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METADATA BINDING MECHANISM

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NATO LETTER OF PROMULGATION

26 October 2018

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
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1 Introduction

1.1 Background

The NATO Information Management Policy (Reference [3]) guides the establishment of an Information Management (IM) Framework for efficient and effective information management, enabling decision-making by the sharing of information within and between NATO, the Nations and their respective Communities of Interest (CoI). The NATO Security Policy (Reference [2]) and supporting directives cover all aspects concerning the secure handling of information.

In accordance with the NATO Interoperability Policy (Reference [19]) standards are to support interoperability between NATO, the Nations and their respective Communities of Interest to act together coherently, effectively and efficiently to achieve allied tactical, operational and strategic objectives, especially to support the achievement of Information Superiority within an information sharing, networked environment.

This ADatP-4778 is published by the Consultation, Command and Control Board (C3B) and is authorized for public disclosure. It supports the cooperation with external actors in line with the Lisbon Summit decisions on the Comprehensive Approach as well as the following principles of the NATO Information Management Policy and NATO Network Enabled Capability (NNEC) Strategies for Data and Technical Services (Reference [20]):

Information Ownership and Custodianship. Information shall have an originator, and clearly defined ownership and custodianship assigned throughout its life-cycle (Reference [3]).

Information Sharing. Information shall be managed with an emphasis on the 'responsibility-to-share' balanced by the security principle of 'need-to-know', and managed to facilitate access, optimise information sharing and re-use, and reduce duplication, all in accordance with security, legal and privacy obligations (Reference [3]).

Information Standardisation. Information shall have standardised structures and consistent representations to enable interoperability, cooperation and more effective and efficient processes (Reference [3]).

Information Assurance. Information shall be protected by applying the principle of Information Assurance, which is described as the set of measures to achieve a given level of confidence in the protection of communication, information and other electronic systems, non-electronic systems, and the information that is stored, processed or transmitted in these systems with respect to Confidentiality, Integrity, Availability, Non-repudiation and Authentication (Reference [3]).

The Military Committee recommendation on the Implementation of the NATO Federated Mission Networking Capability (Reference [21]) provides the framework for establishing information sharing in a federated networked environment in support of coalition operations. The NATO mission environment is evolving from the current network-centric based security architecture to a data centric based security architecture.

Achieving this data-centric architecture requires the ability to establish trust between information sharing partners. This trust is inter alia enabled by appropriate assurance that Metadata is bound to the data it describes using a standardized approach that allows for a common interpretation of the Binding[1].

The information owner has the authority for setting the rules for handling the information and for protecting the Confidentiality, Integrity, and Availability throughout its lifecycle. If the information owner shares the information with another entity, that entity (information custodian) is responsible to the information owner to manage the information in accordance with the rules established by the information owner.

1.2 Objective

A primary goal of this standard is to ensure consistency in the way that Metadata is bound to information throughout its lifecycle and across different enterprises. This is a necessary step to enabling trust between information sharing partners in a data-centric environment.

The objective of this document is to provide a generally applicable, formal and consistent way to describe and categorise Binding Mechanisms of various types and strengths. The primary audiences for this standard are the capability development and information assurance communities.

[1] A Binding expresses the relationship (or association) between metadata and data (for example, this metadata pertains to this data) that is realized by applying a Binding Mechanism.

1.3 Scope

This document addresses the Binding of Metadata to Data Objects throughout their lifecycle amongst information sharing partners.

NATO Metadata is typically categorized and represented as described in the NATO Core Metadata Specification (NCMS) (Reference [5]). However, this document makes no assumptions about the type of Metadata or the format of the Data Object.

The mechanism[2] presented in this standard specifically address the Binding of Metadata to finite Data Objects.

1.4 Assumptions

It is assumed that the Binding Mechanism specified in this document can support the Binding of any type of Metadata to any type of finite Data Object.

1.5 Constraints

The Binding Mechanism associated with this standard does not demand the modification of existing protocols, Metadata and data formats.

[2] Binding Profiles may also be defined to further specify the semantics (additional information on how a Binding is to be interpreted) depending upon how the Binding is used.

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2 Binding Requirements

2.1 Overview

In the traditional paper based environment Metadata is typically associated with the information by virtue of being included and printed on the same piece of paper. This environment typically handles discrete, predetermined information objects.

In the digital environment there are new information distribution mechanisms that require new ways of dealing with Metadata. This environment provides additional opportunities for assuring the Binding however it also increases exposure to new threats that need to be countered.

Metadata in combination with appropriate information management processes supports:

- Proof of origin;
- Discoverability and availability;
- Integrity and authenticity;
- Confidentiality and information protection;
- Chain of custody;
- Information Sharing.

The Binding Mechanism described in this document supports information management processes in a digital environment.

2.2 Requirements

To enable information sharing, this standard must meet the following minimum requirements:

- Support Binding of additional Metadata without affecting existing Bindings e.g. adding an Alternative Confidentiality Metadata Label (see Reference [6]);
- Support the ability to detect alterations to Data Objects and associated Metadata;
- Support the Binding of Metadata at any time in the information life-cycle;
- Provide the ability to bind Metadata to distinct elements of Composite Data Objects e.g. in support of redaction and/or sanitization of Composite Data Objects before access or release; and
- Supports new, emerging and existing protocols, Metadata and data formats.

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3 Binding Concepts

3.1 Introduction

Binding is the relationship between the Data Object (an example of a Data Object is a spreadsheet) and its Metadata (for example, a Confidentiality Metadata Label (Reference [6])). A Binding is created by applying a Binding Mechanism. Operational circumstances and existing trust relationships may require Bindings of different strengths that provide different levels of assurance for the Integrity of the information, the Metadata and their association.

When a Binding is created both the Data Objects and the Metadata are provided as input to the Binding Creation process. The output of the Binding Creation process is the Binding between the Data Object and the Metadata.

This is depicted in Figure 1.

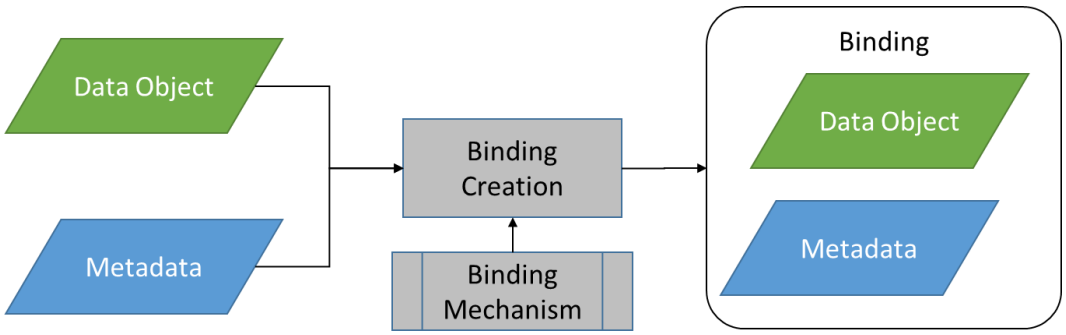

Figure 1: Creation of Binding

Policy and operational requirements may dictate the use of cryptographic techniques to protect the Integrity of the Metadata, the Data Object, and hence the Binding between Metadata and Data Object. The application of the Cryptographic Protection Mechanism results in a Cryptographic Artefact included in the Binding (Cryptographically Protected Binding). This is depicted in Figure 2.

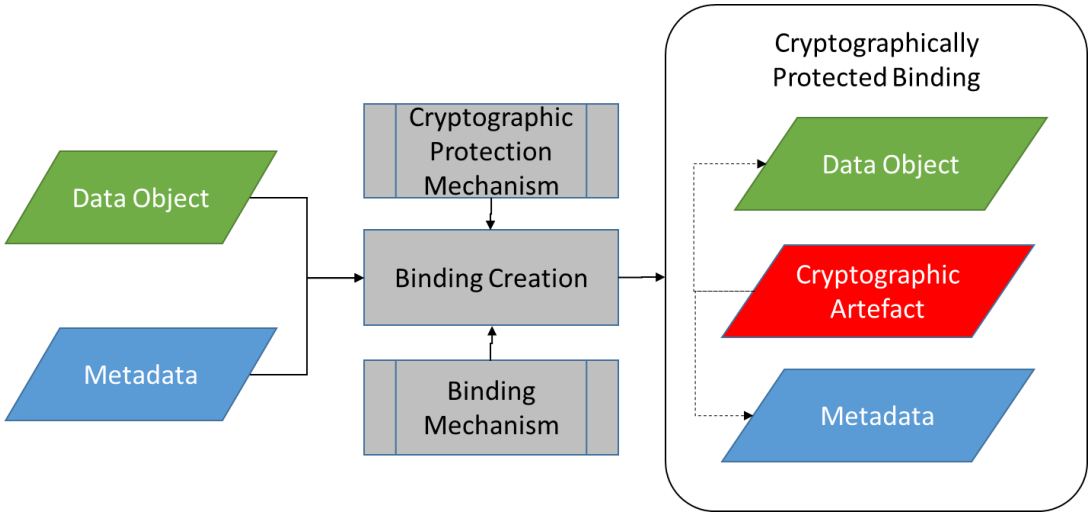

Figure 2: Creation of a Cryptographically Protected Binding

3.2 Binding Approaches

This standard defines three approaches for Binding Metadata with Data Objects[3]:

Encapsulating: The Data Object together with the Metadata is encapsulated within the Binding and is represented by a new Composite Data Object. For example, with eXtensible Markup Language (XML) the Binding may be used as a new Data Object as its root element with the Data Object and Metadata contained directly within the Binding element. This is depicted in Figure 3.

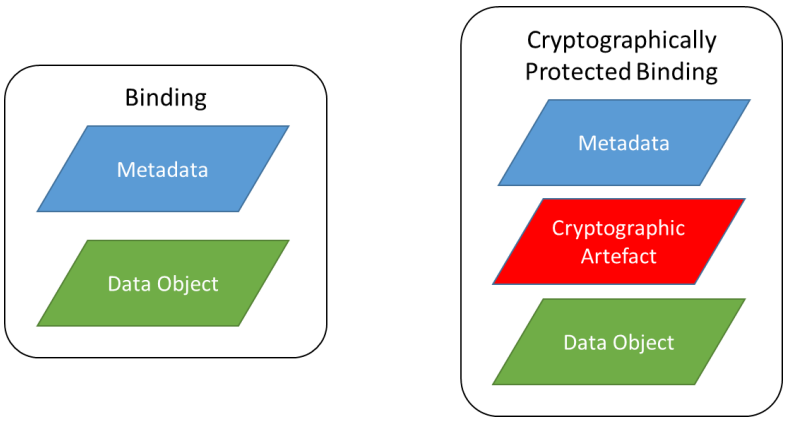

Figure 3: Encapsulating Bindings

Embedded: The Binding is embedded within the Data Object and the Binding contains a reference to the Data Object. For example, an XML Data Object may

[3] Data objects could be single Data Objects or Composite Data Objects.

use a schema that either includes a Binding element, or allows it to be extended with arbitrary elements. This is depicted in Figure 4.

