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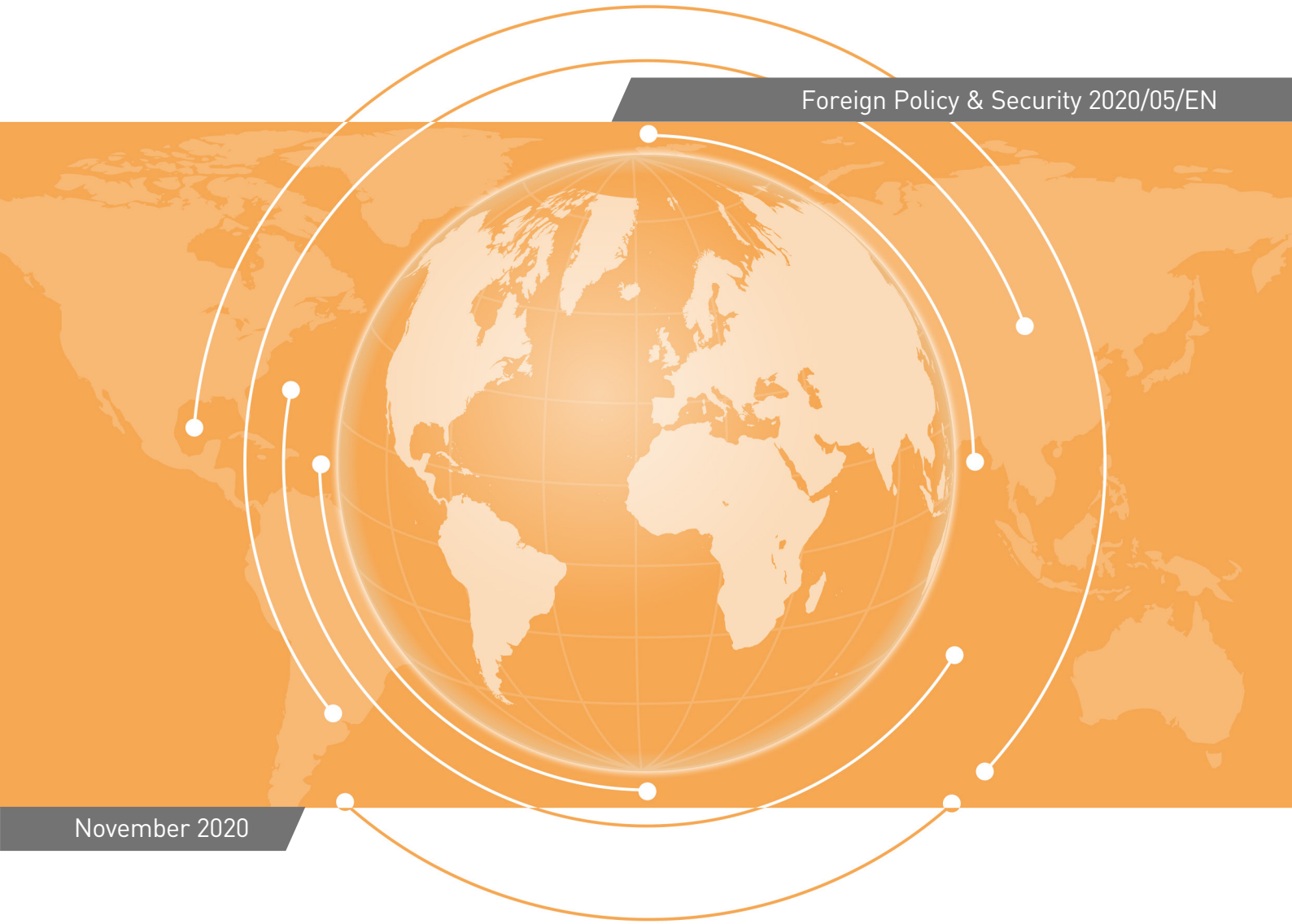

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ANTI-UNMANNED AERIAL VEHICLES WARFARE AND ITS STRATEGIC IMPLICATIONS

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THE SURGE OF UAVS

There have of late been a flurry of articles on progress being achieved in designing and producing anti Unmanned Aerial Vehicles/Systems assets by a high number of firms around the globe. This is understandable because of the frequent employment of UAVs/Ss with success in different conflict zones. It looks evident that the trend to explore and improve technologies of anti UAVs/Ss will continue unabated.

