Net-Enabled Command Capability
NECC INCREMENT 1 DATA ARCHITECTURE

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APPROVAL PAGE

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REVISION HISTORY

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1 NECC INCREMENT 1 ARCHITECTURE – DATA VIEW

1.1 Strategy

In Increment 1, Net-Enabled Command Capability (NECC) will establish an agile and extensible net-centric data sharing environment that supports rapid incorporation of existing and new data sources, so they can be shared across the Global Information Grid (GIG) as Capability Modules (CMs) that can be quickly incorporated into a diverse set of applications or services to support the Warfighter's mission needs.

To accomplish this vision, the NECC data architecture framework aligns both new and legacy data sources with the Department of Defense (DoD) Net-Centric Data Strategy (NCDS) by focusing on these key data concepts:

1. XML (eXtensible Markup Language) as a Key Data Interchange Format – migrate from custom proprietary data interchange formats to open and understandable formats based on XML technologies. These include:
    a. Layered and Extensible Data Models
    b. Key Horizontal Data Formats – those that apply across multiple Domains or Communities of Interest (COIs), such as the Geography Markup Language (GML).
2. Data as an Enterprise Resource – Migrate from system-specific access mechanisms to common access mechanisms.
3. Patterns for Discovery – Migrate from pockets of information to discovery patterns that will enable data discovery across the enterprise.
4. Adoption of or migration towards COI vocabularies in the appropriate context from system-specific interfaces.

The objective of the NECC data architecture is to provide design guidance about these key data concepts to allow disparate data sources to plug-in to the NECC and NCES net-centric data sharing environment. The focus of this strategy is to provide web service access to data, while allowing the use of disparate data sources. The CMs will implement this strategy by exposing data as a resource, along with associated discovery metadata. Implementing this vision does not require modification of the back-office infrastructures or internal data representations.

1.2 Scope

This document discusses the NECC Increment 1 Data Architecture. Other aspects of the architecture are discussed in the related documents listed below.

1.3 Related Documents

NECC Increment 1 Software Architecture, version 1.0

NECC Increment 1 Physical Architecture, version 1.0

NECC Increment 1 Technical Operations Architecture, version 1.0

NECC Increment 1 Information Assurance Architecture, version 1.0

NECC Developer's Handbook, version 1.0

Intelligence Community Multi-Domain Dissemination Implementation (IC MDD) Guide, version 1.0a

Intelligence Community Information Security Markings (IC ISM) Implementation Guide, version 2.0.3

2 Key Concepts

2.1 Data Architecture Concepts

The elements around which the NECC data architecture is built are the Data Asset, Information Resource, XML Schema, and the DoD Discovery Metadata Specification (DDMS) metacard. Figure 1 shows the relationships and linkages among these and other elements.