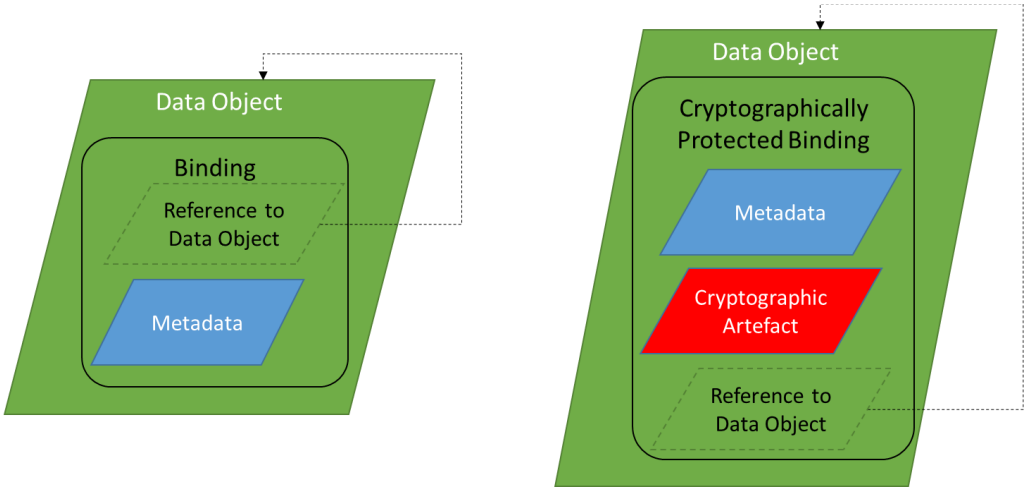

Figure 4: Embedded Bindings

Detached: The Metadata may be stored in a separate structure from the Data Object with the two linked by reference. A detached Binding may be any of the following:

A) a Data Object may be referenced from the Binding (see Figure 5);

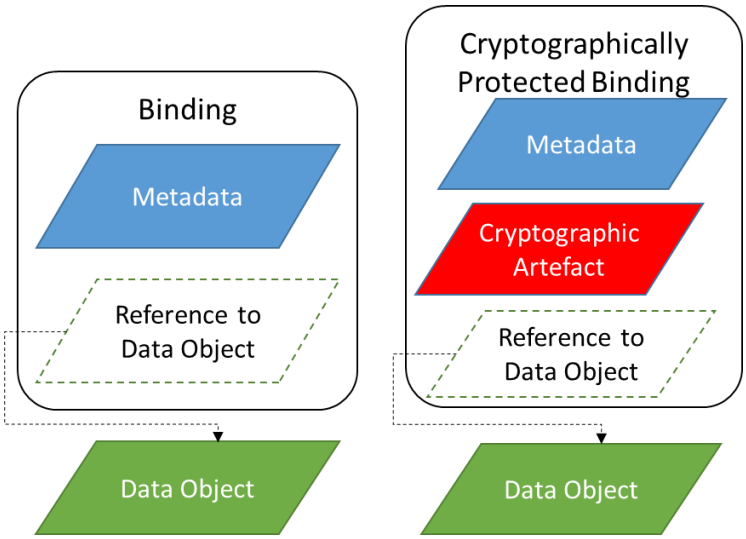

Figure 5: Detached - Data Object Reference

B) Metadata may be referenced from the Binding (see Figure 6);

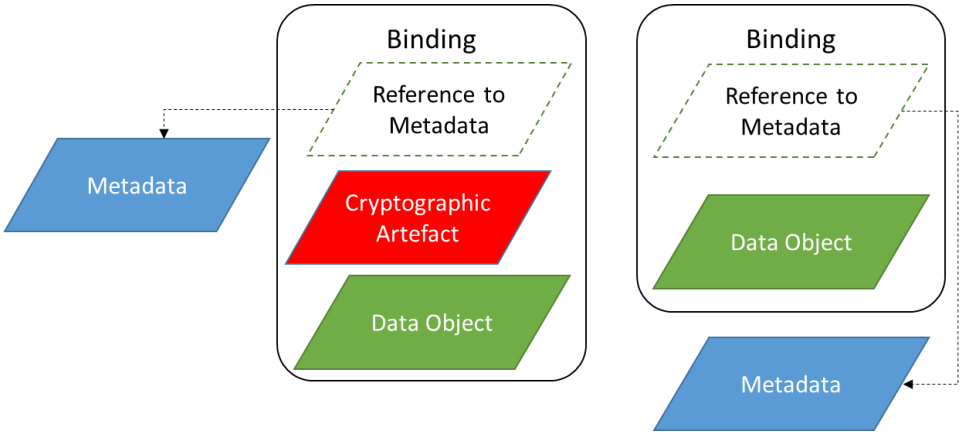

Figure 6: Detached - Metadata Reference

C) both the Metadata and a Data Object may be reference from the Binding (See Figure 7).

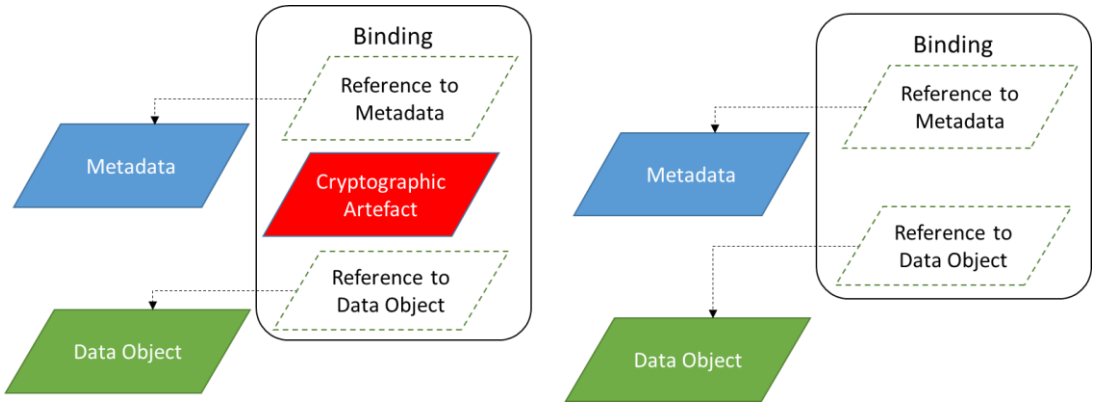

Figure 7: Detached - Metadata and Data Reference

D) the Cryptographic Artefact may be reference from the Binding (see Figure 8 and Section 3.3).

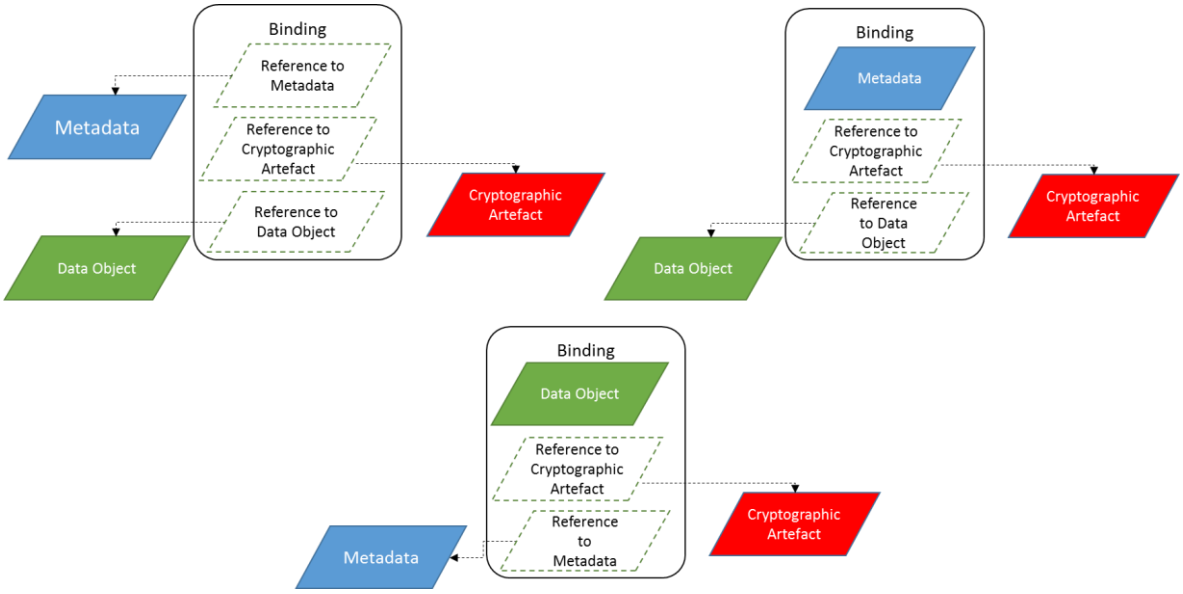

Figure 8: Detached – Reference to Cryptographic Artefact

For example, a separate file containing the Metadata and the Binding element may reference an XML or JPEG file within a file system via a Uniform Resource Identifier (URI).

Which Binding approach to choose depends on many factors and therefore this standard cannot prescribe if and when to apply a particular Binding approach. These Binding approaches may be applied iteratively and in any combination.

3.3 Binding Information

For each approach described in Section 3.2, the visualization of the Binding is a logical visualization; no assumptions are made on the details of the Binding Mechanism or how the Binding is recorded.

The set of Metadata (or references thereto), Data Objects (or references thereto) and Cryptographic Artefact (in the case of a Cryptographically Protected Binding) is referred to as Binding Information. The Binding Information can also include the compound of the Metadata Binding and the Cryptographic Artefact. The Binding Information may be represented and stored in XML as specified in Chapter 4: Metadata Binding Mechanism which provides an open and flexible mechanism that can be integrated with a wide variety of data types. Other grammars such as Extended Backus-Naur Form, formatted text, etc. may also be used if they can be validated against the standard. The structured representation of Binding Information is referred to as a Binding Data Object (BDO).

3.4 Management of BDO

Combining multiple Bindings allows a single BDO to cover large sets of Data Objects with various Metadata. However, it is recommended that a dedicated BDO should be created for each frequently accessed Data Object that independently exists within the data-centric environment to support the following requirements:

- Allow for efficient lookup of Metadata for a specific Data Object;
- Require minimal changes to the BDO;
- Mitigate the impact of denial of service attacks aimed at preventing information management services from processing the BDOs; and,
- For a Cryptographically Protected Binding, allow the verification process to efficiently access all Data Objects or Metadata.

Figure 9, Figure 10 and Figure 11 are provided to illustrate differences in the three Binding approaches in the context of BDO. In these examples the Binding Information is represented as XML BDOs that include the Metadata Binding or the compound of the Metadata Binding and the Cryptographic Artefact such as a Digital Signature element. Binding Information management for the storage, availability and accessibility of BDO is further described in Chapter 4: Metadata Binding Mechanism.

