



Roadmap for Network Centric Operations (NCO)

Thought Leadership



September 2022

Foreword – UKIBC

With the backdrop of the evolving global geopolitical landscape, it becomes critical for likeminded democracies such as the U.K. and India to find avenues of collaboration and co-operation. This need becomes far more pertinent in the space of defence and national security as they are critical aspects of a country's national interests.

As both India and the U.K. strive towards protecting national interests within the purview of international laws, it stands to reason that the ability to jointly conduct operations would be a critical asset for both nations. Network Centric Operations (NCO) are the very first step of moving towards that objective as they would become the necessary backbone for the Indian military to build its own integrated environment. Accordingly, this paper highlights the new and evolving NCO capabilities that are part of modern warfare and how the militaries of today can leverage them effectively and efficiently.

This endeavour would greatly benefit from the combined experience, skills and technologies of companies that have been actively working in this domain, from both countries. For the companies in turn, this represents an immense opportunity for growth while simultaneously contributing to national objectives. As no decisions of this magnitude are assessed in isolation, there is a need to understand the wider landscape of the Indian defence ecosystem.

With the move towards self-reliance and self-resilience, India is keen to attract global investment into the defence sector to reduce its reliance on traditional imports. This represents

an immense opportunity for the companies, industries, and the skilled workforce in both the nations to collaborate and innovate for mutual benefit, especially in the niche domain of NCO.

As the relationship between India and the U.K. continues to evolve and grow, it becomes vital for industry bodies such as the Aerospace & Defence Industry Group (ADIG) of U.K. India Business Council (UKIBC), to continue to identify avenues for collaboration and co-operation. Through this paper, we have attempted to do just that, we are thankful to KPMG in India for their support in this endeavour and look forward to our continued engagement in the future.



Richard McCallum
Group Chief Executive Officer
UKIBC

Foreword – KPMG in India

The military's dependency on technology has grown exponentially over the past few decades. It has been demonstrated in recent conflicts globally that situational awareness has been a decisive advantage in any operation. Therefore, digital systems are being increasingly deployed by the Armed Forces since these are generating critical data, which is vital for developing a coherent picture of the battlespace to maintain operational superiority.

One of the foremost advantages that situational awareness provides is the ability to coherently deploy assets across the land, sea, and air domains. This is only possible when the assets can effectively and securely communicate with each other in real time across a secure data link. This is the philosophical essence of the concept of Network Centric Operations (NCO), as it adapts to reduce the time needed to respond to the changes on the battlefield. The Indian Armed Forces are in the process of deploying NCO as it has become a necessity to deploy critical resources effectively and efficiently. The three services have established and operationalised the Defence Communication Network (DCN) which will form the backbone for the necessary information flow.

Through this paper, we seek to explore the concept of NCO in greater detail, study the frameworks for its development, the roadmap, and challenges in its implementation. The implementation of the various aspects of NCO operations would also provide an opportunity for the Indian industry to leverage its existing expertise in the fields of network communications and IT to help develop a robust and secure system.



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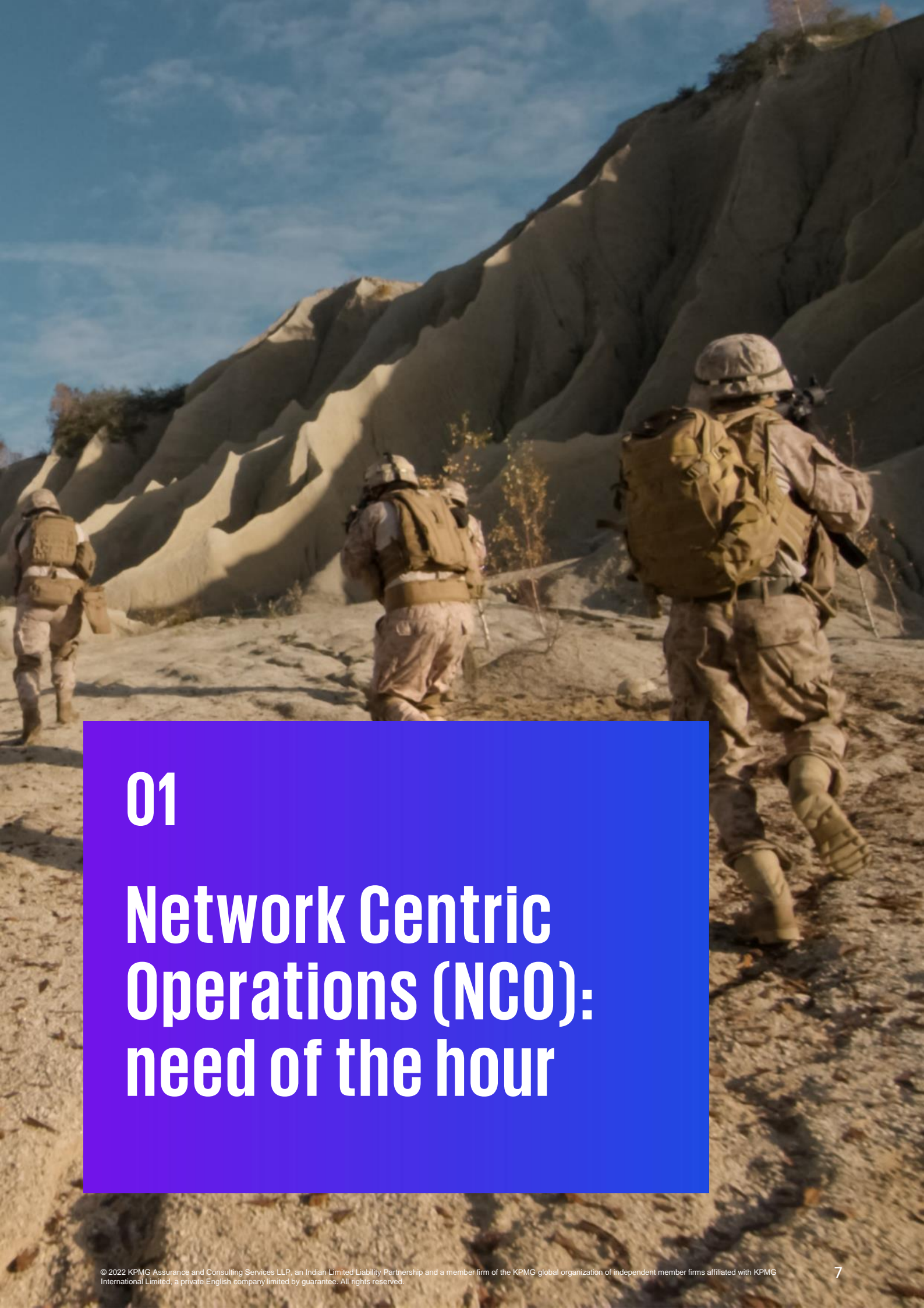
Terms and Abbreviations

