

# Bindings for OBIX: WebSocket Bindings Version 1.0

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#### Related work:

This specification is related to:

- *OBIX Version 1.1*. Edited by Craig Gemmill. Latest version. <http://docs.oasis-open.org/obix/obix/v1.1/obix-v1.1.html>.
- *Bindings for OBIX: REST Bindings Version 1.0*. Edited by Craig Gemmill and Markus Jung. Latest version. <http://docs.oasis-open.org/obix/obix-rest/v1.0/obix-rest-v1.0.html>.
- *Bindings for OBIX: SOAP Bindings Version 1.0*. Edited by Markus Jung. Latest version. <http://docs.oasis-open.org/obix/obix-soap/v1.0/obix-soap-v1.0.html>.
- *Encodings for OBIX: Common Encodings Version 1.0*. Edited by Markus Jung. Latest version. <http://docs.oasis-open.org/obix/obix-encodings/v1.0/obix-encodings-v1.0.html>.

#### Abstract:

This document specifies WebSocket binding for OBIX.

#### Status:

This document was last revised or approved by the OASIS Open Building Information Exchange (oBIX) TC on the above date. The level of approval is also listed above. Check the "Latest

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# 1 Introduction

All text is normative unless otherwise labeled.

## 1.1 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].

## 1.2 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>
- [OBIX] *OBIX Version 1.1*. Edited by Craig Gemmill. Latest version. <http://docs.oasis-open.org/obix/obix/v1.1/obix-v1.1.html>
- [OBIX Encodings] *Encodings for OBIX: Common Encodings Version 1.0*. Edited by Marcus Jung. Latest version. <http://docs.oasis-open.org/obix/obix-encodings/v1.0/obix-encodings-v1.0.html>
- [OBIX REST] *Bindings for OBIX: REST Bindings Version 1.0*. Edited by Craig Gemmill and Markus Jung. Latest version. <http://docs.oasis-open.org/obix/obix-rest/v1.0/obix-rest-v1.0.html>
- [RFC3986] Berners-Lee, T., Fielding, R., and L. Masinter, “Uniform Resource Identifier (URI): Generic Syntax”, STD66, RFC 3986, January 2005. <http://www.ietf.org/rfc/rfc3986.txt>
- [RFC6455] Fette, I, Melnikov, A, “*The WebSocket Protocol*”, IETF RFC 6455, December 2011. <http://www.ietf.org/rfc/rfc6455.txt>
- [SOA-RM] *Reference Model for Service Oriented Architecture 1.0*, October 2006. OASIS Standard. <http://docs.oasis-open.org/soa-rm/v1.0/soa-rm.pdf>

## 1.3 Non-Normative References

- [RFC5246] Dierks, T. and E. Rescorla, “The Transport Layer Security (TLS) Protocol Version 1.2”, RFC 5246, August 2008. <http://www.ietf.org/rfc/rfc5246.txt>
- [mqtt-v3.1.1] *MQTT Version 3.1.1*. Edited by Andrew Banks and Rahul Gupta. 18 May 2014. OASIS Committee Specification 01. <http://docs.oasis-open.org/mqtt/mqtt/v3.1.1/cs01/mqtt-v3.1.1-cs01.html>. Latest version: <http://docs.oasis-open.org/mqtt/mqtt/v3.1.1/mqtt-v3.1.1.html>.

---

## 2 WebSocket Binding

33

34 The WebSocket binding specifies a simple mapping of OBIX requests to WebSocket. After connecting to  
35 endpoint URL and switching to the WebSocket protocol (or recognized sub-protocols like MQTT, see  
36 chapter 6 in [mqtt31]), OBIX messages can be exchanged continuously.

### 2.1 Lobby

37

38 The WebSocket binding SHOULD be announced in the Lobby (see section 5.4.3 in [OBIX]) as follows:

```
39 <uri name="ws" displayName="WebSocket Binding" val="http://docs.oasis-open.org/obix/obix-  
40 websocket/v1.0/csprd01/obix-websocket-v1.0-csprd01.html"/>
```

### 2.2 Requests

41

42 The following table describes the mapping of OBIX request and its WebSocket equivalent. As WebSocket  
43 is a message-based protocol it cannot be mapped directly, but as OBIX messages contain naming the  
44 messages can be send also using this kind of protocol. For a detailed example of the request flow see  
45 section 2.2.4 below.

