Space Assets and their Integration with Land, Air And Maritime Warfare for Enabling National Security Strategy Part-I

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I

> *"Earth space, like Eastern Europe in Makinder's design, is most critical area of astropolitics. Control of earth space not only guarantees control of outer reaches of space but provides advantage on terrestrial battlefield".*
>
> *- Everett C Dolman*

Space is fast emerging as not only the new 'Economic High Ground' but also as the new military frontier of becoming a new 'Strategic High Ground'. The ongoing investment by nations in this arena is expanding in a geometric progression. Space assets have not only become the hub for communications but also for surveillance, guidance, navigation and 'R and D' activities.

The Gulf Wars and the ongoing Afghan and Iraq wars have vindicated the theory of space as a force multiplier for military operations. In India's case, India is a dominant 'Space Faring Nation' with a potential for harnessing the space assets for enabling land, air and maritime military operations. The entire architecture for military missions would require construction of Net Centric Warfare capability, where a configuration of satellites are pre-positioned and monitored to serve the end use of either detecting or destroying military targets both in space and the earth environment.

Military Strategy in the 21st Century requires total synergy between forces on land, sea and air, the electromagnetic spectrum and space. Smaller nations with technologically oriented doctrines and concepts in their forces could succeed in a shorter time frame against huge armies and huge landmass. Realisation and relevance to India, for harnessing assets in space for military purposes is only increasing. India's prowess in civil space technology coupled with highly specialised human resources in IT (software), sensor

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technology including imaging etc makes India one of the most apt nations who can integrate these core competencies to develop 'Space-Military' capabilities like C4I2 or guidance and PGM development. Therefore, an environment study to identify security threats to India, immediate and long term, and how space assets can impact on military vision and strategy needs to be carried out.

Aim

Evolve a concept and architecture of Space Assets with land, air and maritime war waging capabilities for enhancing and enabling military operations in real time.

Scope

The subject being new and innovative would be covered under the following heads :-

(a) **Part 1.** Space Assets – Existing Technology and Military Capabilities.

(b) **Part 2.** RMA Perspective and Net Centric Warfare.

(c) **Part 3.** Tenets of Space Power : Military Analysis.

(d) **Part 4.** Threat Analysis : Indian Sub Continent.

(e) **Part 5.** Way Ahead for Indian Armed Forces

SPACE ASSETS – EXISTING TECHNOLOGY AND MILITARY CAPABILITIES

Arena of space is fast evolving as a laboratory of emerging core technologies related to C4ISR, positioning, timing and guidance system. Satellites are classified into three categories : geo-synchronous, semi-synchronous and orbital. Satellites having more relevance to defence applications are enumerated in succeeding paragraphs.

Surveillance Satellites. These satellites can be divided into four categories : photographic, electronic, ocean surveillance and early warning satellites. They are used for arms control verification and for achieving battle field transparency.

(a) **Photographic Reconnaissance Satellites.** Such satellites include television cameras, multi-spectral scanners and microwave radars, to detect and pinpoint targets. The

USA and Russia are the leaders in this area of space technology. The Peoples Republic of China has also launched many such satellites. KH-11, 9 and 12 are all versions of a photo satellite.

(b) **Electronic Reconnaissance Satellites.** These are the "ears" in space. They carry equipment designed to detect and monitor radio signals generated by potential adversaries. These satellites also gather data on missile testing, new radars and many other types of communication traffic. Not only do they locate systems producing electronic signals but also measure the characteristics of the signal so as to be able to plan penetration of defences.

(c) **Imagery Satellites.** India is very advanced in this satellite technology gaining data through imagery – EO / Multi spectral and IR.

Ocean Surveillance and Oceanographic Satellites. Knowledge of what is happening in the ocean – like the height of waves, the strength and direction of ocean currents, and salinity of the water, — can help in the design of sensors to improve detection of submarines. These factors also contribute to improving the sea-skimming accuracies of missiles launched from submarines and air craft.

Navigation Satellites. Doppler analysis of signals emanating from radiating space-based radio beacons helps in navigation and global positioning. Even weapon trajectories can be monitored and countered suitably. Both the USA and Russia have developed satellite navigation systems. In the USA, an added mission is planned for satellites specifically to detect nuclear explosions in the atmosphere and in outer space. It is planned that US navigation satellites will carry sensors for this purpose also. This effort is in support of nuclear war doctrines, which require early warning of attack, information and assessing the size of the attack and data on the attacked target so that an appropriate response can be made. Other applications are:-

(a) GPS data to enable forces to navigate across any terrain at night or during inclement weather.

(b) Develop a DGPS based on different GPS systems available.

(c) Assist movement of ground troops in areas where there are no navigational aids like in deserts (in 1990 Gulf War, Infantryman moved with the help of GPS).

(d) Today, the 'US Navstar' GPS is providing global services. The Europeans are also producing a different system (Galleleo) with international collaboration of many countries including Israel and China. India's investment in this joint project is also under negotiation.

(e) Nevertheless, India has to build its own different GPS (China has one with four satellites in orbit). From 2008 onwards India would be launching a few satellites for an Indian Regional Navigation and Positioning system which will be incremental on yearly basis upto 2012.

