Information Services for Coalition Operations

Dr Stephen Braim
DERA, St Andrews Rd, Malvern WR14 3PS, UK
spbraim@dera.gov.uk

Abstract

Information is widely regarded as one of the fundamental enablers for successful military operations. The difficulty is in getting the right information to the right person, in the right place, at the right time.

Within the UK a new project is underway to deliver an infrastructure for timely information delivery across UK Defence. It is known as the Defence Information Infrastructure (DII). It will deliver a coherent information infrastructure across most of the strategic and operational levels of UK Defence, and will offer interfaces to the Allies and coalition partners. This paper will use this project as the exemplar to describe how the UK is likely to procure its IT systems in the future, and will thus expose activities necessary to deliver information coherency across coalition operations. The particular case of describing and capturing the all-important "context" within which a specific piece of information should be viewed will be used to identify information services that are likely to be provided within the UK DII. Necessary information descriptors (metadata) will be compared with commercial standards and their utility for the military explored. Finally, the ability of such standard data sets to meet the needs of coalition operations will be discussed.

1. Background

Interoperability has been an issue for as long as different nations have combined to fight against a third party. Significant time, effort and resources continue to be expended on solving interoperability issues. Standardisation and "interface boxes" are equally often used as solutions. The sophistication and complexity of modern Information Systems (IS) make such alignment difficult, especially between the systems of different nations. Interoperability is needed at a number of levels (communications protocols and concepts, computing platform standards and formats, information content and language), each having differing technical needs and emphasis. Such alignment is both eased and exacerbated by the direction of COTS [1] technology – the ubiquitous nature of COTS eases the problems through enforced standardisation, but if the COTS does not meet military requirements, pressures grow for "bespoke" additions. There is a key need to balance the effort in all of these different areas. New activities are underway in the UK that will ease such problem areas in the future.

Defence operates in an information-rich environment. The need to manage such information, to the benefit of commanders and decision-makers alike, is a key driver

[1] COTS – Commercial Off The Shelf

across MOD and thus across coalition operations. A single piece of information[2] is rarely used in complete isolation; many information items are necessary to afford a rich environment in which a decision can be made. These items represent the *context* in which any one piece of information should be viewed. It ensures that information is used in the manner for which it was intended and not wrongly used or misinterpreted. Capturing context is a challenging task; perfect alignment (and interoperation) of differing national IS can simply lead to an ever more perfect state of misunderstanding being achieved if the content of the information is not understood. There is a need to capture context and store it with each item of information. Use of this context will minimise the chance that information is wrongly used.

2. DII and IS procurement

Historically, IS have been procured on an individual basis, each one of which has been built to satisfy a well-defined set of military user's requirements. This philosophy has yielded a series of crafted and thus individually "perfect" solutions, each one of which is matched to the stated requirements. Each one, however, ignores the needs of its peers, and as a collection is often regarded as perfect set of "stovepipes". As such, these systems do not exhibit the degree of flexibility expected for modern IS. They present difficulties (either technical or financial, or both) in their ability to meet additional (new) requirements, often imposed as a result of demanding operational imperatives, or the adoption of newer, different "business" processes within defence. For example, particular emphasis is nowadays placed on the interconnectivity of IS (largely due to norms delivered by the Internet), and thus the ability for information dominance / information superiority to be realised as a sharp instrument of war. Interconnection of disparate stovepipe systems to meet this need has been found to be a complex and costly task. Significant difficulties are also often experienced through the need to support ad hoc coalition operations, such as humanitarian aid and peace keeping / peace enforcing support. A series of independent stovepipes have difficulty in meeting such new operational drivers, and are thereby in danger of reducing the operational effectiveness of a fighting force. Many local interfaces, alterations to formal procedures and even security waivers are used to deliver some degree of interworking. Connectivity is often obtained on a one-to-one basis (which rapidly leads to an n-to-n set of interconnections).