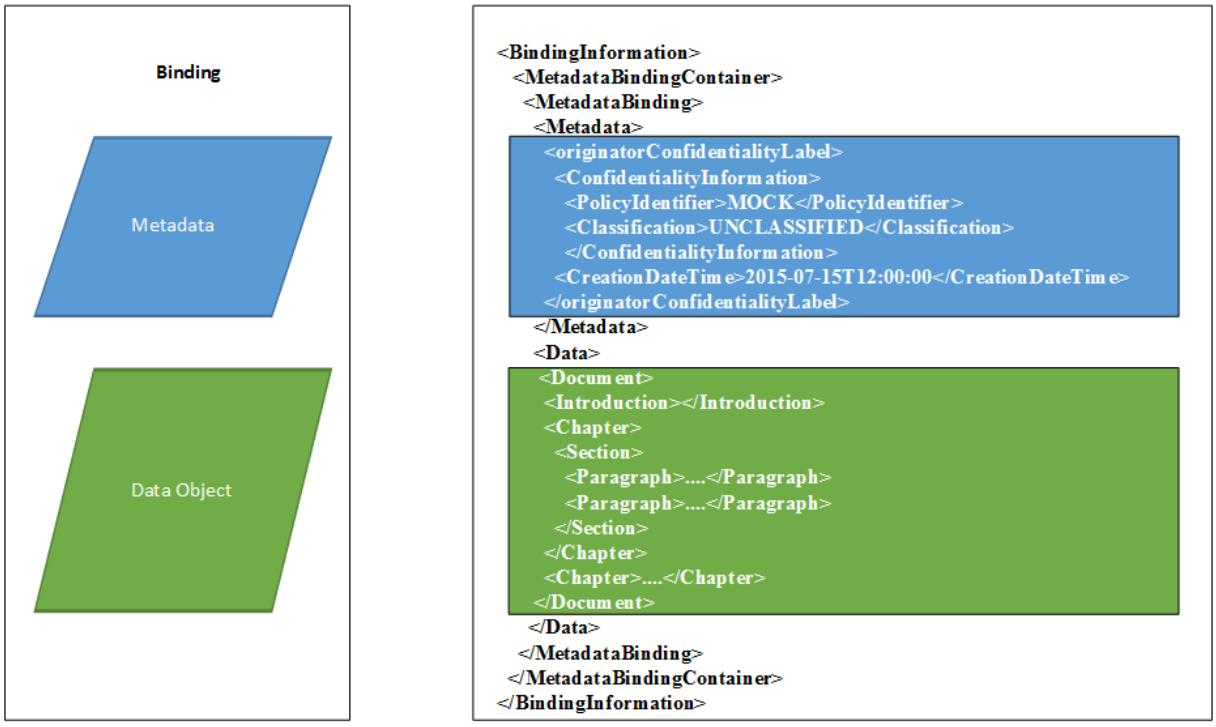

Figure 9: Encapsulating

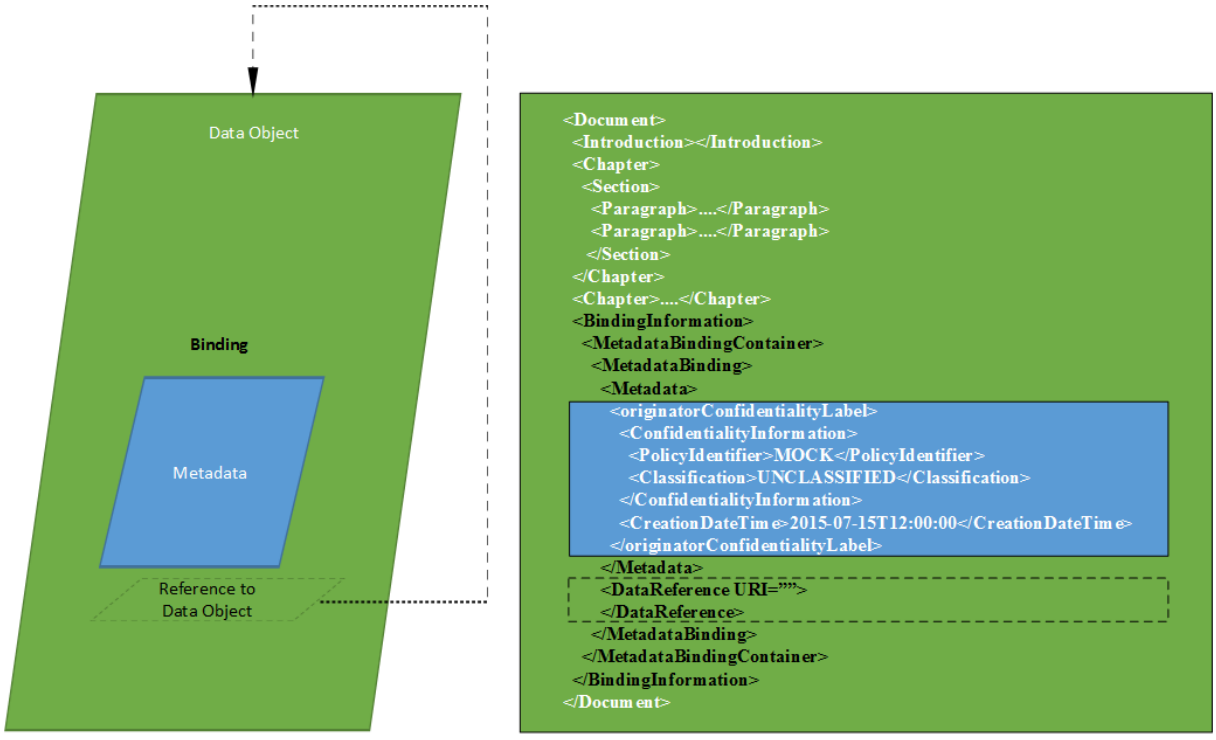

Figure 10: Embedded

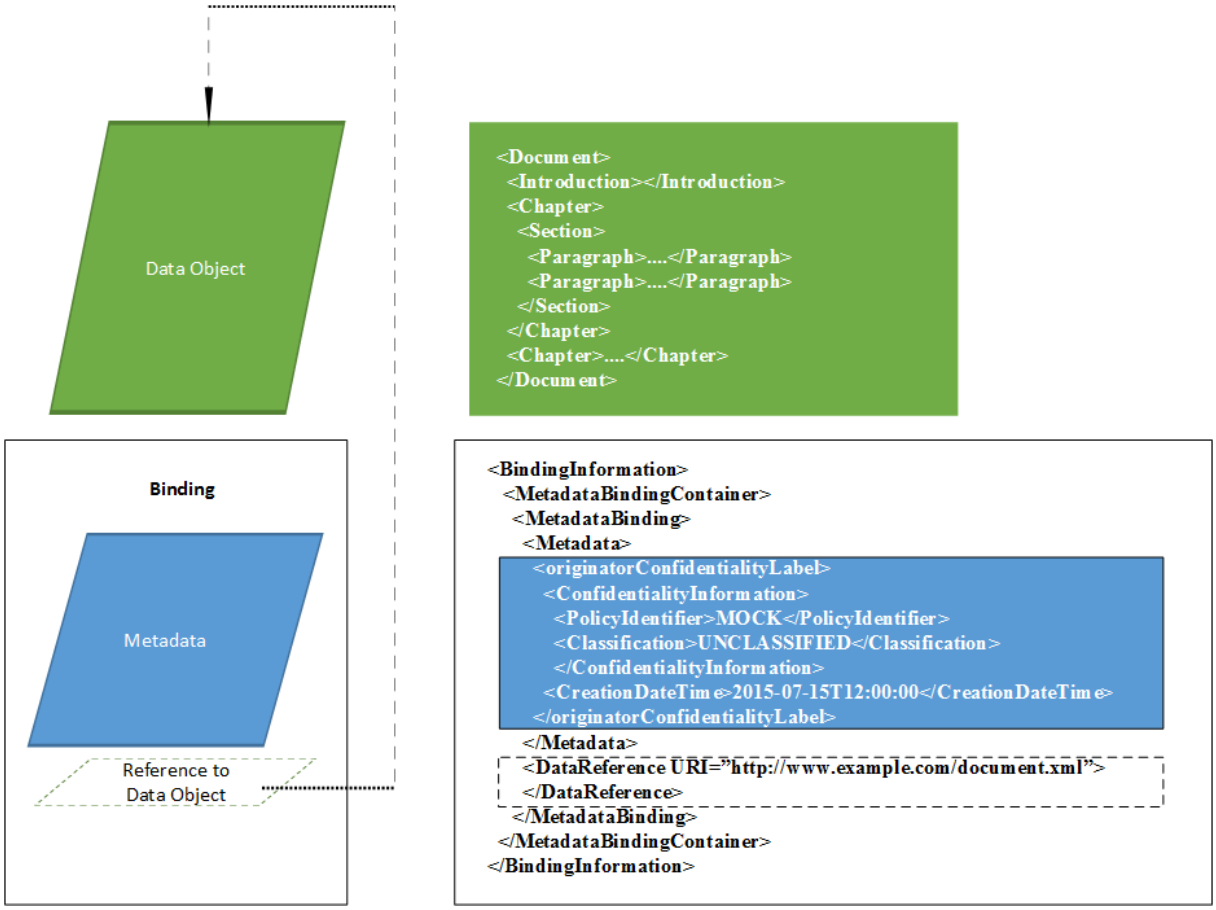

Figure 11: Detached

3.5 Granularity of Bindings

To support the effective and efficient use of information resources in a data-centric environment, information management policies need to be applied at a granular level for Composite Data Objects.

The granular Binding of Metadata to subsets of Data Objects (e.g. individual Data Objects that are part of Composite Data Objects) can be expressed in the following business rules for associating Metadata to subsets of Data Objects:

- Rule 1: If a Composite Data Object has Metadata bound to it, any contained (child) Data Objects inherit the Metadata of the parent unless the child has

Metadata of the same type[4] already bound to it. In other words the Metadata is bound to the root Data Object and all of its descendant Data Objects (if any).

- Rule 2: If a Data Object (a child contained in a Composite Data Object) has Metadata bound to it, any parent Data Objects do not inherit the Metadata of that Data Object.
- Rule 3: If a Data Object with existing Metadata, has Metadata of a different type bound to it (either directly or through inheritance), it will retain all existing Metadata.
- Rule 4: If a Data Object with existing Metadata, has Metadata of the same type bound to it (either directly or through inheritance), the new Metadata will supersede the existing Metadata.

An example of the granular Binding of Metadata to Data Objects is illustrated below. The example in Figure 12: Example of Granular Binding of Metadata to Data Objects uses the case where Confidentiality Metadata is used to identify the sensitivity of various subsets of a Data Object.

[4] Different types of metadata may be bound to data objects. For example, STANAG 4774 defines originatorConfidentialityLabel and alternativeConfidentialityLabel as different types of Confidentiality metadata.

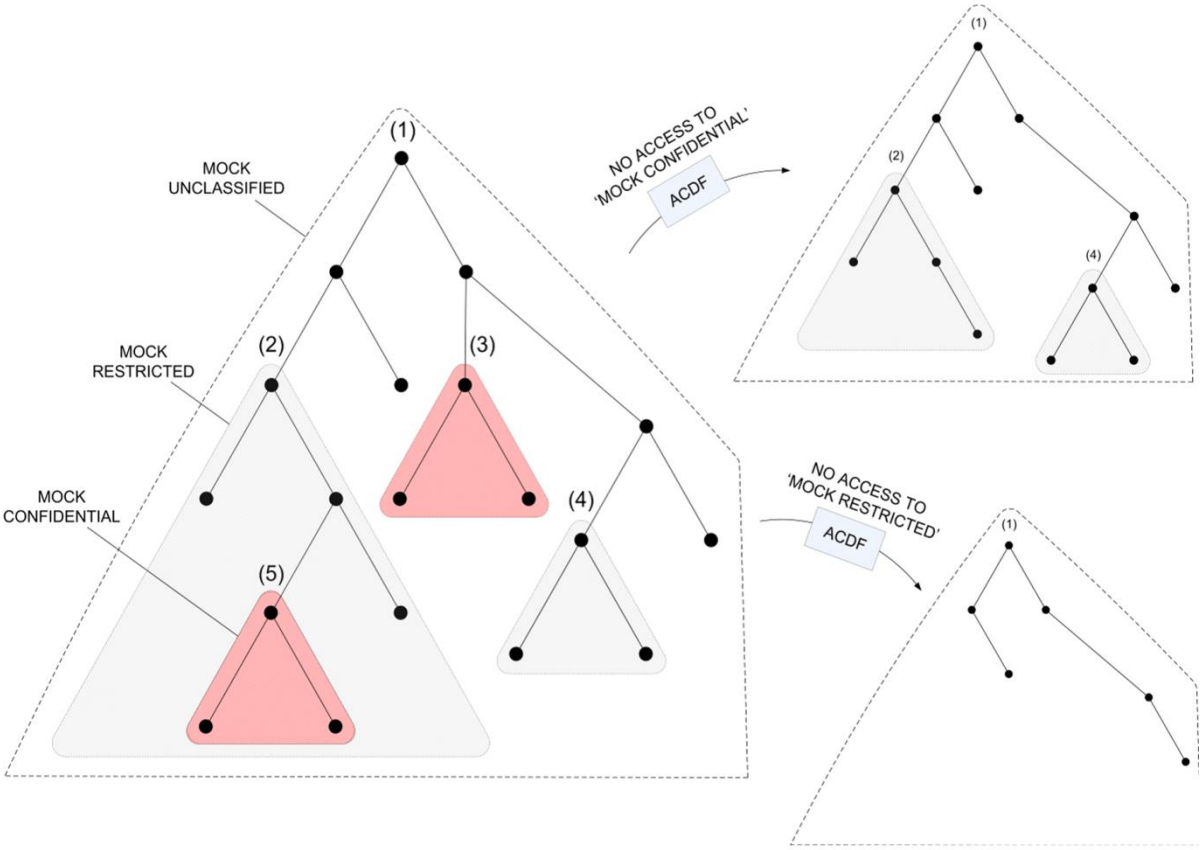

Figure 12: Example of Granular Binding of Metadata to Data Objects

In the example above Confidentiality Metadata is used as the Metadata to be bound to Data Objects (and subsets thereof). The security policy identifier is ‘MOCK’ and the classification levels are hierarchical: UNCLASSIFIED, RESTRICTED, and CONFIDENTIAL. The root Data Object (1) has ‘MOCK UNCLASSIFIED’ bound to it (as a result of Rule 1 all child Data Objects inherit ‘MOCK UNCLASSIFIED’). Then child Data Objects (2) and (4) have ‘MOCK RESTRICTED’ bound to them (as a result of Rule 1, Rule 2 and Rule 4 only child Data Objects (2) and (4) have ‘MOCK RESTRICTED’ bound to them). Child Data Objects (3) and (5) have ‘MOCK CONFIDENTIAL’ bound to them (as a result of Rule 1, Rule 2 and Rule 4 only child Data Object (3) has ‘MOCK CONFIDENTIAL’ bound to it and only child Data Object (5) has ‘MOCK CONFIDENTIAL’ bound to it).

