



CybOX™ Version 2.1.1. Part 36: Network Connection Object

Committee Specification Draft 01 / Public Review Draft 01

20 June 2016

Specification URIs

This version:

<http://docs.oasis-open.org/cti/cybox/v2.1.1/csprd01/part36-network-connection/cybox-v2.1.1-csprd01-part36-network-connection.docx> (Authoritative)

<http://docs.oasis-open.org/cti/cybox/v2.1.1/csprd01/part36-network-connection/cybox-v2.1.1-csprd01-part36-network-connection.html>

<http://docs.oasis-open.org/cti/cybox/v2.1.1/csprd01/part36-network-connection/cybox-v2.1.1-csprd01-part36-network-connection.pdf>

Previous version:

N/A

Latest version:

<http://docs.oasis-open.org/cti/cybox/v2.1.1/part36-network-connection/cybox-v2.1.1-part36-network-connection.docx> (Authoritative)

<http://docs.oasis-open.org/cti/cybox/v2.1.1/part36-network-connection/cybox-v2.1.1-part36-network-connection.html>

<http://docs.oasis-open.org/cti/cybox/v2.1.1/part36-network-connection/cybox-v2.1.1-part36-network-connection.pdf>

Technical Committee:

OASIS Cyber Threat Intelligence (CTI) TC

Chair:

Richard Struse (Richard.Struse@HQ.DHS.GOV), DHS Office of Cybersecurity and Communications (CS&C)

Editors:

Desiree Beck (dbeck@mitre.org), MITRE Corporation

Trey Darley (trey@kingfisherops.com), Individual member

Ivan Kirillov (ikirillov@mitre.org), MITRE Corporation

Rich Piazza (rpiazza@mitre.org), MITRE Corporation

Additional artifacts:

This prose specification is one component of a Work Product whose components are listed in <http://docs.oasis-open.org/cti/cybox/v2.1.1/csprd01/cybox-v2.1.1-csprd01-additional-artifacts.html>.

Related work:

This specification is related to:

- *STIX™ Version 1.2.1*. Edited by Sean Barnum, Desiree Beck, Aharon Chernin, and Rich Piazza. 05 May 2016. OASIS Committee Specification 01. <http://docs.oasis-open.org/cti/stix/v1.2.1/cs01/part1-overview/stix-v1.2.1-cs01-part1-overview.html>.

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 Network Connection Object data model, which is one of the Object data models for CybOX content.

Status:

This document was last revised or approved by the OASIS Cyber Threat Intelligence (CTI) TC on the above date. The level of approval is also listed above. Check the “Latest version” location noted above for possible later revisions of this document. Any other numbered Versions and other technical work produced by the Technical Committee (TC) are listed at https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=cti#technical.

TC members should send comments on this specification to the TC’s email list. Others should send comments to the TC’s public comment list, after subscribing to it by following the instructions at the “Send A Comment” button on the TC’s web page at <https://www.oasis-open.org/committees/cti/>.

For information on whether any patents have been disclosed that may be essential to implementing this specification, and any offers of patent licensing terms, please refer to the Intellectual Property Rights section of the TC’s web page (<https://www.oasis-open.org/committees/cti/ipr.php>).

Citation format:

When referencing this specification the following citation format should be used:

[CybOX-v2.1.1-network-connection]

CybOX™ Version 2.1.1. Part 36: Network Connection Object. Edited by Desiree Beck, Trey Darley, Ivan Kirillov, and Rich Piazza. 20 June 2016. OASIS Committee Specification Draft 01 / Public Review Draft 01. <http://docs.oasis-open.org/cti/cybox/v2.1.1/csprd01/part36-network-connection/cybox-v2.1.1-csprd01-part36-network-connection.html>. Latest version: <http://docs.oasis-open.org/cti/cybox/v2.1.1/part36-network-connection/cybox-v2.1.1-part36-network-connection.html>.

Notices

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](#) 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.

OASIS requests that any OASIS Party or any other party that believes it has patent claims that would necessarily be infringed by implementations of this OASIS Committee Specification or OASIS Standard, to notify OASIS TC Administrator and provide an indication of its willingness to grant patent licenses to such patent claims in a manner consistent with the IPR Mode of the OASIS Technical Committee that produced this specification.

