MULTI-DOMAIN OPERATIONS IN AN URBAN ENVIRONMENT

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The most likely and most dangerous environment for future NATO operations will be the urban environment. It includes three layers — the physical, information, and human system — and heavily influences the emerging principles of multi-domain operations. The multi-domain NATO forces of the future must understand the urban environment, adapt quickly to the conflict, and continuously coordinate cross-domain fires to gain an advantage over the adversary. This article summarizes some of the key ideas of the Multi-Domain Operations in an Urban Environment concept.

IN THE NEAR FUTURE, one of NATO's biggest challenges will be to comply with the principles of multi-domain operations (MDO). The emerging concept seeks to respond to intensified hybrid, asymmetric, and grey-zone challenges by taking joint force cooperation to a higher level and expanding it with two new operational domains: cyberspace and space. In this concept, the use of military force is much more rigorously coordinated, using diplomatic, information and economic instruments of power. The purpose of the MDO in an Urban Environment concept development is to explore the application of the still-developing MDO principles for a highly specialized (urban) operational environment.

Out of the possible special environments (urban, desert, low mountains, high mountains, jungle, arctic), operations in populated settlements are of outstanding political, strategic, informational, and infrastructural importance. Half of the world's population lives in urban environments. Because cities have mostly grown near valuable natural resources and/or transport hubs, their economic importance is huge. In addition, they often hold symbolic value.

In megacities in developing countries, competition for scarce resources is intensifying due to climate change, and the daily disruption of already overladen public services and infrastructure in a congested urban environment keeps the population in turmoil. The cultural, religious and linguistic frictions of the diverse populations of the densely populated cities cause constant tension, which manifests in riots at times. Dysfunctional municipalities engage in a hopeless bureaucratic fight against corruption, while the military, militia, police and volunteer police forces (often using illegal means) fight against organized crime. Amid the chaos, terrorists, cybercriminals and criminal organizations easily hide their activities.

One need only recall near-past operations in an urban environment to understand the importance of military operations in populated areas, and their complexity due to their different sizes and nature. Such operations include peacetime military engagement (e.g. nuclear emergency response in Fukushima in 2011; natural disaster relief in New Orleans after Hurricane Katrina in 2005), peace support (Mogadishu in 1993) and security (Kabul from August 2001 to 2021) as well as high-intensity warfighting (Baghdad in 2003). In such a wide range of military operations, personnel from NATO and partner countries have evacuated military personnel as well as non-combatants; assisted in stabilization and reconstruction; provided humanitarian aid; contributed to peace support; fought against criminals, terrorists and insurgents; and faced natural and industrial disasters.

Headquarters Supreme Allied Commander Transformation (HQ SACT) has been developing urbanization concepts and their military implications since 2014, with the overall aim of developing a comprehensive (strategic, operational and tactical) theoretical framework both for the use of military forces in peacetime and for high-intensity warfare. The overarching capstone concept "Joint Military Operations in an Urban Environment",[1] delivered at the end of 2018, was developed in close cooperation with a large community of interest, including national experts, NATO centres of excellence, academia, and international organizations. These recent efforts provide operational concepts to bridge any gap between the evolving urbanization capstone concept and doctrine.

The Urban Environment

The concept development team, of which I was a member, began by exploring the terminology and concepts of inhabited settlements. Our research did not produce many results, as there is no NATO accepted terminology on the urban environment, and the definitions used by other

PREVIOUS PAGE: (Clockwise) Cybersecurity photo by Tudor Jelescu; a multimedia display of news; tsunami at Fukushima, photo by Fly_Dive/Shutterstock; Norwegian CBRN exercise, photo by Norwegian Armed Forces; torched vehicle during a demonstration; a special operations exercise, photo by Norwegian Armed Forces

sciences (e.g. geographical, civil public law, public administration, architecture) are of little relevance from a military point of view. Instead of making a new definition, we therefore restricted ourselves to circumscribing the concept of the urban environment (UE). For the purposes of the study, a UE is a "system of systems", a network of interconnected complex systems composed of four layers: physical system, information system, human system, and resilience.