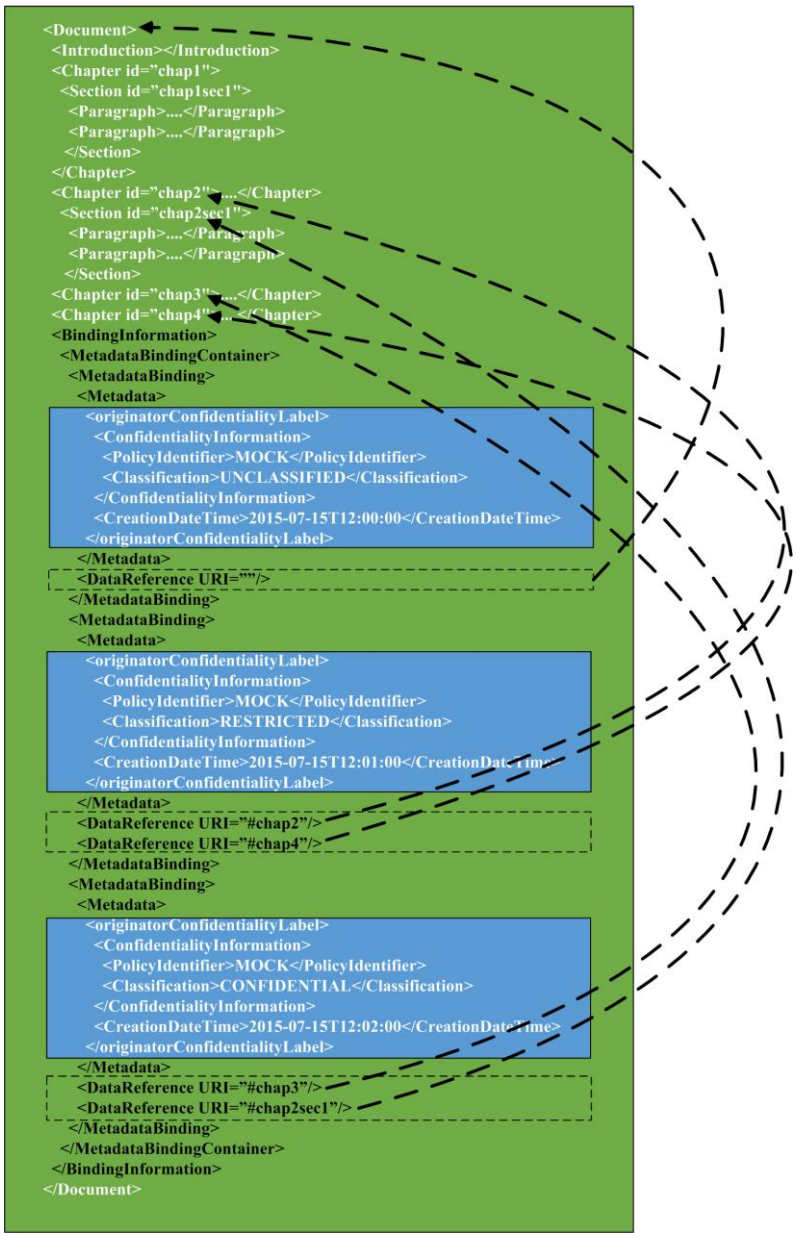

Figure 13: XML representation of the example in Figure 12

3.6 Binding Profile Concepts

Binding Profiles describe how to apply the Metadata Binding Mechanism to specific data formats and protocols using the mechanism described in Chapter 4. The purpose of Binding Profiles is to determine which of the three Binding approaches shall be best used. They specify how the BDO will be stored or transmitted for a specific data format or protocol type leveraging native support, if available.

Due to the variety of data formats and protocols and the rate at which they evolve, Binding Profiles may need to be updated. For this reason the normative specifications for profiling of the BDO are not contained within this standard but are provided in the NATO Interoperability Standards and Profiles (NISP) (Reference [27]) that is updated on an annual basis.

4 Metadata Binding Mechanism

4.1 Introduction

This chapter defines the syntax and semantics of a Metadata Binding Mechanism to support the conduct of a mission through efficient and effective information management, enabling decision-making by the sharing of information within and between NATO elements, the nations and their respective Communities of Interest.

This chapter incorporates support for the Binding of sensitivity Metadata, encoded in the format and syntax of the Confidentiality Metadata Label (Reference [6]) to Data Objects.

This chapter is derived from “NATO Profile for the ‘Binding of Metadata to Data Objects’, Version 1.1”, (Reference [8]), which is a profile of the general Binding specification outlined in (Reference [7]).

4.2 Notational Conventions

- The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in Reference [28].
- Words in *italics* indicate terms derived from Section 4.3 and Section 4.5.
- Courier font indicates syntax derived from various W3C XML Signature (Reference [10]) and XPATH 1.0 (Reference [22]) standards referenced in this chapter.

4.3 Metadata Binding Syntax

An XML schema is defined which contains the elements and attributes of the Metadata Binding.

This section specifies the different elements and attributes of the Metadata Binding.

4.3.1 Namespaces and Constraints

The table below summarizes the XML namespaces and corresponding prefixes used throughout for the Metadata Binding.

Table 1: XML Namespaces for Metadata Binding

Attribute	Namespace
mb	urn:nato:stanag:4778:bindinginformation:1:0
ds	http://www.w3.org/2000/09/xmldsig#
xmime	http://www.w3.org/2005/05/xmlmime
xs	http://www.w3.org/2001/XMLSchema
xsi	http://www.w3.org/2001/XMLSchema-instance

4.3.2 The MetadataBindingContainer Element

The *MetadataBindingContainer* is the top-level element of the Metadata Binding and SHALL be present.

The *MetadataBindingContainer* element contains one or more *MetadataBinding* element(s).

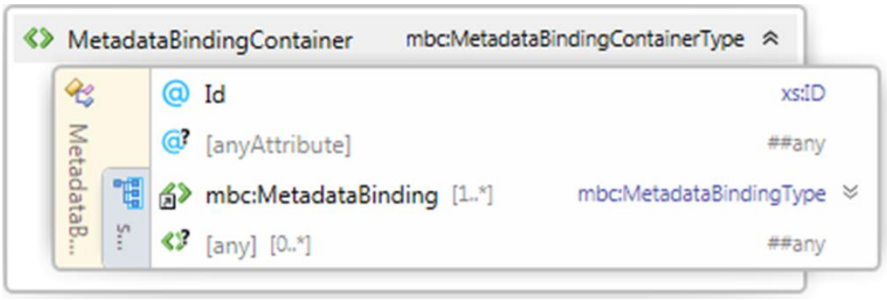

Figure 14: The MetadataBindingContainer Element

The table below specifies the use of attributes of the *MetadataBindingContainer* element with example values.

Table 2: Attributes of MetadataBindingContainer

Attribute	Mandatory/Optional/Prohibited	Notes	Example values
Id	Optional	Unique identifier of this element instance	“mb-bindingId-006”

The *MetadataBindingContainer* can be extended with additional elements and attributes to support Community of Interest or National Binding requirements.

These additional elements and attributes are for local use and MAY be ignored by other systems.

4.3.3 The MetadataBinding Element

The *MetadataBinding* element:

- SHALL contain at least one or more Metadata components (a choice of *Metadata* or *MetadataReference* elements);
- SHALL contain at least one Data Object component (a choice of *Data* or *DataReference* elements).

All of the Metadata (*Metadata* or *MetadataReference* elements) is bound to all of the Data Objects (*Data* or *DataReference* elements) within the *MetadataBinding* element.

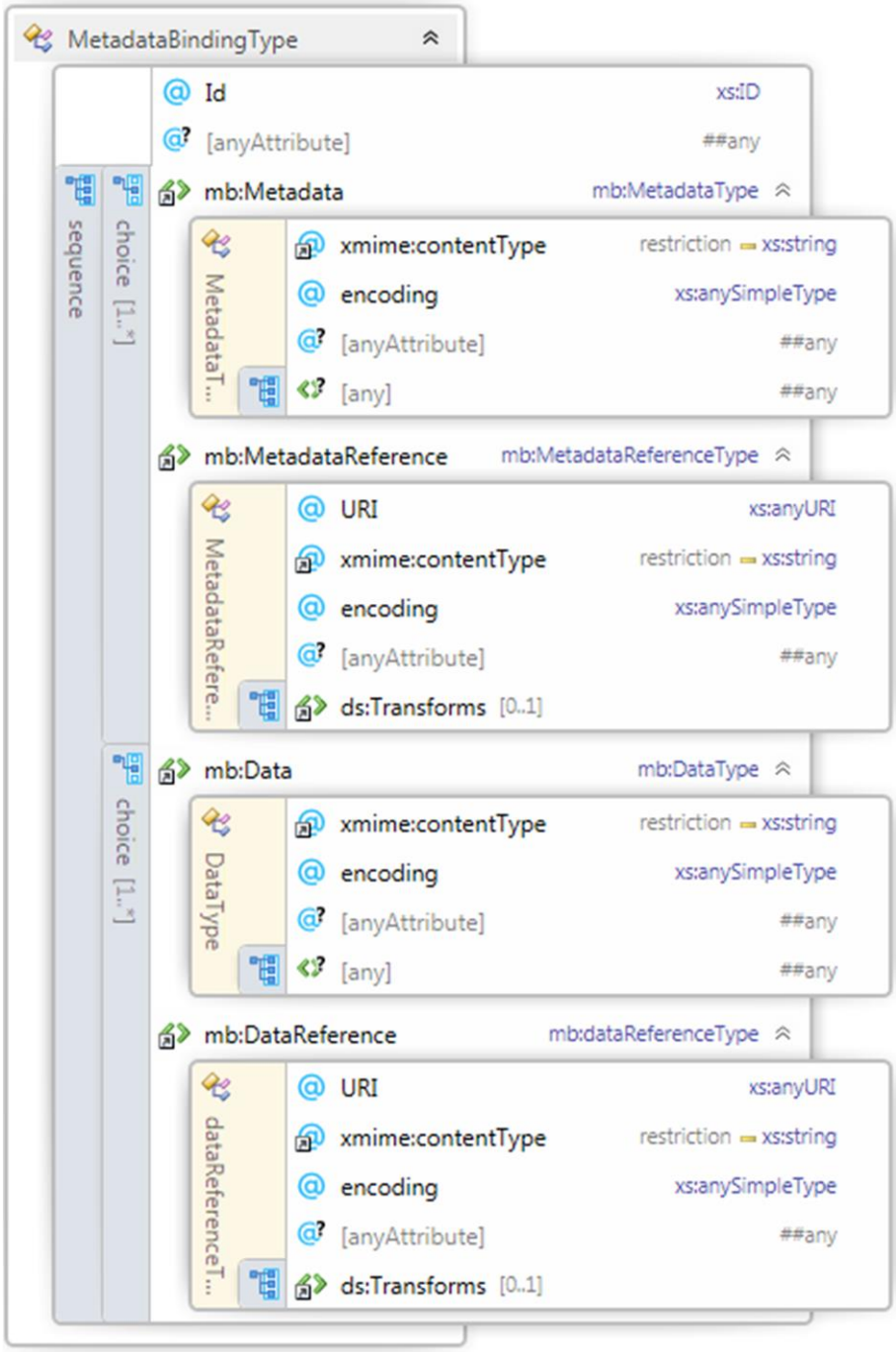

Figure 15: The MetadataBinding Element

The table below specifies the use of the child elements of the *MetadataBinding* element.

Table 3: Child Elements of the MetadataBinding Element

Component	Mandatory/ Optional/ Prohibited	Element Choices	Notes
Metadata	Mandatory	*Metadata*	Element used to embed Metadata within the *MetadataBinding* element. There may be one or more *Metadata* elements.
		MetadataReference	Element used for referencing detached Metadata. There may be one or more *MetadataReference* elements.
Data	Mandatory	*Data*	Element used to embed a Data Object that is bound to the Metadata (embedded or detached) within the *MetadataBinding* element. There may be one or more *Data* elements.
		DataReference	Element used to reference detached data that is bound to the Metadata (embedded or detached) within the *MetadataBinding* element. There may be one or more *DataReference* elements.

The table below specifies the use of attributes of the *MetadataBindingContainer* element with example values.

Table 4: Attributes of MetadataBindingContainer

Attribute	Mandatory/Optional/Prohibited	Notes	Example values
Id	Optional	Unique identifier of this element instance	“mb-metadatabindingId-007”

The *MetadataBinding* can be extended with additional elements and attributes to support Community of Interest or National Binding requirements.

These additional elements and attributes are for local use and MAY be ignored by other systems.

4.3.4 The Metadata Element

In the case that Metadata is embedded within the Metadata Binding; one or more *Metadata* elements SHALL be present in a *MetadataBinding* element.

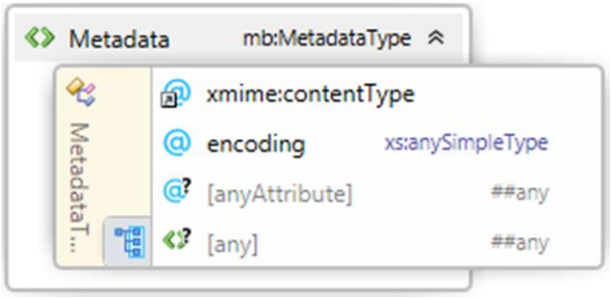

Figure 16: The Metadata Element

Table 5 below describes the use of the attributes of the *Metadata* element.

Table 5: Attributes of the Metadata Element

Attribute	Mandatory/ Optional/ Prohibited	Notes	Example values	Default Value
xmime:contentType	Optional	Attribute imported from (Reference [11]). This attribute is used to signify the content type (also known as media type or MIME type). Attribute values from (Reference [15])	“image/jpeg”, “text/xml; charset=utf-16”	“text/xml; charset=utf-8”
encoding	Optional	Imported from (Reference [12]). This attribute is only used to signify how the non-XML Data Object is encoded.	“base64Binary” or “hexBinary”	N/A

If the *MetaData* element does not contain a *contentType* attribute value the Default Value will be assumed.

The *contentType* attribute MAY be extended to support types that are not IANA registered MIME types. Support for non-registered MIME types are for local use and MAY be ignored by other systems.

For non-XML Metadata, it may be necessary for the Metadata to undergo an encoding transformation in order to be embedded in XML. In the case where Metadata is encoded and is contained in the *MetaData* element the *encoding* attribute SHALL be present with a value indicating the type of encoding.

The *MetaData* element can be extended with additional elements and attributes to support Community of Interest or National Binding requirements. These additional elements and attributes are for local use and MAY be ignored by other systems.

