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## **A Net-Centric Approach to Improving the Management and Use of Interoperability Standards**

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### **Abstract**

Despite numerous advances in information technology over recent years, the way in which current interoperability standards are managed and utilized is still not providing the end user with the seamless connectivity or compatibility that they expect. There are a number of reasons for this, including the time and cost taken to introduce changes to standards in fielded systems, the time taken to respond to new or changed user requirements, and the lack of available resources for users to find out about those parts of a standard that are applicable to them, with formal training where required. This paper suggests how extending the 'Net-Centric' or 'Network Enabled' concept to standards management and use could help to address these problems so we can finally see interoperability standards fully achieve their operational requirement.

## 1. Introduction

It can be very difficult for organizations, perhaps with people from different backgrounds, natural languages or cultures to exchange or interpret information without misinterpreting the intended meaning. This is true whether trying to communicate verbally, by written word or when trying to make two computers exchange information electronically. Even if someone draws a picture, it can still be easily misunderstood unless it uses common Symbology with precisely defined meaning.

To try and overcome the problems of ambiguity and misunderstanding, and enable computer systems and applications to interoperate, a number of different military interoperability standards have been developed and maintained for many years by a variety of organizations, such as NATO, DISA (U.S. Defense Information Systems Agency) and other national authorities.

Example standards include:

**MIL-STD 2525** (US) and **APP-6** (NATO) specify Common Warfighting Symbology, defining the structure and intended meaning of Symbols and Graphics for use within Graphical Information Systems (GIS). *“This standard provides Common Warfighting Symbology along with details on its display and plotting to ensure compatibility, and to the greatest extent possible, the interoperability of DoD Command, Control, Communications Computers”*

**MIL-STD 6040** (US) and **STANAG 5500** (NATO) specify a set of standard Messages used for Information exchange, to improve interoperability between NATO, National forces, agencies and systems. These standards precisely define the format, structure, constraints, grouping and meaning of a number of standard data elements (fragments of information), to ensure unambiguous information exchange.

## 2. The Importance of standards

Interoperability standards attempt to ensure that different military forces, units, systems applications and people can interoperate effectively when brought together to perform a specific role. Often, it is only a case of where the absence of, or lack of use of, an interoperability standard caused a major mistake to be made that their importance is really highlighted. For example without a standard in place for Symbology, how would a Geographical Information System (GIS) represent the existence of aircraft and infantry and whether these are Unknown, Friendly, Hostile or Neutral? Operators changing systems can be easily confused if the shape used to depict Friend on one system can be easily confused with the shape used to depict Unknown on another.

In brief, standards ensure that information is interpreted correctly and that people and systems do not make incorrect assumptions with potentially serious consequences. Misinterpreting the location on which to launch an attack for example could result in the attack taking place on a hospital or school.

### 3. Evolution of Standards Management and Dissemination Techniques

Military interoperability standards have been evolving for many years, with the first versions of some standards being produced more than twenty years ago. As time has progressed, so has the technology being used for managing the standards and disseminating their publications.

Traditionally, standards were manually produced as word-processed documents and distributed to organizations and agencies accordingly. Later, Database repositories were introduced to store data elements and information in order to automatically generate standards publications. To save on paper and distribution costs, the publications were then distributed on CD ROM.

More recently, standards management groups are moving away from delivering anything and simply publishing the standards on a Web site, which with modern standards management software can be done in just a few minutes. However, typically these sites only provide the original paper version of the standards document available for online download and manual interrogation, with no attempt to provide more advanced services for automatic use by computer software applications.

Figure 3.1 highlights the evolution of standards management over the last 20 years.