Abbreviations	Expansion
A&D	Aerospace and Defence
AFNET	Air Force Net
AI	Artificial Intelligence
AMC	Annual Maintenance Contract
AoN	Acceptance of Necessity
AR/VR	Augmented Reality / Virtual Reality
AREN	Army Radio Engineered Network
ASCON	Army Static Switched Communication Network
ASP	Air Situation Picture
BCIP	Bowman Combat Infrastructure and Platform
C4ISR	Command, Control, Communications, Computers, Intelligence Surveillance and Reconnaissance
CCS	Cabinet Committee on Security
CIS	Communication and Information Systems
COTS	Commercial Off the Shelf
DAC	Defence Acquisition Council
DCN	Defence Communications Network
DII	Defence Information Infrastructure
DITCC	Defence Information Technology Consultative Committee
DPSU	Defence Public Sector Undertaking
EW	Electronic Warfare
FICV	Future Infantry Combat Vehicle
FRCV	Future Ready Combat Vehicle
IACCCS	Integrated Air Command, Control and Communications System
IDS	Integrated Defence Staff
IAF	Indian Air Force
ICT	Information Communication Technology
IMAC	Information Management and Analysis Centre
IN	Indian Navy
ISR	Intelligence Surveillance Reconnaissance
MoD	Ministry of Defence
NC3I	Naval Command Control Communication Intelligence
NFS	Network for Spectrum
NMRH	Naval Multi-Role Helicopter
TPCR	Technology Perspective Capability Roadmap
NCO	Network Centric Operations
NCW	Network Centric Warfare
O&M	Operations and Maintenance
OFC	Optical Fibre Cable
PPP	Public Private Partnership
PSU	Public Sector Undertaking
R&D	Research and Development
RFI	Request for Information
RFP	Request for Proposal
SATCOM	Satellite Communication
SDR	Software Defined Radio
SIPRI	Stockholm International Peace Research Institute



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01

Network Centric Operations (NCO): need of the hour

The nature of threats faced by defence forces is changing. Yet, the basic principle of establishing an overwhelming warfighting advantage remains the same – pierce the fog of war quickly and act decisively. In the Indian context, there is a clear call for jointness in operations of the armed forces through interoperability of assets and formations. Towards this endeavour, the position of Chief of Defence Staff (CDS) was created in December 2019 with an aim to strengthen the process of joint planning, operations and procurement.¹

Network Centric Operations (NCO) are a critical enabler that assist the armed forces in increasing speed of operations and ensuring jointness in response to external threats. In case of defence this would include the frontline soldier/ weapon system to the theatre commander to the strategic leadership. NCO can reduce the time required for taking tactical decisions while providing flexibility

to change strategic postures quickly. The focus of NCO adoption, colloquially called as digital transformation, aims to connect every function in the organisation seamlessly and align these functions towards achieving larger organisational goals.

A key element of this transformation exercise is the base networking infrastructure that enables fast and secure transmission of information across users, assets and decision makers. Furthermore, a robust network and communications infrastructure supports the use of technologies like Artificial Intelligence (AI), cloud applications, etc. Based on the armed forces' stated need for integration of the communication networks between the services, this paper builds a preliminary understanding of; India's current NCO deployments, platform level capability enhancements being pursued and to propose a roadmap for NCO deployment in India.



1. Chief of Defence Staff A historic reform in Higher Defence Organisation; Press Information Bureau, Government of India, Ministry of Defence; November 2021

A photograph of two men in camouflage uniforms standing in a server room. They are looking at a laptop held by the younger man. The older man is pointing towards a server rack. The room is filled with rows of server racks, and the lighting is dim with blue and green accents.

02

India's advance towards a networked environment

NCO is an evolving area with precedence set in basic communication networks and the future heading towards full digital connectivity. Network centricity provides advantages in increasing the speed of operations due to which, armed forces globally are moving towards deployment of NCO to meet their strategic and tactical goals

Current status

The joint doctrine and individual doctrines of the Army, Navy and Air Force acknowledge NCO scenarios and propose strategies for excelling in them. The Corps of Signals in the Army, Directorate of Network Centric Operations (DNCO) and Directorate Network and Space Operations (DNSO) in the Navy and Directorate of Signals (Air), Directorate of IT and Directorate of C4ISR in the Air Force are responsible for planning, acquisition and operation of NCO in their respective branches.² Under the aegis of the Department of Military Affairs (DMA) a 'Tri-Services Joint Working Group' has been set up to study and work out the nuances of integrating communication networks between the services.³

As part of the military's pursuit of capacity building for NCO, an integrated Defence Communication Network (DCN) has been operationalised⁴. The DCN is a tri-Service communication and IT network of the armed forces which is a major step towards ensuring network-centricity across the three services, Integrated Defence Staff (IDS) and Strategic Forces Command (SFC). The network provides converged voice, data and video services to the three Services based on a secured system with adequate redundancy.⁵ In addition to the common tri-services network, each branch of the armed forces has deployed its own communications infrastructure based on its unique requirements.



Established networks of the Army

1. Army Radio Engineered Network (AREN) is an indigenously conceived area grid radio communication system for the formations was launched more 02 decades ago. It has since grown into a potent tool for command and control through automated interoperable information and decision support systems.
2. Army Static Switched Communication Network (ASCON) was evolved to integrate the telecommunication infrastructure of the hinterland with the tactical communication networks. It is a digital, fully automated, secure, reliable and survivable static communication system based on microwave radio, optical fibre cable, and satellite communication equipment. Value-added services such as FAX, TELEX, data transfer and video are also available to defence users on this network



2. KPMG in India Analysis based on organisation structure of the Armed Forces
3. Chief of Defence Staff A historic reform in Higher Defence Organisation; Press Information Bureau, Government of India, Ministry of Defence; November 2021

4. IT Roadmap of The Defence Sector; Press Information Bureau, Government of India, Ministry of Defence; February 2018
5. RM dedicates DCN to the Nation; Press Information Bureau, Government of India, Ministry of Defence; June 2016



Established networks of the Navy

1. Naval Communication Network (NCN) is expected to provide boost to the communication throughput of the Indian Navy. Riding on the tri-services backbone, the NCN project will also be a key enabler of jointness in communications. The NCN centre at INS Valsura (inaugurated in November 2019) is one of the 33 centres that would support the NCN⁶.
2. The National Command Control Communication Intelligence (NC3I) network links 51 stations of the Navy and Coast Guard. The Information Management and Analysis Centre (IMAC) is the nodal centre of the NC3I Network and is a joint initiative of Indian Navy, Coast Guard and the DPSU involved in manufacture of electronic systems to improve coastal surveillance⁷.



Established networks of the Air Force

1. The Air Force has commissioned and operationalised an integrated air defence command, control and communications network, called Integrated Air Command, Control and Communications System (IACCCS). This network aims to provide comprehensive Air Situation Picture (ASP) for minimising 'sensor to shooter' loop by integrating all ground and airborne sensors like AWACS, aerostat etc. including civil radar networks⁸.
2. In addition to this, Air Force Net (AFNET) is the backbone of its network-centric warfare capability. The system is an optical fibre-based network on which the IACCS is deployed.⁹



6. Inauguration of Naval Communications Network (NCN) at INS Valsura, Jamnagar, Indian Navy (website), November 2019
7. Raksha Mantri Shri Manohar Parrikar Inaugurates IMAC, a Navy-CG Joint Operations Centre; Indian Navy (website), November 2014

8. Major achievements of ministry of defence from May 2014 to present ministry of defence; Government of India, Ministry of Defence; May 2018
9. AFNET to Herald Network Centric Operations in IAF; Press Information Bureau, Government of India, Ministry of Defence; September 2010

Induction of platforms that are likely to benefit from enhanced NCO

As part of their modernisation plan, the three services are inducting newer platforms with networking capability. The following are some of the major platforms that are at likely to be acquired or whose necessity has been accepted by the MoD.¹⁰



Army

Platforms proposed to be acquired by the army under its modernisation plans¹¹:

1. Helicopters including Light Combat Helicopter (LCH) and Light Utility Helicopter (LUH)
2. Tanks including Arjun Mk. II and a light tank under Make 1 route
3. Modern artillery gun systems - K9 Vajra and Dhanush artillery guns.