4.3.5 The MetadataReference Element

In the case that Metadata is detached from the Metadata Binding; one or more *MetadataReference* elements SHALL be present in a *MetadataBinding* element.

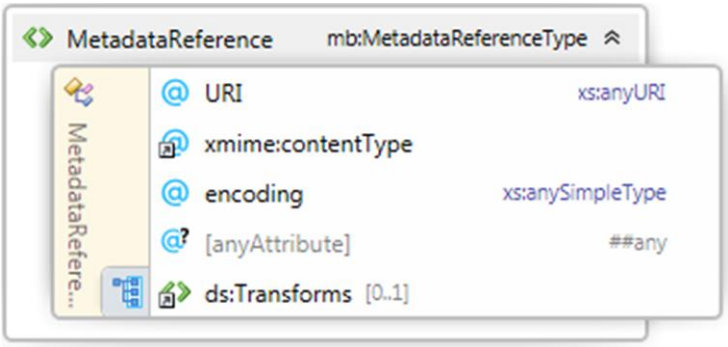

Figure 17: The *MetadataReference* Element

The table below describes the use of the attributes of the *MetadataReference* element.

Table 6: Attributes of the MetadataReference Element

Attribute/ Element	Mandatory/ Optional/ Prohibited	Notes	Example values
URI	Mandatory	A URI reference conformant with (Reference [16]) that indicates the location of the Metadata.	http://smhs.co.uk/policy/smhs/red http://www.someserver.net/example.json#/emailAddr
xmime:contentType	Optional	Attribute imported from (Reference [11]). This attribute is used to signify the content type (also known as media type or MIME type) of the Metadata. Attribute values from (Reference [15])	“image/jpeg”, “text/xml; charset=utf-16”

Attribute/ Element	Mandatory/ Optional/ Prohibited	Notes	Example values
encoding	Optional	Attribute imported from (Reference [14]). This attribute is used to signify how non-XML Metadata is encoded.	"binary"
ds:Transforms	Optional	Element imported from (Reference [10]). Supports the inclusion of an XPath expression for specifying the referenced subset (portion) of an XML Data Object. There may be zero or one ds:Transforms elements.	"<Transforms xmlns="http://www.w3.org/2000/09/xmldsig#"> <Transform Algorithm="http://www.w3.org/TR/1999/REC-xpath-19991116"> <XPath>ancestor-or-self::*[local-name()='Document Root' and namespace-uri()='http://example.com/</XPath> </Transform> </Transforms>"

In the case where the *contentType* attribute is present it SHOULD contain a value from the IANA registered list at (Reference [15]).

The *contentType* attribute MAY be extended to support types that are not IANA registered MIME types. Support for non-registered MIME types are for local use and MAY be ignored by other systems.

In the case where the *encoding* attribute is present it SHALL contain a value from the IANA registered list at (Reference [14]).

If the *MetadataReference* element does not contain a *contentType* attribute value the default value "*text/xml; charset=utf-8*" will be assumed.

The URI generic syntax is specified in (Reference [16]). The URI attribute is mandatory in order to locate the Data Object and subsets of the Data Object.

If the Metadata is XML and only a subset (portions) of the XML is to be referenced as Metadata, XPath expressions can be used to achieve this. XPath expressions are permitted in the Transforms element as specified in (Reference [10]). The

Transforms reference type of the *MetadataReference* element is based on the Transforms element as specified in (Reference [10]).

One and only one *Transform* element (child element of the *Transforms* element) SHALL be present. The input for the *Transform* element is the dereferenced URI attribute value of the *MetadataReference* element.

The *Transform* element SHALL have an *Algorithm* attribute with the value http://www.w3.org/TR/1999/REC-xpath-19991116.

The *Transform* element SHALL contain one or more child *XPath* elements.

The XPath expression contained within a child *XPath* element of the *Transform* element SHALL be compliant with XPATH 1.0 (Reference [22]).

The evaluation of the XPath expression contained within a child *XPath* element of the *Transform* element SHALL be compliant with XML Signature XPath Filtering (XMLDSIG , Reference [10] Section 6.6.3).

XML (de)serialization may result in a namespace prefix to be redefined within the XML document. As a result XPATH transformations may become invalid. In order to avoid invalid XPATH transformations as a result of redefined namespace prefixes it is RECOMMENDED that the local-name and namespace-uri functions (as described in Reference [22]) are used.

The *MetadataReference* can be extended with additional elements and attributes to support Community of Interest or National Binding requirements. These additional attributes are for local use and MAY be ignored by other systems.

4.3.6 The *Data* Element

In the case that data is embedded within the Metadata Binding; one or more *Data* elements SHALL be present in a *MetadataBinding* element.

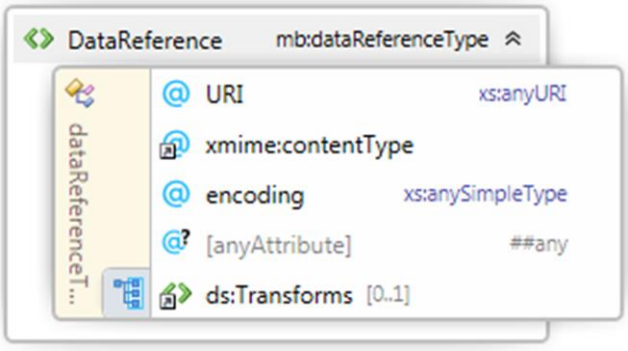

Figure 18: The Data Element

The table below describes the use of the attributes of the *Data* element, together with example values.

Table 7: Attributes of the Data Element

Attribute	Mandatory/ Optional/ Prohibited	Notes	Example values	Default Value
xmime:contentType	Optional	Attribute imported from (Reference [11]). This attribute is used to signify the content type (also known as media type or MIME type). Attribute values from (Reference [15])	“image/jpeg”, “text/xml; charset=utf-16”	“text/xml; charset=utf-8”
encoding	Optional	Imported from (Reference [12]). This attribute is only used to signify how the non-XML Data Object is encoded.	“base64Binary” or “hexBinary”	N/A

If the *Data* element does not contain a *contentType* attribute value the Default Value will be assumed.

The *contentType* attribute MAY be extended to support types that are not IANA registered MIME types. Support for non-registered MIME types are for local use and MAY be ignored by other systems.

For non-XML Data Objects, it may be necessary for the Data Object to undergo an encoding transformation in order to be embedded in XML. In the case where a Data Object is encoded and is contained in the child element of the *Data* element the *encoding* attribute SHALL be present with a value indicating the type of encoding.

The *Data* element can be extended with additional elements and attributes to support Community of Interest or National Binding requirements. These additional attributes are for local use and MAY be ignored by other systems.

4.3.7 The DataReference Element

In the case that a Data Object is detached from the Metadata Binding; one or more *DataReference* elements SHALL be present in a *MetadataBinding* element.

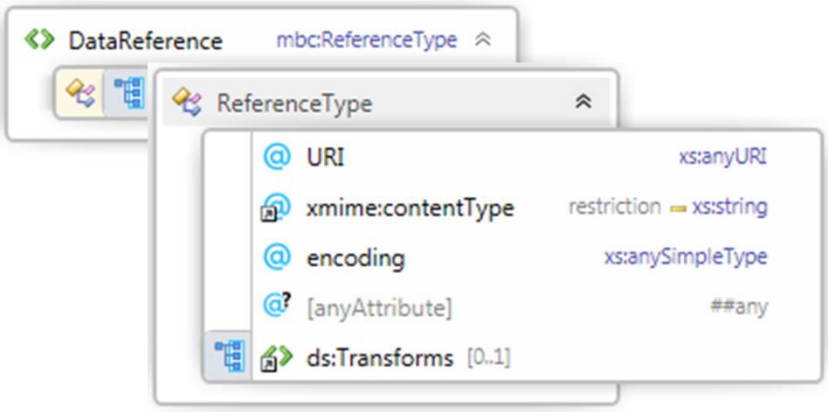

Figure 19: The DataReference Element

Table 8 describes the use of the attributes of the *DataReference* element.

Table 8: Attributes of the DataReference Element

Attribute/Element	Mandatory/ Optional/ Prohibited	Notes	Example values
xmime:contentType	Optional	Attribute imported from (Reference [11]). This attribute is used to signify the content type (also known as media type or MIME type). Attribute values from (Reference [15])	“image/jpeg”, “text/xml; charset=utf-16”
Encoding	Optional	Attribute imported from (Reference [14]). This attribute is used to signify how non-XML Data Object is encoded.	“8bit”, “binary”
URI	Mandatory	A URI reference conformant with (Reference [16]) that indicates the location of the Data Object.	“http://www.someserver.net/example.doc”
ds:Transforms	Optional	Element imported from (Reference [10]). Supports the inclusion of an XPath expression for specifying the referenced subset (portion) of an XML Data Object. There may be zero or one ds:Transforms elements.	“<Transforms xmlns="http://www.w3.org/2000/09/xmldsig#"> <Transform Algorithm="http://www.w3.org/TR/1999/REC-xpath-19991116"> <XPath>ancestor-or-self::*[local-name()='Document Root' and namespace-uri()='http://example.com/</XPath> </Transform> </Transforms>”

In the case where the *contentType* attribute is present it SHOULD contain a value from the IANA registered list at (Reference [15]).

The *contentType* attribute MAY be extended to support types that are not IANA registered MIME types. Support for non-registered MIME types are for local use and MAY be ignored by other systems.

In the case where the *encoding* attribute is present it SHALL contain a value from the IANA registered list at (Reference [14]).

If the *DataReference* element does not contain a *contentType* attribute value the default value "*text/xml; charset=utf-8*" will be assumed.

The URI generic syntax is specified in (Reference [16]). The URI attribute is mandatory in order to locate the Data Object and subsets of the Data Object.

If the Data Object is XML and subsets of the Data Object need to be referenced, the use of the *Transforms* element as a child element of the *DataReference* element is permitted.

The use of the *Transforms* element for referencing subsets of a Data Object is the same as specified for the *MetadataReference* element (refer to Section 4.3.5).

The *DataReference* can be extended with additional elements and attributes to support Community of Interest or National Binding requirements. These additional elements are for local use and MAY be ignored by other systems.

4.4 Schema

The schema for the Metadata Binding is shown in Chapter 4.8: Metadata Binding Schema.

4.5 Binding Information Syntax

The Binding Information is represented as an XML structure that includes the Metadata Binding (the *MetadataBindingContainer* element), or the compound of the Metadata Binding and the Cryptographic Artefact. The Binding Information is stored as a Binding Data Object (BDO)[5].

This section specifies the syntax of the Binding Information.

This section is derived from the Binding of Metadata to Data Objects outlined in (Reference [8]).

[5] The Binding Data Object (BDO) may be stored separately (as a data object stored locally or as a data object stored in a repository) or may be embedded within a data object.

Where discrepancies arise between this section and (Reference [8]), this section is definitive.

This section specifies the different elements for the Binding Information element.

4.5.1 The BindingInformation Element

When creating a BDO the standard name *BindingInformation* (as specified in Chapter 4) SHALL be used as the parent element that holds the Metadata Binding and the Cryptographic Artefact (if present).

The *BindingInformation* element SHALL be qualified with the 'urn:nato:stanag:4778:bindinginformation:1:0' namespace.

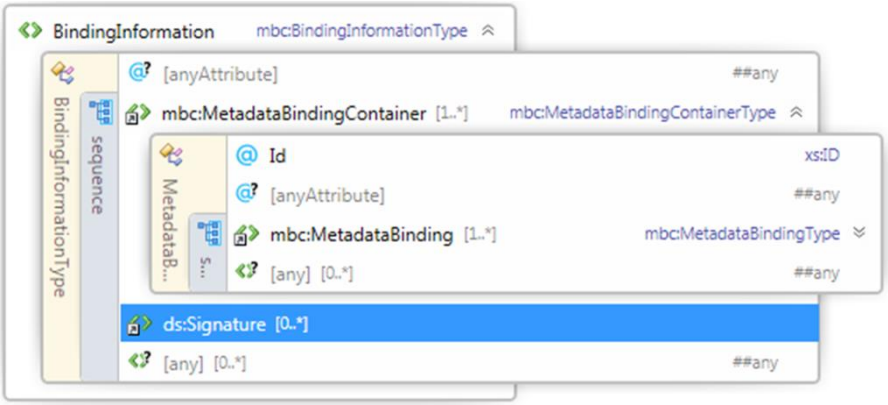

Figure 20: The *BindingInformation* Element

Table 9 describes the use of the elements of the *BindingInformation* element.

Table 9: Elements of the *BindingInformation* Element

Element	Mandatory/Optional/ Prohibited	Notes
mbc:MetadataBindingContainer	Mandatory	This element represents the Metadata Binding. There may be one or more *MetadataBindingContainer* elements in a *BindingInformation* element. There may be one or more *mbc:MetadataBindingContainer* elements
ds:Signature	Optional	This element represents the digital signature of the Metadata Binding. There may be zero or more *Signature* elements in a *BindingInformation* element (Reference [9]). There may be zero or more ds:Signature elements

The *BindingInformation* can be extended with additional elements and attributes to support Community of Interest or National Binding requirements.