46

OBIX Request	WebSocket	Target
Read	After connect use obix:Read messages to read objects and the WatchService functionality to subscribe to objects and receive continuous updates of their state (which is using messages of type obix:Update)	Lobby (single point of WebSocket connection)
Write	Send an obix:Write message containing an obj	Any object with an href and writable=true, sent within an open WebSocket connection context
Invoke	Send an obix:Invoke message containing op element holding input parameters as children, expecting obix:Response message with corresponding request ID as response.	Any op object with an href (especially Watch), sent within an open WebSocket connection context
Delete	If an object has an delete operation defined this operation is used	Any object with delete operation

47 *Table 2-1. OBIX Request Mapping*

48

#### 2.2.1 Connect request

49

50 The connect URL is the name or IP of the OBIX server prefixed by the WebSocket protocol, i.e. either  
51 "ws" or "wss" for a secure connection using TLS. If the server supports multiple encodings a client MAY  
52 request the encoding with the "encoding" parameter on connect (e.g. "wss://myhome/?encoding=json"), if  
53 not specified the server uses its default encoding (it is recommend to support XML encoding as default).  
54 The response send to client upon successful connection MUST be the Lobby object.

## 55 2.2.2 Request, Response and Update messages

56 To ensure that a request and response in the asynchronous message exchange of WebSocket is bound  
57 together, the concept of a request with a defined request ID (denoted as attribute `rid`) is introduced. A  
58 response to a request contains that specific request ID so that the client can match the request and  
59 response. If the server sends a message without the request and response context, it uses the  
60 `obix:Update` type to denote this case.

61 Following are the contract definitions of Read, Write, Invoke, Response and Update:

```
62 <obj href="obix:Read">  
63 </obj>  
64  
65 <obj href="obix:Write">  
66 </obj>  
67  
68 <obj href="obix:Invoke">  
69 </obj>  
70  
71 <obj href="obix:Response">  
72 </obj>  
73  
74 <obj href="obix:Update">  
75 </obj>
```

76 For `obix:Read`, `obix:Write`, `obix:Invoke` and `obix:Response` there is a facet `rid` defined as  
77 `xs:int`, which **MUST** be included (e.g. the attribute can have the value `rid="1"` to denote the request ID  
78 1). The `obix:Request`, `obix:Response` and `obix:Update` objects **MUST** contain an `obj` or `list`.  
79 Here an example for a response object:

```
80 <obj is="obix:Response" rid="1">  
81 <obj href="/device/BrightnessSensor" name="BrightnessSensor" location="Outside"  
82 is="example:Brightness" displayName="Brightness Outside">  
83 <real name="value" val="45.5" unit="obix:units/lux" />  
84 </obj>  
85 </obj>
```

## 86 2.2.3 Watches

87 As WebSocket follows a message exchange pattern the REST-style messages of OBIX needs to be  
88 wrapped. For that, extensive use is made of the “Watch” concept. After a successful connection to the  
89 OBIX server, the client can add a “Watch” to subscribe to object changes. This is done using the `make`  
90 operation on the `WatchService` object. As long as the WebSocket connection is open, the server **MAY**  
91 push unsolicited updates via `obix:Update` messages to the client, as defined in section 12.2 in **[OBIX]**.  
92 This ensures that the client has a consistent state with the server.

## 93 2.2.4 Example Request Flow

94 The request and response flow below shows a non-normative example of WebSocket exchanges in the  
95 XML encoding style:

96

Client	Server
--------	--------



<i>Client initiates action on its own timing</i> Connect to WebSocket server: wss://myhome/	→
←	<u>Server sends message in response to connection from Client</u> Returns the Lobby: <pre>&lt;obj is="obix:Lobby"&gt;   &lt;ref name="about" href="/about", is="obix:About"/&gt;   &lt;op name="batch" in="obix:BatchIn" out="obix:BatchOut"/&gt;   &lt;ref name="watchService" href="/watchService"     is="obix:WatchService"/&gt;   &lt;ref name="device" href="/device" is="example:Device" /&gt; &lt;/obj&gt;</pre>

97 Table 2-2. Exchange 1: Client initiates connection with server for subsequent data exchange  
98

Client	Server
<u>Client sends message on its own timing</u> Call WatchService.make operation: <pre>&lt;obj is="obix:Invoke" rid="1" href="/watchService/make" /&gt;</pre>	→
←	<u>Server sends message in response to "watch service" message from Client</u> Returns the Watch (the lease time is not used): <pre>&lt;obj is="obix:Response" rid="1"&gt;   &lt;obj is="obix:Watch" href="/watch/1"&gt;     &lt;reltime name="lease" val="PT0S" /&gt;   &lt;/obj&gt; &lt;/obj&gt;</pre>