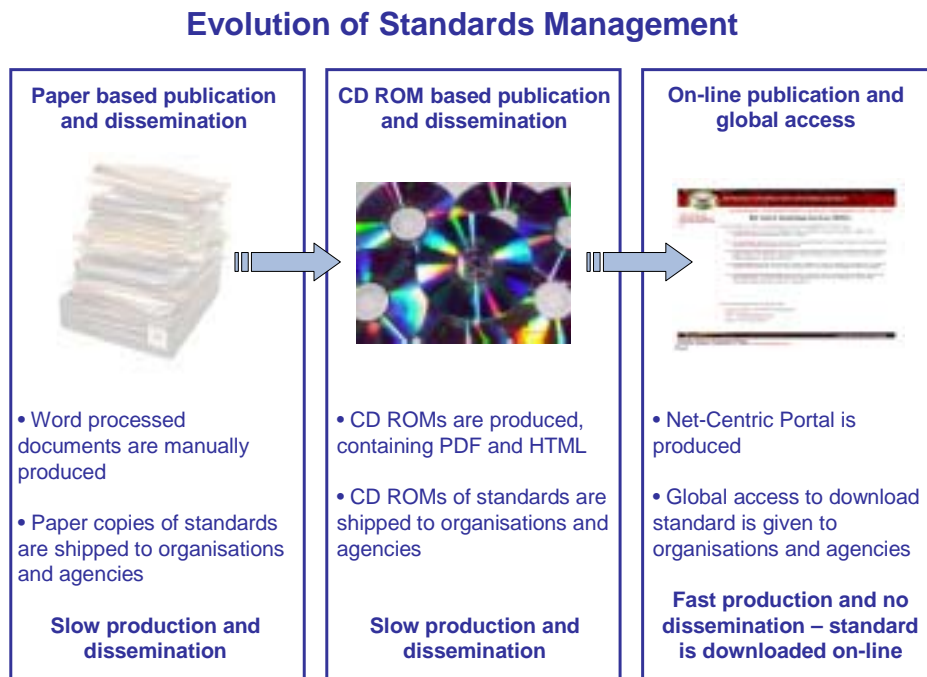


Figure 3.1

Configuration management cycles associated with many standards were based on the significant time and cost taken to manually retype documents and print and ship hundreds of copies of a standard, containing perhaps a thousand pages of information. Hence the refresh cycle for the standard would be based on one or two year cycles with no possibility to correct mistakes or introduce new 'standard' elements in the interim period. Whilst the techniques for storing and disseminating standards information have improved over the years, the configuration management cycle has typically remained the same, sometimes leaving users with the impression that standards are out of date or unable to react quickly enough to their changing needs.

So, is Web based dissemination of information through static HTML pages the final story? Is this sufficient to support the interoperability vision of a Net-Centric environment?

#### **4. Limitations of Current Approaches to Standards Management and Utilization**

Although in theory, standards are generally accepted and it is acknowledged that in order to interoperate effectively they must be followed, in practice it is actually quite difficult to get a number of different systems implemented and fielded, with the same version of a standard at the same time.

Additionally, the availability of standards in the field and limited user involvement in the evolution of them play a big part in why agreed standards may not be adopted throughout as many forces, organizations and systems as could potentially benefit.

This section looks at some of the key limitations of the current approaches to standards management and dissemination and explains why many agencies, organizations, systems implementers etc. may be reluctant to adopt a standard or find it difficult and expensive to keep up to date.

##### ***a) Slow and expensive dissemination and implementation***

New baselines of standards are published on average once every year or every 2 years and are then distributed on CD ROM, or made available over the Web. This drawn out change management cycle results in a long time lag between a requirement for change to a standard being raised and an update being made available for everyone to implement.

Take for example a standard that specifies a way to encode and exchange information relating to all known aircraft types. Such a list would include thousands of entries, with new types being created and old ones being deleted regularly. By the time a standard has been in operation for just a few months, the list of known aircraft types would be completely out of date and perhaps have many important types missing for current operations.

The need for manual standards document interrogation and the subsequent contracting process required to have systems updated, would mean that even if the standard was published more frequently, there would still be an unacceptable time lag between the release of the new revision of the standard and getting the updated type list available in a fielded system.

Furthermore, due to the manual processing requirements associated with 'document' style publication of standards information (even if web based), procurement agencies will typically state that a new system implementation, or refresh, comply with a single, specific version of a standard, with no regard to supporting new revisions or important updates. With limited funds available for system refresh and the need to continuously pay contractors for system updates every time a new baseline or revision is released, this results in different

organizations using different versions or baselines of the same standard at any one time and therefore little chance of real interoperability.

