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NATO Air and Space Power in Counter-IED Operations

A Primer – Second Edition

Joint Air Power Competence Centre

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FROM:

The Executive Director of the Joint Air Power Competence Centre (JAPCC)

SUBJECT:

NATO Air and Space Power in Counter-IED Operations – A Primer (Second Edition)

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Improvised Explosive Devices (IEDs) continue to present a persistent threat to NATO and its allies, both in Afghanistan and elsewhere. With the potential strategic effect of IEDs well-recognised, NATO's approach is designed to address the threat they pose through a combination of measures to defeat IEDs themselves and, through the establishment of robust and agile organisational structures involving Joint, multinational and inter-agency linkages, to attack the networks that support their use. Air and Space Power has an important role to play in pursuing this approach.

This Primer is intended to provide readers with an insight into the ways and means whereby NATO Air and Space Power can contribute to Counter-IED (C-IED) operations. In incorporating changes made in the Alliance's approach to C-IED since publication of the first edition in September 2010, it seeks to set out the generic IED threat to current and future NATO operations, and considers how the inherent characteristics of a range of Air and Space Power capabilities can lend themselves to addressing different aspects of that threat. It identifies that a combination of specific capabilities and the supporting structures, processes and preparatory measures that allow their fullest exploitation, all serve to optimise the Air and Space Power contribution to the C-IED fight.

I hope that this revised Primer will continue to fulfil the intended purpose of its predecessor in providing an introduction to more detailed study of Air and Space Power in the context of C-IED operations, and would welcome readers' feedback and comment; only by strengthening our own networks can we weaken those of our adversaries. Accordingly, please feel free to contact my JAPCC Combat Service Support Branch Head, Group Captain Dai John, at john@japcc.de or on +49 2824 90 2260.

Dieter Naskrent

Lieutenant General, DEU AF
Executive Director

TABLE OF CONTENT

PREFACE

Aim

This publication provides a summary of the Air and Space (A&S) Power contribution to NATO's approach to Counter Improvised Explosive Device (C-IED) operations.

Purpose

In seeking to draw together into a single document the full extent of NATO's A&S Power contribution to C-IED, this Primer addresses an issue that has increasingly come to dominate the stabilisation and counter-insurgency (COIN) operations in which the Alliance is engaged. It considers the factors influencing the employment of A&S capabilities available to commanders, and summarises the issues associated with their use. While offering contemporary real world examples, it is intended to be relevant to any current and future conflict scenarios where the use of IEDs presents a threat to Alliance forces and, therefore, to mission success.

Application

This Primer is designed to provide a readily-accessible reference document for use by those personnel with an interest in, or responsibility for, the application of NATO A&S Power in C-IED, both operationally and in Education and Training (E&T) environments. It is not intended to offer authoritative or definitive advice, nor is it a substitute for relevant doctrine, policy or reference documents. Instead, it attempts to provide a point of entry into a topic that has come to characterise current operations, and the guidance, principles and capabilities presented in it reflect, and are consistent with, NATO's approach to C-IED. Reference to organisational structures and processes is included in order to demonstrate their importance to C-IED operations rather than as a critique of them, and it is expected that these will continue to evolve over time; nevertheless, their importance in facilitating the maximum exploitation of all available capabilities, including those provided by A&S assets, cannot be overstated. It should also be noted that the dynamic nature of C-IED results in constant evolution, not only of the processes that support C-IED operations, but also in the terminology used. While this Primer utilises the terminology currently employed when describing, for example, the C-IED *Areas of Activity* referred to later, this is likely to change on a continuous basis. The underlying principles identified in this Primer are, however, more enduring. The reader is therefore invited to focus on the principles themselves, rather than the labels currently attached to them.

Acknowledgements

The JAPCC gratefully acknowledges the enthusiasm, candour and expertise of all those individuals and organisations responding to requests for support in producing this Primer.

Overview

This Primer provides a summary of the means whereby NATO C-IED operations are supported by its A&S capabilities. In order to offer a self-contained reference source, it sets out the current IED threat, making the point that IED use by adversaries is not necessarily limited to COIN operations but may also feature in the full range of conflict scenarios. It goes on to consider the generic characteristics of IEDs and their use by an adversary. In discussing the specifics of the A&S Power contribution, it utilises the existing approach adopted by NATO, using three mutually supporting and complementary pillars, underpinned by *understanding and intelligence* and relying on five overlapping *areas of activity* as a structure within which to set the various capabilities brought to bear by A&S Power. The document goes on to consider the specific contribution made by E&T within the *Prepare the Force* pillar, summarises emerging technological trends in the A&S domain, and concludes with a reiteration of the key points emerging from this review.

Chapter I – Introduction: Chapter I introduces the importance of the role played by NATO A&S Power in C-IED, and states the aim and scope of the Primer. It assesses the likely enduring and evolving nature of the IED threat, identifying the perceived benefits to

an adversary of IEDs and their potential, as an essentially tactical-level weapon system, to impact at the operational and strategic levels.

Chapter II – Characteristics of IEDs: Chapter II sets out the generic systems and technologies that characterise the design of IEDs, including their categorisation based on mode of initiation and method of deployment. It considers the nature of the likely Tactics, Techniques and Procedures (TTP) of those seeking to use IEDs, and emphasises the agility with which such TTPs can evolve to overcome advances in C-IED capabilities. It identifies the development of simpler IEDs which, through the selective use of materials and a better understanding of C-IED capabilities, are no less of a threat.

Chapter III – Countering the IED Threat: Chapter III identifies C-IED principles and sets out NATO's C-IED approach, before considering how this may support the conduct of C-IED. It discusses the relationships that exist between C-IED and COIN operations, and how these relationships influence the role played by A&S Power. It highlights the importance of processes that support C-IED, and the need for such processes to be responsive, predictive and agile, fully understood and consistently applied. This Chapter also briefly considers developments in NATO's C-IED structures.

Chapter IV – The NATO A&S Contribution to C-IED: This Chapter considers how NATO A&S capabilities can support operations aimed at attacking IED networks and defeating IEDs once emplaced. Against each supporting pillar, it sets out the factors and considerations associated with the use of airborne and Space-based Intelligence, Surveillance and Reconnaissance (ISR), Electronic Warfare (EW), Air Mobility, and kinetic and non-kinetic effects. In each of these areas, it highlights the importance of E&T within the *prepare the force* supporting pillar, and reiterates the critical role played by processes and organisational structures in exploiting fully the available capabilities.

Chapter V – Prepare the Force – Education and Training (E&T) Considerations: This Chapter describes the way in which, within the *prepare the force* pillar, E&T pervades all aspects of C-IED activity via the need to provide appropriate E&T to all those personnel engaged in C-IED. It identifies three discrete training audiences, providing examples of the types of education and specific training required, and considers the needs of a fourth, in the form of Host Nation (HN) E&T requirements.

Chapter VI – Technological Developments and Future Prospects: This Chapter considers the potential for innovative technological solutions to offer significant improvement in C-IED A&S capability, against a background of the need to gain a better understanding of both existing technological capabilities, and the requirements of particular missions and tasks. It identifies the importance of bringing together current capabilities, and considers the relevance of new technological developments in terms both of *Attack the Networks* and *Defeat the Device* activities.

Chapter VII – Points for Consideration: This Chapter takes the form of a summarising conclusion. It brings together the key points identified in the Primer in order to provide an easily accessible summary of issues, factors and considerations that may be of relevance to readers.

Air and Space Power plays a key role in C-IED operations.

CHAPTER 1

Introduction

1.1 Background

1.1.1 In recent years, IEDs in their various forms have become one of the weapons of choice for insurgencies in operational theatres as diverse as Iraq and Afghanistan, as well as representing a generic global threat. Increasingly they characterise asymmetry in conflict scenarios where the military forces of nations, individually or in alliances, confront adversaries unable to compete on equal terms with opponents whose greatly superior mass, technology and training offer, in conventional terms, decisive advantage. Such adversaries could include a combination of conventional armed forces, irregulars, insurgents and criminal networks, as well as non-state and proxy actors and other hostile international groups.

1.1.2 Air and Space (A&S) Power Roles. A&S Power plays a vital role in C-IED operations. While many of the A&S capabilities fielded by NATO, including ISR, are widely recognised as contributing to the inherently Joint nature of C-IED activity, others – for example the agility and flexibility provided by Air Mobility – make contributions that are less immediately obvious. In order to ensure that A&S Power is making the fullest possible contribution to C-IED, it is essential that all those who are in a position to plan, train, command, conduct, analyse or otherwise influence the operational employment of NATO A&S Power have an understanding of the ways in which it can be used as an integral element within Joint, Combined Joint, coalition, and all other forms of cooperative, collective operations. Equally, those who wish to acquire a better understanding of the potential use of A&S capabilities in the context of C-IED are also included in this document's intended readership.

1.2 Aim

This Primer provides a summary of the NATO A&S Power contribution to C-IED, addressing, from an A&S perspective, what has become a global and enduring threat. In doing so, it seeks to describe both the extent and the limitations of current A&S capabilities.

IED use can inflict significant casualties on Coalition and National Security Forces.

1.3 Scope

The scope of this document concerns the contribution made by NATO A&S Power to C-IED operations. The principles identified in it are not intended to be interpreted as relating to specific operational scenarios; instead they are expressed generically to emphasise their wider applicability. In order to reach as broad a readership as possible, this Primer avoids reference to specific aircraft, sensors, weapons and other systems and equipment. This level of detail is, however, readily available, and can be provided by the JAPCC where appropriate and subject to current releasability rules.

1.4 Implications

The implications of a broader understanding of the contribution made by NATO A&S Power to C-IED relate fundamentally to its real-world application, achieved through the provision of relevant E&T to all those individuals, organisations and agencies with an interest, or role to play, in delivering NATO A&S Power. In addition to E&T, the major themes identified, including the need for agile, responsive supporting processes and the judicious combination of existing intelligence collection and sensing technologies and capabilities, have implications for the planning and execution of operations and in the development of future NATO A&S capabilities and TTPs.

1.5 The IED Threat

The attraction of IEDs to adversaries is clear. They are cheap and easy to make, using materials and components, including fertilizer-based explosives (often referred to as Home Made Explosives (HME)) and commercial detonators, readily available for legitimate purposes and which are often mass-produced. In their various forms IEDs can both exploit and defeat – sometimes concurrently – well-proven and reliable technologies, such as Electronic Countermeasures (ECM). Furthermore, design developments and details of IED construction are easily obtainable via the internet, which provides a low-cost and ubiquitous medium for information sharing and the rapid dissemination of ideas.