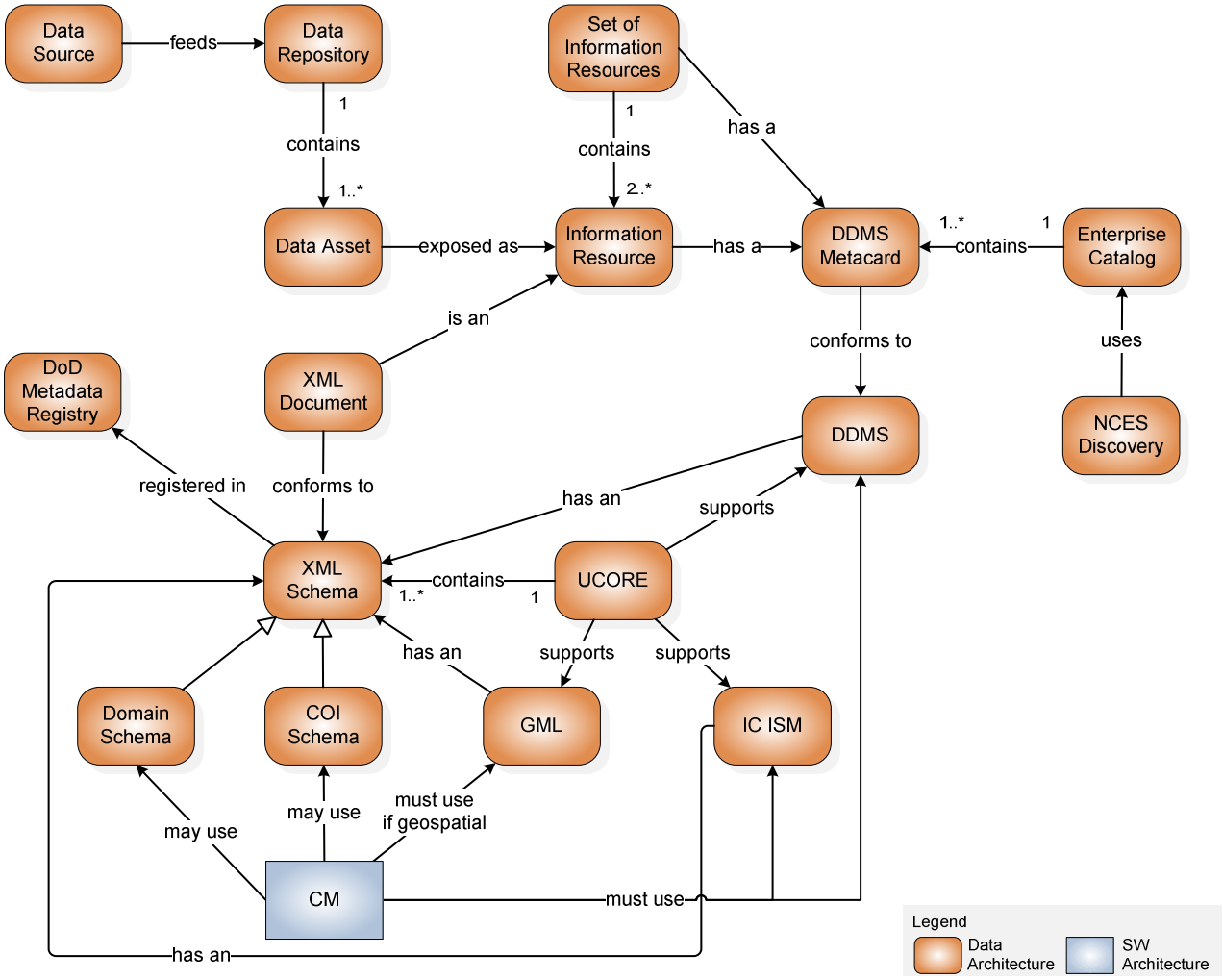

Figure 1: Data Architecture Concepts and Their Relationships

An information resource has the property that it can be entirely conveyed within a message or stream of data. Information resources include text, documents, images, audio, video, sensor observations, and streams of data (e.g. audio or video streams). The other concepts depicted above are discussed below.

2.2 XML as a Key Data Interchange Format

One of the key goals of the DoD's Net-Centric Data Strategy is to "Make Data Understandable." This tenet is primarily concerned with the registration of XML Schemas and vocabularies in the DoD Metadata Registry, so that it is available for CM developers and COI collaboration and to promote integrity in the testing process. In addition, this section describes how the NECC program uses XML technologies and related best-practices to support this goal.

The NECC program will be both the producer and consumer of data across numerous COIs. In most cases, this data will be shared by exchanging one or more XML documents. Of course, NECC also uses industry standard formats for exchanging multi-media products (e.g., video, imagery, audio, and Office products) and for data exchange (e.g., geospatial exchanges using GML).

Using XML as a Data Interchange Format enables the NECC program to leverage a ubiquitous XML technology-base to process and manipulate data, rather than requiring numerous proprietary tools to process data.

XML Schemas are required. Document Type Definitions (DTDs) are not an NECC approved method for specifying XML formats.

The XML language provides great flexibility to describe information content. However, the XML technology alone is insufficient to achieve the DoD's Net-Centric Data Strategy goals. To achieve the goals, designers must apply all the key concepts discussed in section 1.1. The next two subsections discuss two of these key concepts in more detail.

2.2.1 Layered and Extensible Data Model

Except in cases where binary data formats must be used, as in the cases of imagery and video, as well as cases in which a bridge (a mediator) to the tactical edge is necessary (e.g., Link-16 in-flight following), NECC data will be published as XML. This XML must be constructed against schemas recognized by NECC for use in Increment 1. Rather than imposing a single schema on all XML documents, NECC has adopted a layered model, as depicted in Figure 2.