Geodetic Satellites. It is a satellite, which studies the physical nature of the earth and, thus, assists in mapping the earth. Satellite laser ranging and radar altimetry have helped in ascertaining the pattern of earth's gravitational potential. The building of military infrastructure on outer space indicates that the military satellites of the major powers are increasingly becoming part of the world wide nuclear and conventional weapons systems.

Nanosatellites. Nanosatellites represent a revolutionary breakthrough in future satellite development. They are a type of distributed satellite structural system. Such distributed systems, in contrast to integrated systems, are able to avoid the damage that follows the malfunction of an individual satellite, and, thus, will increase the survivability and flexibility of future space systems. Possibly the best application of nonosatellites is their deployment in local satellite groups or in distributed constellations. For example, if we launch nonosatellites in solar stationary orbits, with 37 nanosatellites placed evenly into each of 18 equally spaced orbits, then there would be a total of 666 nanosatellites in orbit. Thus, we could ensure that at any given time, there would be continuous coverage and surveillance of any spot on Earth. Currently, there are already a few western countries that are researching "microscale" satellites. Even in India, sponsored research on the it is already underway. However, there is a case for the military to also initiate similar projects within the scope of our joint military strategy and vision.

Anti-Satellite Weapon (ASW). This is yet another field which requires more investigation from the military point of view. The potentiality of lasers in this regard has to be explored. The 'conventional' weapons are based on missile and satellite technologies. Unconventional weapons are those which use Laser based Directed Energy Weapons (DEW) or directed electromagnetic radiation as a means of destroying or damaging a satellite. Further, adversary's ASW would have to be countered. Therefore, there is a necessity of building Anti-Anti Satellite Weapons (AASW).

Militarisation and Weaponisation. In the regional context, China's investment in military space capabilities cannot be overlooked. Therefore, as a deterrent, India would have to work on it. Militarisation of space falls within the definition of utilising the services of satellites for enhancing performance of terrestrially based weapon, surveillance and communication systems. On the other hand, weaponisation would mean placing of weapon systems in space i.e., using space platforms. This issue will continue to be under hot debate internationally in the coming decade as deployment of Anti-Ballistic Missile (ABM) measures may find place in space. However, the present outer space treaty prohibits weaponisation. The military aspects of existing satellite functions would increasingly encompass the following as our dependence on satellites will increase manyfold even in the sub-continental or regional context:-

(a) Research in lasers in India has been going on since 1950s. A further study of its applications in space should be carried out.

(b) There is emergence of a newer weapon known as Non Nuclear Electro-magnetic Pulse (NNEMP), which has been fired in Kosovo. from space for neutralising or paralysing the adversary's command and control systems. Such a system if fired, in space would also jam satellites and other platforms. Thus, nuclear hardening technology needs to be explored. (A lot of research on it has been carried out in the UK).

IMINT requirements to enhance capabilities of the Armed Forces are given below:

(a) Remote sensing satellites for surveillance should have a revisit capability to meet the operational data update needs.

(b) All weather imaging capability to cater for coverage during night and during inclement weather. This will require radar satellites. India is likely to launch its first commercial RADAR SAT to give high resolution SAR images in 2007.

(c) High resolution (sub metric) sensors with ability to provide very high resolution data during operations.

(d) Stereoscopic capability.

(e) Seamless coverage through a constellation of agile, manoeuvrable satellites with different imaging modes including tracking of moving targets.

(f) Ground locational accuracy to meet precision targeting requirements. In this the capabilities of sensor fuzed ammunition should be taken note of in defining our needs.

II

RMA PERSPECTIVE AND NET CENTRIC WARFARE (NCW)

War fighting has three fundamentals which are, principles of war, strategy of war fighting and the technology with which we fight the war. While the principles of war and strategy have slowly evolved, the technology for war fighting has been growing at a rapid pace with Information Technology at the core. Revolution in Military Affairs (RMA) encompasses various areas including space. Firstly, the transformation of analogue weaponry and equipment to the digital domain plays a critical role in operations. Precision guided long distance attacks are becoming main form of combat. Precision guided weapons used in the Vietnam war accounted for only 0.2 per cent of the total ammunition, the ratio increased to 8 per cent in the 1991 Gulf War, 35 per cent in the 1999 Kosovo war which further rose to 56 per cent and 68 per cent respectively in 2001 Afghan war and 2003 Iraq war. Second, force structure and systems have become more streamlined i.e, reducing size, readjusting force structures and systems, optimising composition

of the logistics and combat elements. The size of military forces are being compressed, while conferring them with stronger combat capabilities. Third, automation is increasingly employed in command and control. Commencing in the 1960's and 1970's up to the present, the military command automation systems of major countries have been promoted from C3I to C4I, C4ISR and C4KISR, in order to meet demands of real-time and highly efficient command and control capabilities. Fourth, a dimensional expansion is taking place from the traditional three dimensions (namely Land, Sea, Air) to the present five dimensions (namely, land, sea , air, space and electromagnetism). The armed forces, who have superior capabilities to control information, will gain the initiative in the high tech battlefield. Security of own information structure and the ability to disrupt that of the enemy will be an important 'Capability' indicator and in this area we are at the stage of 'infancy'. Fifth, the operational patterns have become more system-oriented. In future wars, the past methods and coordination among land, sea and air forces or the "integrated air-land warfare", or the "integrated air-land-sea-space warfare", will transform to the completely integrated operations of a system vs system from the strategic to the tactical domains. In this area, we are at the first stage of coordination between land, sea and air forces.