Platforms approved by the DAC for acquisition by the army:

1. BMP-2/2K Sarath Infantry Fighting Vehicle (IFV) upgrades¹²
2. Future Ready Combat Vehicle (FRCV)
3. Future Infantry Combat Vehicle (FICV).



Navy

The following are the key platforms which are under construction¹³:

1. Indigenous Aircraft Carrier (IAC) (undergoing sea trials)
2. 03 Arihant class nuclear submarine (1 sea trials, 2 in different stages of construction)
3. 02 Scorpene-class submarines
4. 03 P-15 B class missile destroyers
5. 07 P17A class missile frigates (planned)
6. 05 Fleet Support Vessels
7. 04 P1135 Kravac Class Frigates.

The Navy also has Acceptance of Necessity (AoN) for 41 ships including:

1. Multi-purpose support vessels¹⁴
2. 24 Multi-Role Helicopters (MRH)
3. 06 additional P-8I maritime reconnaissance aircraft¹⁵.

Other platforms approved by DAC for acquisition:

1. Light Maritime Utility Helicopter ("Naval Utility Helicopter (NUH)¹⁶
2. Naval Shipborne Unmanned Aerial System (NSUAS)¹⁷
3. Landing platform Docks (LPD)¹⁸
4. Project 75I Submarine¹⁹
5. MQ-9 Sea Guardian (UCAV).

10. KPMG in India analysis based on published RFP/ RFI, MoD press releases for DAC and AON approvals.
 11. KPMG in India analysis based on published RFP/ RFI, MoD press releases for DAC and AON approvals.
 12. Make in India gets a big boost; MoD places indent for supply of 156 upgraded BMP Infantry Combat Vehicles of value Rs 1,094 Cr on OFB; Press Information Bureau, Government of India, Ministry of Defence; June 2020
 13. KPMG in India's analysis based on released RFPs/ RFIs/ MoD press releases for DAC and AON approvals.
 14. Defence contract worth ₹887 crore inked for two multi-purpose vessels for Indian

Navy; The Hindu, March 2022
 15. Delighted With Fleet, Indian Navy Clears Decks For 6 More P-8Is; Livefistdefence.com; November 2019
 16. India to float \$5bn tender for 234 naval choppers: Here is all you need to know; Hindustan Times; August 2017
 17. Centre Approves Indian Navy Proposal To Buy 10 Shipborne Drones; NDTV; January 2021
 18. New Delhi issues RFI for four locally made LPDs for Indian Navy; Janes.com; August 2021
 19. 6 Made-in-India Submarines for Navy for 53,000 Crores; October 2014



Air Force

Platforms proposed to be acquired by the Air Force²⁰:

1. 114 fighter jets under the Multi-role Fighter Aircraft (MRFA) competition
2. CATS Warrior – UAV
3. Medium Altitude Long Endurance (MALE) UAVs
4. Advanced Medium Combat Aircraft (AMCA)
5. Omni Role Combat Aircraft (ORCA)
6. Tejas Mk 2.

Platforms approved by the DAC for acquisition by the Air Force:

1. 83 Tejas MK-1A advanced fighter jets²¹
2. Dassault Rafale fighter aircraft²²
3. 56 C-295 military transport aircraft²³
4. Weaponized Utility Helicopter (Rudra)
5. Light Combat Helicopter²⁴
6. Advanced Light Helicopter Mk 3.²⁵



20. KPMG in India's analysis based on released RFPs/ RFIs/ MoD press releases for DAC and AON approvals
21. Cabinet approves Procurement of 83 Light Combat Aircrafts (LCA) 'Tejas' from HAL for IAF; Press Information Bureau, Government of India, Ministry of Defence; January 2021
22. Rafale aircraft formally inducted into Indian Air Force in the presence of Raksha Mantri Shri Rajnath Singh and Ms Florence Parly, Ministere of Armed Forces of France; Press Information Bureau, Government of India, Ministry of Defence; September 2020

23. Cabinet approves procurement of 56 C-295MW transport aircraft for Indian Air Force; Press Information Bureau, Government of India, Ministry of Defence; September 2021
24. CCS Approves Procurement of 15 Light Combat Helicopters (LCH) Limited Series Production (LSP) from HAL for IAF (10) & IA(05); Press Information Bureau, Government of India, Ministry of Defence; March 2022
25. Defence Acquisition Council headed by Raksha Mantri approves proposals of value Rs.13,165 cr.; Press Information Bureau, Government of India, Ministry of Defence; September 2021

Projected requirement for NCO and associated equipment

In parallel with the acquisition of advanced platforms listed in the previous section, an upgrade of the legacy NCO infrastructure and induction of new technology to maintain a warfighting edge through NCO is integral to the concept of operations of the Armed Forces. A section on networks and communication equipment within the Technology Perspective and Capability Roadmap (TPCR) 2018 encapsulates some of the requirements for technology development in the field of NCO. The technologies required are in the areas of Optical Fibre Cable (OFC) networks, Software Defined Radios (SDRs), Satellite Communication (SATCOM) terminals, High Frequency (HF) sets.²⁶ While, these efforts are aimed at creation of NCO infrastructure, there is a need for a comprehensive roadmap for future acquisitions and capability development.



26. Technology Perspective and Capability Roadmap (TPCR); Government of India, Ministry of Defence; 2018

A photograph of a tank's main gun barrel, angled upwards from the right side of the frame towards the top left. The barrel is dark and metallic, with some wear visible. The background is a bright, overcast sky with soft, white clouds. The tank's turret and some tracks are visible on the right side of the image.

03

NCO deployment frameworks

The advancement of NCO is contingent upon the coming together of multiple organisational elements which must interact with established frameworks. These frameworks pertain to the functions of planning, budgeting, financing and implementation. There are various organisations involved in each of these activities and the eminence of each organisation along with their functions is enumerated in the succeeding sections.

Consultation and planning

The function of consultation and planning applies to the act of developing roadmaps and strategies that will guide the adoption of various NCO components. In a limited capacity, the function of consultation and planning can also be extended to oversight of budgetary allocation and project implementation.

Defence Information Technology Consultative Committee (DITCC)

The DITCC plays an advisory role in the rollout of IT capabilities in the armed forces which comprises of eminent personalities from the MoD, the three Services, Ministry of Communication and IT, Academia and the industry.⁷⁵ In consultation with the DITCC, the defence services have promulgated an ICT Roadmap incorporating 21 IT projects during the period 2016-2020. This roadmap includes ongoing and future tri-services ICT projects leading to effective use of ICT in areas such as network centric operations, information security, planning, stores management, general administration and hospital management. The DCN operationalised in 2016 and the Network For Spectrum (NFS) project, for laying optical fibre to provide a dedicated communication and IT backbone network are few of the prominent projects being pursued under this roadmap.²⁷

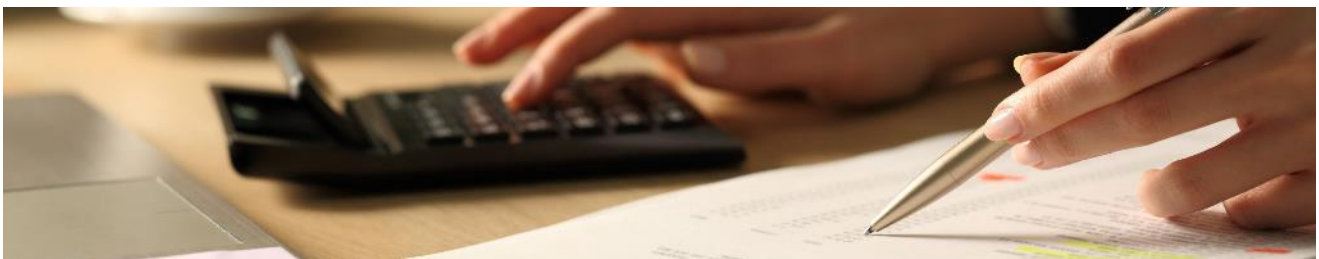
Department of Military Affairs and Chief of Defence Staff

In December 2019, DMA was created to undertake common functions across the tri-services. Concurrently, the position of the Chief of Defence Staff (CDS) was created to head the DMA where CDS holds the position of Permanent Chairman of Chiefs of Staff Committee.²⁸ Also, the CDS has the responsibility of commanding the tri-services agencies related to cyber and space operations.

