SEMINAR REPORT

AMSB SEMINAR: BLOCKCHAIN TECHNOLOGY AND IDENTIFIED USE CASES FOR EFFECTIVELY EXPLOITING BLOCKCHAIN FOR IMPROVING THE ADMINISTRATIVE AND LOGISTICS FUNCTION OF THE INDIAN ARMY

15 Sep 2022

CENTRE FOR LAND WARFARE STUDIES
AND
ASC CENTRE AND COLLEGE

CLAWS Director General: Lt Gen (Dr) Ranbir Singh, PVSM, AVSM**, YSM, SM (Retd)

CLAWS Seminar Co-ordinator: Colonel Munish Tuli

CLAWS Rapporteur: Mr Vaibhav Kullashri (Research Assistant), Ms Naomi Nautiyal (Research Intern), Ms Rhea Rane (Research Intern), Ms Namita Barthwal (Research Assistant), Mr Mrokku Nagamaleshwar Rao (Research Assistant), Mr Harshit Sharma (Research Intern), Ms Ritika Suneja (Research Intern), Ms Anuradha Oinam (Research Assistant), Mr Danish Yousuf (Research Assistant), Mr Ashu Mann (Research Assistant) and Ms Mahek Marwaha (Research Intern)

Centre for Land Warfare Studies
RPSO Complex, Parade Road, Delhi Cantt, New Delhi 110010
Phone: +91-11-25691308; Fax: +91-11-25692347
Email: landwarfare@gmail.com; website: www.claws.in
CLAWS Army No. 33098

The Centre for Land Warfare Studies (CLAWS), New Delhi, is an independent think-tank dealing with national security and conceptual aspects of land warfare, including conventional and sub-conventional conflicts and terrorism. CLAWS conducts research that is futuristic in outlook and policy-oriented in approach.

CLAWS Vision: To establish CLAWS as a leading Think Tank in policy formulation on Land Warfare, National Security and Strategic Issues.

CONTENTS

Seminar Group Photograph at Dr Ambedkar International Centre, New Delhi

EXECUTIVE SUMMARY

Military logistics is the field of planning supplies, carrying out movement and maintenance of military forces in the field. The Indian Army's logistics functions have become increasingly complex and difficult due to varied and vast terrains. The success of military logistics solely depends on the effectiveness and efficiency of its supply chain. Military logistics warrant timely delivery and seamless coordination between all stakeholders and thus, there is a strong felt need to identify various use cases for effectively exploiting blockchain technology for improving the administrative and logistics functions of the Indian Army.

Blockchain is an emerging disruptive technology which provides inherent trust, security, transparency and reliability of peer-to-peer digital transactions over a network, thus obviating the need for any central, intermediary or verification authority. Blockchain can be implemented in various architectures such as Public Permissionless Networks, Private Permissioned Networks and Hybrid Networks having their advantages and disadvantages. Also, blockchain services can be provisioned on Token based or Blockchain as a Service (BaaS) model. Smart Contracts are the heart of many use cases of blockchain that generalize the applicability of blockchain technology to a variety of applications. There is a need to have legal and regulatory mechanisms for smart contracts.

Blockchain has already garnered global attention, with many nations embracing it for certifications, food traceability and many other applications. Nations like China, UAE, Estonia, Brazil, Canada, Singapore, South Korea, Thailand and Chile are already exploiting blockchain in their civil and military use cases and India must not lag behind. Globally businesses are already getting transformed through the adoption of blockchain technology. Supply chain giants like Walmuseuses Blockchain technology for the meat and mangoes supply wherein they track the supply right from the farm to the table. TradeLens is a supply chain formed by IBM and Maersk and uses Blockchain for end-to-end movement of their cargo across the world.

Ministry of Electronics and Information Technology (MeitY) and NITI Aayog have already come out with a broad national-level strategy and framework for the adoption of blockchain in IndSome key projects have already been taken up by various state governments and institutions in adopting blockchain technology in secure land registry, e-procurement, agriculture seed tracking, fertilizer subsidy and issue of digital degrees.

In the Indian Armed Forces context, firstly, there is a need to formulate a Doctrine/ Strategy document spelling out the vision, mission, objectives, scope and the roadmap for adoption of blockchain technology. Concurrently, there is a need to create a trusted digital platform by creating a robust tri-services information infrastructure, which can be used by various services, directorates and establishments for the development and

deployment of their applications. Therefore, the solution for this digital platform is to create a Private Permissioned Blockchain service network on Network for Spectrum (NFS) which is a Tri-Services pan India state-of-the-art captive info structure. Blockchain has several use cases for implementation in the transformation of the military supply chain in the Indian Armed Forces including military transport management, automation using smart contracts, procurement and distribution of perishable and non-perishable supplies, Platform Lifecycle Management(PLM) of components and assets, Human Resource (HR) management, estate management, disaster relief, emergency preparedness and environment conservation.

A suggestive roadmap post-NFS implementation would be to establish Theaterised Nodes hosting the Tri-Services Blockchain Framework for the development and large-scale hosting of Blockchain applications in different areas based on the Blockchain-as-a-Service model. Headquarter Integrated Defence Staff (IDS) in collaboration with the Service Headquarters would define the policies and guidelines and any application/use on case complying with the policies would be on-boarded on the framework. And lastly, the most important facet of establishing ownership and responsibility of the Tri-Services Blockchain Framework needs to be vested with the Corps of Signals.

Also, there is a need to conduct periodic feasibility studies through IDS in the application of Blockchain technology in each service in the Indian Armed Forces. There is a strong need for research to be empowered. There should be more focus on research in the domains of standards and interoperability; scalability and performance; consensus mechanisms; security and privacy; key management; secure smart contracts and detection of vulnerabilities in Blockchain technology-based solutions.

DETAILED REPORT

The Centre for Land Warfare Studies (CLAWS) and ASC Centre and College jointly organised a seminar on "**Blockchain Technology and Identified Use Cases for Effectively Exploiting Blockchain for Improving Administrative and Logistics Function of Indian Army"** under the aegis of Army Management Studies Board (AMSB) on 15 September 2022 at Dr Ambedkar International Centre, New Delhi. Key issues highlighted at the seminar are given in succeeding paragraphs.

The Objective of the Seminar

The objective of the seminar was to debate blockchain technology with a special focus on identifying use cases for exploiting blockchain for improving the administrative and logistics function of the Indian Army. The issues were to be deliberated upon in three sessions on specific aspects to generate insights and recommendations for the adoption of blockchain in the Indian Army for the transformation of logistics and administrative functions.

Conduct

The seminar was conducted under the following sessions:

- **INAUGURAL SESSION**
  - Opening Address by Lt Gen (Dr) Ranbir Singh PVSM, AVSM**, YSM, SM (Retd), Director General CLAWS
  - Keynote Address by Lt Gen SS Mahal, AVSM, VSM, GOC-in-C ARTRAC
- **SESSION 1. Blockchain Technology - Conceptual Evolution**. Chaired by Lt Gen BK Repswal, AVSM, VSM, Commandant ASC Centre & College
  - Blockchain Evolution & Architecture by Prof Subodh Sharma, IIT Delhi
  - Blockchain Framework in India - NITI Aayog Concept Paper, Jan 2020 by Mr Saurabh Thakral, Sr Specialist, NITI Aayog
  - Indian National Blockchain Strategy - GoI, MEITY Document, Dec 2021 by Dr Sunita Verma, Scientist G, MeitY
  - Business Model Transformation - Adoption of Blockchain Technology in India by Mr Sreeram Ananthasayanam, Deloitte India

- Blockchain and Self Sovereign Identity (SSI) by Professor Manindra Agarwal, IIT Kanpur

- **SESSION 2. Global Blockchain Applications**. Chaired by Lt Gen (Dr) Ranbir Singh, PVSM, AVSM**, YSM, SM (Retd), DG CLAWS

  - Blockchain Non-Military Use Cases - Global and Indian by Mr Nitin Arora, KPMG Advisory Services Pvt Ltd

  - Blockchain HR Applications - In Civil Industry and Indian Army by Mr Vivek Tikoo, HR Zing, Mumbai

  - Blockchain Value Framework – Improving Capabilities in Disaster Relief, Emergency Preparedness and Conservation by Prof A Damodaran, IIM Bangalore

  - Blockchain Mobility Applications by Mr Venkatesh VR, Bosch Global Software Tech

- **SESSION 3. Blockchain Military Applications and Roadmap for Adoption in Indian Army**. Chaired by Lt Gen Rajeev Sabherwal, PVSM, AVSM, VSM (Retd)

  - Absorption of Digital Technologies and Embracing Change by Defence Logisticians by Brig GM Attri, Cdr FOHOM, CMM, Jabalpur

  - Smart Contracts - Intricacies and Nuances by Mr Santosh Pathak, Infosys Ltd

  - ASC Supply Chain - Proof of Concept Project by Maj Gen Harsh Chhibber, VSM

  - Digital Footsteps Towards Blockchain Technology for Platform Lifecycle Management (PLM) in Indian Armed Forces by Cdr Jai Kumar Raghunath (Retd), KPMG Advisory Services Pvt Ltd

  - Roadmap - Pan Indian Army Adoption of Emerging Technologies and Blockchain Technology by Mr Amit Vats and Mr Gaurav Tripathi, Infosys Ltd

INAUGURAL SESSION

Opening Address by Lt Gen (Dr) Ranbir Singh PVSM, AVSM, YSM, SM (Retd), Director General CLAWS**

Lt Gen (Dr) Ranbir Singh delivering the Opening Address

Lt Gen (Dr) Ranbir Singh, Director General CLAWS welcomed GOC-in-C ARTRAC, Commandant ASC Centre and College, eminent panellists, senior military dignitaries and esteemed veterans attending the seminar. He talked about the topic at hand on blockchain technology and identified cases for effectively exploiting blockchain for improving the administrative and logistics functions of the Indian army. He mentioned that the seminar was jointly hosted by CLAWS and ASC Centre and College under the aegis of the Army Management Studies Board (AMSB).

Citing the Russian - Ukrainian war, he emphasised the importance of logistics, especially military logistics in the conduct of operations, as it is the field of planning supplies, carrying out movement and maintenance of military forces in the field. He explained how the 20th century is the age of the logistics revolution, which has not only seen drastic improvements in the capabilities of modern armies but has also made them more and more dependent on it. Military logistics involves diligent planning and conduct of quintessential operations of maintaining supplies in secure rear areas and then moving them to the field at the right time and place. He stated that the aspects of the Indian Army's logistics functions have become increasingly complex and difficult with a large number of stakeholders who are jointly involved either directly or indirectly

in the decision-making process at all levels of functioning. This in turn has led to an emergence of a felt need for ensuring an end to end communication, transparency, accountability, traceability, speed and efficiency in planning and conduct of logistics and administration functions of the Indian Army.

Blockchain as an emerging disruptive technology has generated immense interest and has compelled us to adopt it as an effective technological solution. Blockchain is an immutable record of digital transactions often called a digital ledger which is shared and distributed among all stakeholders without central verification or arbitration, thereby providing inherent trust, security, transparency and reliability in the execution of digital transactions over a network. The application of blockchain in logistics will not only allow foolproof tracking of goods in a long and complex supply chain but also facilitate real-time detection of anomalies or disruptions. This would further lead to the triggering of timely remedial actions by concerned stakeholders in early mitigation of disruptions as against the age-old time-consuming and inefficient processes that we have been so used to.

He said that the seminar was aimed at identifying various use cases for effectively exploiting blockchain technology for improving the administrative and logistics functions of the Indian Army. The scope of the seminar has been carefully categorized into the sub-theme namely ‘Blockchain Technology - Conceptual Evolution’, ‘Global Blockchain Applications’ and ‘Blockchain Military Applications and Roadmap for Adoption in Indian Army’. Each of these sub-themes would be dealt with in great depth by various eminent panellists and scholars in three separate sessions. The chairs and the panellists for all three sessions are erudite speakers having in-depth knowledge and rich experience in their respective domains and come from diverse professional backgrounds, with representation from the Indian Army, industry and academia.

The august audience too is diverse having representations from premier institutions of the Indian Army, experienced veterans and distinguished and senior research scholars. He said that at the end of the seminar, the Indian Army would be looking at various key takeaways such as synthesis of strategic partnerships with academia and industry, self-reliance and supply chain disruption mitigation strategies, planned infusion of blockchain technology, resolution of military HR challenges and formulation of policy framework at the apex level and implementation at all levels. Lastly, he highlighted that it was to the credit of ARTRAC that they have been able to pick up such an important topic along with the three sub-themes for discussions during the seminar.

