



XMPP

XEP-0490: Message Displayed Synchronization

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This specification allows multiple clients of the same user to synchronize the displayed state of their chats.

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1 Introduction

In multi-device environments marking a chat as *displayed* on one device should mark that chat as *displayed* on all devices. Historically carbon copies ([Message Carbons \(XEP-0280\)](#)¹) of the `<displayed/>` element of Displayed Markers ([Displayed Markers \(XEP-0333\)](#)²) have been used to achieve this effect. However this approach has a couple of downsides that this specification is trying eliminate:

- The contact has to request Displayed Markers by tagging a message with `<markable/>`.
- Displayed Markers let the contact know that a device has displayed the message. This might not always be advisable when synchronization across multiple devices of the same user is the desired outcome.
- When used in large group chats Displayed Markers can create a lot of unwanted traffic.

This specification isolates the task of multi-device synchronization from providing information to the contact, while borrowing some of the semantics of Displayed Markers such as *displayed* referring to all messages up to this point.

2 Requirements

- Basic functionality should only have minimal server requirements ([Personal Eventing Protocol \(XEP-0163\)](#)³ and [Best Practices for Persistent Storage of Private Data via Publish-Subscribe \(XEP-0223\)](#)⁴).
- Rely on server-injected `<stanza-id/>` (see [Unique and Stable Stanza IDs \(XEP-0359\)](#)⁵) to provide unique and stable IDs. While this is commonly done as part of [Message Archive Management \(XEP-0313\)](#)⁶ it does not technically depend on the message being archived.
- Define the interaction with [Displayed Markers \(XEP-0333\)](#)⁷.
- Provide optional methods for traffic optimizations on supporting servers.
- Make no assertions on what constitutes an *open* or *archived* chat. This specification allows clients to state that they have displayed messages in a certain chat up to a certain point. It does not indicate that a chat is open or in case of group chats joined.

¹XEP-0280: Message Carbons [<https://xmpp.org/extensions/xep-0280.html>](https://xmpp.org/extensions/xep-0280.html).

²XEP-0333: Displayed Markers [<https://xmpp.org/extensions/xep-0333.html>](https://xmpp.org/extensions/xep-0333.html).

³XEP-0163: Personal Eventing Protocol [<https://xmpp.org/extensions/xep-0163.html>](https://xmpp.org/extensions/xep-0163.html).

⁴XEP-0223: Best Practices for Persistent Storage of Private Data via Publish-Subscribe [<https://xmpp.org/extensions/xep-0223.html>](https://xmpp.org/extensions/xep-0223.html).

⁵XEP-0359: Unique and Stable Stanza IDs [<https://xmpp.org/extensions/xep-0359.html>](https://xmpp.org/extensions/xep-0359.html).

⁶XEP-0313: Message Archive Management [<https://xmpp.org/extensions/xep-0313.html>](https://xmpp.org/extensions/xep-0313.html).

⁷XEP-0333: Displayed Markers [<https://xmpp.org/extensions/xep-0333.html>](https://xmpp.org/extensions/xep-0333.html).

3 Glossary

Displayed Colloquially this is also known as read. However since a common implementation of read is: "shown on screen, in full, in the context of the chat", and this gives no indication on whether the user has actually read a message, displayed was chosen as a more accurate terminology. A message might also be manually acknowledged by the user, for example via a mark as read action in a notification. Implementations are also possible, for example in smart home devices or infotainment systems, where the message is read aloud by a Text-to-Speech system, but never actually displayed. It is up to the implementors discretion to determine what the best approximation of the user has had a reasonable chance to mentally process the message is.

4 Use Cases

4.1 Server-side persistence

Clients use items in a private PEP ([Personal Eventing Protocol \(XEP-0163\)](https://xmpp.org/extensions/xep-0163.html) ⁸) node called 'urn:xmpp:mds:displayed:0' to synchronize and persist the displayed state (See [Best Practices for Persistent Storage of Private Data via Publish-Subscribe \(XEP-0223\)](https://xmpp.org/extensions/xep-0223.html) ⁹). The item ID corresponds to the JID of the respective chat. For normal, 1:1 chats this SHOULD be the bare JID of the contact, for group chats this SHOULD be the bare JID of the room and for private messages in group chats the full JID of the participant.