The CDS intends to bring about reforms in the functioning of three services aimed at augmenting combat capabilities which is proposed to be achieved by bringing about jointness through joint planning and integration of their requirements. As a part of this mandate, a Tri-Services Joint Working Group has been set up to study and work out the nuances of integrating communication networks between the services.²⁹

Budgeting

The functions of budgeting and procurement link the strategic intent to on-ground implementation through the process of budgetary allocation and approvals processes.

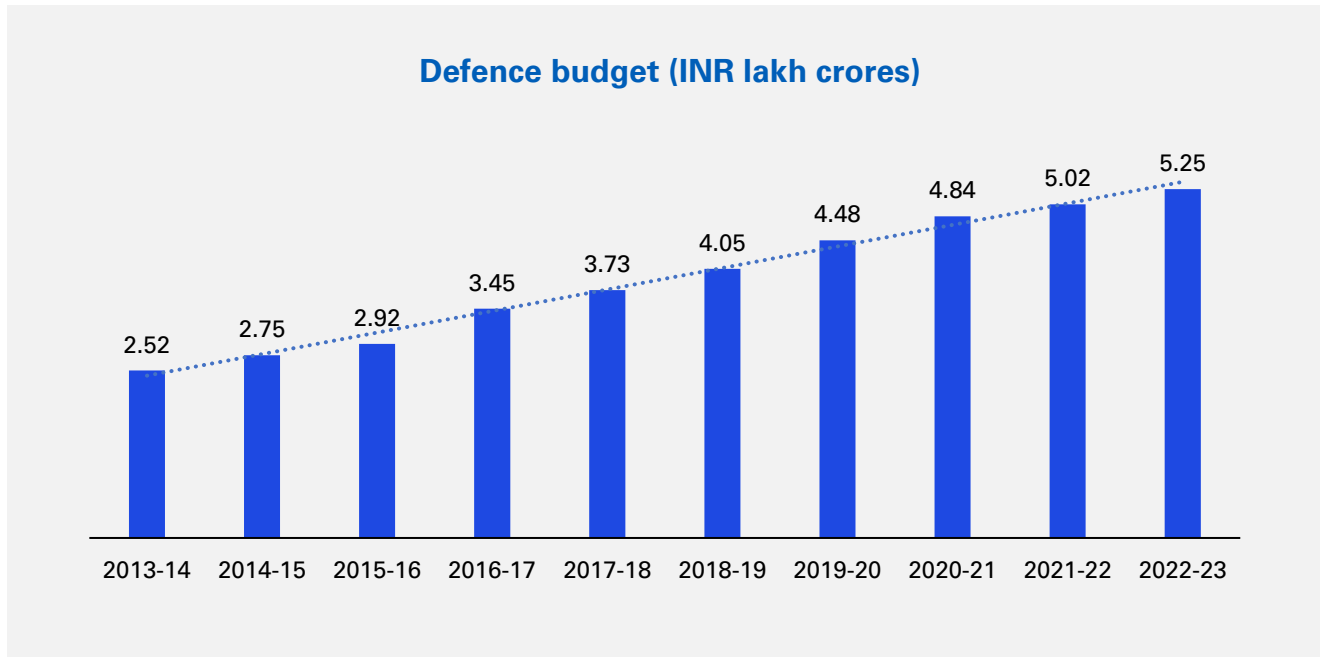


26. IT Roadmap of The Defence Sector; Press Information Bureau, Government of India, Ministry of Defence; February 2018
27. Cabinet approves creation of the post of Chief of Defence Staff in the rank of four star General; Press Information Bureau, Government of India, Ministry of Defence; December 2019

28. Chief of Defence Staff A historic reform in Higher Defence Organisation; Press Information Bureau, Government of India, Ministry of Defence; November 2021

Budget allocation

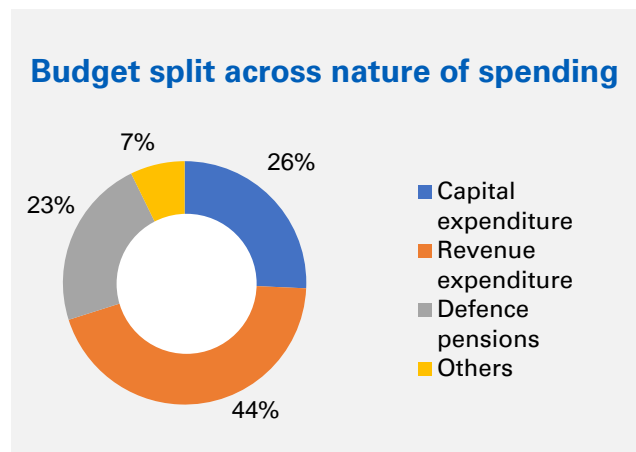
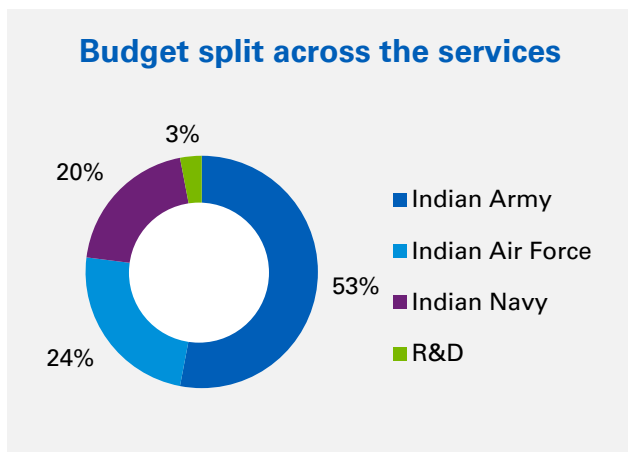
India was the third-largest defence spender in the world in absolute terms, in 2021³⁰ after U.S. and China. In the Union Budget 2022, INR 525,167 crores³¹ (~ USD 70 billion) has been allocated towards the defence budget (including pensions) for FY 2022-23. This constitutes 13.3 per cent of the central government's budget and 2.03 per cent of India's estimated GDP for the same period. Over the past decade, India's annual defence expenditure has increased at a CAGR of approximately 10 per cent.³² This increase is illustrated in the following graphs.