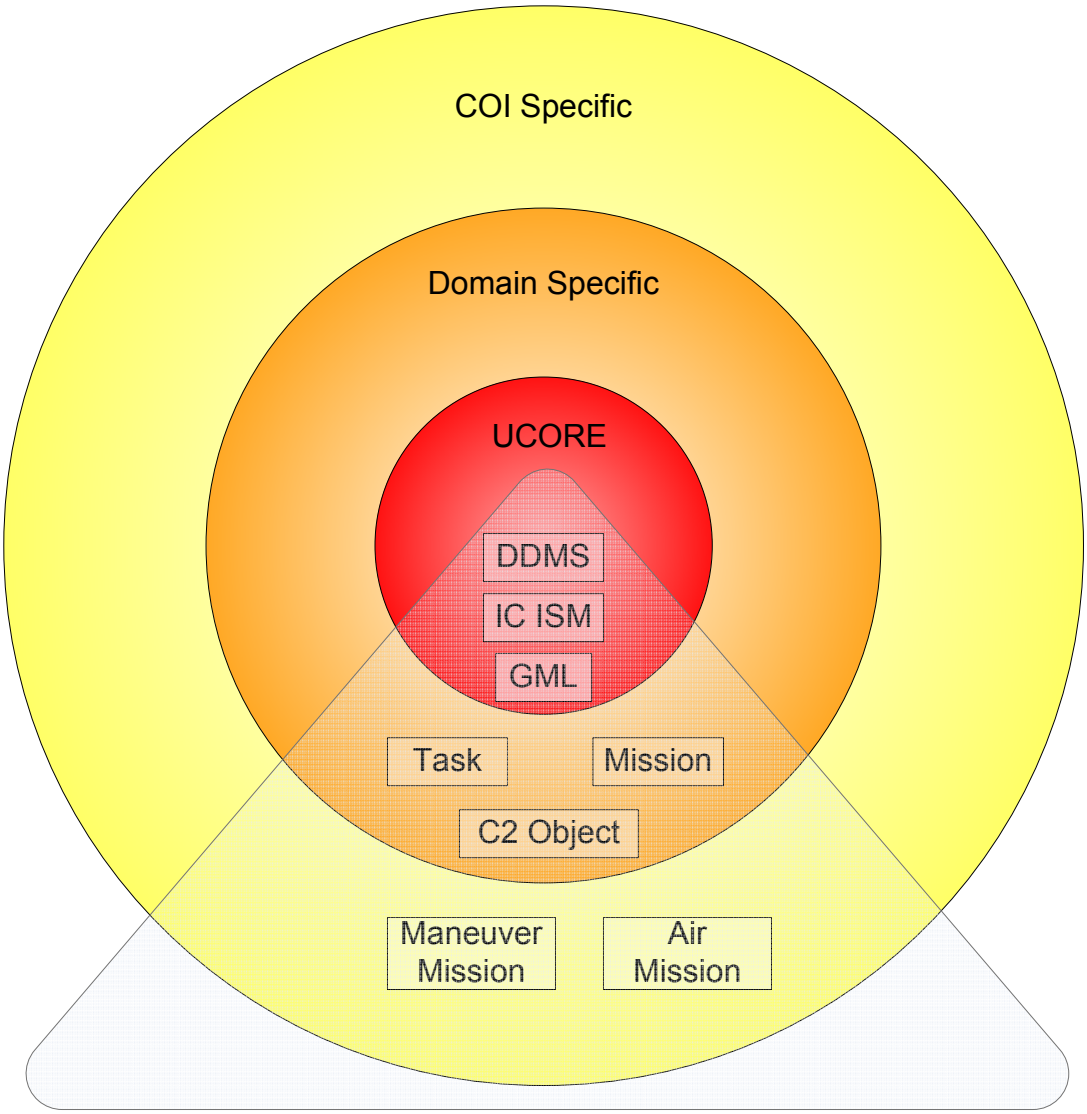

Figure 2: NECC Layered Schema Conceptual Model

At the center of this model is a lightweight core of elements from a small set of standard schemas. This small core, the Universal Core (UCORE) contains the only elements which are common across all CMs. At a conceptual level these are concepts that persist across many COIs, such as geospatial, time, security classification and dissemination control markings, and discovery metadata.

Moving out from the core, the next layer is Domain Specific. This layer consists of schema sets which are specific to a functional domain. These schemas represent the descriptive data that often describes what the object is that crosses related COI lines, such as the Joint Command and Control (J2C) area. The outer-most layer represents COI specific schemas. An example of this would be the Meteorologic and Oceanographic (METOC) schemas used to describe operational and operationally predicated weather products. If a COI has defined an NECC-approved schema, then CMs within that COI must use that schema.

The augmentation with Domain and COI vocabularies is defined initially in the CM specifications. It takes the following general form:

1. Direct guidance to use a particular Domain or COI vocabulary (e.g., XML Schema), when it exists.
2. Direct the use of a hybrid, such as Universal Core (GML profile with IC ISM), then augment with Domain and COI vocabularies (e.g., Blue Force Ground).
3. Work directly with two or more COIs and CMs to mature in parallel (e.g., the METOC COI and the Weather CM).
4. Propose another solution; in the interim between the proposed solution and its acceptance, the JPMO will engage the Joint Command and Control (JC2) Capability Portfolio Manager and the Joint Combat Capability Developer along with the applicable COI for support and adoption.

CMs may be granted permission on an exception basis to use custom schemas for CM specific data only on an interim basis. This requires specific approval by the JMPO.[1]

The set of core elements provides broadly applicable data interoperability. Using the COI schemas allows NECC to leverage the work of domain experts. This strategy supports the spectrum of data consumers: from the unanticipated user, who needs general information, to the Subject Matter Expert (SME), who needs very detailed information.

It is important to note that for those CMs that are not geo-centric, the use of GML as indicated in the core doesn't make sense.[2] Thus some core schemas are not applicable to all CMs.