Keynote Address by Lt Gen SS Mahal AVSM, VSM, GOC-in-C ARTRAC

Lt Gen SS Mahal delivering the Keynote Address

Lt. Gen SS Mahal, AVSM, VSM, GOC-in-C, ARTRAC commenced his keynote address by explaining how blockchain technology has gained much traction in recent years and especially among government, academia, industry and now even the military fraternity. He explained that the seminar has been designed to deliberate on various dimensions of blockchain technology and the reason for choosing this topic was mainly because of its immense importance and the potential it holds for the Armed Forces. The chief guest highlighted that the domain experts will go into detail about the topic which will facilitate intellectually thought-provoking and enriching deliberations during the course of the day. He extended a warm welcome to the Director Generals to be able to find time to attend the prestigious seminar.

He then proceeded to give a brief overview of the Army Management Studies Board (AMSB) and its evolution over the years. He explained that AMSB was constituted by the Government of India in the year 2002 to act as a medium of collaboration and knowledge in the field of management with the academia to identify, approve and fund management research studies and development projects in the Army. Hence, AMSB is an interface between the management process and the Army as well as the academia. The Board comprises of senior military hierarchy as well as various Directors of Indian Institutes of Management. Over the last two decades, AMSB along with the academia has been able to make significant efforts to address several problem statements of the Army through the conduct of various studies and seminars as well as management studies programs run by them jointly with several Indian

Institutes of Technology. He further elaborated that the rich and enduring legacy of the Board has been taken forward through collective effort and wisdom of the Army functionaries as well as the academia and hopes that the endeavour will strive to bear fruit in the future as well.

The chief guest spoke of blockchain technology being the catalyst for change in the Military and Non-Military domains and also as a case of Disruptive Technology. The digital transformation in government and businesses due to the pandemic is being seen as a way to simplify complex systems to enhance procedural efficiencies, delivery of public services and to maximise growth through data protection, data integrity, secure record keeping and faster payment cycles. This has thus made blockchain garner global attention, with many nations embracing it for certifications, food traceability and many other applications. He stated that the Army should not be left behind in taking up this opportunity. Blockchain is also intertwined with other disruptive technologies such as the Internet of Things, Artificial Intelligence, and Cloud Computing and thus entails path-breaking digital transformation as well as automation of traditional business practices through the use of smart technology.

He further explained that Blockchain has its origin in cryptocurrencies, but it ought to be seen as a viable technology beyond that. Blockchain is invested in enhancing transparency, traceability as well as maintenance of trust between multiple users without any need for a third-party regulator or a central authority. He mentioned trice Water House Cooper's report which mentioned the global economic impact of blockchain and how several countries of the world are gaining from it such as the USA and Germany among others. In India, it still remains to be seen how the adoption of blockchain will have an impact on GDP and business corporations that will be immensely investing in the technology. He concluded his keynote address and called upon all stakeholders to crystallise the discussions on the topic as well as the key challenges and implications involved in the adoption of the technology.

SESSION - 1
BLOCKCHAIN TECHNOLOGY- CONCEPTUAL EVOLUTION

Opening Remarks by the Chair

Session Chair Lt Gen BK Repswal delivering the Opening Remarks

The Chair, Lt Gen BK Repswal, AVSM, VSM, Commandant ASC Centre & College commenced his opening remarks by asking a question as to what is blockchain. Some people have said that 'blockchain is a fantastic technology solution looking for a problem. He mentioned that the GOC-in-C ARTRAC had also remarked that it would generate a great future in business. Blockchain has been identified among the first top seven technologies which are likely to revolutionize our lives in the near future and is like to be the next 'Internet Revolution'. Our endeavour should be to at least try and be on the curve, even if we cannot stay ahead of the curve Whether it is for health care, logistics, cyber security, media, government or any other domain.

He further mentioned that during the Chinese Communist Party Summit meeting of November 2019, President Xi Jinping asserted that blockchain was one of the key technologies where China will make a difference and catch the world by storm. When he was talking about all this, even when they were battling with a pandemic, their single-minded focus was on making a difference in blockchain technology. He said that it was extremely difficult to put a new idea in a military mind, but even more difficult than that was to take the old one out. Therefore, we have to sensitize our military that we also need to do what China has already done i.e., they have already deployed a

blockchain-based service network which is facilitating their companies to deploy their technologies faster.

Chinese are already looking at the Central Bank of Digital Currencies, in which the banking transactions and financial movement will be backed by Fiat currencies of Singapore, Sweden and UAE and have already rolled it out. They have also incorporated a smart identification system in all their smart cities and through their Hyperledger, they are making a big difference. Likewise, the European blockchain partnership also intends to bring European Blockchain Services Infrastructure for interoperability. Estonia has brought up a Keyless Signature Infrastructure which is an initiative that enables different organizations to share information securely.

Likewise, the Smart Dubai initiative is to make Dubai the first city fully powered by blockchain from healthcare to education, to traffic management and to environmental sustainability. Brazil is looking forward to bringing in Blockchain voting, Chile for transparency and energy grid and similarly, Canada and Singapore are also making strides in that direction. Therefore, India too needs to do something. It was sometime at the end of 2019 and the beginning of 2020, just before the pandemic, that we suddenly came across a huge compendium of five big handbooks by the World Economic Forum on Redesigning Trust- Blockchain Deployment Toolkit. The five big handbooks are thick and difficult to understand and they make you go to sleep as you go through the pages. There is another one with the inclusive deployment of blockchain for the supply chain. We also got on to doing some work with full support from Western Command and ARTRAC.

The chair concluded his opening remarks by mentioning that we have taken up two projects - the first project is to deploy blockchain in Supply Chain Management in a limited sphere as a POC at 05 outstations. Then there is another one in terms of blockchain in Human Resources (HR). He further mentioned that we can ensure a 200% rollout of blockchain in HR across the board, all that we need to do is to prepare the constituency within.

Sub Theme 1: Blockchain Evolution and Architecture by Dr Subodh Sharma, Associate Professor, CSE, IIT Delhi

Blockchain Evolution and Architecture by Dr Subodh Sharma

Dr Subodh Sharma spoke on the basic components that constitute blockchain technology. He said that blockchain essentially consists of three important components and some methods associated with it, and the entire technology is orchestrated on a computer network which is peer-to-peer i.e., every node has got the same standing and it may be connected to every other part of the network via point-to-point communication channels. More importantly, on top of this network, there is a database which stores the information. Now this database could very well be implemented as a centralized database, replicated across all the nodes of the network or it could be a completely distributed database. In a distributed database, information itself is not replicated across all the participants of the network, but rather is sharded or split into pieces which means that there is no single participant who has got a complete view of the truth. The third important component is the existence of smart contracts. A collection of smart contracts are small programs which essentially allow one to perform arbitrary computation over the network.

He further mentioned that there are physical components of the technology, and the methods associated with it that ask or rather answer two important questions. The first is, how you ensure that the information that you are storing on the network is secure for which one employs very sophisticated cryptographic protocols to make sure that security is provided. So, if there is a sender of some information from point A to point B, then point B has to make sure that the sender cannot repudiate his claims later on, that he was not the originator of that information. So non-reputation has to be guaranteed, confidentiality has to be guaranteed, message integrity has to be ensured

and all that is done through these cryptographic concepts which are well known for almost three decades now. But, how does one add information to this database on the network? Any addition to the database on the network happens through these complicated distributed consensus protocols. In consensus protocols, there is no central operator and there is no central manager of this entire network. Therefore, there is no single person who holds all the truth.

Elaborating further, he explained the differences between centralised and decentralised architectures and the significance of trust, transparency and immutability provided by blockchain technology. In centralization, there is one Central Authority which manages all the decision-making and all the information routes that pass through that Central Authority e.g., Banks. The central authority becomes a single source of truth because only a single copy of the information is maintained and that also means that it is a single point of failure. So, if somebody attacks that particular central agency which is responsible for decision making, he can bring the entire service down. That is the hard part about centralized solutions, but then there are good parts too. In centralized solutions, privacy management is easier, because there is only one person who is holding the entire truth and the synchronization effort that is needed for that also becomes simpler because participants in the network have to engage with only one entity which is at the heart of decision-making, but then because they are the single source of truth, dispute resolution becomes difficult and they are open to insider attacks.

In decentralized solutions, the central decision-making body goes away and leads to a peer-to-peer network, wherein all participants of the network connect. It is like a complete graph where everyone connects to everyone else. Since there is now no single source of truth as the truth is replicated across all the participants, thus leading to audibility. Hence, there cannot be any single point of failure as the truth is replicated across multiple participants of the network. As a result, there is inherent transparency, because everybody has got an equal stake in that truth. Decision-making and the addition of information to the network happen via the complicated distributed consensus protocol because the majority of the network is part of the decision-making process. That further leads to trust as no single entity is taking decisions in an opaque manner and the fact that the databases that store the information are cryptographically sealed through cryptographic primitives, thus getting the power of immutability. The data once stored in the database cannot be fiddled with later on and also cannot be modified. That immutability and the permanence of the data leads to the property of audibility. Through auditability, one can have accountability and traceability as side effects of the technology. So, if we have to put these components together, the data structure has blocks of data which is replicated across the network and these blocks are tied to each other via special cryptographic primitives called hashes.

Hash is a cryptographic summary of an entire data block. So, in the middle block, a hash of the block to the left is stored i.e., the entire data of the block on the left is

hashed and its hash value is maintained in the block to the right and one sequentially continues like this to form a chain of blocks. So essentially, an adversary cannot modulate or manipulate the data within these blocks, because their hash values will change. Hence, anybody having these summary hash values with him can very quickly verify whether some manipulation has been done in the data or not. Each transaction in one's database is digitally signed, which means that the originator of that information or the relayer of that information can at no point in time repudiate his claims which guarantee non-reputability.

Smart Contract is the heart of many use cases of blockchain. These are small pieces of software code that run in computers and execute the business logic under a constrained environment. Those constraints are encoded as rules in the software program. These are well-specified constraints and as an example, if multiple tenants are sharing a particular space and their tenancy arguments need to be authenticated in terms of what rent they would pay, then that entire logic could be encoded in a software blockchain and can come in various permissioned and permissionless modules. In many ways, permissioned blockchains are no different from centralized systems, because they are managed by one single entity which is politically central, perhaps implemented as architecturally decentralised.

There has been a lot of effort that has gone into the blockchain, much of that effort took place in the mid-80s and 90s. Blockchain is an ingenious stitching of technology that has been in existence for a very long time, be it cryptographically sealed databases, peer-to-peer networks and consensus protocols which have been independently worked upon by academia and industry researchers for years altogether. In 2009, they were used in a specialized use case called cryptocurrency. The speaker touched upon the evolution of blockchain since 2009 when Bitcoin emerged. Another revolution happened through the induction of Smart Contracts around 2013-2014. Smart contracts came in and that truly generalized the applicability of blockchain to a variety of scenarios like land records and digital identity management which are essentially driven by smart contracts.

We are now at a stage where we are moving towards capacity building, and we are plateauing towards productivity where we have to build enough capacity in terms of people who could program and who could configure blockchain systems. People who can understand use cases very well and apply them with these newer technologies. People have been researching how one can inject privacy on top of these blockchains, and how one uses blockchain for newer use-cases such as: Can one protect one's domain name servers on the network leading to Web 3.0 or can anyone help boost one's public key infrastructures which are open to attacks a day in and day out? So not only in Supply Chain management and audibility, but blockchain could also be extended to the domain of cyber security.

Sub Theme 2: Blockchain Framework in India – NITI Aayog Concept Paper, Jan 2020 by Mr Saurabh Thakral, NITI Aayog

Blockchain Framework in India by Mr Saurabh Thakral, NITI Aayog

Mr Saurabh Thakral talked about the application of blockchain technology and how it can be exploited. He explained that if we look at any transaction which is happening between party A and party B, a lot of trusts is required and that trust is being provided by the intermediaries. If we look at any sector, be it the movement of money or the movement of goods, there is always an intermediary which is providing trust. In the financial sector, trust is provided by banks, mutual funds and insurance companies. If we look at the supply chain sector, where goods are moving from the manufacturer to the end consumer, we have several intermediaries and if we look at the property transaction, where there is an exchange of documents, there too, we have so many intermediaries, both from the public sector and the private sector and the role of those intermediaries is to provide trust. These intermediaries pose lots of challenges such as high transaction costs, more time consumption, more complexity and introducing more risk and increasing the compliance burden for all the stakeholders. Now the question is, can the role of these intermediaries be replaced by blockchain and can the technology help us to bring trust? That is the overall idea. How we can remove this intermediary and use technology to have the same trust as we were having in the past? Blockchain is a technology which can be used and one would be explaining how it can be used to just reduce the compliance burden by providing trust. We have trusted intermediaries, now in the world of blockchain party A and party B would be able to interact on the blockchain network and the trust would be coming from the technology.

