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Military Internet: An Introduction

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ABSTRACT

Since the world has moved into the digital age, the use of the Internet by the military (Internet of Military Things - IoMT) is now a powerful tool which is multifaceted, encompassing communication, information dissemination, intelligence gathering, and operational coordination. The good understanding of how the military utilizes the Internet helps to provide valuable insights into its modern strategies and capabilities. The Internet helps to foster global connectivity and partnership among military organizations worldwide, enabling and enhancing swift and coordinated response to global challenges. The Internet of Military Things encompasses a large range of devices that possess intelligent physical sensing, learning, and actuation capabilities through virtual or cyber interfaces that are integrated into systems like sensors, vehicles, robots, UAVs, human-wearable devices, biometrics, munitions, armor, weapons, and other smart technology [1]. This is not, however, without some challenges. This paper attempts to look at the benefits/importance of military internet, the challenges, and the ways forward.

KEYWORDS: *Military internet, cyber warfare, intelligence gathering, training and simulation, sensor networks*

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HISTORY OF MILITARY INTERNET

The advancements in IoMT technology stemmed from military efforts to bolster the development of sensor networks and low-power computing platforms during the 1960s for defense applications [2, 3]. During the Cold War, the US military pioneered the use of wireless sensor network technologies to detect and track Soviet submarines via the use of Sound Surveillance System (SOSUS), which was a network of underwater acoustic sensors, i.e. hydrophones, placed throughout the Atlantic and Pacific Oceans to act as underwater listening posts for above-ground facilities [4]. The US Department of Defense (DoD) use of sensor and networking technologies during this period was the foundation for modern IoT systems, leading to the creation of ARPANET in the late 1960s – an early precursor to the Internet that geographically-dispersed military scientists used to share data [5]. In the 1980s, the Defense Advanced Projects Agency (DARPA) partnered with the Massachusetts Institute of Technology (MIT) and Carnegie Mellon University to further develop distributed, wireless sensor networks, which later was of use for industrial applications such as power distribution, wastewater treatment, and factory automation [4, 5].

Furthermore, late 1990s saw the US Department of Defense announced plans for "network centric" warfare integrating the physical, information, and cognitive domains to enhance information sharing and collaboration, that led to projects such as the Nett Warrior (formerly known as the Ground Soldier System or Mounted Soldier System) and the Force XXI Battle Command Brigade and Below communication platforms, which were prevalent in the early 2000s [6].

In computer networking, MILNET (fully Military Network) was the name give to the part of the ARPANET Internetwork designated for unclassified United States Department of Defense traffic [7, 8]. MILNET was physically separated from ARPANET in 1983 [9]. The ARPANET remained in service for the academic research community, but direct connectivity between the networks was severed for security reasons. Gateways relayed electronic mail between the two networks. BBN Technologies built

and managed both the MILNET and the ARPANET and the two networks used were of similar technology – known as "Military Net" [6].

During the 1980s the MILNET expanded as part of the Defense Data Network (DDN) [10], a worldwide set of military networks running at different security levels. While in the 1990s, MILNET became the NIPRNET [11, 12].

INTERNET OF MILITARY THINGS (IoMT)

The Internet of Military Things (IoMT) is a class of Internet of Things (IoT) for combat operations and warfare. This is a complex network of interconnected entities, or "things", in the military domain that continually communicate with each other to coordinate, learn, and interact with the physical environment to accomplish a broad range of activities in a more efficient and informed manner [13, 14]. The IoT has strong military applications, connecting ships, planes, tanks, drones, soldiers, and operating bases in a cohesive network that increases situational awareness, risk assessment, and response time. The Internet of Battlefield Things (IoBT) involves the full realization of pervasive sensing, pervasive computing, and pervasive communication, leading to an unprecedented scale of information produced by the networked sensors and computing units [15, 16].

