



Intelligence Community Technical Specification

XML Data Encoding Specifications for Contextual Entity Markup

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Chapter 1 - Introduction

1.1 - Purpose

This *XML Data Encoding Specification for Contextual Entity Markup* (CEM.XML) defines detailed implementation guidance for XML-encoding of Contextual Entity Markup elements (e.g. country, drug, compound). CEM.XML is used to curate textual content adding information such as a pseudonym for the string “Mary Jane” to be marijuana or picking the precise pub chem (<https://pubchem.ncbi.nlm.nih.gov/substance/49898702#section=Top>) substance id 49898702 for what is actually being discussed. This specification is intended to supplement other specifications, such as PUBS.XML^[14], by enhancing the in-line metadata tagging with contextual meaning that is not part of normal document or metadata markup. The use of such enhancements facilitates search, discovery, and many other enterprise tasks by more clearly tagging intent and disambiguating terms.

CEM.XML has a set of Entity tags that may grow over time as the requirements are presented. The starting set of Entities was extracted from PUBS.XML^[14] 2016-SEP, and versions of PUBS.XML^[14] starting with 2018-APR use CEM.XML to replace the inline markup that it had since inception. The Schema Guide lists all of the currently defined entities, their attributes, and definitions.

1.2 - Scope

This specification is applicable to the Intelligence Community (IC) and information produced by, stored, or shared within the IC. This Data Encoding Specification (DES) may have relevance outside the scope of intelligence; however, prior to applying outside of this defined scope, the DES should be closely scrutinized and differences separately documented and assessed for applicability.

1.3 - Background

The Intelligence Community Chief Information Officer (IC CIO) is leading the IC's enterprise transformation to an “interoperable federated architecture.” Intelligence Community Directive (ICD) 500, *Director of National Intelligence Chief Information Officer*^[6] grants the IC CIO the authority and responsibility to:

- Develop an Intelligence Community Enterprise Architecture (IC EA).
- Lead the IC's identification, selection, development, and management of IC enterprise standards.
- Incorporate technically sound, de-conflicted, interoperable enterprise standards into the IC EA.
- Certify that IC elements adhere to the architecture and standards.

In the area of enterprise standardization, the IC CIO is called upon to establish common Information Technology (IT) standards, protocols, and interfaces, to establish uniform information security standards, and to ensure information technology infrastructure, enterprise architecture, systems, standards, protocols, and interfaces support the overall information sharing strategies and policies of the IC as established in relevant law, policy, and directives.

Enterprise standards facilitate the information exchanges, service protocols, network configurations, computing environments, and business processes necessary for a service-enabled

federated enterprise. As the enterprise develops and deploys shared services employing approved standards, not only will information and services be interoperable, but significant efficiencies and savings will be achieved by promoting capability reuse. As detailed in Intelligence Community Standard (ICS) 500-21, *Tagging of Intelligence and Intelligence-Related Information* [\[8\]](#) the extensive and consistent use of Extensible Markup Language (XML) within data encoding specifications allows for improved data exchanges and processing of information, thereby facilitating achievement of the IC's data discovery, data sharing, and interoperability goals.

An encoding specification defines a concrete implementation – a file format for example – for concepts in the *IC Abstract Data Definition ADD* [\[2\]](#). Many IC encoding specifications are based on XML, but other technologies are possible. For example, IC-ID [\[4\]](#) defines a plain-text format for IC Identifiers as well as an associated XML structure.

1.4 - Enterprise Need

This DES is designed to fulfill a number of requirements in support of the transformational efforts of the IC. These requirements include:

- Capturing descriptive metadata markup
- Supplementing other specifications with descriptive metadata markup.

Both enterprise needs and requirements for this specification can be found in the following policies and implementation guidance:

- 500 Series:
 - ICD 500, *Director Of National Intelligence Chief Information Officer* [\[6\]](#)
 - ICS 500-20, *IC Enterprise Standards Compliance* [\[7\]](#)
 - ICS 500-21, *Tagging of Intelligence and Intelligence-Related Information* [\[8\]](#)

1.5 - Audience and Applicability

DESS are primarily intended to be used by those developing tools and services to create, modify, store, exchange, search, display, or further process the type of data being described.

The conditions of use and applicability of this technical specification are defined outside of this technical specification. ICS 500-20, *Intelligence Community Enterprise Standards Compliance* [\[7\]](#), defines the Intelligence Community Enterprise Standards Baseline (IC ESB) and the applicability of such to an IC element.

The IC ESB defines the compliance requirements associated with each version of a technical specification. Each version will be individually registered in the IC ESB. The IC ESB will define, among other things, the location(s) of the relevant artifacts, prescriptive status, and validity period, all of which characterize the version and its utility.

Additional applicability and guidance may be defined in separate IC policy guidance.