99 Table 2-3. Exchange 2: Client sets up a watch service on the server  
100

Client	Server
<u>Client sends message on its own timing</u> Call Watch.add operation to add /device/: <pre>&lt;obj is="obix:Invoke" rid="2" href="/watch/1/add"&gt;   &lt;obj is="obix:WatchIn"&gt;     &lt;list name="hrefs"&gt;       &lt;uri val="/device" /&gt;     &lt;/list&gt;   &lt;/obj&gt; &lt;/obj&gt;</pre>	→
←	<u>Server sends message in response to "add device" message from Client</u> List devices: <pre>&lt;obj is="obix:Response" rid="2"&gt;   &lt;list name="device" href="/device" of="obj"&gt;     &lt;obj href="/device/bathTemp" name="BathTemperature"       location="Bathroom" is="example:Temperature"</pre>

	<pre> displayName="Temperature Bathroom"&gt;   &lt;abstime name="Timestamp"     val="2013-07-24T10:01:15.883+02:00"&gt;   &lt;/abstime&gt;   &lt;real name="ActualValue" val="28.2"     unit="obix:units/celsius"     displayName="ActualValue"&gt;   &lt;/real&gt;   &lt;bool name="Warm" val="true"     displayName="Warm"&gt;&lt;/bool&gt; &lt;/obj&gt; &lt;obj href="/device/bathLight" name="BathLight"   location="Bathroom" is="example:Switch"   displayName="Light Bathroom"&gt;   &lt;abstime name="Timestamp"     val="2013-07-14T22:25:31.331+02:00"&gt;   &lt;/abstime&gt;   &lt;bool name="Status" val="false"     displayName="Status" writeable="true"&gt;   &lt;/bool&gt; &lt;/obj&gt; &lt;/list&gt; &lt;/obj&gt; </pre>
--	---

101 Table 2-4. Exchange 3: Client adds default devices to established watch service  
102

Client	Server
<i>Client sends message on its own timing</i>	
<p>Call Watch.remove operation to remove /device/:</p> <pre> &lt;obj is="obix:Invoke" rid="3" href="/watch/1/remove"&gt;   &lt;obj is="obix:WatchIn"&gt;     &lt;list name="hrefs"&gt;       &lt;uri val="/device/" /&gt;     &lt;/list&gt;   &lt;/obj&gt; &lt;/obj&gt; </pre>	➔
X	<p><u>Server does not send out any message upon reception of "watch remove" message from Client</u></p> <p>Removed successfully, no response</p>

103 Table 2-5. Exchange 4: Client removes established default devices from an established watch service  
104

Client	Server
<i>Client sends message on its own timing</i>	
<p>Watch.add /device/bathTemp:</p> <pre> &lt;obj is="obix:Read" rid="4" href="/watch/1/add"&gt;   &lt;obj is="obix:WatchIn"&gt;     &lt;list name="hrefs"&gt;       &lt;uri val="/device/bathTemp" /&gt;     &lt;/list&gt;   &lt;/obj&gt; &lt;/obj&gt; </pre>	➔

<pre>&lt;/list&gt; &lt;/obj&gt; &lt;/obj&gt;</pre>	
<p style="text-align: center;">←</p>	<p><u>Server sends message in response to “add device” message from Client</u></p> <p>Send bathTemp information within the WatchOut object:</p> <pre>&lt;obj is="obix:Response" rid="4"&gt;   &lt;obj is="obix:WatchOut" href="/watch/1"&gt;     &lt;list name="values"&gt;       &lt;obj href="/device/bathTemp"         name="BathTemperature"         location="Bathroom"         is="example:Temperature"         displayName="Temperature Bathroom"&gt;         &lt;abstime name="Timestamp"           val="2013-07-24T10:01:15.883+02:00"&gt;         &lt;/abstime&gt;         &lt;real name="ActualValue" val="28.2"           unit="obix:units/celsius"           displayName="ActualValue"&gt;&lt;/real&gt;         &lt;bool name="Warm" val="true"           displayName="Warm"&gt;&lt;/bool&gt;       &lt;/obj&gt;     &lt;/list&gt;   &lt;/obj&gt; &lt;/obj&gt;</pre>
<p><u>Client sends message on its own timing after having received the “device information” message from Server</u></p> <p>Watch.pollChanges</p> <pre>&lt;obj is="obix:Invoke" rid="5" href="/watch/1/pollChange"&gt; &lt;/obj&gt;</pre>	<p style="text-align: center;">→</p>
<p style="text-align: center;">←</p>	<p><u>Server sends message in response to “watch poll changes” message from Client</u></p> <p>Send empty response as the state is current</p> <pre>&lt;obj is="obix:Response" rid="5"&gt; &lt;/obj&gt;</pre>
<p><u>Client sends message on its own timing</u></p> <p>To keep the WebSocket session open send an empty WebSocket frame like e.g. ""</p>	<p style="text-align: center;">→</p>
<p style="text-align: center;">X</p>	<p><u>Server does not send out any message upon reception of empty WebSocket messages from Client</u></p> <p>No response, just the session is kept open</p>

