Experiences in Surveillance and Target Acquisition

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Battle field transparency in the new world dispensation is ever expanding both in terms of range coverage and the day/night capability. While contact battle primarily focuses on night capability, the depth battle moves a little further, looking for airborne/long range day/night all weather sensors. What 'ability to fight' at night is for contact battle, all weather day/night surveillance & target capability is for the depth battle.

Technology has been the driver of methods of war-fighting since the start of civilizations. The last century has been characterised by a phase where the rate of upgrade in technology has forced military leaders, planners and the scientist community to continuously adopt new paradigms and methods of war fighting. The interplay between technology and operational concepts has increased; in many cases technology has driven the operational concepts. It is imperative to develop weapons or surveillance devices that aid victory with minimum human cost.

Two recent benchmarks in high technology battlefield that merit special consideration are as follows:-

a. **Operation Desert Storm.** Operation Desert Storm was probably the first war wherein years of technology advancement outpaced operational concepts, and fresh doctrines and approach to warfare were practised and tested as the war progressed. The experience also brought out the criticality to build

capacities in employment of technology both in terms of human interface or the operator skills and capacities to deal with larger amount of data for optimum utilisation of both **'battlefield transparency' and 'long range combat power'.**

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b. **Operation Neptune Spear.** The operation that finally nailed Osama bin Laden was a culmination of the employment of the most advanced surveillance systems in the world and hence can be taken as a benchmark for some time to come. The intelligence collection phase involved started from ground intelligence followed by the use of the most technologically advanced surveillance systems in the world—it involved the best of area and satellite surveillance tools; however again in the end ground intelligence was critical for final corroboration; **thus reinforcing the importance of the human element to special technical tools.** The actual operation phase involved the real-time information of progress available to the Presidential Command Post 7000 miles away. It reinforced the paradigm where a **small military operation can have an operational or strategic context as** the execution was enabled only by a high level of long range surveillance and acquisition technologies besides other technologies.

c. Operation Desert Storm provided the motivation to China to focus on technology and enter an age what the Chinese called **'informisation'.** It redefined the scope of technology in conventional operations; the warfare paradigm again shifted after 11 September attacks wherein **'hybrid warfare'** entered our military dictionary. Operation Geronimo demonstrated the level of technology and operations linkages demanded in a hybrid war scenario. The military and scientific hierarchy need to introspect how ready we are to execute a similar mission if the nation or situation so demands. No future war is likely to remain purely conventional and **hence the need for surveillance and target acquisition to cater for both the hybrid and conventional domains.** We as a nation need such a capability to be made available to the military.

The Indian Experience

Indian armed forces have in the last decade seen a quantum jump in **surveillance** technologies. Counter insurgency, especially in Jammu & Kashmir, the border

fencing experience and hinterland security requirements have tested the efficacy of use of these by the military. In addition, the long mobilisation in Operation Parakaram highlighted the need to integrate surveillance and target acquisition. India has a **formidable technological capability which needs to be optimised for operational employment.** We are in a position to execute surveillance and acquire targets well in depth of the enemy. The continuous **surveillance and intelligence collection or target acquisition process in peace is a precursor to what can be achieved in war.**

There are several examples of a peace time information analysis of target areas. Better resolution, varied payloads, image analysis tools and finally ground intelligence form the complete matrix required to get results suitable for engagement ie to qualify to be termed under target acquisition. In this case development of our national assets for accurate target coordinates of target area in enemy territory are a challenge for the scientific community.

There are also examples of surveillance over a period of time for inputs on change in target profile. Different payloads can be employed to seek or substantiate information; task-specific imagery is obtained and analyzed. On identification of focus areas, fresh imagery is obtained using long range payloads which confirm/negate changes in the target profile.

Most examples are limited to satellite and aerial imagery for target acquisition. However, similar examples are equally relevant to electronic intelligence and ground based sensors. While such examples validate our technology capability there is no room for comfort as such examples are more as technology demonstrators. There is a long journey from technology availability to fully integrated operation military system. It is this arena of system integration where we need to build capacities. **Building capacities include communication media for data/imagery transmission, softwares for analysis, operator training and sensor to shooter links.**

The examples validate the capabilities available in India. However, there are large gaps in capabilities that need attention of the scientific community and the industry, which include

- Resolution capabilities for all kinds for imagery from radar to optical.
- Variety of payloads for imagery.
- Satellites for defence purposes, for which earlier capabilities had to be enhanced. Need for adequate revisit and repeativity capability.

- Electronic Warfare (EW) payloads have limitation of range due to the height from which it operates. Aerial platforms for such payloads will enhance the range and our reach.
- Numbers ie availability which affects timeliness.
- Crew availability as also the stations for imagery exploitation.
- Network structures to enable data handling and timeliness in converting surveillance input into target data for engagement.

An additional factor that has to be kept in perspective is the large dependence on imported surveillance equipment; **no system caters for the diversity in terrain and weather conditions as experienced by the Indian soldier. It is therefore imperative we look for a combination of ToT (transfer of technology) and our Indian R&D to develop equipment suited to Indian conditions.**

Division & Operation Level

The current capability profile at Div and Corps level include a wide variety of sensors and platforms; from ground based radars, LORROS, TIIOE and EW assets to air based HMSS, UAVs, aviation and IAF assets. Satellite imagery forms the top end of the surveillance profile. Special forces form the contact intelligence assets for depth surveillance and interdiction. TIIOF needs a special mention as a custom built target acquisition and engagement device which has distinctly improved capabilities of troops in contact; the tendency of using the equipment as a surveillance device needs to be guarded against.