What is blockchain? One would like to decode that simply. Blockchain is like a digital ‘Khaata’ and has more nuances. All the involved stakeholders have a copy of that ‘Khaata’ and something which is written in that ‘Khaata’ cannot be changed or modified. Everyone has the same copy and so if one of the nodes or one of the stakeholders is making an update or is manipulating an entry in that ‘Khaata’, then others will not acknowledge it, because they do not have the same entry. Hence, it is very difficult to modify that ‘Khaata’ because everyone is having the same copy of that ‘Khaata’. So, if one node is manipulating it, it needs to be acknowledged by all the nodes. Only then will it get updated in everyone’s ‘Khaata’ and it would be considered as the golden record. So, it is very difficult for a single entity to manipulate it. For any new update, everyone will see that it is the latest entry with the acceptance of all the stakeholders.

In the blockchain, we try to link all the subsequent entries by having a reference to the previous entry using a hash. “Block B” is having a reference to “Block A”, that's why we say that all the blocks are connected and that's why it is called a blockchain. Each block is having some entry which cannot be modified. Whenever there is a new entry, it needs to have a reference to the previous entry. That is how they are linked to each other and it is called the blockchain. Now, what happens if one wants to change entries in Block 1 and Block 2? If one wants to change the entry in Block 1, then one of the stakeholders can change the entry, but the linkage between Block 1 and Block 2 will be broken because they are linked with the hash and once there is a change in the data entry, the hash will change and the linkage will be broken. Once the chain is broken, others will not acknowledge that entry. Thus, we cannot change the previous entry because they are all interlinked, we can just add new blocks which will always get linked to the previous blocks.

Blockchain is one of the technologies which can be a game changer to achieve the vision of our Prime Minister to bring more transparency, more accountability and more visibility in government processes and transactions. Last year, in December 2021, our Honorable PM launched a ‘Blockchain Digital Degree’ at IIT Kanpur. So, if a student has to receive a college degree, and then he goes for higher studies or any employment, his certificates need to be verified by the university or the employer which takes a lot of processing and time and has intermediaries who are doing third-party validation. Now, if we can host our degree certificates on the blockchain network and if a student is going to a global university or a global employer, he can just give a reference to that block on the blockchain network for instantly validating those certificates issued by his university.

The second one is how we can use blockchain in government within the governance process. So, for the fertilizer subsidiary, we have a lot of stakeholders involved- we have the manufacturer, we have the warehouse, we have the retailers and they all maintain their different ‘Khaatas’ and the Department of Fertilizer needs to reconcile

all those ‘Khaata’ before giving out the subsidy. Now instead of them maintaining three different ‘Khaata’ can there be one digital ‘Khaata’ and everyone can have a copy of that ‘Khaata’ so that the reconciliation becomes easy? Everyone agrees to their digital ‘Khaata’ and the subsidy processing time and effort can be reduced. We did a pilot project in the Gujarat state with the Department of Fertilizers and we are currently working on how we can scale it up.

Speaking on the application of blockchain in the defence sector, the speaker said that blockchain can be used for tracking and tracing from source to destination. For defence equipment tracking, we can use blockchain and hence bring that accountability. One can understand where it was manufactured and how it was transported from the source to the destination. And let's assume that every piece of information is stored on a digital ‘Khaata’ which everyone acknowledges then it is sure to bring in a lot of transparency. There can be a barcode scanner which can be used to scan and the entire history of that equipment would be available – a process which can really streamline the record-keeping and it can also be used for critical weapons and systems.

Additionally, digital identity can also be stored on the blockchain. These are some of the very good use cases which are being experimented on in other countries. Apart from the defence sector, if we can store our land records on the blockchain network, it will streamline a lot of processes related to the land registry in the country. In the case of gold that is seized by customs, there are complex procedures involved to correctly trace the original owner. If we have a transparent network for tracking the gold movement on the blockchain, it will help us to bring in a lot of transparency and accountability. These are a few low-hanging fruits which should be experimented with and are game-changers in our country.

Sub Theme 3: Indian National Blockchain Strategy - GoI, MEITY Document, Dec 2021 by Dr Sunita Verma, Scientist G, MeitY

Indian National Blockchain Strategy by Dr Sunita Verma

Dr Sunita Verma talked about MeitY's initiatives towards the blockchain strategy, popularizing it, implementing it and taking the applications on board. If one looks at the initiatives, considering the importance of blockchain technology, the government is here to facilitate and take up the applications on board. Blockchain is already here and the applications have already been built. So how various applications or platforms are being used can be facilitated by the government and towards that, to explore the potential of blockchain technology in different application domains and to address the challenges, MEITY has come out with a National Strategy for the Blockchain. This document was formulated in 2021, when it was understood that technology is here to stay and will be an integral part of our transactions in our lives. With a vision of creating a trusted and collaborative digital ecosystem, promoting R&D, innovation technology and application development and facilitating state-of-the-art, transparent, secure and trusted digital service delivery to citizens and businesses and making India a global leader, the document has been prepared and the strategy has been outlined.

She further explained that in the last couple of years, globally, many countries including India have assessed this potential and presently the POCs and pilot projects for specific applications are there on the record. If you look at the objectives of the blockchain strategy, we are evolving a national blockchain infrastructure. This is so because the hardware or the infrastructure is very important. Unless we have it in place, we cannot implement the blockchain strategy or the applications around them.

Propagation of a great application of national interest, strengthening India's collaboration with global organizations, fostering R&D and encouraging the development of standard innovation roadmap for blockchain technology, identifying the legal, social and political requirements, encouraging multiple stakeholder models and promoting capacity building, and skill development in the arena. So, towards this objective, we are trying to have a comprehensive plan and strategies have been built.

The National Blockchain strategy will be focusing on the government as a catalyst to advanced R&D, for the onboarding of applications, some collaborative execution models and how to bring out the capacity building initiatives with the help of our academia with our R&D institutions and industry on-board. The National Blockchain Framework, if we look at it, we have a strategy for a roadmap. We also have recommendations for harnessing the benefits of emerging technology or focusing on technology and administrative aspects. The roadmap is prepared with a clear strategy for five years. What we want to do down the line in these five years, although we have a plan that will be reviewed because this is a fast-growing technology, we have to keep pace with it. It will be reviewed next year also so that if there are any mid-term corrections, we will be coming out with another version of it.

Also, we would like to keep abreast with what is happening in India and the global scenario and blockchain is a strategy or a technology where it is not only the country’s effort but has to be tightly coupled with the global arena. So, the whole roadmap is built in such a way that we are implementing strategies with the help of global dialogues and collaborations.

There is a need for a national-level framework for large-scale adoption. To adopt a shared blockchain infrastructure and easy adoption of technology, some geographically distributed National infrastructures have been planned and the deployment of blockchain solutions over multiple platforms is envisaged. Technology stacks with open Application Programming Interfaces (APIs) for easy onboarding of applications about various domains are planned for easy integration with existing services namely Digilocker, e-Sign, and e-Praman, to name a few. Interoperability between deployed applications on cross platforms and chains and increasing the performance of smart contracts and scalability, thereby enhancing security for sensitive information and privacy and enablement are some of the requirements for the framework and the large-scale adoption.

Version 1 of the National Blockchain Framework will be ready by December this year and towards that, we are already building a framework with the technology stack. If you see, this framework provides a technology stack that will aid in the rapid development of blockchain applications. NIC and CDAC are involved in this endeavour. We will be putting up some infrastructure and then identifying some applications from the government as well as the industry, inviting the start-ups to take on-board various applications along with the very integral part of it as being that of

inter-operability and also, taking all the stakeholders on-board to use this blockchain framework to the maximum possible extent. This will also address the challenge which will be related to security, scalability, performance and hosting on distributed systems. The framework also provides an API so that each application can take advantage of the platform-specific strength and leverage the data sourcing from multiple applications. The speaker mentioned that within two years, the government will be having a Hackathon where we will be inviting applications from various Ministries and they are also looking forward to the Army for some problems. The speaker further mentioned that we have a solution, now we are looking for problems for which we can create some solutions that can then be onboarded on our framework; also, to come out with solutions for the industry, taking the start-ups on board and thereby create a complete ecosystem through this platform.

Sub Theme 4: Business Model Transformation - Adoption of Blockchain Technology in India by Mr Sreeram Ananthasayanam, Deloitte India

Business Model Transformation - Adoption of Blockchain Technology in India by Mr Sreeram Ananthasayanam

Mr Sreeram Ananthasayanam began his talk by emphasising the fact that it is the business model that will make or break blockchain technology. He proceeded to talk about the importance of the sequential nature of the events in a ledger. He gave an overview of the three types of blockchain networks i.e., Public Permissionless Networks, Private Permissionless Networks and Hybrid Networks wherein he focused

on bitcoin being a Public Permissionless Network which consumes a lot of energy and is anti-carbon and loosely translates to being an open-ended network.

A private permissionless network is the most significant in enterprise-grade blockchain, wherein we are aware of all the parties involved. So, differing consensus mechanisms come into the picture in Private Permissionless Networks and thus all the parties are known. A Hybrid Blockchain is essentially a private network that operates with certain principles of the public network. He then talked about current business models wherein blockchain technology can be placed i.e., Token based or Peer to Peer model and Blockchain as a Service (BaaS).

There are popular cases of blockchain in the Indian context which are business to business, government to business, business to consumer and government to citizen. He reinforced the importance of trust concerning the application of blockchain technology, thereby leading to such applications being implemented in Armed Forces. Focusing on future cases as well, he mentioned gamification of training as a key prospect in the future. He concluded his talk by suggesting a Private Permissioned Blockchain with the orchestrator being the Army as a plausible option for the future in correlation to the said use cases already discussed.

Sub Theme 05: Blockchain and Self Sovereign Identity (SSI) by Prof. Manindra Agarwal, IIT Kanpur

Blockchain and Self Sovereign Identity (SSI) by Prof. Manindra Agarwal

Professor Manindra Agarwal began his talk by explaining the National Blockchain Project, which is an initiative of the National Security Council Secretariat, where the task at hand was to generate a generic Permissioned Blockchain. Then he talked about the implementations and uses cases to include Land Records Management, Advancing E-procurement, Self-Sovereign Identity Ecosystem and Crypto Forensics. He also brought out that the Kaveri Blockchain Property Registration project was the first in many projects for the government of Karnataka to bring their land records on the blockchain. He further highlighted that through the use of blockchain technology, the challenge of the vulnerability of insider attacks has been significantly reduced.

As the Karnataka model had several nodes endorsed to ensure that any report enters is the valued record. He even mentioned the work being done to secure Land Registry documents for the Lucknow Development Authority as well as advancing E-procurement and the importance of the 'Trust Layer'. Several participating States for the 'e-GP Blockchain Network' are Karnataka, Telangana, Andhra Pradesh, Chhattisgarh and Assam.

He explained that Self-Sovereign Identity (SSI) being a key aspect about blockchain technology is essentially a digital identity ecosystem enabling trusted, verifiable and privacy-preserving credential exchange interactions. This identity resides in the mobile wallet at the expense of the users to share their data as well as the use of Zero Knowledge Proofs as well to disclose only minimum information with a verifier. The speaker then delved deeper into the working of SSI with an example of a student-university degree case highlighting its importance due to its unique features like selective disclosure, data ownership etc. He also cited the 54th e-convocation of Pradhan Mantri Rashtriya Bal Puraskar and the degrees issued by IGNOU as other examples.

Closing Remarks by the Chair

Session Chair Lt Gen BK Repswal delivering the Closing Remarks

Lt Gen BK Repswal, AVSM, VSM, Commandant ASC Centre & College in his closing remarks stated that when the road roller of technology moves on and we are not part of the road roller, we will soon be part of the road. So, it is good for us and let us at the same time be careful while adopting newer technology, because technologies also have self-lives. He further said that the European Defense Agency is exploring the utilisation of cyber-attack, cyber resilience, information security, data security and authentication. DARPA is exploring possibilities to secure military hardware and military logistics. China also employs blockchain technology in battlefield information, managing weapons and equipment, enhancing military logistics and facilitating operations. South Korea is deploying a defence acquisition program and Thailand has signed a contract with Estonia for Keyless Signature Infrastructure. However, there are challenges in legacy-driven systems like our mammoth organisation. We must be very mindful, because of the interoperability and many other issues. However, the fact is that we need blockchain technology only to sort out the problems where there is a matter of trust deficit. Also, if there is already a robust and functional system, we can think of bringing blockchain technology and likewise, we need the political will to contribute to such technology.