The split of military expenditure across the services in the current budget is Army 53 per cent followed by Air Force 24 per cent and Navy 20 per cent respectively. The expenditure towards DRDO is around 03 per cent.³³

Military expenditure is split across the heads of revenue expenditure, capital outlay, defence pensions, civil and miscellaneous expenditure. Capital outlay includes expenditure on purchasing

defence equipment; land, naval and air platforms; and construction of roads and bridges in border areas. Revenue expenditure is directed towards purchase of supplies, spares and other items required for the upkeep of platforms and to maintain operational positions. Personnel costs which comprise of pay and allowances and pensions are one of the largest heads for defence expenditure and MoD spends more than half of its defence budget on salaries and pensions.³⁴



30. Trends in world military expenditure, 2021; Stockholm International Peace Research Institute (SIPRI), April 2022.

31. Union Budget 2022-23; Press Information Bureau, Government of India, Ministry of Defence; February 2022

32. KPMG in India analysis of the Union Budget 2022-23

33. KPMG in India analysis of the Union Budget 2022-23

34. KPMG in India analysis of the Union Budget 2022-23

Budget for acquisition and maintenance of NCO infrastructure

The budgetary allocation for creation of new NCO infrastructure generally comes from the capital outlay, while the budgetary allocation for acquisition of new equipment and capabilities for existing platforms is embedded within various minor heads of the larger revenue expenditure head. In recent years the armed forces have focused on life-cycle costs of equipment and not just the upfront purchase costs.

An analysis of recent NCO acquisitions which include maintenance cost of existing NCO infrastructure and independent analysis of annual maintenance contracts for existing NCO infrastructure reveals that the cost of deploying new systems comes to approximately INR 3,000 crore and the expenditure on maintenance is approximately INR 100 crore per annum . With the lifecycle of NCO technology being between 6 to 10 years, the lifecycle costs add up to almost INR 4,000 crore. In the Indian context, multiple such systems are being deployed and maintained which burdens the budgetary allocations.³⁵



Procurement

Procurement procedures, policies and processes

The DAP and DPM are the primary processes for procurement within the defence services. The features of each and differences between them are illustrated in the below table.

S NO	DAP	DPM
a	For capital procurement	For revenue procurement
b	Only done by service headquarters and MoD	Delegated to command headquarters up to unit level
c	Two bid system only	Procured under various methods
d	Only OEMs can participate	Agents/ Distributors/ Authorised representatives can participate
e	Time duration longer	Time duration truncated

In the context of NCO infrastructure, the DAP defines the mechanism for high value capital procurements for large multi-service or service-wide backbone networks and the DPM defines the mechanisms for maintain and upgrading existing NCO and communications infrastructure. Both these activities require meticulous planning and financial allocation in different budget heads.

The 2020 version of DAP includes a chapter on ICT procurement. This inclusion is a welcome move for NCO technologies which have longer lifecycle times and require significant investments in maintenance over their lifecycles.

35. KPMG in India analysis of NCO RFP, awarded NCO contracts, annual reports of system integrators

Network and communications technology backbone

A common network and communications technology backbone can bridge the gap between independent intelligence gathering and dissemination agencies by creating an overarching structure of data sharing on a central platform. The following table compares the current capabilities of the backbone network infrastructure to technologically feasible capabilities that can be incorporated in the network and communications infrastructure.

Current capabilities	Future developments
Platform-centric	Network-centric
Circuit based data transmission	Data transmission based on internet protocol
Bandwidth limitations	Bandwidth on demand
Limited operational picture	Situational awareness
Fixed and remote command and control	Mobile, deployable, in-transit command and control
Individual	Collaborative
Stovepipe decision making	Communities of interests
Private data	Shared data
Single points of failure	Diverse routing
Interoperability by standard applications	Interoperability designed from start

In addition to its core capabilities, NCO infrastructure has the potential to act as a key enabler for other maturing technologies viz. Augmented Reality (AR)/ Virtual Reality (VR), Internet of Things (IoT), Artificial Intelligence (AI) and robotics. These technologies have potential applications that span across the areas of training and simulation, automation, vehicle to everything (V2X communication), etc. With the deployment of a robust NCO backbone, these technologies can reach maturity levels for enterprise wide use faster.



Implementation

System Integrators

The implementation of ICT projects is typically done by a System Integrator (SI) with the responsibility for architecture design, procurement and operationalisation of all components of the project. The selection of SIs is done through competitive bidding typically following the procedure laid out in DPP and DPM. In the matter of national security, it is critical to have indigenous SIs and to ensure the origin of components used in the creation of NCO infrastructure. Indian IT industry has built adequate capability in this aspect.

Network for Spectrum (NFS)

The NFS project was approved in 2012 with a budget of INR 13,334 crore, which was enhanced by INR 11,330 crore³⁶ by the Cabinet Committee on Economic Affairs chaired by the Prime Minister. Network For Spectrum (NFS) is an exclusive optical fibre based 'Nationwide Communication Network' for defence services. This will be a countrywide secure, multi-service and multi-protocol converged network based on a dedicated tri-services optical transport backbone.³⁷ It is being implemented by a Public Sector Undertaking (PSUs) under the Department of Telecommunications

Case Study

The joint doctrine guidance by the British military on planning and execution of Communications and Information Systems (CIS)³⁸ support to joint operations states the following characteristic of the deployed CIS are essential to ensure that the most effective and efficient CIS solution emerges to accommodate the commander's intent. The British Armed Forces operate a wide range of communications and information systems in active field situations. Some of these are specialised bespoke systems, while others are Commercial Off- The- Shelf (COTS). They fall into three main categories:

Digital communication

Digital communication is the backbone of a modern battlefield where increasingly large amounts of information must flow without interruption.

Tactical communication

The Bowman Combat Infrastructure and Platform (BCIP) of tactical radios provide the British Army with High Frequency (HF), Very High Frequency (VHF) and Ultra High Frequency (UHF) voice and data communications from formation headquarters forward to the fighting units.

Satellite communication

Skynet 5 military communications satellite system is a constellation of 04 next-generation spacecraft built to meet the needs of the UK Armed Forces and other government organisations.

In addition to this, there is a core network called the Defence Information Infrastructure (DII) which is a secure military network owned by the United Kingdom's MoD. It is used by all branches of the armed forces, including the Royal Navy, British Army and Royal Air Force as well as MoD civil servants

36. Cabinet approves enhancement of budget for implementation of Network for Spectrum for Defence Services; Press Information Bureau Government of India Cabinet Committee on Economic Affairs (CCEA); May 2018

37. Connecting Bharat; Department of Telecommunications, Ministry of Communications & Information Technology, Government of India; 20144

38. House of Commons - Public Accounts Committee: Defence Information Infrastructure First Report of Session 2008-09



04

Challenges in NCO adoption

Network infrastructure projects are both large and complex. Their execution requires bringing in vast investments and policy changes, while navigating through technical, operational and management impediments. Ensuring timely deployment of technologies, protection of network data and simultaneously meeting industry assurances presents considerable issues on the technical front. Investments remain a bigger challenge as these decisions need to come through various agencies that are responsible for individual and joint commands. These issues represent challenges that must be overcome to reach the ultimate goal of working in a networked environment that supports joint operations seamlessly.

Balancing priority between platforms and capabilities

Induction of major platforms across the tri-services is a priority to ensure operational effectiveness while managing obsolescence of vintage equipment. There is a need to balance platform acquisition with capability enhancement in NCO. A move towards jointness in operations by the tri-services would need interoperability and bring to focus operational gaps in the respective NCO. Therefore, a joint plan for building NCO capability must be made, keeping in mind the needs of interoperability and obsolescence management.