OASIS invites any party to contact the OASIS TC Administrator if it is aware of a claim of ownership of any patent claims that would necessarily be infringed by implementations of this specification by a patent holder that is not willing to provide a license to such patent claims in a manner consistent with the IPR Mode of the OASIS Technical Committee that produced this specification. OASIS may include such claims on its website, but disclaims any obligation to do so.

OASIS takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; neither does it represent that it has made any effort to identify any such rights. Information on OASIS' procedures with respect to rights in any document or deliverable produced by an OASIS Technical Committee can be found on the OASIS website. Copies of claims of rights made available for publication and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementers or users of this OASIS Committee Specification or OASIS Standard, can be obtained from the OASIS TC Administrator. OASIS makes no representation that any information or list of intellectual property rights will at any time be complete, or that any claims in such list are, in fact, Essential Claims.

The name "OASIS" is a trademark of [OASIS](#), the owner and developer of this specification, and should be used only to refer to the organization and its official outputs. OASIS welcomes reference to, and implementation and use of, specifications, while reserving the right to enforce its marks against misleading uses. Please see <https://www.oasis-open.org/policies-guidelines/trademark> for above guidance.

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
1.1	CybOX™ Specification Documents.....	6
1.2	Document Conventions.....	6
1.2.1	Fonts.....	6
1.2.2	UML Package References.....	7
1.2.3	UML Diagrams.....	7
1.2.4	Property Table Notation.....	8
1.2.5	Property and Class Descriptions.....	8
1.3	Terminology.....	9
1.4	Normative References.....	9
2	Background Information.....	10
2.1	Cyber Observables.....	10
2.2	Objects.....	10
3	Data Model.....	11
3.1	NetworkConnectionObjectType Class.....	11
3.2	Layer7ConnectionsType Class.....	13
3.3	Layer3ProtocolType Class.....	13
3.4	Layer7ProtocolType Class.....	14
3.5	TCPStateEnum Enumeration.....	14
3.6	Layer3ProtocolEnum Enumeration.....	15
3.7	Layer7ProtocolEnum Enumeration.....	16
4	Conformance.....	21
	Appendix A. Acknowledgments.....	22
	Appendix B. Revision History.....	26

1 Introduction

[All text is normative unless otherwise labeled]

The Cyber Observable Expression (CybOX™) 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 Network Connection 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 Network Connection Object data model. We present the Network Connection Object data model specification details in Section 3 and conformance information in Section 4.

1.1 CybOX™ 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](#) 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](#) also summarizes the relationship of CybOX to other languages, and outlines general CybOX data model conventions.

1.2 Document Conventions

The following conventions are used in this document.

1.2.1 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](#).

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 (with single 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*

1.2.2 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](#) document contains the full list of CybOX packages, along with the associated prefix notations, descriptions, and examples.

The `package_prefix` for the Network Connection data model is `NetworkConnectionObj`. Note that in this specification document, we do not explicitly specify the package prefix for any classes that originate from the Network Connection Object data model.

1.2.3 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.

1.2.3.1 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.

1.2.3.2 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.

1.2.4 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 Network Connection 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.

1.2.5 Property and Class Descriptions

Each class and property defined in CybOX is described using the format, “The X property verb Y.” 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
<u>captures</u>	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.
	<p><i>Examples:</i></p> <p>The <code>Observable_Source</code> property characterizes the source of the Observable information. Examples of details <u>captured</u> include identifying characteristics, time-related attributes, and a list of the tools used to collect the information.</p> <p>The <code>Description</code> property <u>captures</u> a textual description of the Action.</p>
<u>characterizes</u>	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.
	<p><i>Examples:</i></p> <p>The <code>Action</code> property <u>characterizes</u> a cyber observable Action.</p> <p>The <code>Obfuscation_Technique</code> property <u>characterizes</u> a technique an attacker could potentially leverage to obfuscate the Observable.</p>
<u>specifies</u>	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.
	<p><i>Example:</i></p> <p>The <code>cybox_major_version</code> property <u>specifies</u> the major version of the CybOX language used for the set of Observables.</p>

1.3 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].

1.4 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>.

2 Background Information

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

2.1 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.