1.6 - Conventions

Certain technical and presentation conventions were used in the creation of this document to ensure readability and understanding.

1.6.1 - Language

When appearing in all capital letters in this technical specification, the keywords “MUST,” “MUST NOT,” “REQUIRED,” “SHALL,” “SHALL NOT,” “SHOULD,” “SHOULD NOT,” “RECOMMENDED,” “MAY,” and “OPTIONAL” are to be interpreted as described in Internet Engineering Task Force (IETF) Request for Comments (RFC) 2119, “Key words for use in RFCs to Indicate Requirement Levels” [9]. When these words appear in regular case, they are meant in their natural-language sense.

1.6.2 - Typography

Certain typography is used throughout the body of this document to convey certain meanings, in particular:

- *Italics* – A title of a referenced work or a specialized or emphasized term
- Underscore – An abstract data element
- **Bold** – An XML element or attribute

1.6.3 - Terminology

For an implementation to conform to this specification, it MUST adhere to all normative aspects of the specification. For the purposes of this document, normative and informative are defined as:

- *Normative*: considered to be prescriptive and necessary to conform to the standard.
- *Informative*: serving to instruct, enlighten or inform.

1.6.4 - XML Namespaces

Namespaces referenced in this document and the prefixes used to represent them are listed in the following table. The namespace prefix of any XML Qualified Name used in any example in this document should be interpreted using the information below.

Table 1 - XML Namespaces

Prefix	URI
cem	urn:us:gov:ic:cem

1.7 - Dependencies

1.7.1 - Types of Dependencies

Specifications often rely on other specifications, components or artifacts, either directly or indirectly. Dependencies play an important role in functionality or provide informational relationships between the various artifacts. The following terms are defined to help assist with understanding how the various artifacts work together:

Dependency Directly or transitively influenced by.

Examples:

1. A is influenced by B therefore B is a dependency of A.
2. A is influenced by B and B is influenced by C; therefore C is a dependency of A.

Direct Dependency	Explicit influence. Example: A influences B.
Inverse Dependency	Directly or transitively influences. Example: B influences A.

1.7.2 - Specification Dependencies

This technical specification directly depends on the technical specifications, documentation, and implementations listed in [Table 2](#). The dependencies listed below are directly referenced in this specification (e.g., Schema, Schematron), and are normative or informative as indicated.

The subsequent figure, [Figure 1](#), is an informative graphical representation of all of the IC CIO specifications related to this specification. The graphic depicts dependencies. However, the representations may not match an exact schema import tree or dependency diagram that an analysis of the Schema, Schematron or other documents would yield. For example, the graphic only shows a given specification once even though it may actually be imported by many specifications or be a direct dependency. All IC CIO specifications listed in [Table 2](#) will be shown in [Figure 1](#); however not all IC CIO specifications listed in [Figure 1](#) may appear in [Table 2](#). [Figure 1](#) is to aid users in gaining a general understanding of all dependencies whether direct or transitive.

Table 2 - Direct Dependencies

Name	Dependency Description
<i>XML Data Encoding Specification for Information Security Marking Metadata</i> (ISM.XML.V13+) ^[10]	This specification does not depend on a specific version of ISM.XML ^[10] ; versions later than version 13 MAY be used. The minimum version was based on the earliest non-retired version; Enterprise Standards Baseline (ESB) 17-3 was used for determining the version.
<i>XML Data Encoding Specification for Virtual Coverage</i> (VIRT.XML.V1+) ^[18]	This specification does not depend on a specific version of VIRT.XML ^[18] ; versions later than version 1 MAY be used. The minimum version was based on the earliest non-retired version; ESB 17-3 was used for determining the version.

Name	Dependency Description
<p>Transformations (XSLT) 2.0^[23] implementation of Schematron^[15] by Rick Jelliffe (2010-04-14)</p> <p>Note: The only available identifying descriptors for this implementation are the implementer's name and date of release. This implementation may be found at the following Uniform Resource Locator (URL): http://code.google.com/p/schematron/.</p>	<p>The International Organization for Standardization does not create nor endorse reference implementations of its standards. For the purposes of this specification the <i>behavior</i> of the implementation created by Mr. Jelliffe is normative.</p> <p>Implementers MAY use any encodings, tools, or languages desired to implement validation schemes for conformance to this specification. To conform to this specification, a validator MUST find a document valid <i>if and only if</i> the Schematron implementation by Mr. Jelliffe would find the document valid according to the Schematron rules in this specification.</p>
<p>Value enumerations used for several XML structures are defined in the various Controlled Vocabulary Enumeration (CVEs) included in this DES.</p>	<p>Specification uses CVEs to encode controlled vocabularies. The use of the CEM.XML CVEs is normative.</p>

