5G Future Ready: Nascent Steps

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Abstract

Over the next few years, 5G applications and networks are set to roll out across the world. The applications will evolve and cause disruptions in the industry as also in the next generation war fighting. it is heavily dependent on software unlike its predecessors. The low latency of 5G will enable remote operations and thereby democratise labour globally the same way as the Internet has democratised knowledge. It will also enable proliferation of autonomous weapons in the battlespace and use of robots for specialised and routine tasks in various operations.

Its adoption will change the command and control systems for the next generation warfare wherein, the military applications will evolve to improve efficiency, transparency and faster decision making process. The cyber security requirements for sliced networks and data clouds, being managed by a network provider or a vendor with security clearances, will also need to be clarified. Logistic efficiency improvement can be attained by adopting already available COTS technologies.

Key Points

- 5G technology offers high bandwidth and low latency which will enable remote operations and democratise labour and it is also heavily dependent on software and is capable of causing disruptions in next generation war fighting.
- It will also enable the proliferation of autonomous weapons in the battlespace as also the use of robots for specialised and routine tasks in operations.
- The testbed of Indian 5G research at IIT Madras, have achieved complete end to end solutions indigenously and is customisable.
- There is a need to immediately deploy small R & D testbeds for adopting 5G technologies and their military applications.

The testbed of Indian 5G research at IIT Madras, has achieved complete end- to-end solutions indigenously and is customisable including a secure NB-IoT Chip. There is a need for indigenised solutions for deploying 5G across varied terrain configurations while utilising the existing radio, fibre and satellite data links.

There is a need to immediately deploy small R&D testbeds for adopting 5G technologies and their military applications at a faster pace. There is also a requirement for quick transition from the prototyping stage to the scaled-up production stage for exploiting the power of the 5G to its full potential.

Introduction

The future of mobile networks is 5G— a digitally connected battlespace that is designed to connect virtually everyone together including machines, objects and devices. Over the next few years, 5G applications and networks will roll out across the world, and thereafter the applications will evolve and cause disruptions in the industry as also in next generation war fighting. The 5G technology is highly software-centric unlike its predecessors before 4G. It will deliver high GBPS (giga bytes per second) data speeds, low latency, more reliability and a huge network capacity. **The developed world has already moved onto rolling out 5G promptly and is presently in the process of deploying 6G testbeds.**[1] The roll-out will be funded by a huge consumer base and industry needs and will also enable evolution for niche military applications.

Internet of skills

The future prospective application of 5G lies in stretching its use to transmit physical skills over a distance. **Low latency of the technology will enable remote operations and thereby democratise labour globally the same way as the Internet has democratised knowledge**.[2] It will also enable the proliferation of autonomous weapons in the battlespace and use of robots for specialised and routine tasks in various operations. Few examples includes the 5G drone trial in Europe with control across the Atlantic (22 February 2018); 5G enabled virtual surgery skills globally; the possibility of distributed musicians collaborating for a concert around the world, etc.

The ability to demonstrate skills over different time zones via the virtual medium can only be realised by **trimming down the application latency lower than the human cortex requirement of 10 milliseconds**. This can be achieved through 'slicing' the data transfer using 5G networks, overcoming application delay by compressing signals, and using AI(Artificial Intelligence) to reduce the effects of latency.[3]

The Indian telecom industry has already commenced testing for various use cases and part-use cases across the country, and South Korea and China are at the cusp of a commercial rollout. The **number of 5G subscribers world over, may reach upto 3,500 million by 2026 (four to five times the existing user base).[4]** Therefore, the Indian Armed Forces need to focus on incubating the new military applications of 5G with a long term aim of preparing for next generation warfare.

5G in India

The Indigenous 5G Testbed Project at IIT Madras, Chennai (Rs. 250 crores), funded by the DoT (Department of Telecommunications) has a PDC (Proposed Date of Completion) of December 2021, providing, initially, high bandwidth and low latency with 70 GBPS. The aim is to build end- to- end 5G testbed in India. Over Eight institutions, with about 200 researchers and 40 faculties, are involved in this project and are also engaging the Indian telecom startups ecosystem for providing various subsystems for the 5G technologies. MCTE Mhow (Military College of Telecommunication Engineering) will also have a testbed deployment during latter part of the project.[5]

Present challenges to the 5G rollout includes the requirement of replacing one 4G BTS (Base Transceiver Station) with four to five 5G BTS—presently only 20% of the BTS are connected with Optical Fibre Cable(OFC) backhaul. India has low Average Revenue Per User (ARPU) (approx. Rs. 124), therefore indicating the need for a higher funding *ab inito* for rolling out of the 5G and the need for indigenous manufacturing of subcomponents of 5G.