The degree of technical maturity delivered by commercial (COTS) products allows the differing layers of an IS (applications, computing infrastructure and communications infrastructure) to be procured independently. This offers a far more flexible approach to IS provision. The reality of the separation of these layers is exemplified in the ubiquitous "home PC" marketplace. The computing platform, the operating system and the software applications can be specified independently, and the customer/user is sufficiently confident that they will work successfully together to commit his/her own hard earned cash to the purchase. If the communications / interworking capability delivered by the Internet is added to the PC then we have a good example of a discretely procured, fully functioning, layered system. This flexible approach can be contrasted with the norms of defence procurement, which, even now, are still procuring integrated, bespoke, hardware and software "turnkey system solutions".

---

[2] Information: a collection of facts or data; items of knowledge.

Figure 1 illustrates the 3-layer approach to IS provision. It is based on a service approach, with each layer providing a specific suite of services to deliver its capability and also supplying some services to the layer above. The Figure also shows the aspiration for this single model to be applied at all levels of command (strategic to tactical), and at all levels of security classification.

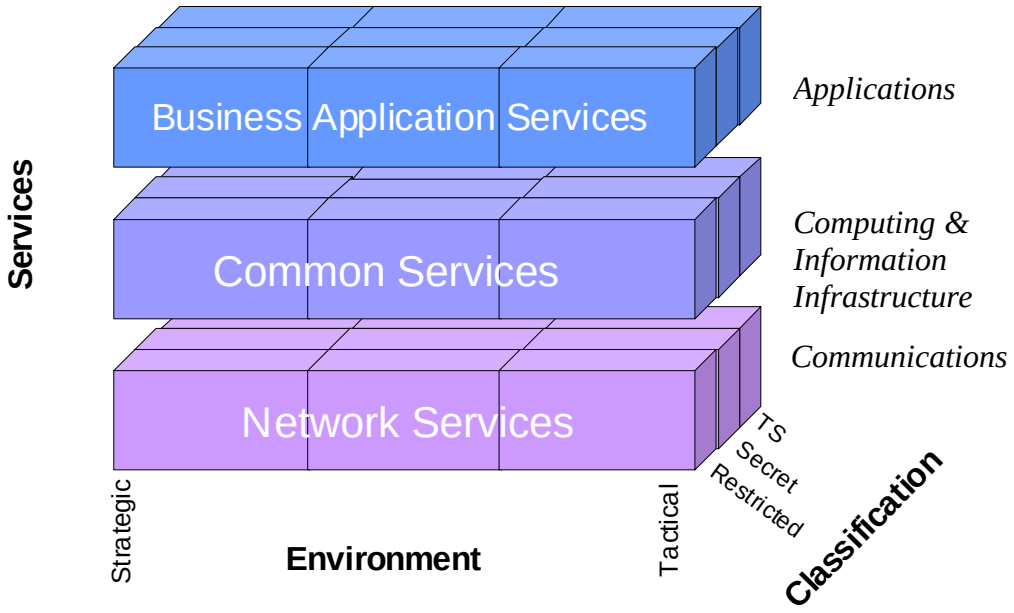

Figure 1 - 3-layer model

The UK MOD has taken significant steps towards basing its future procurement of IS on the layered approach of Figure 1. Its first overt action was the formation of the Defence Communications Services Agency (DCSA), which was set up in 1998 to deliver a coherent communications backbone for UK Defence. Its scope is now being extended to provide a broader range of information services, as shown by the current versions of its mission and role statement.

DCSA Mission

To deliver and sustain interoperable communication and information services and to enable timely, assured and secure access to information world-wide in order to provide UK Defence with an information edge

DCSA Role

To manage Defence communication and information services, including the GII, end to end and, where appropriate, provide, operate and sustain elements of those services, world-wide.

The direct benefits to be accrued by the MOD in forming DCSA can be gauged by the ministerial statement made in 1999, in which it was quoted [3] that "*the formation of the DCSA has resulted in a reduction in associated infrastructure costs for telecommunications services of some £11M in 1998/99*"

[3] John Spellar, Armed Forces Minister, 3/8/99

A new initiative is underway in the "Infrastructure" layer, to complement this step, which will formalise the separation of application procurement from that of the computing infrastructure. This project is known as the DII – the (UK) Defence Information Infrastructure. Its requirements are set by several key drivers:-

- The need to keep in step UK Government best practice and the Allies
- Secure information exchange, internal and external to Defence
- A need to enhance personal productivity via new ways of working
- The need to support business flexibility and organisational change
- Electronic records and document management.