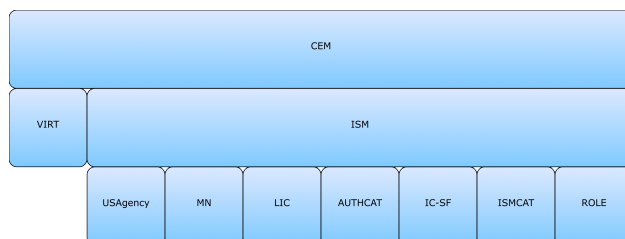


Figure 1 : Related Specifications

1.7.3 - Inverse Dependencies

Generally, it is only necessary to think of the *dependencies* in the dependency tree. However, with the specification versions being decoupled, it is also important to consider the *inverse dependencies*, for compatibility with newer versions of a given specification. The changes introduced to a given specification can sometimes make it incompatible with current versions of its inverse dependencies (specifications that uses the given specification).

Since this specification is one such specification that is used by other specifications released by the IC CIO, the [Figure 2](#) has been included to assist readers in understanding all of the inverse dependency relationships and how changes in this given specification may impact others specifications. This diagram is representative of direct and transitive inverse dependencies at the time of the release of this specification, but are subject to change over time and is presented in a list format that is different than [Figure 1](#).

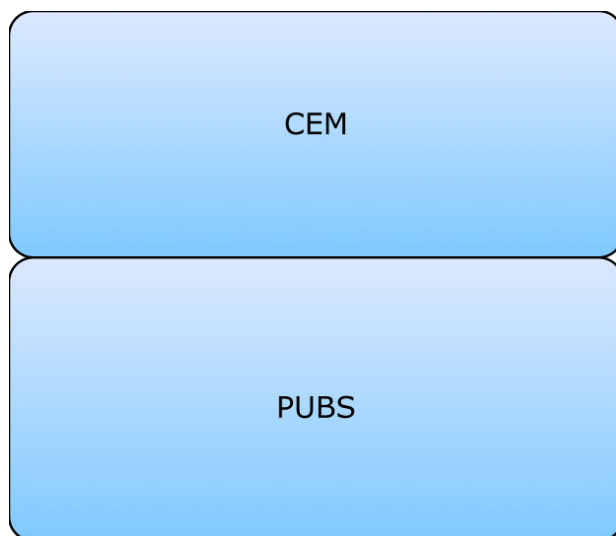


Figure 2 : Inverse Dependency Specifications

1.7.4 - Standalone and Convenience Packages

The standalone package of this specification does not include the specifications that it is dependent on since there may be more recent versions of those specifications available. There is a convenience package of the specification that includes the most recent versions of all dependent (see [Dependency](#)) specifications at the time the package is generated. It is anticipated that this convenience package will be updated when any of the dependent specifications change; however, it will not be signed as a formal package. In order to obtain all the necessary standalone packages, this specification's dependencies and their dependencies will have to be traversed and obtained. These packages will have to be downloaded and copied into the appropriate directories for paths to the schema and CVEs to validate and operate as intended.

Convenience packages convey all dependencies pre-packaged together and are tested as interoperable. When trying to mix and match versions that have not been pre-packaged together, there may be risk that a particular combination may not be compatible, especially when mixing with versions of specifications that were not available at the time of a specification's release.

1.8 - Conformance

For an implementation to conform to this specification, it **MUST** adhere to all normative aspects of the specification. For the purposes of this document, normative and informative are defined as:

- *Normative*: considered to be prescriptive and necessary to conform to the standard.
- *Informative*: serving to instruct, enlighten or inform.

The XML schemas (unless noted otherwise), CVE values from the XML CVE files, and any Schematron^[15] rules are normative for this specification. The rest of this document and the rest of this package, including the descriptive content referenced within the XML Schema Guide, the Extensible Stylesheet Language (XSL) transformations, the SchematronGuide, and PDF CVE value files, are informative. Additionally, the use of keywords defined in IETF RFC 2119^[9] is

considered normative within the scope of the sentence. All other parts of this document are informative.

The XML schemas provided may import other specifications. The versions of dependency specifications imported are not normative in that to import a different version of a component specification you could modify the import or substitute a different version of the component using the existing import path. This could be done by changing the schema file or by using XML Catalogs^[21]. For example, a schema could be changed to incorporate a different version of a dependency like ISM.XML^[10] by changing the attribute declaration of `@ism:DESVersion="201508"` to `@ism:DESVersion="201609"` in the `xsd:schema` statement. The ability to specify which version of a dependent specification to import enables the configuration change control of parent specifications (such as AUTHCAT.CES^[3]) to be “decoupled” from the configuration change control of dependent specifications (such as UIAS.XML^[17] CVE updates). This “decoupling” method has not been in place for all versions of these parent specifications; therefore, please verify with the dependency table to ensure use of allowed dependency versions.