The standing committee on defence during its assessment of demand for grants remarks that, "During the course of the deliberations on Demands-for-Grants, the Committee learnt that any modern armed forces should have one-third of its equipment in the vintage category, one-third in the current category and one-third in the state-of-the-art category. However, the current position in the Indian Army reveals that 68 per cent of

equipment is of vintage category, just about 24 per cent of the current category, and only eight per cent of the state-of-the-art category..."³⁹ Despite the variation in its vintage, all equipment must be able to communicate effectively and be able to access the various NCO capabilities developed to increase warfighting effectiveness.

The platforms proposed to be acquired will come with current generation NCO capabilities which would then be integrated with vintage equipment. Therefore, there is an urgent need to view all equipment through the lens of NCO capability and invest in core infrastructure that can support interoperability of equipment with different vintages and subsequently, interoperability across the services. A vision for a common network that can bring about interoperability and the requisite frameworks that can aid in the achievement of the vision of interoperability both need to be addressed.

Budgetary allocations

An analysis of the allocation for modernisation of armed forces against the committed liabilities for the period between 2016-2022 reveals that the budget allocation for modernisation majorly covers committed liabilities with minimal funds for new schemes. With an aim to avoid defaults on defence procurement contracts and considering the long-term nature of defence acquisition, the Standing Committee on Defence (2017) had recommended creation of a non-lapsable capital fund account for defence modernisation. There was objection to this fund on various grounds by

the Ministry of Finance (MoF) and eventually, the 15th Finance Commission constituted an expert group to examine the proposal for setting up of a non-lapsable fund or other options for continued defence capital expenditure funding⁴⁰.

NCO, jointness in operations and interoperability of assets are considered critical investments, however these aspects have not merited dedicated budgetary allocations yet. Non-availability of budget is a major impediment to the timely roll out of NCO

39. "41st Report: Demands for Grants (2018-19) Army, Navy, Air Force", Standing Committee on Defence, March 12, 2018,

40. 41st Report: Demands for Grants (2018-19) Army, Navy, Air Force", Standing Committee on Defence, March 12, 2018,

Standards and frameworks for ICT rollout

The DITCC, which is tasked with overseeing the rollout of ICT in armed forces, plays a consultative role to provide oversight and guidance. However, there is a need for a more proactive role to be played to lay a strong foundation for ICT in the forces leading to an effective and efficient NCO network. The architecture of NCO infrastructure plays a vital role in building mitigating factors for managing risks and vulnerabilities. Joint operations would need better interconnectivity which would require defining of robust standards for technology adoption, lifecycle maintenance, System Integrator (SI) selection and project management.

Technical training and maintenance

The operation and maintenance of the existing equipment remain a challenge, and many of the technologically advanced devices available for deployment are not optimally utilised because of the required technical expertise. These issues arise because the user is different from the maintainer; hence the availability of technical personnel must be uniform. Further, the exorbitant cost of the electronic devices and the lack of easy availability of spare parts act as a deterrent against their use.

Involvement of private industry

ICT is one area in which private industry has surged ahead of the defence sector in both R&D and implementation. Indian ICT capability in private industry is commendable and recognised globally. However, the reliance of the defence sector on Defence Public Sector Undertakings (DPSUs) has disincentivised private industry from involving itself in the defence sector.

Offsets have been used effectively in the creation of local competence in defence manufacturing across a wide spectrum of products and services. However, this opportunity has not been extended to organisations developing ICT/ NCO solutions.





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Roadmap for NCO

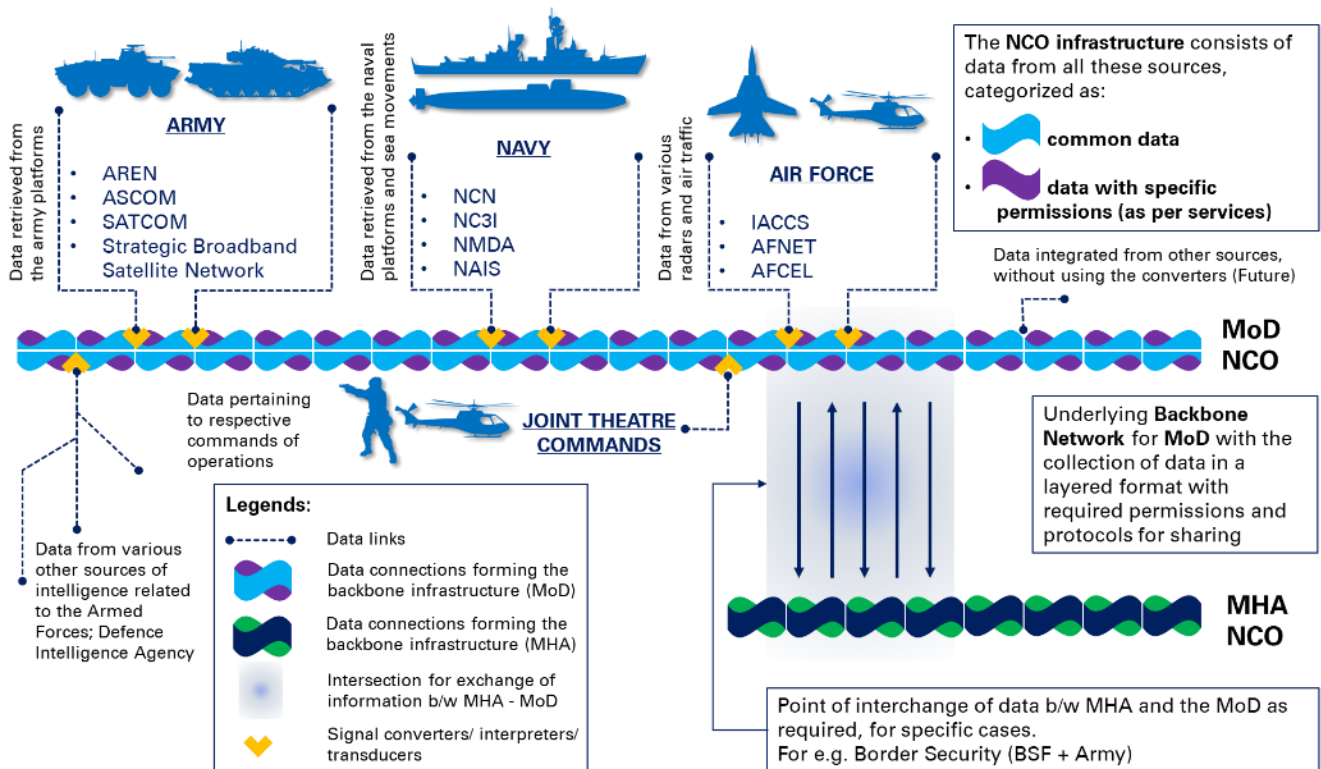
Globally, there is a precedence for investment in communications infrastructure. The race to develop next-generation solutions is being led by private industry, and lifecycle of each technology generation is becoming increasingly shorter.

The vision of a networked future

In the Indian context, the organisational changes precipitated through the formation of the DMA and CDS, are expected to redefine the role of NCO. The emphasis of CDS on jointness in operations needs to be translated into a vision for a networked future wherein network infrastructure is interoperable between the tri-services and is based on a common defence network which seamlessly

connects all networks and platforms of the three services.

The following graphic illustrates the proposed NCO backbone architecture. It represents a layered approach for information dissemination while considering the proposed theatre commands and options for data interchange to external networks for extended applications in internal security..