The DII will provide a coherent information infrastructure at both strategic and operational levels, both within the territory of the UK and overseas. It will:

- create a flexible infrastructure delivering connectivity and common computing services;
- support information storage, retrieval and display;
- allow communication and interaction across Defence and with organisations external to MOD;
- host military command and control applications and MOD corporate business applications;
- utilise the coherent defence communications infrastructure provided by DCSA.

DII is a key ingredient of MOD's strategy to meet the demands of the UK Government's "Information-Age Government" agenda. The UK Government has set demanding targets for its conduct over the coming years:-

Government targets for conduct of business electronically:

- 25% by 2002
- 50% by 2005
- 100% by 2008.

Government targets for e-commerce:

- 90% by value of low-value purchases by central Government carried out electronically (2001).

Government business targets - Citizen's services:

- All Public Record Office research information available electronically (1999)
- Whole population can access NHS Direct (National Health Service) (2000)
- Job-seekers able to look and apply for jobs anywhere in UK via telephone and Internet (2002)
- Access to National Grid for Learning from all schools, colleges and libraries (2002)
- Electronic booking of driving tests (2002)
- Submission of self-assessment tax returns (2002).

The MOD is not alone is finding these targets a real challenge.

The overall aim of the DII is to deliver a secure and coherent Information Infrastructure to Defence, at minimum whole life costs. In practice this will mean enabling a user to log-on to the Infrastructure at any workstation within Defence to access those applications which they are authorised to use. Information will be able to be passed between any two or more users on the system. All necessary Corporate, Business Unit or Local applications will be provided to any user and every user will be provided with a Quality of Service (QOS) that is appropriate to that their operational or business requirements.

Thus DII Will Deliver:-

- Networks, Servers, Terminals and Operating Systems
- Core Services - Security, Authentication, directories etc.
- Productivity Tools
- Messaging Services
- Web Services
- Directory Services
- Access to Gateway Services
- A suite of common applications (Office Automation, e-mail…),

and will host Corporate, Business Unit and Local applications, such as planning.

Overall, the DII is a seen as a major component of a coherent approach to the provision of an information infrastructure across the whole of UK defence – this overall initiative is known as the GII – the Global Information Infrastructure. The GII embraces the DII, all deployed and tactical elements of the battlespace and the computing and information infrastructure within all fighting platforms. It also