SESSION - 2
GLOBAL BLOCKCHAIN APPLICATIONS

Opening Remarks by the Chair

Session Chair Lt Gen (Dr) Ranbir Singh delivering the Opening Remarks

The Chair, Lt Gen (Dr) Ranbir Singh, PVSM, AVSM**, YSM, SM (Retd) started his Opening Remarks and said that in the first session of the seminar, the eminent speakers elucidated various aspects of blockchain technology including its basic concepts, evolution, architecture, our national level blockchain framework and national strategy for adoption and transformation of businesses in India and key projects which have been initiated in various state governments and at the national level. In this second session, we shall dwell on the global applications of blockchain. Firstly, we shall look into non-military applications of blockchain as applicable to India and on a global scale. Secondly, we shall delve into how blockchain technology can transform HR management in both civil and the Indian Army. Thirdly, we shall understand the applications of blockchain in disaster management and relief operations and how we can improve our emergency preparedness. In the fourth and last talk of the session, we shall be exposed to the mobility applications of blockchain.

Sub Theme 1: Blockchain Non-Military Use Cases – Global and Indian Army by Mr Nitin Arora, KPMG Advisory Services Pvt Ltd

Blockchain Non-Military Use Cases – Global and Indian Army by Mr Nitin Arora

Mr Nitin Arora said that there are different definitions and ways of implementing Blockchain which is a common thing to do with any emerging technology. But there are only a handful of people who understand Blockchain technology and technology, like Artificial Intelligence, Machine Learning and Drones are at the nascent stage in India, but are picking up rapidly. He mentioned that Blockchain was invented in 2008 and is still evolving. It has become part of the Dark Web and was used for illegal reasons. It was initially not used for legal reasons, but now it is used to serve the public at large. In 2022, Blockchain technology has become a tool to resolve business-related problems and an enabler of businesses. The speaker briefly touched upon the concepts of Blockchain including ledger, decentralised system, consensus, the sanity of information and verification process.

He suggested that Blockchain technology should become part of the Defence Services IT strategy in the future. Industry pundits forecast that the integration of IoT with Blockchain will become a USD 58 billion industry in the next five years. The logistics, retail and supply chain industries are the biggest and the earliest users of Blockchain technologies. He gave an example of Walmart which uses Blockchain technology for the meat and mangoes supply wherein they track the supply right from the farm to the table.

The speakers explained certain use cases of Blockchain as given under:

- TradeLens is a supply chain formed in 2018 by IBM and Maersk and uses Blockchain technologies for end-to-end movement of their cargo across the world. Over 40 ports utilize the cargo and freight services using Trade Lens. The Trade Lens platform is completely built on blockchain and takes care of many issues and paperwork. It has made the movement of cargo hassle-free and the platform has been used by 100 organisations so far. Similarly, the Armed Forces could benefit from the merits of Blockchain technologies, since logistics is one of the important components of the military.

- E-Estonia- Powered by Keyless Signature. E-Estonia started between 2006 and 2007 and encompasses all services human-intervention free on one single platform. He, however, argued that it was easier to implement in countries like Estonia as it has a small and higher per capita income. It is a very good case study of bringing everything onto a single platform.

- China's BSN. China's Blockchain-Based Service Network (BSN) has been integrated with 5G as a cross-clout framework platform. This lateral Blockchain system has the aim to bring down the cost of the business and in some cases, has achieved an 80 % reduction in costs.

- Kaveri Blockchain. Kaveri Blockchain in Karnataka is a digital wallet with a smart card and key for storing property records and has been developed by IIT Kanpur.

- Tracking Seed Distribution. Jharkhand is the "first" state to implement blockchain in the country, which is being used to track seed distribution. The blockchain platform tracks seed supply distribution from issuing supply orders from the Directorate of Agriculture, placing seed demand by District Agriculture Officer, tracking seed distribution from empanelled government seed-producing agencies to distributors, retailers, LAMPS/PACS, FPOs and finally to the farmers.

In conclusion, he reiterated that the start of Blockchain technology has already happened and that there was a need to integrate digital wallets with the blockchain. The future of Blockchain is bright and something to reckon with in our nation-building efforts.

Sub Theme 2: Blockchain HR Applications in Civil Industry and Indian Army by Mr Vivek Tikoo, ZingHR, Mumbai

Blockchain HR Applications in Civil Industry and Indian Army by Mr Vivek Tikoo

Mr Vivek TIkoo began his talk by first introducing ZingHR to the audience. He then discussed the importance of Blockchain technology in HR applications in the civil industry that could be replicated in the military domain as well. He enunciated the term 'Outcomation' i.e. an outcome with automation. He argued that businesses have to drive Blockchain technology to make it user-friendly. He informed me that ZingHR helps clients right from the hiring to retiring process, and this service can help the Armed Forces. He stated that Blockchain technologies are productivity boosters and will add a new layer for the military in its effectiveness. He then highlighted the following few use cases of ZingHR's Blockchains services that the military can use.

- Managing statutory employee data
- Digital Mobile App *Onboarding 2.0*
- Real-Time Pay Roll that can boost business efficiency
- Multi-Mode Attendance Solutions for all scenarios
- The New-Age Life ID: Auto-builder crypto-graphic address and Digi locker that will trail all the information of the user and create a consumer-created marketplace.

While highlighting the issue of carbon emission in using Blockchain technology, he gave an example of RubiX's Blockchain Green Initiative, which provides an enterprise-level Zero Carbon Footprint blockchain alternative that is cryptographically 1,000,000

times more secure than the ECDSA 256 encryption used by Bitcoin or Ethereum. In conclusion, he reiterated the fact that Blockchain technology is zero-error technology that works in real time with speed, compliance and trust.

Sub Theme 3: Blockchain Value Framework – Improving Capabilities in Conservation, Disaster Relief and Emergency Preparedness by Prof A Damodaran, IIM Bangalore

Improving Capabilities in Conservation, Disaster Relief and Emergency Preparedness by Prof A Damodaran

Prof Damodaran, in his address to the audience, stressed the role of the Armed forces and how it could be bettered with more efforts and initiatives. This is to say that he highlighted that a lot had been said about blockchains, but the biggest problem with the Armed Forces in any part of the world is that they are not given sufficient funds. With the current political dispensation, there has been a substantial scale, but the Army is still lacking in funds. That is partly because a lot of other excellent work that the Armed Forces do outside the military or strategic operations never gets reflected. For instance, the Army does a lot of public work in places like Ladakh or places like Chamoli, which never gets documented. It is not seen as mainstream Army work; therefore, the focus is on three aspects which are peripheral and not mainstream in nature.

During natural disasters, Army plays a very important role. Under the disaster management act, Army is the first move and the civilian structures start moving after

that. The second is that the Army plays a very important role in the conservation of wildlife. Ushering from a biodiversity background and having been the environment sustainability guide, Prof Damodaran has been studying Blockchain for quite some time. Conservation programs, especially for critical species in remote areas like Ladakh and Kashmir are never highlighted to the extent it is now. These are the public goods created by the Army, which never get accounted for and one of the basic strategies of suggesting blockchains is to get this monetised or valued so that it pitches the Armed Forces in a much bigger light in terms of the enhanced flow of funds.

The Chamoli landslide, which happened in Feb 2021was because of global warming. The Army has played a very important role in conservation, but the peripheral nodes never get connected, so the central authority has to give way to a more distributed community. There has been a fair amount of discussion on public, private and hybrid blockchains. Defence activities are private and they are not private in the regular sense. It is a closed system of Permissioned Blockchains, but it is closed because it is for national security reasons. However, the Army goes beyond national security. The biggest point or challenge before the Army is to have a blockchain database. Blockchain is obviously stored data, but they don't store too much data, so a lot of work which is happening must be in real-time. The floods in Chamoli were due to avalanches that resulted in the landslide and thus required real-time data.

The Armed Forces need to talk more about Permissioned Blockchain, a database that is much more than the data being stored now. The Big SQL database is a structured database and then abstracts the Blockchain from above. Technology is important because of privacy issues. In the preceding section, speakers mentioned privacy is becoming a big issue, and Professor Agarwal talked about his own self-sovereign system of identity production. Sharding is when you have a large database; you dice it, slice it, put it in different corners, and then distribute it among the community. Each one only sees one part of it; therefore, nobody is in charge of the entire system.

While talking about disaster management by the Army in Uttarakhand, he showed a map of Uttarakhand. He showed the reds, which are extremely vulnerable areas, whereas orange is a little less vulnerable area. So, if one has that kind of data, all the Reds have been in a ledger of the Army, which would have been proactively knowing that this was going to happen and therefore, it can work very well. Pointing to one of the slides, he says that these would be the different rings in which you can store blockchain databases. In glacier retreat climate change issues, if snow leopard is conserved well, climate change is solved for that area, but that is not done well. So, the Army needs to play an important role here.

Let us go to the Army's role in disaster management. He pointed out that the First Actor Disaster Management act says that it is the most critical thing. For instance, in Chamoli, they deployed very promptly four columns and two medical teams, which was highly appreciated. But it could have been anticipated if there was a blockchain

database solution. Now, the mantra should be a rapid response, rapid mobilization and rapid relief and Blockchains can help.

There is an issue of snow leopard conservation in Ladakh and Nanda Devi National Park. Though people talk about the forest department, the Army plays a very important role in the conservation of all the species, because one has to man those borders. And if they are sensitive borders, the Army will have a lot of data on potential trails of snow leopards. All this data is being collected, but one is not using it. So that is something which can be verified and confirmed with communities because this is not the security data. It is non-security data. Pointing to a slide, he brings attention to the terrain map and remarks that the Reds are telling that the snow leopard does not just belong to India. They don't obey the borders of India, Pakistan, and Tajikistan; they migrate and come back. All these need to be tracked as much as infiltrators need tracking.

India has a sensitive border with China. The Army plays a very important role in the Heavens National Park. All this data can be huge. As the previous speakers have said, it has to be a Permissioned Blockchain which means it is private and closed. He suggested that it has to be a Private and a Hybrid kind of blockchain where local communities put data on conservation matters. They have got authentic information since they are the local people and so they must be trained. They collect data and report that there is some degree of melting observed in the Glacier. Nowadays, blockchains are used for better interactive maps, not just Google Maps. Blockchain-based solutions are much more accurate in terms of location, so they can also be built, but it needs the integration of blockchains with data systems.

The data from drones is very important. The visual data is very difficult to catch because it is a very small ledger. It is not meant for data storage, but now research is going on where layer one will be the big database, and layer two will be the abstracted metadatabase. Roads collect data on forests at the seedling level. It is not like satellite data; you are using two routes, so if you are also tracking infiltrators, they also need to have that kind of resolution. He proposed that the drones might as well capture what is happening to the forest and what is happening to the glacier etc. How will it work for disaster management? He proposed one of his old schemes that he had proposed for floods. It is a cloud-based solution. They are linked to Microsoft Azure, so one does not have that problem when there is an IoT Hub and IoT gateway, as then you have a blockchain, then you have data to Cloud, and then Cloud to data downloading, and then the visual. Then, one can apply geospatial analysis, and all these visuals will be presented before the CM, the PM and the Ministers. They can be given the revenue model that could be collected and recycled, and in that way, it can be monetized. This can be applied to floods as well as landslides.

Pointing to a slide, he said this is a blockchain database for public goods in general, especially in remote areas like Ladakh. So, you have data from the remote local communities, so you integrate the data of avalanche and conservation data, and then

you segregate all sensitive personal data because of privacy. It clearly distinguishes between sensitive data and community data. So, you save those data divided and distributed so that it doesn't get hacked. The metadata can be stored, and these days, block querying means retrieving the data. People have this impression that blockchains don't allow you to retrieve data. Ethereum has got solidity. A programming language allows data to be retrieved and put into analytics.

He concluded by saying that there is a lot of work which remains and is still invisible to all. The Army needs to come forward and one should say that this is the kind of value that we add not just for security, but also add a lot by way of public good in remote areas. Communication and border roads have been improved substantially. We are having problems with our neighbours but, at the same time, we are also helping wildlife and a few local communities to live in harmony. So blockchain is a good solution; it is for both peace and harmony.

Sub Theme 4: Blockchain Mobility Applications by Mr Venkatesh VR, Bosch Global Software Tech

Blockchain Mobility Applications by Mr Venkatesh VR

Mr Venkatesh correlated his paper to the theme of the session and established the case by exploring the possibilities of how the data of vehicles can be integrated with Blockchain systems and drive the automotive sector. He highlighted that one of the key components of logistics operations is the tool used in the logistics and the vehicle itself and how this vehicle can benefit from the use of blockchain. He explained how

blockchain could influence the transition of the automotive sector. The major transition that is happening in the automotive sector is about IoT and vehicles becoming autonomous in nature.

In layman's terms, Blockchain would do away with excessive human intervention in vehicle movement. In future, forces do not need to rely too much on the drivers to move vehicles from point A to point B. The mobility also could move towards a service model, which means the owner would be redundant. The growth of technology in the automotive sector must effectively and accurately replace human activity. Operating in the ecosystem has to reduce human activity and increase the autonomous vehicle segment, economic deliverables and support transition.