1.5.1 Tactical Impact. The single greatest attribute of IEDs is their effectiveness. At the tactical level their use, for example in Afghanistan, continues to inflict significant numbers of casualties on Coalition and National Security Forces, as well as among the local

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In Afghanistan, IEDs continue to pose a threat to local populations.

civilian population. According to Afghanistan Rights Monitor (ARM), in 2010 IEDs 'were the most lethal tools, which killed over 690 civilians and wounded more than 1,800 people'[1] with predictably devastating effects on close-knit, often rural communities. In terms of Coalition losses, it has been estimated that since 2003 between 70% and 90% of overall military casualties in Afghanistan have been inflicted by IEDs, with the number of US troops killed by IEDs increasing by 60% in 2010, and with a threefold increase in those wounded.[2] As a result, insurgents have constrained Coalition Forces' Freedom of Movement (FoM), affecting their ability to engage with local populations, an aspect of their role regarded by senior commanders as critical to the success of ongoing COIN operations.[3] At the strategic level, the insurgency continues to exploit global media to maximise the propaganda effect of IED strikes, simultaneously maintaining the support of those sympathetic to its cause, seeking to influence national domestic support in Coalition countries, and consequently influencing political decision-makers. The influence of IED use is also evident in its effect on governments' military procurement strategies.

1.5.2 Strategic Impact. At the strategic level a particular aspect of IED use is its effect on the cohesion of alliances and the willingness of International Organisations (IO), Non-Governmental Organisations (NGO) and others supporting NATO's Comprehensive Approach (CA) to remain in theatre. It is likely that early withdrawal of such agencies would undermine the CA and necessitate the provision from other sources of the humanitarian and reconstruction support that they provide.

1.5.3 Conflict Scenarios. IEDs offer adversaries a lethally effective capability that is both inexpensive and, although tactical in its immediate effect, has the potential to have significant impact at the operational and strategic levels. While the current focus is on IED use by adversaries supporting an armed insurgency, it is also the case that IED capability is a potential factor within a wide range of crisis and conflict scenarios, including stabilisation operations, cross-border law enforcement and as a feature of hybrid warfare.[4]

1. ARM Report 'The Civilian Human Cost of the War in 2010' dated 1 February 2011.
2. United Press International 'US troops killed by IEDs' jumps in 2010, published 26 January 2011.
3. COIN is defined by NATO as 'The set of political, economic, social, military, law enforcement, civil and psychological activities required to defeat insurgency and address core grievances.'
4. Though not currently formally defined, hybrid warfare in the context of this document is characterised by a combination of irregular activity and advanced capabilities, including in weapons and communications, that together offer predominantly non-state actors effects previously unavailable to them.

CHAPTER 11

Characteristics of the IED System and IEDs

2.1 The IED System and Technologies

2.1.1 NATO regards the IED threat as a systemic problem and its approach aims to defeat the IED System.[1] Such a System will contain personnel, resources and a range of linked actions, including recruitment, training and coordination. It may or may not be hierarchical, and may incorporate support from external sources, including international leadership or state sponsorship. Conversely, the IED System may operate locally and independently from other entities. An adversary will seek to utilise his IED System and its networks to deliver the IED threat, and identifying the critical vulnerabilities within the System is an important C-IED activity.

2.1.2 Within the IED System, the design of IEDs is determined by a number of factors, including the availability of key components, the standards of training and experience of IED makers, and the capabilities fielded by those they seek to attack. Given that practical constraints may deny an adversary complete freedom in the design and employment of IEDs, the most significant factor is likely to be the intended target. For example, the intention may be to attack the indigenous population, national government and security forces, NGOs and other agencies, symbolic structures and infrastructure, commercial institutions and economic nodes, or NATO forces. The extent to which the intent is achieved will depend on where IEDs are placed, their destructive power and the means of delivery used. While patterns will inevitably emerge in any given theatre, a common feature of IEDs is the ingenuity evident in their construction and emplacement. For example, multiple configurations and IED use in sophisticated complex attacks have become a feature of modern warfare, combined with the tactical use of other weapon systems and, potentially, with chemical, biological and radiological materials to create weapons of mass destruction. An important factor that limits the options of those using IEDs is their willingness to risk their own lives, with some individuals being prepared to undertake suicide attacks, and others wishing to escape harm or detection by remaining at distance from the intended target. These considerations allow an IED classification to be used, based on the method of initiation and deployment, as set out below.

2.1.3 Means of IED Initiation. From the perspective of A&S C-IED capability, the main IED initiation methods are as follows:

2.1.3.1 Timed IEDs, which offer an adversary a delay between emplacement and initiation ranging from seconds to months, as a result putting time and space between him and the detonation of the device;

2.1.3.2 Victim-Operated IEDs (VOIEDs), which are initiated by some action performed by the target, whether an individual or a vehicle; VOIEDs may incorporate a variety of firing switches and may be armed manually, with timers, or remotely;

2.1.3.3 Command-Initiated IEDs, which incorporate an element of separation between the main charge at the Contact Point (CP) and the firing point, allowing the operator to choose the optimum moment of initiation. Command-Initiated IEDs may take the form of **Command Wire** IEDs (CWIED), where a firing current is sent along an electrical wire to the CP, or **Radio-Controlled** IEDs (RCIED), where a radio transmission is sent from the firing point to a receiver at the CP.

2.1.4 Methods of IED Deployment. The deployment of IEDs can be undertaken in a number of ways, for example:

2.1.4.1 Manually, where the IED may be emplaced by hand or thrown into position in anticipation of a target. Such deployment is potentially capable of being detected using A&S assets. Alternatively, an IED may be delivered by an innocent or coerced party;

2.1.4.2 By Vehicle, whether ground-based vehicle-borne IEDs or via aircraft, including Unmanned Aerial Systems (UAS) and other small platforms;

2.1.4.3 Via Suicide Attack, allowing the operator to optimise the time and location to initiate an IED;

2.1.4.4 Through Projection, for example when IEDs are delivered to the intended target by direct or Indirect Fire (IDF) using rocket or mortar systems.

2.2 IED Tactics, Techniques and Procedures (TTP)

2.2.1 Resources. Resourcing activities conducted within the IED System will include identifying and obtaining financial and technical support, recruitment, training and the provision of the materials necessary for IED production. The adversary may also undertake the development and refinement of IED design and of TTPs. The TTPs employed may display a number of characteristics broadly conforming to the same principles of irregular warfare as, for example, the Mujahedeen fighters who inflicted significant losses on Soviet forces in Afghanistan between 1979 and 1989. Speed, surprise, mobility and flexibility are integral factors in such campaigns, as are the favoured methods of ambush, sabotage and roadside IEDs, the latter often comprising HME main charges produced using commercially-available fertilizer. The use of military ordnance is also a common feature in the manufacture of IEDs. Locating, identifying and denying access to stockpiles of conventional ammunition should therefore be a major consideration for Alliance forces.

2.2.2 Electronic Countermeasures (ECM). Methods of deployment and means of initiation tend to evolve over time, usually in response to advances in the opponent's ability to detect and defeat IEDs. For example, success in mitigating the threat posed by RCIEDs through the use of ECM may result in the adversary reverting to CWIEDs or victim initiation, or in seeking to defeat or circumvent ECM by identifying and avoiding the frequency range covered, or simply by out-powering fixed-frequency ECM. Forces lacking an ECM capability altogether may find themselves increasingly targeted using RCIEDs, creating challenges for NATO where ECM capability varies significantly between the forces deployed by different nations. Furthermore, increasingly sophisticated detection methods employed against IEDs may have the effect of encouraging an adversary to use IEDs that, although simple in their construction and means of initiation, are no less lethal. For example, VOIEDs can be produced from the most basic of locally available materials, with minimum metallic content making detection more challenging.

2.2.3 Counter-C-IED. The evolving IED threat will therefore not necessarily involve increasing sophistication or destructive force, but could instead be apparent in simpler devices that are less reliant on external sources of components, are easily made, and are used in large numbers. An adversary's TTPs are also likely to change to reflect different approaches to COIN adopted by NATO forces in response to prevailing local circumstances. Where dismounted patrols are regarded as an appropriate means of pursuing campaign goals, use of VOIEDs may be more common, whereas in areas where patrols are routinely conducted by vehicle on Lines of Communication (LoC) used by convoys, the use of larger CWIEDs and RCIEDs is potentially more likely. Whatever the level of protection provided to NATO forces, the opponent can, if he wishes, ultimately overmatch that protection or circumvent it in other ways, hence the need for a systemic approach to C-IED, and for a robust Lessons Identified process.

1. The IED System comprises the activities conducted by an adversary to enable the use of IEDs, and which are linked by networks.

CHAPTER III

Countering the IED Threat

3.1 Principles

3.1.1 Joint Considerations. Countering the IED threat is fundamentally a Joint activity, with a range of capabilities contributing to the overall effort and intended effect. Within NATO, a wide range of nations, component commands, national and multinational agencies and other entities all exploit capabilities from across the different environmental domains and beyond (including from Joint organisations) and in various combinations. These may all be directed against specific aspects of an adversary's IED System. Accordingly, any attempt to consider A&S Power's role in C-IED in isolation of contributions from elsewhere would result in an incomplete picture. This is certainly the case in the Joint intelligence area, where the ability to provide timely, relevant and authoritative intelligence at a suitable level of classification is paramount. Such intelligence results from transparent, coordinated joint effort, enabled by swift, reliable feedback from multiple sources, and its application depends on the flat, all-informed structures necessary to support agile targeting. It is therefore essential that in discussing A&S capabilities that contribute to the C-IED effort, these capabilities are always considered in the context of a Combined Joint operation.

3.1.2 C-IED and the Comprehensive Approach (CA). The Combined Joint environment within which C-IED is conducted forms part of NATO's CA. The IED threat permeates all aspects of the CA, affecting a variety of civil actors including HN civilian administration, IOs such as the United Nations, NGOs and many others, and NATO's response to the threat must acknowledge this; to do otherwise would not only expose those working in these organisations to unnecessary risk but could potentially prompt their withdrawal, with the associated strategic implications. The creation of a secure environment and the provision of E&T are thus key considerations.

Countering the IED threat is an inherently Joint activity.

3.1.3 Countering the IED threat has been described as a perpetual game of cat and mouse, in which advances made in C-IED are swiftly countered by an adversary using IEDs to pursue his aims and objectives or to exploit Alliance or HN vulnerabilities. As already described, the evolving IED threat will not necessarily involve increasing sophistication or destructive power, but could instead be apparent in devices which are less reliant on external sources of components, and which are at the same time potentially both harder to detect and equally effective. An appropriate response to the IED threat, therefore, requires mental agility, experience, reliable intelligence on changes in enemy TTPs (which are updated regularly), and constant innovation. This sort of response is also supported by NATO's C-IED approach, with 3 mutually supporting and complementary pillars of activity. These are:

- **Attack the Networks**, consisting of both offensive and proactive Joint, multinational and inter-agency activities, intelligence driven and designed to disrupt the networks of an adversary's IED System;

- **Defeat the Device**, comprising predominantly military activities responding proactively and reactively to emplaced or suspected IEDs;

- **Prepare the Force**, ensuring that the force is appropriately organised, interoperable with the HN and allies, manned, equipped and, crucially, ***educated*** in relevant doctrine and ***trained*** in TTPs to an appropriate level.

