CybOXTM Version 2.1.1 Part 23: Email Message Object

Working Draft 01

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* *CybOXTM Version 2.1.1 Part 1: Overview*. [URI]
* *CybOXTM Version 2.1.1 Part 2: Common*. [URI]
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* *CybOXTM Version 2.1.1 Part 4: Default Extensions*. [URI]
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* *CybOXTM Version 2.1.1 Part 22: Domain Name Object*. [URI]
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* *CybOXTM Version 2.1.1 Part 91: Win User Account Object*. [URI]
* *CybOXTM Version 2.1.1 Part 92: Win Volume Object*. [URI]
* *CybOXTM Version 2.1.1 Part 93: Win Waitable Timer Object*. [URI]
* *CybOXTM Version 2.1.1 Part 94: X509 Certificate Object*. [URI]

Related work:

This specification is related to:

* *STIXTM Version 1.2.1 (placeholder)*

Abstract:

The Cyber Observable Expression (CybOX) is a standardized language for encoding and communicating high-fidelity information about cyber observables, whether dynamic events or stateful measures that are observable in the operational cyber domain. By specifying a common structured schematic mechanism for these cyber observables, the intent is to enable the potential for detailed automatable sharing, mapping, detection and analysis heuristics. This specification document defines the Email Message Object data model, which is one of the Object data models for CybOX content.

Status:

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# Introduction

[All text is normative unless otherwise labeled]

The Cyber Observable Expression (CybOXTM) provides a common structure for representing cyber observables across and among the operational areas of enterprise cyber security. CybOX improves the consistency, efficiency, and interoperability of deployed tools and processes, and it increases overall situational awareness by enabling the potential for detailed automatable sharing, mapping, detection, and analysis heuristics.

This document serves as the specification for the CybOX Email Message Object Version 2.1.1 data model, which is one of eighty-eight CybOX Object data models.

In Section **1.1** we discuss additional specification documents, in Section **1.2** we provide document conventions in, and in Section **1.3** we provide terminology. References are given in Section **1.4**. In Section **2**, we give background information necessary to fully understand the Email Message Object data model. We present the Email Message Object data model specification details in Section **3** and conformance information in Section **4**.

## CybOXTM Specification Documents

The CybOX specification consists of a formal UML model and a set of textual specification documents that explain the UML model. Specification documents have been written for each of the key individual data models that compose the full CybOX UML model.

CybOX has a modular design comprising two fundamental data models and a collection of Object data models. The fundamental data models – CybOX Core and CybOX Common – provide essential CybOX structure and functionality. The CybOX Objects, defined in individual data models, are precise characterizations of particular types of observable cyber entities (e.g., HTTP session, Windows registry key, DNS query).

Use of the CybOX Core and Common data models is required; however, use of the CybOX Object data models is purely optional: users select and use only those Objects and corresponding data models that are needed. Importing the entire CybOX suite of data models is not necessary.

The [*CybOX Version 2.1.1 Part 1: Overview*](#AdditionalArtifacts) document provides a comprehensive overview of the full set of CybOX data models, which in addition to the Core, Common, and numerous Object data models, includes various extension data models and a vocabularies data model, which contains a set of default controlled vocabularies. [*CybOX Version 2.1.1 Part 1: Overview*](#AdditionalArtifacts) also summarizes the relationship of CybOX to other languages, and outlines general CybOX data model conventions.

## Document Conventions

The following conventions are used in this document.

### Fonts

The following font and font style conventions are used in the document:

* Capitalization is used for CybOX high level concepts, which are defined in [*CybOX Version 2.1.1 Part 1: Overview*](#AdditionalArtifacts).

Examples: Action, Object, Event, Property

* The Courier New font is used for writing UML objects.

Examples: ActionType, cyboxCommon:BaseObjectPropertyType

Note that all high level concepts have a corresponding UML object. For example, the Action high level concept is associated with a UML class named, ActionType.

* The ‘*italic’* font (withsingle quotes) is used for noting actual, explicit values for CybOX Language properties. The *italic* font (without quotes) is used for noting example values.

Example:  *‘HashNameVocab-1.0,’ high, medium, low*

### UML Package References

Each CybOX data model is captured in a different UML package (e.g., Core package) where the packages together compose the full CybOX UML model. To refer to a particular class of a specific package, we use the format package\_prefix:class, where package\_prefix corresponds to the appropriate UML package. The [*CybOX Version 2.1.1 Part 1: Overview*](#AdditionalArtifacts) document contains the full list of CybOX packages, along with the associated prefix notations, descriptions, and examples.

Note that in this specification document, we do not explicitly specify the package prefix for any classes that originate from the Email Message Object data model.