The Internet of Military Things (IoMT) is synonymous with the Military Internet of Things (MIoT) or Battlespace Internet of Things (BIoT) which is a militarized extension of the IoT and describes the employment of a network of devices connected via the Internet, and the actors operating within it. Currently, the IoMT most commonly make use of a multitude of sensors, deployed across various domains, to achieve full situational awareness and control within complex and diverse zones. Several advanced military forces, among which the Australian Defense Force (ADF), have invested in command and control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) infrastructure and systems in order to collect, analyze, and disseminate information. As much as there are lots of benefits of IoT to the military, so also are risks to overall security of the communication systems and networks [17].

FUTURE CAPABILITIES

The future of the IoMT will be in the development of additional capabilities through the integration of sensors, robots, munitions, wearable devices, vehicles, and weapons. With the current and applicable technology, weapon magazines could be made "smart", allowing them to track and report ammunition states directly for the automated generation of logistical requests. Wearable devices placed on soldiers could aid in human performance and management on the battlefield, as well as allow for more accurate triage and improved medical treatment if required. The wearable devices would include sensors which augment the traditional Battle Management Systems (BMS) by collecting more accurate data on individual troop movements and the surrounding environment. Similar sensors could as well be remotely deployed from an uncrewed aerial vehicle (UAV) to allow for remote exploitation of sites – to generate a detailed and manipulable three-dimensional model which can be explored and preserved by offsite intelligence analysts. Other opportunities can be tapped from imagination and innovation of the creators [17].

RELEVANCE

When weighed against the potential advantages, many believe that the IoMT would greatly increase the efficiency of the "observe, orient, decide, act" (OODA) loop, making it an invaluable tool through increased information collection, ease of communication between nodes, and supported decision-making. Specifically, the risks posed by external and internal actors may jeopardise communication systems and networks that could result in the loss of communication systems or loss of data, thereby making their protection to be of utmost concern. There is the need to also explore the potential risks posed by failing to develop the Australian Defence Force (ADF) IoMT [17].

EXTERNAL THREATS

The use of IoMT is faced with some critical obstacles due to the rise of cyber and electronic warfare. It is a well known fact that cyber security breaches can occur at multiple levels, which may include device, network, application, storage, and data levels. Specifically, the IoMT presents a large attack surface consisting of the IoMT devices, the communication channels between those devices, the back-end system and IoMT-specific back-end applications, and finally back-end data storage. There are many methods of identifying and monitoring risks, and providing or ensuring protective measures [17].

PHYSICAL ATTACK VECTORS

There is the increased likelihood of physical access an attacker may have due to the quantity of devices introduced into the battlespace – leading to decreased physical integrity being guaranteed.

CYBER ATTACK VECTORS

According to the Australian Cyber Security Centre (ACSC), common attack vectors include ransomware, phishing, brute force, distributed denial of service (DDoS), compromised credentials, Trojans, SQL injections, session hijacking, and man-in-the-middle

attacks. These electromagnetic attack vectors are often associated with the term "hacking", which is an array of different actors, methods, and outcomes, that may result in the risk of ceding critical information or potentially the control of a system if exploited [17].

RISK MITIGATION

The Australian Cyber Security Centre (ACSC) has described the methods for reducing vulnerability to both physical and electromagnetic attack vectors such as [17]:

- Remote-wiping capable devices
- Authentication
- Encryption
- Private data storage
- Network structuring
- Investment in software engineering, quantum computing, machine intelligence

INTERNAL THREATS

Considering the aspect of internal threat, study conducted by IBM and the Cyber Security Intelligence Index, cyber security breaches are most often caused by human error. The rise in grey zone activity, specifically electronic and cyber warfare, the education of users surrounding safety and secure employment of communication systems and networks is paramount. Other range of actions which could be taken may include personnel reduction to system susceptibility and threat accessibility. Some common insider actions – or inactions – which could increase system vulnerability can include failure to utilize a robust password, downloading a malware-infected attachment from an email, or connecting unsafe devices to work computers. These may not seem too detrimental to the user at the time but can in fact range from minor to catastrophic – and all caused by insider actions [17].