3.1.4 These pillars are underpinned by understanding and intelligence, and are addressed through a number of overlapping *areas of activity* that together serve to reinforce the Alliance's FoM and to constrain or prevent the adversary's. As described in Chapter IV, A&S Power makes a full contribution to this approach. The *areas of activity* are:

3.1.4.1 Understanding, gained through the development of a comprehensive picture of the IED System;

3.1.4.2 Pursuing full spectrum, inter-agency, multinational action to degrade an adversary's IED capability;

3.1.4.3 Preventing, through Influence Activity (IA) designed to deter involvement in the IED System and to reject the use of IEDs;

3.1.4.4 Protecting, through measures intended to improve HN and Alliance force protection, FoM and security;

3.1.4.5 Preparing HN and Alliance forces to conduct effective C-IED.

3.1.5 Coordination and Prioritisation of Areas of Activity. While each *area of activity* has a specific focus, their effectiveness individually in attacking the networks that provide the linkages and interfaces within the IED System is dependent on their coordinated application. Not only must this coordination take place within the Joint, Combined context of the Joint Operations Area (JOA), it must also be applied at the strategic inter-governmental and inter-agency level. This effort must in turn be supported by agile and effective information sharing and communication capability, and the optimisation of the processes supporting it. Ultimately, the priority *area of activity* will be to **Prevent** involvement in the IED System by deterring those who would seek to pursue their aims through the use of IEDs and by encouraging the rejection by local populations of their use, in effect separating the population from IED use, including though an explanation of the human cost of IEDs. The effective combination of deterrence and separation of the population from the IED System is complex, and requires an understanding of the mix of ideological, cultural, tribal and familial loyalties that exist within a population, and the delivery of a credible, consistent IA message.

3.2 Countering the IED Threat in Practice

3.2.1 Wider Context. As already discussed, in principle C-IED is an inherently Joint activity; this is also borne out in practice. In order to understand the practical contribution to Joint C-IED made by A&S Power, the wider context within which C-IED is conducted needs to be considered. In particular, and

accepting that the use of IEDs can be a feature of the full spectrum of conflict, contemporary operations demand that NATO focuses in particular on IED use as an aspect of asymmetric, insurgent-led operations conducted in fragile and failing states. In such a scenario, the relationship between C-IED and COIN is worthy of closer consideration.

3.2.2 C-IED as a Feature of COIN. The use of IEDs and the consequent need for C-IED capability represents one element of a COIN campaign. There is, however, a danger that the tactical, operational and strategic impact of IED use will result in an emphasis being placed on C-IED at the expense of wider COIN goals. When the potential impact of IED use is already becoming apparent through an emphasis on C-IED operations, the perception can readily arise that COIN and C-IED operations always share common aims and objectives. This may be the case where, for example, efforts made to interdict cross-border land LoCs in order to disrupt the inbound and outbound movement of illicit cargoes of value to an insurgency also prevent key IED materials from reaching their intended destination. Activities such as these therefore serve both the broader interests of a COIN campaign as well as the specific needs of C-IED. Furthermore, given that the IED System and its constituent networks, nodes and linkages may fulfil a variety of purposes other than facilitating the manufacture, storage, transportation, and emplacement of IEDs, the categorisation of networks as IED-specific can appear somewhat artificial. In reality, networks can include those associated with ethnic rivalries and loyalties, tribalism and criminal groupings, which serve a wide variety of purposes, and any of which may support *inter alia* the production and use of IEDs. The difference between C-IED activities and wider stabilisation or COIN is thus indistinct, where success in COIN reduces the use of IEDs and C-IED increases an alliance's FoM and thus supports COIN goals. Commanders must therefore understand the relationships between networks and nodes, the potential implications of C-IED directed against networks, and the kind of circumstances where C-IED operations and COIN operations serve different purposes, if the pursuit of one is not to be at the expense of success in the other.

3.2.3 C-IED and A&S Power. As we have seen, it is important to understand the distinction between the aims and objectives of C-IED operations and the requirements of a broader COIN campaign; while the two may often be mutually supportive, this is not necessarily always the case. This distinction is also apparent in the relationship that exists between NATO's potential A&S contribution to Joint C-IED operations and to wider campaign goals. For example, while the A&S contribution to C-IED can be viewed as a combination of the platforms, sensors, systems, processes and procedures that together offer C-IED capabilities – and could therefore be labelled as 'A&S C-IED capability', in fact these represent part of a much broader suite of capabilities in all environments, including land, maritime and Special Operations Forces (SOF) that contribute to, but are not devoted exclusively to, C-IED. The challenge is therefore to view the A&S contribution to C-IED as one element of its role in the broader COIN campaign. This is important because decisions on apportionment made by air commanders need to be on the basis of both the intended impact on the broader COIN campaign and, at the same time, mindful of the potential effect on C-IED operations – and vice versa. In concentrating on one at the expense of the other, commanders must consider the potential adverse impact on COIN and C-IED efforts respectively. For example, Alliance Air Power used in support of targeted IA, such as Shows of Presence (SoP) and Shows of Force (SoF), may be intended primarily to support the *Understand, Prevent* and *Protect* C-IED *areas of activity*. However, depending on how they are perceived by their intended audiences (of which there may be several for each such individual activity), they may in fact cause sufficient nuisance or fear to undermine the support of the local population. In the worst case, the actual effect may be to encourage local populations to align themselves with an adversary, including by supporting his IED campaign, at the expense of relationships between the local population and Alliance forces.

3.2.3.1 Measures of Effectiveness. A specific issue here is how Measures of Effectiveness (MoE) are developed that provide some objective evidential data on how actions intended to have a particular effect on a

target audience are actually perceived by that (or other) audiences. MoE, or 'criteria for success', may include such indicators as voluntary reporting from the population, although there will need to be verification, for example by the percentage of tip-offs that prove to be accurate, to ensure that reporting is not motivated by factors other than a willingness to support the Alliance.

short (and perhaps longer-term) C-IED fight, and the strategic aims of the COIN campaign, such as setting the conditions for withdrawal. It is also worth bearing in mind that C-IED operations represent, both in principle and in reality, one element in a wider COIN campaign, and while the strategic and operational focus of A&S capabilities should remain on delivering the

The effectiveness of Shows of Force and Shows of Presence in C-IED operations depends on an understanding of target audiences' perceptions.

3.2.4 Mutually Supportive A&S Activities. Having noted the challenges of identifying the unintended second-order effects of A&S operations aimed at achieving specific C-IED and COIN effects, it must be remembered that there are other areas where A&S efforts simultaneously serve both COIN and C-IED aims. These may include training HN forces in C-IED TTPs, addressing at the same time the needs of the full range of effects in support of COIN goals, where the use of IEDs risks undermining the overall success of the COIN campaign, commanders may, nevertheless, be obliged to afford C-IED their highest priority.

3.2.5 A&S Power and C-IED – Supporting Processes. The fullest exploitation of NATO A&S Power capability in C-IED operations is reliant on those processes,

organisational structures and networks that are in place to plan, coordinate and execute C-IED operations, and to analyse, assess and disseminate the effects achieved. These processes and their supporting structures are frequently complex, reflecting the need to engage and cooperate with a large number of agencies and actors. Operationally, a close working relationship is essential between: the Subject Matter Experts (SME) within the main C-IED coordinating organisation (often a C-IED branch or cell); those responsible for overall coordination of A&S capabilities; and, within the A&S tasking and coordination organisations themselves, between those SMEs with responsibility for specific aspects of support to C-IED, including Electronic Warfare (EW) and ISR. Once established, and subsequently maintained and supported by properly configured staff structures, these relationships will permit the best possible prioritisation and allocation of assets to C-IED. Process-related factors include:

3.2.5.1 Mission Planning. For prioritisation and allocation of assets to succeed, it is essential that those with responsibility for allocation of particular assets, for example ISR platforms, are included as early as possible in the process of planning a Joint mission. This will allow relevant ISR assets to be better integrated into the overall plan and will provide sufficient time, prior to execution, for liaison between the agencies involved, both in the air and on the ground. This will apply to most types of operation and is not dependent on its nature or scale;

3.2.5.2 Air Tasking Order (ATO) Constraints. In practice, the requirements of a standard ATO cycle may not always allow sufficient time for maximum coordination and, therefore, optimal mission planning, between air and ground assets. Depending on the type of mission, the overall operational design and the desired effect, it may be appropriate to allocate A&S capabilities to the lowest level of command for a

There is a need for agile, responsive C-IED processes, universally understood and consistently applied.

finite period, giving the commander at that level the greatest degree of control over those capabilities. This will permit him to plan detailed operations with the confidence that the A&S capabilities, or more precisely the effects, requested will be available, maximising their usefulness in C-IED;

3.2.5.3 Feedback Loops. The importance of feedback, whether in the form of a land formation acknowledging the receipt of A&S-provided C-IED intelligence products, or aircrew and analysts having potential IED finds confirmed, underlines the challenge of establishing swift, reliable, means of providing that feedback. For example, while the ability of aircrew and analysts to successfully identify emplaced IEDs would be improved by the confirmation fed back to them that a potential find was in fact an IED, those on the ground are often more likely simply to avoid a potential IED than to investigate it. Consequently, the potential find is not confirmed and the knowledge and experience, and not least the morale, of aircrew and analysts are not enhanced;

3.2.5.4 ISR Support Structures. Tasks such as detection, discrimination and tracking from the air are onerous, particularly in remote or urban areas. They place considerable demands on ISR support, data exploitation and intelligence dissemination networks. Meanwhile, the emphasis in C-IED operations on reconnaissance and surveillance assets has been described as 'overwhelming ISR', in contrast to the more traditional 'overwhelming force.'[1] Furthermore, the crucial importance to C-IED of ISR operations itself underlines the need for all-source, inter-agency intelligence, processing and dissemination infrastructure capable of exploiting ISR products. In C-IED network terms, this can be summarised as **'making a network to break a network'**. In other words, regardless of the number of platforms, sensors, overhead passes and innovative technologies employed in C-IED operations, there is a fundamental need for agile, predictive and responsive processes, universally understood and consistently applied. Processes must be capable of determining which aspects of the IED System to attack and how best to do this. Factors to be considered will include: desired effects and their consequences (as well as the management of unintended consequences); prioritising and sequencing to balance demands and resources; balancing short-term impact against longer term considerations; and MoE. To achieve this, processes must be designed to be inherently swift, flexible and able to respond rapidly to changing circumstances or opportunities. Furthermore, they must be fully understood and must be as free as possible from organisational, structural and releasability constraints. Most importantly, they must actually be used; only through their application will they evolve to reflect the dynamic demands of C-IED operations.