The speaker rightly argued that taking away the role of humans is not so easy. Just like human beings have needs; when vehicles start replacing human elements, they will start demanding certain mechanical needs. Vehicles would also have their needs in the transition from physical needs to having their own identity. This transition in the automotive sector can be enabled by IoT and blockchain. He explained how this transition would happen for the vehicle from being a mere mechatronics device to a device that can operate economic transactions by itself. At the primary stage, the vehicle shall have its own unique identity. Second, every vehicle integrated into automation would demand the data associated with the vehicle and mission, which could be obtained and stored against the vehicle's unique identity. Besides, the speaker illustrated real-time examples. When we are looking to buy a vehicle in seconds, it is hard to know whether that vehicle has an accident history, as such information can be fabricated. The meter of overall travel could have easily been tampered with a few tricks, or the previous owner changed the meter. The speaker described how such data can be kept in an immutable fashion using the blockchain ledger, which is hard to tamper with, is available to public knowledge and can be retrieved at any time.

He further contextualised the above illustrations to Armed Forces vehicles and logistic operations. The forces are not immune to accidents; whether they are choppers or trucks, any accident causes loss of life and damage to vehicles. First, the integration would come in handy during the investigation. Second, this integration would keep a record of whether or not the right components have been fitted in those vehicles. Can other details be accessed without going back to physical documents or people responsible for maintaining the particular vehicle? A proper log of how such a vehicle has been used would help to audit trial and investigation processes. He believed that this process could be a good use case for the Army to explore.

In the first stage, the vehicle assumes an identity of its own. In the later stage, the vehicle becomes a social being. The vehicle starts collaborating and cooperating with other vehicles. At present, the driver is doing the job, looking at whether it is good to take a lane change. There is always a question of whether the driver is efficient in

making decisions. As per the statistics, every day in India, 426 lives are lost because of accidents that happen on roads. One of the reasons is drivers are not efficient on the roads. For example, there are a lot of blind spots that a driver has to negotiate. It doesn't have a very meaningful way to negotiate, but in Advanced Driver assist systems, the lane change can be managed by a technology called V2X.

Regarding the issue of collaboration, the speaker suggested that V2X communication could be used to enable Machine to Machine (M2M) collaboration. Further, a peer-to-peer platform for Electric Vehicle (EV) charging could also be explored. The V2X has several components. One, it offers vehicle-to-vehicle communication. When a lane change is happening, the vehicle in the blind spot can communicate with another vehicle. Through V2X communication, collisions would come down.

Two, vehicles do not just communicate with pedestrians and also communicate with everything in the ecosystem. Mr Venkatesh illustrated a situation of a junction where two cars negotiate for the right of way to cross the junction. Here negotiating which car gets the right of way can be resolved with blockchain's smart contracts. As the ecosystem has the telematics data of each vehicle, the speed at which each of these vehicles is moving can be transmitted to others. This particular contract negotiation between and among vehicles is what blockchain can enable.

Third, the speaker explained another scenario for the Army in which vehicles can communicate in harsh terrain and share weather information with other connected vehicles. In the case of a convoy movement, communication about the terrain or the weather information to other vehicles in the convoy would make the mission fail-proof. It is a safe method to convey information to other vehicles in a convoy.

Fourth, electric vehicles (EVs) have become popular. There is greater acceptance for adoption, but there has been a lack of adequate infrastructure for charging. As of now, the country does not have to charge stations in remote locations like petrol stations or CNG stations. This problem can be solved by utilizing the spare capacity of the charging ports or the charging infrastructure available to electric vehicle owners. In such an ecosystem, the owners of the electric vehicles can put up a peer-to-peer platform and allow other users of the electric vehicles to use this charging station when they are not in use.

There is also a need to monetise the sharing of assets with others. Monetisation and exchange of value come into the picture without an intermediary in place. Here blockchain becomes a very useful technology to do disintermediation and facilitates the exchange of value between peers sharing the infrastructure.

With lots of data being stored in the vehicle, it could be further extended to avoid delays at highway toll booths. The physical toll payments can be eliminated using vehicle geolocation. In this scenario, human intervention and toll boots facilities can be avoided.

The ecosystem can also find use in the maintenance of vehicles. The service engineer is required to check the brake pad and replacement. In the context of a trust deficit in which one doesn't trust their service engineer to give them valuable feedback, the telematics data of the vehicle can say whether it is the right time to change your brake pad or a clutch pattern. In case the owner is not present at the service centre, the vehicle itself can negotiate with the service engineer and know what services have to be carried out and which components have to be replaced. As the vehicles have an identity, they also have a wallet. Commercial transactions can settle in no time without the involvement of the owner or any other interpreter.

Finally, the speaker believes as vehicles become autonomous entities, they contain an application. For the Army vehicles, separate applications can be developed. Under the concept of structuring the truck platooning method - a fleet of vehicles goes in a pre-set path with a similar amount of distance between them. The pre-set path with a similar distance between them enables the fleet of the truck to beat the air. Under this method, the fuel consumption of the lead vehicle can be saved by about eight per cent. Whereas the trucks following could save up to 16 per cent of fuel. This model is not just economical, driver’s fatigue is reduced and also does not lose any of the vehicles in the platoon.

The speaker summarised by answering how blockchain can help in mobility, and how it can help in the transition in the automotive sector. The IOT device to COT means collaboration of things and eventually to EOT which is economy of things. From this process, Armed Forces could be going away from human intervention, which has been consuming the human resources of the forces. Besides, the human element in logistics is becoming redundant due to automation. Since it is easy to provide each vehicle with a unique identity, the data could be stored against this unique identity. Logistics integration with Blockchain can be used in the Indian Armed Forces to audit vehicles.

A typical road map of the use cases is: one can think of the easiest one, in his opinion to start with the vehicle digital passport, which is creating a unique identity and collecting the data regarding the vehicles. Moreover, the software is becoming a medium for getting over-the-year updates like mobile phones. Now and then, the Android goes through an upgrade version. Similarly, vehicles would go through an upgrade version process. Here the blockchain can help prove where the software is coming from and whether it is the right software to be implemented in the vehicle.

In the speaker’s opinion, both are low-hanging fruits, something that can be started in the automotive use of blockchain. The electric vehicles, again, don't have much of

dependencies. However, truck platooning will depend on the development of autonomous driving systems. It would be advantageous when the development of V2X communication technologies was put in place before blockchain was bought into the picture.

Closing Remarks by the Chair

Session Chair Lt Gen (Dr) Ranbir Singh delivering the Closing Remarks

In his Closing Remarks, Lt Gen (Dr) Ranbir Singh mentioned that he would like to conclude the session by saying that we have had an extremely informative and thought-provoking exposition from the eminent panellists on various aspects related to the global applications of blockchain. We saw that blockchain technology can be very effectively adopted for military and non-military use cases both in the Indian context and also on a global scale. The technology has immense potential to transform not only logistics function and supply chain management, but also human resource management in the Indian Army. We have also been educated as to how this disruptive technology can be harnessed to improve our capabilities in conservation, disaster relief and emergency preparedness with specific influence in species conservation, natural disasters like flash floods, and landslides in the state of Uttrakhand and infrastructure development for inaccessible communities. We also saw how blockchain-based solutions can be employed in the conservation of endangered snow leopard species in the Ladakh region of India. Lastly, we had an exposition on leveraging blockchain for mobility management. He once again thanked the learned panellists for their participation and invaluable contribution to the overall objectives of the seminar.

SESSION -3
BLOCKCHAIN MILITARY APPLICATIONS AND ROADMAP FOR ADOPTION IN THE INDIAN ARMY

Opening Remarks by the Chair Lt Gen Rajeev Sabherwal, PVSM, AVSM, VSM (Retd)

Session Chair Lt Gen Rajeev Sabherwal delivering the Opening Remarks

Lt Gen Rajeev Sabherwal began his opening remarks by stating the theme of the session and highlighting its importance and relevance in the Indian Army. He further stated that 'Each Technology is either revolutionary or evolutionary. While revolutionary technologies go on to become disruptive, other evolutionary technologies are enforced upon the Defense Forces for their adoption. Blockchain is still a revolutionary technology and it has the potential to become a disruptive one. Its adoption would accrue huge operational payoffs in terms of enhanced security, transparency, trust, instant traceability, improved efficiency and automation. Therefore, the predicament today before the decision makers is not spreading awareness of these disruptive technologies, but the adoption of future emerging technologies, which have a high chance of getting adopted in the Indian Army depending upon the operational payoffs. The first step is to come out with a strategy document for the technology, which is to be adopted in the Indian Army and this case, it is Blockchain.

The Chair brought out that there is already a national strategy on Blockchain existing, but the same is required to be issued by HQ IDS and ARTRAC for the tri-services. The Indian Army spells out the vision, mission, objectives, scope and roadmap to produce this technology. Concurrently, there is a need to create a trusted digital platform by creating a robust tri-services information infrastructure, which can be used by various services, directorates and establishments for the development and deployment of their applications and not just specific to Blockchain, but all other emerging technologies. All the emerging technologies like AI, IoT and Big Data would require a trusted digital platform. Therefore, the solution for this digital platform is to create a Private Permissioned Blockchain. There is progress in the creation of a Tri-Services Information Infrastructure also called the Network for Spectrum (NFS), which has already been rolled out in the South-Western Command and the Western Command and it is soon going to become a reality in all Commands of the Indian Army. The Chair further elaborated that NFS is a Green Field Network, which encompasses both Federated and Central Data Centers. All three services have their Data Centers as part of NFS which has a multi-level multi-layer security architecture. There also exists a Defense Communication Network (DCN) with Data Centre which was inaugurated in 2016.

Sub Theme 1: Absorption of Digital Technology and Embracing Change by Defence Logisticians by Brig GM Attri, Cdr FOHOM, CMM Jabalpur

Absorption of Digital Technology and Embracing Change by Defence Logisticians by Brig GM Attri

Brig GM Attri started his talk by addressing the impediments in the absorption of digital technology and associated changes to be embraced by Military Logisticians and how it has become essential to embrace it irrespective of the bottlenecks. With varied and vast terrains which coexist on the huge Indian landmass, the required equipment, technology and infrastructure also vary according to the geographic features. The success of Military Logistics solely depends on its supply chain with the inclusion of different terrains. Military Logistics require timely delivery and seamless coordination and there is a strong need to meet the desired end state with end-to-end visibility. There is a strong need for the creation of a real-time demand and supply, to create a search capacity and to maintain effective command and control in a contested environment. The technologies that are required for modernising military logistics are AI, predictive analytics and machine learning which accrue various advantages such as demand and supply forecasting, route optimization, risk management, predictive logistics, IoT, real-time tracking and predictive maintenance. He opined that it was easy to scale up, but that comes with huge costs such as blockchain technology with high-speed data highways. All predefined logistics and payments are recorded in uninterrupted ledgers, the documents for the deal are in unalterable blocks and nothing can be tweaked in favour of anyone. Permissioned Blockchains offer high scalability in which only authorized entities can have access to private data. The Hyper Ledger is an open-source software based on the Hyper Linux platform to create personal Blockchains. The Indian Army is currently working on ERP SAP which has a stable structure and will be used for Human Resource Management.

Sub Theme 2: Smart Contracts - Intricacies and Nuances by Mr Santosh Pathak, Infosys Ltd

Smart Contracts - Intricacies and Nuances by Mr Santosh Pathak

Mr Santosh Pathak highlighted that Blockchain is one of the best-suited technologies for certain kinds of contracts in which written agreements benefit businesses of all sizes and across all sectors. Written contracts are sometimes very burdensome and a source of commercial and legal controversies. But, by substituting smart contracts for conventional ones, a problem can be solved. A smart contract is an agreement that takes the form of a computer program that executes itself automatically when specific pre-programmed conditions are met. A smart contract on Blockchain aims to make commerce and trading between identifiable and unidentified parties easier, sometimes without the need for an intermediary. A smart contract reduces the formality and expenses linked to conventional approaches without sacrificing reliability and trustworthiness. Smart contracts have an owner and a life span. It has to be owned by some entity in the whole chain. Smart contracts are thus autonomous programs that directly control numeric insecurities (digital aspects), based on mutually agreed terms. The scenarios where Smart Contracts are used include:

- Supply chains, where one requires a whole trace and at the same time the whole chain.
- Insurance for vehicles and travels because most of the time the terms and conditions are static.
- Tax compliances.

- Rent agreements.