2.2.2 Key Horizontal XML Data Formats

As stated above, the NECC program will be both a producer and consumer of data across numerous COIs. There are several concepts that are cross-cutting in nature and transcend these individual COIs. Rather than have each COI develop a unique vocabulary for these concepts the NECC program will leverage four key XML vocabularies:

1. GML – is an XML vocabulary to encode geospatial information. The GML XML encoding (ISO 19136) is a reference implementation, in the World Wide Web Consortium (W3C) XML Schema language, of the family of geospatially-related set of ISO Standards managed under ISO TC211—The ISO 191** family of standards.
2. ISO 8601 – ISO 8601 defines standard representations for date and time. The W3C XML Schema language has defined XML data types (e.g., xs:dateTime) that represent a profile of the IS0 8601 standard.[3]

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[1] This case is reserved for CMs needing interim solutions in advance of formal COI adoption of CM proposed formats and vocabularies. These schemas and vocabularies are required to be registered in the DoD Metadata Registry under an appropriate Governance Namespace.

[2] The concept of the Core and Domain/Custom data schemas is consistent with Universal Core definitions: http://collab.core.gov/GetAttachment.aspx?id=20122&pname=attachment&lang=en-US&aid=8476

[3] See http://www.w3.org/TR/NOTE-datetime.

3. Discovery Metadata – The DoD has defined the DDMS to describe the discovery metadata associated with any information resource. The DDMS also employs GML, W3C Profile of ISO 8601, and the IC ISM.
4. Marking of Security Classification and Dissemination Controls – The Intelligence Community (IC) has defined a set of XML attributes in an XML Schema that is used specifically to mark-up information resources with security classification and dissemination control markings. This set of attributes is called the IC ISM. The IC ISM is supported by the IC ISM guide as well as the IC Multi-Domain Document (IC MDD) and the IC Metadata Standard for Publications, (IC MSP) that provide implementation and usage guidance on applying the IC ISM.

Tagging data refers to the following three activities:

1) **Encoding the resource in XML when exchanged;**
2) **Using IC ISM to convey the security classification and dissemination controls; and**
3) **Ensuring that a DDMS metacard (DDMS conformant XML document) for the information resource exists and is available via NCES Federated Search.**

2.3 Data as an Enterprise Resource

One key goal of the DoD Net-Centric Data Strategy is to make data accessible. This section describes how the NECC program uses the concept of "Data as an Enterprise Resource" to support this goal.

This concept focuses on migrating data sources from system-specific interfaces, towards treating all data assets as enterprise resources. It supports the goal of making data accessible by modeling data assets as individually addressable information resources that are accessible via common access mechanisms, per the NECC Enterprise Resource Pattern, also known as the Web Services Management Resource Access Pattern (see the NECC Software Architecture document).

An XML document resource is an information resource that is an XML document. In the notional figure below, a data repository's data assets are modeled as one or more individual XML document resources. Optionally, these individual XML document resources could be organized into one or more Sets of Information Resources, [4] as indicated in Figure 4. Since individual XML documents and sets are resources, both are individually addressable. Therefore, these entities can have links to other local or remote resources.

Although information resources are exposed as XML to the enterprise, this does NOT imply that the underlying data is natively XML, nor that the underlying data model follows an Object-Collection paradigm. However, they are exposed to the enterprise as though they were.

[4] Sets can also be composed of a hierarchy of sets.

