

12th ICCRTS

Adapting C2 to the 21st Century

IMPROVING C4ISR BETWEEN UK AND US FUTURE LAND FORCES (PAPER I-048)

Topics	1 Concepts, theory and policy 2 Modelling and simulation 3 Network centric experimentation and application.
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ABSTRACT

Improving interoperability between US and UK Land Systems has been identified as a high priority requirement. In Dec 04, the UK and US signed the Land Battlespace Memorandum of Understanding (LBS MoU). Under this, the US/UK Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance Interoperability Project Arrangement (US/UK C4ISR Interoperability PA) seeks to deliver significant improvements in C4ISR capability through a two-phase programme of work, to be completed by 2014.

Phase 1 is a two-year systematic review of US/UK C4ISR planned interoperability capability on the basis of current programmes, and to assess options for improvement that will be required within the 2015 timeframe.

Phase 2 will involve the completion of a US/UK programme that plans to deliver improved interoperability capability across all UK (and US equivalent) defence lines of development.

Phase 1 is underway and progressing by means of a combination of concepts and doctrine development informed by experimentation.

This paper will explain the rationale behind the PA and the results of the work undertaken so far. It will also discuss some of the issues encountered under a bilateral programme of work which is Network Enabled (in UK terms)/ Network Centric (in US terms) rather than hardware centric, which is the basis of more conventional activities.

Introduction

History

In the past there has been ad hoc cooperation between the UK and the US on army equipment programmes, notably Apache and the defunct TRACER Programme.

Several years ago, it became clear that co-operation in the land environment required a more structured approach and this led to the Land Battlespace MoU, which was signed on 15 December 2004 by Brig Moore (Director Equipment Capability Ground Manoeuvre (DEC GM) in the UK and Brig Gen Cartwright (Program Manager Future Combat System (FCS)) in the US.

The MoU has a wide scope and has several PAs at different stages of maturity. However the most pressing need was to look at and plan for interoperability in the C4ISR arena, and this is the PA that is most mature in terms of bilateral working and progress.

Project Arrangement

Following the signature of the overarching MoU, the first priority was to address C4ISR interoperability issues. The aim of the C4ISAR PA “is to enable C4ISR interoperability and integration between U.S. future force and UK land battlespace within a Combined and Joint force environment to support integrated coalition operations in the Network-Centric/Network Enabled paradigm of 2014 and beyond”. However, in the early stages of the discussions, it was clear that there was a major disconnect between the UK and the US in terms of project timescales. Whereas the US activity was part of a major programme of record, in the UK there are a number of programmes that make up the future land programme which are coordinated but do not make up a single entity.

In order to address this, the PA was split into two phases, not least to provide a baseline for future UK programme activity:

Phase 1 is a two-year, systematic review of US/UK C4ISR planned interoperability capability on the basis of current programmes, to assess options for improvement that will be required within the 2015 timeframe.

Phase 2 will involve the completion of a US/UK programme that plans to deliver improved interoperability capability across all UK (and US equivalent) lines of development.

This was essentially a pragmatic choice driven by the UK’s need in formal staffing terms to establish an activity to interface with the US FCS programme office.

The current programme, which is still in phase 1, seeks to explore potential solutions. In doing so, we have had to reconcile US processes and aspirations, which tend to be more experimentation-driven than the UK processes which are concepts and doctrine-driven.

Inter-organisational reconciliation and background

The US Army FCS is a Network Centric Warfare (NCW) programme. The FCS overview has the network at the centre, and at the centre of this there is the critical element of integrating middleware called the System of Systems Common Operating Environment (SOSCOE). There is no UK equivalent from a programme-centric point of view but, in the PA, we have been effectively creating this. The FCS programme naturally assumed that the FRES programme was its UK counterpart, which is arguably a more vehicle-centric programme more equal in scope, if not size, to the manned vehicle element of the FCS programme.

In the UK, Network Enabled Capability (NEC) is a strategic aspiration but it is not a formally funded programme in its own right. As it is effectively an NEC programme, the PA interfaces with a large number of UK and US systems. However, it is not just an equipment programme, as it calls heavily on other lines of development (a UK term - DOTLMPF (Doctrine, Organizations, Training, Leader Development, Materiel, Personnel and Facilities) in US terms). This is a somewhat different approach to the UK's involvement in Joint Strike Fighter (JSF), where participation in the programme from the start has been forcing a number of issues in a more traditional acquisition sense.