The item contains a single <displayed/> element qualified by the 'urn:xmpp:mds:displayed:0' namespace. The <displayed/> element MUST contain exactly one [Unique and Stable Stanza IDs \(XEP-0359\)](https://xmpp.org/extensions/xep-0359.html) ¹⁰ <stanza-id/> element that corresponds to the stanza-id of the most recent, displayed message, in that particular chat.

4.2 Flagging chat as displayed

Only messages **received** by the user (meaning sent by third parties such as a contact, a participant in a group chat, etc) SHOULD be flagged as 'displayed'. However since 'displayed' means *all messages up to this point* and the stanza-id of a message **sent** by the user indicates a valid point in the chat history, sent messages MAY be flagged as well.

Flagging a chat as *displayed up to this point* happens by publishing a PEP item with an id corresponding to the JID of the chat and a <displayed/> payload element into the 'urn:xmpp:mds:displayed:0' node.

For group chats the <stanza-id/> child of the <displayed/> element refers to the stanza-id injected by the room. For all other chats the stanza-id child refers to the stanza-id injected by the user's server (the server hosting the user account).

⁸XEP-0163: Personal Eventing Protocol <<https://xmpp.org/extensions/xep-0163.html>>.

⁹XEP-0223: Best Practices for Persistent Storage of Private Data via Publish-Subscribe <<https://xmpp.org/extensions/xep-0223.html>>.

¹⁰XEP-0359: Unique and Stable Stanza IDs <<https://xmpp.org/extensions/xep-0359.html>>.

The client MUST include appropriate publish-options in the publication, including, but not limited to, setting the access model to whitelist and the max-items to max.

Listing 1: Client marks a chat as display

```
<iq from='juliet@capulet.lit/balcony' type='set' id='flag-as-displayed-1'>
  <pubsub xmlns='http://jabber.org/protocol/pubsub'>
    <publish node='urn:xmpp:mds:displayed:0'>
      <item id='romeo@montague.lit'>
        <displayed xmlns='urn:xmpp:mds:displayed:0'>
          <stanza-id xmlns='urn:xmpp:sid:0'
            by='juliet@capulet.lit'
            id='0f710f2b-52ed-4d52-b928-784dad74a52b' />
        </displayed>
      </item>
    </publish>
    <publish-options>
      <x xmlns='jabber:x:data' type='submit'>
        <field var='FORM_TYPE' type='hidden'>
          <value>http://jabber.org/protocol/pubsub#publish-options</value>
        </field>
        <field var='pubsub#persist_items'>
          <value>true</value>
        </field>
        <field var='pubsub#max_items'>
          <value>max</value>
        </field>
        <field var='pubsub#send_last_published_item'>
          <value>never</value>
        </field>
        <field var='pubsub#access_model'>
          <value>whitelist</value>
        </field>
      </x>
    </publish-options>
  </pubsub>
</iq>
```

Listing 2: Server acknowledges successful storage

```
<iq to='juliet@capulet.lit/balcony' type='result' id='flag-as-displayed-1' />
```

4.3 Retrieving notifications

A client interested in synchronizing the displayed state with other clients SHOULD include the 'urn:xmpp:mds:displayed:0+notify' feature in its [Entity Capabilities \(XEP-0115\)](#)¹¹, as per [Personal Eventing Protocol \(XEP-0163\)](#)¹² rules.

4.4 Catching up

Upon bind and initial presence a client retrieves all items in the 'urn:xmpp:mds:displayed:0' node to learn what changes to the displayed state have occurred while the client was offline.

Listing 3: Client retrieves all displayed items

```
<iq from='juliet@capulet.lit/balcony' type='get' id='catchup-1'>
  <pubsub xmlns='http://jabber.org/protocol/pubsub'>
    <items node='urn:xmpp:mds:displayed:0' />
  </pubsub>
</iq>
```