### UML Diagrams

This specification makes use of UML diagrams to visually depict relationships between CybOX Language constructs. Note that the diagrams have been extracted directly from the full UML model for CybOX; they have not been constructed purely for inclusion in the specification documents.  Typically, diagrams are included for the primary class of a data model, and for any other class where the visualization of its relationships between other classes would be useful.  This implies that there will be very few diagrams for classes whose only properties are either a data type or a class from the CybOX Common data model.  Other diagrams that are included correspond to classes that specialize a superclass and abstract or generalized classes that are extended by one or more subclasses.

In UML diagrams, classes are often presented with their attributes elided, to avoid clutter. The fully described class can usually be found in a related diagram. A class presented with an empty section at the bottom of the icon indicates that there are no attributes other than those that are visualized using associations.

#### Class Properties

Generally, a class property can be shown in a UML diagram as either an attribute or an association (i.e., the distinction between attributes and associations is somewhat subjective). In order to make the size of UML diagrams in the specifications manageable, we have chosen to capture most properties as attributes and to capture only higher level properties as associations, especially in the main top-level component diagrams. In particular, we will always capture properties of UML data types as attributes. For example, properties of a class that are identifiers, titles, and timestamps will be represented as attributes.

#### Diagram Icons and Arrow Types

Diagram icons are used in a UML diagram to indicate whether a shape is a class, enumeration, or a data type, and decorative icons are used to indicate whether an element is an attribute of a class or an enumeration literal. In addition, two different arrow styles indicate either a directed association relationship (regular arrowhead) or a generalization relationship (triangle-shaped arrowhead). The icons and arrow styles we use are shown and described in **Table 1‑1.**

Table 1‑1. UML diagram icons

|  |  |
| --- | --- |
| **Icon** | **Description** |
|  | This diagram icon indicates a class. If the name is in italics, it is an abstract class. |
|  | This diagram icon indicates an enumeration. |
|  | This diagram icon indicates a data type. |
|  | This decorator icon indicates an attribute of a class. The green circle means its visibility is public. If the circle is red or yellow, it means its visibility is private or protected. |
|  | This decorator icon indicates an enumeration literal. |
|  | This arrow type indicates a directed association relationship. |
|  | This arrow type indicates a generalization relationship. |

### Property Table Notation

Throughout Section **3**, tables are used to describe the properties of each data model class. Each property table consists of a column of names to identify the property, a type column to reflect the datatype of the property, a multiplicity column to reflect the allowed number of occurrences of the property, and a description column that describes the property. Package prefixes are provided for classes outside of the Email Message Object data model (see Section **1.2.2**).

Note that if a class is a specialization of a superclass, only the properties that constitute the specialization are shown in the property table (i.e., properties of the superclass will not be shown). However, details of the superclass may be shown in the UML diagram.

### Property and Class Descriptions

Each class and property defined in CybOX is described using the format, “The X property verbY.” For example, in the specification for the CybOX Core data model, we write, “The id property specifies a globally unique identifier for the Action.” In fact, the verb “specifies” could have been replaced by any number of alternatives: “defines,” “describes,” “contains,” “references,” etc.

However, we thought that using a wide variety of verb phrases might confuse a reader of a specification document because the meaning of each verb could be interpreted slightly differently. On the other hand, we didn’t want to use a single, generic verb, such as “describes,” because although the different verb choices may or may not be meaningful from an implementation standpoint, a distinction could be useful to those interested in the modeling aspect of CybOX.

Consequently, we have chosen to use the three verbs, defined as follows, in class and property descriptions:

|  |  |
| --- | --- |
| **Verb** | **CybOX Definition** |
| captures | Used to record and preserve information without implying anything about the structure of a class or property. Often used for properties that encompass general content. This is the least precise of the three verbs. |
|  | *Examples*:  The Observable\_Source property characterizes the source of the Observable information. Examples of details captured include identitifying characteristics, time-related attributes, and a list of the tools used to collect the information.  The Description property captures a textual description of the Action. |
| characterizes | Describes the distinctive nature or features of a class or property. Often used to describe classes and properties that themselves comprise one or more other properties. |
|  | *Examples*:  The Action property characterizes a cyber observable Action.  The Obfuscation\_Technique property characterizes a technique an attacker could potentially leverage to obfuscate the Observable. |
| specifies | Used to clearly and precisely identify particular instances or values associated with a property. Often used for properties that are defined by a controlled vocabulary or enumeration; typically used for properties that take on only a single value. |
|  | *Example*:  The cybox\_major\_version property specifies the major version of the CybOX language used for the set of Observables. |

## Terminology

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [**[RFC2119]**](#rfc2119).