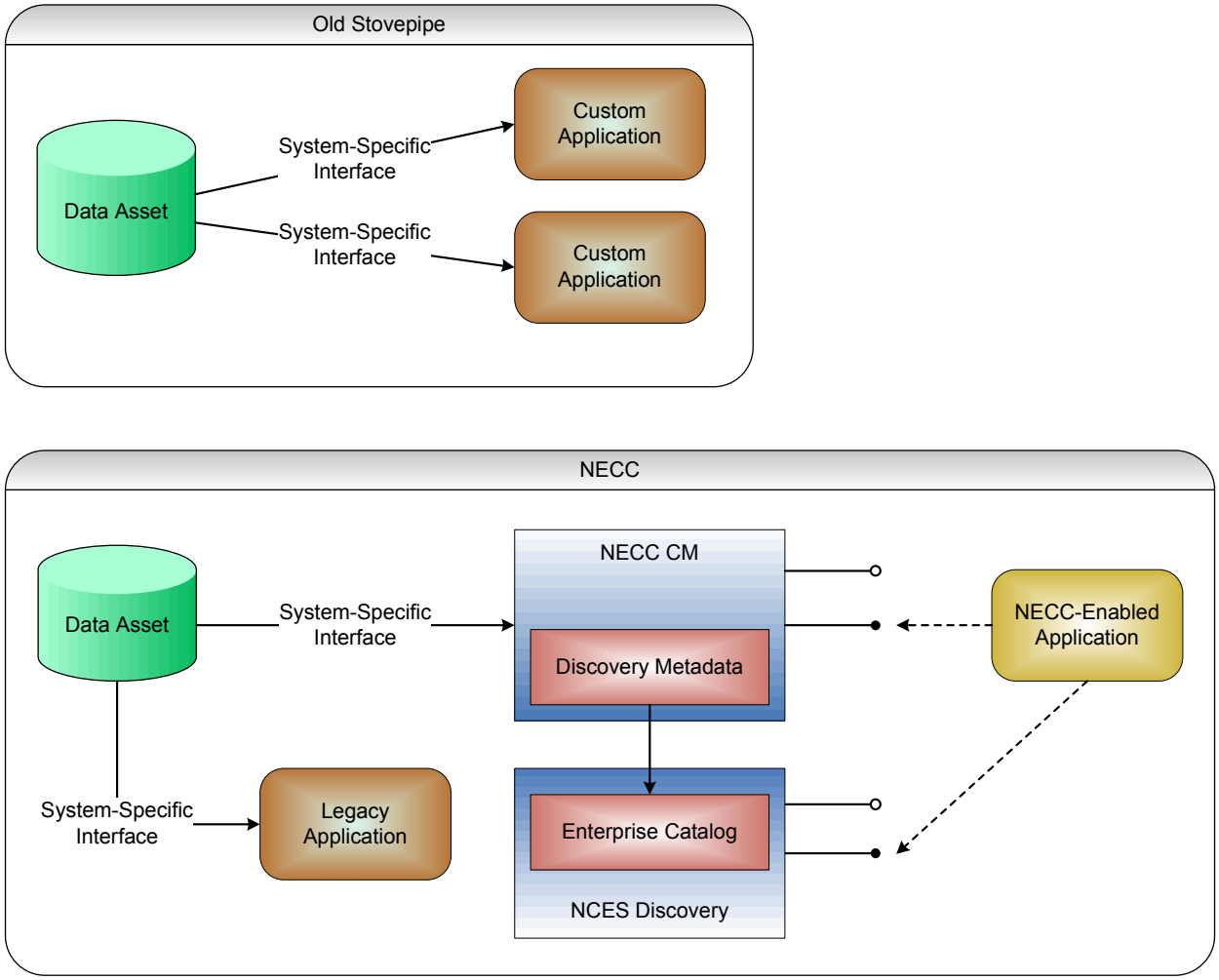

Figure 3: Exposing NECC CM Data Assets as Enterprise Resources

One of the key engineering decisions the CM developer needs to make is the granularity of the resources. Too fine-grained may require a data consumer to make many access calls to retrieve the necessary information for their application. Too coarse-grained may require the data consumer to process a large XML document to retrieve a relatively small amount of information that is necessary for their application. The CM developer will determine optimal granularity via analysis of use-cases. Over time, this granularity may evolve as unanticipated users become known stakeholders. Another engineering mandate is to design for information resource accessibility to the unanticipated or ad-hoc user.

Discovery in NECC shall be biased towards the widest possible accessibility and lowest security classification level. This supports both unanticipated and anticipated users. This means starting with the discovery needs that are already inherent in the CM and consistent with the underlying capability the CM is exposing. In general, the existing community needs for search capabilities are understood by the relevant SMEs.

2.4 DDMS Metacards

One of the key goals of the DoD's Net-Centric Data Strategy is to "Make Data Discoverable". This section describes how the NECC program uses DDMS metacards to support this goal.

Information resources are made discoverable by the generation of DDMS conformant XML documents known as metacards. These metacards are then stored either locally or in the NCES Enterprise Catalog. If stored locally, the local metacard catalog must be made visible to the NCES Federated Search, using the established Application Programming Interfaces (APIs).

Information resources span the gamut from individual spot reports to a battle plan for a major combat operation. Clearly, different strategies will be applicable for different types of information resources. This section attempts to address the following questions:

1. What information resources should be described with a DDMS metacard?
2. When should a DDMS metacard be generated? In other words, what kinds of event triggers should drive the creation of DDMS metacards?
3. At what point in the process or architecture is a DDMS metacard created? Are they manufactured *a priori*, or at run-time via a service?

The following example describes a pattern for discovery.

To help illustrate the concepts, consider an Intelligence Surveillance and Reconnaissance (ISR) video service. An ISR video service receives a real-time video stream; it processes this stream, creating discrete video clips, and stores them in a video repository. Furthermore, it indexes key events of interest (via analysis products) and exposes relevant annotated clips or video stills as a service.

2.4.1 How Metacards are Allocated to Information Resources

There are two patterns for allocating metacards to information resources: one metacard per individual resource or one metacard per set of information resources (see Figure 4).