NCW. Combat edge will be with the Forces which are better networked rather than better platform weapons. New architecture demands space, air and land-based electronic and photographic equipment and sensors to be networked and gather the array of surveillance and intelligence data. These are then passed in real time through communication satellites, to a data fusion centre, integrated in military command and decision-making system. Computer analyses and dissemination is done thereafter. In times to come C4I2 systems would be in place and would also affect the nuclear deterrence capabilities. India needs to make a concerted effort in this direction. C4I2 cannot operate without space assets and these cannot but be joint. In the Indian case, a sub-continental model which is theatre or sub-regional capable needs to be architectured. Success in an NCW context is achieved by effectively linking command and control, sensor and engagement systems. It is a network, to facilitate enhanced situational awareness, collaboration and offensive potential. Understanding a few definitions will be of great help.

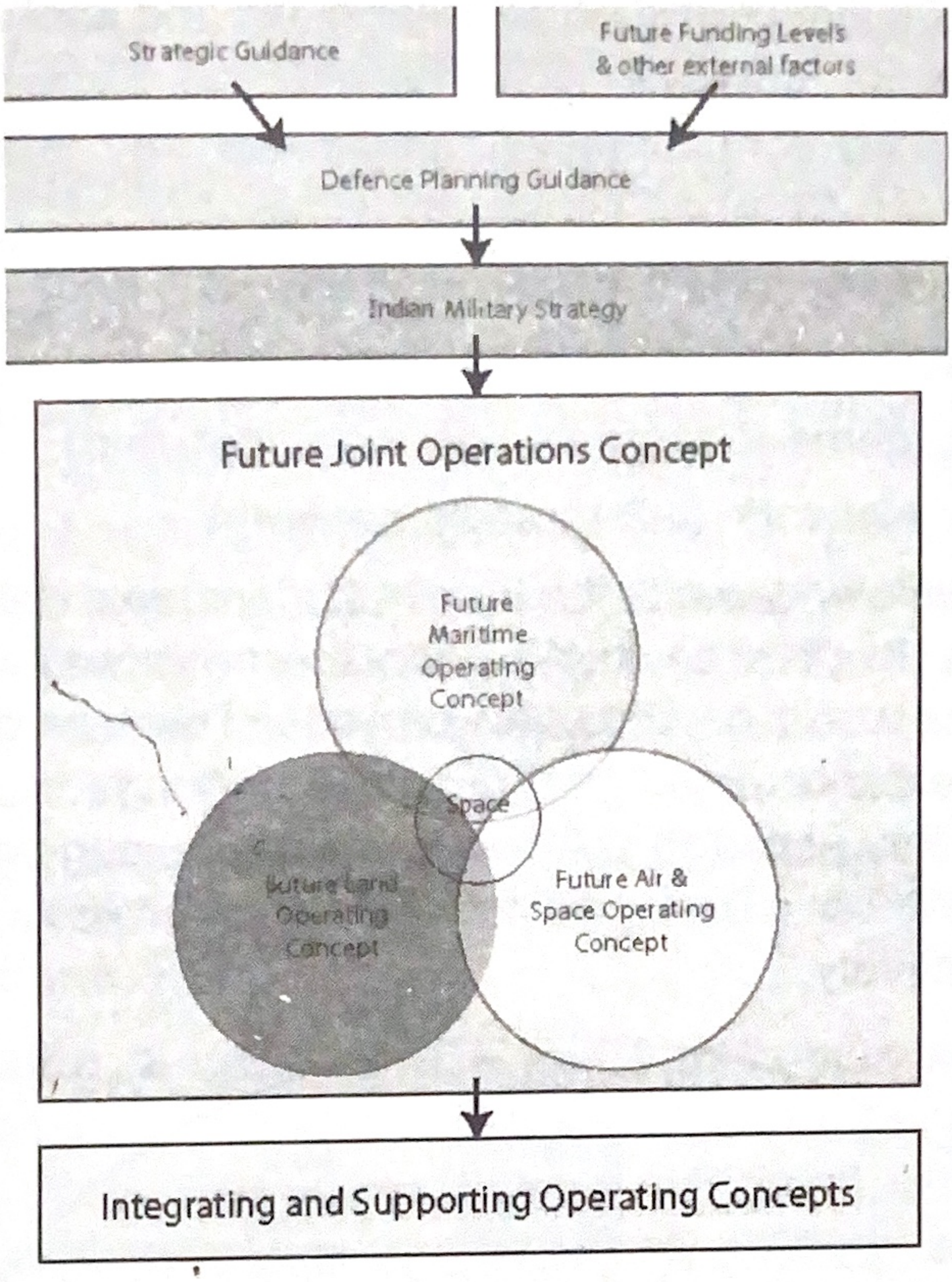
Space Assets. Space assets, space forces and space systems are terms used to describe different categories of space capabilities. Space assets available to our nation include military, civil, commercial, and foreign space systems, their supporting infrastructure, terrestrial elements with the primary mission of affecting space systems and the personnel who operate them.

