radar which are generally required for military purposes are as under:

- Frequency range, frequency band and frequency hopping facility
- Pulse width—gives the minimum range of radar
- Pulse Repetition Frequency (PRF)—gives the maximum possible range of radar
- Peak power output—gives the requirement of power of jammer
- Type of antenna—gives beam shape, beam width, antenna gain and side lobe pattern
- Antenna rotation per minute (RPM)—frequency of data update of target
- Type of polarisation
- Time of opening and duration

ELINT Collation. When an intelligence problem is defined, methodology specialists and resource allocators select the system and plan the mission, taking into account the capabilities and limitations of collection platforms. Weather, terrain, technical capabilities and hostile countermeasures too determine the potential for successful collection. Through an understanding of all available platforms, the collection agency synchronises available assets, and allocates them to theatre and corps.

Means for Collection. All platforms have limitations. Desirability of a given method of intelligence collection is dependent on varying circumstances including requisite time frame. The various means of collection are enumerated below:

- **HUMINT** includes assets such as open literature, physical capture and espionage. However, it may not be able to provide information in a given time frame.
- **Ground-based ESM Equipments** have limitation due to terrain masking and technical capabilities.
- **Aircraft, unmanned aerial vehicles (UAVs), drones, aerostats or balloons** can access/peek into the enemy territory to greater distances. These have limitation due to technical capabilities, weather and enemy air-defence. However, drones can fly for a few hours, balloons can be up till helium gas lasts and aircraft cannot be up 24x7 nor venture into enemy space.
- **Military Satellites** are not custom made for ELINT function and sometimes, the orbits of such satellites may not be suitable for the requirement.

Agencies Involved. Our armed forces along with the civil agencies keep an eye on enemy radars.

The Electronic Emission Policy (EEP) and its implementation by the users in the field, dictates how easy or difficult it is to carry out Electronic Support Measures (ESM) cycle (search, intercept, locate, analyse and record). These processes predominantly are being carried by Electronic Warfare (EW) units/sub-units and Wireless Experimental Units (WEU). They are aided by agencies under the cabinet secretariat such as National Technical Research Organisation (NTRO) and Aviation Research Cell (ARC). A word about these organisations is given in the succeeding paragraphs.

- **Electronic Warfare (EW) and Wireless Experimental Unit (WEU).** EW and WEU units have basically ground-based equipment to carry out ELINT functions. A large number of such units/ detachments are deployed along the border. However, they have limitations in discharging their functions, due to line of sight equipment in their inventory. The data available at a location varies from time to time, depending upon the activation of electronic equipment by the adversary to achieve frequency diversity. The productive efficiency of the electronic data collation unit is much dependent on the capability of the analysts.
- **NTRO.** It has access to data from ground-based sensors, **Technology Experimental Satellite (TES)**, **Cartosat-2A** and **Cartosat-2B** besides two **Radar Imaging Satellites** namely **RISAT-1** and **RISAT-2**. These satellites do not have EM intelligence capturing capability.
- **Aviation Research Cell (ARC).** ARC flies ELINT aircraft and their main function is aerial surveillance. ELINT operations aircraft are fitted with state-of-the-art electronic surveillance equipment and long-range cameras capable of taking pictures of targets from very high altitudes. The limitation of these aircraft are that they have to fly on own side of border and use Sideways Looking Airborne Radars (SLAR) (which have limited accuracy). The Cell has limited number of aircraft, varying schedule and with ageing have great down time. One has to wait till the mission is complete and the processing takes place only after the images/recordings have been handed over physically to the decipher section.
- **Military Capable Satellites.** India currently has six to eight satellites (CARTOSAT, RISAT, TES), which are exclusively used for military and surveillance purposes. The military satellites have resolution of up to 50 cm currently. Their image capture is of high quality and they are capable of taking short videos to monitor activities of any person, group and enemy assets. However, these satellites are not custom made for ELINT and their usefulness is limited to interpretation of equipment photographed.

EMISAT Launch. Polar Satellite Launch Vehicle (PSLV)-C45 was launched on April 1, 2019. Indian Space Research Organisation's (ISRO) PSLV, for the first time, released payloads in three orbits. The rocket first released the 436-kg Defence Research and Development Organisation's (DRDO) Electromagnetic Intelligence Satellite (EMISAT) at 748 km height, about 17 minutes and 12 seconds after lift-off. Thereafter, it was brought down to place 28 foreign satellites in 504 km orbit (24 x US, 2 x Lithuania, 1 x Spain and 1 x Switzerland) and finally the last rocket stage (PS4) was further brought down to 485 km orbit, where it doubled up as an experimental platform. The PS4 hosts the following three payloads:

- Automatic Identification System (AIS) from ISRO
- Automatic Packet Repeating System (APRS) from Radio Amateur Satellite Corporation (AMSAT)
- Advanced Retarding Potential Analyser for Ionospheric Studies (ARIS) from Indian Institute of Space Science and Technology (IIST).