1. Individual resource – a DDMS metacard that describes the individual information resource. In the ISR video service example,
    a. The live video stream offered by a particular ISR collector would be described by a DDMS metacard.
    b. Each individual video clip would have a DDMS metacard (e.g., metadata such as "Video Clip #1 from location XYZ from time T1 to time T2).
    c. Post processing (annotated) video clips would have a DDMS metacard that indexes items or events of interest.
2. Set of Information Resources – a DDMS metacard that describes a set of information resources. In our example, the video service repository would have a set of video clips from the various ISR collectors that store their clips in that repository. The DDMS metacard would describe the aggregate set of video clips (e.g., metadata such as "Video Clip Repository that contains 250 video clips the earliest one occurring at time T_0 and latest occurring at time $T_{n,}$ with the Video clips contained within geographic region ABC").

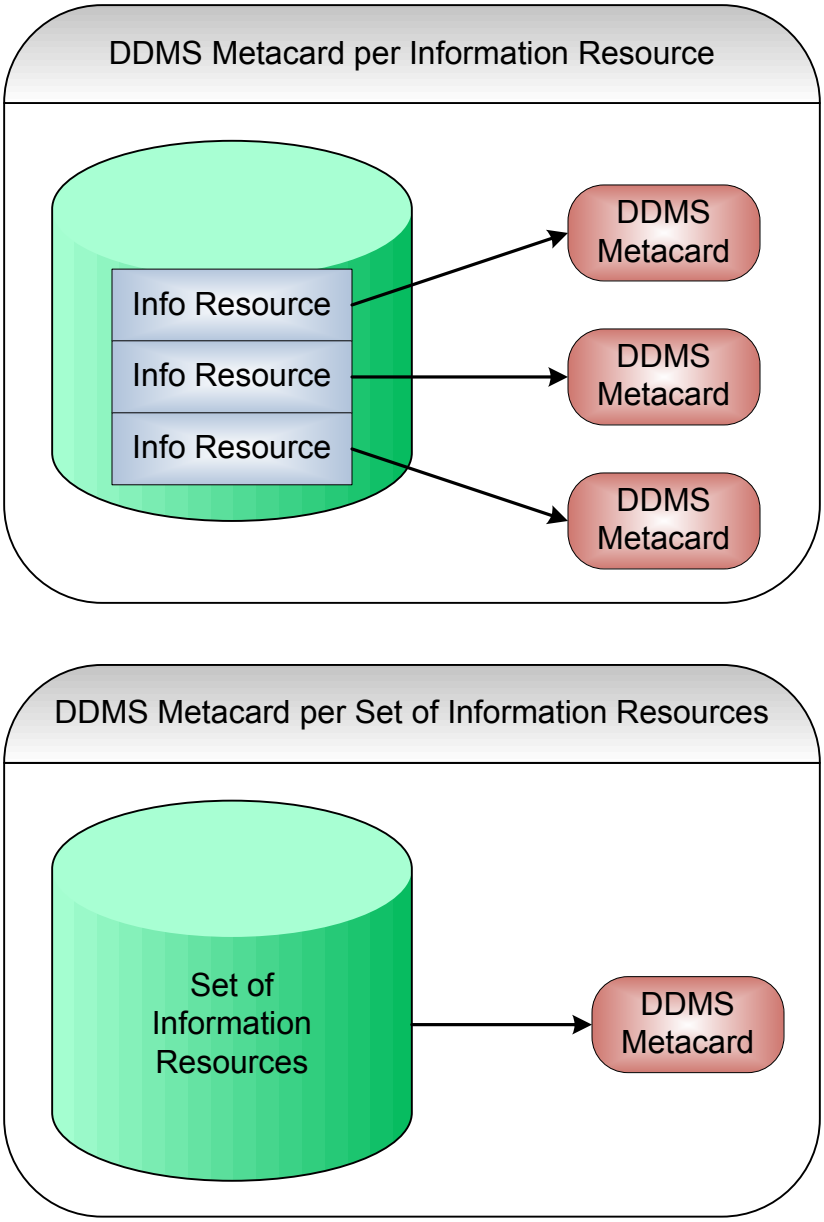

Figure 4: Allocating DDMS Metacards to Information Resources

2.4.2 Discovery Patterns

There are two patterns for determining when to generate DDMS metacards (see in Figure 5).

1. *A priori* Metacard Generation – the service generates DDMS metacards when the information resource is created (or modified). In our example, the video service would create a DDMS metacard when a new video clip is inserted into its repository. This DDMS metacard is exposed to the enterprise either by publishing the DDMS metacard to the NCES Enterprise Catalog, or via a Federated Search interface implemented by the video repository.

2. Event-Driven Metacard Generation – the service creates a DDMS metacard when an external source requests metadata about a relevant information resource. This implies the implementation of a web-service that supports discovery on demand. This should be accomplished by implementing the NCES Federated Search Interface. This pattern is typically invoked when the information resources being exposed are highly dynamic and the registration of static *a priori* DDMS metacards would be imprudent.