UK/US interoperability is managed by the interoperability commission. As well as reporting into the 1 star MOU Steering Committee, the PA reports to the 2 star interoperability commission working group. This provides high-level governance but again this is not part of a programme in the sense of having a set of requirements or dedicated funding.

As the customer, Director Equipment Capability, Command, Control and Information Infrastructure (DEC CCII) takes the lead on coordinating issues across the sponsor organisation. The Integration Authority (IA) is charged with "improving the clarity and delivery of NEC" but it is not a NEC programme office. In practice, this means architectures (what should I build?), assurance (am I building it right?), and assistance (help!). The IA runs the PA on behalf of DEC CCII.

Although the UK is going through major changes in its acquisition organisation and process, it is worth pointing out that there are currently around 160 separate Integrated Project Teams (IPTs) procuring equipment but only a relatively light structure for inter-IPT coordination. This is in the process of changing through a number of initiatives but a key tenet of the Smart Acquisition initiative was an empowered, output-focused IPT leader. This did, however, assume that project boundaries were well-defined and contiguous with related projects. This has not always been the case and so there has been some organisational tension between incentivised IPTs and those parts of the organisation concerned with overall programme coherence.

In practice, this has meant that the PA has had a clear governance structure within the scope of the MOU but that, outside the MOU, there are a large number of interfaces to organisations whose objectives are not necessarily

mutually aligned. Unless MoD UK wishes to move to a completely top-down defence architecture (which is not the case), the PA shows the organisational challenges that any “programme” contributing to NEC will encounter.

Conceptual and doctrinal provenance for the UK/US C4ISR PA

It has been important to ensure that the conceptual and doctrinal provenance underpinning the US/UK C4ISR work is coherent and endorsed by both sides. To that end, a mutual High-level Vision Paper and Concept Document have been developed. The paragraphs that follow are drawn from these two documents.

Future Operating Environment

The UK Centre for Doctrine and Concept Development’s summary of the military dimension of Strategic Trends ¹ suggests that when military forces are deployed on operations:

‘conventional military superiority will be met by asymmetric tactics such as: denying force entry to theatre; disabling force multipliers (such as communications and information systems); disrupting enablers (including logistical arrangements); and avoiding direct combat.’

The UK Future Manoeuvre Sub Concept ² goes on to assess that, in the land environment, the existing trend will continue towards a continuum of operations. The tidy distinctions between pre-conflict, conflict and post-conflict activities may become less relevant and operations may merge into an amalgamation of phases and activities. The task of Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) will be particularly complex, as adversaries may mount operations from within the cover of the local population, making it difficult to differentiate between friend, foe or neutral party. The need to assess and share intelligence rapidly to determine an adversary’s intent will provide a considerable challenge.

Against this backdrop, decisive joint (and combined) operations will be conducted principally on the land and forces will be required to switch adeptly from one posture to another. As a result, force structures should be balanced and adaptable enough to meet most operational challenges, including the rapid transition between different types of military activity. Thus, whilst the Land Component’s Brigade and below forces should still be prepared to fight in symmetric, less dense, open-terrain warfare, they should principally expect to fight less well-defined opponents in various types of non-linear, asymmetric warfare. Forces will need to operate with a range of possible coalition forces with the closest co-operation being with US Forces.

This increasingly-asymmetric threat spectrum will make the tactical environment of 2014+ very challenging for US and UK Crisis Response Operations (CRO) forces. As they continue to co-operate in CRO, US/UK warfighting elements must work closely to accomplish mission objectives within a dynamic and complex operational environment. It is anticipated that US and UK brigades deployed on such operations will need to exchange

information for the purpose of Command and Control and battlefield situational awareness within a very dynamic tactical environment. The transfer of battle command information will occur in a near-real time-exchange between US and UK units at the halt and on the move. It should be noted that by 2014, those elements of the US Army that are FCS-equipped will be a genuinely networked force and, to be an effective military ally, the relevant UK force elements must be able to interoperate effectively with it. If they are not, they will only be able to co-operate at a significantly reduced level of battle effectiveness.