2.2 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.

3 Data Model

3.1 NetworkConnectionObjectType Class

The NetworkConnectionObjectType class is intended as a way of characterizing local or remote (i.e. Internet) network connections. The UML diagram corresponding to the NetworkConnectionObjectType class is shown in Figure 3-1.

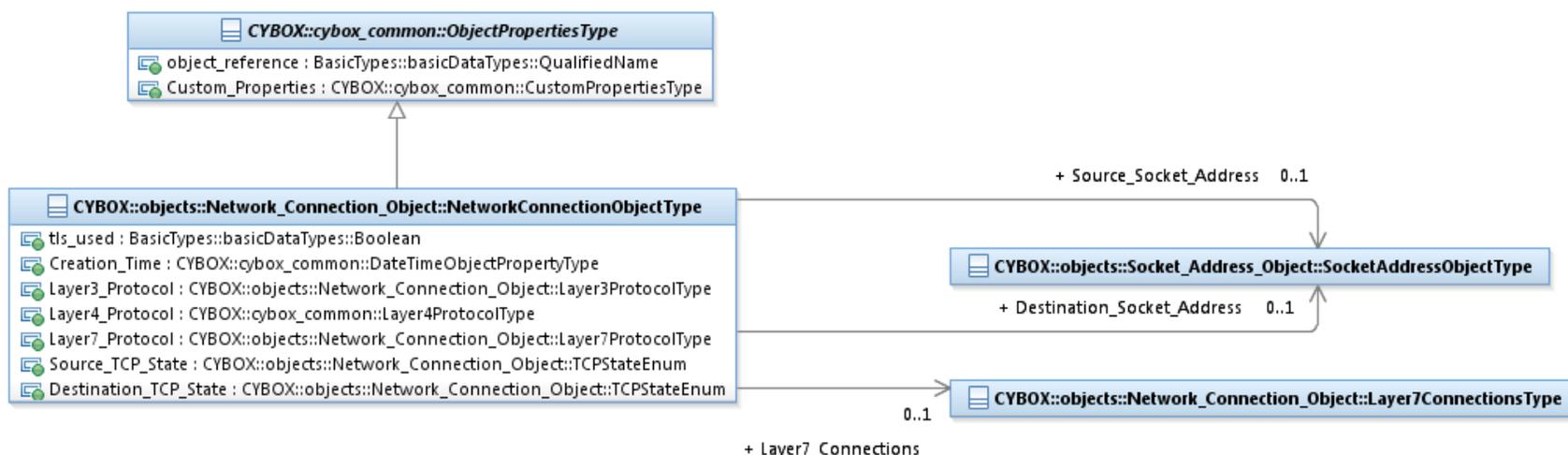


Figure 3-1. UML diagram of the NetworkConnectionObjectType class

The property table of the NetworkConnectionObjectType class is given in Table 3-1.

Table 3-1. Properties of the NetworkConnectionObjectType class

Name	Type	Multiplicity	Description
tls_used	basicDataTypes:Boolean	0..1	The tls_used property specifies whether or not Transport Layer Security (TLS) is used in the network

			connection.
Creation_Time	cyboxCommon: DateTimeObjectPropertyType	0..1	The Creation_Time property specifies the date/time the network connection was created.
Layer3_Protocol	Layer3ProtocolType	0..1	The Layer3_Protocol property specifies the particular network (layer 3 in the OSI model) layer protocol used in the connection.
Layer4_Protocol	cyboxCommon: Layer4ProtocolType	0..1	The Layer4_Protocol property specifies the particular transport (layer 4 in the OSI model) layer protocol used in the connection.
Layer7_Protocol	Layer7ProtocolType	0..1	The Layer7_Protocol property specifies the particular application (layer 7 in the OSI model) layer protocol used in the connection.
Source_Socket_Address	SocketAddressObj: SocketAddressObjectType	0..1	The Source_Socket_Address property specifies the source socket address, consisting of an IP Address and port number, used in the connection.
Source_TCP_State	TCPStateEnum	0..1	The Source_TCP_State property specifies the current state of the TCP network connection at the source, if applicable.
Destination_Socket_Address	SocketAddressObj: SocketAddressObjectType	0..1	The Destination_Socket_Address property specifies the destination socket address, consisting of an IP Address and port number, used in the connection.
Destination_TCP_State	TCPStateEnum	0..1	The Destination_TCP_State property specifies the current state of the TCP network connection at the destination, if applicable.