These additional elements and attributes are for local use and MAY be ignored by other systems.

4.6 Binding Information Management

To ensure that information (data of a finite size) is handled effectively, efficiently and securely the BDO SHALL be accessible to information management services (Reference [2]) that are applying information management policies. The information management services SHALL be able to uniquely associate the BDO with a Data Object, i.e. for a given Data Object information management services SHALL be able to locate the associated BDO.

The information management services SHALL be able to uniquely associate the BDO with a Data Object, e.g. for a given Data Object, information management services SHALL be able to locate the associated BDO and for a given BDO, information management services SHALL be able to locate the associated Data

Object and Metadata. The information management services SHALL be able to resolve any URI that is used to reference Data Objects and Metadata. The syntax and semantics of a URI SHALL be represented as specified in (Reference [16]). Metadata or Data Objects that are referenced in a BDO SHALL be unambiguous and globally accessible within the data-centric environment.

In order to facilitate simplified processing for information management services it is RECOMMENDED that Metadata is embedded within a BDO and not referenced. Hence, the Metadata is contained in the *Metadata* element of the Metadata Binding.

A BDO can be categorised as follows (See Section 3.2):

- Encapsulating – whereby the Data Object is embedded within the BDO;
- Embedded – whereby the BDO is embedded in a XML Data Object and the Data Object is identified via a reference ; and
- Detached – whereby the Data Object is external to the BDO and is identified via a reference.

4.6.1 Encapsulating Binding Information

An Encapsulating BDO is an XML document that SHALL have the *BindingInformation* element as the root element of that XML document (as specified in Section 4.5).

It is RECOMMENDED that an Encapsulating BDO only contain *Data* element(s) within a Metadata Binding.

An Encapsulating BDO SHALL be capable of supporting any type of Data Object in a *Data* element within a Metadata Binding.

4.6.2 Embedded Binding Information

If a Data Object is XML and the schema definition for that XML document supports extensibility then the BDO can be embedded as a child element of that Data Object. In this case, the root element of the BDO SHALL be the *BindingInformation* element (as specified in Section 4.5).

A non-XML Data Object may be capable of supporting an Embedded BDO as a child of that Data Object. In this case, the root element of the BDO SHALL be the *BindingInformation* element (used to hold the Metadata Binding and the Cryptographic Artefact (if present) as children of the *BindingInformation* element). In this case it MAY be required to encode the Embedded BDO in a format supported by the media type of the parent Data Object.

It is RECOMMENDED that an Embedded BDO only contain *DataReference* element(s) within a Metadata Binding.

It is RECOMMENDED that the *DataReference* element(s) contained within a Metadata Binding are not references external to the Data Object that the BDO is a child element of.

4.6.3 Detached Binding Information

A Detached BDO is external to the Data Object(s) that is (are) being referenced. In this case, the root element of the BDO SHALL be the *BindingInformation* element ((as specified in Section 4.5).

A Detached BDO can be a standalone XML document with external references to physically separated Data Objects.

A Detached BDO can be a child node of a parent node, whereby the BDO contains references to other child nodes of that parent node. In this case the BDO is external to the child nodes (of the parent node) that it references.

It is RECOMMENDED that a Detached BDO only contain *DataReference* element(s) within a Metadata Binding.

It is RECOMMENDED that the *DataReference* element(s) contained within a Metadata Binding are external to the BDO.

4.7 Same-Document References

In the case of Embedded and Detached BDOs *DataReference* elements can be used to refer to Same-Document references. In other words, the reference that is to be dereferenced based on the *DataReference URI* attribute value is contained within the same Data Object as the BDO.

In all cases dereferencing a null *DataReference URI* attribute value (*URI=“”*) MUST return the root node of the document (Data Object).

In all cases dereferencing a Base Uri (refer to Reference [16] Section 5.1.3) *DataReference URI* attribute value (for example; *URI=“http://www.example.com/example.json”*) MUST return the root node of the document (Data Object).

A component of the URI (see Reference [16]) is the fragment identifier that is used to build a URI reference. A URI reference is a powerful concept that allows indirect identification of a secondary resource (within the Same-Document) by reference to a primary resource. The fragment identifier is indicated by the

presence of a number sign ("#") character and terminated by the end of the URI (for example; *URI="#foo"*;or, *URI="http://www.example.com/example.json#foo"*).

The significance of the fragment identifier is a function of the content type (also known as media type or MIME type). In other words, unless the content type is known the syntax and the semantics for interpreting the fragment identifier are unknown. Content types are registered on the internet and the registered list of content types is maintained at the Internet Assigned Numbers Authority IANA Reference [15]. Content types that are registered with IANA also specify how applications must interpret fragment identifiers. As such, the interpretation of the fragment identifier is dependent upon the content type of the Data Object.

In all cases dereferencing a *DataReference URI* attribute value that contains a fragment URI, the characters and interpretation of those characters after the number sign ('#') character MUST conform to the syntax and semantics of fragment identifiers specified by the content type identified by the *xmime:contentType* attribute value.

4.8 Metadata Binding Schema

This section provides the complete syntax for the Metadata Binding Mechanism in XML format.

```
<?xml version="1.0" encoding="UTF-8"?>

<!--
**********************************************************************

                NATO UNCLASSIFIED

XML Schema for capturing the Metadata Binding specification for
binding metadata to data objects.

        I
       / \
      -< + >-
       \ /
        I             NCI AGENCY
  ##   #   ####   #     P.O. box 174
  ##   #   #   #   #    2501 CD The Hague
  # # #   #       #
  #  # #   #   #   #    Core Enterprise Services
  #   ##    ####   #
    A  G  E  N  C  Y

**********************************************************************
-->

<xs:schema
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-Instance"
  xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
  xmlns:xmime="http://www.w3.org/2005/05/xmlmime"
  targetNamespace="urn:nato:stanag:4778:bindinginformation:1:0"
  version="1.4"
  elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:appinfo>
      <UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0</UniqueIdentifier>
      <Name>Metadata Binding Schema</Name>
      <Definition>Schema for binding metadata to data objects</Definition>
      <VersionIndicator>1.4</VersionIndicator>
      <UsageGuidance>Used within NATO to bind metadata to data objects, including the NATO Core
Metadata.</UsageGuidance>
      <RestrictionType/>
      <RestrictionValue/>
      <slab:originatorConfidentialityLabel ReviewDateTime="2021-12-16T09:00:00Z"
xmlns:slab=”urn:nato:stanag:4774:confidentialitymetadatlabel:1:0”>
        <slab:ConfidentialityInformation>
          <slab:PolicyIdentifier>NATO</PolicyIdentifier>
          <slab:Classification>UNCLASSIFIED</Classification>
          <slab:Category Type="PERMISSIVE" TagName="Context">
            <slab:GenericValue>NATO</slab:GenericValue>
          </slab:Category>
        </slab:ConfidentialityInformation>
      <slab:CreationDateTime>2016-12-16T09:00:00Z</CreationDateTime>
      </slab:originatorConfidentialityLabel>
    </xs:appinfo>
    <xs:documentation>
      The schema can be used with the confidentiality label schema to bind confidentiality label metadata (such as those
defined in the NATO Core Metadata Specification NCMS)) to data objects.
    </xs:documentation>
  </xs:annotation>
```

```
<xs:import namespace="http://www.w3.org/2000/09/xmldsig#" schemaLocation="http://www.w3.org/2000/09/xmldsig#"/>

<xs:import namespace="http://www.w3.org/2005/05/xmlmime" schemaLocation="http://www.w3.org/2005/05/xmlmime"/>

<xs:element name="BindingInformation" type="mb:BindingInformationType"/>
<xs:complexType name="BindingInformationType" id="bindingInformationType">
  <xs:annotation>
    <xs:appinfo>
      <UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0:appinfo:bindingInformationType</UniqueIdentifier>
      <Name>Binding Information Type</Name>
      <Definition></Definition>
      <VersionIndicator>1.2</VersionIndicator>
      <UsageGuidance>Used to bind arbitary metadata to data objects</UsageGuidance>
      <RestrictionValue></RestrictionValue>
    </xs:appinfo>
    <xs:documentation>

    </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element ref="ds:Signature" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element ref="mb:MetadataBindingContainer" maxOccurs="unbounded"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:anyAttribute processContents="lax"/>
</xs:complexType>

<xs:element name="MetadataBindingContainer" type="mb:MetadataBindingContainerType"/>
<xs:complexType name="MetadataBindingContainerType" id="metadataBindingContainerType">
  <xs:annotation>
    <xs:appinfo>

<UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0:appinfo:metadataBindingContainerType</UniqueIdentifier>
      <Name>Metadata Binding Container Type</Name>
      <Definition>A sequence of Metadata Bindings</Definition>
      <VersionIndicator>1.2</VersionIndicator>
      <UsageGuidance></UsageGuidance>
      <RestrictionType></RestrictionType>
      <RestrictionValue></RestrictionValue>
    </xs:appinfo>
    <xs:documentation>

    </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element ref="mb:MetadataBinding" maxOccurs="unbounded"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="Id" type="xs:ID"/>
  <xs:anyAttribute processContents="lax"/>
</xs:complexType>

<xs:element name="MetadataBinding" type="mb:MetadataBindingType"/>
<xs:complexType name="MetadataBindingType" id="metadataBindingType">
  <xs:annotation>
    <xs:appinfo>
      <UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0:appinfo:metadataBindingType</UniqueIdentifier>
      <Name>Metadata Binding Type</Name>
      <Definition>A binding between metadata and data objects.</Definition>
      <VersionIndicator>1.2</VersionIndicator>
      <UsageGuidance></UsageGuidance>
      <RestrictionType></RestrictionType>
      <RestrictionValue></RestrictionValue>
    </xs:appinfo>
    <xs:documentation>

    </xs:documentation>
  </xs:annotation>
  <xs:sequence>
```

```
    <xs:choice maxOccurs="unbounded">
      <xs:element ref="mb:Metadata"/>
      <xs:element ref="mb:MetadataReference"/>
    </xs:choice>
    <xs:choice maxOccurs="unbounded">
      <xs:element ref="mb:Data"/>
      <xs:element ref="mb:DataReference"/>
    </xs:choice>
  </xs:sequence>
  <xs:attribute name="Id" type="xs:ID"/>
  <xs:anyAttribute processContents="lax"/>
</xs:complexType>

<xs:element name="Metadata" type="mb:MetadataType"/>
<xs:complexType name="MetadataType" id="metadataType" mixed="true">
  <xs:annotation>
    <xs:appinfo>
      <UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0:appinfo:metadataType</UniqueIdentifier>
      <Name>Metadata Type</Name>
      <Definition>In-line metadata.</Definition>
      <VersionIndicator>1.3</VersionIndicator>
      <UsageGuidance></UsageGuidance>
      <RestrictionType></RestrictionType>
      <RestrictionValue></RestrictionValue>
    </xs:appinfo>
    <xs:documentation>

    </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:any namespace="##any" processContents="lax"/>
  </xs:sequence>
 <xs:attribute ref="xmime:contentType"/>
 <xs:attribute name="encoding"/>
  <xs:anyAttribute processContents="lax"/>
</xs:complexType>

<xs:element name="MetadataReference" type="mb:MetadataReferenceType"/>
<xs:complexType name="MetadataReferenceType" id="metadataReferenceType">
  <xs:annotation>
    <xs:appinfo>
      <UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0:appinfo:metadataReferenceType</UniqueIdentifier>
      <Name>Metadata Reference Type</Name>
      <Definition>A reference to a piece of metadata.</Definition>
      <VersionIndicator>1.2</VersionIndicator>
      <UsageGuidance></UsageGuidance>
      <RestrictionType></RestrictionType>
      <RestrictionValue></RestrictionValue>
    </xs:appinfo>
    <xs:documentation>

    </xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="mb:ReferenceType">
    </xs:extension>
  </xs:complexContent>
</xs:complexType>

<xs:element name="Data" type="mb:DataType"/>
<xs:complexType name="DataType" id="dataType" mixed="true">
     <xs:annotation>
    <xs:appinfo>
      <UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0:appinfo:dataType</UniqueIdentifier>
      <Name>Data Type</Name>
      <Definition>In-line data object.</Definition>
      <VersionIndicator>1.2</VersionIndicator>
      <UsageGuidance></UsageGuidance>
      <RestrictionType></RestrictionType>
```

```
      <RestrictionValue></RestrictionValue>
     </xs:appinfo>
     <xs:documentation>

     </xs:documentation>
   </xs:annotation>
   <xs:sequence>
     <xs:any namespace="##any" processContents="lax"/>
   </xs:sequence>
   <xs:attribute ref="xmime:contentType"/>
   <xs:attribute name="encoding"/>
   <xs:anyAttribute processContents="lax"/>
 </xs:complexType>

 <xs:element name="DataReference" type="mb:dataReferenceType"/>
<xs:complexType name="dataReferenceType" id="dataReferenceType">
 <xs:annotation>
  <xs:appinfo>
   <UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0:appinfo:dataReferenceType</UniqueIdentifier>
   <Name>Data Reference Type</Name>
   <Definition>A reference to a data object.</Definition>
   <VersionIndicator>1.1</VersionIndicator>
   <UsageGuidance></UsageGuidance>
   <RestrictionType></RestrictionType>
   <RestrictionValue></RestrictionValue>
  </xs:appinfo>
  <xs:documentation>

  </xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="mb:ReferenceType">
  </xs:extension>
 </xs:complexContent>
</xs:complexType>

 <xs:complexType name="ReferenceType" id="referenceType">
   <xs:annotation>
     <xs:appinfo>
       <UniqueIdentifier>urn:nato:stanag:4778:bindinginformation:1:0:appinfo:referenceType</UniqueIdentifier>
       <Name>Reference Type</Name>
       <Definition>A reference to a data object, or part of a data object.</Definition>
       <VersionIndicator>1.2</VersionIndicator>
       <UsageGuidance></UsageGuidance>
       <RestrictionType></RestrictionType>
       <RestrictionValue></RestrictionValue>
     </xs:appinfo>
     <xs:documentation>

     </xs:documentation>
   </xs:annotation>
   <xs:sequence>
     <xs:element ref="ds:Transforms" minOccurs="0" maxOccurs="1"/>
   </xs:sequence>
   <xs:attribute name="URI" type="xs:anyURI" use="required"/>
   <xs:attribute ref="xmime:contentType"/>
   <xs:attribute name="encoding"/>
   <xs:anyAttribute processContents="lax"/>
 </xs:complexType>

</xs:schema>
```