I. Physical System

The physical system of UE is made up of the geographical environment and the system of three-dimensional buildings. The geographical environment is the topography, the soil, the climate and the hydrography of the city, fundamentally determining the structure, architecture and vulnerability of the UE as well as the likelihood of natural disasters. The artificial environment of the urban area greatly overrules the geographical environment: It changes its climate and terrain, eliminates the original flora and fauna, and transforms the threat of disaster, though it cannot eliminate basic geographical features. For instance, an extensive dam system may provide sufficient protection against annual floods, but is of no use against a rarer and more severe tsunami or tide (e.g. New Orleans, Fukushima). Mexico City is an urban environment built on human alterations to the geography: The Aztec city Tenochtitlan originally occupied a prominent island in a shallow lake, which was later drained and the megalopolis Mexico City built in its place. Due to the solidification of underground clay layers, the city sinks 50 centimetres every year, increasing its vulnerability to earthquakes.

Three-dimensional human-made structures are the underground (basements, tunnels, canals), the surface (single-storey houses, streets, roads, parks, dams, embankments, monuments) and above-ground (multi-storey houses, power lines, overpasses, bridges) build-ups, which together form the material structure of the urban environment. This environment, with a visibility and range between five metres and five kilometres, poses a fundamental challenge to intelligence, surveillance, target acquisition, and reconnaissance systems: Walls and roofs make it difficult to acquire visual or technological information, and allow large-scale formations and extensive manoeuvres to remain hidden.

Districts are usually distinguished by the purpose and structure of the characteristic buildings there: historic district, business and financial centre, heavy and light industrial district, high and low population density, slum, underground district, etc. In the planning phase of operations, the structure of the urban environment must be taken into account: How dense are the buildings; of what material do they consist? How penetrable are the walls? Are roofs suitable for helicopter landing? Which type of road network is in place; how wide are the roads and are they negotiable by military vehicles?

The visual representation of information is also a challenge, as the traditional two-dimensional representation of the built-up environment does not reflect the typically three-dimensional operations of urban combat. The interiors of tall and large buildings cannot be displayed either, so command and control at the operational and tactical levels require alternative visual assistance such as aerial and ground photographs, videos, three-dimensional models, Google Street View, or augmented and virtual reality. Command and control in an urban environment is further complicated by the high operational tempo in the air, cyberspace and space domains, which leaves limited options for obtaining, processing and visualizing real-time information about activities and capabilities.

The most significant and populous cities were built primarily on the banks of rivers or seas, or at the confluence of the two, at huge estuaries. The ports of such cities are of paramount importance as hubs between sea and land transport routes. Ports generally connect important industrial areas with global trade sea routes, so countries prioritize their protection and cyber security. Port infrastructure is also extremely vulnerable, and important for the sustainment of urban operations.

Attacks on civilian infrastructure are admissible under international humanitarian law and the law of armed conflict only if its purpose, nature, or location is of military significance and their acquisition, destruction or neutralization has a tangible military advantage. Even this is tempered by the principle of proportionality, which establishes that any collateral damage must not be excessive in relation to the concrete, direct military advantage anticipated from the attack. Certain buildings of religious or cultural value, or critical infrastructure essential for the supply of the civil population, enjoy special protection status. The layers of transport, information, education, health, law enforcement, drinking water supply, sewage and waste management, finance and economics, etc. and their infrastructural systems also belong to the physical system. Their continuous operation has a great impact on the human population of the city.

II. Information System

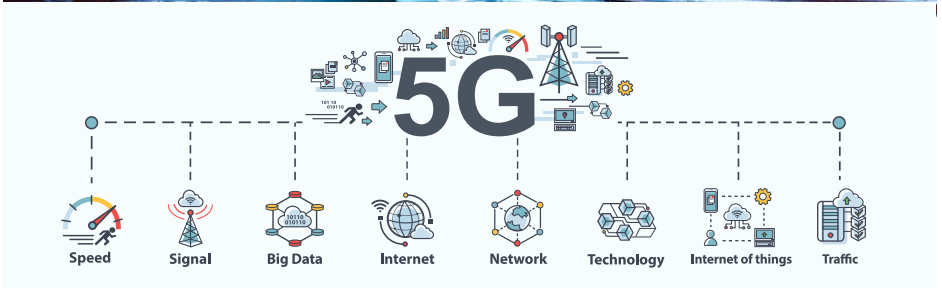
The information system of urban environments refers to the information infrastructure and the mass of information users, their interactions, their behaviours, and changes in their behaviour. Due to cities' well-developed information systems, the NATO forces are monitored and recorded at every step. Even the slightest mistake or misinterpreted activity might be published online in real time and draw thousands of social media comments from the international public. This possibility must be taken into account in all operations, from peacetime military engagement to warfighting. Cyberspace is the "high ground" to achieve direct effects in the cognitive domain; therefore, it should be never left without control. If an adversary builds up a "bridgehead" in this domain, they may achieve initiative to influence the local population. Their arsenal in cyberspace ranges from critical comments on real news portals to website defacement, deepfake videos and entirely fake news websites or news streaming.