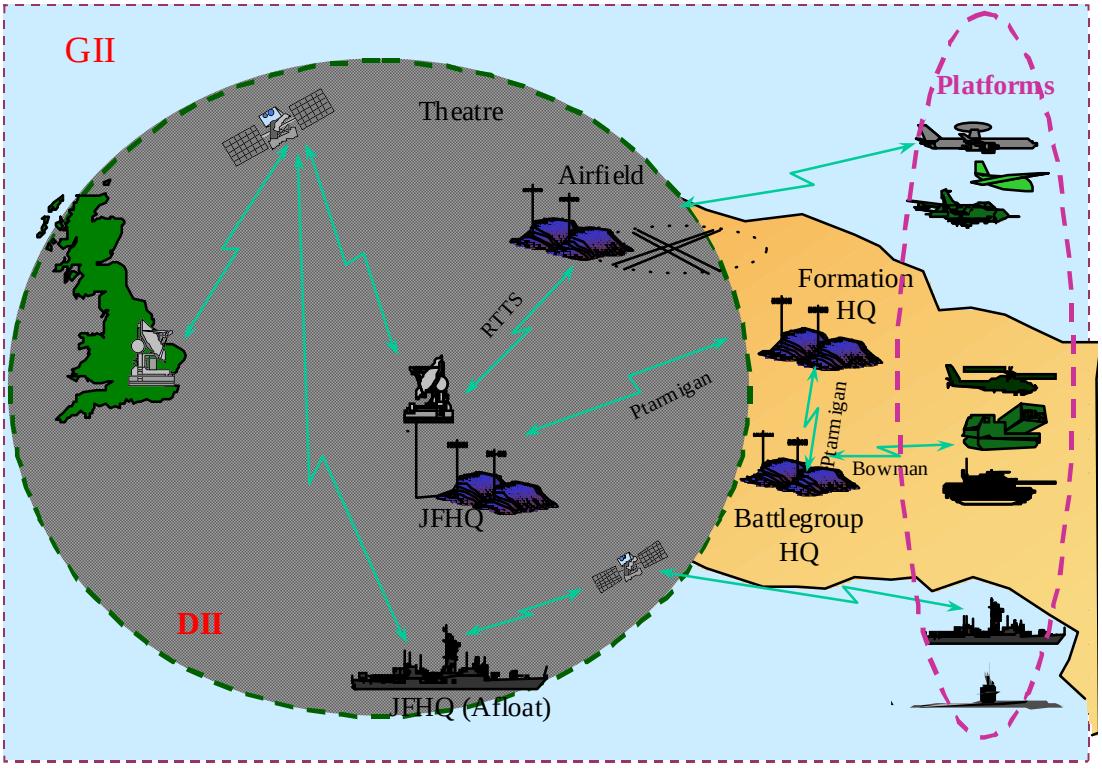

Figure 2 - The UK GII Concept

includes all external interfaces to the Allies, NATO, coalition forces, UK Government Departments and OGDs [4] (a subset of which will be delivered by the DII).

3. Information services

It has been described how the UK is moving towards IS procurement based on a 3-layer model. This model is underpinned by a "service" based approach to the provision of functionality within the IS. The service metaphor is receiving increasingly wide acceptance – the structure and approach to the delivery of these services does vary, however.

DII is likely to provide the following core services:-

IP Address Allocation	Name Services
Network & System Management	Directory Service
Security Services	Messaging
Network Time Services	Web Services
Operating System Services	Network Operating System Service
Data Management Services	Collaborative Computing Services
Data backup & archiving service	Database support.

Additional services to support the domain-specific applications need to be added to this core list. As an example, the following list cites representative services essential to realise information management. It is debatable whether information management is a core service or not.

Example Information Services [5]:-

Information Collection

- Interface to tasking and CCIRM mechanisms

Information Lifecycle

- Maintenance, disposal, archiving, security, priority, integrity
- Information management (incl. configuration management)
- Information process management and support

Information Access

- Subscribing, discovery, mining

Information generation

- Analysis, manipulation

Information Dissemination

- Publication, report generation, "view management"
- Interface to knowledge management services

[4] OGDs – Other (UK) Government Departments

[5] This theme is developed in " The Shared Information Environment – SIE" A. Alston, S. Braim, M. Farrington , K. Johnson, 2000, DERA/KIS/SEB/WP001198

Information Support

- Directories (incl. user profiles, security rating, access rights)
- cache management (time-stamping, perishability)
- transfer management (messaging, file transfer service)
- Survivability service (distribution and replication of information)
- Information service availability.

Optimal means for the provision of such a rich set of services across the layer model, given the essential backdrop of COTS, is the subject of ongoing research activity.

4. Coherence

Over the coming years, the UK will increasingly move towards fielding a unified IS based on a) the 3 layer model b) a coherent suite of services and c) the DII as its core. This model is similar to the US DII, and its associated COE [6] and has synergy with the US DOD and NATO Technical Reference Models [7] [8]. Such similarities of approach between the UK and at least some of the Allies will directly benefit interoperability with the Allies and coalition partners.

Taking each layer in turn, we can review the likely impact on interoperability:-

Communications

The unification of the myriad of communications networks within any one nation into a unified architecture will ease interoperability issues. There will be a better definition of interfaces to external networks, allowing a gateway solution that is implemented at one location to work equally well at other locations. Protocol and network management issues will be better defined (at the system of system level), allowing interactions to be simplified and thus QOS between networks to be enhanced.

Computing Infrastructure

The adoption of an increasingly similar set of "common" services within each nation will simply their alignment at the IS boundaries. This is currently being eased due to the essentially similar IS hardware and core software (e.g. operating system) used by nations, due to the global market in computing systems. There is a vital need to identify and align information services at system boundaries.