4.9 Examples

This section contains fictitious examples that illustrate the different categorisations of Binding Information as Binding Data Objects (BDOs). Also included are examples of BDOs that illustrate the flexibility of the Metadata Binding Mechanism to support one-to-one, one-to-many, many-to-one and many-to many relationships between metadata and Data Objects. All examples use Confidentiality Metadata Labels (Reference [6]) as example Metadata.

4.9.1 Encapsulating BDO

The following example depicts the encapsulation of an XML Data Object within the *Data* element of a BDO.

```
<mb:BindingInformation
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:xsd="http://www.w3.org/2001/XMLSchema"
 xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0">
  <mb:MetadataBindingContainer>
    <mb:MetadataBinding>
      <mb:Metadata>
       <slab:originatorConfidentialityLabel
        xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
        <slab:ConfidentialityInformation>
         <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
         <slab:Classification>UNCLASSIFIED</slab:Classification>
        </slab:ConfidentialityInformation>
        <slab:CreationDateTime>
         2015-09-30T12:30:00Z
        </slab:CreationDateTime>
       </slab:originatorConfidentialityLabel>
      </mb:Metadata>
      <mb:Data>
        <Document xmlns="http://example.com/doc">
          <Title>BDO Examples</Title>
          <Author>alan.ross@reach.nato.int</Author>
          <Abstract>
           Example XML File to support illustration of different types of BDO
          </Abstract>
          <Introduction>....</Introduction>
          <Chapter Id="chapter-1">
            <Paragraph Id="para-1-1" />
            <Paragraph Id="para-1-2" />
          </Chapter>
          <Chapter Id="chapter-2">
            <Paragraph Id="para-2-1" />
            <Paragraph Id="para-2-2" />
          </Chapter>
        </Document>
      </mb:Data>
    </mb:MetadataBinding>
  </mb:MetadataBindingContainer>
</mb:BindingInformation>
```

This example shows a non-XML Data Object (html) embedded within the *Data* element of a BDO.

```
<mb:BindingInformation
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:xsd="http://www.w3.org/2001/XMLSchema"
 xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
 xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
 xmlns:xmime="http://www.w3.org/2005/05/xmlmime">
  <mb:MetadataBindingContainer>
    <mb:MetadataBinding>
      <mb:Metadata>
       <slab:originatorConfidentialityLabel
        xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
        <slab:ConfidentialityInformation>
         <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
         <slab:Classification>UNCLASSIFIED</slab:Classification>
        </slab:ConfidentialityInformation>
        <slab:CreationDateTime>
         2015-09-30T12:30:00Z
        </slab:CreationDateTime>
       </slab:originatorConfidentialityLabel>
      </mb:Metadata>
     <mb:Data
      encoding="base64Binary"
      xmime:contentType="text/html">
      VGV4dHVhbCBpbGx1c3RyYXRpb24gb2YgZW5jYXBzdWxhdGluZyBCRE8=
     </mb:Data>
    </mb:MetadataBinding>
  </mb:MetadataBindingContainer>
</mb:BindingInformation>
```

4.9.2 Embedded BDO

This example illustrates a BDO that is embedded within an XML document. As the Data Object is an XML object the *DataReference URI* attribute value is interpreted as a Same-Document reference (see Section 4.7). As such, for this example the null *URI* attribute value ‘’ is interpreted as the whole Data Object (root element) is bound to the Metadata.

```
<Document xmlns="http://example.com/doc">
  <Title>BDO Examples</Title>
  <Author>alan.ross@reach.nato.int</Author>
  <Abstract>
  Example XML File to support illustration of different types of BDO
  </Abstract>
  <Introduction>....</Introduction>
  <Chapter Id="chapter-1">
    <Paragraph Id="para-1-1" />
    <Paragraph Id="para-1-2" />
  </Chapter>
  <Chapter Id="chapter-2">
    <Paragraph Id="para-2-1" />
    <Paragraph Id="para-2-2" />
  </Chapter>
 <mb:BindingInformation
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0">
```

```
    <mb:MetadataBindingContainer>
     <mb:MetadataBinding>
      <mb:Metadata>
       <slab:originatorConfidentialityLabel
        xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
        <slab:ConfidentialityInformation>
         <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
         <slab:Classification>UNCLASSIFIED</slab:Classification>
        </slab:ConfidentialityInformation>
        <slab:CreationDateTime>
         2015-09-30T12:30:00Z
        </slab:CreationDateTime>
       </slab:originatorConfidentialityLabel>
      </mb:Metadata>
      <mb:DataReference URI="" />
     </mb:MetadataBinding>
    </mb:MetadataBindingContainer>
   </mb:BindingInformation>
  </Document>
```

This example illustrates a BDO that is embedded within an XML document. As the Data Object is an XML object the *DataReference URI* attribute value is interpreted as a Same-Document reference (see Section 4.7). As such, for this example the null *URI* attribute value '""' is interpreted as the whole Data Object (root element) is bound to the Metadata. This example also shows how an XPath expression can be used to realise the same interpretation that the whole Data Object is bound to the Metadata.[6]

```
  <Document xmlns="http://example.com/doc">
   <Title>BDO Examples</Title>
   <Author>alan.ross@reach.nato.int</Author>
   <Abstract>
   Example XML File to support illustration of different types of BDO
   </Abstract>
   <Introduction>....</Introduction>
   <Chapter Id="chapter-1">
     <Paragraph Id="para-1-1" />
     <Paragraph Id="para-1-2" />
   </Chapter>
   <Chapter Id="chapter-2">
     <Paragraph Id="para-2-1" />
     <Paragraph Id="para-2-2" />
   </Chapter>
  <mb:BindingInformation
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:xsd="http://www.w3.org/2001/XMLSchema"
   xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
```

[6] Note: the use of the XPath expression in this example is only for illustration. XPath expressions are used for Binding a subset(s) of a data object(s) to the metadata. The main purpose for illustrating the use of XPath expressions was the use of the `local`-name and *`uri-namespace`* functions to avoid redefinitions of namespace prefixes.

```
    xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
    <mb:MetadataBindingContainer>
     <mb:MetadataBinding>
      <mb:Metadata>
       <slab:originatorConfidentialityLabel
        xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
        <slab:ConfidentialityInformation>
         <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
         <slab:Classification>UNCLASSIFIED</slab:Classification>
        </slab:ConfidentialityInformation>

        <slab:CreationDateTime>
         2015-09-30T12:30:00Z
        </slab:CreationDateTime>
       </slab:originatorConfidentialityLabel>
      </mb:Metadata>
      <mb:DataReference URI="">
       <ds:Transforms>
        <ds:Transform Algorithm="http://www.w3.org/TR/1999/REC-xpath-19991116">
         <ds:XPath>
          ancestor-or-self::*[local-name()='Document' and namespace-uri()='http://example.com/doc']
         </ds:XPath>
        </ds:Transform>
       </ds:Transforms>
      </mb:DataReference>
     </mb:MetadataBinding>
    </mb:MetadataBindingContainer>
   </mb:BindingInformation>
  </Document>
```

4.9.3 Detached BDO

The following example shows a BDO that is referencing a physically separate Data Object to the BDO. By using a *DataReference URI* attribute value that is dereferenced using the HTTP (Reference [24]) uri scheme to locate the Data Object, the root node of the physically separate Data Object is bound to the Metadata (as specified in Same-Document References Section 4.7).

```
   <mb:BindingInformation
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema"
    xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
    xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
    xmlns:xmime="http://www.w3.org/2005/05/xmlmime">
    <mb:MetadataBindingContainer>
     <mb:MetadataBinding>
      <mb:Metadata>
       <slab:originatorConfidentialityLabel
        xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
        <slab:ConfidentialityInformation>
         <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
         <slab:Classification>UNCLASSIFIED</slab:Classification>
        </slab:ConfidentialityInformation>
        <slab:CreationDateTime>
         2015-09-30T12:30:00Z
        </slab:CreationDateTime>
```

```
      </slab:originatorConfidentialityLabel>
     </mb:Metadata>
     <DataReference
      URI="http://www.example.com/images/image.png"
      xmime:contentType="image/png" />
    </mb:MetadataBinding>
   </mb:MetadataBindingContainer>
  </mb:BindingInformation>
```

This example shows a BDO that is referencing an external Data Object to the BDO. Both the Data Object and the BDO are siblings of another Data Object. By using a *DataReference URI* attribute value that is dereferenced using a shortname XPointer to locate the Data Object, the external Data Object (in this example: <Paragraph Id="para-2-2" />) is bound to the Metadata. This example also illustrates the use of the Same-Document reference as specified in Section 4.7. In this case the *contentType* attribute of the *DataReference* element is not set and the default value of "*text/xml; charset=utf-8*" is assumed. As such, the syntax and semantics for interpreting the fragment identifier (value of the *DataReference URI* attribute) is conformant with XPointer (Reference [23]) as specified in Reference [13].

```
 <Document xmlns="http://example.com/doc">
  <Title>BDO Examples</Title>
  <Author>alan.ross@reach.nato.int</Author>
  <Abstract>
  Example XML File to support illustration of different types of BDO
  </Abstract>
  <Introduction>....</Introduction>
  <Chapter Id="chapter-1">
   <Paragraph Id="para-1-1" />
   <Paragraph Id="para-1-2" />
  </Chapter>
  <Chapter Id="chapter-2">
   <Paragraph Id="para-2-1" />
   <Paragraph Id="para-2-2" />
  </Chapter>
 <mb:BindingInformation
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
  <mb:MetadataBindingContainer>
   <mb:MetadataBinding>
    <mb:Metadata>
     <slab:originatorConfidentialityLabel
      xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
      <slab:ConfidentialityInformation>
       <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
       <slab:Classification>UNCLASSIFIED</slab:Classification>
      </slab:ConfidentialityInformation>
      <slab:CreationDateTime>
       2015-09-30T12:30:00Z
      </slab:CreationDateTime>
```

```
        </slab:originatorConfidentialityLabel>
       </mb:Metadata>
       <mb:DataReference URI="#para-2-1" />
      </mb:MetadataBinding>
     </mb:MetadataBindingContainer>
    </mb:BindingInformation>
   </Document>
```

4.9.4 One-to-One Metadata Binding

All previous examples illustrate a one-to-one relationship of binding a single Data Object to a single Metadata label.