## Normative References

[RFC2076] Palme, J., “Common Internet Message Headers”, Informational, RFC 2076, February 1997. <https://tools.ietf.org/rfc/rfc2076.txt>.

[RFC2119] Bradner, S., “Key words for use in RFCs to Indicate Requirement Levels”, BCP 14, RFC 2119, March 1997. <http://www.ietf.org/rfc/rfc2119.txt>.

# Background Information

In this section, we provide high level information about the Email Message Object data model that is necessary to fully understand the specification details given in Section **3**.

## Cyber Observables

A cyber observable is a dynamic event or a stateful property that occurs, or may occur, in the operational cyber domain. Examples of stateful properties include the value of a registry key, the MD5 hash of a file, and an IP address. Examples of events include the deletion of a file, the receipt of an HTTP GET request, and the creation of a remote thread.

A cyber observable is different than a cyber indicator. A cyber observable is a statement of fact, capturing what was observed or could be observed in the cyber operational domain. Cyber indicators are cyber observable patterns, such as a registry key value associated with a known bad actor or a spoofed email address used on a particular date.

## Objects

Objects in CybOX are individual data models for characterizing a particular cyber entity, such as a Windows registry key, or an Email Message. Accordingly, each release of the CybOX language includes a particular set of Objects that are part of the release. The data model for each of these Objects is defined by its own specification that describes the context-specific classes and properties that compose the Object.

# Data Model

## EmailMessageObjectType Class

The EmailMessageObjectType class is intended to characterize an individual email message. The UML diagram corresponding to the EmailMessageObjectType class is shown in **Figure 3‑1**.

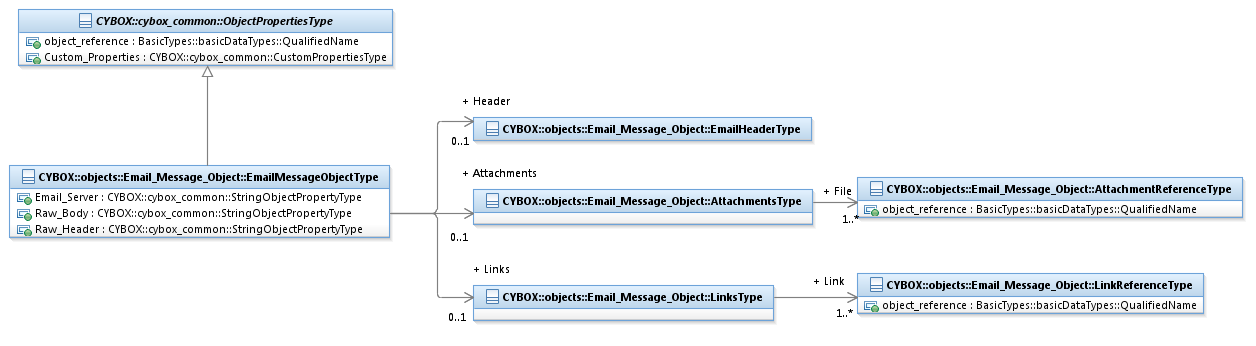


Figure ‑. UML diagram of the EmailMessageObjectType class

The property table of the EmailMessageObjectType class is given in **Table 3‑1**.

Table ‑. Properties of the EmailMessageObjectType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Header** | EmailMessageObj:EmailHeaderType | 0..1 | The Header property specifies a variety of common headers that may be included in the email message. |
| **Email\_Server** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Email\_Server property specifies the relevant email server. |
| **Raw\_Body** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Raw\_Body property specifies the complete (raw) body of the email message. |
| **Raw\_Header** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Raw\_Header property specifies the complete (raw) headers of the email message. |
| **Attachments** | EmailMessageObj:AttachmentsType | 0..1 | The Attachments property specifies any files that were attached to the email message. It imports and uses the CybOX FileObjectType class from the File\_Object to do so. |
| **Links** | EmailMessageObj:LinksType | 0..1 | The Links property specifies any URL links contained within the email message. It imports and uses the CybOX LinkObjectType class from the Link\_Object to do so. |

## AttachmentsType Class

The AttachmenstType class captures a list of attachments for an email message.

The property table of the AttachmentsType class is given in **Table 3‑2**.

Table ‑. Properties of the AttachmentsType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **File** | EmailMessageObj:AttachmentReferenceType | 1..\* | The File property specifies a file that was attached to the email message, via a reference to an Object included elsewhere in the document. |

## EmailHeaderType Class

The EmailHeaderType class captures a representation of a standard email header. The UML diagram corresponding to the EmailHeaderObjectType class is shown in Figure 3‑2.