Listing 4: Server returns the displayed states for various chat

```
<iq type='result'
  to='juliet@capulet.lit/balcony'
  id='catchup-1'>
  <pubsub xmlns='http://jabber.org/protocol/pubsub'>
    <items node='urn:xmpp:mds:displayed:0'>
      <item id='romeo@montague.lit'>
        <displayed xmlns='urn:xmpp:mds:displayed:0'>
          <stanza-id xmlns='urn:xmpp:sid:0'
            id='0f710f2b-52ed-4d52-b928-784dad74a52b'
            by='juliet@capulet.lit' />
        </displayed>
      </item>
      <item id='example@conference.shakespeare.lit'>
        <displayed xmlns='urn:xmpp:mds:displayed:0'>
          <stanza-id xmlns='urn:xmpp:sid:0'
            id='ca21deaf-812c-48f1-8f16-339a674f2864'
            by='example@conference.shakespeare.lit' />
        </displayed>
      </item>
    </items>
  </pubsub>
</iq>
```

¹¹XEP-0115: Entity Capabilities <<https://xmpp.org/extensions/xep-0115.html>>.

¹²XEP-0163: Personal Eventing Protocol <<https://xmpp.org/extensions/xep-0163.html>>.

4.5 Interaction with Displayed Markers and Server Assist

A [Displayed Markers \(XEP-0333\)](#)¹³ displayed marker refers to the message id set by the sender of the message whereas the displayed element defined in this specification refers to the stanza-id injected by the user's server.

In the likely scenario that a client wishes to share the displayed state with their own devices and the sender of the message, a client SHOULD send a [Displayed Markers \(XEP-0333\)](#)¹⁴ displayed marker and ensure that the 'urn:xmpp:mds:displayed:0' node gets updated.

4.5.1 Server assist

A [Publish-Subscribe \(XEP-0060\)](#)¹⁵ item publication is a fairly verbose operation for something that is expected to happen rather frequently. Therefore this specification defines an optional way to combine the PEP node item update and the Displayed Marker in one simple message.

4.5.2 Discovering support

Server assisted displayed node updates are an optional feature a user's server can provide. To signal support the server announces an [Entity Capabilities \(XEP-0115\)](#)¹⁶ feature of 'urn:xmpp:mds:server-assist:0' on the account.

Listing 5: Client queries for server features

```
<iq type='get' id='disco-1' to='juliet@capulet.lit' from='
  juliet@capulet.lit/balcony'>
  <query xmlns='http://jabber.org/protocol/disco#info' />
</iq>
```

Listing 6: Server responds with features

```
<iq type='result' id='disco1' from='juliet@capulet.lit' to='
  juliet@capulet.lit/balcony'>
  <query xmlns='http://jabber.org/protocol/disco#info'>
    <feature var='urn:xmpp:mds:server-assist:0' />
  </query>
</iq>
```

¹³XEP-0333: Displayed Markers <<https://xmpp.org/extensions/xep-0333.html>>.

¹⁴XEP-0333: Displayed Markers <<https://xmpp.org/extensions/xep-0333.html>>.

¹⁵XEP-0060: Publish-Subscribe <<https://xmpp.org/extensions/xep-0060.html>>.

¹⁶XEP-0115: Entity Capabilities <<https://xmpp.org/extensions/xep-0115.html>>.

4.5.3 Sending assisted displayed

To update the displayed item in the 'urn:xmpp:mds:displayed:0' PEP node more efficiently a client MAY send a message with the 'to' attribute set to the item id (which is equivalent to the JID of the contact) and with a <displayed/> element qualified by the 'urn:xmpp:mds:displayed:0' namespace. The server MUST strip the <displayed/> element from the message and continue to process it normally. The server MUST publish a PEP item on the 'urn:xmpp:mds:displayed:0' node where the item id is taken from the 'to' attribute and the payload is the <displayed/> element. A client MUST NOT include the <displayed/> element qualified by the 'urn:xmpp:mds:displayed:0' namespace if the message would otherwise be empty. A client that wishes to update the device synchronized displayed state but not inform the sender of the message via Displayed Markers SHOULD use the regular PubSub publication process.