***b) Lack of knowledge about Standards***

The community of interest in standards is wide and diverse, ranging from the end users, who use the standards operationally, to the developer concerned with the intricacies of the standard. Building up the knowledge required for users and developers is not an easy task and the lack of available training material means that users and developers alike must research their specific areas in order to understand the detail. Furthermore, the complexity of standards is such that even those familiar with an individual standard will still need to refresh their knowledge from time to time.

***c) Unresponsive to changing user needs***

Users wanting to make changes to standards are faced with difficult issues – How do they request changes to an element or part of a standard? Who should they contact? Successful standards will be used by thousands of users, but how can they get involved in the standards development process to ensure it continuously meets their changing needs?

In addition to this, user knowledge and understanding of a standard is crucial in submitting a valid Change Proposal to an agreed revision. Technically incorrect Change Proposals (CPs) take time to ‘fix’ and if errors are missed in the review process this can result in errors being introduced into a standard.

***d) Unintuitive and static***

Publication of a standard on a CD ROM traditionally includes a hard copy of the standard and in some cases HTML pages. Either way, this distribution provides very limited search/query facilities.

The lack of search/query facilities make it difficult for individual users to identify the area of the standard relating to their field of interest. Furthermore, it is not possible to change the way in which the data is displayed to the user, making it difficult for certain users to read or understand the information they are presented with.



## 5. Net-Centric Standards Management

There is a lot of work going on in a number of different countries to try and create a Net-Centric (or Network Enabled) environment to provide a range of improved capabilities, with better information flow up and down the chain of command, getting the right information, to the right place, at the right time. Information exchange between different systems will still rely on interoperability standards, so to achieve the full potential of Net-Centric warfare, the approach to standards management itself must also become fully Net Centric.

### a) *Traditional Standards Management Approach*

Section 4 summarizes a number of problems inherent in the traditional approach to standards management. Figure 5.1 depicts the problems. The standards management organization is either offline, or provides only a weak level of services to the people and systems that need to conform to the standard, with a long lead time between the production of new baselines. Different systems are procured over time, without the ability to dynamically adapt to new standards baselines resulting in a mismatch of standards compliance. For example, in figure 5.1, one system is procured to implement baseline 11, the second a year later to implement baseline 12, when will the money be available to bring the first into line with the second?

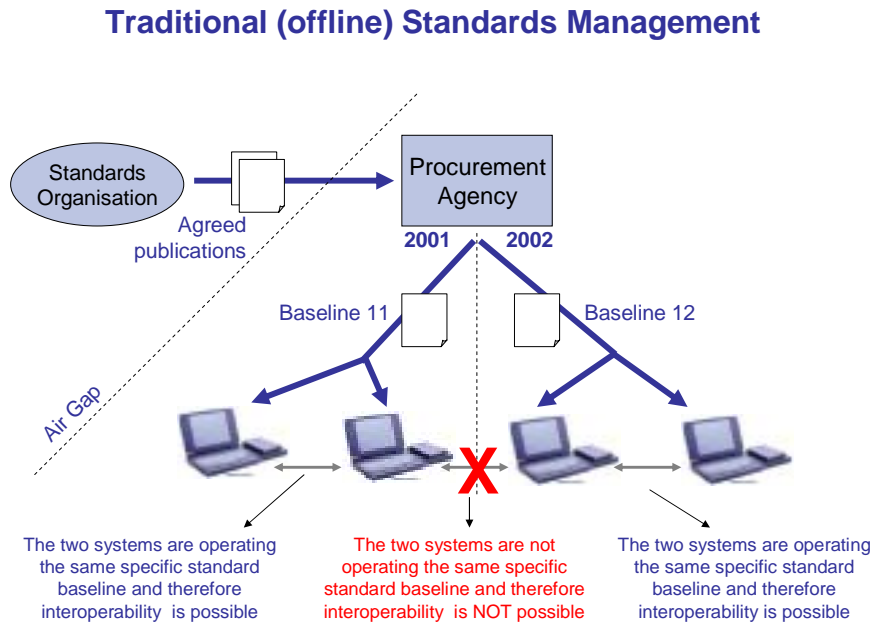


Figure 5.1

***b) Configuration Management Cycles - the need for major and minor revisions***

In order to rectify this situation, the configuration management cycle must be carefully reconsidered to address the need for systems to quickly adapt to new requirements and dynamically keep themselves up to date with latest revisions for as long as possible, without the need for software changes. Some level of major and minor revision scheme is required where major changes are kept for the long lead times, but minor updates can be released as and when necessary - similar in concept to typical software release cycles.