https://www.nato.int/cps/en/natohq/official_texts_196951.htm

EXTRACT FROM NATO MADRID SUMMIT DECLARATION

(12) Climate change is a defining challenge of our time with a profound impact on Allied security. It is a threat multiplier. We have decided on a goal to significantly cut greenhouse gas emissions by the NATO political and military structures and facilities, while maintaining operational, military and cost effectiveness. We will integrate climate change considerations across all of NATO's core tasks.

The development of digital technology will increasingly result in "smart cities", within which the infrastructure listed in the previous section is interconnected to ensure a sustainable, prosperous, and inclusive future for the populace. Cities around the world will have financial, commercial, and thousands of other information and cultural connections. However, this results in a serious exposure to cyberattacks as well as failure or destruction of the network infrastructure. The impact of such breakdowns in cities' information systems may not only be local but also global. Examples of cyberattacks include data leaks, distributed denial-of-service (amplification) attacks, blocking news sites and attacks on logistics systems.



III. Human System

The UN estimates that more than half of the world's population already lives in cities, and this percentage will continue to increase in the future. The human system is what fundamentally distinguishes the urban environment from other operating environments (desert, mountain, jungle, arctic). The human system includes the population, the social, political-administrative and other institutional (economic and cultural) subsystems. Furthermore, the human system includes the continuous interactions of humans and the flow of people, services, goods, and vehicles within the city, between suburbs and other closely related conurbation.

In the urban environment, inequalities impacting minorities and women often worsen during times of crisis and conflict. Such grievances preserve the conflict and form a basis for further violence for a long time. In order to understand the human rights aspect of the human system, the gender and minority situation of the society must be analysed and assessed in detail with particular attention to the situation of the most vulnerable disabled or sick patients, the injured, the elderly, refugees, women, adolescents, children, lesbians, and gay, bisexual and transgender people. The majority of the urban population is non-combatant. Every effort must be made to minimize the operations' impact on their daily lives and to keep the inevitable harm to a minimum.

An urban environment densely equipped with security cameras, various sensors, and communication systems such as internet and mobile phone networks can provide a huge amount of information. This wealth of data may currently seem impossible to monitor, evaluate and turn into intelligence, but future disruptive technologies will utilize artificial intelligence and machine learning to process, store and analyse patterns of population movement, detect unusual changes, identify faces and compare them across databases, identify trends, criminals, terrorists, extremists and other dangerous individuals. Following the same logic in the cyberspace domain, monitoring and analysis of social media content will allow operations commanders to detect changes in public perceptions and sentiments, and to launch a timely, effective information operation to communicate the NATO narrative.

IV. Resilience

Understanding, assessing and using the city's resilience is of paramount importance to NATO operations. The resilience[2] of a city means the ability of individuals, communities, institutions, infrastructure, and economic and financial enterprises to survive, adapt and further develop in the event of chronic stress or an acute shock. The resilience concept is valid in the event of a natural disaster or military conflict and can be applied to both the human and physical layers of the urban environment. The traditional military approach (enemy-centric and area-dominant) to urban operations has ignored how operations generally exacerbate the situation of the human system and cause a number of problems that cannot be addressed using traditional military thinking. In order to enhance the city's security, its resilience must be enhanced and protected. Ignoring urban resilience will result in further conflicts and problems to address, and ultimately in failure of the operation.

An experiment previously led by HQ SACT[3] has found 12 aspects that must be considered in resilience assessment: government legitimacy; government capacity; rule of law; effective security system; civil society organization; provision of essential services; livelihood and economic security; quality of labour force; social cohesion; ability to reconcile; perceived safety and security, and quality ecosystem services.