105 Table 2-6. Exchange 5: Client adds first device with ability to watch for changes, but that device has no changes that  
106 occur  
107

<b>Client</b>	<b>Server</b>
---------------	---------------

Client sends message on its own timing

Watch.add /device/kitchenTemp:

```
<obj is="obix:Invoke" rid="6" href="/watch/1/add">
  <obj is="obix:WatchIn">
    <list name="hrefs">
      <uri val="/device/kitchenTemp" />
    </list>
  </obj>
</obj>
```



Server sends message in response to "add device" message from Client

Send kitchenTemp containing the current object:

```
<obj is="obix:Response" rid="6">
  <obj is="obix:WatchOut" href="/watch/1">
    <list name="values">
      <obj href="/device/kitchenTemp"
        name="KitchenTemperature"
        location="Kitchen"
        is="example:Temperature"
        displayName="Temperature Kitchen">
        <abstime name="Timestamp"
          val="2013-07-24T10:01:15.883+02:00">
        </abstime>
        <real name="ActualValue" val="26.1"
          unit="obix:units/celsius"
          displayName="ActualValue"></real>
        <bool name="Warm" val="true"
          displayName="Warm"></bool>
      </obj>
    </list>
  </obj>
</obj>
```



A period of two minutes has elapsed during this time slot, in the mean time only the empty frames are sent to keep the WebSocket connection open

Server sends message after 2 minutes from previous message

Send unsolicited update as an update from the temperature sensor was received:

```
<obj is="obix:Update">
  <obj is="obix:WatchOut" href="/watch/1">
    <list name="values">
      <obj href="/device/kitchenTemp"
        name="KitchenTemperature"
        location="Kitchen"
        is="example:Temperature"
        displayName="Temperature Kitchen">
        <abstime name="Timestamp"
          val="2013-07-24T10:03:15.883+02:00">
        </abstime>
        <real name="ActualValue" val="26.2"
          unit="obix:units/celsius"
          displayName="ActualValue"></real>
        <bool name="Warm" val="true"
          displayName="Warm"></bool>
      </obj>
    </list>
  </obj>
```



	<pre> &lt;/list&gt; &lt;/obj&gt; &lt;/obj&gt; </pre>
--	--

108 Table 2-7. Exchange 6: Client adds second device with ability to watch for changes, and that device has changes that  
109 occur  
110

Client	Server
<i>Client sends message on its own timing</i>	
Update bathLight <pre> &lt;obj is="obix:Write" href="/device/bathLight" rid="7"&gt;   &lt;bool name="Status" val="true" displayName="Status"     writeable="true"&gt;&lt;/bool&gt; &lt;/obj&gt; </pre>	→
X	<u>Server does not send out any message upon reception of "update" messages from Client</u> No direct response as not watched

111 Table 2-8. Exchange 7: Client attempts to update a device that has not been setup for watching  
112

Client	Server
<i>Client sends message on its own timing</i>	
Disconnect from wss://myhome/	→
	Server disconnects from Client

113 Table 2-9. Exchange 8: Client removes connection from Server  
114

## 115 2.3 Security

116 Existing standards SHOULD be used when applicable for OBIX WebSocket implementations including:  
117

- RFC 5246 – The Transport Layer Security (TLS) Protocol Version 1.2, see [RFC5246]

## 118 2.4 Localization

119 Servers SHOULD localize appropriate data based on the desired locale of the client agent. Localization  
120 SHOULD include the `display` and `displayName` attributes. The desired locale of the client SHOULD  
121 be determined through authentication. A suggested algorithm is to check if the authenticated user has a  
122 preferred locale configured in the server's user database.