3.3 Strategic Considerations

3.3.1 Strategic-Level Processes and Structures. The proliferation of IED use in recent operations has resulted in a wide range of national, multinational, Alliance and coalition activities intended to find ways of addressing the threat. While often effective in developing approaches to deal with the IED threat in its current form, these activities risk duplication of effort and limited visibility between different programmes and projects. Consequently, the need to establish shared awareness of C-IED efforts through better coordination – ideally at the same time avoiding the creation of more network nodes – has been recognised at national and NATO levels.

3.3.2 Strategic Communications (STRATCOM). In 2009, NATO introduced a new STRATCOM policy, designed to coordinate a number of functions at the strategic level and, in so doing, providing support to the CA. As we have seen, the use of IEDs can present a significant threat to Alliance cohesion, and robust STRATCOM, delivering a consistent message at the highest level, can serve to counter this effect. Target audiences for a coherent STRATCOM approach include domestic populations and politicians, IOs and NGOs, the HN population and, potentially, adversaries.

3.3.3 Joint IED Defeat Organization. The US Joint IED Defeat Organization (JIEDDO) has been in existence since 2006, charged with overseeing US efforts to counter the threat of IEDs, and now represents a

cornerstone of US C-IED capability. JIEDDO's recent focus has been on counter-IED network activities, supporting units conducting operations through improvements in intelligence collection, Information Operations (Info Ops), forensic exploitation and surveillance. The range and complexity of C-IED activities conducted by the USA nationally was reflected in the creation of a Department of Defense C-IED Task Force in 2010.

3.3.4 NATO C-IED Task Force (TF). At the Alliance level, the need for cohesive and coordinated effort throughout NATO organisations, structures, components, and nations has been recognised by the establishment of a NATO C-IED TF. In implementing an agreed C-IED Action Plan, the TF coordinates efforts to validate strategic, operational and tactical requirements and works towards ensuring that the management of technological developments and industrial solutions is conducted through appropriate NATO bodies. It also addresses coherent, mutually reinforcing capability requirements with the European Union (EU).

3.3.5 C-IED Centre of Excellence (CoE). A further focusing of C-IED effort across the Alliance is provided by the NATO-accredited C-IED CoE. One of a number of independent, NATO-accredited CoEs (including the JAPCC) whose activities are coordinated by the Transformational Network Branch of Allied Command Transformation, the C-IED CoE offers independent expertise and capacity, complementing and supporting the NATO C-IED TF, Alliance members and partner nations.

1. Kemsley, H: 'Combat Air Power in Irregular Warfare: Operational Utility, the Lack of Narrative and the Risk of Strategic Failure'.

NATO A&S Power can make a decisive contribution to C-IED operations, both in attacking IED networks and defeating emplaced IEDs.

CHAPTER IV

The NATO Air and Space (A&S) Power Contribution to C-IED

4.1 General

NATO A&S Power offers a broad variety of capabilities that, individually and collectively with other assets, can make a decisive contribution to C-IED, whether in attacking the networks or defeating the device once assembled and emplaced. This contribution includes ISR assets tasked independently or cued by other ISR capabilities, the employment of airborne or Space-based Coherent Change Detection (CCD) technologies, the application of precision engagement, and the inherent ability of airborne assets to mitigate the effects of IEDs by using their own environment to circumvent the threat and, importantly, the rapid movement of specialist personnel and exploitable materiel. This Chapter will consider the ways and the extent to which each of these stands to contribute to Joint C-IED effort in contemporary operations, both in *attack the networks* and *defeat the device* activities.

4.2 A&S Power to Attack the Networks

4.2.1 It is sometimes suggested that NATO's A&S capability is, in C-IED terms, predominantly configured to *defeat the device*, in particular to mitigate, detect or neutralise the threat, actual or potential, caused by IED use. As a consequence of this view, its ability to contribute to the *attack the networks* pillar may be seen as comparatively limited. Experience gained from recent operations indicates that that this is not in reality the case, and suggests that this view arises, at least in part, from the challenge posed in differentiating in practical terms between action that is specifically intended to *defeat the device*, and that which is

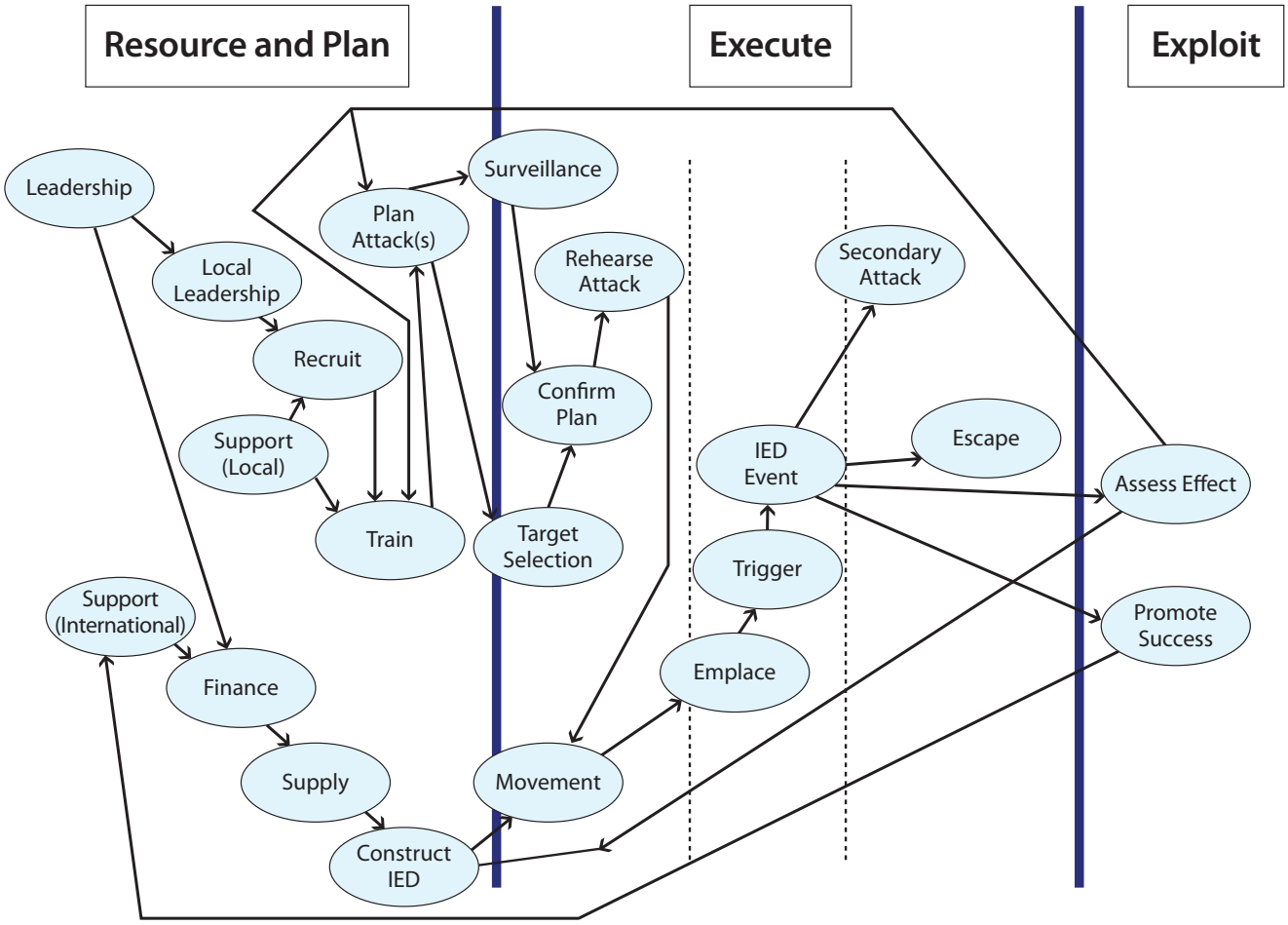

Figure 1 – Generic IED Network Schematic.

primarily designed to attack the component parts of networks supporting the IED System. The key distinction lies in the specific end result sought, though it remains possible that action intended to neutralise an embedded device may also target an identified vulnerability within the IED System as a whole, for example through the forensic exploitation of recovered IED materiel. Similarly, the use of A&S capability to target activities associated with the emplacement of IEDs may serve to contribute to both attacking the networks and to defeating the individual device itself. Once again, however, A&S capability should not be regarded in isolation. While it can provide the sensor capability for a Joint C-IED package intended to target a network linkage or node, when employed on its own it lacks the ability to, for example, detain a suspect, and thus does not necessarily possess the ability to conduct the full range of counter-network roles.

4.2.2 Before reviewing the particular contribution made by A&S capability to the *attack the networks* pillar, it is worth reiterating one further factor that also serves to complicate the issue; not only is it potentially difficult to distinguish, other than in terms of intended effect, between counter-network and counter-device action, the distinction between 'IED networks' and other networks used by insurgents is, as we have already seen, also itself often little more than notional. Nevertheless, a number of agencies have produced schematics seeking to visualise the key features of IED networks. In essence, these comprise their constituent linkages and nodes, both physical (for example the facilities used to construct IEDs) and conceptual (including the ability to train and to plan attacks), and three recurring phases: *resource and plan; execute;* and *exploit*. For any single IED event, these phases will occur in sequence, but in

the course of ongoing IED use are likely to take place simultaneously. A generic IED network schematic, derived from work undertaken in the UK and the US, is at Figure 1.

4.2.3 Accepting that particular networks are less clearly defined in reality than they are theoretically, the key to attacking them involves identifying and addressing an adversary's vulnerabilities at critical points in those networks, including for example the smuggling of components, the training of IED makers and the FoM of leaders. NATO A&S Power can bring to bear a range of capabilities that contribute to the achievement of this aim, specifically:

- The full use of airborne and Space-based ISR capabilities;
- The ability of airborne and Space-based assets to detect, collect and disseminate, in real time or near-real time, actionable intelligence over a longer timeframe than is available from other sources, including through the use of Space platforms to provide long-term perspectives on strategic issues;
- The ability, including through EW, SoP and SoF, to disrupt and deter IED activity, and through IA to seek to gain local support for Alliance actions;
- The use of Air Mobility to support forensic exploitation of IED and other material.

4.2.4 The employment of each of these capabilities is considered in an *attack the networks* role in greater detail in the following paragraphs.