THE RISK OF INACTION

Furthermore, an important concept to be explored is the significant risk presented in failing to take further action in developing the ADF's IoMT. Adopting the IoMT comes with likely security risks, but regardless of these, the benefits of developing such a capability are likely far more numerous and significant. To understand this, first one must fully comprehend the changes in regional, domestic, and global operating environments – detailed at length in the Army's Accelerated Warfare Document – and the character of warfare itself (think domains and ranges). All said and done, the key to success lies in swift communications allowing for command and control, superior decision-making, and an information advantage [17].

SOME KEY BENEFITS OF THE IoMT

Some of the key benefits include [17]:

1. Augment existing communications systems and networks – more nodes, increases speed "real-time.
2. Greatly increase information advantage.
3. Opportunity to construct an integrated system which lends to decision-making using artificial intelligence (AI) and machine learning (ML).

This is apart from the employability as training aids, health monitoring and care, and medical improvements.

A BRIEF LOOK AT DRONES IN MILITARY OPERATIONS/DEFENCE

Drones also referred to as unmanned aerial vehicles (UAVs) for over a decade now are being used by India's defense and security forces. They come in various size categories ranging from nano drones weighing from less than a kilogram to large and heavy drones weighing almost a ton. Drones are ideal surveillance tools, which are capable of monitoring large land areas with relatively little manpower. These platforms and sensors today are getting more advanced, and while global militaries are looking at drones to fulfill multiple additional roles, such as active combat/surgical strikes, electronic warfare, mid-air refuelling, delivery of critical cargo to remote locations, etc. [18].

Military drones can be deployed in a maritime environment, for maritime reconnaissance, to track ship traffic and scan over the horizon to assist in targeting and providing a lookout for piracy/other criminal activities.

Infantry level/tactical battlefield surveillance: Drones deployment is vital in providing real-time situational awareness on the battlefield, which is often the primary determinant of success in modern operations. The drones are used to scout enemy positions and movements, provide real-time spotting data for artillery guns and help establish a Line of Sight (LoS) virtual network, as shown in Figures 12 and 13.

In the case of counterinsurgency and border surveillance, drones act as force multipliers. This is especially pertinent in a country with as diverse geography as India, where physical patrols pose a significant challenge in terms of manpower and logistics. Drones equipped with thermal and infrared cameras also provide round-the-clock vigilance, including at night and in adverse weather conditions.

Electronic intelligence gathering and airborne early warning: Electronic intelligence (ELINT) is one of

the most important aspects of modern surveillance and data gathering. Drones with extremely sensitive and sophisticated sensor equipment are used to monitor enemy transmissions, radar emissions, communications and aircraft movements – roles for which drones are most suited, as they can be designed to operate stealthily and have long endurance, and can be deployed in theatres of operations that are too risky for human pilots and ELINT operators [18].

CHALLENGES CUM OPPORTUNITIES OF IoMT

Some of the challenges that could arise as a result of the lack of technology in the military could include [19]:

- Adapting to asymmetrical warfare.
- Cybersecurity.
- Recruiting and retaining talented personnel.
- Limited intelligence gathering.
- Lack of training.
- Increased risk to personnel.

As there are two sides to a coin, the above mentioned challenges are with some Opportunities-to-IoT-in-Military-Applications, such as [20]:

- Smart devices.
- Smart infrastructure.
- Cybersecurity.
- Unmanned systems.
- Asset tracking.
- Predictive maintenance.
- Remote monitoring.
- Surveillance.
- Logistics and supply chain management.
- Intelligence gathering.
- Connected soldier systems.
- Training and simulation.
- Health and safety.
- Communication and connectivity.

CONCLUSION

Despite some of the obstacles around security development and expansion of the IoMT, most especially with the rise of cyber and electronic warfare – particularly hacking attacks, insecurity in communications systems and networks can also be caused by user errors or lack of education. The benefits of employing IoMT far outweigh the risks involved. Drones that can effectively deploy Artificial Intelligence (AI), operate as a swarm, perform network-centric operations, etc. will have a decisive advantage in the battlefield. The advances in modern technology will further lead to more developments and innovations in the present day advanced militaries, but must need to pursue these capabilities with a deep sense on how to construct and operate it securely.

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Figure 1 Internet of Military Things.