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To evaluate the urban environment and its different parts according to the criteria above, a separate core element of appropriate experts must be developed; this element is called "green cell" in the capstone concept. The green cell obtains the necessary information through

ABOVE: Chemical, biological, radiological and nuclear (CBRN) hazard technicians. Photo by NATO

its network of contacts and keeps it up to date. The purpose of the cell is to identify civilian factors of operational significance.[4] They liaise with NATO civil-military cooperation (CIMIC) units; leaders of the local armed forces and law enforcement agencies; influential economic, financial and political leaders; representatives of local society and refugees; leaders of governmental, non-governmental and international organizations; and journalists.

The urban environment is particularly attractive to the adversary seeking to neutralize NATO's technological superiority, to create uncertainty about their own role, to hide their own involvement and interests, and to remain on the brink of war. Such adversaries finance proxy forces, mercenaries, criminals, terrorists, insurgents, extremists, religious fanatics and dissidents who can set up their political and/or armed struggle below the threshold of what would constitute civil war, thus blocking international military aid. Consequently, the urban environment is a great terrain for actors pursuing asymmetric and hybrid warfare.

Enemy forces moving within the flow of the human system cannot be attacked as they are difficult to identify. The city provides inexhaustible opportunities for them to hide, to disguise their activities. During their manoeuvres, they wear no distinctive signs or uniforms, conceal their weapons, use public transport to relocate, and and set up bases in protected buildings, hospitals, schools and residential buildings, attacks on which are prohibited both by international law and NATO rules of engagement. Their weapons and explosives (e.g. improvised explosive devices from chemical fertilizers) and other (dual-use) technical devices (e.g. UAVs) can be obtained directly from civilian trade.

Irregular forces in the urban environment form a flexible, modular organization, and their command and control is organized along a decentralized, so-called herd intelligence, also known as swarming. Such forces adapt quickly to changing circumstances, are highly resilient (able to perform tasks even if one or more members fail), self-organizing (the units need no supervision or command and control centre), and self-coordinating.

Future NATO Operations in an Urban Environment

NATO's operations must adapt to the challenges of the urban environment even at the planning phase. In urban environments, the borders between the strategic, operational and tactical levels are almost blurred because military operations must be coordinated with other instruments of power (diplomatic, economic, informational, etc.) that are not at operational commanders' disposal. This challenge to the planning process requires coordination between the different levels, unity of command through a common understanding of strategic objectives, and realization of a new, higher level of mission command philosophy.

> "**NATO MDO forces** will be capable of **high-intensity combat, law enforcement, humanitarian operations** and **military advisory operations.**"

Multi-domain operations (MDO) in an urban environment will naturally be land operations, but both adversarial parties will also seek to acquire the other domains. NATO operations should therefore be extended to all five domains of operation (land, sea/riverine, air, space and cyberspace). Cyberspace is the high ground, so it is critical to dominate this domain and, through it, the information layer of the urban environment. This results in decisive influence on the human system.

NATO must prepare for and accept that MDO will be a long-standing ongoing rivalry, a constant cycle of competition and struggle throughout the full spectrum of the conflict, from peacetime engagement to warfighting. The nature of the conflict may vary over time and through space, from one urban district to another, from peaceful coexistence, through irregular warfare, to traditional wars between states. The conflict may escalate to a higher level without transition and then return to a lower level. The level of competition will be difficult to predict and will vary in different areas, so NATO will have every reason to use military forces whose action can be fine-tuned to the level of violence in the crisis. The key to MDO command and control is automated connectivity and information sharing at the highest possible speed, in real time, connecting every sensor and weapon system available in the five domains and enabling the synchronization of cross-domain effects.

MDO require effective decision-making, for which NATO forces need an accurate understanding of all three layers of the urban environment, as well as the adversary and the conflict itself. NATO MDO forces will be capable of high-intensity combat, law enforcement, humanitarian operations and military advisory operations alike. They must be able to operate independently for a prolonged time, secure their own supplies, disaggregate if they find themselves overwhelmed by enemy forces, aggregate independently, reorganize, and perform manoeuvres and fires in three physical dimensions. They will be capable of cross-do-

main (joint) cooperation and coordination with other MDO units in the absence of command and control, but they will also be suitable for civil-military interaction and cooperation with the host nation's armed forces, law enforcement agencies, and local supporting militias.