4.2.5 Attack the Networks – ISR. The unique ability of airborne ISR and Non-Traditional ISR (NTISR) [1] platforms and sensors to support *attack the networks*, when compared with non-airborne or Space-based sensing capabilities, derives primarily from their agility, speed, reach and persistence. In deploying the full range of sensors as collectors, all types of intelligence, including Signals Intelligence (SIGINT) and Imagery Intelligence (IMINT), can be brought to bear against networks. Although the utility of airborne NTISR in this role is usually more limited than that of specialist ISR capabilities, with training and experience the detection of changes on the ground, for example in the position and size of temporary structures, the extent of vegetation and the movement of vehicles, can be reliably identified and interpreted. Similarly, Space-based capability has the potential to identify and monitor patterns of life, identifying changes over time and making possible the targeting of individual nodes within the networks; nodes may include individuals, production, storage, and staging and transportation facilities. As with airborne ISR, Space-based sensing capabilities can identify network nodes through a variety of indications, including changes in the routines of individuals or groups, the arrival, expansion or removal of man-made features including settlements and encampments, and changes in apparently natural features, such as water courses. However, without sufficient well-trained analysis capability or useful MoE, there is a danger of the data collected not being fully exploited. The use of Space-derived intelligence against IED networks is further complicated by the fact that high demand, low density capabilities, such as those provided by satellites, need even more reliable MoE to ensure that the effort expended in prosecuting network node missions is justified by the results. It is worth remembering though that tasking Space-based platforms and sensors for a particular mission does not necessarily mean that they cannot concurrently undertake other missions and tasks. Furthermore, the full use of Space-derived products is constrained by procedural factors; considerable effort and ingenuity may be needed by those with access to Space capabilities to provide access to others without breaching releasability protocols. The E&T aspects of *prepare the force* have a part to play here as well, both in ensuring that those requesting Space products are assisted with asking the 'right' question, and more generally to make sure that commanders at all levels are as well informed as possible about how Space-based ISR can support C-IED network operations.

4.2.6 Use of ISR in Attack the Networks – Key Factors. The key factors influencing the success of airborne and Space-based ISR capabilities in *attack the networks* are:

- The maximum integration with other ISR and EW assets, including those on the ground, providing layered, cross-cued effects;

- Mission planning that reflects the fullest utilisation of key A&S Power attributes, particularly that of persistence, when compared with ground-based ISR collection, and which is purposeful and intentional;

- The ability, with the necessary planning and co-ordination, for Space-based assets to conduct concurrent missions, with the data collected being analysed by different means and for different purposes;

- Relevant E&T;

- Collection capability matched by the ability to swiftly and accurately analyse, and subsequently deliver, actionable intelligence.

4.2.7 EW Capability to Attack the Networks. As will be seen with the use of EW in *defeat the device* (discussed below), the provision of relevant, focused E&T is an essential prerequisite for its successful employment in *attack the networks* activities. This is particularly true for EW Officers (EWO), whose skills and knowledge require regular updating if they are to exploit successfully the available capabilities, and of commanders, who need to be aware of the EW capabilities available to them. Used in conjunction with other capabilities and coordinated within a comprehensive IA and Info Ops plan, airborne EW capability can make a significant contribution to the targeting of network nodes and linkages, and can do so in ways that are less apparent to an adversary than a more overt approach – and thus have considerable benefit in discreetly gaining actionable intelligence. Given that such capabilities are likely to be limited in scale and number, and that there will be conflicting demands on available resources, it is particularly important that airborne EW does not duplicate other, similar, capabilities and, in particular, that that EW effort is brought to bear in supporting other forces – usually on the ground – that lack their own organic EW capability.

The success of EW capabilities in C-IED requires regular, relevant E&T and experience.

4.2.8 Counter-Network Air Mobility. The *defeat the device* role played by Air Mobility in mitigating the need for surface transit (covered in more detail below), and the corresponding reduction in exposure to emplaced IEDs, is complemented by its ability, exploiting Air Power's inherent agility, speed and reach, to provide the rapid movement by air of those capabilities and personnel engaged in *attack the networks* activities. These may, for example, include SOF, Human Intelligence (HUMINT) and Civil-Military Cooperation (CIMIC) teams, though actions ostensibly aimed at the networks of the IED System may look remarkably similar to those undertaken with broader COIN goals in mind. This is the case too when Air Mobility is used to support, for example, Key Leader Engagement (KLE), which in serving wider campaign interests also contri-

butes to network-focused effort. One area where Air Mobility can be used in a specifically counter-networks context is in the transportation of IED exploitation specialists, who need to be able to move rapidly to IED events and elsewhere in order to produce comprehensive, evidence-based, actionable intelligence, derived from the technical analysis of material associated with the event itself, including biometric information and data capture obtained from individuals or material associated with it. Such intelligence is by its very nature often time-critical, and may allow action to be taken against individual or collective nodes that may themselves appear physically remote from the IED event, and which may include identifying, implicating and locating suppliers, bomb-makers, emplacers and other nodes within the adversary's IED System.

4.2.9 Info Ops, SoP and SoF. As we have seen in recent years, adversaries have demonstrated their adeptness at exploiting IED events, using global media such as the internet to disseminate key Info Ops messages. Messages of this kind, unconstrained by the need for truthful objectivity, may focus on claims that civilian casualties caused by IEDs intended to target Alliance forces are the responsibility of those forces, or that the incident itself was caused by, for example, a misdirected air strike. They therefore constitute a strategic issue and, as well as seeking to defeat the IED threat by attacking supporting networks, NATO commanders also need to consider the strategic implications of perceptions in those nations contributing to an alliance.

4.2.9.1 Info Ops. At the operational level, the full range of activities that sit within, or are coordinated by, an overarching Info Ops plan can be supported by A&S Power in the interests of *attack the networks* activities. As well as EW, CIMIC and KLE, these activities may include Command and Control (C2) warfare, Psychological Operations (PsyOps), Posture, Presence and Profile (PPP), Public Affairs and Computer Network Operations (CNO). In supporting them, NATO Air Power can provide a degree of speed, range and agility not available from other environments, offering the prospect of pre-empting an adversary's own Info Ops effort and providing a means of delivering effects that are consistent and persistent.

4.2.9.2 SoP and SoF. SoP and SoF activity can serve to degrade an adversary's IED capability by, for example, disrupting IED emplacement (consistent with the **Pursue** C-IED *area of activity*), as well as reassuring friendly forces and, in support of **Prevent,** the civilian population. However, as noted above, without a clear understanding of how these techniques are perceived by their target audiences, particularly local populations, their effects may be neither consistent nor enduring. Again, useful, reliable MoE are often elusive, and it is at least possible that in specific scenarios SoP and SoF may in reality be counter-productive.

4.2.10 Kinetic Effects. Fundamentally, kinetic effects delivered from the air against nodes and linkages within networks supporting the IED System share

A key Air Mobility contribution to counter-network operations is the rapid exploitation of IED incidents.

many of the same characteristics and limitations as those intended to destroy or disrupt emplaced IEDs. Furthermore, the weapon systems used will depend on the type of node being prosecuted as a target, which could include manufacturing or storage facilities, an adversary's LoCs and staging locations, communications nodes, training, leadership, and supporting infrastructure. Given the challenges of identifying IED networks, whether from airborne and Space-based intelligence collection capabilities or from the ground, and accepting the need to ensure that, whatever the nature of the node, its relevance to C-IED has been established, further considerations also apply. Foremost amongst these is the need to understand how kinetic targeting of network nodes is perceived, both by those against whose interests it is directed and in the wider population. While MoE may on the face of it appear less problematical where kinetic effects are concerned, the second-order effects of, for example an air strike on an IED manufacturing facility, will nevertheless need to be considered, with Info Ops coordinating an assessment of the potential costs and benefits of such action.

4.3 A&S Power – Defeat the Device

4.3.1 Experience tends to confirm that while it is possible to significantly degrade an adversary's IED System through attacking the networks that support it, it is unlikely that this alone will remove the IED threat. Accordingly, in pursuit of the **Protect** *area of activity,* it will be necessary to *defeat the device*. In simple terms,

A&S Power is capable of defeating IEDs and IED events by detecting devices and by neutralising and mitigating their effects, as follows:

- *Detecting* devices using dedicated airborne and Space-based ISR and airborne NTISR, exploiting existing capabilities and capitalising on technological enhancements, including those offered by CCD technology;

- *Neutralising* devices and *Mitigating* their effects through:

- Airborne EW capabilities, including Electronic Attack (EA), by employing ECM to disrupt or detonate RCIEDs;

- The initiation or disruption of IEDs using kinetic targeting via airborne (or potentially Space) platform-based weapon systems, including by direct fire;

- The physical avoidance of emplaced IEDs using Air Mobility, utilising Fixed-Wing (FW) and Rotary-Wing (RW) intra-theatre airlift, including the use of Air Despatch[2] capabilities.

4.3.2 Detection of IEDs. In practice, the use of A&S Power to *defeat the device* is predominantly focused on the detection of emplaced IEDs, achieved through the use of ISR capabilities, either individually or in combination ('layered'), both persistent and non-persistent. Employing scarce and expensive A&S assets in this way can appear disproportionately resource-intensive, an impression frequently reinforced by the challenge of producing significant, rapid and measurable results within the dynamic tempo that characterises the contemporary operational environment. Without readily-available MoE, there is a danger of C-IED capability – potentially useful in a variety of applications requiring the flexibility, speed and responsiveness that it offers – being used instead primarily in pre-planned operations. It may even be diverted to non-C-IED tasks which are less critical to overall success, but where MoE result in tangible effects being more obvious. Commanders must therefore plan carefully their employment of A&S C-IED capability, the intended effects, and possible MoE. NATO A&S Power is capable of detecting IEDs in a number of ways, as set out below.

4.3.3 Airborne ISR. The ability of A&S assets to detect emplaced IEDs consistently and reliably has in recent years benefitted from significant technological development. Among many enhancements, Infrared (IR) and electronic imaging represent important steps forward, and other Multi-Sensor ISR (MSI) configurations are capable of bringing together multiple systems, providing the kind of persistent, layered ISR capability that is the key to successful airborne ISR-delivered C-IED, and which represents a primary data provider for many of the intelligence disciplines. Ongoing research in airborne ISR detection technologies includes systems able to sense electromagnetic emissions, those with improved IR capability, Synthetic Aperture Radars (SAR) with enhanced resolution and such capabilities as ground-penetrating radars, potentially mounted on small UASs as well as on manned platforms. Nevertheless, achieving substantive, repeatable results remains a challenge, and there is likely to be pressure on ISR assets for other tasks. Furthermore, the optimisation of airborne ISR remains reliant on both the provision of appropriate E&T to the training audiences identified in Chapter V, and on processes able to exploit the data collected, and described in Chapter VI. Lastly, device detection is requiring sensors to become more and more specialised and highly sensitive. The number of sensors needed to detect all of the various types of IEDs is expanding and is expected to continue to do so. As such, it is important to seek a 'plug and play' capability so that multiple types of sensors can be utilised and exchanged on a single airborne platform. UAS-type platforms, which minimise risk to human life, may be preferable through their longer endurance and ability to avoid detection when airborne. Plug and play capability also minimises the use of ramp space and the number of personnel required to operate a completely separate platform. When nations are seeking to procure new sensors for C-IED (or other) missions, it is, therefore, desirable that such sensors are capable of operating on UAS types already used by that nation. Likewise, if a nation

is procuring a new UAS, the platform should be able to operate multiple sensor types, themselves capable of being exchanged depending on the mission.

