CybOXTM Version 2.1.1 Part 94: X509 Certificate Object

Working Draft 01

15 December 2015

Technical Committee:

[OASIS Cyber Threat Intelligence (CTI) TC](https://www.oasis-open.org/committees/cti)

Chair:

Richard Struse ([Richard.Struse@HQ.DHS.GOV](mailto:Richard.Struse@HQ.DHS.GOV)), [DHS Office of Cybersecurity and Communications (CS&C)](http://www.dhs.gov/office-cybersecurity-and-communications)

Editors:

Desiree Beck ([dbeck@mitre.org](mailto:ikirillov@mitre.org)), [MITRE Corporation](http://www.mitre.org/)

Trey Darley ([trey@soltra.com](mailto:trey@soltra.com)), [Soltra](http://www.soltra.com/)

Ivan Kirillov ([ikirillov@mitre.org](mailto:ikirillov@mitre.org)), [MITRE Corporation](http://www.mitre.org/)

Rich Piazza ([rpiazza@mitre.org](mailto:ikirillov@mitre.org)), [MITRE Corporation](http://www.mitre.org/)

Additional artifacts:

This prose specification is one component of a Work Product which consists of:

* *CybOX™ Version 2.1.1 Part 01: Overview*. [URI]
* *CybOX™ Version 2.1.1 Part 02: Common*. [URI]
* *CybOX™ Version 2.1.1 Part 03: Core*. [URI]
* *CybOX™ Version 2.1.1 Part 04: Default Extensions*. [URI]
* *CybOX™ Version 2.1.1 Part 05: Default Vocabularies*. [URI]
* *CybOX™ Version 2.1.1 Part 06: UML Model*. [URI]
* *CybOX™ Version 2.1.1 Part 07: API Object*. [URI]
* *CybOX™ Version 2.1.1 Part 08: ARP Cache Object*. [URI]
* *CybOX™ Version 2.1.1 Part 09: AS Object*. [URI]
* *CybOXTM Version 2.1.1 Part 10: Account Object*. [URI]
* *CybOXTM Version 2.1.1 Part 11: Address Object*. [URI]
* *CybOXTM Version 2.1.1 Part 12: Archive File Object*. [URI]
* *CybOXTM Version 2.1.1 Part 13: Artifact Object*. [URI]
* *CybOXTM Version 2.1.1 Part 14: Code Object*. [URI]
* *CybOXTM Version 2.1.1 Part 15: Custom Object*. [URI]
* *CybOXTM Version 2.1.1 Part 16: DNS Cache Object*. [URI]
* *CybOXTM Version 2.1.1 Part 17: DNS Query Object*. [URI]
* *CybOXTM Version 2.1.1 Part 18: DNS Record Object*. [URI]
* *CybOXTM Version 2.1.1 Part 19: Device Object*. [URI]
* *CybOXTM Version 2.1.1 Part 20: Disk Object*. [URI]
* *CybOXTM Version 2.1.1 Part 21: Disk Partition Object*. [URI]
* *CybOXTM Version 2.1.1 Part 22: Domain Name Object*. [URI]
* *CybOXTM Version 2.1.1 Part 23: Email Message Object*. [URI]
* *CybOXTM Version 2.1.1 Part 24: File Object*. [URI]
* *CybOXTM Version 2.1.1 Part 25: GUI Dialogbox Object*. [URI]
* *CybOXTM Version 2.1.1 Part 26: GUI Object*. [URI]
* *CybOXTM Version 2.1.1 Part 27: GUI Window Object*. [URI]
* *CybOXTM Version 2.1.1 Part 28: HTTP Session Object*. [URI]
* *CybOXTM Version 2.1.1 Part 29: Hostname Object*. [URI]
* *CybOXTM Version 2.1.1 Part 30: Image File Object*. [URI]
* *CybOXTM Version 2.1.1 Part 31: Library File Object*. [URI]
* *CybOXTM Version 2.1.1 Part 32: Link Object*. [URI]
* *CybOXTM Version 2.1.1 Part 33: Linux Package Object*. [URI]
* *CybOXTM Version 2.1.1 Part 34: Memory Object*. [URI]
* *CybOXTM Version 2.1.1 Part 35: Mutex Object*. [URI]
* *CybOXTM Version 2.1.1 Part 36: Network Connection Object*. [URI]
* *CybOXTM Version 2.1.1 Part 37: Network Flow Object*. [URI]
* *CybOXTM Version 2.1.1 Part 38: Network Packet Object*. [URI]
* *CybOXTM Version 2.1.1 Part 39: Network Route Entry Object*. [URI]