Applications

Direct interworking of applications across national boundaries is relatively unexplored territory. Alignment of the individual layers between national systems will allow the potential of full interworking to be realised (especially using relatively simple collaborative tools and low specification "personal conferencing" software). Information management applications, relying on a common set of information services will also allow real benefits to be realised.

---

[6] Ref. http://diicoe.disa.mil.coe/
[7] Ref. http://www-trm-itsi.disa.mil/index.htm
[8] Ref. http://www.nc3a.nato.int/ppdiv/nose/nosevol3.htm

It is a key aspect of this alignment that a common view is held as to which layer holds which services (e.g. is network management a communications layer issue, or an infrastructure issue by virtue of being part of system management ?).

5. Information context [9]

The above has discussed the ability to align the communications, infrastructure and applications layers. As implied in the opening paragraph of this paper, the key aspect far as the user is concerned is the delivery of information. Alignment of the layers will achieve connectivity and permit information flow, but could still lead to timely passage of utter rubbish. To this end there needs to be a common understanding of the meaning and content of a specific item of information, and some of its characteristics. Historically the military often dealt with colleagues on a one to one basis – a feeling of mutual trust and understanding of the other person's point of view developed, which minimised misunderstandings. Nowadays in a wider, web-enabled, coalition environment, the user is less clear where the information he or she is using came from, or indeed whom he or she may be dealing with. There is a serious danger of misinterpretation. It is therefore vital that the context in which any item of information should be viewed is understood.

Dictionaries provide the following definitions of context:

(1) Conditions and circumstances that are relevant to an event or fact;
(2) Parts of a piece of writing / speech etc that precede and follow a word or passage and contribute to its full meaning

The extension (or interpretation) of these definitions, relating them specifically to "information", will be covered below.

Context, in context

Context is pervasive in our everyday lives. Daily actions are performed within a framework of external circumstances. Such circumstances (such as gravity) are accepted as being relevant to an action (such a dropping a glass), leading to a predictable result. In a similar way, the auditory cue of a phone ringing can result in a hand being outstretched (without looking) to pick up the handset from its "known" location, leading to a (relatively) predictable conversation. In both of these cases we have used a world-model, based on a lifetime of conditions and circumstances, to capture our (local) context, which we hold mentally. If we see common items in an unusual, or unexpected, context we can be easily misled, as in some optical illusions. Figure 3, below, shows a well known illusion (Ames room), in which two similar-sized children are viewed from a specific point (i.e. in a specific context). The observer's expectation of normal orthogonal structures leads him to conclude that the children are of different sizes. This conclusion is "forced" by the optic/brain system, despite an alternative explanation (of a trapezoidal room, as shown in Fig 4) being plausible[10].

---

[9] A fuller treatment is contained in "Information, in context", S Braim, Jan 2001, DERA/KIS/SEB/Proj /19k/00/5/WP/01

[10] When you look (through a peephole, to remove any cues from stereopsis) into an Ames Room, the room looks normal and cubic, but its true shape is cleverly distorted. The floor, ceiling, some walls, and the far windows are actually trapezoidal surfaces. Although the floor appears level, it is actually at an incline (the far left corner is much lower than the near right corner). The walls appear perpendicular to the floor, although they are actually slanted outwards. Figure 2 shows how the Ames Room forms an identical image of a normal cubic room on your