4.3.4 Space-Based ISR. There is a view that the simpler the IED, the less useful is Space-based ISR in detecting it. While this may be the case, for example, in respect of small VOIEDs constructed from basic materials, larger or more complex devices *are* susceptible to detection using existing CCD technologies. In fact, one of the most significant factors limiting the use of Space-based ISR in defeating emplaced IEDs lies in the finite number of satellite passes available in any given period. Apart from its own ISR contribution, the utility of Space capability in the counter-device role may instead fundamentally lie in providing, or at least facilitating, the more rapid passage of warnings from Space-based, airborne or ground-based ISR capabilities to personnel in the vicinity of a threat, including potential emplaced IEDs, as well as to other agencies. In short, while Space-based ISR capability needs to be deployed in a way that capitalises on its strengths, including in CCD, this should not detract from its key role in enabling rapid and reliable communications. As with airborne ISR, relevant *prepare the force* provisions and robust, agile, well understood processes are needed if the maximum C-IED benefit is to be gained from this and other Space-based capabilities.

4.3.5 NTISR. The difficulty in justifying the use of A&S capability in C-IED operations, particularly where MoE are elusive and when there are multiple demands on inevitably finite resources, is exemplified, for example, by the use of fast jet hours to overfly LoCs and other key terrain, potentially expending NTISR effort with apparently limited results. If success is defined in terms of the number of emplaced IEDs positively identified, this view has some justification. However, if success is instead gauged on the basis of, for example, the deterrent effect on emplacers,[3] or on their having to resort to hasty emplacement of IEDs that in turn increases the likelihood of their detection and identification – including by NTISR assets, such monitoring of LoCs may appear more productive. This again underlines the importance of MoE. Notwithstanding desirable second-order effects such as these, the ability of NTISR capability to detect emplaced IEDs has itself improved recently. Sensitive Electro-Optical (EO) sensors, together with digital imagery and real-time data links, assist in the delivery of IMINT products and, with better IR fidelity, are capable of detecting recent digging for

The ability of A&S assets to detect emplaced IEDs has in recent years benefitted from significant technological development.

Space-based systems make a unique contribution to the C-IED fight, both in detection and in enabling rapid, reliable and robust communications.

extended periods of time. However, unless cued with other ISR or EW assets, the likelihood of detecting IEDs using NTISR capability remains comparatively limited. That said, assuming that the primary purpose of fast jet sorties is not adversely affected, and given the availability of the necessary sensors and data links, a C-IED contribution can result using flying hours that otherwise would have been expended in less productive activities, such as maintaining an orbit in anticipation of tasking.

4.3.6 Three Key Considerations. The importance of airborne and Space-based ISR in the detection of emplaced devices is clearly apparent, as is the need for readily-applied MoE in better understanding the totality of its overall contribution. However, three further factors influence the success of A&S capability in detecting IEDs, and should be kept in mind when considering its operational employment. These are: *Timeliness; Persistence;* and *Training*.

4.3.6.1 Timeliness. The limitations on A&S capability in its ability to successfully detect emplaced IEDs are partly a consequence of the time elapsing between a potential IED being detected and appropriate action being taken to follow it up, whether to neutralise or mitigate the threat, or to exploit the find. The possibility exists that there will be sufficient time for the emplacer to remove and relocate the device detected, effectively eradicating all potential advantages – both practically and in terms of *prepare the force* E&T benefit – of its original detection. The processes through which airborne or Space-based ISR detects a potential IED, and through which that find is investigated, therefore need to be as swift as possible, with those personnel required to use these processes having a clear understanding of their contribution to overall success.

4.3.6.2 Persistence. The ability of ISR to detect the emplaced device (as well as the wide variety of nodes within networks) is usually improved when persistent ISR can be brought to bear. By employing persistent ISR, IED hot-spots, cleared areas, LoCs and so on can be held over time, allowing ground units to pass over them without the risk of that area having been re-seeded with IEDs; it is worth bearing in mind that it may take as little as 30 minutes or less to plant an IED.

Persistence can serve the interests of convoy moves as well as dismounted patrols and other activities aimed at engagement with local communities and, although the tactical-level 'ownership' of key assets – including small UASs – may appear to serve the interests of persistent surveillance, its fullest exploitation could in fact be more reliant on better integration and ISR data-sharing than on who actually 'owns' the platform.

4.3.6.3 Training. The role of A&S capability to *defeat the device* highlights the importance of relevant E&T as a key supporting measure of the *prepare the force* pillar. The fullest exploitation of ISR assets to detect emplaced IEDs requires that all those with a stake in the process, whether planners, attack aircraft aircrew, imagery analysts, information managers, communications specialists or others, are given the E&T relevant to their specific role and the contribution that it makes to the overall effort. Given the inherently Joint nature of C-IED operations, E&T also needs to impart an understanding of the contribution made by the other components to the overall success of the NTISR provided, also emphasising inter-agency and multinational integration and mutual understanding of the NATO C-IED approach. This is discussed further in Chapter V.

4.3.7 Neutralising and Mitigating the Effects of IEDs. As well as the use of ISR to detect emplaced devices, A&S Power offers a number of other capabilities that can be employed in a C-IED role, specifically to neutralise and mitigate their effects, whether or not detected using A&S assets. These are considered in the following paragraphs. One of these capabilities – Air Mobility – can also be used to exploit IED events.

4.3.7.1 EW. With the ability of ECM to mitigate and neutralise the effects of IEDs being largely provided via land-based systems, the main focus for A&S Power is in the area of EW. Airborne EW has the potential to affect both IEDs and the communications on which an adversary may rely, consequently disrupting his ability to execute attacks at a time and place of his choosing. Within EW, Electronic Attack (EA) also represents an important aspect of overall capability. In addition to an alliance's ability to deploy and maintain the technology necessary to prosecute electronic counter-device operations, the success of EW is reliant on a number of factors, foremost amongst which is, once again, E&T. For example, specialist EWOs require regular refresher training if their knowledge is to remain current in an area where even short absences from a theatre of operations can result in their relying on earlier, often out-dated, knowledge and experience. The same is true of Forward Air Controllers (FAC) and Joint Terminal Attack Controllers (JTAC), whose skills require them to maintain EA skills in addition to those required to deliver precision kinetic effects onto a target, and of commanders, whose individual and collective E&T needs to equip them to 'ask the right question' when seeking airborne C-IED EW support for particular purposes.

4.3.7.2 Kinetic Effects. The use of kinetic effects to support C-IED efforts offers the prospect of defeating the emplaced device by initiating an IED's main charge, or disrupting the ability of an adversary to detonate it himself, using A&S capabilities, including by kinetic engagement. This effect could be delivered via precision fires using weapon systems as diverse as fast-jet mounted conventional munitions and specialist small arms deployed on RW platforms. Research undertaken in late 2009[4] considered a number of 'effectors' currently capable of delivering an effect on emplaced IEDs once detected and, in addition to the use of conventional ammunition, raised the possibility that fluorescent dye marking of IEDs, airborne heat sources and high-pressure water guns may have near-term contributions to make in the kinetic targeting of IEDs from the air. The potential of Directed Energy Weapons (DEW) is also being considered, with lasers tested successfully against a variety of IED types demonstrating their potential.[5]

4.3.7.3 Air Mobility. Air Mobility has a unique role to play in circumventing and, therefore, avoiding altogether the physical threat posed by IEDs. By making maximum use of intra-theatre airlift, the requirement to move personnel, equipment and stores by road is reduced, and NATO forces are able to make full use of a capability that is unlikely to be available to an adversary. Using RW and FW capability, an alliance can thus,

When operationally appropriate, the use of Air Mobility allows an IED threat to be circumvented.

on the face of it, effectively neutralise the IED threat and, where surface movement is necessary, Air Mobility assets can serve to re-establish, via Overwatch and downlinks, a degree of the Situational Awareness (SA) lost when personnel are required to operate from within heavily armoured protected mobility and protected patrol vehicles.

4.3.7.4 Air Mobility can also enable the rapid movement of C-IED specialist teams and exploitable IED materiel. Serving both counter-device and counter network purposes, this is considered in more detail at Paragraph 4.2.8 above. In seeking to make the most of what is in effect an asymmetric advantage, capabilities such as Air Despatch can also be considered, with recent developments in GPS-guided Precision Air Drop (PAD) complementing unguided drops and allowing the delivery of stores, including food, water, ammunition and construction materials, into small forward operating bases and patrol bases. Current capability within NATO also includes Tilt-Rotor Air Mobility, and this offers the potential of significant benefit in its ability to avoid the IED threat while combining many of the practical advantages of intra-theatre RW and FW capabilities. However, the clear benefits of maximum recourse to Air Mobility must be set against a number of potential disadvantages which, though to an extent scenario-specific, should nevertheless be considered. These are as follows:

Air Mobility can re-establish a degree of Situational Awareness when the IED threat necessitates that personnel operate from armoured vehicles.

A&S Capabilities	C-IED Areas of Activity				
	Understand	Pursue	Prevent	Protect	Prepare
Fixed-Wing (FW)	■	■	■	■	■
Rotary-Wing (RW)		■	■	■	■
Air Mobility		■	■	■	■
Space-based Intelligence, Surveillance & Reconnaissance (ISR)	■			■	
Airborne ISR	■			■	
Non-kinetic Effects/ Influence Activity (IA)		■	■	■	
Electronic Warfare (EW)		■		■	
Kinetic Effects		■		■	
Unmanned Aerial System (UAS)	■	■		■	

Key: A&S Contribution ■

Figure 2 – A&S Contributing to C-IED – Areas of Activity.

- In a COIN scenario, the use of Air Mobility may further reduce the ability of alliance forces to engage with and reassure the local population, and in this respect may to an extent be self-defeating;

- Greater reliance on RW and FW assets for intra-theatre movement could result in an adversary evolving his TTPs, targeting Helicopter Landing Sites (HLS) and Tactical Landing Zones (TLZ) with IEDs, as well as with other weapon systems including small arms, rocket propelled grenades and IDF;

- Intra-theatre Air Mobility assets are usually limited in number and subject to multiple, sometimes conflicting, tasking;

- Practical constraints on the use of Air Mobility are likely to include a limited number of suitable aircraft, physical constraints on ramp space, specialist training requirements (for example to conduct Air Despatch), and the need to regularly re-role aircraft.

4.4 A&S Power Contribution to C-IED – Summary

In summarising the role of NATO A&S Power in C-IED, the *areas of activity* described in Chapter III provide a framework within which to highlight the predominant contribution made by each of the broad A&S capabilities referred to in this Primer. The shaded areas in the table at Figure 2 therefore indicate overall A&S Power utility in respect of each of the *areas of activity* specified.