123 Localization MAY include auto-conversion of units. For example if the authenticated user has configured  
124 a preferred unit system such as English versus Metric, then the server might attempt to convert values  
125 with an associated `unit` facet to the desired unit system.

---

## 126 3 Conformance

127 An implementation is conformant with this specification if it satisfies all of the MUST and REQUIRED level  
128 requirements defined herein for the functions implemented. Normative text within this specification takes  
129 precedence over normative outlines, which in turn take precedence over examples.

130 An implementation is a conforming OBIX Server supporting WebSocket if it meets the conditions  
131 described in Section 3.1. An implementation is a conforming OBIX Client supporting WebSocket if it  
132 meets the conditions described in Section 3.2. An implementation is a conforming OBIX Server  
133 supporting WebSocket and a conforming OBIX Client supporting WebSocket if it meets the conditions of  
134 both Sections 3.1 and 3.2.

### 135 3.1 Conditions for conforming OBIX Server supporting WebSocket

- 136 1. An OBIX server supporting WebSocket MUST conform to an OBIX server as defined in **[OBIX]**.
- 137 2. An OBIX server supporting WebSocket MUST accept WebSocket connections and MUST return  
138 the Lobby object on successful connection.
- 139 3. An OBIX server supporting WebSocket MUST support the `make` operation of the  
140 `obix:WatchService` object.
- 141 4. An OBIX server supporting WebSocket MUST support the `obix:Read`, `obix:Write`,  
142 `obix:Invoke`, `obix:Response` and `obix:Update` contracts and return the request id "rid"  
143 within the `obix:Response` object.

### 144 3.2 Conditions for conforming OBIX Client supporting WebSocket

- 145 1. An OBIX client supporting WebSocket must conform to an OBIX client as defined in **[OBIX]**.
- 146 2. A conformant OBIX client supporting WebSocket must support WebSocket connections and the  
147 request flow as stated in Section 2.2.
- 148 3. A conformant implementation MUST generate request IDs for each across `obix:Read`,  
149 `obix:Write` and `obix:Invoke` message

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150 **Appendix A. Acknowledgments**

151 The following individuals have participated in the creation of this specification and are gratefully  
152 acknowledged:

153 **Participants:**

154 Gareth Johnson, Tridium Inc.  
155 Craig Gemmill, Tridium Inc.  
156 Ludo Bertsch, CABA  
157 Markus Jung, University of Vienna

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## Appendix B. Revision History

Revision	Date	Editor	Changes Made
WD01	1-Aug-2013	Matthias Hub	Initial submission
WD02	8-Aug-2013	Toby Considine	Moved to standard template, added some normative references
WD03	13-Aug-2013	Matthias Hub	Incorporated review comments by Gareth Johnson
WD04	15-Oct-2013	Matthias Hub	Incorporated review comments from TC: removed separate watch concept – instead re-using standard watch concept, added definition of Watch properties
WD05	18-Oct-2013	Matthias Hub	Incorporated Craig Gemmill input to Watches
WD06	29-Oct-2013	Ludo Bertsch	Improved example in Section 2.1.5
WD07	30-Oct-2013	Matthias Hub	Updated Terminology section Added bufferHandling property to the Watch Changed request / response flow style in the example Updated conformance section for different naming and to refer to the core spec
WD08	18-Nov-2013	Matthias Hub	Introduced obix:Read, obix:Write and obix:Invoke as message type similar to the SOAP binding Clarified FIFO / LIFO means that messages are dropped Adapted request / response flow style
WD09	25-Nov-2013	Matthias Hub	Added definition of obix:Read, obix:Write and obix:Invoke Updated the example flow to use obix:Read, obix:Write and obix:Invoke Using "example" prefix instead of "gateway"
WD10	16-Dec-2013	Matthias Hub	Added Lobby definition section Removed duplicate Watches definition as they are moved into core Fixed spelling (OBIX-85) Updated table titles (OBIX-86)
WD11	26-May-2014	Matthias Hub	Incorporated comments from the public review: OBIX-103, OBIX-117, OBIX-118, OBIX-119, OBIX-120, OBIX-121, OBIX-184, OBIX-185, OBIX-186



			Corrected request operators in examples Added reference to MQTT over WebSocket Smaller formatting changes
WD12	15-Oct-2014	Matthias Hub	Changed "names" property to "name" of the list object to match contract definition

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