UAV/S started to take the stage, albeit in primitive forms, in the mid- 19th. century. Since then there has been an unprecedented evolution both in their employment and technology. Efforts to develop their capabilities and designs gained some traction in the late 1970s and various systems have been put into use, particularly in the military field. What we today witness is an ever increasing use of different types of UAVs/Ss both in military and civil domains. And it has become evident that their employment will increase greatly in the foreseeable future.

It is undeniable that successful employments of different types of UAVs/Ss, or Remotely Piloted Vehicles/Aircrafts (RPA) to use a commonly referred term in military circles, have made these platforms much more attractive for many military and defence experts.

There exist primarily three classes of UAVs/Ss in use; micro, mini(miniature) and small UAVs/Ss (Class I in NATO jargon); medium-sized tactical systems(Class II), and Medium Altitude Long Endurance (MALE) / High Altitude Long Endurance (HALE) type UAVs/Ss (ClassIII) that could be described as strategic level types. There also exist Ultra High Altitude UAVs/Ss, still in experimental stages, which could be defined as sub-orbital satellites or high altitude pseudo-satellites using either solar energy or traditional types of fuel.

UAVs/Ss have become extremely useful platforms both in the civil and military domains. They are used for protection/defence of High Value Assets (HVA) such as airports, seaports, military bases, maritime and aerial assets, deployed troops and non-expendable military assets and capabilities. They also contribute to having a more accurate Recognised Air Picture (RAP) to enhance air superiority in different theatres both in peacetime and wartime. They are also effective instruments in conducting Intelligence, Surveillance, and Reconnaissance efforts, mounting counterterrorism operations and surgical strikes against adversary's military capabilities in the military field as well as in delivery of goods, postal services, covering large scale media events etc. in the civil sector.

They are also used for sinister purposes by state and non-state actors against military assets and capabilities in different theatres of war, for espionage, including the industrial field, sabotage and disruptive activities in an ever expanding spectrum. Hence the clear need to develop a new generation of anti UAV/S technologies and counter measures against the potential damage they could inflict on civil and military sectors.

TRIGGERS INTEREST IN ANTI-UAV SYSTEMS

It is somewhat ironic, although understandable, that analyses on anti-UAV systems are in comparative terms scant barring the last few years. There are certainly novel and innovative/disruptive technologies and emerging concepts based on them , but they seem to be in their incipient stages. A brief look at the counter measures against UAVs/Ss follows the usual pattern of detecting, tracking, engaging and neutralising. There exist different techniques, technologies, procedures and practices in use both in detecting/tracking vector and in engaging and destroying UAVs/Ss.

Detecting and tracking 'Low, Slow and Small'(LSS) type UAVs/Ss, which fly at low altitudes (below 5.000 feet), are a subject that increasingly attract the attention of military and defence experts and planners. Different counter measures are in play when it comes to Line of Sight(LOS) and Beyond Line of Sight (BLOS) LLS type UAVs/Ss.

In detecting, tracking and engaging UAVs/Ss used for malign intentions the whole gamut of electronic jamming, electromagnetic operations, 'spoofing', that is, radio frequency engagements/attacks, Directed Energy Weapons such as High Power Microwaves or High Energy Lasers would be employed. GSM related capabilities against UAVs/Ss could also be utilised, particularly for medium to high altitude UAVs/Ss. There is even the use of trained birds of prey for downing LSS type UAVs/Ss.