Technology plays an intrinsic part in the formation of a long-term vision. 5G is widely believed to be a disruptive technology which can be merged with existing fibre optic networks with the use of micro cells and provide fast reliable and secure communication of voice, data and video to field units. With the current status of 5G development,

its inclusion in the vision of a networked future must be considered.

Publication of CDS's approach through whitepapers and NCO doctrines would enable stakeholders and private industry to build appropriate capacity to fulfil the needs of the armed forces

Managing network infrastructure lifecycle

Time is of the essence in deploying NCO solutions due to the fast pace of technology development. If the procurement process for capital acquisition runs into years, it is more than likely that by the time a system is inducted, it is already a generation old. Therefore, the definition of tangible goals along with planning and execution for the timely achievement needs to be done in mission mode. This involves planning for obsolescence management, phasing of procurement, ensuring budgetary allocation and coordination with multiple agencies. Hence, Mission planning is the most critical aspect of NCO deployment and is necessary regardless of the vision being pursued.

Definition of standards, frameworks and architectures

In recent years, at least 03 SIs have been awarded contracts for establishment or O&M⁴¹ of different networks. If a standard architecture with interchangeable components is developed at the start of deployment, overall O&M costs can be brought down significantly. Also, this would aid in interoperability of systems and foster jointness in operations.

Investment in network infrastructure is made over a 15 to 20-year horizon wherein there can be multiple overlapping phases of NCO system implementation, each being done by a different SI. A digital network consists of an assortment of

hardware, software and monitoring components. The development of a robust architecture is critical to the successful design, implementation, operation and long-term maintenance of the network. To achieve this successfully, it is imperative that network design be seen as a development programme that caters for feasibility study, architecture design, proof of concept, system integration and long-term lifecycle upgradation and maintenance.

Just as standards are required for network architecture, standards are also required for the selection of SIs and monitoring of project implementation. It is therefore strongly recommended that a reference framework for project implementation, which is likely to ensure compatibility of solutions from different SIs and timely implementation of each phase, while restricting lifecycle costs may be created. This can include detailed provisions for on-boarding partners who can assist in all phases of solution deployment. It is recommended that standards and reference architectures of NCO may be clearly defined in consultation with manufactures, private industry, SIs and end-users to enhance the effectiveness of the implementation of network infrastructure and the corresponding communication systems.

The following two approaches can facilitate lowering of lifecycle costs:

Approach 1 – Open Architecture	Approach 2 – Design of dual use systems
Open architectures that allow multiple vendors to supply components/systems is a cost-effective method for deploying capital intensive NCO infrastructure. Multiple vendors will be able to bid for network maintenance and upgrade contracts leading to lower lifecycle costs	Dual use of NCO infrastructure between military, para-military and civil authorities can lead to economies of scale leading to lower lifecycle costs.

Traceability and use of indigenous content

The use of indigenous content and development of NCO operations is central to the idea of security of the network infrastructure. The control over the network supply chain provides the much-needed insulation from disruption and cybersecurity threats. Use of indigenous content and traceability of components would assure the users of quality of sub-systems leading to fewer checks and faster procurement process.

41. KPMG in India analysis of RFP/ RFI and annual reports of System Integrators

Implementation

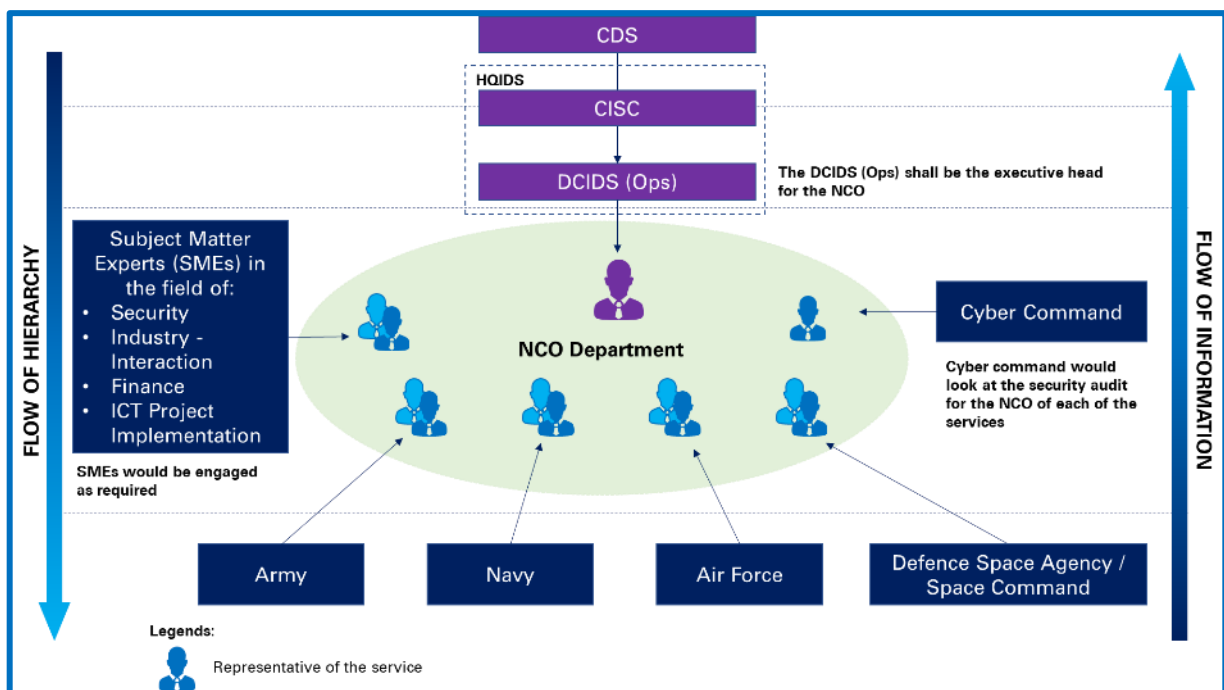
Implementation is where all vision and mission planning are ultimately tested as technology reaches end-users. Fast and effective implementation is key to maintaining technological superiority and managing lifecycle costs. The following recommendations are proposed to oversee implementation of NCO infrastructure in line with the vision and innovation components of the broader NCO roadmap.

Establishment of a dedicated department for NCO

The lifecycle for military platforms ranges from 30 to 40 years, and the lifecycle for network connectivity solutions ranges from 6 to 8 years. Hence, each platform is likely to have 4 to 6 upgrades of network connectivity equipment over its lifecycle. This constant need for upgrades requires a cyclic implementation of vision and technological development hand in hand, so as to ensure readiness for the future and present

capability development. Further, since the induction of platforms is staggered, inevitably, platforms of different vintage operate simultaneously as described earlier. In this scenario, a dedicated department of NCO can manage the challenge of interoperability among equipment of different vintage.