Important characteristics of Smart Contracts are as under:

- It reduces audit and execution costs, and frauds.
- Smart contracts are non-self-executable.
- Contract addresses are needed to communicate with a smart contract.
- Smart contract execution can be launched by human intervention or by smart contract calls.
- Once it is executed, transactions resulting from the execution are transcribed on the Blockchain and eventually smart contract's metadata are updated.
- Smart Contracts have many advantages as listed below:
  - Safety: Data in the decentralised registry cannot be lost and cyber-attacked.
  - Security: The distributed ledger is impenetrable and unaffected by changes.
  - Precision: No mistakes can be made due to the absence of hand-filled forms.
- Disintermediation enables parties to reach agreements with a lesser reliance on middlemen.
- Once the relevant conditions are met, near real-time execution occurs, where everything happens virtually instantaneously for all parties across participating machines.
- Transparency - Fosters trust by making the information and logic contained in the contract available to all users of the blockchain network.

The disadvantages of Smart Contracts are as under:

- It is difficult to make changes in smart contracts.
- The third-party agents do not disappear but start playing a different role. The need for lawyers experienced in IT increases in the future because the programmers of smart contracts will need consultations for making new kinds of contracts.
- The consumers are quite suspicious because it is a new technology and they do not understand it yet.
- One can keep and save data in smart contracts safely and it is void of any distortions, only if the code is written perfectly and precisely.

Sub Theme 3: ASC Supply Chain – Proof of Concept Project by Maj Gen Harsh Chhibber, VSM

ASC Supply Chain – Proof of Concept Project by Maj Gen Harsh Chhibber, VSM

To construct Blockchain specifically, Maj Gen Harsh Chhibber suggested first building the foundations around it, because the maximum challenge any new technology faces is establishing communication between the developer or the technology expert and the prospective beneficiary.

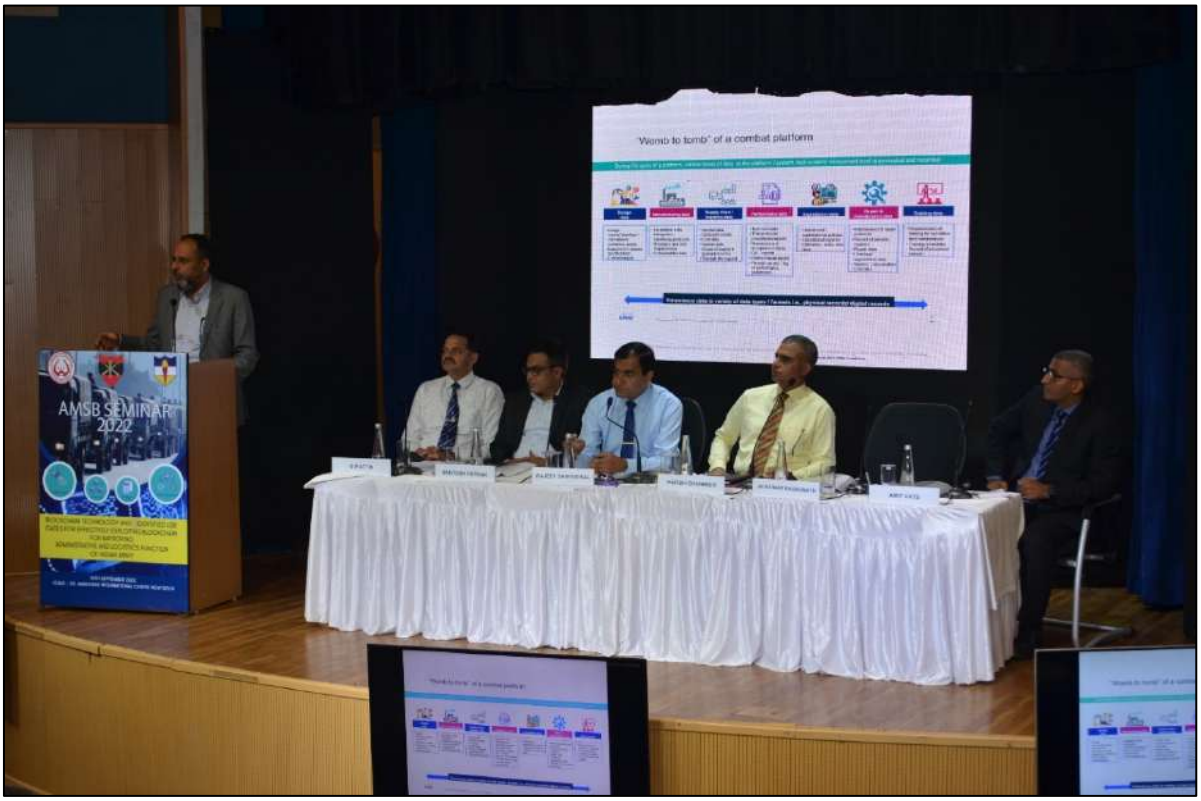
The speaker further stated that motivation for infusing technology into military logistics comes from the scale at which military logisticians operate. He exemplified that 1.4 million people's human resources are required to be fed. Recording the performance is not an easy task, since there is no way of recording the performance reliably. Hence, employment of technological solutions probably performance-based contracts will become a reality and better-quality service will become a norm rather than just incentivizing. If there is any data/information exchange happening within the organisation in absence of an external player, then blockchain is not required and thus not to waste time and energy in infusing technology in a system wherein there is no external entity involved. In such cases, unless there is a multi-party data exchange, blockchain is not required.

In the tri-services environment, data exchange will require some kind of trust, which needs to be built when two types of systems interact with each other. The suitability of Blockchain is only when the system needs to integrate with another system. If the

existing systems were functioning, then one should not hammer them with Blockchain. If it requires the integration of diverse systems, it will seek Blockchain technology solutions.

The speaker explained that Blockchain technology is all about enabling work in its system, developing it, having ownership of it and at the same time interacting with other parties or systems. Blockchain has a language which enables transparent information exchange. Seeing this kind of diversity, this design has been implemented in Western Command. The speaker concluded his talk by recommending that the Indian Army should formulate a Blockchain doctrine which should be broad-based and has to be flexible because the technology is evolving technology. This is the stage where there is a requirement to nominate an agency, that will be looking after smart contracts, compliance issues, and documentation, and start working on a conceptual framework to carry out Proof of Concept.

Sub Theme 4: Digital Footsteps Towards Blockchain Technology for Platform Lifecycle Management (PLM) in Indian Armed Forces by Cdr Jai Kumar Raghunath (Retd), KPMG Advisory Services, Pvt Ltd



Digital Footsteps Towards Blockchain Technology for Platform Lifecycle Management (PLM) in Indian Armed Forces by Cdr Jai Kumar Raghunath (Retd)

Cdr Jai Kumar Raghunath began his talks by addressing that similar challenges are being faced by the three services. He opined that platforms are complex and all kinds of technologies are being thrust into platforms. As a 'Womb to Tomb' concept of a combat platform from the time it is conceived to the time it is scrapped i.e., during the entire cycle of its exploitation, there is voluminous data that is generated around it. These are the data generated throughout the life cycle including manufacturing-related data, data in consumable space, supply chain logistics, vendor contract data, repairs and maintenance data and performance data. Different entities are generating data such as system designers, manufacturers, suppliers of the component and equipment, platform users like serving officers, people who are running the platforms and quality assurance inspections agencies.

Platform Lifecycle Management (PLM) involved recording and utilizing this voluminous data in such a manner that it will be able to optimally exploit the platform for the purpose in the best possible manner. There are so many systems that are interconnected and typically sourced from different suppliers. However, PLM has some challenges, which are given below:

- First there is no single and reliable source of truth. This is because of a lack of information and interoperability. Record keeping is done by multiple entities in different formats and may lead to completely unreliable information.
- Different supplier chain procurement is from different vendors and hence it is very difficult to keep track of as to which vendor, is supplying what and whether it was the right component and also reliable throughout its lifetime. Therefore, there is a lack of trust issue. On such a large scale/ a large number of players, trust and collaboration are practically impossible in comparison to a closed supply chain.

When operating several platforms, there are so many supply chains and these supply chains can be disrupted easily because of natural disasters and level disputes. Lack of collaboration is exacerbated in critical scenarios when real-time information on the platform is not available.

A combat platform is an integrated block of systems/subsystems with a hierarchy through its subsystems right up to its component level. It can be visualized as a combination of several systems and each system can have several sub-systems and each sub-system can have several components. It breaks down the hierarchy and each of the systems/sub-systems are interlinked and interdependent.

To maintain a platform is to manage the lifecycle with the data that is associated with the platform. The digital replica of the platform can be conceptualized which comprises data sets related to each of the systems and sub-systems of the platform.

Hierarchical multi-level and multi-faceted data capture during the platform lifecycle leads to the breakdown of digital replicas into various systems, sub-systems and components as it needs to capture all kinds of data. It is already happening in papers and files. As a component comes in, it is tested and the test record gets into the file. Then the component is explored, and the book is maintained in a separate log book and entered into an excel sheet on a computer. The logistics chain gives a list of spares and provides repair and maintenance protocols and logs in a document or a pdf document. Therefore, in a digital environment, there is a necessity to translate these physical records into digital records of the same set of information at each level of the hierarchy.

Blockchain technology in PLM can facilitate the continuous, dynamic and immutable recording of the data of each of the platforms, systems, sub-systems and components in the form of digital data. It establishes traceability of the source of information and provides assurance and transparency of all transactions in a long and complex supply chain. One of the greatest advantages of Blockchain is the immutable record of data and everything that happens with the platform is continuously being recorded. Some use cases of Blockchain technology in PLM are:

- Use Case 1: Blockchain technology for the provenance of components to ensure operational availability
- Use Case 2: How Blockchain technology and data analytics can improve asset exploitation/efficiency and aid decision-making.

Footsteps for adopting Blockchain technology for PLM are as under:

- Data standardization and interoperability
- To standardize the work breakdown structure of a platform so that data interoperability is easily established.
- Follow Integrated Platform Data Environment (IPDE).

The speaker concluded his talk by saying that BCT in combination with IPD and data analysis has a great potential for transforming the platform’s lifecycle. Nevertheless, to embrace this meaningfully, it is essentially digital transformation footsteps, which is adopting a standardized work breakdown structure and slowly transforming it into an integrated product data environment. Finally, it is possible to transform it into a network-centric operation.

Sub Theme 5: Roadmap-Pan India Army Adoption of Emerging Technologies and Blockchain Technology by Mr Amit Vats and Mr Gaurav Tripathy, Infosys Ltd

Roadmap-Pan India Army Adoption of Emerging Technologies and Blockchain Technology by Mr Amit Vats & Mr Gaurav Tripathy

Mr Amit Vats and Mr Gaurav Tripathy opined that the Blockchain initiative should be looked at through the prism of the following:

- ***Is it Relevant***: Is it the right scope that one is going to attack while looking at the Blockchain as a technology solution? Blockchain should not be looked upon as a solution. Instead, the area of focus should be on practical problems. Focus on the top considerations that the Indian Armed Forces are facing and whether is Blockchain making sense to some of them. If yes, then it is a relevant thing to look at. By relevance, the three highest priorities for the Indian Army are:

  - **Enhanced Fit-to-Fight Capabilities**: Automation using smart contracts in key areas.
    - Procurement and Distribution of Perishable and non-perishable products.
    - Management of Equipment Lifecycle.

  - **Optimal Manpower Management:** Identity management becomes a big challenge. A few weeks back there was a fraudulent attempt by someone trying to participate in the 'Agniveer' scheme using fraudulent documents. Similarly, with existing manpower management there will be a need to be able to trace the validation of people joining the Army and maintain their training history, transitions, and acquired skills. Identity management will play a big part in getting all the information in one place, managing rotations among the manpower and trying to keep it more optimized

  - **Bolster Theaterisation:** Relevant areas that need to be identified that need to be pushed into the Blockchain. Only the relevant bits of information can be plucked out from all the various systems already in practice in the Armed Forces and then bringing them up to a common platform through which decision-making involving all the services and arms could be considered.

  These are the potential areas where Blockchain is a very powerful choice of technology. Given that potentially these are the three relevant justifiable business imperatives or goals for the Indian Armed forces and the fact that relevant bits of technology i.e., Blockchain being through smart contracts, identity management and secure data integration provide direct benefits. It could be a potential choice and there has to be an effort to look at what is possible in the short term and the long term.

- ***Tangible***: It needs to be ensured, that Blockchain is tangible in the short term. It should have some cost benefits to be tangible. Tangibility both in terms of

optimized process savings and cost and timeline-based outcome. Some tangible Outputs for the Indian Army are as under:

- **Short-Term Objectives:** In the short term, the focus of our efforts should be more on the exploration and evaluation of Blockchain technology to include evaluating benefits, challenges, investments, costs, and efforts required. All these things have to be considered to do an objective and fair evaluation of the cost-benefit analysis of Blockchain technology. To achieve this, we should start with a tightly scoped and well-understood use case that can be quickly implemented. The use case of supply chain optimization on the fuel and frozen meat items is an excellent use case on this behalf. In this case, we have already mapped out what we need to do and what outcomes we expect out of it. If we can run this project in the next 1 -3 years in pilot mode and see whether we are able to realize those benefits and what are the challenges and the cost that we had to incur to do this implementation. This way we will be able to have the learnings and make any adjustments that are required and make any changes on demand of the leadership. This is the outcome of running this short-term use case. The other outcome would be that we would have a foundation Blockchain, a private permission network that can be used to build additional use cases. This infrastructure will be reusable. This can be started small in a command and as we learn and make adjustments, we can gradually expand it to cover all the remaining commands.