Major changes can be categorized as those likely to cause software re-writes in fielded systems, i.e. the underlying principles of the standard, or elements of it change so drastically that fielded software cannot possibly automatically interpret and handle the degree of change, e.g. the structure of an information exchange document is completely overhauled.

However, many changes that are required to standards can be handled by fielded software just by changes to dynamic look up tables, or making new drawings available. For instance, lists of aircraft types can be maintained as dynamic lists, with updates being applied to fielded systems all the time without the need to change software. New symbology could be introduced to represent new features, which again could be made immediately available just by issuing the image file in an appropriate format along with associated descriptive text and unique transfer codes. With the introduction of appropriate Web services, fielded systems could download the update and introduce new pick lists for the user to select the new symbol type for display on the GIS. Information exchange systems would be made aware of the new unique code for the symbol.

***c) Net-Centric Standards Management***

Figure 5.2 shows how in a Net-Centric environment, all connected systems can dynamically update themselves to reflect new revisions of a standard within minutes of the changes being approved.

## Net-Centric Standards Management

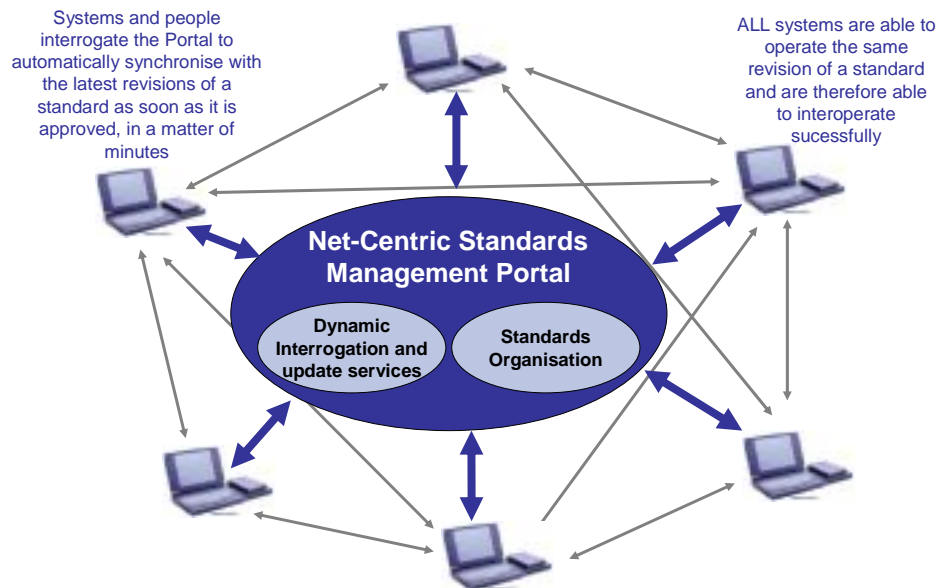


Figure 5.2

The Standards Management organization is fully 'plugged-in' to the operational fielded systems through a Standards Management Portal and a range of associated Web services that ensure operational systems are able to remain conformant with the standard as it evolves. People can interrogate the portal for information, and interact with the standards management agency itself through well structured services for reporting errors and recommending enhancements.

With all systems 'plugged-in' to the Standards Management Portal, the standard itself can be dynamic and responsive to change requirements, and all fielded systems can be developed such that they automatically keep up to date with the minor releases of a standard in real time, promoting greater interoperability between a much wider variety of systems.

## 6. Improving the management and use of standards

Using a Net-Centric approach, all standards management activities can be available through an integrated and personalized Web-based interface providing access to standards information, applications and collaborative services which assist in the development and maintenance and deployment of standards.

Each of the inherent limitations associated with traditional approaches to standards management, described in section 4, will now be addressed discussing how Net-Centricity could provide a solution:

### *a) Quick and Cost-effective dissemination and implementation*

One of the main problems with the way standards are currently managed is the slow dissemination process of new baselines and revisions, which in some situations may be sent through a chain of 4 or 5 different agencies and organizations, before it reaches its intended recipient. It could therefore take months before a published standard is actually received and implemented.