Listing 7: Juliet receives a message from Romeo

```
<message to='juliet@capulet.lit' from='romeo@montegue.lit/orchard' id='the-msg-1'>
  <body>Hi. How are you?</body>
  <markable xmlns='urn:xmpp:chat-markers:0' />
  <stanza-id xmlns='urn:xmpp:sid:0' by='juliet@capulet.lit' id='0423e3a9-d516-493d-bb06-bee0e51ab9fb' />
</message>
```

Listing 8: Juliet lets both Romeo and her other devices know she has displayed the message

```
<message to='romeo@montegue.lit'>
  <displayed xmlns='urn:xmpp:chat-markers:0' id='the-msg-1' />
  <displayed xmlns='urn:xmpp:mds:displayed:0'>
    <stanza-id xmlns='urn:xmpp:sid:0' by='juliet@capulet.lit' id='0423e3a9-d516-493d-bb06-bee0e51ab9fb' />
  </displayed>
</message>
```

Listing 9: Juliet's server strips the displayed element used for server assist and forwards the stanza to Romeo

```
<message to='romeo@montegue.lit' from='juliet@capulet.lit/balcony'>
  <displayed xmlns='urn:xmpp:chat-markers:0' id='the-msg-1' />
</message>
```

Listing 10: Server sends out PEP notifications to Juliets connected devices

```
<message from='juliet@capulet.lit' to='juliet@capulet.lit/balcony'
  type='headline' id='new-displayed-pep-event'>
  <event xmlns='http://jabber.org/protocol/pubsub#event'>
    <items node='urn:xmpp:mds:displayed:0'>
      <item id='romeo@montegue.lit'>
```

```
<displayed xmlns='urn:xmpp:mds:displayed:0'>
  <stanza-id xmlns='urn:xmpp:sid:0' by='juliet@capulet.lit' id
    ='0423e3a9-d516-493d-bb06-bee0e51ab9fb' />
</displayed>
</item>
</items>
</event>
</message>
```

5 Business Rules

5.1 Client

- The displayed state only moves forward. Receiving a displayed state with a stanza-id that references a message older than the current local representation is considered redundant and MUST be ignored.
- Displayed states with a stanza-id not found in the respective chat MUST be ignored.
- Receiving an outgoing message (for example via [Message Carbons \(XEP-0280\)](#)¹⁷ or [Message Archive Management \(XEP-0313\)](#)¹⁸) SHOULD NOT mark the chat as displayed. Outgoing messages are neutral towards the overall displayed state of a given chat. For example if the *displayed up to* state references the most recent incoming message and this message is only followed by outgoing messages the overall state of that chat SHOULD be considered *displayed*.
- A client receiving an outgoing message MAY NOT update the displayed node item with that stanza-id. However clients SHOULD be able to handle displayed states that use stanza-ids that refer to outgoing messages and simply consider the chat as displayed up to that point.
- While Displayed Markers ([Displayed Markers \(XEP-0333\)](#)¹⁹), in 1:1 chats, MAY be sent to a full JID, a client combining both <displayed/> elements in a single message MUST address that message to the bare JID, as the server will use the verbatim 'to' attribute as the item ID.

5.2 Server

- The PEP item id (or 'to' attribute when using server-assist) and the stanza-id are opaque values that MAY NOT be validated by the server beyond the requirements of [Publish-Subscribe \(XEP-0060\)](#)²⁰.

¹⁷XEP-0280: Message Carbons <<https://xmpp.org/extensions/xep-0280.html>>.

¹⁸XEP-0313: Message Archive Management <<https://xmpp.org/extensions/xep-0313.html>>.

¹⁹XEP-0333: Displayed Markers <<https://xmpp.org/extensions/xep-0333.html>>.

²⁰XEP-0060: Publish-Subscribe <<https://xmpp.org/extensions/xep-0060.html>>.

- Processing and stripping of the `<displayed/>` element qualified by the `'urn:xmpp:mds:displayed:0'` namespace on the server MUST happen before the message is stored in the archive ([Message Archive Management \(XEP-0313\)](#) ²¹) and before it is reflected back to the sender via [Message Carbons \(XEP-0280\)](#) ²² or [IM Routing-NG \(XEP-0409\)](#) ²³.
- If processing the `<displayed/>` element would implicitly create the PEP node the server MUST ensure that an appropriate node configuration is applied (see the Security Considerations of this specification).

6 Accessibility Considerations

This specification comes with no accessibility considerations that go beyond what is required of any client (i.e. providing an accessible distinction between *read* and *unread* chats).