* *CybOXTM Version 2.1.1 Part 40: Network Route Object*. [URI]
* *CybOXTM Version 2.1.1 Part 41: Network Socket Object*. [URI]
* *CybOXTM Version 2.1.1 Part 42: Network Subnet Object*. [URI]
* *CybOXTM Version 2.1.1 Part 43: PDF File Object*. [URI]
* *CybOXTM Version 2.1.1 Part 44: Pipe Object*. [URI]
* *CybOXTM Version 2.1.1 Part 45: Port Object*. [URI]
* *CybOXTM Version 2.1.1 Part 46: Process Object*. [URI]
* *CybOXTM Version 2.1.1 Part 47: Product Object*. [URI]
* *CybOXTM Version 2.1.1 Part 48: SMS Message Object*. [URI]
* *CybOXTM Version 2.1.1 Part 49: Semaphore Object*. [URI]
* *CybOXTM Version 2.1.1 Part 50: Socket Address Object*. [URI]
* *CybOXTM Version 2.1.1 Part 51: System Object*. [URI]
* *CybOXTM Version 2.1.1 Part 52: URI Object*. [URI]
* *CybOXTM Version 2.1.1 Part 53: URL History Object*. [URI]
* *CybOXTM Version 2.1.1 Part 54: Unix File Object*. [URI]
* *CybOXTM Version 2.1.1 Part 55: Unix Network Route Entry Object*. [URI]
* *CybOXTM Version 2.1.1 Part 56: Unix Pipe Object*. [URI]
* *CybOXTM Version 2.1.1 Part 57: Unix Process Object*. [URI]
* *CybOXTM Version 2.1.1 Part 58: Unix User Account Object*. [URI]
* *CybOXTM Version 2.1.1 Part 59: Unix Volume Object*. [URI]
* *CybOXTM Version 2.1.1 Part 60: User Account Object*. [URI]
* *CybOXTM Version 2.1.1 Part 61: User Session Object*. [URI]
* *CybOXTM Version 2.1.1 Part 62: Volume Object*. [URI]
* *CybOXTM Version 2.1.1 Part 63: Whois Object*. [URI]
* *CybOXTM Version 2.1.1 Part 64: Win Computer Account Object*. [URI]
* *CybOXTM Version 2.1.1 Part 65: Win Critical Section Object*. [URI]
* *CybOXTM Version 2.1.1 Part 66: Win Driver Object*. [URI]
* *CybOXTM Version 2.1.1 Part 67: Win Event Log Object*. [URI]
* *CybOXTM Version 2.1.1 Part 68: Win Event Object*. [URI]
* *CybOXTM Version 2.1.1 Part 69: Win Executable File Object*. [URI]
* *CybOXTM Version 2.1.1 Part 70: Win File Object*. [URI]
* *CybOXTM Version 2.1.1 Part 71: Win Filemapping Object*. [URI]
* *CybOXTM Version 2.1.1 Part 72: Win Handle Object*. [URI]
* *CybOXTM Version 2.1.1 Part 73: Win Hook Object*. [URI]
* *CybOXTM Version 2.1.1 Part 74: Win Kernel Hook Object*. [URI]
* *CybOXTM Version 2.1.1 Part 75: Win Kernel Object*. [URI]
* *CybOXTM Version 2.1.1 Part 76: Win Mailslot Object*. [URI]
* *CybOXTM Version 2.1.1 Part 77: Win Memory Page Region Object*. [URI]
* *CybOXTM Version 2.1.1 Part 78: Win Mutex Object*. [URI]
* *CybOXTM Version 2.1.1 Part 79: Win Network Route Entry Object*. [URI]
* *CybOXTM Version 2.1.1 Part 80: Win Network Share Object*. [URI]
* *CybOXTM Version 2.1.1 Part 81: Win Pipe Object*. [URI]
* *CybOXTM Version 2.1.1 Part 82: Win Prefetch Object*. [URI]
* *CybOXTM Version 2.1.1 Part 83: Win Process Object*. [URI]
* *CybOXTM Version 2.1.1 Part 84: Win Registry Key Object*. [URI]
* *CybOXTM Version 2.1.1 Part 85: Win Semaphore Object*. [URI]
* *CybOXTM Version 2.1.1 Part 86: Win Service Object*. [URI]
* *CybOXTM Version 2.1.1 Part 87: Win System Object*. [URI]
* *CybOXTM Version 2.1.1 Part 88: Win System Restore Object*. [URI]
* *CybOXTM Version 2.1.1 Part 89: Win Task Object*. [URI]
* *CybOXTM Version 2.1.1 Part 90: Win Thread Object*. [URI]
* *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*. (this document)