Conceptual and Doctrinal Provenance

The work under the C4ISR PA is founded upon the assumption that, within US forces, the FCS-equipped Brigade Combat Team (FCSBCT) will form the ground manoeuvre core of any US Crisis Response and that this will be mirrored on the UK side by the FRES-equipped Brigade Group (FRES Bde Gp) at the core of the future UK Joint Medium Weight Capability (UKJMWCAP). Of course, many operations may be instigated by the insertion of Light or Special-purpose Forces but, in the majority of cases, a rapidly-deployable, "medium-weight" element of the type represented by the US FCSBCT and UK FRES Bde Gp will be required to provide the combination of mobility, firepower, protection and communications necessary for the delivery of rapid manoeuvre and effect and the sustainment of follow-on and stabilization operations.

The provenance of these assumptions is based upon a concepts, doctrine and force development (CD&FD) audit trail, conducted concurrently by the US and UK joint authors, that describes the baseline for the work. These are summarized as follows:

- **UK Policy Drivers.** The policy requirements for UK/US interoperability are described in full within Defence Strategic Guidance (DSG) 2005 and include:

Influence. To contribute to the UK's international influence by enhancing bilateral or multinational relations with:

(1) The US, by contributing capable forces at an equal command level or below in a similar timescale to US forces.

(2) NATO, by contributing capable forces to the NATO Response Force (NRF).

- **US Policy Drivers.** The policy requirements for the UK/US interoperability objectives and intended effects are described within the DOD QDR (Department of Defense Quadrennial Defense Review) 2005³. The QDR 2005 directs a strong multinational interoperability and cooperative effort with allies and other coalition nations to influence future adversaries from undertaking potential adversarial actions. The intent is to demonstrate an overmatch position thereby preventing the use of terrorist extremism, use of Weapons of Mass

Destruction, and influence other nations decision-making prior to undertaking a strategic military build up.

- **UK Conceptual Provenance.** UK DSG, the UK Joint High Level Operational Concept (Jt HLOC) ⁴, and the UK Joint Doctrine and Concepts Board-endorsed Future Land Operational Concept (FLOC) ⁵ espouse the need for rapid deployment and agile forces that exploit the Effects Based Approach (EBA). Both papers also advocate that force packages should be 'tailored' or 'optimised' on deployment according to operational need and that they be capable of operating effectively at the tactical level with coalition forces and, especially, with US Forces.
- **US Conceptual Provenance.** The Current Joint Operational Concept Family of documents ^{6,7}, direct the capabilities for the future DoD joint fighting force. The documents direct capabilities related to Command and Control, Force Application, Battlespace Awareness, and Protection functional areas. To meet these capabilities, the US FCS-equipped forces must attain interoperability across U.S. services and multinational partners. The US/UK C4ISR PA supports these efforts through the establishment of solutions to exchange Red/Blue/White Situational Awareness (SA) information, Collaborative Planning solutions, and Joint Fires among others. The objective is to be able to conduct combat operations off-the-ramp in either a symmetric or asymmetric threat environment.

Experimentation Development

It was recognised early during the scoping of the C4ISR PA that a System-of-Systems Systems Engineering approach would be required to improve US/UK C4ISR interoperability. Experimentation is an integral part of this System-of-Systems approach and supports all stages of the programme, from early pre-concept and concept definition activities with the investigation of interoperability options and migration strategies, to assessment activities with the investigation and evaluation of candidate interoperability mechanisms, and through to demonstration and implementation with the incorporation of evolving systems and interoperability solutions. Experimentation is a means of accelerating and de-risking the acquisition cycle. In the US, this has been formally recognised for some time as part of the US overall acquisition cycle whereas, in the UK, experimentation is starting to be used to help inform requirements, solution options and approvals at major acquisition gates.

The C4ISR PA focuses on technical C4ISR interoperability experimentation aspects while fully embracing guidance and findings from concepts and doctrine, Tactics Techniques and Procedures (TTPs) and battle-lab experiments. Indeed, through iteration and feedback, the technical experiments inform concepts, doctrine and TTP development. C4ISR PA experiments build on extensive US Army-developed facilities and draw together previous UK investments in simulation and modelling to provide a comprehensive experimentation capability.