Additional guidance that is either classified or has handling controls can be found in separate annexes distributed to the appropriate networks and environments as necessary. Systems and services operating in those environments MUST consult the appropriate annexes.

1.9 - Version Policies

1.9.1 - XML Namespace Policy

The XML namespaces defined in this specification do not incorporate a version number and do not change with revisions of the specification. This choice aligns with perspective two from “The Disposition of Names in an XML Namespace.”^[16] This decision allows for systems that process information encoded with these specifications to use the same Path Language (XPath) expressions across multiple revisions. It was agreed the burden of updating all XPath based systems for every revision to the specification was unacceptable. See section 4.2.2 “Versioning and XML namespace policy” of “Architecture of the World Wide Web, Volume One.”^[19]

There is a version attribute (e.g., `@DESVersion`, `@CESVersion`, `@TESVersion`, `@version`) for each namespace defined in an IC CIO specification. Version attributes are used to capture the specification version number the specification author intends an instance to conform to. Namespaces do not change, so the version attribute is required to fully understand an instance document.

As changes to the specification are released, the version number captured in the “version” attribute increments. See [Section 1.9.2 - Version Numbering](#) for information on the numbering scheme.

This XML namespace policy only applies to the namespaces defined in this specification, any namespaces that are included by reference should define their own namespace policy.

1.9.2 - Version Numbering

The version numbering for this specification is defined by a year-month structure (e.g., YYYY-^{MM}). This provides a temporal representation of when the specification was released. Revisions

to a version of the specification also use a year-month structure (e.g., YYYY-MMM). When the version number is used in the version attribute, the expression follows the Augmented Backus-Naur Form^[1] below:

Version Format when used in the version attribute:

- [1] Version ::= [Year Month](#)["." [Revision](#)] ["-" [CustomizationSuffix](#)]
- [2] VersionYear ::= 4(DIGIT)
- [3] VersionMonth ::= 2(DIGIT)
- [4] Customization ::= 1*23(ALPHA / DIGIT / "_")
Suffix
- [5] RevisionYear ::= 4(DIGIT)
- [6] RevisionMonth ::= 2(DIGIT)
h
- [7] Revision ::= [Year Month](#)

Version in XML Lexicon

The following vocabulary helps explain the meaning of terms used in the version documentation, and it may further constrain the set of allowable values:

Version	The version number as it might be expressed in a DESVersion, CESVersion or other XML attribute for indicating the version/revision being referenced.
VersionYear	The four digit year from the version of the specification being referenced.
VersionMonth	The 2 digit month from the version of the specification being referenced.
CustomizationSuffix	An optional suffix used when customizing a version of a specification. This would be used to indicate that you have extended the specification in some fashion for a particular use case.
RevisionYear	The four digit year from the revision of the specification being referenced.
RevisionMonth	The 2 digit month from the revision of the specification being referenced.
Revision	The Year and Month from the revision of the specification being referenced. Revisions are modifications to Versions.

Chapter 2 - Development Guidance

2.1 - Contextual Entity Markup Usage

CEM.XML is not a standalone specification. It is a library of metadata elements that is meant to be imported by other specifications where metadata markup for contextual entities is useful. To use CEM.XML in another specification,

- Import the CEM.XML schema.
- Reference cem:DescriptiveElementsGroup where descriptive metadata markup is needed.
- Make sure that the versions of VIRT.XML^[18], ISM.XML^[10], and ISMCAT.CES^[11] are defined since CEM.XML has elements that may depend on those specifications.

2.2 - CSV Notes

There are Comma Separated Value (CSV) files provided for all of the CVEs. They are in the CVE folder with the XML and JavaScript Object Notation (JSON) versions of the information. They are provided to assist developers using the CVEs; the specifications do not use them at this moment. There are no new requirements because of their existence.



Important

The CSV files on many systems will open “automatically” in Microsoft Excel; the default opening however, may not correctly read UTF-8 special characters. These are found in some country names such as “Republic of Côte d’Ivoire”. We added the Byte Order Mark (BOM) as this appears to make newer versions of Excel work properly without the following workaround. If you need to use a CVE that contains such special characters, or you think may contain such characters in Excel, you should:



Note

The following steps tested successfully for macOS Excel version 15.3.9 and Microsoft Windows Excel version 14.0.7; it was unsuccessful for macOS Excel version 14.7.1

1. Open Excel to a blank sheet
2. Under the Data menu choose to get external data from a text file
3. Choose UTF-8 as the file origin
4. Choose delimited as the format
5. Choose next
6. Change from tab to Comma as the delimiter

7. Finish import to get the data in with the UTF-8 Characters properly encoded in Excel.

2.3 - JSON Notes

There are JSON format files provided for all of the CVEs. They are in the CVE folder with the XML and CSV versions of the information. They are provided to assist developers using the CVEs; the specifications do not use them at this moment. There are no new requirements because of their existence. The JSON files are formatted using JavaScript Object Notation for Linked Data (JSON-LD) based on a proposed method for JSON in National Information Exchange Model (NIEM).