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 X509 Certificate Object data model, which is one of the Object data models for CybOX content.

Status:

This [Working Draft](https://www.oasis-open.org/policies-guidelines/tc-process#dWorkingDraft) (WD) has been produced by one or more TC Members; it has not yet been voted on by the TC or [approved](https://www.oasis-open.org/policies-guidelines/tc-process#committeeDraft) as a Committee Draft (Committee Specification Draft or a Committee Note Draft). The OASIS document [Approval Process](https://www.oasis-open.org/policies-guidelines/tc-process#standApprovProcess) begins officially with a TC vote to approve a WD as a Committee Draft. A TC may approve a Working Draft, revise it, and re-approve it any number of times as a Committee Draft.

URI patterns:

Initial publication URI:  
http://docs.oasis-open.org/cti/stix/v1.2.1/csd01/part1-overview/stix-v1.2.1-csd01-part1-overview.docx

Permanent “Latest version” URI:  
http://docs.oasis-open.org/cti/stix/v1.2.1/stix-v1.2.1-part1-overview.docx

(Managed by OASIS TC Administration; please don’t modify.)

Copyright © OASIS Open 2016. All Rights Reserved.

All capitalized terms in the following text have the meanings assigned to them in the OASIS Intellectual Property Rights Policy (the "OASIS IPR Policy"). The full [Policy](https://www.oasis-open.org/policies-guidelines/ipr) may be found at the OASIS website.

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published, and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this section are included on all such copies and derivative works. However, this document itself may not be modified in any way, including by removing the copyright notice or references to OASIS, except as needed for the purpose of developing any document or deliverable produced by an OASIS Technical Committee (in which case the rules applicable to copyrights, as set forth in the OASIS IPR Policy, must be followed) or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by OASIS or its successors or assigns.

This document and the information contained herein is provided on an "AS IS" basis and OASIS DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY OWNERSHIP RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Portions copyright © United States Government 2012-2016. All Rights Reserved.  
  
STIX™, TAXII™, AND CybOX™ (STANDARD OR STANDARDS) AND THEIR COMPONENT PARTS ARE PROVIDED “AS IS” WITHOUT ANY WARRANTY OF ANY KIND, EITHER EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY THAT THESE STANDARDS OR ANY OF THEIR COMPONENT PARTS WILL CONFORM TO SPECIFICATIONS, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR FREEDOM FROM INFRINGEMENT, ANY WARRANTY THAT THE STANDARDS OR THEIR COMPONENT PARTS WILL BE ERROR FREE, OR ANY WARRANTY THAT THE DOCUMENTATION, IF PROVIDED, WILL CONFORM TO THE STANDARDS OR THEIR COMPONENT PARTS. IN NO EVENT SHALL THE UNITED STATES GOVERNMENT OR ITS CONTRACTORS OR SUBCONTRACTORS BE LIABLE FOR ANY DAMAGES, INCLUDING, BUT NOT LIMITED TO, DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES, ARISING OUT OF, RESULTING FROM, OR IN ANY WAY CONNECTED WITH THESE STANDARDS OR THEIR COMPONENT PARTS OR ANY PROVIDED DOCUMENTATION, WHETHER OR NOT BASED UPON WARRANTY, CONTRACT, TORT, OR OTHERWISE, WHETHER OR NOT INJURY WAS SUSTAINED BY PERSONS OR PROPERTY OR OTHERWISE, AND WHETHER OR NOT LOSS WAS SUSTAINED FROM, OR AROSE OUT OF THE RESULTS OF, OR USE OF, THE STANDARDS, THEIR COMPONENT PARTS, AND ANY PROVIDED DOCUMENTATION. THE UNITED STATES GOVERNMENT DISCLAIMS ALL WARRANTIES AND LIABILITIES REGARDING THE STANDARDS OR THEIR COMPONENT PARTS ATTRIBUTABLE TO ANY THIRD PARTY, IF PRESENT IN THE STANDARDS OR THEIR COMPONENT PARTS AND DISTRIBUTES IT OR THEM “AS IS.”