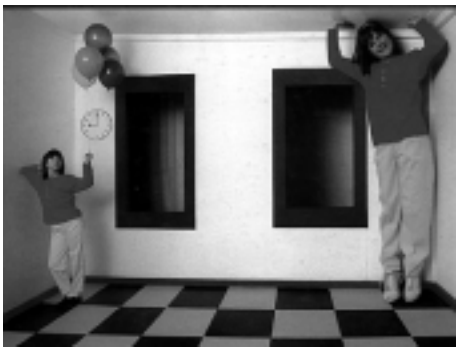

Figure 3 – Ames Room

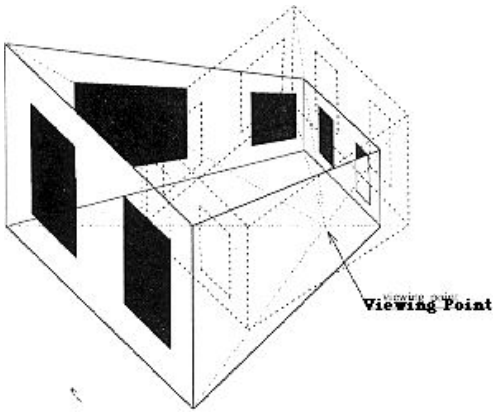

Figure 4 - Explanation

In a similar way, the text around an individual sentence provides the context in which is should be interpreted. An example is a headline in a newspaper. It is designed to be eye-catching, but is often meaningless without the supporting story. Indeed several different stories could fit the same headline, leading to widely differing interpretation of the headline, depending on the context provided by the story. As an example, consider the following headline "Salisbury still in turmoil" – it could relate to flooding in the City of Salisbury, England, rioting in Salisbury, South Africa, or the problems faced by the England cricketer Ian Salisbury. Context is also crucial to distinguish fictional documents and text from non-fictional ones.

Context can be related to the more dynamic flows normally associated with military information. The quantity of external or supporting information required to assist the decision of the Captain of a Royal Navy ship who is given the message "Sea skimming missile travelling at Mach 2 directly towards us" is very small. However the amount of supporting information needed to assist the Army tactical HQ commander who receives the message "6 tanks travelling at high speed towards our position" is much higher (are they our 6 tanks which left 2 hours ago on a reconnaissance mission?; are their main armaments pointing towards us or away from us?). In both cases contextual information is crucial to making the correct decision – the quantity is the variable, driven, at least in part, by timeliness.

Given the definitions of context and the examples cited above, one could argue that: -

Data + context → Information;
and Information + context → Knowledge.

This is perhaps a more accurate representation of the normal flow of:

Data → Information → Knowledge.

The corollary is that knowledge is information *within a context*.

---

retina. If a straight line (representing a ray of light) is drawn from one corner of an imaginary cubic room to your eye, the corner can meet this ray at any point along its length and still appear cubic. Since the two visible corners of the room subtend the same visual angle to the eye through the peephole, the two corners appear to be the same size and distance away. The left corner, however, is actually twice as far away as the right corner. When one sees the room from another angle, the true shape of the room is revealed.
(Ref. http://www.illusionworks.com/html/ames_room.html)

The examples above demonstrate that context is vital for correct (informed) decision making. Context can be provided by discrete items of information and also by a number of less tangible factors, such as how the enemy behaved yesterday, or what is the morale of the troops. These latter aspects can be documented as context; they are not often done so.

Describing context

Having given examples of context, and shown its crucial role in decision making, we need to understand what it is precisely, in order to capture it successfully. The ability to describe context is a key ingredient to sharing information, especially across coalition operations, with their associated language and cultural differences.

In the physical world every material object has specific properties (colour, shape, size) associated with it. These can be used to label and describe the object. In the same way, any item of information has certain properties (such as who produced it, when it was produced). Such information attributes can be associated with the information and used to describe it. If a set of attributes can be derived to describe context sufficiently, then we will have a powerful means of capturing context.

If we take the first of the definitions of context quoted above ("Conditions and circumstances that are relevant to an event or fact"), then for an individual piece of information there are various attributes that are relevant to the identification of the information. Examples are: the title; the author; when and why the item was created; any constraints over its use; and the purpose for which the item was derived or collected in the first place.

There is a second set of attributes, additional to those cited above, which would help a user to determine the existence or the location of the sought item from amongst a number of others (assuming that one could search on these attributes). Aspects that fall into this category are: geographic area; a summary and/or a description of the information item or a categorisation of its content against a list of subject and keywords; its format (i.e. image or text); the language in which it is written; and some form of identification or reference.

A third set of attributes relating to context can be derived from the second definition of context given above ("Parts of a piece of writing / speech etc that precede and follow a word or passage and contribute to its full meaning"). This definition can be extended (in the case we are considering of a stream or flow of data and information) to refer to other information that has gone before, or other relevant items of information that need to be brought to the users attention. Attributes such as: related or linked items and items pertaining to an audit trail or history log; the originators organisation (for credibility and confidence); and the currency of the information (i.e. indicating whether it is up to date), fall into this list.