The government has taken several steps, including standardisation of 5GI – a variant of 5G with larger coverage for rural India Low Mobility Large Cell (LMLC use case); building of a reliable testbed architecture, robust core networks and deployment of 5G (Alpha testbed) in IIT Madras campus, where it is showcasing a remote radio head sub (6 GHz band) and an RRH mm Wave Band(Remote Radio Heads millimeter wave), besides an indegenised base station with 08 layer MIMO (Multiple Input Multiple Output antennas) support. Also in process is the NB-IoT Chip (Narrow Band Internet of Thing) from IIT Hyderabad, that is likely to be under production in 2022. An Indian Display Technology is also being developed for 05 and 10 inches AMOLED (active matrix organic light emitting diodes) screens for DRDO.[6]

In today's world, complete end- to- end solutions are indigenously available and customisable solutions to 5G rollout can be adopted for industry and consumers

including a secure NB-IoT Chip. The project will enable customisable secure solutions from Customised User Devices to Radio heads to a Core-in-Box.[7]

Next Generation Warfare

Modern day conflicts have no set beginning or end, therefore the militaries have to multi-task. They have to be prepared for non-contact wars in an era when conventional wars will be rare. Given the operational level focus of joint operations, a key conceptual consideration would be the command and control structures where one needs to orchestrate multi-domain campaigns. This can be achieved by digital integration. Decision making architectures and the processes must be redesigned around an increasing range of technical capabilities, to manage an ever more complex battlespace. Logistical efficiency improvement can be effected by adopting already available COTS (commercial off the shelf) technologies.

5G Spectrum for military applications

Adoption of 5G technology will change the command and control systems for the next generation warfare. The efficiency, transparency of military applications would be improved, which would further enhance the decision making process. The technology will also streamline the logistics by ensuring granular visibility of inventory and hence improving productivity.

Key 5G technologies which will have a military application are MM Wave, Massive MIMO, SDN (software defined networking), NFV (network functions virtualisation) and D2D communication (Disk to Disk backup) as the backbone of the rollout.[8] 5G technology will be utilised in three bands:-

- *High Bands (24-300 GHz).* Its superfast but effective in short distance; ideal for distributed sensors.
- *Mid Bands (1-6GHz).* Ideal for bigger volume of data sensors like Radars, Missile Defence, EW and monitoring air space.
- *Low Bands (Below 1GHz).* High Degree of Robustness and increased area coverage and is useful for deploying broadband solutions and tactical Radio sets.

China has already deployed 4,10,000 5G base stations with its mobile operators vis. China Mobile, China Unicom and China Telecom. Integrated 5G testbed approach has been adopted for **Chongqing** city jointly by China Telecom and China Aerospace Science and Technology Corporation. **The PLA is moving towards 'Intelligentisation of the**

Battlefield' using AI and IoT. It has already advanced the Infra Network for deployment of 5G on the borders.[9]

Defence Use Case

The **Norwegian project '5G VINNI'** (5G Verticals Innovation Infrastructure) is an integrated use case of defence and the commercial components together with satellite, fibre and BTS based redundancies. It provides applications like mobile core, voice, push to talk, Hermod P2P communication and Security as a service provider through a central cloud and/or an Edge Cloud. This Network Slice enabled the military to have better security through Priority on Data, Removal of attack vectors, shielding of Meta data, disable legacy technology and autonomy through Edge Computing, and coverage 'On Demand' by using both Public and Private 5G networks. Leading to provision of necessary services, improved security and better availability.[10]

5G Use Cases for Military

Atmanirbhar or self-reliance is key for deploying disruptive 5G military applications, but one must guard against a temporal loss as this technology, like any other, is time sensitive— the earlier we graduate to it, easier will it be to keep pace for the fusion and proliferation with other 'sister technologies'. Swarming UAVs, virtual reality and augmented reality simulation & training, real-time ISR, distributed command & control, and smart warehousing facilities, are only the start.

The all-pervasive nature of 5G will see the amalgamation of better spectrum usage with disruptive technology such as unmanned systems, IoT and AI. The exploitation of 5G should ensure effective testing, strong cyber security for the Data pipes and Data Clouds. The 5G solutions should cover front haul, medium haul, long haul and switching aggregators and router layers of the existing networks.

The cyber security requirements for sliced networks and data Clouds, being managed by a network provider or a vendor with security clearances, also needs to be clarified. There is a need for indigenised solutions for deploying 5G across varied terrain configurations while utilising the existing radio, fibre and satellite data links. Denser user areas will involve a different 5G solution than a solution for the tactical battle areas, however this will change depending on the connectivity of Internet of Battle Things (IoBT).
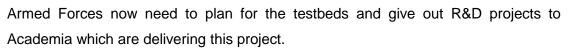
Logistical efficiency can enhanced if technologies, already available with home delivery platforms, are adopted for improving our supply chains, 3D printing of spares, visibility of the fleet, etc. There is a need to communicate the requirement definitions by the users which will lead to innovative solutions by the industry.