Table of Contents

[1 Introduction 6](#_Toc450224664)

[1.1 CybOXTM Specification Documents 6](#_Toc450224665)

[1.2 Document Conventions 6](#_Toc450224666)

[1.2.1 Fonts 6](#_Toc450224667)

[1.2.2 UML Package References 7](#_Toc450224668)

[1.2.3 UML Diagrams 7](#_Toc450224669)

[1.2.3.1 Class Properties 7](#_Toc450224670)

[1.2.3.2 Diagram Icons and Arrow Types 7](#_Toc450224671)

[1.2.4 Property Table Notation 8](#_Toc450224672)

[1.2.5 Property and Class Descriptions 8](#_Toc450224673)

[1.3 Terminology 9](#_Toc450224674)

[1.4 Normative References 9](#_Toc450224675)

[2 Background Information 10](#_Toc450224676)

[2.1 Cyber Observables 10](#_Toc450224677)

[2.2 Objects 10](#_Toc450224678)

[3 Data Model 11](#_Toc450224679)

[3.1 X509CertificateObjectType Class 11](#_Toc450224680)

[3.2 X509CertificateContentsType Class 12](#_Toc450224681)

[3.3 X509CertificateSignatureType Class 13](#_Toc450224682)

[3.4 SubjectPublicKeyType Class 13](#_Toc450224683)

[3.5 ValidityType Class 14](#_Toc450224684)

[3.6 RSAPublicKeyType Class 14](#_Toc450224685)

[3.7 X509V3ExtensionsType Class 15](#_Toc450224686)

[3.8 X509NonStandardExtensionsType Class 18](#_Toc450224687)

[4 Conformance 19](#_Toc450224688)

[Appendix A. Acknowledgments 20](#_Toc450224689)

[Appendix B. Revision History 24](#_Toc450224690)

# 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 X509 Certificate 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, 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 X509 Certificate Object data model. We present the X509 Certificate 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 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 package\_prefix for the X509 Certificate data model is X509CertificateObj. Note that in this specification document, we do not explicitly specify the package prefix for any classes that originate from the X509 Certificate 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.

#### 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 X509 Certificate 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 preferred 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 identifying 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**]**.

## Normative References

[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 X509 Certificate 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

Cyber observable objects (Files, IP Addresses, etc) in CybOX are characterized with a combination of two levels of data models.

The first level is the Object data model which specifies a base set of properties universal to all types of Objects and enables them to integrate with the overall cyber observable framework specified in the CybOX Core data model.

The second level are the object property models which specify the properties of a particular type of Object via individual data models each focused on 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.

Any specific instance of an Object is represented utilizing the particular object properties data model within the general Object data model.

# Data Model

## X509CertificateObjectType Class

The X509CertificateObjectType class is intended to characterize X.509 certificates. The UML diagram corresponding to the X509CertificateObjectType class is shown in **Figure 3‑1**.

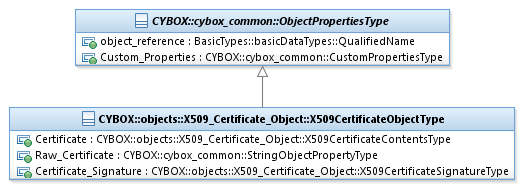


Figure 3‑1. UML diagram of the X509CertificateObjectType class

The property table of the X509CertificateObjectType class is given in **Table 3‑1**.