The challenge faced here is the degree of autonomy of the UAVs/Ss to be countered. If the type of UAV/S is self autonomous and equipped with a highly intriguing algorithm, then it would require daunting work to deal with it. The difficulty of making ultra high long endurance UAVs/Ss and those UAVs/Ss equipped with hypersonic propulsion intended to achieve the speed of Mach5 and beyond are challenges yet to be seriously considered.

Conventional counter measures such as counter rocket, mortar/projectiles and artillery as well as general purpose air defences are among the more familiar methods of intercepting, engaging and neutralising UAVs/Ss. However, there are limits to countering the threat of UAVs/Ss when such assets are employed. They would prove useless or offer limited success, particularly when there is a swarm attack of 'kamikaze UAVs/Ss'.

The crucial point to detect and track UAVs/Ss both in lower altitudes and medium to high altitudes is to have enhanced early warning capabilities in place. The ideal scenario in this field of activity would be to detect them and their operators/locations before they take off with their payloads. That is indeed a very challenging strand of work, which, however, must be among the primary objectives of countering UAVs/Ss.

Another intriguing aspect facing defence/military experts and planners is to elaborate tactics, techniques and procedures for those UAVs/Ss designed on artificial intelligence using 5G networks. Dedicated development and research on this aspect is necessary to succeed in anti UAV/S warfare.

Due to the different types and capabilities of UAVs/Ss, defence against them must be layered like in the case of Ballistic Missile Defence. The proposed layered architecture must have the ability, preferably embedded in its design and production, to defend against UAVs/Ss by using cyber capabilities both in defensive and offensive modes to render the attacking UAV/S' algorithm dysfunctional. Consequently, integrating cyber capability to anti UAVs/Ss assets may prove attractive. That would certainly not preclude the need to counter them by leveraging existing cyber capacities.

There have been successful initiatives to introduce stealth technology in UAVs/Ss and this would enhance over time. Given that, anti UAV/S capabilities should be designed not to allow those UAVs/Ss with stealth technology to infiltrate into defence lines of a designated area. And that requires a very sophisticated network of highly developed radars able to detect those UAVs/Ss having built-in stealth capability.

It is well known that not all types of UAVs/Ss have all-weather capability, which are one of their weaknesses. Under circumstances where those UAVs/Ss without stealth technology are in use, producing non-conducive climatic effects to hinder their operations might well be a simple, but an effective defensive measure against them.
Production and use of UAVs/Ss in civil and military domains have gained tremendous traction in recent years. This fashionable trend is likely to continue for the foreseeable future. By contrast, defensive and offensive measures against them pale in comparison to investments in further research and development of UAV/S. However, we are witnessing particularly in the last few years serious attempts and initiatives on designing counter UAVs/Ss assets and

capabilities. This is bound to achieve progress given the fact that UAVs/Ss have been inflicting heavy damages in different theatres of conflict and also causing the loss of civilian lives. The collateral damage they wreak, when used in dense areas, is exorbitant.

It is certain that defensive and offensive capabilities will soon be in place to counter UAVs/Ss. Because of the complexities involved in anti UAV/S measures due to the highly sophisticated use of technology in UAVs/Ss, the defensive/offensive toolbox to be developed for anti UAV/S is destined to be by default multi-domain and interdisciplinary bringing together different strands of activity and practice.
Any anti UAV/S architecture must be layered like BMD and leverage, to the maximum extent, AI capabilities extending to space-based systems.

Novel technologies to be launched for the sixth generation aircraft should proceed in tandem with anti UAV/S architecture informing its design and capabilities. While further developing anti UAV/S platforms, the means of integrating defensive/offensive capabilities against UAVs/Ss into the current and future BMD architecture should be explored, thus fusing both BMD and anti UAV/S capability in the same toolbox. In a nutshell, BMD and anti UAV/S should be interoperable and 'talk to each other.' Defensive/Offensive anti UAVs/Ss architecture that smack of Iron Dome should be re-designed to cater also for priorities and needs of an anti UAV/S capability. This would indeed be a costly endeavour, but it is worth it because of risks and threats involved due to UAVs/Ss.