- **Medium-Term Objectives**: In the medium term we should start with a foundation network that has already been rolled out in short term. The next thing to do will be to build additional capability onto it. We can enhance the already running supply chain system by adding more items to it. That could be dry rations, ammunition, lubricants, or canteen items. The next step will be to integrate this foundation blockchain infrastructure with the rest of the IT infrastructure of the Indian Army. We will have to start integrating this infrastructure which was so far running in isolation with the IT infrastructure backbone of the Indian Army. In parallel, another activity that needs to be done in the medium term would be to onboard the people and the use cases from the other services onto the blockchain network that has already been established. It will result in a unified blockchain platform available for the combined Indian Armed Forces. This would be a step towards the Theaterisation objective where all three arms of the Indian Armed Forces can collaborate and combine towards the unified objective.

- **Long-Term Objectives**: In the long term, additional capabilities can be rolled out. More use cases can be implemented along with continuous innovation. Also, it is essential to create a convergence of Blockchain with other emerging technologies like AI, Machine Learning and Quantum Computing as it is

necessary to have a roadmap for these emerging technologies as well as a well-defined strategy for convergence of these technologies with Blockchain because this is how the future of warfare will happen.

Closing Remarks by the Chair

Session Chair Lt Gen Rajeev Sabhrewal delivering the Closing Remarks

Lt Gen Rajeev Sabhrewal in his closing remarks thanked the panellists for an extremely insightful, interesting and educative session and the invaluable contribution made by each one of them to the overall objective of the Seminar. He said that the applications and use cases highlighted during the session would go a long way in improving the efficiency of the Indian Armed Forces in every given manner. To ensure these applications see the light of day as early as possible a suggestive roadmap for the next 3-5 years is as under:

- **Tri-Services Blockchain Framework**. This framework would be based on the shared info infrastructure of the three services as part of NFS, DCN and ASCON Phase IV, and would be the basis for the reference implementation, integration with various existing infrastructure and services, reference implementations of real-life projects and sandbox environments for development and testing of applications.

- **Theaterised Nodes**. The Tri-Services Blockchain Framework would be hosted on nodes which are geographically distributed across the country in each Theatre and enabled as shared Blockchain infrastructure. For onboarding any entity (Directorates/Establishments), basic technical parameters may be evolved. Interested entities need to undergo security audits and assessments by empanelled agencies before being part of the Tri-Services Blockchain infrastructure.

- **Blockchain-as-a-Service**. Tri-Services Blockchain Framework would be used for the development and large-scale hosting of Blockchain applications in different areas as discussed in Session 3 today as well highlighted during the Seminar by various speakers. This infrastructure will be used for providing Blockchain-as-a-Service.

- **Policy and Guidelines**. Tri-Services Blockchain Framework would be open for relevant stakeholders. HQ IDS in collaboration with the Service HQ would define the **policies & guidelines** and any application/use case complying with the policies would be on-boarded on the framework.

- **Ownership**. As has been seen through several successes and failures over the years, a project succeeds only when a sense of ownership is ensured. The responsibility of the Tri-Services Blockchain Infrastructure needs to be vested with the Corps of Signals under the SO-in-C since they have steered the NFS, DCN and ASCON architecture on behalf of the three Services.

CLOSING SESSION

Closing Address by Lt Gen BK Repswal, AVSM, VSM, Commandant ASC Centre & College

Lt Gen BK Repswal delivering the Closing Address

Lt Gen BK Repswal began his closing address by stating that we should not work from a fear of failure and that there cannot be a big-bang solution. We have to start incrementally, piecemeal and that is the way to move forward. He quoted, ‘Science and Technology multiply around us to an increasing extent that dictates the languages in which we speak and think. We use those languages or we remain mute. The need is to allow people who are using these technologies to be on board and start taking small initiatives and not letting a single person take control of everything. There should be a strategy, which would guide the future. The speaker alluded that over the obsession with what will happen if the information goes out is preventing us from moving forward.

He further mentioned that there would be and there are several challenges, but let us not fall in love with these technology stacks and reverse engineer for the enterprise to put Blockchain into the system. There are challenges; we are such a legacy-driven organisation that it is very difficult to get rid of the old idea. Therefore, first, we have to start incrementally and we need to the forefront of our technology design choices. This is the real challenge in larger organisations and all our initiatives have to be piecemeal in pockets.

There is a need to have legal and regulatory mechanisms for smart contracts and that is how these smart contracts have to be given legal protection because their biggest use is in HR and supply chain management. The speaker also mentioned that political will within the organisation is equally important.

Towards the end, Lt Gen BK Repswal emphasised that there is a strong need for research to be empowered. There should be more focus on research in the domains of standards and interoperability; scalability and performance; consensus mechanisms; security and privacy; key management; secure smart contracts and detection of vulnerabilities in Blockchain technology-based solutions. Once these things are in place it will eventually result in a robust indigenous Blockchain platform that will scale it up in the years to come and involve everybody. He then urged GOC-in-C ARTRAC to take the lead in formulating a doctrine and a strategy for the Army and recommendations for the Indian Armed Forces.

Vote of Thanks by Lt Gen (Dr) Ranbir Singh PVSM, AVSM, YSM, SM (Retd), Director General CLAWS**

Lt Gen (Dr) Ranbir Singh delivering the Vote of Thanks

Lt Gen (Dr) Ranbir Singh, PVSM, AVSM**, YSM, SM (Retd), Director General CLAWS concluded the seminar with his Vote of Thanks. He thanked Commandant ASC Centre and College and his team for guiding CLAWS to pick up the right speakers and themes. He was grateful to the Army Service Corps for the valuable initiatives taken by them in adopting technology and how they were being translated on the ground in Western Command. He said that it inspires so much confidence that the Army is in the

right direction, on the right trajectory and it would be a great help to take great leaps forward in times to come.

Recalling the first session, the DG mentioned about Lt Gen. Repswal's remarks that blockchain is an excellent technology looking for problems and now the seminar has been able to identify problems of the Armed Forces and how to utilise the blockchain to solve those problems. He further said that the seminar had opened minds to understand what capability exists, the requirements and how it will interact between academia, R&D, the industry and the users. He was optimistic about the kind of work which is going on and said that if we all can put our heads together and identify the needs, we should be able to move forward in the direction of adopting Blockchain technology.

He stated that the recommendations made by the Commandant ASC Centre and College on how to evolve a doctrine on the usage of Blockchain technology in the Army and the Armed Forces are a step towards looking forward. He thanked all the distinguished speakers for making excellent presentations and recalled their in-depth knowledge during their presentations. He also expressed his gratitude to all the serving officers, retired veterans and a large number of scholars and the online audience for their valuable time.

He expressed his gratitude for the presence of DG EME and thanked GOC-in-C ARTRAC, Commandant ASC Centre and College and the entire audience providing an excellent opportunity to discuss this essential subject. He articulated his faith that the Army Commander will take the recommendations and lessons forward to have more such seminars focused on the Army's requirements, the problem statements and what needs to be done for the future.

KEY TAKEAWAYS AND RECOMMENDATIONS

Detailed deliberations on important aspects of Blockchain technology and its immense potential to transform military logistics and administrative functions in the Indian Army have resulted in the generation of the following key takeaways including use cases, roadmap and recommendations for the adoption of blockchain technology by the Indian Army:

- **Blockchain Doctrine/ Strategy Document**. The first and most important step is to come out with a Doctrine or Strategy document for the adoption of Blockchain technology. The same is required to be issued by IDS and ARTRAC for the Tri-services and Indian Army spelling out the Vision, Mission, Objectives, Scope and Roadmap for the adoption of the technology.

- **Trusted Digital Platform**. Create a trusted digital platform by creating a robust and secure Tri-Service Information Infrastructure which can be used by various Directorates and establishments for the development and deployment of their applications not only related to Blockchain but other emerging technologies like Big Data Analytics, Cloud Computing, AI, ML, IoT etc.

- **Roadmap**. A suggestive roadmap for the next 3-5 years is as under:

  - **Tri-Services Blockchain Framework**. This framework would be based on the shared info infrastructure of the three services as part of NFS, DCN and ASCON Phase IV, and would be the basis for the reference implementation, integration with various existing infrastructure and services, reference implementations of real-life projects and sandbox environments for development and testing of applications. For better understanding and clarity, a brief on the proposed Tri-Services Blockchain Framework is enclosed as **Annexure I**. The illustration in the brief gives out the layer below which all functions would be performed within the NFS Network (including the Data Centers) by the network administrators (Corps of Signals), and above it by the user directorates/establishment for all application-related functions. This layer is the Tri-Services API layer through which all applications would access the underlying data.

  - **Theaterised Nodes**. The Tri-Services Blockchain Framework would be hosted on nodes which are geographically distributed across the country in each Theatre and enabled as shared Blockchain infrastructure. For onboarding any entity (Directorates/Establishments), basic technical parameters may be evolved. Interested entities need to undergo security

audits and assessments by empanelled agencies before being part of the Tri-Services Blockchain infrastructure.

- **Blockchain-as-a-Service**. Tri-Services Blockchain Framework would be used for the development and large-scale hosting of Blockchain applications in different areas. This infrastructure will be used for providing Blockchain-as-a-Service (BaaS)

- **Policy and Guidelines**. Tri-Services Blockchain Framework would be open for relevant stakeholders. HQ IDS in collaboration with the Service HQ would define the policies & guidelines and any application/use case complying with the policies would be on-boarded on the framework.

- **Ownership**. As has been seen through several successes and failures over the years, a project succeeds only when a sense of ownership is ensured. The responsibility of the Tri-Services Blockchain Framework needs to be vested with the Corps of Signals under the SO-in-C as the complete infrastructure on which it is going to be based i.e., NFS, DCN and ASCON have been steered by the Corps of Signals on behalf of the three Services.

- **Identify Use Cases**. Need to establish synergy between Academia, R&D, Industry and users to identify the use cases for the Indian Army and move forward in the direction of adopting Blockchain technology. Some suggested uses cases which emerged during the seminar are as under:
  - Automation using smart contracts
  - Procurement and Distribution of Perishable and non-perishable products
  - Platform Lifecycle Management (PLM)
    - Provenance of components to ensure operational availability
    - Improve asset exploitation/efficiency and aid decision-making
  - HR Management - Identity management, hiring to retiring process, document verification
  - Supply chain optimization on the fuel and frozen meat items (short term), dry rations, ammunitions, lubricants, or canteen items (mid-term), additional capabilities be implemented along with continuous innovation (long term)
  - Bolster Theaterisation in the Armed Forces by bringing the services onto a common platform through which decision-making involving all services and arms could be considered.
  - Blockchain with IoT in mobility management, vehicle-to-vehicle communication and collision avoidance, car diary and logbooks maintenance and driver assist systems.

- Defence estate management.
- Disaster relief, emergency preparedness and environment conservation.

- There is a need to have legal and regulatory mechanisms for smart contracts.

- There is a strong need for research to be empowered. There should be more focus on research in the domains of standards and interoperability; scalability and performance; consensus mechanisms; security and privacy; key management; secure smart contracts and detection of vulnerabilities in Blockchain technology-based solutions.

- There is a need to create a convergence of Blockchain with other emerging technologies like AI, Machine Learning, Internet of Things (IoT) and Quantum Computing.

- **Feasibility Study/Paper**. Feasibility study/ paper on the following issues about the adoption of Blockchain technology in the Indian Armed Forces;

  - CLAWS may suggest IDS conduct a feasibility study for Blockchain technology applications in each service. Such studies may be carried out regularly based on feedback and adaptation to advancements in such technology.
  - A dedicated paper on China's advancements and challenges concerning the seminar topic is suggested as it offers a comprehensive overview and where India must take great leaps and maintain progress.