Layer7_Connections	Layer7ConnectionsType	0..1	The <code>Layer7_Connections</code> property allows for the characterization of any application (layer 7 in the OSI model) layer connections observed as part of the network connection.
---------------------------	-----------------------	------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

3.2 Layer7ConnectionsType Class

The `Layer7ConnectionsType` specifies the different class of application (layer 7 in the OSI model) connections that may be initiated as part of the network connection.

The property table of the `Layer7ConnectionsType` class is given in [Table 3-2](#).

Table 3-2. Properties of the `Layer7ConnectionsType` class

Name	Type	Multiplicity	Description
HTTP_Session	HTTPSessionObj: HTTPSessionObjectType	0..1	The <code>HTTP_Session</code> property specifies a single HTTP session initiated between source and destination IP addresses/ports, and includes 1-n HTTP Request/Response pairs.
DNS_Query	DNSQueryObj: DNSQueryObjectType	0..*	The <code>DNS_Query</code> property specifies a single DNS query/answer pair initiated between source and destination IP addresses/ports.

3.3 Layer3ProtocolType Class

The `Layer3ProtocolType` data type specifies the Layer 3 protocol type. Its core value SHOULD be a literal found in the `Layer3ProtocolEnum` enumeration. Its base type is the `BaseObjectPropertyType` data type, in order to permit complex (i.e. regular-expression based) specifications.

3.4 Layer7ProtocolType Class

The `Layer7ProtocolType` data type specifies the Layer 7 protocol type. Its core value SHOULD be a literal found in the `Layer7ProtocolEnum` enumeration. Its base type is the `BaseObjectPropertyType` data type, in order to permit complex (i.e. regular-expression based) specifications.

3.5 TCPStateEnum Enumeration

The literals of the `TCPStateEnum` enumeration are given in [Table 3-3](#).

Table 3-3. Literals of the `TCPStateEnum` enumeration

Enumeration Literal	Description
UNKNOWN	Indicates an unknown TCP connection state.
CLOSED	Indicates the closed TCP connection state--i.e. no connection state at all.
LISTENING	Indicates the listening TCP connection state.
SYN_SENT	Indicates the SYN sent TCP connection state--i.e. wait for a matching connection request after having sent a connection request.
SYN_RECEIVED	Indicates the SYN received TCP connection state--i.e. waiting for a confirming connection request acknowledgment after having both received and sent a connection request.
ESTABLISHED	Indicates the established TCP connection state--i.e. an open connection in which data received can be delivered to the user.
FIN_WAIT_1	Indicates the FIN-WAIT-1 TCP connection state--i.e. waiting for a connection termination request from the remote TCP, or an acknowledgment of the connection termination request previously

	sent.
FIN_WAIT_2	Indicates the FIN-WAIT-2 TCP connection state--i.e. waiting for a connection termination request from the remote TCP.
CLOSE_WAIT	Indicates the CLOSE-WAIT TCP connection state--i.e. waiting for a connection termination request from the local user.
CLOSING	Indicates the CLOSING TCP connection state--i.e. waiting for a connection termination request acknowledgment from the remote TCP.
LAST_ACK	Indicates the LAST-ACK connection state--i.e. waiting for an acknowledgment of the connection termination request previously sent to the remote TCP (which includes an acknowledgment of its connection termination request).
TIME_WAIT	Indicates the TIME-WAIT connection state--i.e. waiting for enough time to pass to be sure the remote TCP received the acknowledgment of its connection termination request.
DELETING_TCB	Indicates the DELETE-TCB connection state--i.e. the Transmission Control Block (TCB) is being deleted.

3.6 Layer3ProtocolEnum Enumeration

The literals of the `Layer3ProtocolEnum` enumeration are given in [Table 3-4](#).