Space systems. The comprise nodes and links. There are two types of nodes : terrestrial and space. The space node includes satellites, space stations, or reusable space-transportation systems like the space shuttle. The terrestrial node includes land, sea, or airborne equipment used to interact with space node. These nodes are tied together by information conduit called links.

Space activities can be planned and conducted to achieve effects to fulfil individual theatre, multiple theatre and national objectives. Those space forces that will primarily support multiple theatre and/or national objectives are referred to as national assets and would normally be controlled by the COSC/CDS/Commander, Indian Unified Space Command (IUSC). IUSC's control function includes the capability, authority, responsibility, and accountability to execute those forces. Some forces' effects are primarily focused on a 'Single Front' with little or no impact outside the designated area of responsibility. These theatre space forces work under the control of Integrated theatre commanders in chief and are executed by theatre component forces. Although commanders are responsible for producing effects, their decisions on how to do that are greatly influenced by policy, strategy and doctrine, which influence space operations. All three are distinct and have the potential to change dramatically. Therefore, a thorough understanding of both interaction and differences between policy, strategy and doctrine in relation to the NCW architecture is important. It is true that we don't have theatre commands today.

In my view we are already late. How can we have RMA if networks are to be only Service specific.

The Future Joint Operations Hierarchy of Concepts. Space assets would become the hub to enable time sensing NCW capabilities.



Space based NCW would serve the Future Joint Operations Concept which would provide a point of reference for the range of integrated support to earth, oceanic and space environment operating concepts.

The NCW Package. Success in an NCW context is achieved by linking command and control, sensor and engagement systems via a network, to facilitate enhanced situational awareness, collaboration and offensive potential. Personnel within the networked force rely on secure and responsive linkages that allow the right information to be accessed at the right time by the right force elements. Increases in combat power from being a networked force are derived from the quality and timeliness of shared information and through the exploitation of new system and command relationships. Operational experience has demonstrated that improved information sharing and increased collaboration through NCW can provide enhanced understanding of the situation by decision-makers. Synchronisation is improved, permitting to deliver more controlled and precise military effects. In the future this could include rapid and reliable, direct sensor-shooter conûgurations. Same needs to be architectured for the Indian Armed

Forces and thus would require an integrated and joint approach for the three services to enable NCW capabilities. Synchronisation of effect is achieved conceptually through four key, interdependent elements:

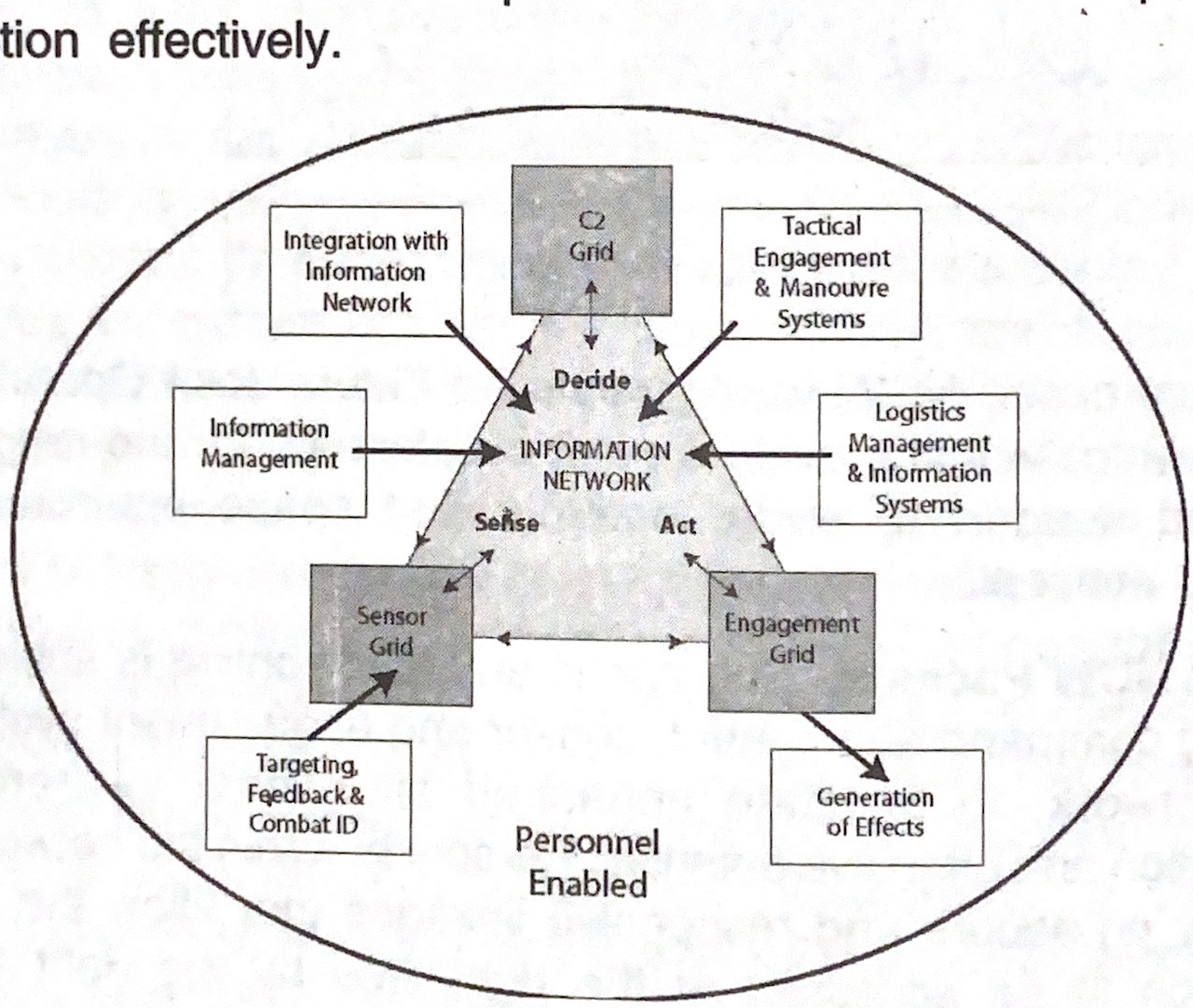
(a) Command and Control systems (C2 grid).