Table 3‑1. Properties of the X509CertificateObjectType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Certificate** | X509CertificateContentsType | 0..1 | The Certificate property specifies the contents of an X.509 certificate, including items such as issuer, subject, and others. |
| **Raw\_Certificate** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Raw\_Certificate property captures the raw content of an X.509 certificate including the -----BEGIN CERTIFICATE----- and -----END CERTIFICATE----- lines. |
| **Certificate\_Signature** | X509CertificateSignatureType | 0..1 | The Certificate\_Signature property contains the signature and signature algorithm of this X.509 certificate. |

## X509CertificateContentsType Class

The X509CertificateContentsType class represents the contents of an X.509 certificate, including items such as issuer, subject, and others.

The property table of the X509CertificateContentsType class is given in **Table 3‑2**.

Table 3‑2. Properties of the X509CertificateContentsType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Version** | cyboxCommon:  IntegerObjectPropertyType | 0..1 | The Version property describes the version of the encoded certificate. |
| **Serial\_Number** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Serial\_Number property is a unique identifier for each X.509 certificate issued by a specific Certificate Authority. |
| **Signature\_Algorithm** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Signature\_Algorithm property is the algorithm used to sign the X.509 certificate. |
| **Issuer** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Issuer property is the Certificate Authority who issued the X.509 certificate. |
| **Validity** | ValidityType | 0..1 | The Validity property is the time interval during which the issuer warrants that it will maintain information about the status of the certificate. |
| **Subject** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Subject identifies the entity associated with the public key stored in the subject public key property of the X.509 certificate. |
| **Subject\_Public\_Key** | SubjectPublicKeyType | 0..1 | The Subject\_Public\_Key property is used to carry the public key and identify the algorithm with which the key is used. |
| **Standard\_Extensions** | X509V3ExtensionsType | 0..1 | The Standard\_Extensions property captures standard X509 V3 extensions that may be specified in the certificate. |
| **Non\_Standard\_Extensions** | X509NonStandardExtensionsType | 0..1 | The Non\_Standard\_Extensions property captures non-standard X509 extensions that may be specified in the certificate. |

## X509CertificateSignatureType Class

The X509CertificateSignatureType class contains the signature and signature algorithm of this X.509 certificate.

The property table of the X509CertificateSignatureType class is given in **Table 3‑3**.

Table 3‑3. Properties of the X509CertificateSignatureType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Signature\_Algorithm** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Signature\_Algorithm property contains the algorithm identifier for the algorithm used by the Certificate Authority to compute the signature. |
| **Signature** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Signature property contains a digital signature computed upon this X.509 certificate. |

## SubjectPublicKeyType Class

The SubjectPublicKeyType class is used to carry the public key and identify the algorithm with which the key is used.

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

Table 3‑4. Properties of the SubjectPublicKeyType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Public\_Key\_Algorithm** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Public\_Key\_Algorithm property is the algorithm with which to encrypt data being sent to the subject. |
| **RSA\_Public\_Key** | RSAPublicKeyType | 0..1 | The RSA\_Public\_Key property is the public key contained in this X.509 certificate. |

## ValidityType Class

The ValidityType class is the time interval during which the issuer warrants that it will maintain information about the status of the certificate.

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

Table 3‑5. Properties of the ValidityType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Not\_Before** | cyboxCommon:  DateTimeObjectPropertyType | 0..1 | The Not\_Before property is the date on which the certificate validity period begins. |
| **Not\_After** | cyboxCommon:  DateTimeObjectPropertyType | 0..1 | The Not\_After property is the date on which the certificate validity period ends. |

## RSAPublicKeyType Class

The RSAPublicKeyType class captures details of RSA public keys.

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

Table 3‑6. Properties of the RSAPublicKeyType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Modulus** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Modulus property is the modulus portion of a public key. |
| **Exponent** | cyboxCommon:  IntegerObjectPropertyType | 0..1 | The Exponent property is the exponent portion of a public key. |

## X509V3ExtensionsType Class

The X509V3ExtensionsType class captures the standard X509 V3 Extensions that may be used in X509 certificates. Based on RFC 3280, "Standard Extensions": <http://www.ietf.org/rfc/rfc3280.txt>.