The support of the urban population and the influence of the human system are essential for the success of MDO. In order to secure influence, NATO troops must be in constant contact with the actors, audiences and organizations that are vital to the administration and management of the city. In summary, the NATO multi-domain forces will be able to understand the urban environment and adapt quickly to the conflict, and they will be able to continuously coordinate cross-domain fires and thus gain an advantage over the adversary.

Multi-Domain Operations Command and Control

The most important factor in the command and control (C2) of MDO in the UE is the speed of the forces. Shortening the decision cycle and sharing the information at the highest possible speed is crucial in securing NATO forces' superiority of information and leadership. The key to future leadership in an urban environment is the integration of intelligence, surveillance, and C2 systems: the fully automated, computerized C4ISTAR[5] system. This network system ensures that command has direct access to all intelligence provided by the unified systems through a computer network, and can use this intelligence in planning and execution, which will pave the way for the next-generation C5ISR[6] system. In the course of the C2 cycle, it is also necessary to cope with the processing of huge amounts of data and the cognitive overload experienced by staff. Revolutionary technological developments will eventually provide the solution: Artificial intelligence and machine learning will facilitate the analysis and extraction of the vast amount of incoming data, interpret it, and support decision-making processes with analysis, pattern recognition and predictions.

• **Decentralized C2:** The command posts of the future is a series of tiny, decentralized cells in constant motion, always connected to each other, but with as little physical and electromagnetic radiation as possible.

• **Communication and Information Systems:** The communication required to control and coordinate the activities of NATO MDO forces must not rely on traditional CIS, but on alternative procedures and tools. These may include existing civilian systems and infrastructure (landlines and mobile phones), or secondary use of police, rescue or fire department systems. When using civilian systems, their reliability, security and the protection of information must obviously be ensured. In addition to the satellite communications available to NATO members, cheaper ground and airborne communications relays may facilitate communication in a congested environment (such as autonomous, robotic, stratospheric balloons and airships).

• **Manoeuvre:** Multi-domain forces trained and specially equipped for urban combat[7] carry out their activities in a dispersed, independent manner, within the framework set by the operation commander, knowing the strategic objectives and the desired end state.

• **Planning:** Operational plans should be rigorously reviewed and tested through red-teaming, wargames, and modelling and simulation. Wargames will be supported by artificial intelligence in the future. Several experiments within a short timespan will help staff understand the secondary and tertiary effects of the operation in all three dimensions (cognitive, virtual, physical) and in all four layers of the urban environment (physical, information, human, and resilience).

Conclusion

In this article, I have sought to summarize the key features of future MDO in one of the most challenging environments in modern warfare. The most important requirement for these operations to succeed, however, will be the change in command culture. Commanders of the future must move beyond service-focused activity, and predetermined timelines and deliberate, sequenced activities if they are to adapt to the uniqueness of the urban environment. This cultural shift will be required at all levels of command and will demand an adoption of "extreme mission command". NATO forces must be prepared for constant competition and adapt to rapidly changing conflicts, synchronizing cross-domain fires to gain an advantage over the adversary.

ENDNOTES

1 Capstone Concept – Joint Military Operations in an Urban Environment, dated 27 November 2018.

2 Resilience (fault tolerance): The ability of a functional unit to continue to perform a required function in the presence of faults or errors (NATOTerm). This term refers to information technology, but I found it applicable to social resilience as well.

3 Bodnar, J., Collins, S 2019. NATO Joint Military Operations in an Urban Environment: A Capstone Concept, The Three Swords Magazine 34/2019, https://www.jwc.nato.int/images/stories/_news_items_/2019/three-swords/NATOUrbanization_2035.pdf

4 The green cell reflects the PMESII (political, military, economic, social, information and infrastructure) factors described in AJP-01.

5 C4: command, control, communications and computers; ISTAR: intelligence, surveillance, target acquisition, and reconnaissance.

6 C5: coalition, command, control, communication, computers.

7 There are currently no troops dedicated and specially equipped for urban combat in NATO member states, but their creation seems to be modelled on other light infantry troops specialized on special operating environments (such as mountain troops).