(b) Sensor systems (sensor grid).

(c) Engagement systems (engagement grid).

(d) The Network (information network).

Figure below depicts the inter-relationships between these key elements. In practice these grids are not always distinct and some systems are a combination of grids. The four elements are in effect the exterior packaging of what NCW has the potential to offer . Within this package are few fundamental components, each of which must be developed for the overall NCW package to function effectively.



ALL SUPPORTED BY SPACE ASSETS

Any NCW package would have to increasingly depend on space based assets, for enabling future war fighting capabilities. Consideration and understanding of the NCW Concept is, therefore, a necessary prerequisite for appreciating the NCW Roadmap. Whilst the NCW Roadmap seeks to avoid restating the NCW Concept, the central themes of the Concept, the network dimension and the human dimension which causes transition directly to the Roadmap are important.

The Network Dimension. The network connects military systems, including engagement, sensor and command systems. The network dimension will be the initial focus of development, and change here is expected to have a profound inûuence on the human dimension.

The Human Dimension. The human dimension is based on professional mastery and mission command. It requires high standards of training, education, doctrine, organisation and leadership. Human dimension is about the way people collaborate to share their awareness of a situation, so that they can fight more effectively (become 'networkers'). It requires trust between warfighters across different levels, and trust between warfighters and their supporting agencies. The NCW Roadmap develops these reinforcing dimensions through addition of a third fundamental component, networking.

Networking. It consists of a range of human and technical networks, which it synchronises to achieve operational effectiveness. Networking describes the manner in which networks interface or collaborate to build a self-synchronising, self-informing system of systems.

Target End States for Network Centric Warfare Capability. NCW aspirations for 2020 can be described in Target End States. These should be derived directly from national directives. These could be as given below :

(a) **Force Application in 2020. To generate a range of lethal and non-lethal effects that are both timely and appropriate and are synchronised with other Assets to achieve the desired effect.**

(i) NCW allows to accurately applying an appropriate level of force in close combat and from standoff ranges in complex environments.

(ii) Forces are able to identify friendly, hostile and neutral forces in the battlespace with enhanced accuracy.

(iii) This information is distributed through a Common Operating Picture (COP).

(iv) The COP greatly reduces fratricide and the number of platforms on standby and deployed, while significantly increasing the lethality of friendly forces.

(v) Have a robust ability - in demanding environments - to gain and share data on the effects of its application of force.

(vi) Commanders should possess a greatly enhanced decision making environment.

(b) **Information Superiority and Support in 2020. Defence has continuous information connectivity to link fighting units, sensors and decision-makers in a way that increases situational awareness and the capacity to act decisively.**

(i) Seamless interfaces exist between fixed and deployed domains within the Defence Information Environment (DIE) and between National and Armed Forces intelligence domains. An inter-Services Group of Officers would be necessary. (i.e. DISIG).

(ii) All source coordination of collection and tasking should exist across both national/services controlled capabilities.

(iii) Information is processed and analysed to provide integrated intelligence products to the right people at the right time. This would probably involve the help of the corporate sector for developing right software.

(iv) The information architecture should be robust enough to ensure continuous availability under demanding conditions, including frequent denial of service attacks by an adversary.

(c) **Command and Control in 2020. The command and control system would only get streamlined after the institution of the CDS and linkages with the INCP to enable the 'GIS' system to operate effectively :-**

(i) Commanders to achieve a virtual presence with senior decision-makers.

(ii) Make Decision-support tools as an integral and trusted element of decision-making ability of commanders and their staff.

(iii) Commanders are trusted and capable of adaptation and employing highly ûexible command arrangements in the accomplishment of assigned missions.

(iv) Capable of ûltering information for speedy decision-making in ambiguous circumstances.

(d) **Force Deployment in 2020.Be capable of rapid and accurate identiûcation, and the protected deployment, of an optimised force in the Region including the 'IOR'.**

(i) Deployment assets have access to appropriate areas of the Common Operating Picture (COP) and the tactical information environment.

(ii) The deployment of forces should be conducted with maximum efficiency and in-transit visibility and with minimum risk of interdiction enroute.