2.4 - RELAX NG Notes

There are REgular LAnguage for XML Next Generation (RELAX NG) format files provided for all of the CVEs. They are in the Schema folder with the XML Schema Definition (XSD) versions of the information. They are provided as a convenience to developers who wish to import IC Specification CVEs into other XML specifications that utilize RELAX NG. They will not affect specifications that do not utilize RELAX NG and there are no new requirements because of their existence. RELAX NG is an alternative schema language for XML and it provides both an XML syntax and a compact non-XML syntax. The XML syntax format fragments are provided with the .rng file name extension and the Compact syntax fragments are provided with the .rnc file name extensions.

Chapter 3 - Definitions, Interfaces, and Constraints

3.1 - Constraint Rule Types

Data constraint rules fall into two categories - validation and rendering constraints. Data validation constraints explicitly define policy validation constraints, describing how data should be structured and encoded in order to comply with IC policy. Validation constraint rules are implemented as a combination of basic XML Schema constraints and supplemental constraints for more complex rules. Complex constraint rules contain technical rule descriptions, Schematron rule implementations, and *Human Readable* descriptions. The human readable text describes the intent and meaning behind the more technical rule description. The semantics of the constraint rules are normative, whereas the use of the Schematron implementation is informative. Implementers developing alternative validation code should follow the technical rule descriptions and Schematron logic. Should there be a perception of conflict, implementers should bring it to the attention of the appropriate configuration control body for resolution. Rendering constraint rules define constraints on the display and rendering of documents. While expressed in a similar manner to the data validation constraint rules, there is no expectation that evaluation of these rules can be automated; rather these rules should inform the evaluation of a system's capabilities and functionality.

3.2 - "Living" Constraint Rules

These constraint rules are a "living" rule set. The constraint rules provided are a valid starter set and do not attempt to address the full scope of Contextual Element Markup concerns. These rules will be expanded and modified as the model matures, and as applicable policies change.

3.3 - Classified or Controlled Constraint Rules

Additional rules that are either classified or have handling controls can be found in separate annexes closely associated with the encoding specification artifacts wherever they are located.

3.4 - Constraint Terminology

For the purposes of this document, the following statements apply:

- The term "is specified" indicates that an attribute is applied to an element and the attribute has a non-null value.
- The term "must be specified" indicates that an attribute **MUST** be applied to an element and the attribute **MUST** have a non-null value.
- The term "is not specified" indicates that an attribute is not applied to an element, or an attribute is applied to an element and the attribute has a null value.
- The term "must not be specified" indicates that an attribute **MUST NOT** be applied to an element.

3.5 - Errors and Warnings

The severity of a constraint rule violation is categorized as either an "Error" or a "Warning." An "Error" is more severe and is indicative of a clear violation of a constraint rule, which would be

likely to have a significant impact on the quality of a document. A “Warning” is less severe although noteworthy, and may not necessarily have any impact on the quality of a document. The severity of a constraint rule violation is indicated in brackets preceding each constraint rule description.

Each system responsible for processing a document (e.g., create, modify, transform, or exchange) MUST make a mission-appropriate decision about using a document with errors or warnings based on mission needs.

3.6 - Rule Identifiers

Each constraint rule has an assigned rule identifier, indicated in brackets preceding the constraint rule description. CEM.XML data validation constraint rule identifiers are prefixed with "CEM-ID-" and followed by a 5 digit unique number, assigned from pre-defined ranges to group rules by classification. The numerical ranges are described in [Section 3.6 - Rule Identifiers \[12\]](#). As the constraint rules are managed over time, IDs from deleted rules will not be reused.

Table 3 - Numerical Rule Identifier Ranges

Rule Identifier Range		Description
Start	End	
00001	09999	Reserved for Unclassified constraint rules
10001	19999	Reserved for Unclassified but For Official Use Only (FOUO) constraint rules
20001	20999	Reserved for constraint rules classified at the “Secret//REL USA, FVEY” level
21001	21999	Reserved for constraint rules classified at the “Secret//NF” level
22001	29999	Reserved for constraint rules classified at the “Secret//TBD” level
30001 and above		Reserved for constraint rules classified with other classifications

3.7 - Data Validation Constraint Rules

3.7.1 - Purpose

The CEM.XML schema defines the data elements, attributes, cardinalities and parent-child relationships for which CEM.XML instances must comply. Validation of these syntax aspects is an important first step in the validation process. An additional level of validation is needed to ensure that the content complies with the constraints as specified in applicable IC policy guidance and codified in these constraint rules. Traditional schema languages are generally unable to effectively represent these additional constraints.