This C4ISR PA experimentation capability uses the US Army-run, annual series of technical experiments for the FCS programme, based around the FCS Systems Engineering Experimentation Laboratory (SEEL). This is combined with FCS Lead Systems Integrator experimentation and development activities and the United States Air Force (USAF)-led, biennial, Joint Expeditionary Force Experiments (JEFX). This series of experiments, together with the Coalition Warrior Interoperability Demonstration (CWID) yearly activities, are used to investigate, develop and evaluate interoperability options and capabilities against a C4ISR PA incremental capability implementation plan or roadmap.

Experiments utilise a mix of virtual (models and simulations), live (real equipments, systems and people), constructive (simulated people on simulated systems) and surrogate systems (current systems used to represent a future capability) to achieve their objectives. The C4ISR PA experimentation capability comprises a mix of high-fidelity models representing current and future C4ISR systems and a live, virtual and constructive experimentation environment that enables the interfacing of live systems to a real-time simulation environment such as Distributed Interactive Simulation (DIS) and High Level Architecture (HLA). Additionally, the FCS SEEL provides for rapid prototyping with hardware and software, which enables promising technology or early system developments to be investigated as part of the experiments.

C4ISR PA experiments focus on two areas:

- The definition, development and introduction of interim levels of US/UK C4ISR interoperability to support current forces;
- The identification, definition and development of future (2015) net-centric/net-enabled US/UK C4ISR interoperability and the development of migration strategies from current force solutions to achieve this future capability.

Areas of investigation for C4ISR PA experiments cover the development of options to achieve the required high-level C4ISR interoperability and specific system or interoperability mechanism assessments. The high-level C4ISR interoperability investigations include:

- Provision of tactical-level command and control and collaborative planning capabilities;
- Improving the quality of situational awareness exchanges in terms of level of coverage and latency and assessing the contribution this can make to avoiding fratricide and increasing the tempo and agility of coalition operations;
- Improving targeting and combined network fires;
- Exploitation of novel ground sensor systems.

Specific system or interoperability mechanism investigations include:

- The definition of interoperability translators;

- Examination of the effectiveness of tactical communications system interoperability gateways and the determination of their optimal deployment;
- The definition of net-centric/net-enabled infrastructure enablers, particularly information assurance components.

Results So Far

The USAF JEFX'06 in April 2006 was the first occasion where the C4ISR PA could exploit coalition experimentation. Experiment objectives were focused on a mix of near-term capabilities and systems and medium-term emerging capabilities, primarily in the land/air environment. Many of the capabilities were of interest as potential net-centric/net-enabled coalition interoperability mechanisms. JEFX'06 comprised a mix of live, virtual and surrogate components with many live aircraft and a complete coalition Combined Air Operations Centre (CAOC). The USAF focus was on the use of the Continuous Air Planning and Execution (CAPE) and the Non-Traditional ISR Information Services (NTISR-IS) approaches with land forces as an integral part.

The FCS programme focus was on joint interoperability to provide situational awareness, to request and support time-sensitive targeting missions using the continuous theatre air planning and architecture and to extend forward Intelligence, Surveillance and Reconnaissance (ISR) using capabilities planned for FCS Spin Out 1 (the first FCS capability fielding). This included the FCS SOSCOE, Battle Command Services, and Tactical-Unattended Ground Sensors (T-UGS). There was a particular emphasis on closing interoperability gaps between the US Army and Air Force to reduce fratricide, to provide an accurate blue picture, to provide extended ISR for Close Air Support (CAS) missions and to enhance joint combat effects. JEFX'06 also proved FCS integration with current US land force systems which in turn provided a useful mechanism for UK current forces to access early FCS spin-out capabilities. Additionally, new, net-centric, battlespace communications-enabling capabilities were proven, as was the use of a new, efficient, binary, tactical, message-exchange format.

The latest C4ISR PA SEEL EXperiment (SEELEX) # 5 in January 2006 established the value of using high-fidelity models to represent future C4ISR systems that could be scaled to brigade-size forces, in this case to investigate brigade and below interoperability and real-time simulations to represent a range of potential future interoperability options. SEELEX#5 was focused on the investigation of a range of tactical interoperability exchange options for the current and future force and a number of key infrastructure enablers for operation in a net-centric/net-enabled environment. Of particular importance was an examination of the effectiveness of these options when deployed at echelons below brigade.