1. NTISR is also referred to as Armed Overwatch.
2. Also referred to as Aerial Delivery.
3. Although strictly-speaking a counter-network effect, this underlines the limitations of C-IED definitions when set against real-world factors, and though difficult to assess in terms of MoE, there is little doubt that it makes a contribution to C-IED effort.
4. NATO Industrial Advisory Group (NIAG) SG128 Study on Airborne C-IED, NIAG-D (2009)0018 dated 10 September 2009.
5. Trials of Boeing Laser Avenger system reported by UPI in December 2009.

CHAPTER V

Prepare the Force – Education and Training (E&T) Considerations

5.1 General

The roles of A&S Power in pursuing the first two of the three pillars of NATO's approach to C-IED *(attack the networks* and *defeat the device)* are considered in Chapter IV of this Primer. The third, *prepare the force*, both pervades every aspect of the A&S contribution to C-IED and is crucial to the individual success of each of the capabilities identified so far, and so warrants separate consideration in this Chapter. In overall terms, *prepare the force* involves all the activities required prior to conducting operations where an IED threat exists, and includes reconnaissance, planning, liaison, administration and E&T. It is important to note that the 'force' to be prepared includes the HN, NGOs, Other Governmental Departments (OGD), contractors and non-deployed force elements, and not only members of Alliance armed forces. In preparing the force, such factors as the development of new technologies and capabilities as covered in Chapter VI, and the evolution of doctrine to provide guiding principles and to codify best practice, are all relevant. So too are the reorganisation of headquarters and force structures to reflect, for example, advances in specific remote sensing capabilities. However, preparation of the force is ultimately dependent on the provision of both **education** to develop mental power and understanding, and on **training** to prepare individuals and groups for specific tasks in given circumstances. The importance of coherent, consistent, comprehensive and, crucially, targeted C-IED E&T has been highlighted throughout this Primer and, in A&S Power terms, involves a wide variety of roles, from aircrew, JTAC, FAC and EWO to imagery analyst, information manager, communications specialist and senior leadership. In essence, all those individuals who contribute individually to the delivery of an effect need to understand both the overall process to which they are contributing, and be capable of fulfilling their own role within

It is essential that land commanders know what A&S C-IED capabilities are available to them.

that process. At the same time, those who are seeking to exploit C-IED capability need to understand what assets may be available to them and how to access and use them optimally. It is clear from this that a number of different target audiences for E&T can be identified and which allow training effort to be properly directed. Three key categories for C-IED E&T, considered further in the following paragraphs, are:

5.1.1 E&T to enable land commanders at all levels to fully exploit the A&S Power C-IED capabilities available to them;

5.1.2 E&T for individuals whose roles are primarily C-IED-related or include aspects of C-IED or C-IED support;

5.1.3 E&T for those individuals needing a generic awareness of C-IED principles and practice.

5.2 Land Commanders

To a great extent, the success of the C-IED contribution made by A&S Power depends on those seeking support having as clear an understanding as possible of the capabilities at their disposal. They therefore need to know what assets are available, how and when to access them, and the real-world limitations of their use – including in terms of speed of response and conflicting requests for tasking. Leaders must thus be able to lead, command and incorporate into military planning the capabilities available to them. Accordingly, when seeking ISR capability, commanders

Host Nation E&T constitutes a key element in the C-IED effort.

at all levels need to have an understanding of what is available to them and what actionable intelligence is likely to result. In this respect, it is vital that their training allows them to consider the effect that they are seeking to achieve rather than identifying the most obvious means of achieving it. For example, while the use of a dedicated unmanned air platform may suggest itself as the best means of providing persistent Overwatch along a specified LoC, the sensing capability of the UAS may not be optimised for the type – or types – of IED most likely to be encountered. More relevant and comprehensive, albeit less persistent, sensing capability may be available from another platform or a range of platforms. Similarly, whereas a fast jet may be less able than a dedicated ISR platform to identify emplaced IEDs, the latter is less likely to be in a position to disrupt or seek to destroy such a device, once identified, than would a fast jet conducting Armed Overwatch. Such considerations need to be borne in mind by land commanders at all levels, which in turn requires relevant E&T.

5.3 C-IED Support Personnel

A large number of personnel undertake specialist roles that directly support the A&S contribution to C-IED operations, and that require those individuals filling them to possess the training, currency and competence necessary to exploit the available resources. These roles include specific C-IED-related posts, for example in deployed headquarters, as well as those that support, but are not exclusively focused

on, C-IED. Among the latter are RW and fast jet aircrew who may contribute to airborne NTISR capability, EW operators and analysts, IMINT analysts, FACs and JTACs. Worth noting in particular is the overall benefit to be gained from the appropriate E&T of specialist personnel increasingly filling C-IED-related roles within land formations. The primary purpose of these personnel is to support land formations by providing commanders with advice on the intelligence and other products potentially available to them. In particular, they should be able to understand: the C-IED support requirements from the point of view of the land commander; the means through which these requirements are incorporated into the planning process within the land formation; how this is effected in Joint planning terms; and the degree of urgency. As with all such digital appointments within formed units, the successful delivery of specialist C-IED support will depend to a considerable extent on the credibility and trust they manage to achieve; this will often be based on practical and socio-cultural considerations such as their integration into the pre-deployment collective mission rehearsal training process, itself a crucial element of *prepare the force*.

5.4 Generic C-IED E&T Requirements

Consideration of the full range of generic C-IED E&T requirements is beyond the scope of a Primer whose purpose is directed at the A&S Power contribution, albeit within the overall context of the Joint C-IED effort. Nevertheless, many of the Joint generic C-IED E&T requirements apply equally in the A&S domain. Foremost amongst these are to ensure that current NATO C-IED policy and procedures are reflected in the E&T delivered to personnel both at the national level and within an alliance, and that the E&T provided by those Nations supporting an alliance conforms to a common standard. E&T should both be reviewed and refreshed regularly, reflecting the dynamic, constantly evolving nature of the IED threat and, correspondingly, the C-IED effort to defeat it. These regular reviews should be informed by intelligence on an adversary's TTPs, itself coordinated from a wide range of national and multinational sources, with the resultant E&T being multidisciplinary, broad-based, encompassing individual and organisation-specific education, training and exercises, and embracing the various disciplines that will be required to interact during operations.

5.5 Host Nation C-IED E&T Requirements

The E&T audiences so far identified comprise personnel supporting or seeking to utilise C-IED capability from within NATO Alliance partners. A fourth training audience usually represented in contemporary operations and which falls firmly within an overall E&T strategy is that represented by the HN. Not only do HN forces, and the civilian population, often confront the IED threat to the same extent as Alliance forces but, as we have seen in Chapter I, in an insurgency often bear the brunt of IED use. As well as the immediate benefits of providing C-IED E&T to HN forces – not least in reducing casualties and providing local populations with an Info Ops message that supports overall campaign aims, such an approach may also serve longer-term COIN and security aims, and thereby underpin enduring stability and engender local trust in legitimate governance. In building a robust, indigenous C-IED capability within the HN's forces, an alliance will thus vicariously address, through *attack the networks* and *defeat the device*, the IED System itself. Furthermore, the delivery of C-IED E&T to the HN will facilitate the reassignment of NATO forces in order to spread campaign and government authority to new areas, and will ultimately contribute to transition and eventual withdrawal.

CHAPTER VI

Technological Developments and Future Prospects

6.1 General

Considerable effort and resources have been devoted in recent years in attempting to identify potential technological developments that may assist in the defeat of emplaced IEDs and the networks that produce them and support their use, and therefore the IED System itself. It has, however, become increasingly clear that technological solutions in isolation are unlikely to provide the definitive defeat of an adversary determined to continue to employ IEDs, either as the primary means of pursuing his aims or in conjunction with other weapon systems and TTPs. Rather, it is by gaining an understanding of the potential exploitation of existing sensing, disrupting and destructive capabilities and their supporting systems, individually and together, that technology currently stands to make the fullest contribution. Accordingly, the importance of matching the available A&S technology to the specific requirements of a task or operation should not be underestimated. While no single system or combination of sensors and platforms can provide optimal C-IED utility in all circumstances, they collectively contribute to a fused intelligence picture that provides sufficient confidence for commanders to base their decisions on it.

6.1.1 Balancing Current and Future Technologies. A more holistic approach of this kind has now been adopted by agencies, many having previously focused effort on a diverse variety of mainly technological solutions to the IED threat. Such an approach nevertheless includes pursuing innovative technologies, as well as seeking to better utilise those already fielded, and the following paragraphs consider the scope, opportunities and limitations of sensing and other technologies from the A&S perspective, identifying a number of emerging technological trends which currently show promise.

The importance of matching the available A&S technology to the specific C-IED task should not be underestimated.

6.2 Technology and Attack the Networks Capability

As described in Chapter IV, the networks that contribute to the IED System can be envisioned as containing three recurring phases: *resource and plan*; *execute*; and *exploit*. From the perspective of innovative technological solutions, the *resource/plan* and *exploit* phases fall broadly within the capabilities of proven airborne and Space-based ISR capabilities. For example, existing ISR sensors are in principle able to locate, identify and track personnel, installations, facilities and other nodes within an adversary's networks, and although these nodes may serve both the networks and broader activity associated with an adversary's pursuit of his goals, the use of detailed analysis capability and the fusing of multiple sources of intelligence can achieve specific C-IED effects. Similarly, existing airborne EW capabilities stand to be effective against the sort of activities taking place within each of these phases, including the final assembly of IEDs, their movement and emplacement, and their monitoring by an adversary in advance of their use. It is therefore probable that technological innovations in A&S C-IED capability will support efforts to detect and defeat IEDs in the execute phase, with *attack the networks* activities benefitting from the enhancements, in terms of cueing of capabilities and fusing of intelligence, gained from the better use of existing A&S capabilities.

6.3 Technological Developments to Defeat the Device

As we have seen, the principle activities capable of being conducted by A&S assets in seeking to *defeat the device* are those associated with detecting emplaced devices and with neutralising them or mitigating their effects.

6.3.1 Detection – the Silver Bullet. In terms of detection, the allure of a 'silver bullet', a single technological innovation that offers the potential to allow the reliable, repeatable detection of emplaced IEDs, to an extent continues to influence efforts in this area. To date, the variety of IED types, their design, the nature of their main charge, their means of initiation and mode of deployment, together with the ability of those using them to constantly vary their TTPs, all serve to reinforce the perception that no such silver bullet exists, and that even if it did emerge and prove successful, an adversary would simply turn to alternative means of pursuing his desired goals and end state. Given that no single technology is yet capable of detecting all possible types of IED or their employment, developments in such areas as laser-induced breakdown spectroscopy, hyper-spectral imaging and bio-molecular sensing capabilities all demonstrate potential, though again caution needs to be exercised when technological demonstrators embark on the process of real-world operationalisation and field trialling. This is also true of increasingly sophisticated CCD software algorithms and ground penetrating and scintillating radars, all of which offer the prospect of being mounted on airborne platforms, and of significantly enhancing NATO's ability to detect emplaced IEDs.