The property table of the X509V3ExtensionsType class is given in **Table 3‑7**.

Table 3‑7. Properties of the X509V3ExtensionsType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Basic\_Constraints** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Basic\_Constraints property captures a multi-valued extension which indicates whether a certificate is a CA certificate. The first (mandatory) name is CA followed by TRUE or FALSE. If CA is TRUE then an optional pathlen name followed by a non-negative value can be included. Also equivalent to the object ID (OID) value of 2.5.29.19. |
| **Name\_Constraints** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Name\_Constraints property captures a name space within which all subject names in subsequent certificates in a certification path MUST be located. Also equivalent to the object ID (OID) value of 2.5.29.30. |
| **Policy\_Constraints** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Policy\_Constraints property captures any constraints on path validation for certificates issued to CAs. Also equivalent to the object ID (OID) value of 2.5.29.36. |
| **Key\_Usage** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Key\_Usage element property captures a multi-valued extension consisting of a list of names of the permitted key usages. Also equivalent to the object ID (OID) value of 2.5.29.15. |
| **Extended\_Key\_Usage** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Extended\_Key\_Usage property captures a list of usages indicating purposes for which the certificate public key can be used for. Also equivalent to the object ID (OID) value of 2.5.29.37. |
| **Subject\_Key\_Identifier** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Subject\_Key\_Identifier property captures the identifier that provides a means of identifying certificates that contain a particular public key. Also equivalent to the object ID (OID) value of 2.5.29.14. |
| **Authority\_Key\_Identifier** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Authority\_Key\_Identifier property captures the identifier that provides a means of identifying the public key corresponding to the private key used to sign a certificate. Also equivalent to the object ID (OID) value of 2.5.29.35. |
| **Subject\_Alternative\_Name** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Subject\_Alternative\_Name property captures the additional identities to be bound to the subject of the certificate. Also equivalent to the object ID (OID) value of 2.5.29.17. |
| **Issuer\_Alternative\_Name** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Issuer\_Alternative\_Name property captures the additional identities to be bound to the issuer of the certificate. Also equivalent to the object ID (OID) value of 2.5.29.18. |
| **Subject\_Directory\_Attributes** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Subject\_Directory\_Attributes property captures the identification attributes (e.g., nationality) of the subject. Also equivalent to the object ID (OID) value of 2.5.29.9. |
| **CRL\_Distribution\_Points** | cyboxCommon:  StringObjectPropertyType | 0..1 | The CRL\_Distribution\_Points property captures how CRL information is obtained. Also equivalent to the object ID (OID) value of 2.5.29.31. |
| **Inhibit\_Any\_Policy** | cyboxCommon:  NonNegativeIntegerObjectPropertyType | 0..1 | The Inhibit\_Any\_Policy property specifies the number of additional certificates that may appear in the path before anyPolicy is no longer permitted. Also equivalent to the object ID (OID) value of 2.5.29.54. |
| **Private\_Key\_Usage\_Period** | X509CertificateObj:ValidityType | 0..1 | The Private\_Key\_Usage\_Period property captures the validity period for the private key, if it is different from the validity period of the certificate. Also equivalent to the object ID (OID) value of 2.5.29.16. |
| **Certificate\_Policies** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Certificate\_Policies property captures a sequence of one or more policy information terms, each of which consists of an object identifier (OID) and optional qualifiers. Also equivalent to the object ID (OID) value of 2.5.29.32. |
| **Policy\_Mappings** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Policy\_Mappings property captures one or more pairs of OIDs; each pair includes an issuerDomainPolicy and a subjectDomainPolicy. The pairing indicates whether the issuing CA considers its issuerDomainPolicy equivalent to the subject CA's subjectDomainPolicy. Also equivalent to the object ID (OID) value of 2.5.29.33. |

## X509NonStandardExtensionsType Class

The X509NonStandardExtensionsType class captures some non-standard or deprecated X509 extensions that may be useful. Based on the OpenSSL "Deprecated Extensions" documentation: [https://www.openssl.org/docs/apps/x509v3\_config.html#Deprecated\_Extensions](https://www.openssl.org/docs/apps/x509v3_config.html%23Deprecated_Extensions). Also based on the Alvestrand certificate extension reference: <http://www.alvestrand.no/objectid/2.5.29.html>.