Some of these identified attributes actually refer to the item itself, rather than the context in which it should be utilised. They capture basic attributes of the information, and are useful for purposes other than context. Thus it is helpful to classify these three groups under the two headings of information attributes and context attributes:

Information attributes:	*Context attributes:*
Title	Releasability / constraints over use
Author	Purpose/ why collected
Creation Date	Related/linked items
Coverage	Currency
Subject and Keywords	Organisation
Format	Description
Reference / Identifier	
Language	

Thus we have derived a minimal set of relevant key features which can be preserved with each item of information to assist in its interpretation, and thereby, it is suggested, capture its context. Note that the *combination* of these two sets of attributes is proposed as the necessary minimum to capture context. The set of information attributes only captures the minimum basic set of features of the information item itself. These could be considered as the minimum data-set that should be mandated to be recorded with each information item. Ideally, the combined set of information and context attributes should be stored with each information item.

Having identified those necessary attributes that can (minimally) convey the context around each information item, we must now consider how such attributes should best be stored. Conveniently, storage of information about information (or data about data) is a well studied topic in the fields of librarianship, and more recently in computer-based information systems. It goes under the generic name of metadata [11].

Metadata

Metadata is a useful aid to information sharing and manipulation (i.e. access, delivery), information discovery and interoperability. Metadata describes an information resource. It is the Internet-age term for information that librarians traditionally put into catalogues, and is now commonly used to refer to descriptive information about Web resources. The term metadata has only been used in the past 15 years, and has become particularly common through the popularity of the World Wide Web. However, the underlying concepts have been in use for as long as collections of information have been organised. Library catalogues represent a well-established variety of metadata that has served for decades as collection management and resource discovery tools. Its very general definition permits its use across an almost limitless spectrum of possibilities ranging from human-generated textual description of an information resource to machine-generated data that may be useful only to software applications. Metadata can serve a variety of purposes, from identifying a resource that meets a particular information need, to evaluating their suitability for use, to tracking the characteristics of resources for maintenance or usage over time. A metadata record consists of a set of attributes, or elements,

[11] The term "meta" comes from a Greek word that denotes something of a higher or more fundamental nature. Metadata is therefore structured data about data.

necessary to describe the resource in question. It is precisely matched to the need to capture information and context attributes identified above.

Dublin Core [12]

Although the concept of metadata predates the Internet and the World Wide Web, universal interest in metadata standards and practices[13] has exploded with the increase in electronic publishing and digital libraries, and the concomitant "information overload" resulting from the vast quantity of undifferentiated digital data available online. A central initiative has emerged which has underpinned all subsequent work – the Dublin Core initiative [14]. The Dublin Core (DC) metadata standard is a simple yet effective element set for describing a wide range of networked resources. It comprises fifteen elements, the semantics of which have been established through consensus by an international, cross-disciplinary group of professionals from librarianship, computer science, text encoding, museum communities, and related academic fields.

The basic DC list is unordered, and is often quoted in the historical order in which the elements were defined and agreed.

Title	Creator	Subject and Keywords
Description	Publisher	Contributor
Date	Resource Type	Format
Resource Identifier	Source	Language
Relation	Coverage	Rights Management

This set has been extended through a core set of qualifiers (derived through the Dublin Core Metadata Initiative - DCMI). This adds more richness in the areas such as date (e.g. created, valid, available, issued, modified) and relation (e.g. is part of, has part, is referenced by, references).

We are now able to compare the DC set of attributes with those proposed earlier in this paper which are suggested as sufficient to capture context. The following table summarises the mapping of information and context attributes to their equivalents from the DC plus DCMI qualifiers set.