6.3.2 Disruption and Destruction. The ability of airborne platforms to disrupt and destroy emplaced IEDs remotely stands to benefit from a number of technological innovations derived from existing applications. These include the combination on single platforms of multiple sensors able to detect IEDs and the means of attacking them. Engaging IEDs using conventional kinetic means can be effective in this context, and work is in hand to establish the potential utility of high power radio frequency transmissions, high power microwave technology and DEW; the latter have been trialled successfully against a variety of IED types and in a wide range of conditions designed to replicate the operating environment, and it is probable that such a system could be mounted on airborne platforms. Where the requirement to exploit detected IEDs is paramount, the use of innovative approaches such as water guns and fluorescent dye marking may prove fruitful. With many of these approaches, a particular challenge is presented by the need for an effective, lightweight, durable high output electrical system to supply sufficient power to sustain multiple sensors and other systems, particularly when UAS-mounted.

CHAPTER VII

Points for Consideration

7.1 General

Throughout this Primer, issues, factors and considerations have been identified as influencing the contribution made by A&S capabilities in C-IED operations. Those considered to warrant highlighting are reiterated in this Chapter in order to provide cross-referencing that may be useful to those currently involved in C-IED activity. They may also facilitate the practical production of checklists to establish, for example, that:

- Reliable MoE are in place, which are able to assess how IA, such as SoF and SoP, affects the target audience (Paragraph 3.2.3);

- ISR assets are included early in the C-IED mission planning process (Paragraph 3.2.5.1);

- Control of A&S assets is pushed to the lowest possible level to enhance early coordination and planning processes, and to ensure ground commanders that they will get the A&S assets they need for their C-IED missions (Paragraph 3.2.5.2);

- Swift, reliable feedback loops are in place to inform A&S personnel (aircrew, analysts and so on) about the accuracy of their products, such as feedback on reports of potential IED locations reported by aircrew or viewed in imagery by analysts (Paragraph 3.2.5.3).

7.2 Key Points

The following key points include those issues, factors and considerations that may be of relevance to readers:

7.2.1 C-IED is fundamentally a Joint activity, with A&S Power contributing to the overall effort and intended effect (Paragraph 3.1.1);

7.2.2 In a COIN scenario, the A&S contribution to C-IED represents one aspect of its broader role, and decisions on apportionment should be made on the basis of both the intended impact on the broader COIN campaign and the potential effect on C-IED operations (Paragraph 3.2.3);

7.2.3 Those personnel responsible for the allocation of particular A&S assets, including ISR, should be included as early as possible in the process of planning Joint C-IED operations (Paragraph 3.2.5.1);

7.2.4 The allocation of A&S C-IED capabilities to the lowest level of command for a finite period may provide commanders with the greatest degree of control over those capabilities and the ability to maximise their utility (Paragraph 3.2.5.2);

7.2.5 Exploitation of A&S Power in a C-IED role relies on the processes, organisational structures and networks that support it for planning, coordinating, executing, analysing, assessing and disseminating the required effects (Paragraph 3.2.5), with robust, swift feedback loops being a key feature (Paragraph 3.2.5.3);

7.2.6 Processes supporting the A&S contribution to C-IED should be as free as possible from avoidable constraints and must be fully utilised (Paragraph 3.2.5.4);

7.2.7 A&S C-IED capability tends to support efforts to detect and defeat IEDs in the *execute* phase of the generic IED network, with counter-network activities benefitting from the enhancements, in terms of cueing of capabilities and fusing of intelligence, gained from the better use of existing A&S capabilities (Paragraph 6.2).

7.3 Attack the Networks

7.3.1 Key attributes of airborne ISR and NTISR platforms and sensors in *attack the networks* operations are agility, speed, reach and persistence (Paragraph 4.2.5).

7.3.2 While the utility of airborne NTISR in *attack the networks* activities is more limited than that of specialist ISR capabilities, the combination of E&T and

experience can deliver successful change detection capability (Paragraph 4.2.5).

7.3.3 Space-based sensing capabilities can successfully identify network nodes through a variety of indicators: sufficient numbers of well-trained analysts and useful MoE are nevertheless necessary if the data collected is to be fully utilised (Paragraph 4.2.5).

7.3.4 Considerable effort may be required in order to ensure that access to Space-derived *attack the networks* products is available to those that require them, including through the provision of relevant E&T (Paragraph 4.2.5).

7.3.5 Airborne EW capability, used in conjunction with other capabilities and coordinated within a comprehensive Info Ops plan, can make a significant contribution to *attack the networks* (Paragraph 4.2.7).

7.3.6 Air Mobility allows the rapid movement of those capabilities and personnel required for *attack the networks* operations, in order that action can be taken against individual or collective nodes that may themselves appear physically remote from the emplaced IED, but which contribute to the overall effort against the IED System (Paragraph 4.2.8).

7.3.7 A&S Power can provide a degree of speed, range and agility not available from other environments, offering the prospect of pre-empting an adversary's Info Ops effort and providing a means of delivering Info Ops effects that are consistent and persistent (Paragraph 4.2.9.1).

7.3.8 SoF and SoP have a contribution to make to *attack the networks*, and their success will partly depend on developing MoE on the perceptions of their various target audiences (Paragraph 4.2.9.2); the same will apply in local perceptions of the kinetic targeting of network nodes (Paragraph 4.2.10).

7.4 Defeat the Device

7.4.1 Enhancements in sensors and their combination in MSI configurations, allied to layering of ISR capability, are crucial to successful airborne ISR-delivered C-IED (Paragraph 4.3.3).

7.4.2 The provision of a 'plug and play' approach, allowing multiple sensors capable of detecting different IED types to be utilised and exchanged on single airborne platforms, will contribute to successful detection, including from UASs (Paragraph 4.3.3).

7.4.3 In addition to their own ISR contribution, Space platforms may also support C-IED operations by facilitating the rapid passage of warnings from Space-based, airborne or ground-based ISR capabilities to personnel on the ground (Paragraph 4.3.4).

7.4.4 Relevant *prepare the force* provisions and robust, agile, well understood processes are needed if the maximum benefit is to be gained from Space-based C-IED capabilities (Paragraph 4.3.4).

7.4.5 NTISR contributes to *defeat the device* operations both in its ability (supported by effective cueing) to detect emplaced IEDs and by delivering a deterrent or disruptive effect (Paragraph 4.3.5).

7.4.6 *Timeliness, Persistence* and *Training* are key factors influencing the success of airborne and Space-based ISR in the detection of emplaced IEDs (Paragraph 4.3.6).

7.4.7 Air Mobility can serve to neutralise the threat from emplaced IEDs, can re-establish a degree of SA for ground forces (Paragraph 4.3.7.3), and can provide a key capability in its ability to support C-IED exploitation operations (Paragraph 4.3.7.4).

7.5 Prepare the Force – Education and Training (E&T)

7.5.1 The success of the C-IED contribution made by A&S Power depends on those seeking A&S capabilities having as clear an understanding as possible of those capabilities at their disposal, including what assets are available, how and when to access them, and the limitations of their use (Paragraph 5.2).

7.5.2 It is essential that personnel undertaking specialist roles that directly support the A&S contribution to C-IED operations possess the training, currency and competence necessary to exploit the available resources (Paragraph 5.3).

7.5.3 Existing NATO C-IED policy and procedures must be reflected in the E&T provided to personnel within *prepare the force* both at the national level and within an alliance, and the E&T provided by those nations supporting an alliance should conform to a common standard and be reviewed and refreshed regularly (Paragraph 5.4).

7.5.4 The delivery of C-IED E&T to HN forces serves to reduce casualties and can contribute to longer-term campaign aims (Paragraph 5.5).

7.6 Technological Developments

7.6.1 Technological solutions in isolation are unlikely to provide the definitive defeat of an IED System (Paragraph 6.1).

7.6.2 While no single system or combination of sensors and platforms can provide optimal C-IED utility in all circumstances, they contribute to a fused intelligence picture on which commanders can base informed decisions (Paragraph 6.1).

7.6.3 The variety of IED types, together with the ability of those using them to constantly vary their TTPs, suggests that no single technological innovation, or 'silver bullet', is likely to offer the reliable, repeatable detection of emplaced IEDs (Paragraph 6.3.1).

ANNEX A

Acronyms

ANSF	Afghan National Security Forces
ARM	Afghanistan Rights Monitor
A&S	Air and Space
ATO	Air Tasking Order
C2	Command and Control
CA	Comprehensive Approach
CCD	Coherent Change Detection
C-IED	Counter-Improvised Explosive Device
CIMIC	Civil-Military Cooperation
COA	Course of Action
CoE	(NATO-accredited) Centre of Excellence
COIN	Counter-Insurgency
CNO	Computer Network Operations
CP	Contact Point
CWIED	Command Wire Improvised Explosive Device
DEW	Directed Energy Weapons
EA	Electronic Attack
ECM	Electronic Countermeasures
EO	Electro-Optical
E&T	Education and Training
EU	European Union
EW	Electronic Warfare
EWO	Electronic Warfare Officer
FAC	Forward Air Controller
FoM	Freedom of Movement
FW	Fixed-Wing
HLS	Helicopter Landing Site
HME	Home-Made Explosive(s)
HN	Host Nation
HUMINT	Human Intelligence
IA	Influence Activity
IDF	Indirect Fire
IED	Improvised Explosive Device
IMINT	Imagery Intelligence
Info Ops	Information Operations
IO	International Organisation(s)
IR	Infrared
ISAF	International Security and Assistance Force
ISR	Intelligence, Surveillance and Reconnaissance
JAPCC	Joint Air Power Competence Centre
JOA	Joint Operations Area
JIEDDO	(US) Joint Improvised Explosive Device Defeat Organisation

JTAC	Joint Terminal Attack Controller
KLE	Key Leader Engagement
LoC	Line(s) of Communication
MoE	Measure(s) of Effectiveness
MSI	Multi-Sensor ISR
NGO	Non-Governmental Organisation(s)
NTISR	Non-Traditional ISR
OGD	Other Governmental Departments
PAD	Precision Air Drop
PPP	Posture, Presence and Profile
PsyOps	Psychological Operations
RCIED	Radio-Controlled Improvised Explosive Device
RW	Rotary-Wing
SA	Situational Awareness
SAR	Synthetic Aperture Radar
SIGINT	Signals Intelligence
SME	Subject Matter Expert(ise)
SOF	Special Operations Forces
SoF	Show(s) of Force
SoP	Show(s) of Presence
STRATCOM	Strategic Communications
TF	Task Force
TLZ	Tactical Landing Zone
TTP	Tactics, Techniques and Procedures
UAS	Unmanned Aerial System
VOIED	Victim-Operated Improvised Explosive Device

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