EMISAT Development. It is a powerful electromagnetic intelligence (ELINT)/surveillance satellite which has been developed jointly by DRDO and ISRO in over five years. It is modelled after a famous Israeli spy satellite called SARAL (acronym for Satellite with ARgos and ALtika). This satellite is going to be used for intercepting signals at high-resolution including from the Indian Navy. DRDO (Defence Electronics Research Laboratory (DLRL) Hyderabad) was the

lead developing agency under Project Kautilya. EMISAT has been placed in a highly-elliptical sun-synchronous orbit, with a tilt of 98.4 degrees. This is expected to give the satellite enough dwell time for picking up signals from a specific area on the ground and recording them. It has been developed for monitoring radar network. The satellite is based on Indian Mini Satellite Bus series (IMS2 Bus) which can have a maximum launch weight of 450 kg with a payload no more than 200 kg. The Ka-band frequency that EMISAT is sensitive to, allows to scan through ice, rain, coastal zones, land masses, forests and wave heights with ease. EMISAT also has a special altimeter (a radar altitude measuring device) called ALtiKa that works in the Ka-band.

EMISAT Characterstics

- Launcher Agency : ISRO
- Launch vehicle : PSLV-C45
- Launch date and time : April 1, 2019, 09:27am IST
- Weight : 436 kg
- Orbit : 748 km height
- Inclination : 98.4 deg
- Satellite speed : 7.6 km/sec
- Power Source : 800 Watts from twin solar panels
- Function : ELINT gathering for Defence Forces
- Main payload : Kautilya system by DRDO for ELINT

Project Kautilya. The details of all military satellites always remain a closely guarded secret. Accordingly, the ELINT capabilities of EMISAT too are highly classified. The Defence Ministry's annual report of 2013-14 mentioned about Project Kautilya—for **Space Borne ELINT System,** which involves the development of ELINT payload for integration on an indigenous mini-satellite. However, nothing was heard about this project until the plan for launch of EMISAT was made public. Perhaps the need was felt during the **Balakot** air strike. EMISAT will be able to scan the ground and air for electromagnetic signals emanating from hostile radars as well as other electronic broadcast frequencies.

EMISAT as Force Multiplier. None of the existing means have 24x7 data collation capability. ELINT missions typically involve monitoring radar signals and using these to determine the nature and location of the transmission›s source. EMISAT enables our forces with data collation as follows:

- Monitor location and intensity of Electromagnetic (EM) radiation (activity).
- Help in creating a digital topography of enemy areas which are of interest to our forces (both immediate and long term).
- Detect the frequency band and quantity of devices operating in an area at a point of time (help in assessing the force levels).
- Its other characteristics include the following:
  - Analysing the orbital pattern of the EMISAT, it seems to be more Pakistan-centric. The frequency detection and analysis, range would include UHF, P, L, S, C, X, Ku, K and Ka-bands. Virtually the entire spectrum of Pakistan non-communication equipment, it will be able to monitor.
  - It has the ability to scan through any terrain obstruction to detect signal, alert defence systems well in advance and help in delaying the enemy by targeting transmission (location).
  - The ELINT capability includes recordings and analysis of intercepted signals and helps create an RF signature library of all radars. This would be used for locating and quickly identifying the radar in subsequent encounters in near real time.
  - The height (748 km) of satellite dictates that it will a sufficiently large footprint (swath), do 6 to 8 revolutions per day and may have a revisit frequency (over same point) of up to 2 per day. This may be increased by swivelling the transponder along the vertical axis.

- To ensure a continuous coverage in terms of time, there may be a requirement of 4 to 6 such satellites during hostility period.

Artificial Intelligence. Availability of an appropriate collation platform does not mean that the job is done. It will be useful only if the facilities needed to analyse and process the information are also available. The collection capability, even with self-generating reports, can quickly get overloaded by sheer volume of data. Therefore, Artificial Intelligence is needed to sort, sift, analyse, record and disseminate the intelligence.

Military Significance. The EMISAT is the first custom built intelligence satellite for non-communication equipment. It will enable both our ground and air forces to detect gaps and blind spots over the border area and in depth location. It will enable the electronic warfare elements to execute jamming and deception timely and just in time. Alternatively, it will enable commanders to decide on hard kill option for specific emitters. It will also enable the forces to take countermeasures for own equipment to function optimally and efficiently. Thus it will enable the forces to plan and execute, Uri and Balakot type operations, better and successfully.

Conclusion. ELINT ground stations may be able to accept sensor data, but the networks and information-processing systems may be inadequate to get data to analysts and commanders. Commanders and staff are accustomed to receiving ready to use information. Having the details of all emitters with location and time of operation will make their task simple to decide the specific ones that are to be nominated for hard kill. This will ensure that own operations proceed unhindered with minimum risk and effort. Processing of downloaded data during exercises may be possible with high-speed fixed networks for small span of time. However, in a mobile, fluid battle it would be nearly impossible to develop a network capable of handling the same amount of data over sustained period. Collation management to include sort, sift, analyse, record and disseminate is the cornerstone on which intelligence operations are desired. EMISAT and AI together will go a long way to make operations like Uri and Balakot a sure success. These would enable the planners to select a relatively safer and shortest route. It would also enable detection of redeployment of existing radars or activation of enemy dormant airfields.

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CENTRE FOR LAND WARFARE STUDIES (CLAWS)
RPSO Complex, Parade Road, Delhi Cantt, New Delhi 110010
Tel.: +91-11-25691308, Fax: +91-11-25692347, Email: landwarfare@gmail.com
Website: www.claws.in
CLAWS Army No. 33098