7 Security Considerations

- When publishing displayed states via [Publish-Subscribe \(XEP-0060\)](#) ²⁴ the client MUST use publish-options to set the access model on the node to *whitelist*. To ensure the server supports publish-options the client MUST first check for the `"http://jabber.org/protocol/pubsub#publish-options"` feature.
- Servers that support the server assist feature MUST strip the `<displayed/>` element in the `"urn:xmpp:mds:displayed:0"` namespace from the message to avoid the stanza-id being leaked to the recipient of that message.
- Clients MUST NOT put the `<displayed/>` into a message to trigger server-assisted displayed synchronization unless the server announces the `"urn:xmpp:mds:server-assist:0"` feature.
- This specification provides a convenient process to synchronize a user's own devices and informing the third party in one, single message. However letting the third party know is not always desirable, for example when the user has generally opted out of transmitting the displayed status or when a non-contact initiated a chat. In those cases the client MUST use the [Publish-Subscribe \(XEP-0060\)](#) ²⁵ method instead of server-assist.

²¹XEP-0313: Message Archive Management <<https://xmpp.org/extensions/xep-0313.html>>.

²²XEP-0280: Message Carbons <<https://xmpp.org/extensions/xep-0280.html>>.

²³XEP-0409: IM Routing-NG <<https://xmpp.org/extensions/xep-0409.html>>.

²⁴XEP-0060: Publish-Subscribe <<https://xmpp.org/extensions/xep-0060.html>>.

²⁵XEP-0060: Publish-Subscribe <<https://xmpp.org/extensions/xep-0060.html>>.

8 Privacy Considerations

Implementing this specification gives the server the opportunity to perform activity tracking of a similar scope than implementing [Chat State Notifications \(XEP-0085\)](#) ²⁶ or [Displayed Markers \(XEP-0333\)](#) ²⁷ would.

When using the server assist feature in conjunction with [Displayed Markers \(XEP-0333\)](#) ²⁸ the Privacy Considerations of *Display Markers* apply.

9 IANA Considerations

This document requires no interaction with the Internet Assigned Numbers Authority (IANA).

10 Design Considerations

10.1 Distinct Element for Server Assist

This specification introduces a distinct element to enable server assist instead of utilizing [Displayed Markers \(XEP-0333\)](#) ²⁹ because Displayed Markers use the message id instead of stanza-ids. Translating between message id and stanza-id would require that the message (or parts of it) are archived on the server. Archiving should not be a requirement to offer server assist. (Especially since archived or not can depend on user settings.)

10.2 Server Assist without Display Markers

Server assist is not allowed in messages that would otherwise be empty. Overloading the semantic of sending a stanza to a third party entity solely to perform an action on the account that involves said third party is a dangerous example to set. (For example if server assist fails due to implementation errors a third party can be flooded with messages.) While stripping elements from stanzas is a common requirement on XMPP dropping entire stanzas without error is not.

11 XMPP Registrar Considerations

This specification defines the following XML namespace:

²⁶XEP-0085: Chat State Notifications <<https://xmpp.org/extensions/xep-0085.html>>.

²⁷XEP-0333: Displayed Markers <<https://xmpp.org/extensions/xep-0333.html>>.

²⁸XEP-0333: Displayed Markers <<https://xmpp.org/extensions/xep-0333.html>>.

²⁹XEP-0333: Displayed Markers <<https://xmpp.org/extensions/xep-0333.html>>.

- urn:xmpp:mds:displayed:0

12 XML Schema

```
<?xml version='1.0' encoding='UTF-8'?>

<xs:schema
  xmlns:xs='http://www.w3.org/2001/XMLSchema'
  xmlns:sid='urn:xmpp:sid:0'
  xmlns='urn:xmpp:mds:displayed:0'
  targetNamespace='urn:xmpp:mds:displayed:0'
  elementFormDefault='qualified'>

  <xs:annotation>
    <xs:documentation>
      The protocol documented by this schema is defined in
      XEP-0490: https://xmpp.org/extensions/xep-0490.html
    </xs:documentation>
  </xs:annotation>

  <xs:import namespace='urn:xmpp:sid:0'
    schemaLocation='xep-0359.xsd' />

  <xs:element name='displayed'>
    <xs:complexType>
      <xs:sequence>
        <xs:element ref='sid:stanza-id' />
      </xs:sequence>
    </xs:complexType>
  </xs:element>

</xs:schema>
```