4.9.5 One-to-Many Metadata Binding

This example depicts a detached BDO that binds multiple physically separated Data Objects to a single Metadata label.

```
  <Document xmlns="http://example.com/doc">
   <Title>BDO Examples</Title>
   <Author>alan.ross@reach.nato.int</Author>
   <Abstract>
   Example XML File to support illustration of different types of BDO
   </Abstract>
   <Introduction>....</Introduction>
   <Chapter Id="chapter-1">
    <Paragraph Id="para-1-1" />
    <Paragraph Id="para-1-2" />
   </Chapter>
   <Chapter Id="chapter-2">
    <Paragraph Id="para-2-1" />
    <Paragraph Id="para-2-2" />
   </Chapter>
  <mb:BindingInformation
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:xsd="http://www.w3.org/2001/XMLSchema"
   xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
   xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
   xmlns:xmime="http://www.w3.org/2005/05/xmlmime">
   <mb:MetadataBindingContainer>
    <mb:MetadataBinding>
     <mb:Metadata>
      <slab:originatorConfidentialityLabel
       xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
       <slab:ConfidentialityInformation>
        <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
        <slab:Classification>UNCLASSIFIED</slab:Classification>
       </slab:ConfidentialityInformation>
       <slab:CreationDateTime>
        2015-09-30T12:30:00Z
       </slab:CreationDateTime>
      </slab:originatorConfidentialityLabel>
     </mb:Metadata>
     <DataReference
      URI="http://www.example.com/images/image1.png"
      xmime:contentType="image/png" />
```

```
      <DataReference
       URI="http://www.example.com/images/image2.png"
       xmime:contentType="image/png" />
      <DataReference
       URI="http://www.example.com/images/image3.png"
       xmime:contentType="image/png" />
      <DataReference
       URI="http://www.example.com/images/image4.png"
       xmime:contentType="image/png" />
     </mb:MetadataBinding>
    </mb:MetadataBindingContainer>
   </mb:BindingInformation>
  </Document>
```

4.9.6 Many-to-One Metadata Binding

The following example illustrates an embedded BDO that binds two Metadata labels to a single Data Object.

```
  <Document xmlns="http://example.com/doc">
   <Title>BDO Examples</Title>
   <Author>alan.ross@reach.nato.int</Author>
   <Abstract>
   Example XML File to support illustration of different types of BDO
   </Abstract>
   <Introduction>....</Introduction>
   <Chapter Id="chapter-1">
    <Paragraph Id="para-1-1" />
    <Paragraph Id="para-1-2" />
   </Chapter>
   <Chapter Id="chapter-2">
    <Paragraph Id="para-2-1" />
    <Paragraph Id="para-2-2" />
   </Chapter>
  <mb:BindingInformation
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:xsd="http://www.w3.org/2001/XMLSchema"
   xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
   xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
   <mb:MetadataBindingContainer>
    <mb:MetadataBinding>
     <mb:Metadata>
      <slab:originatorConfidentialityLabel
       xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
       <slab:ConfidentialityInformation>
        <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
        <slab:Classification>UNCLASSIFIED</slab:Classification>
       </slab:ConfidentialityInformation>
       <slab:CreationDateTime>
        2015-09-30T12:30:00Z
       </slab:CreationDateTime>
      </slab:originatorConfidentialityLabel>
      <slab:alternateConfidentialityLabel
       xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
       <slab:ConfidentialityInformation>
        <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
        <slab:Classification>UNCLASSIFIED</slab:Classification>
```

```
        </slab:ConfidentialityInformation>
        <slab:CreationDateTime>
         2015-09-30T12:30:00Z
        </slab:CreationDateTime>
       </slab:alternateConfidentialityLabel>
      </mb:Metadata>
      <mb:DataReference URI="" />
     </mb:MetadataBinding>
    </mb:MetadataBindingContainer>
   </mb:BindingInformation>
  </Document>
```

4.9.7 Many-to-Many Metadata Binding

This example shows an embedded BDO that contains multiple *MetadataBinding* elements. The first *MetadataBinding* element binds the root element of the document to the two Metadata labels. The second *MetadataBinding* element binds a subset of the Data Object (in this example: <Introduction/>) to two Metadata labels.

```
  <Document xmlns="http://example.com/doc">
    <Title>BDO Examples</Title>
    <Author>alan.ross@reach.nato.int</Author>
    <Abstract>
    Example XML File to support illustration of different types of BDO
    </Abstract>
    <Introduction>....</Introduction>
    <Chapter Id="chapter-1">
      <Paragraph Id="para-1-1" />
      <Paragraph Id="para-1-2" />
    </Chapter>
    <Chapter Id="chapter-2">
      <Paragraph Id="para-2-1" />
      <Paragraph Id="para-2-2" />
    </Chapter>
   <mb:BindingInformation
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema"
    xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
    xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
    <mb:MetadataBindingContainer>
     <mb:MetadataBinding>
      <mb:Metadata>
       <slab:originatorConfidentialityLabel
        xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
        <slab:ConfidentialityInformation>
         <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
         <slab:Classification>UNCLASSIFIED</slab:Classification>
        </slab:ConfidentialityInformation>
        <slab:CreationDateTime>
         2015-09-30T12:30:00Z
        </slab:CreationDateTime>
       </slab:originatorConfidentialityLabel>
       <slab:alternateConfidentialityLabel
        xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
        <slab:ConfidentialityInformation>
```

```
          <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
          <slab:Classification>UNCLASSIFIED</slab:Classification>
         </slab:ConfidentialityInformation>
         <slab:CreationDateTime>
          2015-09-30T12:30:00Z
         </slab:CreationDateTime>
        </slab:alternateConfidentialityLabel>
       </mb:Metadata>
       <mb:DataReference URI="" />
      </mb:MetadataBinding>
      <mb:MetadataBinding>
       <mb:Metadata>
        <slab:originatorConfidentialityLabel
         xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
         <slab:ConfidentialityInformation>
          <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
          <slab:Classification>RESTRICTED</slab:Classification>
         </slab:ConfidentialityInformation>
         <slab:CreationDateTime>
          2015-09-30T12:30:00Z
         </slab:CreationDateTime>
        </slab:originatorConfidentialityLabel>
        <slab:alternateConfidentialityLabel
         xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
         <slab:ConfidentialityInformation>
          <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
          <slab:Classification>RESTRICTED</slab:Classification>
         </slab:ConfidentialityInformation>
         <slab:CreationDateTime>
          2015-09-30T12:30:00Z
         </slab:CreationDateTime>
        </slab:alternateConfidentialityLabel>
       </mb:Metadata>
       <mb:DataReference URI="">
        <ds:Transforms>
         <ds:Transform Algorithm="http://www.w3.org/TR/1999/REC-xpath-19991116">
          <ds:XPath>
           ancestor-or-self::*[local-name()='Introduction' and namespace-uri()='http://example.com/doc']
          </ds:XPath>
         </ds:Transform>
        </ds:Transforms>
       </mb:DataReference>
      </mb:MetadataBinding>
     </mb:MetadataBindingContainer>
    </mb:BindingInformation>
   </Document>
```

The following example shows a BDO that is referencing a physically separate Data Object to the BDO. By using a *DataReference URI* attribute value that is dereferenced using the HTTP (Reference [24]) uri scheme to locate the Data Object, the root node of the physically separate Data Object is bound to the Metadata (as specified in Same-Document References Section 4.7). As such, in this example, the root node of the Data Object is the root value of a JavaScript Object Notation (JSON; Reference [25]) document. As the *contentType* attribute value of the *DataReference* element is “*application/json*” the syntax and

semantics for interpreting the fragment identifier are conformant with the JSON Pointer (Reference [26]) to bind the "*foo*" JSON Data Object to the Metadata.

```
<mb:BindingInformation
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:mb="urn:nato:stanag:4778:bindinginformation:1:0"
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
  xmlns:xmime="http://www.w3.org/2005/05/xmlmime">
 <mb:MetadataBindingContainer>
  <mb:MetadataBinding>
   <mb:Metadata>
    <slab:originatorConfidentialityLabel
     xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
     <slab:ConfidentialityInformation>
      <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
      <slab:Classification>UNCLASSIFIED</slab:Classification>
     </slab:ConfidentialityInformation>
     <slab:CreationDateTime>
      2015-09-30T12:30:00Z
     </slab:CreationDateTime>
    </slab:originatorConfidentialityLabel>
   </mb:Metadata>
   <DataReference
    URI="http://www.example.com/example.json"
    xmime:contentType="application/json" />
  </mb:MetadataBinding>
  <mb:MetadataBinding>
   <mb:Metadata>
    <slab:originatorConfidentialityLabel
     xmlns:slab="urn:nato:stanag:4774:confidentialitymetadatalabel:1:0">
     <slab:ConfidentialityInformation>
      <slab:PolicyIdentifier>ACME</slab:PolicyIdentifier>
      <slab:Classification>RESTRICTED</slab:Classification>
     </slab:ConfidentialityInformation>
     <slab:CreationDateTime>
      2015-09-30T12:30:00Z
     </slab:CreationDateTime>
    </slab:originatorConfidentialityLabel>
   </mb:Metadata>
   <DataReference
    URI="http://www.example.com/example.json#foo"
    xmime:contentType="application/json" />
  </mb:MetadataBinding>
 </mb:MetadataBindingContainer>
</mb:BindingInformation>
```

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5 Terms and Definitions

5.1 Definitions

Binding: An expressed relationship between a Data Object and its Metadata, such as Confidentiality Metadata Labels. (Reference [6])

Binding Creation: A Binding is created as the output of the Binding Creation process resulting in a Binding between a Data Object and its Metadata.

Binding Data Object: The structured representation of Binding Information denoted in languages such as XML, Extended Backus-Naur Form, and message text format.

Binding Information: The Binding Information includes the Metadata Binding, or the compound of the Metadata Binding and the Cryptographic Artefact.

Binding Mechanism: See Metadata Binding Mechanism.

Binding Profiles: Binding Profiles describe how to apply the Metadata Binding Mechanism to specific data formats and protocols.

Composite Data Objects: A Composite Data Object is a Data Object that consists of multiple individual Data Objects. Metadata can be applied to each individual Data Object within a Composite Data Object.

Confidentiality: The property that information is not made available or disclosed to unauthorised individuals, entities or processes. (Reference [3])

Confidentiality Metadata Label: A set of Metadata representing the collection of confidentiality elements and attributes that indicate the sensitivity of the information. It is represented with a structure and a controlled value domain that can be automatically processed to determine the sensitivity of the information to which it refers. (Reference [6])

Cryptographic Artefact: The data object resulting from applying a Cryptographic Protection Mechanism.

Cryptographically Protected Binding: A Cryptographically Protected Binding is an expressed relationship between a Data Object and its Metadata, such as Confidentiality Metadata Labels, that provides an appropriate level of assurance of the Integrity of the association between the Data Object and the Metadata.

Cryptographic Protection Mechanism: A method to provide a standardized way for applying cryptographic techniques (such as digests, message authentication codes or digital signatures) to protect the Integrity of the Binding (Cryptographically Protected Binding).

Data Object: Data that has a known finite size given some unit of measure and a known structure which allows associating a content type to the data object. A data object may be composed of other data objects and may be decomposable into those data objects.

Information: Any communications or representation of knowledge such as facts, data, or opinions in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audio-visual forms. (Reference [17])

Information Custodian: The nation or organisation which receives information and makes it visible and is responsible to the information owner for the agreed level of safe-keeping and availability of information. (Reference [17])

Information Owner: The nation or organisation which creates and maintains content, defines access rules, negotiates and agrees to release constraints, establishes disposition instructions, and is the authority for the life-cycle of information. (Reference [17])

Integrity: The property that information (including data) has not been altered or destroyed in an unauthorised manner. (Reference [1])

Metadata: Structured information that describes, explains, locates, and otherwise makes it easier to retrieve and use an information resource (i.e. Data Object). The structure consists of ‘elements’, each of which contains ‘values’. The values relate to the resource itself; there may be controls over what the actual values can be. (Reference [18])

Metadata Binding: see Binding

Metadata Binding Mechanism: A method to provide a standardised way for creating a Binding.

5.2 Abbreviations

BDO	Binding Data Object
C3B	Consultation, Command and Control Board
CoI	Community Of Interest
IM	Information Management
NATO	North Atlantic Treaty Organisation
NCMS	NATO Core Metadata Specification
NISP	NATO Interoperability Standards and Profiles
NNEC	NATO Network Enabled Capability
NSO	NATO Standardization Organization
URI	Uniform Resource Identifier
XML	eXtensible Markup Language
JPEG	Joint Photographic Experts Group

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6 References

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[4] AC/322-D(2004)0021 (INV), “INFOSEC Technical and Implementation Guidance for Electronic Labelling of NATO Information”, March 2004

[5] AC/322-D(2014)0010, “NATO Core Metadata Specification (NCMS)”, January 2015

[6] STANAG 4774, Confidentiality Metadata Label Syntax, Brussels, Belgium

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[8] NCIA TN-1455-REV1, “NATO Profile for the Binding of Metadata to Data Objects”, Version 1.1, December 2012

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[11] W3C XMLMIME, 2005, “Describing Media Content of Binary Data in XML”, at http://www.w3.org/TR/xml-media-types/, W3C

[12] W3C XMLMIME, 2004, “XML Schema Part 2: Datatypes Second Edition”, at http://www.w3.org/TR/xmlschema-2/, W3C Recommendation, W3C, 28 October 2004.

[13] IETF RFC 7303, “XML Media Types”, at http://tools.ietf.org/html/rfc7303, July 2014

[14] IANA Transfer Encodings, 2009, “Transfer Encodings”, at http://www.iana.org/assignments/transfer-encodings/transfer-encodings.xhtml, 17 August 2009.

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