An online browsing capability would provide users with instant access to latest revisions of a standard and all documentation, without having to wait for this slower based dissemination process. The instant a standard is approved, it becomes available for viewing through the Standards Management Portal, where users can automatically synchronise their system with the latest revision of a standard, or a subset of it.

Following receipt of a new revision or baseline of a standard, agencies and organizations currently must pay contractors to make the relevant system updates and deploy new compliant software revisions. Not only does this take considerable times and effort, but it is also a rather costly process.

For example, the process of incorporating a new revision of Warfighting Symbolology, involves the following:

- Releasing a paper/word processor copy of the standard
- Requirements managers specify that new Command and Control (C2) systems be compliant with the standard, or that existing systems be updated
- Symbolology application vendors manually create the necessary symbols, using their chosen implementation technology and include the capability in a subsequent release of their product
- Integration and deployment of the updated GIS product within C2 systems.

This whole process could be reduced from a couple of months, to just a few minutes through the use of a Symbology Run-time Download API, made available as a Web service for systems in the field to automatically update themselves whenever an appropriate network link is available. This would enable updates to the standard to be available in the field within a few minutes of publication.

A Symbology Run-time Download API service could provide Symbology application vendors with the ability to programmatically perform the following functions:

- Download a full version or a subset of a standard
- Download a specific identified symbol or changes since the last download
- Maintain a client side cache of all downloaded Symbology
- Provide a report of new/changed symbols to the client software, for interaction with an administrative user if required
- Present all new/changed symbols to the client software, and or user, once downloaded

The benefits of a Run-time Download API service, whether it be for Symbology, or other interoperability standard, include:

- Removal of the need to continuously pay contractors for system updates and deploy new versions of software. Once a Run-time Download aware version has been installed, it can continuously update itself automatically
- The use of a common Database schema for both definition and distribution of a standard, with an open Web service API for systems to keep their cached copy of data up to date, ensures that C2 vendors can support new revisions of standards as soon as they are published
- End users of Run-time download API aware C2 packages will be able to use new standards immediately on publication, enabling everyone to update quickly resulting in consistency of the version of the standard being used throughout the military

#### ***b) Increased knowledge and awareness of Standards***

As already discussed, the Community of Interest (CoI) in standards is wide and diverse, ranging from the operational end users, who use standards operationally, to the developer concerned with the intricacies of the standard. A Computer Based Training (CBT) package which allows anyone from this broad spectrum to access the appropriate knowledge in the relevant detail in his own time will promote the common understanding of the issues necessary to ensure that standards properly support the operational requirement.

The benefits of a Computer Based Training (CBT) service could include:

- New and/or experiences users can introduce/familiarize themselves with military standards
- Promotes greater understanding of the standard generally
- Users are able to work at their own pace
- Users are able to select the modules which most apply to their area of work/expertise
- Users can return to familiarize themselves with modules as many times as necessary
- Standards are presented to the community consistently, leaving little room for misinterpretation

***c) Responsive to changing user needs***

The lack of user involvement in the management of standards plays a large part in why individuals are reluctant to adopt and maintain standards. An online capability to create and submit new Change Proposals via the appropriate Service Co-ordination authority (SCA), or Sponsor, would enhance user involvement and address this issue.

Take for example a Symbology Change Proposal Development Wizard, providing the capability to create, submit and monitor the progress of a new Symbol or Graphic to a Symbology standard. A step by step Web based tool could walk the user through the process of creating a new Symbol, maximizing the use of existing standard components and leaving less room for user error.

The benefits of such a Change Proposal Development Wizard include:

- A user friendly tool that automates the Change Proposal process, leaving less room for error
- Enables all users to feel they can influence the standard and that it is a fast, responsive service able to meet the challenges of keeping up with changes in operational requirements and procedures
- Ensures that Service co-ordination authorities and sponsors receive better quality Change Proposals
- Enables users to submit Change Proposals making maximum use of existing information and data, simplifying the process for organizations and agencies to maintain development repositories

Figure 6.1 below highlights just how responsive this process could be. A user, uses the Change Proposal Development Wizard to propose a change to a standard. Through the input of relevant Service Co-ordination Authorities and Sponsors, this Change Proposal is approved, at which point, all fielded Command and Control Systems are automatically updated, using the Download API, to reflect the approved changes to the standard.