Information attributes:	*DC / DCMI equivalent(s)*	*Context attributes:*	*DC /DCMI equivalent(s)*
Title	Title	Releasability / Constraints over use	Rights or rights qualifier Description or description qualifier
Author	Creator and Contributor	Purpose/ why collected;	Subsume into description

[12] Named after the initial meeting at Dublin, Ohio, USA
[13] Through bodies such as W3C, OASIS, OMG, MDC, ISO and ECMA.
[14] Ref. http://purl.org/DC/

Information attributes:	*DC / DCMI equivalent(s)*	*Context attributes:*	*DC /DCMI equivalent(s)*
			element, or add a new qualifier
Creation Date	Date; Date qualifiers (Created, Available, Issued Modified)	Related/linked items	Source & Relation; Relation qualifiers (Is Part Of; Has Part; Is Referenced By; References)
Coverage	Coverage; temporal & spatial qualifiers	Currency	Date valid qualifier
Subject and Keywords	Subject	Organisation	Publisher
Format	Format & Type	Description	Description
Reference / Identifier	Identifier		
Language	Language		

The match is excellent, thus it is suggested that the DC elements, plus selected qualifiers from the agreed DCMI list, offer sufficient richness to capture the attributes of information essential to convey context. The only weaknesses are is in the areas of *constraints* and *releasability*. The need to convey *constraints* could be embodied within the scope of the *description* element. However, consideration should be given to adding a defence-specific qualifier as part of the *description* element, to ensure visibility of the need for *constraints*. It is suggested that the topic of *releasability* be handled within defence either as a local qualifier under *rights*, or as a "defence interpretation" of the *rights* field. The difference between these two options is only likely to emerge after real use of these fields with realistic information sets and appropriate metadata support tools. It depends on whether there is a perceived need for a pure DC *rights* field, when issues of information exchange and interoperability with Allies and coalition partners are taken into consideration.

6. Coalition issues

The UK is not alone in its movement towards a "layered" approach to IS procurement and operation. Furthermore the global shift towards basing military IS on COTS and associated de facto and open standards is of direct benefit to defence, removing many old, proprietary boundaries. Options for interoperability will be significantly enhanced once this layered philosophy is widespread. Interoperability can be achieved at each layer, leading to differing degrees of interaction and concomitant benefit. Simple communications connection will assist direct voice interconnection; common services within the computing infrastructure layer will allow e-mail and file transfer. A fuller suite of common services, together with common application sets, will allow collaborative working (e.g. video conferencing, shared data environments and joint planning) across different national infrastructures. Suitably defined interfaces will allow services to be delivered across infrastructure components provided by two, or more, nations.

There is an important, associated, need to focus on the "meaning of information" – metadata is a key concept and an important mechanism to take this forward. The use of *context* has been cited as an example to show how relatively few metadata fields (based on a minimalist approach) can yield real benefit in capturing the meaning of information. Alignment of similar concepts across the Allies is a key step [15].

7. Conclusions

The UK MOD has embarked on a path aimed at discrete procurement of communications, computing and information infrastructure, and applications. Its key infrastructure project (DII) is expected to yield significant efficiencies within UK defence, covering cost saving due to bulk purchase, common maintenance and lower training, and enhanced access to information and its timely delivery. Other national defence forces are adopting this layered approach to IS provision. Interoperation of these systems, and even full integration, will be made significantly easier by the adoption of a common approach. Comparison of the "break-points" between the layers is essential to ensure that the service boundaries match across coalition forces. A compatible set of services will further ease this interface.

The crucial need to align understanding of *information* has been discussed. It has been postulated that information context can be represented by a manageable set of data fields, and that metadata definitions, as used in academia and commerce, are appropriate and should be used to capture context. Is has been shown that there is sufficient scope in the standard Dublin Core metadata element set to allow its use for information management and to capture context (although there may be a need one or two additional defence-specific qualifiers), and a suitable set of metadata elements for context has been derived in this paper. It is suggested that follow-on work is conducted to trial the proposed set of "context" elements against realistic military information.

Technology is not the only impediment to achieving interoperability – security issues (releasability, system resilience) and political imperatives are common difficulties. The technical approaches outlined above will not solve any of these issues. Staff work, liaison, and a sense of common purpose need to be enthusiastically pursued in times of both peace and crisis to yield that which is required to realise information superiority for coalition operations - complete information anytime, anywhere.

[15] "Standard or standards ? – some issues to consider in the use of metadata for coaltion operations", J Miles, S Braim, R Furze, M Peck, NATO IST symposium, Quebec, Canada, 28-30 May 2001