Way Ahead

There is a **need for quick transition from the prototyping stage to the scaled-up production stage.** Following Way Ahead is recommended for a fast, seamless and smooth rollout of the 5G Military Applications:

- *Induction Priority.* The Indian Armed Forces needs to be ahead in the forthcoming technology disruption curve emerging, due to rollout of 5G on our Northern Borders, and focus on incubating the new military applications of 5G to prepare for the next generation warfare. The timelines for implementation of 'incubating and inducting' new military applications of 5G, needs to be adhered to once decided upon and funds available. The conventional RFI/RFP model will not yield desired results and will end up in the procurement of obsolete technologies and perpetual dependencies on specific hardware. The acquisition process needs to incentivise innovation at the speed of relevance. As per Maj Gen Punaro (Retd) 'the United States increasingly relies on dual-use technologies under development in the commercial sector, such as artificial intelligence, machine learning, and advanced sensors, to maintain its competitive advantages'.[11]

- *Need for National 5G Policy/Strategy.* There is only one High Level Forum Report that exists in public domain namely, "Making India 5G Ready".[12] The gap created by the absence of a national policy or a national security strategy, pertaining to 5G technology, can be bridged by incorporating lessons from Norwegian 5G Communication Security Act (2019) and two strategies of the USA— 5G Protection Strategy (March 2020) and DoD 5G Strategy (May 2020). Such a strategy would ensure security from backdoors, that are likely to be encountered while setting up and subsequently sustaining the networks for 5G and the evolving military applications.

- *Indegenised 5G solution.* The project at IIT Madras has a PDC of December 2021 with another 5G testbed rollout at Mhow. The progress of the IIT Madras testbed is vital for securing vital military applications. **Complete end to end 5G solutions are indigenously available** and is customisable **including a secure NB-IoT Chip**.

Armed Forces now need to plan for the testbeds and give out R&D projects to Academia which are delivering this project.

- *Defence Use Case.* The **Norwegian project '5G VINNI'** is an integrated use case of defence network slice alongside the commercial 5G rollout with satellite, fibre and BTS based redundancies. This is the integrated approach which is best suited for the 5G rollout of our Armed Forces and also is cost effective. Collaboration of the 5G ecosystem stakeholders i.e. the Network operators, the use case application developers and the user vertical in a secure environment is essential.

- *Logistic Efficiency.* Potential Use cases includes asset tracking, personal tracking, fleet management, connected ambulance, tele-operated vehicles (mine removal), autonomous vehicles, drone logistics and smart warehousing. These are COTS technologies and easily deployable to increase the efficiencies of operations.

Conclusion

The 5G rollout is imminent and it will be a game changer for the next generation warfare. The reliance on autonomous weapon systems, which has already witnessed deployment in the Azerbaijan-Armenia conflict and the assassination of Iran's Nuclear scientist, will only increase further. There is a need to immediately deploy small R& D testbeds for adopting the 5G technologies as nascent steps and evolving the 5G military applications at a faster pace in the defence forces as our adversary is already ahead in the technology deployment curve. An integrated civil-military testbed approach with refined procurement procedure ,will enable a faster absorption of the new technologies.

End Notes

[1] Mischa Dohler, "Military Applications of 5G", *CLAWS Webinar*, 18 August 2021.

[2] Ibid.
[3] Ibid.
[4] S O'Dea, "5G mobile subscriptions worldwide 2020-2026, by region", *Statista*, 21 October 2021. Accessible at https://www.statista.com/statistics/521598/5g-mobile-subscriptions-worldwide/. Accessed on 21 October 2021.
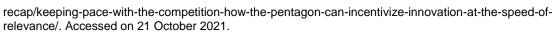
[5] Bhaskar Ramamurthy, "Military Applications of 5G", *CLAWS Webinar*, 18 August 2021.

[6] Ibid.

[7] Ibid.

[8] AK Channan, "Military Applications of 5G", *CLAWS Webinar*, 18 August 2021.

[9] MU Unnikrishnan Nair, "Military Applications of 5G", *CLAWS Webinar*, 18 August 2021.

[10] Radhey Shyam Sarda, "Military Applications of 5G", *CLAWS Webinar*, 18 August 2021.

[11] Julia, Siegel, "Keeping pace with the competition: How the Pentagon can incentivize innovation at the speed of relevance" , *Atlantic Council*, 16 February 2021. Accessible at https://www.atlanticcouncil.org/commentary/event-

recap/keeping-pace-with-the-competition-how-the-pentagon-can-incentivize-innovation-at-the-speed-of-relevance/. Accessed on 21 October 2021.

[12] The Steering Committee, "Making India 5G Ready", *Department of Telecommunications (India)*, 23 August 2018. Accessible at https://dot.gov.in/whatsnew/making-india-5g-ready-report-5g-high-level-forum. Accessed on 21 October 2021.

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