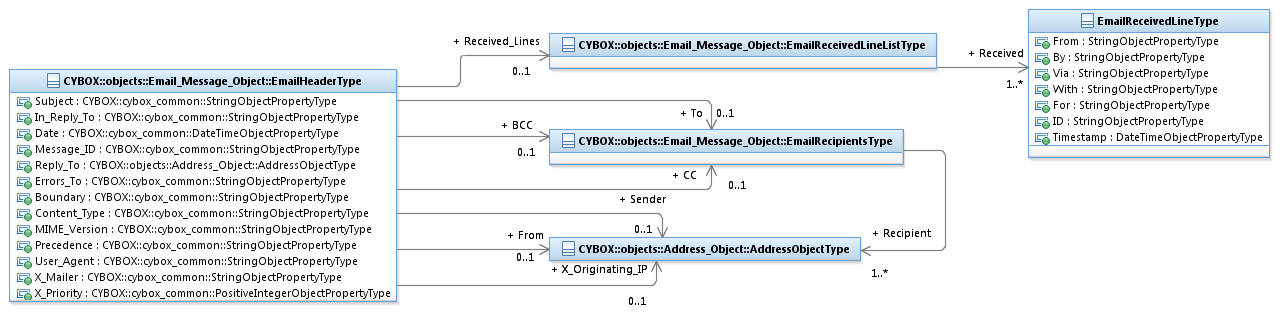


Figure ‑: UML diagram of EmailHeaderType class

The property table of the EmailHeaderType class is given in **Table 3‑3**.

Table ‑. Properties of the EmailHeaderType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Received\_Lines** | EmailMessageObj:  EmailReceivedLineListType | 0..1 | The Received\_Lines property specifies one or more 'Received' lines that may be included in the email header. |
| **To** | EmailMessageObj:  EmailRecipientsType | 0..1 | The To property specifies the email addresses of the recipients of the email message. |
| **CC** | EmailMessageObj:  EmailRecipientsType | 0..1 | The CC property specifies the email addresses of any recipients that were included in the carbon copy header of the email message. |
| **BCC** | EmailMessageObj:  EmailRecipientsType | 0..1 | The BCC property specifies the email addresses of any recipients that were included in the blind carbon copy header of the email message. |
| **From** | AddressObj:AddressObjectType | 0..1 | The From property specifies the email address of the sender of the email message. |
| **Subject** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Subject property specifies the subject (a brief summary of the message topic) of the email message. |
| **In\_Reply\_To** | cyboxCommon:  StringObjectPropertyType | 0..1 | The In\_Reply\_To property specifies the message ID of the message that this email is a reply to. |
| **Date** | cyboxCommon:  DateTimeObjectPropertyType | 0..1 | The Date property specifies the date/time that the email message was sent. |
| **Message\_ID** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Message\_ID property specifies the automatically generated ID of the email message. |
| **Sender** | AddressObj:AddressObjectType | 0..1 | The Sender property specifies the email address of the sender who is acting on behalf of the author listed in the From: field. |
| **Reply\_To** | AddressObj:AddressObjectType | 0..1 | The Reply\_To property specifies the email address that should be used when replying to the email message. |
| **Errors\_To** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Errors\_To property specifies the entry in the (deprecated) errors\_to header of the email message. |
| **Boundary** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Boundary property specifies a boundary tag that may be included in a MIME multipart message. This boundary tag is used to indicate the parts of a multipart message. |
| **Content\_Type** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Content-Type property specifies the internet media, or MIME, type of the email message content. |
| **MIME\_Version** | cyboxCommon:  StringObjectPropertyType | 0..1 | The MIME-Version property specifies the version of the MIME formatting used in the email message. |
| **Precedence** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Precedence property specifies the (non-standard) priority value of the message, which can influence transmission speed and delivery. Use of this field is typically discouraged, as per [**[RFC2076]**](#rfc2076). |
| **User\_Agent** | cyboxCommon:  StringObjectPropertyType | 0..1 | The User-Agent property specifies the identity of the email user agent software that may have been used to send the email message. |
| **X\_Mailer** | cyboxCommon:  StringObjectPropertyType | 0..1 | The X-Mailer property specifies the software used to send the email message. This field is non-standard. |
| **X\_Originating\_IP** | AddressObj:AddressObjectType | 0..1 | The X-Originating-IP property specifies the originating IP Address of the email sender, in terms of their connection to the mail server used to send the email message. This field is non-standard. |
| **X\_Priority** | cyboxCommon:  PositiveIntegerObjectPropertyType | 0..1 | The X-Priority property specifies the numerical priority of the email message. This is a non-standard field, but typically a value of '1' is considered the highest priority, '3' is normal, and '5' is the lowest priority. |

## EmailRecipientsType Class

The EmailRecipientsType class captures a list of recipients for an email message.