(iii) Deployment agility is achieved through self-synchronising networks at the service level and a signiûcant part of the joint force. **A joint Headquarters would have to play a lead role towards this.**

(e) **Force Protection in 2020.Forces deployed both towards the Western and the Eastern sides should have a pervasive network of active and passive sensors which are automatically fused into a COP in order to achieve an enhanced level of shared situational awareness about their surroundings.**

(i) Able to predict a wide range of environmental threats and protect deployed forces against them.

(ii) The underlying information infrastructure employed by the networked force has continuous protection in the most demanding of circumstances to ensure continuous availability in the face of determined attacks on the network by an adversary.

(iii) The fusion of information and intelligence provides automatic early warning, through secure protected networks. The existing Army, Air Force and Naval networks would have to be made interoperable and then integrated securely.

(xi) The ability to counter an adversary's Information Operations has been enhanced to such a level that they have a minimal capacity to deny the achievement of the desired effect.

(f) Force Generation and Sustainment in 2020. India will have to obtain 'out of Region' capabilities. Therefore, key logistic function networks within the National Support Area (NSA) should get linked with those in theatre and provide connectivity and a collaborative ability with industry and cooperating countries.

(i) Commanders have an end-to-end visibility of the logistic system providing the ability to rapidly and effectively prioritise scarce resources required to generate and sustain deployed force elements.

(ii) Automated ordering and replenishment takes place as supplies and ordnance are consumed by platforms and field units.

(iii) The deployed force has minimised its vulnerabilities and greatly enhanced its mobility through more effective reach back, optimum force presence and the precision sustainment for the majority of logistic requirements.

(iv) The target states outlined are necessarily broad in nature but they do not dictate how this will be achieved.

Australian Approach. Australian NCW capability development plan is being executed by a programme manager headed by a three star officer on integrated basis. In 2015, the Australian Defence Forces (ADF) will have achieved the infrastructure, tools and command and control systems capable of providing a robust battle space network and a fully networked joint task force. Communications beyond line of sight, will be synchronised and synergised through significant capability delivered by 2008 on military satcom Upgrades. Improved technology in communications would be attained through Battle Space Communication Systems for Land (JP 2072), Maritime Communication (SEA 1442) and Air Communication (AIR 5432). This will also enable battle space networks that complement surveillance, engagement and command and control systems.

(a) 2008: Broadband Networked Maritime Task Group– initial capability.

(b) 2008: Network Aerospace Surveillance and Battle space Management capability.

(c) 2009: Interim Networked Land Combat Force.

(d) 2010: Networked Fleet – mature capability.

(e) 2010: Integrated Coalition network Capability.

(f) 2012: First Networked Brigade.

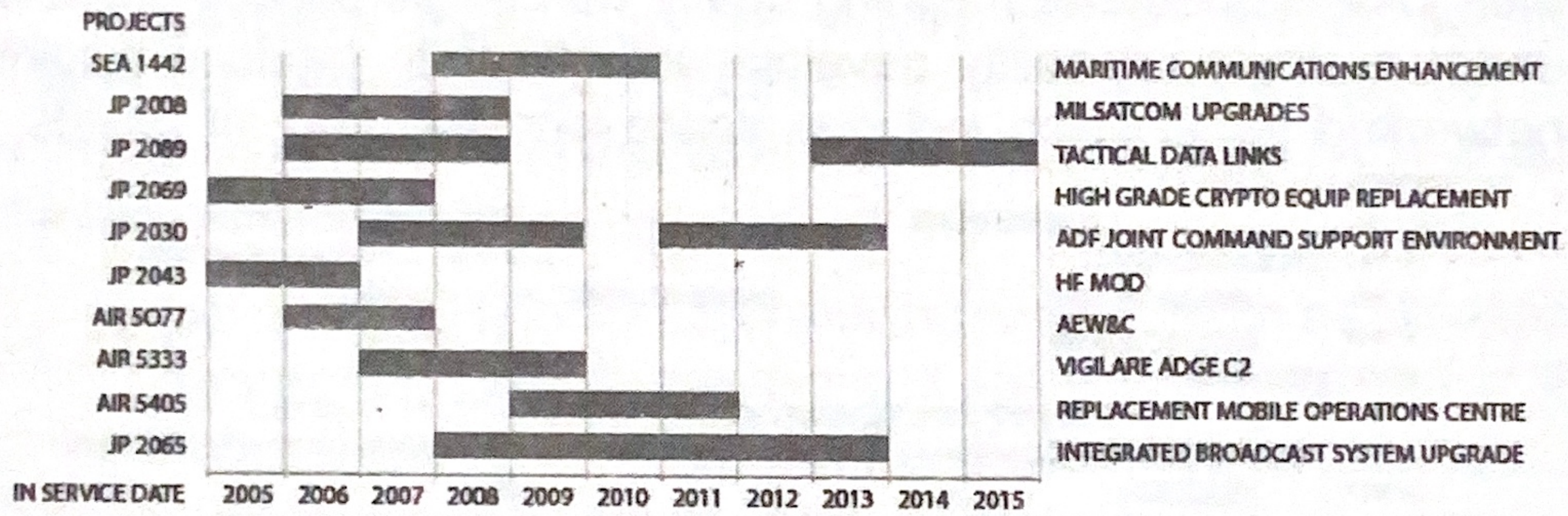
(g) 2013: Networked Air Warfare Force.