3.7.2 - Schematron

Schematron^[15] is the formal language used in this specification to encode normative data validation constraints. The Schematron rules are normative in the sense that they convey criteria a document MUST meet, exactly as English may be used to convey normative criteria.

It is not necessary for implementers to use the specific Schematron encoding in this specification, and implementers MAY use any encodings, tools, or languages desired to implement validation schemes for conformance to this specification. To conform to this specification, a validator MUST find a document valid *if and only if* the Schematron implementation by Mr. Jelliffe would find the document valid according to the Schematron rules in this specification.

For better understanding, the Schematron^[15] rules for this specification may be executed in *Oxygen*^[13] or with an XSLT 2.0-compliant processor using the XSLT 2.0^[23] transforms in the Schematron implementation from Rick Jelliffe (see [XSLT 2.0 implementation of Schematron by Rick Jelliffe](#) in the Dependency table).

The constraint rules for this specification are dependent on XPath 2.0^[22] and XSLT 2.0^[23] features. Regarding the use of XPath 2.0 and XSLT 2.0 with Schematron, the editor of the International Organization for Standardization (ISO) Schematron standard^[12] stated the following:

By default, Schematron uses the XPath language as used in XSLT 1.0, and is typically implemented by converting the schema into an XSLT 1.0 script which is run against the document being validated. However, ISO Schematron also allows XSLT 2.0 to be used, and this is becoming an increasingly popular choice because of the extra expressive convenience of XPath 2.0: a different skeleton is available for this.



Note

For convenience, the specification package provides the XSLT 2.0^[23] implementation of Schematron^[15] along with a compiled version of the rules.

3.7.3 - Non-null Constraints

XML syntax allows all elements with content declared to be of data type “string” to have zero or more characters of content, meaning elements can be empty or null. According to this specification, all required elements (and certain conditional elements) MUST have content, other than white space.¹ Elements, which are allowed to only have text content, MUST have text content specified.

3.7.4 - Value Enumeration Constraints

Several elements and attributes of the CEM.XML model use CVEs to define the data allowed in the element or attribute. In some cases the specific CVE is specified via an attribute, which may include a default CVE. Further, in some of the cases where the CVE can be specified, the attribute may restrict the list of CVEs allowed and some may allow for the author to specify their own CVE. For each of these, the value must be in the specified external CVE or the default CVE.

Some CVEs are not available on all networks. A subset CVE will be provided for use on networks not approved for the entire list. If the processing will occur on a network where the entire CVE is not available, the subset CVE may be substituted in the constraint rules since the excluded values would be excluded from use on the lower network.

¹“White space” is defined in XML 1.0^[20] as “(white space) consists of one or more space (#x20) characters, carriage returns, line feeds, or tabs.”

As noted in the specific rules, a failure of validation against a CVE will generate an Error.

3.7.5 - Additional Constraints

3.7.5.1 - DES Constraints

The DES version is specified through attributes on the root element. The schema constrains the values of these attributes. The **DESVersion** attribute enables systems processing an instance document to be certain which set of constraint rules, schema, CVEs and business rules are intended by the author to be used.

3.7.5.2 - Revision Constraints

When validating an instance document against the validation rule sets and schema provided by the specification there is a certain philosophy that SHOULD be applied to both protect the data and the systems processing that data. This validation philosophy consists of the following seven basic rules that describe how the DESVersion matters to validation:

1. One MUST NOT validate with rules older than the integer version declared in an instance; this is an error.
2. One MAY validate with rules that are of a greater integer version than an instance.
3. When validating an instance with a lower integer version number than that of the validation rules, there MAY be a minimum integer version cutoff for a set of rules. If such a limit exists, this is an error.
4. Within an integer, validation MUST only occur with the newest decimal value implemented by the validator; that is a validator MUST only implement one signed validation rule set within an integer and it SHOULD be the latest.
5. When a validator detects an instance document claiming a version newer than what is implemented in the validator, a notice/log SHOULD be generated so a human can evaluate if the validator needs to be updated to the latest rule set, as passing the old rules MAY not comply with current law or policy.
6. A validator SHOULD document and communicate all versions and revisions it accepts, including the constraints (business/policy rules, allowed values, schema formats, etc.) in each of those versions.