Source:https://www.google.com/search?sca_esv=512b414220c41cc4&sxsrf=ADLYWII87kjdaO3BDUopX3bBfw9WQtjyfw:1724916785238&q=images+on+internet+of+military+things+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYqV91QqM6LWLrLFWKmjC_P6yIDKkCHq3GGQ94mnVKDrjOCIy2E3tlg6qOsP11UqL1C5r99KqlUFtXdoCN1t2Cz778C3wfExfNrSe2Xnhompvb6p7NU&sa=X&ved=2ahUKEwjm_YDi15mIAxWyVqQEHdtYC4sQ0pQJegQIEBAB&biw=1366&bih=580&dpr=1#imgrc=cRMN6OBAy7pWAM

Figure 2 Military.

Source:https://www.google.com/search?sca_esv=512b414220c41cc4&sxsrf=ADLYWII87kjdaO3BDUopX3bBfw9WQtjyfw:1724916785238&q=images+on+internet+of+military+things+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYqV91QqM6LWLrLFWKmjC_P6yIDKkCHq3GGQ94mnVKDrjOCIy2E3tlg6qOsP11UqL1C5r99KqlUFtXdoCN1t2Cz778C3wfExfNrSe2Xnhompvb6p7NU&sa=X&ved=2ahUKEwjm_YDi15mIAxWyVqQEHdtYC4sQ0pQJegQIEBAB&biw=1366&bih=580&dpr=1#imgrc=SLjdYC1QU77qNM

Figure 3 Military Personnel.

Source:https://www.google.com/search?sca_esv=512b414220c41cc4&sxsrf=ADLYWII87kjdaO3BDUopX3bBfw9WQtjyfw:1724916785238&q=images+on+internet+of+military+things+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYqV91QqM6LWLrLFWKmjC_P6yIDKkCHq3GGQ94mnVKDrjOCIy2E3tlg6qOsP11UqL1C5r99KqlUFtXdoCN1t2Cz778C3wfExfNrSe2Xnhompvb6p7NU&sa=X&ved=2ahUKEwjm_YDi15mIAxWyVqQEHdtYC4sQ0pQJegQIEBAB&biw=1366&bih=580&dpr=1#imgrc=LhPT2j4BGBDa2M

Figure 4 Military Intelligence.

Source: https://en.wikipedia.org/wiki/Military_intelligence

Figure 5 Military-digital complex.

Source:https://www.google.com/search?sca_esv=512b414220c41cc4&sxsrf=ADLYWIL5Lv3cYJtoe2Vw5tCIpjMPTppvew:1724918316805&q=images+on+internet+of+military+things+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYq

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Figure 6 Technology.

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Figure 7 National security.

Source:https://www.google.com/search?sca_esv=512b414220c41cc4&sxsrf=ADLYWIL5Lv3cYJtoe2Vw5tCIpjMPTppvew:1724918316805&q=images+on+internet+of+military+things+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYqV91QqM6LWLrLFWKmjC_P6yIDKkCHq3GGQ94mnVKDrjOCIy2E3tlg6qOsP11UqL1C5r99KqlUFtXdoCN1t2Cz778C3wfExfNrSe2XnhompvB6p7NU&sa=X&ved=2ahUKEwjktai83ZmIAxX7U6QEHVuFH5AQ0pQJegQIERAB&cshid=1724918492892292&biw=1366&bih=625&dpr=1#imgrc=Ugjnjp7qj6ilxM

Figure 8Military communications.