The property table of the EmailRecipientsType class is given in **Table 3‑4**.

Table ‑. Properties of the EmailRecipientsType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Recipient** | AddressObj:AddressObjectType | 1..\* | The Recipient property represents a single recipient for an email message. |

## LinksType Class

The LinksType class captures a list of URIs, representing the links contained in the message.

The property table of the LinksType class is given in **Table 3‑5**.

Table ‑. Properties of the LinksType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Link** | EmailMessageObj:LinkReferenceType | 1..\* | The Link property specifies a single URL link contained within the email message, via a reference to an Object included elsewhere in the document. |

## EmailReceivedLineType Class

The EmailReceivedLineType class captures a single 'Received' line in an email message header.

The property table of the EmailReceivedLineType class is given in **Table 3‑6**.

Table ‑. Properties of the EmailReceivedLineType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **From** | cyboxCommon:StringObjectPropertyType | 0..1 | The From property captures the 'from' portion of the Received line, if applicable. |
| **By** | cyboxCommon:StringObjectPropertyType | 0..1 | The By property captures the 'by' portion of the Received line, if applicable. |
| **Via** | cyboxCommon:StringObjectPropertyType | 0..1 | The Via property captures the 'via' portion of the Received line, if applicable. |
| **With** | cyboxCommon:StringObjectPropertyType | 0..1 | The With property captures the 'with' portion of the Received line, if applicable. |
| **For** | cyboxCommon:StringObjectPropertyType | 0..1 | The For property captures the 'for' portion of the Received line, if applicable. |
| **ID** | cyboxCommon:StringObjectPropertyType | 0..1 | The ID property captures the 'id' portion of the Received line, if applicable. |
| **Timestamp** | cyboxCommon:DateTimeObjectPropertyType | 0..1 | The Timestamp property captures the timestamp portion of the Received line, if applicable. |

## EmailReceivedLineListType Class

The EmailReceivedLineListType class captures a list of 'Received' lines in an email message header.

The property table of the EmailReceivedLineListType class is given in **Table 3‑7**.

Table ‑. Properties of the EmailReceivedLineListType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Received** | EmailMessageObj:EmailReceivedLineType | 1..\* | The Received property captures a single Received line in the list. |

## AttachmentReferenceType Class

The AttachmentReferenceType class specifies a reference to an Object defined elsewhere in the document which characterizes an attachment included in the email message.

The property table of the AttachmentReferenceType class is given in **Table 3‑8**.

Table ‑. Properties of the AttachmentReferenceType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **object\_reference** | basicDataTypes:QualifiedName | 0..1 | The object\_reference property specifies a reference to an file-oriented (i.e., the File Object or one its derivations such as the Windows File Object) Object defined elsewhere in the document, via its id. |

## LinkReferenceType Class

The LinkReferenceType class specifies a reference to a URI Object defined elsewhere in the document which characterizes a hyperlink embedded in the body of the email message.

The property table of the LinkReferenceType class is given in **Table 3‑9**.

Table ‑. Properties of the LinkReferenceType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **object\_reference** | basicDataTypes:QualifiedName | 0..1 | The object\_reference property specifies a reference to a URI Object defined elsewhere in the document, via its id. |

# Conformance

Implementations have discretion over which parts (components, properties, extensions, controlled vocabularies, etc.) of CybOX they implement (e.g., Observable/Object).

[1] Conformant implementations must conform to all normative structural specifications of the UML model or additional normative statements within this document that apply to the portions of CybOX they implement (e.g., implementers of the entire Observable class must conform to all normative structural specifications of the UML model regarding the Observable class or additional normative statements contained in the document that describes the Observable class).

[2] Conformant implementations are free to ignore normative structural specifications of the UML model or additional normative statements within this document that do not apply to the portions of CybOX they implement (e.g., non-implementers of any particular properties of the Observable class are free to ignore all normative structural specifications of the UML model regarding those properties of the Observable class or additional normative statements contained in the document that describes the Observable class).

The conformance section of this document is intentionally broad and attempts to reiterate what already exists in this document.

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|  |  |  |  |
| --- | --- | --- | --- |
| **Revision** | **Date** | **Editor** | **Changes Made** |
| wd01 | 14 October 2015 | Desiree Beck Trey Darley Ivan Kirillov Rich Piazza | Initial transfer to OASIS template |