Challenges at Operation Level. The challenges that merit attention of the scientific community and are an opportunity for the industry include the following:

- **Networks.** Networks guide speed of transaction of data and hence timeliness. Network involves **communication links and data handling software—**both are a specialisation which need to be custom made for the task, hence need to be developed in close coordination between users, scientists and the industry. Fast change in technology necessitates flexibility and continuous upgrade to provide the fighting soldier the best available.
- **Passive Sensors.** Passive sensors like sound ranging and EW equipment have high survivability compared to emitters. Modern systems duly tested to meet requirements of battle and pre contact phase in the field need to be fielded.

- Organisation structure to integrate multi sensor and multi agency inputs.
- Crew training and technology support to enable 24h surveillance and to cater for crew fatigue.
- **Analysis Tools.** The ability to glean actionable intelligence from mass of data has to be supported/aided by software like change detection and advanced filters to optimise inputs from a sensor.
- **Accuracy of Coordinates.** Acquisition of target coordinates with accuracy enabling engagement by long range/ beyond visual range precision equipment is a capability that has to be a forerunner to the development of high precision engagement system; it in this field that we need to focus to build indigenous capabilities. The accuracy of target coordinates is dictated by the CEP of the precision engagement weapons. While satellite imagery does give the ability to pick targets in operational and strategic depth of the enemy, ability to fix such targets to get accurate coordinates is a field which needs additional focus.
- **Range.** Commanders have always needed to look deeper, which necessitates moving sensors higher and higher. Masts for such sensors continue to be plagued by problems of stability and depletion in quality with sensor hardware separation.

Satellite Surveillance

While aerial surveillance was the forerunner of quantum upgrade in surveillance and target acquisition capability, satellite imagery brought it to another level which today has invaded our private or civil space. What few years back was a prized possession of advanced military forces is available to everyone including the terrorist at the click of a button. However military requirements in war have to meet the requirement of accuracy and timeliness; which is the area where we need to focus.

Our integral capabilities have largely been defined by the earlier TES, RISAT and now CARTOSAT 2B; for balance we largely rely on foreign satellite imagery. There is no need to stress that foreign imagery cannot be relied for during war and hence the need for integral capabilities. In terms of the requirements of the commander in field, well short of Geronimo and what we think is within our current capabilities today, can be said to include

- Resolution - sub-meter.
- Accuracy of coords - based on CEP of precision weapons.
- Availability time - 6h, to the field user. Mobile download stations upto Div

level, in the interim at op level.

- Variety of payloads for day/night and all weather inputs.
- National imagery software - Bhumika with integrated softwares for military application.

Intra & Inter Services Issues

It has been well stated that **numbers are a serious constraint** in current surveillance grids. This enhances the need for **optimizing the existing resources,** which in turn impinges on us to ensure **seamless cross-tasking and information sharing.** This moves into challenges in **communication compatibility, automation in seamless sensor tasking and information sharing, building capacities to enable imagery/data analysis, common designators** and allied means of synergy within a service and inter-service. Laser target designators are a key area for precision targeting in the battle zone. Small teams primarily SF, which work on strict load limitations need to be empowered to do target designation by variety of laser guided munitions of the Air Force and Artillery, this demands development of a **man-portable laser designator** which is common to all types of delivery methods. Further, a partnership between the user and the scientific minds; especially the software and communication experts to enable sharing and cross tasking between the services is an area that needs focused effort.

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Challenges in Mountain Terrain

Most of the equipment developed in last few decades in Europe and elsewhere has focused on mechanised warfare and mostly plains. India' ground realties are clearly different where most of our unresolved borders are mountains. A substantial portion of this is extreme HAA. Mountains by nature expose all equipment and the crews to **harsher climatic conditions, extreme temperatures, reduced mobility and serious limitations on radar coverage & radio communications.** The terrain naturally supports an adversary trying to make a stealth move. It is a natural corollary that Indian scientific community and industry has to work to adapt existing technologies as per the peculiarities of rugged mountainous terrain. This is an area where we seek fresh thoughts and capabilities.

Future

Armed UAV. Armed UAVs and drones epitomise the **confluence of surveillance, target acquisition and engagement into a single platform;** while the ethics of drone attacks in Af-Pak may a matter of debate, their effectiveness is largely uncontested. In conventional operations they could form mainstay of all high value target engagements; hence they are definitely a top priority in the wish list for the Indian military.

Hybrid War. Most surveillance systems that are being developed and deployed cater to a conventional war scenario. However our threats both in peace time and war have moved into the hybrid domain. Conventional war needs linear surveillance grids which have a reasonably well laid out FLOT; surveillance focus and target discrimination is relatively easier compared to a hybrid situation. We are likely to encounter hybrid threats both within our own territory and in captured territories; this situation puts undermentioned challenges for the military thinkers to cater for the future needs. The future systems will need

- Advance FoF system for ground forces. Improved situation awareness of own forces.
- Increased automation to enable real time updates both of integral forces and surveillance updates from sensors.
- Automated tools to deploy surveillance sensors to grid coverage vis-à-vis a linear coverage; a fresh look at concept of surveillance. Increased synergy in various subsystems to provide a comprehensive picture; the fine balance between preventing fratricide and hitting enemy hybrid threats would need high reliability in situation awareness.

Conclusion. We can only reiterate the need for the three pillars of scientist–industry– soldier to integrate for building capacities in surveillance and target acquisition that would be the deciding factor of both the **result** and **the human cost** of the next war. Technology development and absorption specific to Indian conditions which will further our operational readiness has to be a continuous process. Specific projects to build surveillance capabilities, capacities to handle data and extract accurate target data and effective networks have to move concurrently and in sympathy to achieve desired battlefield transparency.

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