Source:https://www.google.com/search?sca_esv=512b414220c41cc4&sxsrf=ADLYWIL5Lv3cYJtoe2Vw5tCIpjMPTppvew:1724918316805&q=images+on+internet+of+military+things+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYqV91QqM6LWLrLFWKmjC_P6yIDKkCHq3GGQ94mnVKDrjOCIy2E3tlg6qOsP11UqL1C5r99KqlUFtXdoCN1t2Cz778C3wfExfNrSe2XnhompvB6p7NU&sa=X&ved=2ahUKEwjktai83ZmIAxX7U6QEHVuFH5AQ0pQJegQIERAB&cshid=1724918492892292&biw=1366&bih=625&dpr=1#imgrc=kKhdw7p4gvL04M

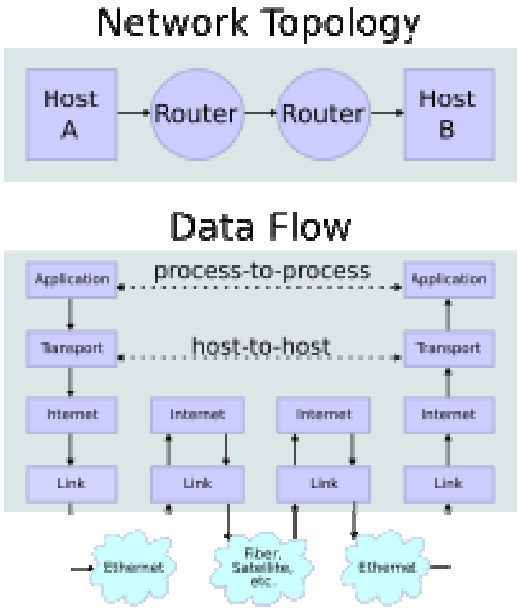

Figure 9 Internet

Source: https://upload.wikimedia.org/wikipedia/commons/thumb/c/c4/IP_stack_connections.svg/220px-IP_stack_connections.svg.pnghttps://upload.wikimedia.org/wikipedia/commons/thumb/c/c4/IP_stack_connections.svg/220px-IP_stack_connections.svg.png

Figure 10 Anonymous (hacker group)

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Figure 11Information Operations (United States)

Source:https://www.google.com/search?sca_esv=512b414220c41cc4&sxsrf=ADLYWIL5Lv3cYJtoe2Vw5tCIpjMPTppvew:1724918316805&q=images+on+internet+of+military+things+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYqV91QqM6LWLrLFWKmjC_P6yIDKkCHq3GGQ94mnVKDrjOCIy2E3tlg6qOsP11UqL1C5r99KqlUFtXdoCN1t2Cz778C3wfExfNrSe2Xnhompvb6p7NU&sa=X&ved=2ahUKEwjktai83ZmIAxX7U6QEHVuFH5AQ0pQJegQIERAB&cshid=1724918492892292&biw=1366&bih=625&dpr=1#imgrc=vEHYl07_P3MUWM

Figure 12 Unmanned combat aerial vehicle.

Source:https://www.google.com/search?sca_esv=3a158260ac093e64&sxsrf=ADLYWIKCs0V-M4ZvTMXvVWBQri2BE2c3xQ:1725016458955&q=images+on+military+drones+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYqV91QqM6LWLrLFWKmjC_P6yIDKkCHq3GGQ94mnVKDrjOCIy2E3tlg6qOsP11UqL1C5r99KqlUFtXdoCN1t2Cz778C3wfExfNrSe2Xnhompvb6p7NU&sa=X&ved=2ahUKEwiB7JGKy5yIAxXJTaQEHU5RCUIQ0pQJegQIERAB&biw=1366&bih=580&dpr=1#imgrc=gGkSX3JctHFVGM

Figure 13Unmanned aerial vehicle

Source:https://www.google.com/search?sca_esv=3a158260ac093e64&sxsrf=ADLYWII8TJLmdNrxuD2hzTePaTfgZGCMzw:1725017320729&q=images+on+military+drones+by+wikipedia&tbm=isch&source=lnms&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWERaHdBms7ttHL1116ec0FnDIxrxgGhNFSZEtYqV91QqM6LWLrLFWKmjC_P6yIDKkCHq3GGQ94mnVKDrjOCIy2E3tlg6qOsP11UqL1C5r99KqlUFtXdoCN1t2Cz778C3wfExfNrSe2Xnhompvb6p7NU&sa=X&ved=2ahUKEwjPqIilzpyIAxX3WUEAHVMUFDoQ0pQJegQIEhAB&biw=1366&bih=580&dpr=1#imgrc=EM80GKga4vhvNM