It is recommended that a dedicated central department with overall responsibility and authority to determine all aspects of NCO adoption may be established. The responsibility and authority of the department shall extend over technical specifications, project planning and execution, and budget allocation for all NCO projects. The department should be staffed by RF engineers, Industry 4.0 experts and representatives of end-users. The department shall be the nodal agency for NCO across the three services and the upcoming space and cyber commands. The following structure is proposed for this independent department:



The offices of CDS and the DMA have a key role to play in this activity of coordination with multiple organisations leading to the transformation of the armed forces through induction of NCO capability. The CDS should be designated as the nodal head of the department of NCO, while the HQIDS acts as the executive agency to manage operational level activities

Creation of a budget head for funding NCO projects

The much-needed flexibility and planning required for development, induction and commissioning of the latest solutions for NCO can be catered by the creation of a separate budget head. A ring-fenced budgetary allocation is necessary to ensure continuous deployment, maintenance and upgrade of NCO infrastructure. The control of the budget must fall under the ambit of the HQIDS, delegated to DCIDS (Ops), which shall decide upon the demands for the NCO infrastructure,

To ensure availability of budget it is recommended that minor budget heads be created in the MoD demand for grants. Also, the budget heads are necessary for both capital acquisitions and revenue expenditure.

Training and human resource development

The deployment of state-of-the-art equipment and complex backbone infrastructure for the NCO entails the deployment of skilled manpower for operation and maintenance of the network. Furthermore, with the anticipated growth of NCO across diverse sectors, the prevalence of such equipment is going to increase manifold, with which there will be an increased demand for skilled manpower across the armed forces. Therefore, induction of manpower with right skillsets and the training of existing manpower to upskill them to handle the NCO equipment becomes essential. The skilling, training and development of the human resource will improve the effectiveness of the armed forces through a streamlined use of NCO, by enabling the workforce to be comfortable with the equipment, in terms of usage and applicability. The skilled manpower should be able to operate and maintain the equipment as per the requirements and must be able to plan, implement and develop solutions for defence requirements using existing/emerging technology frameworks.

To bring in the required expertise, it is proposed that new cadre of IT/NCO ranks be created within the armed forces, this cadre could be housed within the existing organisation structure, within the departments dealing with communications and NCO. The proposed department of NCO should look to develop the requisite training infrastructure for the above mentioned (up)skilling requirements and must ensure that along with the introduction of NCO equipment, capable and skilled workforce also enters the services to use the NCO infrastructure effectively.

Involvement of private industry in shaping NCO policy and strategy

It is evident from the recent deployment of NCO projects that private industry is both capable and cost-competitive compared to DPSUs and has been awarded contracts in competitive bidding. Specifically, the capability of Indian private enterprises and PSUs is elaborated in Chapter 5, Section 5.3 of this whitepaper. Also, it is pertinent to mention that private industry has outpaced defence establishments in the R&D and adoption of NCO infrastructure; hence the participation of private industry in NCO development must be encouraged.

Since the private industry has taken the lead in developing solutions, its participation in creating frameworks, standards and reference architectures is of utmost importance. Private industry can play a proactive role in guiding defence departments in defining frameworks for defence and internal security NCO. Furthermore, private industry is attuned to the fast pace of technology development and is aptly equipped to suggest means for faster deployment and improvement of NCO infrastructure. It is, therefore, recommended that private industry be given a larger role in policy and strategy formulation for NCO.

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KPMG in India

KPMG in India, a professional services firm, is the Indian member firm of KPMG International and was established in September 1993. Our professionals leverage the global network of firms, providing detailed knowledge of local laws, regulations, markets and competition. KPMG has offices across India in Delhi, Chandigarh, Ahmedabad, Mumbai, Pune, Chennai, Bengaluru, Kochi, Hyderabad and Kolkata. We strive to provide rapid, performance based, industry-focussed and technology enabled services, which reflect a shared knowledge of global and local industries and our experience of the Indian business environment.

Aerospace and Defence practice, KPMG

KPMG has a strong global Aerospace and Defence (A&D) practice that serves most of the leading OEMs across the globe. In India, KPMG recognises the significant opportunity that this sector presents to our clients. We have a dedicated and specialist team to help clients and to provide a complete solution – from strategy formulation to execution. Our professionals have extensive direct industry experience having worked with the defence services, defence procurement and defence programmes. We have a well-defined and robust approach to support our clients effectively across a spectrum of projects in business performance services, transaction services and tax and regulatory services including offset advisory.

About Us - UKIBC Aerospace & Defence Industry Group

The UK India Business Council (UKIBC) supports UK businesses with the insights, networks, policy advocacy, services, and facilities needed to succeed in India. Working with the UK Government and other influential and connected partners, we ensure business interests are conveyed to India's Union and State legislators. The UK India Business Council seeks to influence decisions that will make it easier for UK businesses to operate in India.

On the 28th Nov 2019, at an event in Delhi hosted by the High Commissioner Sir Dominic Asquith, the MOD's Permanent Secretary Sir Stephen Lovegrove announced the launch of the UK India Business Council's Aerospace & Defence Industry Group. This initiative is the culmination of extensive consultation between the Defence & Security Organisation (DSO), UK Defence Solutions Centre (UK DSC), ADS, the Department for International Trade (DIT), industry and UKIBC. Alongside the recently signed Defence Technology and Industrial Capability Cooperation MoU, and ongoing Defence Industry Dialogues, this industry platform is central to the 'Team UK' strategy for engagement and success in India.

The group is chaired by Kishore Jayaraman, President, India & South-Asia Rolls-Royce and the current membership includes: Rolls-Royce, BAE Systems, MBDA, Thales UK, Leonardo, TVS Supply Chain Logistics, Pattonair, Pexa and Cranfield University. It is our intention that membership grows to reflect the full spectrum of British industry participation in the Indian market; including eventually cyber and security to broaden the narrative beyond land, maritime and air and to allow cross sector work.

The purpose of the group is to enhance UK-India strategic cooperation, drive improvements and efficiency in India's defence acquisition process and to foster longer term technology and hardware transfers between the UK and India. UKIBC will support this by:

- Acting as a voice for British business interest in India in these sectors; articulating collective interests to influencers and stakeholders and facilitating interactions between business, politicians and policymakers to generate a shared understanding of businesses' issues;
- Advocating for reform to India's operating and procurement environment, to reduce or remove market access impediments –landscape issues like IPR, offsets, licensing etc;
- Providing intelligence, insight and best practice about dealing with ease of doing business challenges in India;
- Interpreting and analysing policy developments in India;
- Allowing HMG to talk one to many in-market and receive feedback directly from businesses;
- Helping companies meet the right stakeholders within India's procurement landscape and – for smaller firms or supply chains – help them identify appropriate potential partner firms in India, including through alliances with Indian defence associations.

The formation of this group comes at a time when the UK-India relationship in aerospace and defence is at a critical turning point, with distinct and powerful drivers on both sides. At the same time, the UK Government is looking to deepen its international relationships after leaving the European Union and aims to replicate in defence the trade success it has achieved in other sectors in India recently. HMG is focused on making India a long-term and strategic partner (replacing the traditional, transactional buyer-seller dynamic), with an emphasis on co-development of technology and capability, 'Make in India' and, ultimately 'export from India'. This will involve much more than just hardware – for example, it means focusing on specific areas of technology collaboration and skills-building in India. We welcome your enquiries about joining our Aerospace & Defence Industry Group or questions you have about the Indian Aerospace & Defence market.

Richard McCallum, Group Chief Executive Officer, UKIBC

Dickie is the Vice Chair of UK India Business Council, India. He is a graduate of the Universities of Durham (History) and Cambridge (International Relations). After University, Dickie joined the John Swire & Sons' management trainee programme based in Hong Kong and Pakistan. From 2005 to 2007 he was Manager Delhi & North India for Cathay Pacific Airways. From 2007 until 2013, Dickie was a founder director of Flying Fox, an innovative adventure tourism company headquartered in Delhi. E-mail- Richard.McCallum@ukibc.com

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