The property table of the X509NonStandardExtensionsType class is given in **Table 3‑8**.

Table 3‑8. Properties of the X509NonStandardExtensionsType class

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Multiplicity** | **Description** |
| **Netscape\_Comment** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Netscape\_Comment property captures a comment which may be displayed when the certificate is viewed in some browsers. |
| **Netscape\_Certificate\_Type** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Netscape\_Certificate\_Type property captures a list of flags which indicate the purposes for which a certificate could be used. |
| **Old\_Authority\_Key\_Identifier** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Old\_Authority\_Key\_Identifier property captures the old version of the authority key identifier, equivalent to the object ID (OID) value of 2.5.29.1. |
| **Old\_Primary\_Key\_Attributes** | cyboxCommon:  StringObjectPropertyType | 0..1 | The Old\_Primary\_Key\_Attributes property captures the old version of the primary key attributes, equivalent to the object ID (OID) value of 2.5.29.2. |

# 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.

1. Acknowledgments

The following individuals have participated in the creation of this specification and are gratefully acknowledged.

|  |  |
| --- | --- |
| **Aetna**  David Crawford  **AIT Austrian Institute of Technology**  Roman Fiedler  Florian Skopik  **Australia and New Zealand Banking Group (ANZ Bank)**  Dean Thompson  **Blue Coat Systems, Inc.**  Owen Johnson  Bret Jordan  **Century Link**  Cory Kennedy  **CIRCL**  Alexandre Dulaunoy  Andras Iklody  Raphaël Vinot  **Citrix Systems**  Joey Peloquin  **Dell**  Will Urbanski  Jeff Williams  **DTCC**  Dan Brown  Gordon Hundley  Chris Koutras  **EMC**  Robert Griffin  Jeff Odom  Ravi Sharda  **Financial Services Information Sharing and Analysis Center (FS-ISAC)**  David Eilken  Chris Ricard  **Fortinet Inc.**  Gavin Chow  Kenichi Terashita  **Fujitsu Limited**  Neil Edwards  Frederick Hirsch  Ryusuke Masuoka  Daisuke Murabayashi  **Google Inc.**  Mark Risher  **Hitachi, Ltd.**  Kazuo Noguchi  Akihito Sawada  Masato Terada  **iboss, Inc**.  Paul Martini  **Individual**  Jerome Athias  Peter Brown  Elysa Jones  Sanjiv Kalkar  Bar Lockwood  Terry MacDonald  Alex Pinto  **Intel Corporation**  Tim Casey  Kent Landfield  **JPMorgan Chase Bank, N.A.**  Terrence Driscoll  David Laurance  **LookingGlass**  Allan Thomson  Lee Vorthman  **Mitre Corporation**  Greg Back  Jonathan Baker  Sean Barnum  Desiree Beck  Nicole Gong  Jasen Jacobsen  Ivan Kirillov  Richard Piazza  Jon Salwen  Charles Schmidt  Emmanuelle Vargas-Gonzalez  John Wunder  **National Council of ISACs (NCI)**  Scott Algeier  Denise Anderson  Josh Poster  **NEC Corporation**  Takahiro Kakumaru  **North American Energy Standards Board**  David Darnell  **Object Management Group**  Cory Casanave  **Palo Alto Networks**  Vishaal Hariprasad  **Queralt, Inc**.  John Tolbert  **Resilient Systems, Inc.**  Ted Julian  **Securonix**  Igor Baikalov  **Siemens AG**  Bernd Grobauer  **Soltra**  John Anderson  Aishwarya Asok Kumar  Peter Ayasse  Jeff Beekman  Michael Butt  Cynthia Camacho  Aharon Chernin  Mark Clancy  Brady Cotton  Trey Darley  Mark Davidson  Paul Dion  Daniel Dye  Robert Hutto  Raymond Keckler  Ali Khan  Chris Kiehl  Clayton Long  Michael Pepin  Natalie Suarez  David Waters  Benjamin Yates  **Symantec Corp.