Table 3-4. Literals of the `Layer3ProtocolEnum` enumeration

Enumeration Literal	Description
---------------------	-------------

IPv4	Specifies the Internet Protocol, version 4.
IPv6	Specifies the Internet Protocol, version 6.
ICMP	Specifies the Internet Control Message Protocol.
IGMP	Specifies the Internet Group Management Protocol.
IGRP	Specifies the Interior Gateway Routing Protocol.
CLNP	Specifies the Connectionless Networking Protocol.
EGP	Specifies the Exterior Gateway Protocol.
EIGRP	Specifies the Enhanced Interior Gateway Routing Protocol.
IPSec	Specifies the Internet Protocol Security suite.
IPX	Specifies the Internetwork Packet Exchange protocol.
Routed-SMLT	Specifies the Routed Split Multi-Link Trunking protocol.
SCCP	Specifies the Signalling Connection Control Part protocol.

3.7 Layer7ProtocolEnum Enumeration

The literals of the `Layer7ProtocolEnum` enumeration are given in [Table 3-5](#).

Table 3-5. Literals of the `Layer7ProtocolEnum` enumeration

Enumeration Literal	Description
HTTP	Specifies the Hypertext Transfer Protocol.
HTTPS	Specifies the Hypertext Transfer Protocol Secure.
FTP	Specifies the File Transfer Protocol.
SMTP	Specifies the Simple Mail Transfer Protocol.
IRC	Specifies the Internet Relay Chat protocol.
IDENT	Specifies the Identification Protocol, IDENT.
DNS	Specifies the Domain Name System protocol.
TELNET	Specifies the Telnet protocol.
POP3	Specifies the Post Office Protocol, version 3.
IMAP	Specifies the Internet Message Access Protocol.
SSH	Specifies the Secure Shell protocol.
SMB	Specifies the Microsoft Server Message Block protocol.
ADC	Specifies the Advance Direct Connect protocol.
AFP	Specifies the Apple Filing Protocol.

BACNet	Specifies the Building Automation and Control Network protocol.
BitTorrent	Specifies the BitTorrent protocol.
BOOTP	Specifies the Bootstrap Protocol.
Diameter	Specifies the Diameter protocol.
DICOM	Specifies the Digital Imaging and Communications in Medicine protocol.
DICT	Specifies the Dictionary protocol.
DSM-CC	Specifies the Digital Storage Media Command and Control protocol.
DSNP	Specifies the Distributed Social Networking Protocol.
DHCP	Specifies the Dynamic Host Configuration Protocol.
ED2K	Specifies the EDonkey2000 protocol.
Finger	Specifies the Finger protocol.
Gnutella	Specifies the Gnutella protocol.
Gopher	Specifies the Gopher protocol.
ISUP	Specifies the ISDN User Part protocol.
LDAP	Specifies the Lightweight Directory Access Protocol.

MIME	Specifies the Multipurpose Internet Mail Extensions protocol.
MSNP	Specifies the Microsoft Notification Protocol.
MAP	Specifies the Mobile Application Part protocol.
NetBIOS	Specifies the Network Basic Input/Output System protocol.
NNTP	Specifies the Network News Transfer Protocol.
NTP	Specifies the Network Time Protocol.
NTCIP	Specifies the National Transportation Communications for Intelligent Transportation System Protocol.
RADIUS	Specifies the Remote Authentication Dial In User Service protocol.
RDP	Specifies the Remote Desktop Protocol.
rlogin	Specifies the rlogin protocol.
rsync	Specifies the rsync potocol.
RTP	Specifies the Real-time Transport Protocol.
RTSP	Specifies the Real-time Transport Streaming Protocol.
SISNAPI	Specifies the Siebel Internet Session Network API protocol.
SIP	Specifies the Session Initiation Protocol.

SNMP	Specifies the Simple Network Management Protocol.
STUN	Specifies the Session Traversal Utilities for NAT protocol.
TUP	Specifies the Telephone User Part protocol.
TCAP	Specifies the Transaction Capabilities Application Part protocol.
TFTP	Specifies the Trivial File Transfer Protocol.
WebDAV	Specifies the Web Distributed Authoring and Versioning protocol.
XMPP	Specifies the Extensible Messaging and Presence Protocol.
Modbus	Specifies the Modbus Protocol.

4 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.

Appendix A. 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

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

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

Rutger Prins
Andrei Sirghi
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.

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

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

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

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.

Appendix B. Revision History

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