ANNEXURE I

PROPOSED TRI-SERVICES BLOCKCHAIN FRAMEWORK

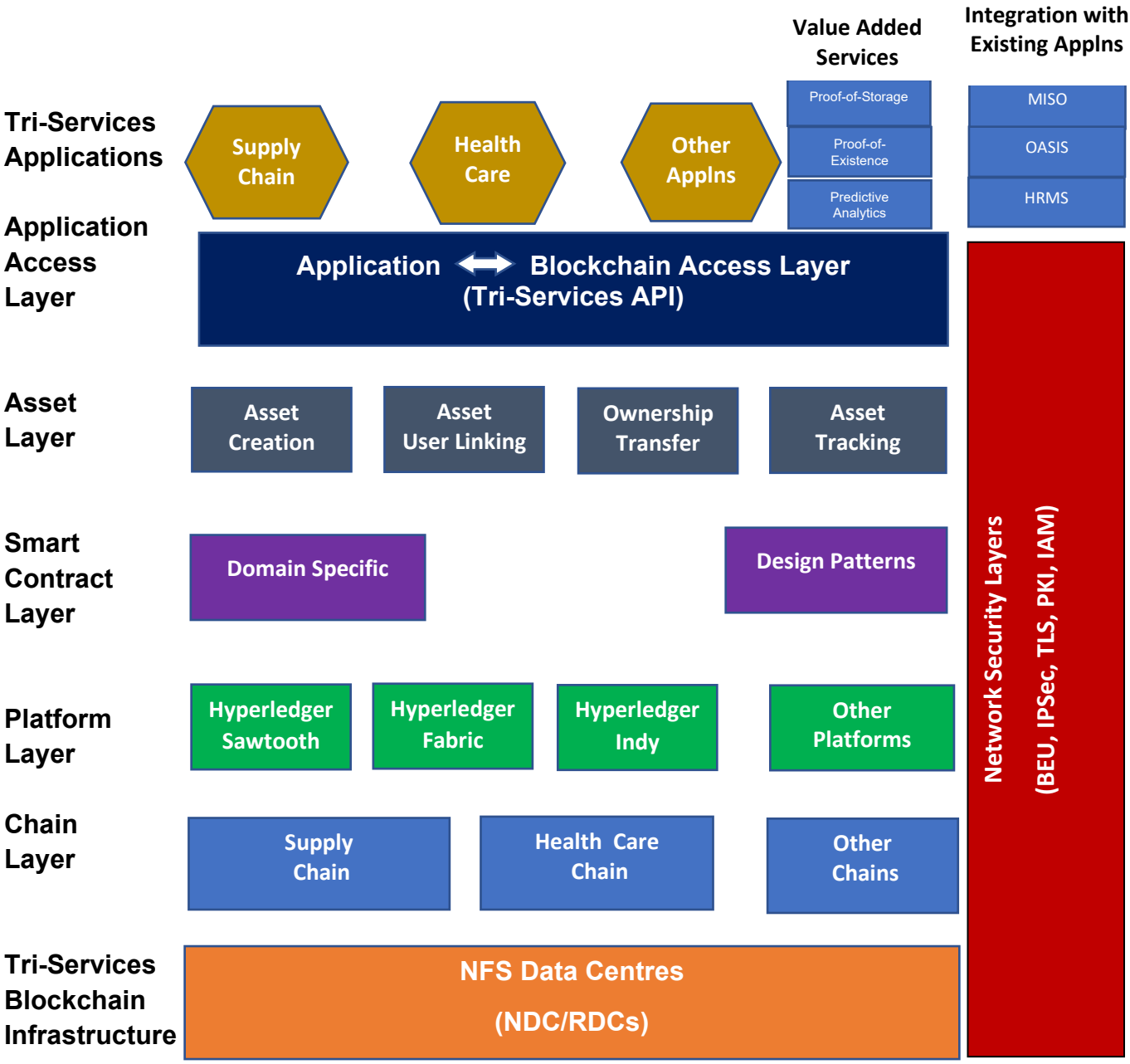


Figure 1: Proposed Tri-Services Blockchain Framework

Legend

NDC – National Data Centre, RDC – Regional Data Centre, BEU-Bulk Encryption Unit, IPSec – IP Security, TLS-Transport Layer Security, PKI -Public Key Cryptography, IAM - Identity and Access Management, API-Application Programming Interface

- Based on the National Blockchain Framework given in the National Blockchain Strategy document issued by the Ministry of Electronics and Information Technology (MeitY)[1], a Tri-Services Blockchain Framework for the Indian Armed Forces is proposed and the same is depicted in Figure above. A Tri-Services Blockchain Framework is an essential requirement for ensuring a robust, inter-workable and upward-scaling platform for all blockchain applications. The Tri-Services Blockchain Framework would be used by the Services for the development and large-scale hosting of Blockchain applications in different areas such as supply chain, electronic health records, equipment management, HR management, financial management etc. The proposed framework will facilitate the development of cross-domain blockchain applications across the three Services. The framework will be used for providing Blockchain-as-a-Service (BaaS).

- The Tri-Services Blockchain Framework is proposed to be established on the Network for Spectrum (NFS) cloud infrastructure comprising a central National Data Centre (NDC) and distributed Regional Data Centres (RDCs). On top of the NFS infrastructure layer, the Chain Layer will host domain-specific chains (distributed immutable digital ledgers) about the supply chain, health care, HR, equipment, finance, and many other domains. The Platform Layer will host multiple blockchain platforms such as open-source Hyperledger Fabric, Hyperledger Sawtooth, Hyperledger Indy and other platforms including future indigenous platforms. These platforms will provide the required tools and libraries for the development of domain-specific blockchain applications. The Smart Contract Layer will host and implement many domains' specific or custom-designed smart logic.

- The Asset Layer will provide all functional aspects about the creation, linking and tracking of assets and accessible through standard Application Programming Interfaces (APIs) through the Tri-Services Blockchain API. This will provide an ecosystem for fulfilling workflow requirements for customized applications. Other general-purpose Value-Added Services (VAS) such as proof-of-storage, proof-of-existence and predictive analytics can be exploited by any blockchain application to extend its functionality. The framework will also act as a point of integration with other applications of the three Services such as MISO, OASIS, HRMS etc. The core network security architecture of NFS will ensure the provisioning of multi-layered security services to all blockchain applications hosted by the three Services. The Tri-Services Blockchain framework will thus have the capability and scalable capacity to host multiple blockchain applications for supporting Service specific use cases of the three Services as well as cross-domain use cases across the three Services.

Multi-Organisational Approach for Tri-Services Blockchain Framework

- To plan and implement the Tri-Services Blockchain Framework, a multi-organizational approach is proposed. The entire infrastructure of the Blockchain Framework from the bottom Tri-Services distributed infrastructure layer up to the Application Access Layer including all intermediatory layers (Chain Layer, Platform Layer, Smart Contract Layer and Asset Layer) is proposed to be vested with the Corps of Signals as the responsibility of provisioning of Information and Communication Technology (ICT) infrastructure rests with the Corps. The topmost Application Layer where blockchain application will be developed to harness the underlying framework should be the responsibility of the concerned Line Directorate/Branch in close coordination with DGIS which has been mandated to develop all applications for the Indian Army.

- The roles of the policy-making and auditing agencies like HQ IDS and DCyA within the current workflow of application development should remain unchanged. SO-in-C being the de-facto Chairman of the Joint Services Communication Committee (JSCC) should be responsible for synergizing the efforts of all Services into establishing the proposed Tri-Services Blockchain Framework over NFS infrastructure. Likewise, all Line Directorates and Branches including the Navy and Airforce should be responsible for the development of their Service specific, use-case-specific or cross-domain blockchain applications over the established Tri-Services Blockchain Framework. The proposed distribution of responsibilities between different organizations is as under.

S. No	Organization	Responsibility
1.	HQ IDS	Formulation and issue of specific policies and guidelines in collaboration with Service HQs for exploitation of the Tri-Services Blockchain Framework for the development of blockchain applications by the services.
2.	Corps of Signals	Provision of NFS infrastructure and all layers up to the Application Access Layer for hosting of the Tri-Services Blockchain Framework and offering Blockchain-as-a-Service (BaaS) for exploitation by all three Services for the development of blockchain applications.
3.	DGIS	Undertake projects for the development of specific blockchain applications in collaboration with concerned services, directorates/branches by exploiting the underlying Tri-Services Blockchain Framework.
4.	DCyA	To carry out periodic security audits of the Tri-Blockchain Framework and blockchain applications to ensure cyber security compliance.
5.	Army/Navy/ Airforce Directorates/ Branches	To formulate user requirements and RFPs for the development of specific blockchain applications over the

S. No	Organization	Responsibility
		Tri-Services Blockchain Framework in coordination with DGIS.
6.	ADB	Act as a single window for conducting technology surveys and carrying out interactions with the industry/PSUs for facilitating the development of blockchain applications in coordination with the Service HQs and DGIS.

1. National Strategy on Blockchain – Towards Enabling Trusted Digital Platforms, MeitY, December 2021.

SCHEDULE OF EVENTS

Time	Event/Topic	Speaker/Guest
0900-0930 H	Registration	
0930 H	**Arrival of the Chief Guest**	Lt Gen SS Mahal AVSM, VSM, GOC-in-C ARTRAC
0930-1000 H	**Inaugural Session**	
0930-0945 H	Opening Address	Lt Gen (Dr) Ranbir Singh, PVSM, AVSM**, YSM, SM (Retd), DG CLAWS
0945-1000 H	Keynote Address by the Chief Guest	Lt Gen SS Mahal, AVSM, VSM, GOC-in-C ARTRAC
1000-1030 H	**Tea & Group Photograph**	
1030-1210 H	**Session 1: Blockchain Technology - Conceptual Evolution**	
1030-1035 H	Opening Remarks by the Chair	Lt Gen BK Repswal, AVSM, VSM, Commandant ASC Centre & College
1035-1050 H	Blockchain Evolution & Architecture	Prof Subodh Sharma, IIT Delhi
1050-1105 H	Blockchain Framework in India - NITI Aayog Concept Paper, Jan 2020	Mr Saurabh Thakral, Sr Specialist, NITI Aayog
1105-1120 H	Indian National Blockchain Strategy - GoI, MEITY Document, Dec 2021	Dr Sunita Verma, Scientist G, MeitY
1120-1135 H	Business Model Transformation - Adoption of Blockchain Technology in India	Mr Sreeram Ananthasayanam, Deloitte India
1135-1150 H	Blockchain and Self Sovereign Identity (SSI)	Prof Manindra Agarwal, IIT Kanpur
1150-1205 H	Ques & Ans Session	
1205-1210 H	Concluding Remarks by the Chair	
1215-1340 H	**Session 2: Global Blockchain Applications**	
1215-1220 H	Opening Remarks by the Chair	Lt Gen (Dr) Ranbir Singh, PVSM, AVSM**, YSM, SM (Retd), DG CLAWS
1220-1235 H	Blockchain Non-Military Use Cases - Global and Indian	Mr Nitin Arora, KPMG Advisory Services Pvt Ltd
1235-1250 H	Blockchain H Applications - In Civil Industry and Indian Army	Mr Vivek Tikoo, H Zing, Mumbai
1250-1305 H	Blockchain Value Framework – Improving Capabilities in	Prof A Damodaran, IIM Bangalore

Time	Event/Topic	Speaker/Guest
	Disaster Relief, Emergency Preparedness and Conservation	
1305-1320 H	Blockchain Mobility Applications	Mr Venkatesh VR, Bosch Global Software Tech
1320-1335 H	Ques & Ans Session	
1335-1340 H	Concluding Remarks by the Chair	
1340-1500 H	**Lunch**	
1500-1640 H	**Session 3: Blockchain Military Applications and Roadmap for Adoption in the Indian Army**	
1500-1505 H	Opening Remarks by the Chair	Lt Gen Rajeev Sabherwal, PVSM, AVSM, VSM (Retd)
1505-1520 H	Absorption of Digital Technologies and Embracing Change by Defence Logisticians	Brig GM Attri, Cdr FOHOM, CMM, Jabalpur
1520-1535 H	Smart Contracts - Intricacies and Nuances	Mr Santosh Pathak, Infosys Ltd
1535-1550 H	ASC Supply Chain - Proof of Concept Project	Maj Gen Harsh Chhibber, VSM
1550-1605 H	Digital Footsteps Towards Blockchain Technology for Platform Lifecycle Management (PLM) in Indian Armed Forces	Cdr Jai Kumar Raghunath (Retd), KPMG Advisory Services Pvt Ltd
1605-1620 H	Roadmap - Pan Indian Army Adoption of Emerging Technologies and Blockchain Technology	Mr Amit Vats and Mr. Gaurav Tripathi, Infosys Ltd
1620-1635 H	Ques & Ans Session	
1635-1640 H	Concluding Remarks by the Chair	
1640-1650 H	**Closing Session**	
1640-1645 H	Closing Remarks	Lt Gen BK Repswal, AVSM, VSM, Commandant ASC Centre & College
1645-1650 H	Vote of Thanks	Lt Gen (Dr) Ranbir Singh, PVSM, AVSM**, YSM, SM (Retd), DG CLAWS
1650-1720 H	**High Tea**	