The matrix of fictional generic examples in [Table 4](#) are provided to illustrate these validation concepts with the following assumptions:

- Version 11: Technically incompatible with newer versions
- Version 12: Technically compatible with newer versions, but retired from the Enterprise Standards Baseline
- Version 13: Oldest in the Enterprise Standards Baseline

- Version 13.201701: Revision to version 13
- Version 13.201804: Revision to version 13
- Version 201508: Standard release
- Version 201609: Latest version release

Table 4 - Revision Constraints table

Validation Rules Version	11	12	13	13.201701	13.201804	201508	201609
Instance Version							
11	Version Match	Instance Too Old (Tech)	Instance Too Old (Tech)	Instance Too Old (Tech)	Instance Too Old (Tech)	Instance Too Old (Tech)	Instance Too Old (Tech)
12	Instance Too New	Version Match	Instance Too Old (ESB)	Instance Too Old (ESB)	Instance Too Old (ESB)	Instance Too Old (ESB)	Instance Too Old (ESB)
13	Instance Too New	Instance Too New	Version Match	Same Integer	Same Integer	Allowed	Allowed
13.201701	Instance Too New	Instance Too New	Same Integer	Version Match	Same Integer	Allowed	Allowed
13.201804	Instance Too New	Instance Too New	Same Integer	Same Integer	Version Match	Allowed	Allowed
201508	Instance Too New	Instance Too New	Instance Too New	Instance Too New	Instance Too New	Version Match	Allowed
201609	Instance Too New	Instance Too New	Instance Too New	Instance Too New	Instance Too New	Instance Too New	Version Match

3.7.6 - Constraint Rules

The detailed constraint rules for the CEM.XML schema can be found in a separate document inside the SchematronGuide directory, in the CEM_Rules.pdf file. This document is generated from the individual Schematron files to provide a single searchable document for all of the constraint rules encoded in Schematron. Obsolete rule numbers are listed in the SchematronGuide.

3.8 - Data Rendering Constraint Rules

3.8.1 - Purpose

Rendering rules define constraints on the rendering and display of CEM.XML documents. The intent is to inform the development of systems capable of rendering or displaying CEM.XML data

for use by individuals not familiar with the details of the CEM.XML markup. While expressed in a similar manner to the data validation constraint rules above, there is no expectation that evaluation of these rules can be automated; rather these rules should inform the evaluation of a system's capabilities and functionality.

3.8.2 - Rendering Constraint Rules

The following table contains the information for the CEM.XML data rendering constraint rules.

Table 5 - Constraint Rules

Rule Number	Severity	Description	Human Readable Description
There are no Data Rendering Constraint rules at this time.			

Chapter 4 - Conformance Validation

An instance document conforms with this specification if it conforms to all normative guidance of this specification and this specification's dependencies and it passes all of the following validation steps. This specification does not dictate how this validation strategy is implemented.

4.1 - Schema Validation

An instance document **MUST** comply with the schemas for this specification and this specification's dependencies, and schema validation **SHOULD** occur prior to other validation steps. If schema validation fails, results from later steps may be indeterminate.



Warning

If IC-TDF.XML^[5] is being used it is critical to follow the validation strategy outlined in IC-TDF.XML^[5] to achieve proper schema validation. Failure to do so will have a high probability of schema invalid data appearing to be valid.

4.2 - Business Rule Validation

An instance document **MUST** comply with the business rules expressed in this specification and those expressed in this specification's dependencies. The business rules in this specification are expressed in Schematron, but it is not necessary for implementers to use the specific Schematron encoding in this specification. Implementers **MAY** use any encodings, tools, or languages desired to implement validation schemes for conformance to this specification. To conform to this specification, a validator **MUST** find a document valid *if and only if* the Schematron implementation by Mr. Jelliffe would find the document valid according to the Schematron rules in this specification.

Chapter 5 - Generated Guides

5.1 - Schema Guide

The detailed description and reference documentation for the CEM.XML schema can be found as a collection of HyperText Markup Language (HTML) files inside the SchemaGuide directory. These files comprise a guide that serves as an interactive presentation of the CEM.XML schema as well as an implementation-specific data element dictionary.

The guide was generated with a commercially available product named *oXygen@^[13]* produced by SyncRO Soft.

The guide provides an interactive index to:

- Global Elements and Attributes
- Local Elements and Attributes
- Simple and Complex Types
- Groups and Attribute Groups
- Referenced Schemas

Where applicable, the guide provides:

- Diagram
- Namespace
- Type
- Children (Child Elements)
- Used by
- Properties
- Patterns
- Enumerations
- Attributes
- Annotations
- Source Code

The guide is published in a folder consisting of the master HTML file *SchemaGuide.html* with supporting graphics.

5.2 - Schematron Guide

The detailed description and reference documentation for the CEM.XML Schematron rules can be found in a separate document named *CEM_Rules.pdf*, which is located inside the SchematronGuide directory. This document is generated from the individual Schematron^[15] files to provide a single searchable document for all of the constraint rules encoded in Schematron^[15].

Appendix A Feature Summary

The following table shows the version dependencies for CEM.XML on other specifications. Direct dependencies are marked with an asterisk.