How to design and develop UAV/S-specific Identification Friend or Foe (IFF) system or to adapt the current IFF capability to be mounted on evolving anti UAV/S platforms is yet another aspect in need of further exploration. To achieve that ultimate goal toward making anti UAV/S assets much more effective against all types of UAVs/Ss, tireless efforts should be deployed to seek an exhaustive inventory of libraries being used in existing UAVs/Ss. This may well prove to be an almost untenable objective, but it is worth trying to expand the pool of such libraries to detect and track friendly assets and distinguish them from those to be used by potential adversaries.

THE NATO DIMENSION

It would be prudent to closely examine potential legal repercussions whilst addressing the use of anti UAV/S assets and capabilities. In that regard , it would be a wise preference to reminisce discussions and consultations that took place within NATO prior to the adoption of the Renegade Concept for aircraft violating the airspace of a country with the intent to attack. It is possible to take cues from that concept and adapt it to renegade or attacking UAVs/Ss.

Here a few remarks on civil-military cooperation in countering UAVs/Ss are in order:

- Both civil and military firms operating in developing systems against UAVs/Ss should combine their efforts to lay out a code of conduct particularly for those UAVs/Ss intended for civil purposes. They should aim at introducing a designated electronic identity and allocated frequency for civil UAVs/Ss despite conceivable legal intricacies involved.

- The rule to have transponders open round the clock on civil UAVs/Ss should be sought and enforced to avoid any mishaps or to prevent malign use. Such a regulation may well be out of reach for UAVs/Ss produced for military purposes.

- All walks leading to UAVs/Ss, be it for actual use in different theatres or anti systems against them, point to the clear need for a holistic policy involving both public and private sectors operating in a coherent manner. This certainly necessitates a rigorous legal reflection, a priori, which would present a number of hard to surmount challenges in the use of a wide variety of UAVs/Ss.

The important subject of UAVs/Ss, including the potential they offer for the future, will remain on the global agenda of both the military and civil authorities. Put differently, the current euphoria and fervour on them is not of a transient nature. It is true that UAV/S capability has proven its effectiveness in different conflict zones such as Syria, Iraq, Yemen, Libya, Ukraine, and most recently in Nagorno Karabakh. They have demonstrated their kinetic potential to suppress adversary's ground-to-air defence capabilities. That said, in almost all those examples there have existed a permissive environment which made possible the effective employment of different types of UAVs/Ss. And there is, in some circles, a misleading inclination to treat them as a miraculous instrument for air supremacy.

The effect they have so far created in permissive environments is undeniable. However, in non-permissive environments, which would erect an A2AD barrier by effectively deploying various tiers of air defence, the effect of UAVs/Ss will remain limited. Therefore, too much reliance on their employment in air operations under a non-permissive environment is militarily risky and flawed. They will certainly be deployed as an inseparable part of air campaigns, but not represent the whole key for Suppression of Enemy Air Defence (SEAD).

Put simply, they cannot be the magic wand by themselves in establishing air superiority over adversaries' airspace in all cases. Neither will they be able to effectively operate, as some would conceive, in environments where all constituent parts of not only traditional air defence, but cyber, electronic warfare, non-conventional capabilities and certainly evolving anti UAV/S assets are at play. Thus, under such circumstances their success will remain modest and not bring about the 'final blow' to the adversary, as some would aspire and advertise.

They are and should remain as a part of a broader defensive/offensive architecture to be complemented and supported by a whole host of aerial and otherwise assets and capabilities. It is clear the demand for anti UAV/S capability is on the rise. Today's reality is that as UAV/S technology and capability develops, the need and demand for anti UAV/S platforms would increase at a higher rate. It might well be the case that military UAVs/Ss could become the 'relic of the past' by the mid 2030s to be reserved for military museums for curious spectators so long as groundbreaking technologies are used in designing systems against UAVs/Ss.

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