(h) 2014: Second Networked Brigade.

(j) 2015: Robust Battle space Network.

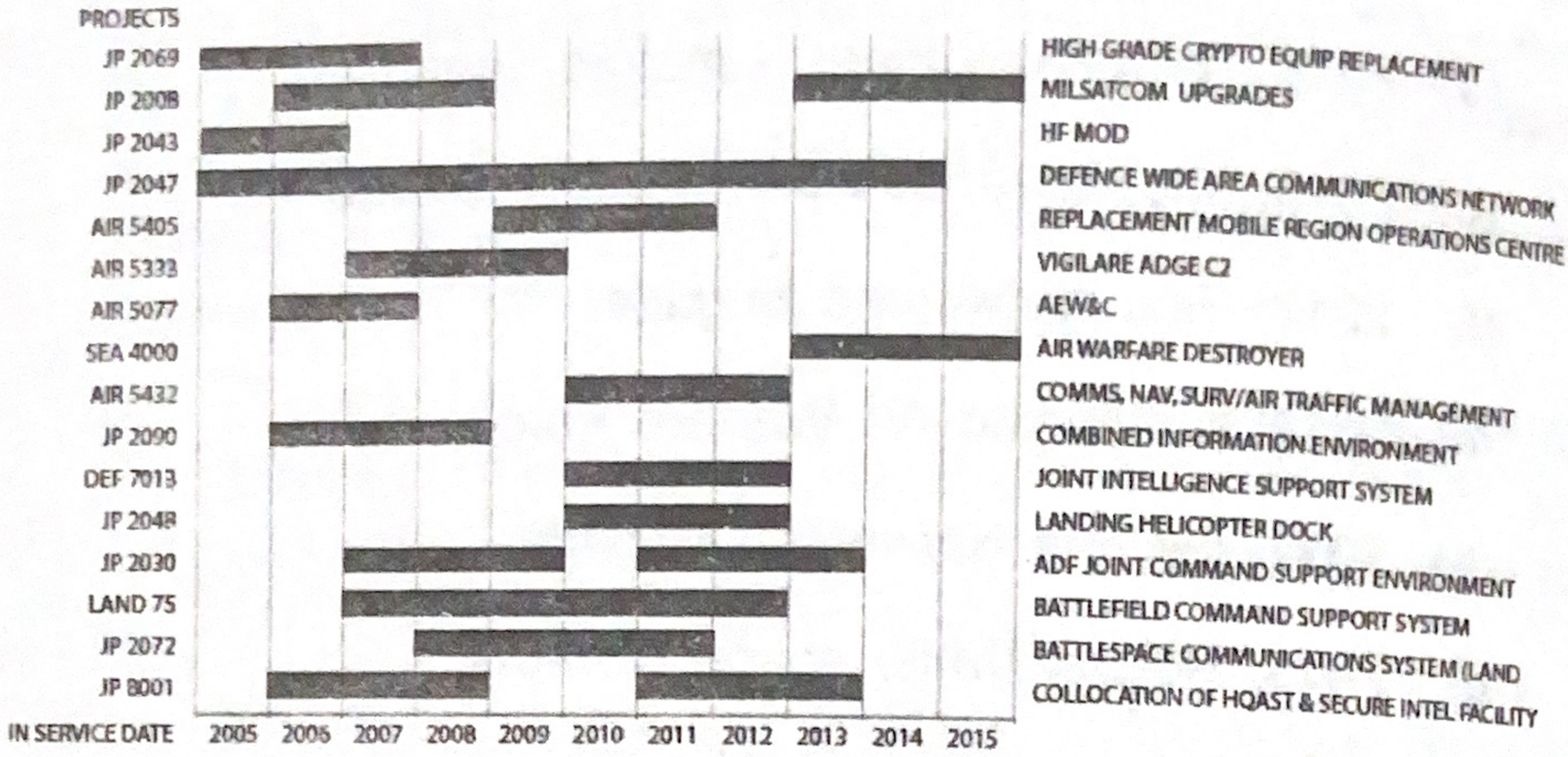
(k) 2015: Networked Joint Task Force.

2008 : Australian Network Aerospace Surveillance and Battlespace Management Capability