### Responsiveness of Change Proposal Wizard

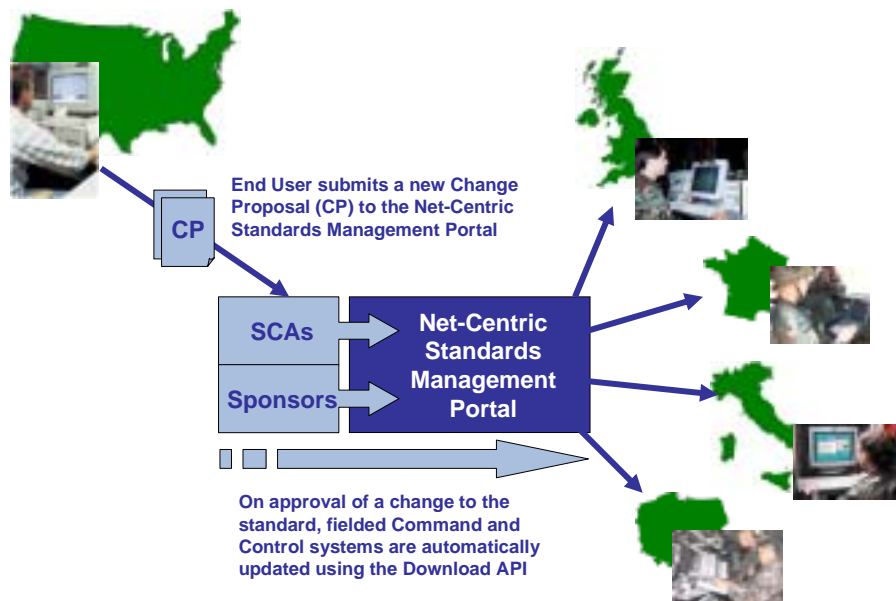


Figure 6.1

#### d) *Intuitive and Flexible*

Traditional standards distribution is in the form of a CD ROM containing PDF and HTML files. Such documentation is cumbersome to search and navigate around, with users often spending the majority of their time simply sifting through inappropriate information.

One of the services offered by Net-Centricity could be that of a Browsing Service offering a simple, but powerful means of searching published data online. The functionality would allow the user to specify complex search criteria based on a combination of property values and keywords.

The benefits of such a Browsing service include:

- The ability for users to navigate around standards via an intuitive graphical representation to find information about specific areas
- The ability to search for specific property values and keywords, enabling rapid identification of data relating to their field of interest
- The look and feel of the information presented to the user can be tailored to users' individual needs through the use of XML and Stylesheets
- Users are provided with a sophisticated search/query facility not available with the more traditional CD ROM based publication

## 7. Summary

There is no doubt that the range of possible Net-Centric services discussed in this paper would significantly enhance the use of standards throughout the military, improving the quality, accessibility, usability and timeliness of standards information when compared to a more traditional paper/CD ROM or static Web site capability. It would enable end users to inform agencies and organizations in a much faster, more efficient fashion of deficiencies in the standard, and in turn, both Sponsors and Service Co-ordination Authorities to react quickly with appropriate updates that could, if required, be made available to Net-Centric systems worldwide in a matter of minutes, though the standards interrogation and download Web services.

The ideas discussed in this paper only touch the surface of how a Net-Centric capability could be utilised to improve the management and use of standards. We have set out a vision for making the users' life easier, but the Configuration Management groups also need to adapt to approve appropriate changes to standards within faster time scales. Close liaison will also need to be maintained with the systems community to ensure the appropriate differentiation between major and minor releases.



## 8. References

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2. NATO STANAG 2019 (APP6) Military Symbols for Land Based Systems
3. ADatP-3 Part 1, Message Text Formatting System (FORMETS)
4. Capability Development Document for Net-Centric Enterprise Services (NCES), DISA, Washington