Table 6 - CEM.XML Dependency over Time

Dependent Specification	V2018-APR
ISM.XML ^[10] *	V13+
VIRT.XML ^[18] *	V1+
ISMCAT.CES ^[11]	V2017-SEP+

The following tables summarize major features by version for CEM.XML. The “Required date” is the date when systems SHOULD support a feature based on the specified driver. Executive Orders, Information Security Oversight Office (ISOO) notices, ICDs and other policy documents have a variety of effective dates. The “Required date” may be later than the date of applicable policy based on the effective date defined in the policy (e.g. The IC Marking System Register and Manual has an implementation date of one year after issuance).

Table 7 - Feature Summary Legend

Key	Description
F	Full (able to comply and verified by spec to some degree)
P	Partial (Able to comply but not verifiable)
N	Non-compliance (Can’t comply)
N/A	Not Applicable. Feature is no longer required.
Cell Colors represent the same information as the Key value	

A.1. CEM.XML Feature Summary

Table 8 - CEM.XML Feature Comparison

Required date	Feature	V2018-APR
	Provides a baseline of descriptive metadata markup	F

Appendix B Change History

The following table summarizes the version identifier history for this DES.

Table 9 - DES Version Identifier History

Version	Date	Purpose
2018-APR	April 20, 2018	Initial Release. For details, see Section B.1 - V2018-APR Initial Release Summary

B.1 - V2018-APR Initial Release Summary

Significant drivers for Version V2018-APR include:

- Creation of CEM.XML specification.

The following table summarizes the initial release in V2018-APR.

Table 10 - Data Encoding Specification V2018-APR Initial Release Summary

#	Change	Artifacts changed	Compatibility Notes
1	Creation of CEM.XML specification.(CR-2017-167)	Documentation Schema Schematron	Initial Release.

Appendix C List of Abbreviations

This appendix lists all the acronyms and abbreviations referenced in this encoding specification.

CSV	Comma Separated Value
CVE	Controlled Vocabulary Enumeration
DES	Data Encoding Specification
DNI	Director of National Intelligence
ESB	Enterprise Standards Baseline
FOUO	For Official Use Only
HTML	HyperText Markup Language
IC	Intelligence Community
IC CIO	Intelligence Community Chief Information Officer
ICD	Intelligence Community Directive
IC EA	Intelligence Community Enterprise Architecture
IC ESB	Intelligence Community Enterprise Standards Baseline
ICS	Intelligence Community Standard
IETF	Internet Engineering Task Force
ISO	International Organization for Standardization
ISOO	Information Security Oversight Office
IT	Information Technology
JSON	JavaScript Object Notation
JSON-LD	JavaScript Object Notation for Linked Data
NIEM	National Information Exchange Model
RELAX NG	REgular LAnguage for XML Next Generation
RFC	Request for Comments
URL	Uniform Resource Locator
XML	Extensible Markup Language
XPath	XML Path Language

XSD	XML Schema Definition
XSL	Extensible Stylesheet Language
XSLT	XSL Transformations

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Appendix E Points of Contact

The Intelligence Community Chief Information Officer (IC CIO) facilitates one or more collaboration and coordination forums charged with the adoption, modification, development, and governance of IC technical specifications of common concern. This technical specification was produced by the IC CIO and coordinated with these forums, approved by the IC CIO or a designated representative, and made available at the following Director of National Intelligence (DNI)-sponsored web sites.

Public Website: <https://w3id.org/ic/standards/public>

Intelshare: <https://w3id.org/ic/standards/data-specs>

Direct all inquiries about this IC technical specification, IC technical specification collaboration and coordination forums, or IC element representatives involved in those forums, to the IC CIO.

E-mail: ic-standards-support@odni.gov.

Appendix F IC CIO Approval Memo

An IC CIO Approval Memo should accompany this enterprise technical data specification bearing the signature of the IC CIO or an IC CIO-designated official(s). If an IC CIO Approval Memo is not accompanying this specification's version release package, then refer back to the authoritative web location(s) for this specification to see if a more complete package or a specification update is available.

Specification artifacts display a date representing the last time a version's artifacts as a whole were modified. This date most often represents the conclusion of the IC Element collaboration and coordination process. Once the IC Element coordination process is complete, the specification goes through an internal IC CIO staffing and coordination process leading to signature of the IC CIO Approval Memo. The signature date of the IC CIO Approval Memo will be later than the last modified date shown on the specification artifacts by an indeterminable time period.

Upon signature of the IC CIO Approval Memo, IC Elements may begin to use this specification version in order to address mission and business objectives. However, it is critical for IC Elements, prior to disseminating information encoded with this new specification version, to ensure that key enterprise services and consumers are prepared to accept this information. IC Elements should work with enterprise service providers and consumers to orchestrate an orderly implementation transition to this specification version in concert with mandatory and retirement usage decisions captured in the IC ESB as defined in ICS 500-20^[7].