All of these questions are concerned with the architectural patterns that are to be leveraged in a particular case to ensure that the visibility and accessibility goals of the Net-Centric Data Strategy are met. For any particular CM, the approach to discovery should be based on known user needs and requirements of the capability being developed, and the requirement to support the unanticipated user.[5] Indeed in many cases, the *a priori* and event-driven metacard generation strategies will be used in tandem.

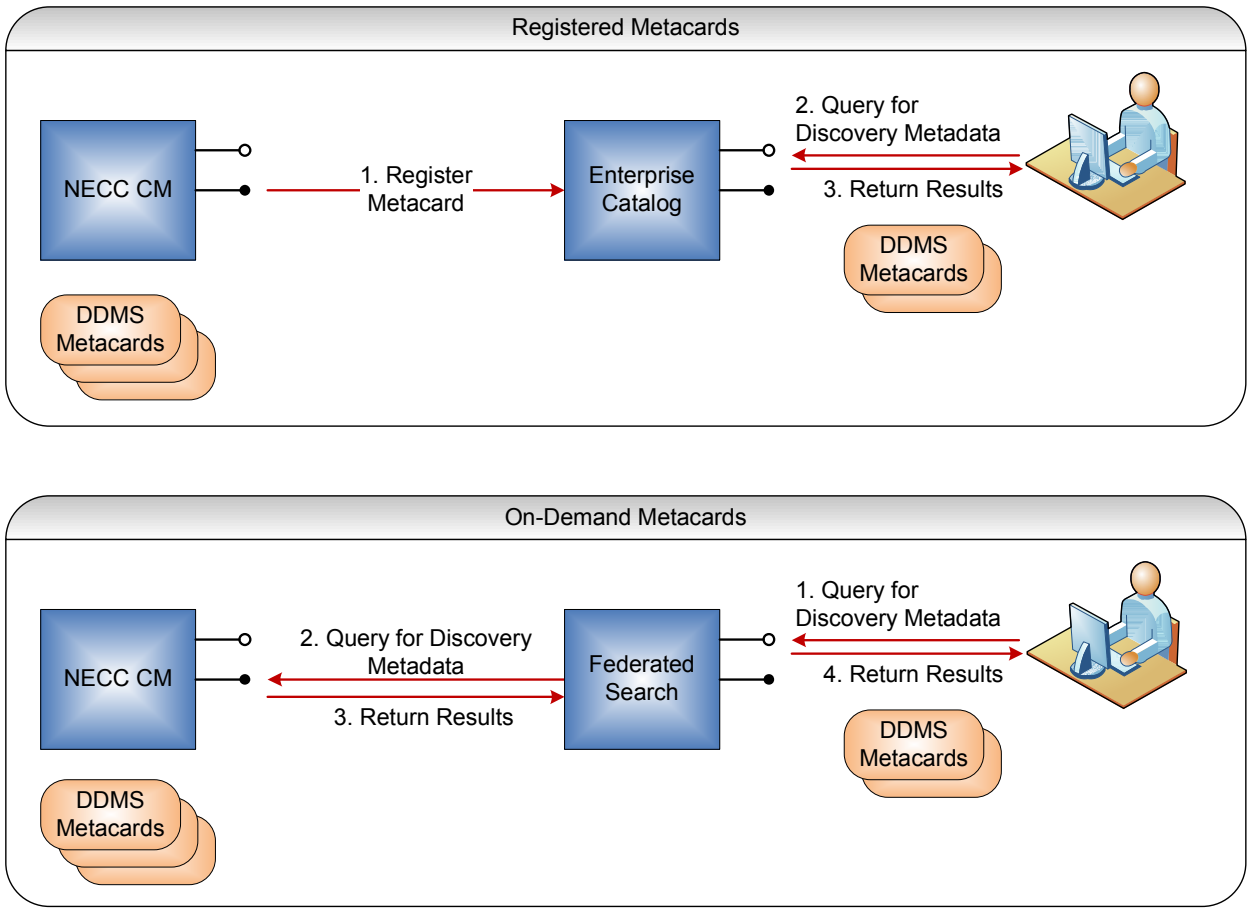

Figure 5: NECC Patterns for Discovery

[5] A CM's implemented patterns for discovery will evolve as the unanticipated-user community becomes a known stakeholder.

2.4.3 Security Markings

Data services must tag data resources with IC ISM security attributes. Furthermore, if data services are required to disseminate data between security, multinational or interagency domains, they shall employ a tearline model when tagging data resources with IC ISM security attributes, as specified in the IC Multi-Domain Dissemination Guide. This model will allow NECC to take advantage of upgrades in XML cross-domain solutions.