Experiments considered the near-real-time exchange of blue and red situational awareness information using a variety of communications exchange mechanisms and different situational awareness architectures that reflect current and future force configurations. The results of these

experiments proved the value and effectiveness of the proposed interoperability options and identified significant operational benefits of lower-level interoperability. The findings will help to de-risk further option and solution development and help to define new interoperability requirements and the need for core infrastructure enablers on current and future programmes.

The results of JEFX'06 and SEELEX#5 have both helped to inform and de-risk capability development options for the C4ISR PA and are being used to structure a series of further SEELEX experiments in 2007 and 2008 and for JEFX'08 in 2008.

Challenges

Governance

The importance of the role of governance and the importance that has been placed on it has taken some people by surprise. However, as the PA is novel and contentious with a large number of senior stakeholders, clarity in what is being done, for whom and why is of particular importance.

In the UK, despite continued internal and external scrutiny and criticism, governance at project level is well-defined. This is rather more difficult at the next level up - at capability level in current UK parlance. The UK has several programme offices with 2 star Senior Responsible Owners. However, the relationship between SROs, DEC's and IPTs is complicated, especially as key equipment programmes contribute to multiple capability areas. Adding international interfaces, in particular the interfaces with the US and NATO, just makes things even more complicated.

The PA has been challenging what is really meant by NEC and how to manage it for reasons touched on throughout this paper. The prospect of significant improvements in military capability and interoperability through relatively minor changes to existing projects is what has driven the PA. However, each of those projects has its own governance and funding and influencing them sufficiently to enable the capability increments that the PA seeks is a major exercise in stakeholder management, especially as they are a mixture of legacy, future legacy and new projects. Again, this is compounded by the reality that both the UK and the US forward equipment programmes are subject to change on a regular basis. Ensuring that the team is aware of wider UK/US interoperability issues has been a challenge for such a small team, but the danger of just developing another stove pipe is there, albeit with the best intentions. To mitigate against this as far as possible, the PA team has developed a very constructive relationship with the British Defence and Liaison Staff in the British Embassy in Washington, who have been particularly helpful.

Last but not least, there is the subject of security. It is inappropriate to go into a lot of detail in open forum but this has been regarded as a key enabler from the outset of the PA. To give an example, UK has accredited its systems on a system-by-system basis. UK is now moving towards a more system-of-

systems approach, which reflects the reality of NEC. The PA extends this argument further into the international arena. Suffice to say that it has been evident that even with agreed concept and doctrine and the elegant technical solutions, ignoring security would mean that would not be possible to connect the systems together.

Culture

This should not be overstated, but there has clearly been a period of the teams getting to know each other over the past few years.

This has taken a number of forms. Firstly there has been the team dynamics of establishing ways of working between two very different organisations and organisational cultures. Whilst the PA is not unusual in this respect it has nonetheless needed some work. One complication has been that the US FCS programme, as a programme of record, is working on a much firmer foundation than the UK's aspirations for NEC. The fact that the UK team have had to establish the programme from nothing has taken a considerable effort: effort has not been available for "real work".

There are clearly different concerns that drive behaviours some of the time. Some of our US friends have been rather surprised by their own regulatory framework, and from time to time have been heard to say "but they're the Brits, why can't we give it to them?" Whilst the US is constrained by the security regulations, the UK tends to be driven by safety in some areas, not least software safety, and this has led to behaviours that have surprised US colleagues on other programs – although the PA has not yet reached that stage. Rules are rules, as they say, and these things need to be accommodated both in terms of time and effort, even if they seem counter-intuitive to the other nation.

Conclusions

This is a real-life example of engineering NEC and NCW, all the more interesting as it has had to accommodate the differences in these similar but not identical concepts.

In programme management terms, it has had to work with the challenge of trying to coordinate a number of UK programmes to interface with one very large US one – FCS. In practice, this has only been possible because it has been obvious from the outset that both sides were very keen for this to happen. It would have been easy for things to fall apart at a number of stages.

It is still early days, but there is now an agreed UK/US land concept, which again has been generated through a hybrid process that tries to satisfy both the UK and US concepts and doctrine communities.

A draft capability implementation roadmap has been produced of how to get incremental improvements in military capability and the first of an ongoing series of bilateral experiments to test the assumptions upon which this is based has been completed. All that is required now is to deliver.

Although it is easy to focus on equipment, the success of the PA depends on overall coherence and political will on both sides of the Atlantic. Those involved are keen to see this succeed as the prize is a significant improvement in front line capability.

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