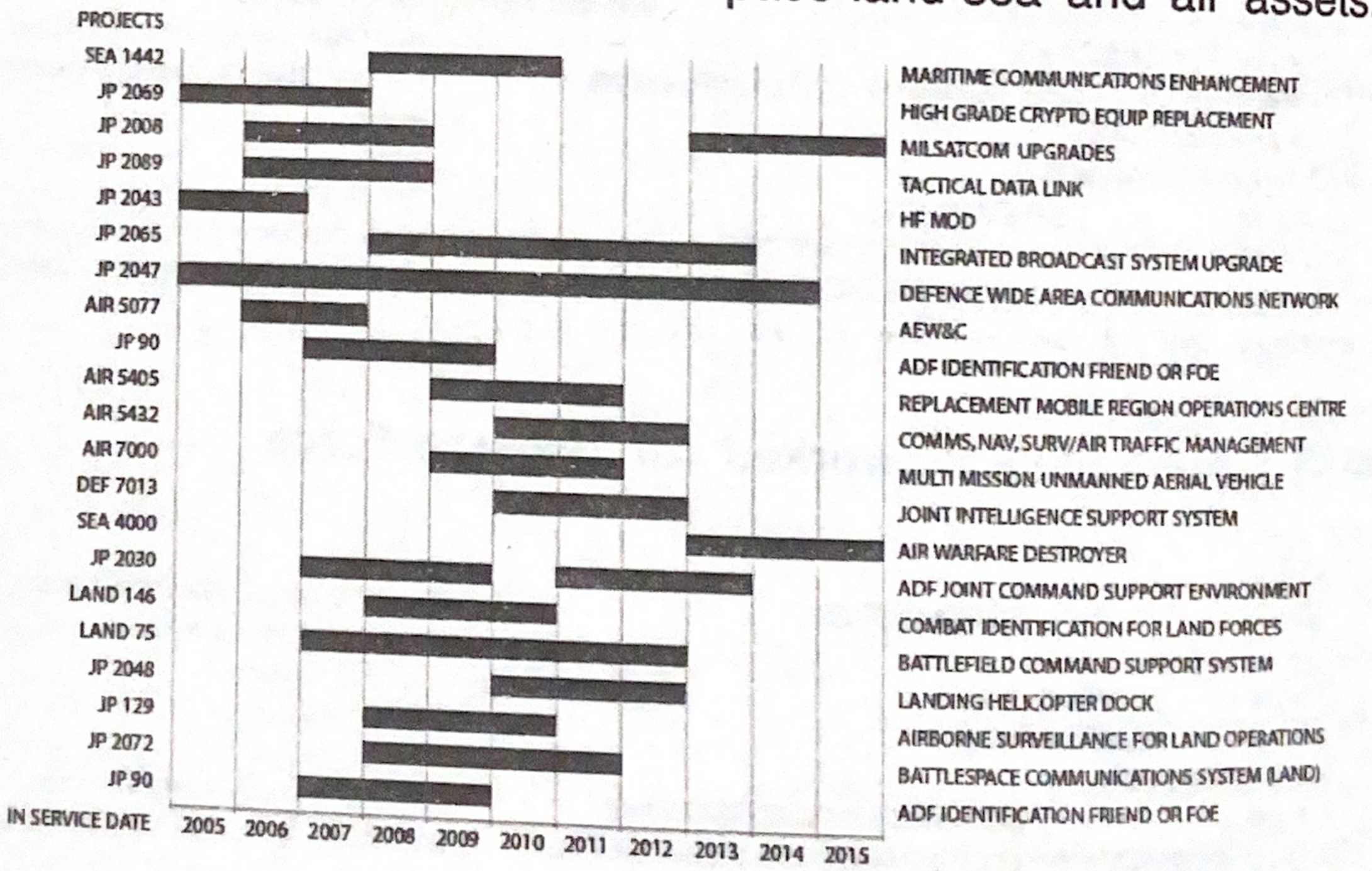


2013 : Australian Networked Air Warfare Force

2015: Australian Robust Battlespace Network



2015: Australian Networked Joint Task Force. The important point to note is the phased manner in which the project is being replaced to create a system with well deferred phased objectives. Secondly, note the number of joint projects handled by their joint headquarter meshing neatly with single service projects under a single capability development officer to produce a joint networked force which includes space-land-sea and air assets.



Current Status of NCW in India

Current status is almost negligible as no dedicated work in India has been ordered by the military on this account. It needs to be looked into by HQ IDS as military planners.

The aspect of Human Resource Development needs a strategic direction.

Network Centric Warfare Education Training and Development.

The human dimensions of NCW in respect to education, training and development (ET and D) must examine the follows requirements :-

(a) A common approach to educating Defence personnel in NCW concepts, and development of an NCW education strategy for Defence.

(b) An audit of what is currently being done with regard to education and training of Defence personnel.

(c) Identification of key target groups with regard to education and training in NCW.

(d) Development of recommendations regarding what needs to be done now, by 2010 and by 2020 with regard to education and training of Defence personnel in NCW.

Doctrine. NCW does not require its own specific doctrine products. (However, C4I2 doctrine that is developed must support the relevant aspects of the NCW Concept). The future NCW should include the following :-

(a) The provision of C2 (including aspects such as situational awareness, decision making and self-synchronisation) to the network enabled force.

(b) The integration and delivery of effects by the network enabled force.

This is a time critical task because new and more capable equipment will be delivered into service within the next five to 10 years. Without adequate doctrine to promote effective networking, this new equipment will not deliver the capability anticipated. As a matter of fact capable non-integrated systems are likely to be more of a liability in future wars than assets.

Implementation A dedicated study on road map would need to be done by the Armed Force on NCW Capability Development in collaboration with a number agencies like the National Security Council Secretariat (NSCS), NTRO, Department of Space, etc. Such a blue print would necessarily have to consider not just the technological dimensions but also the areas of organisation, doctrine and operational concepts. NCW demands flexibility, acceptability innovation and openness to change at all levels.