3 IMPLEMENTATION GUIDANCE

3.1 Alignment with the DoD Net-Centric Data Strategy

For Increment 1, alignment with the NCDS means focusing on three key goals: making data discoverable, accessible, and understandable.

The following sections provide CM developers with the technical guidance required to align with the NCDS. Additionally, this technical guidance specifies the key standards, the NCES Services, and the other NECC CMs that developers must use.

In the guidance that follows, the word "shall" denotes a threshold requirement and the word "will" denotes an objective requirement.

3.1.1 Make Data Discoverable

In order to support the DoD NCDS tenet of making data discoverable, data service developers must observe the following guidelines.

- The XML schemas of data resources shall be registered in the DoD Metadata Registry (MDR).
- Data services shall be registered in the NCES Service Registry. Part of the registration process requires that metadata be provided which is consistent with DDMS and the NCES Service Registry Requirements.
- Data services shall assert references to taxonomies as mandated by NECC.
- DDMS metacards shall be generated for information resources made available via Data services.
- Data services shall be accessible per the web service access mechanisms identified in the NECC Software Architecture Framework.
- Data services will support NCES Federated Search APIs to query the data service for relevant information resources.
- Data services will support NCES Federated Search APIs to access data resources, i.e., return the information resources to the requestor.

3.1.2 Make Data Accessible

In order to support the DoD NCDS tenet to make data accessible, data service developers must observe the following guidelines.

- Data services shall register their web service endpoints with the NCES Service Registry.

- Data services shall provide secure access via the NCES Security Services per the NECC Increment 1 Security Architecture Framework to support secure access to all data services.
- Data services shall provide retrieval mechanisms (synchronous or asynchronous) per the web service access mechanisms identified in the NECC Increment 1 Software Architecture Framework.
- Data services will provide filtering support for synchronous and asynchronous web service access mechanisms per the filtering standards identified in the NECC Increment 1 Software Architecture Framework.
- Data services will provide full Create/Retrieve/Update/Delete (CRUD) capabilities consistent with the applicable user roles per the web service access mechanisms identified in the NECC Increment 1 Software Architecture Framework.
- Data services shall provide a browser-based interface to interact with the data service. The browser-based interface shall provide capabilities to retrieve information resources from a data service.
- Data services will provide a mechanism to establish subscriptions to the data service.
- Data services shall tag data resources with IC ISM security attributes.
- Data services shall employ a tearline model when tagging data resources with IC ISM security attributes (refer to the IC MDD guide).

3.1.3 Make Data Understandable

In order to support the DoD NCDS tenet "make data understandable", data service developers must observe the following guidelines.

- Data services that are geospatial in nature and intended for map display shall use GML to encode geospatial with temporal representations associated with information resources.
- Data services shall use registered formats, (i.e., those registered in the DoD Metadata Registry) to encode common aspects of information resources.
- Exposed data services shall expose information resources in industry standard data representations.
- All structural metadata, e.g., XML schemas developed in conjunction with CM development shall be registered in the DOD Metadata Registry.

3.2 Technical Standards

The following table details the key data standards to support the NECC data architecture.

Table 1: Technical Standards

Standard	Version	Purpose
XML Schema	V1.1	Encoding XML content.
XML Path Language	V1.0	Accessing an XML document.

XML Query Language	V1.0	Query an XML data source.
Geography Markup Language	V3.2.1	XML encoding geography and temporal entities.
DoD Discovery Metadata Specification	V1.4.1.1	XML encoding of discovery metadata.
IC ISM	V2.0.3.1	XML encoding of security metadata.
ISO 8601	http://www.w3.org/TR/NOTE-datetime and http://www.w3.org/TR/xmlschema-2/#dateTime	Encoding of time in exchange formats.

4 CONCLUSION

This document has described the major NECC data architecture concepts and implementation guidance applicable for NECC Increment 1. Concepts such as information resources, DDMS metacards, the Universal Core, related XML schemas, and other elements of the NECC data architecture were discussed in this document. Technical standards that materiel developers must follow are also included.

5 REFERENCES

NCES Developer Community

https://www.us.army.mil/suite/page/38284

DDMS Home Page

http://metadata.dod.mil/mdr/irs/DDMS/

Intelligence Community Multi-Domain Dissemination Implementation Guide

https://dnidata.org/schema/IC/MDD/v1.x/IC-MDD-v1.0/docs/IC-MDD-DEDandImplementationGuide-v1.0a.pdf

Intelligence Community Information Security Markings Implementation Guide

https://dnidata.org/schema/IC/ISM/v2.x/IC-ISM-v2.0.3.1/docs/IC-ISM-Implementation-Guide-v2.0.3.pdf

DoD Metadata Registry

http://metadata.dod.mil/

Universal and Common Cores for DoD and DNI, Renner, Scott

http://collab.core.gov/GetAttachment.aspx?id=20122&pname=attachment&lang=en-US&aid=8476