**  Curtis Kostrosky  **The Boeing Company**  Crystal Hayes  **ThreatQuotient, Inc.**  Ryan Trost  **U.S. Bank**  Mark Angel  Brad Butts  Brian Fay  Mona Magathan  Yevgen Sautin  **US Department of Defense (DoD)**  James Bohling  Eoghan Casey  Gary Katz  Jeffrey Mates  **VeriSign**  Robert Coderre  Kyle Maxwell  Eric Osterweil | **Airbus Group SAS**  Joerg Eschweiler  Marcos Orallo  **Anomali**  Ryan Clough  Wei Huang  Hugh Njemanze  Katie Pelusi  Aaron Shelmire  Jason Trost  **Bank of America**  Alexander Foley  **Center for Internet Security (CIS)**  Sarah Kelley  **Check Point Software Technologies**  Ron Davidson  **Cisco Systems**  Syam Appala  Ted Bedwell  David McGrew  Pavan Reddy  Omar Santos  Jyoti Verma  **Cyber Threat Intelligence Network, Inc. (CTIN)**  Doug DePeppe  Jane Ginn  Ben Othman  **DHS Office of Cybersecurity and Communications (CS&C)**  Richard Struse  Marlon Taylor  **EclecticIQ**  Marko Dragoljevic  Joep Gommers  Sergey Polzunov  Rutger Prins  Andrei Sîrghi  Raymon van der Velde  **eSentire, Inc.**  Jacob Gajek  **FireEye, Inc.**  Phillip Boles  Pavan Gorakav  Anuj Kumar  Shyamal Pandya  Paul Patrick  Scott Shreve  **Fox-IT**  Sarah Brown  **Georgetown University**  Eric Burger  **Hewlett Packard Enterprise (HPE)**  Tomas Sander  **IBM**  Peter Allor  Eldan Ben-Haim  Sandra Hernandez  Jason Keirstead  John Morris  Laura Rusu  Ron Williams  **IID**  Chris Richardson  **Integrated Networking Technologies, Inc.**  Patrick Maroney  **Johns Hopkins University Applied Physics Laboratory**  Karin Marr  Julie Modlin  Mark Moss  Pamela Smith  **Kaiser Permanente**  Russell Culpepper  Beth Pumo  **Lumeta Corporation**  Brandon Hoffman  **MTG Management Consultants, LLC.**  James Cabral  **National Security Agency**  Mike Boyle  Jessica Fitzgerald-McKay  **New Context Services, Inc.**  John-Mark Gurney  Christian Hunt  James Moler  Daniel Riedel  Andrew Storms  **OASIS**  James Bryce Clark  Robin Cover  Chet Ensign  **Open Identity Exchange**  Don Thibeau  **PhishMe Inc.**  Josh Larkins  **Raytheon Company-SAS**  Daniel Wyschogrod  **Retail Cyber Intelligence Sharing Center (R-CISC)**  Brian Engle  **Semper Fortis Solutions**  Joseph Brand  **Splunk Inc.**  Cedric LeRoux  Brian Luger  Kathy Wang  **TELUS**  Greg Reaume  Alan Steer  **Threat Intelligence Pty Ltd**  Tyron Miller  Andrew van der Stock  **ThreatConnect, Inc.**  Wade Baker  Cole Iliff  Andrew Pendergast  Ben Schmoker  Jason Spies  **TruSTAR Technology**  Chris Roblee  **United Kingdom Cabinet Office**  Iain Brown  Adam Cooper  Mike McLellan  Chris O’Brien  James Penman  Howard Staple  Chris Taylor  Laurie Thomson  Alastair Treharne  Julian White  Bethany Yates  **US Department of Homeland Security**  Evette Maynard-Noel  Justin Stekervetz  **ViaSat, Inc.**  Lee Chieffalo  Wilson Figueroa  Andrew May  **Yaana Technologies, LLC**  Anthony Rutkowski |

The authors would also like to thank the larger CybOX Community for its input and help in reviewing this document.

1. Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision** | **Date** | **Editor** | **Changes Made** |
| wd01 | 15 December 2015 | Desiree Beck Trey Darley Ivan Kirillov Rich Piazza | Initial transfer to OASIS template |