XMPP Core
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Status of this Memo

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Abstract

This document describes the core features of the eXtensible Messaging
and Presence Protocol (XMPP), which is used by the servers, clients,
and other applications that comprise the Jabber network.

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[1]. Introduction

1.1 Overview

   The eXtensible Messaging and Presence Protocol (XMPP) is an open XML
   [1] protocol for near-real-time messaging and presence. The protocol
   was developed originally within the Jabber community starting in
   1998, and since 2001 has continued to evolve under the auspices of
   the Jabber Software Foundation and now the XMPP WG. Currently, there
   exist multiple implementations of the protocol, mostly offered under
   the name of Jabber. In addition, there are countless deployments of
   these implementations, which provide instant messaging (IM) and
   presence services at and among thousands of domains to a user base
   that is estimated at over one million end users. The current
   document defines the core constituents of XMPP; XMPP IM [2] defines
   the extensions necessary to provide basic instant messaging and
   presence functionality that addresses the requirements defined in RFC
   2779 [3].

1.2 Conventions Used in this Document

   The capitalized 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 RFC
   2119 [4].

1.3 Discussion Venue

   The authors welcome discussion and comments related to the topics
   presented in this document, preferably on the "xmppwg@jabber.org"
   mailing list (archives and subscription information are available at
   http://www.jabber.org/cgi-bin/mailman/listinfo/xmppwg/).

1.4 Intellectual Property Notice

   This document is in full compliance with all provisions of Section 10
   of RFC 2026. Parts of this specification use the term "jabber" for
   identifying namespaces and other protocol syntax. Jabber[tm] is a
   registered trademark of Jabber, Inc. Jabber, Inc. grants permission
   to the IETF for use of the Jabber trademark in association with this
   specification and its successors, if any.

[2](#). **Generalized Architecture**

[2.1](#) **Overview**

   Although XMPP is not wedded to any specific network architecture, to
   this point it has usually been implemented via a typical client-
   server architecture, wherein a client utilizing XMPP accesses a
   server over a TCP [[5](#)] socket.

   The following diagram provides a high-level overview of this
   architecture (where "-" represents communications that use XMPP and
   "=" represents communications that use any other protocol).

   C1 -   S1 - S2 - C3
        / \
   C2 -   G1 = FN1 = FC1

   The symbols are as follows:

   o C1, C2, C3 -- XMPP clients

   o S1, S2 -- XMPP servers

   o G1 -- A gateway that translates between XMPP and the protocol(s)
      used on a foreign messaging network

   o FN1 -- A foreign messaging network

   o FC1 -- A client on a foreign messaging network

[2.2](#) **Server**

   A server acts as an intelligent abstraction layer for XMPP
   communications. Its primary responsibilities are to manage
   connections from or sessions for other entities (in the form of XML
   streams to and from authorized clients and other servers) and to
   route appropriately-addressed XML data "stanzas" among such entities
   over XML streams. Most XMPP-compliant servers also assume
   responsibility for the storage of data that is used by clients (e.g.,
   the contact list for each IM user); in this case, the XML data is
   processed directly by the server itself on behalf of the client and
   is not routed to another entity. Compliant server implementations
   MUST ensure in-order processing of XML stanzas received from
   connected clients, servers, and services.

2.3 Client

   Most clients connect directly to a server over a TCP socket and use
   XMPP to take full advantage of the functionality provided by a server
   and any associated services. (Clients on foreign messaging networks
   may also be part of the architecture, made accessable via a gateway
   to that network.) Multiple resources (e.g., devices or locations) MAY
   connect simultaneously to a server on behalf of each authorized
   client, with each resource connecting over a discrete TCP socket and
   differentiated by the resource identifier of a Jabber ID (Section 3)
   (e.g., user@domain/home vs. user@domain/work). The port assigned by
   the IANA [6] for connections between a Jabber client and a Jabber
   server is 5222. For further details about client-to-server
   communications for the purpose of instant messaging and presence,
   refer to XMPP IM [2].

2.4 Gateway

   A gateway is a special-purpose server-side service whose primary
   function is to translate XMPP into the protocol(s) of another
   messaging system, as well as to translate the return data back into
   XMPP. Examples are gateways to Internet Relay Chat (IRC), Short
   Message Service (SMS), SMTP, and foreign instant messaging networks
   such as Yahoo!, MSN, ICQ, and AIM. Communications between gateways
   and servers, and between gateways and the foreign messaging system,
   are not defined in this document.

2.5 Network

   Because each server is identified by a network address (typically a
   DNS hostname) and because server-to-server communications are a
   simple extension of the client-to-server protocol, in practice the
   system consists of a network of servers that inter-communicate. Thus
   user-a@domain1 is able to exchange messages, presence, and other
   information with user-b@domain2. This pattern is familiar from
   messaging protocols (such as SMTP) that make use of network
   addressing standards. The usual method for providing a connection
   between two servers is to open a TCP socket on the IANA-assigned port
   5269 and to negotiate a connection using the Dialback Protocol
   (Section 5.2) as defined in this document.

[3](). Addressing Scheme

[3.1]() Overview

Any entity that can be considered a network endpoint (i.e., an ID on the network) and that can communicate using XMPP is considered a Jabber Entity. All such entities are uniquely addressable in a form that is consistent with [RFC 2396]() [[7]()]. In particular, a valid Jabber Identifier (JID) contains a set of ordered elements formed of a domain identifier, node identifier, and resource identifier in the following format: [node@]domain[/resource].

All JIDs are based on the foregoing structure. The most common use of this structure is to identify an IM user, the server to which the user connects, and the user's active session or connection (e.g., a specific client) in the form of user@domain/resource. However, node types other than clients are possible; for example, a specific chat room is offered by a multi-user chat service is addressed as room@service, where "room" is the name of the chat room and "service" is the hostname of the multi-user chat service.

[3.2]() Domain Identifier

The domain identifier is the primary identifier and is the only REQUIRED element of a JID (a simple domain identifier is a valid JID). It usually represents the network gateway or "primary" server to which other entities connect for XML routing and data management capabilities. However, the entity referenced by a domain identifier is not always a server, and may be a service that is addressed as a subdomain of a server and that provides functionality above and beyond the capabilities of a server (a multi-user chat service, a user directory, a gateway to a foreign messaging system, etc.).

The domain identifier for every server or service that will communicate over a network SHOULD resolve to a Fully Qualified Domain Name, and a domain identifier SHOULD conform to RRC 952 [[8]()] and REF 1123 [[9]()]. Specifically, a domain identifier is case-insensitive 7-bit ASCII and is limited to 255 bytes.

[3.3]() Node Identifier

The node identifier is an optional secondary identifier. It usually represents the entity requesting and using network access provided by the server or gateway (e.g., a client), although it can also represent other kinds of entities (e.g., a multi-user chat room associated with a multi-user chat service). The entity represented by a node identifier is addressed within the context of a specific domain (e.g., user@domain). Node identifiers are restricted to 256

bytes. A node identifier MAY contain any Unicode character higher
than #x20 with the exception of the following:

o   #x22 (")

o   #x26 (&)

o   #x27 (')

o   #x3A (:)

o   #x3C (<)

o   #x3E (>)

o   #x40 (@)

o   #x7F (del)

o   #xFFFE (BOM)

o   #xFFFF (BOM)

Case is preserved, but comparisons are made in case-normalized
canonical form.

3.4 Resource Identifier

The resource identifer is an optional third identifier. It
represents a specific session, connection (e.g., a device or
location), or object (e.g., a participant in a multi-user chat room)
belonging to the entity associated with a node identifier. An entity
may maintain multiple resources simultaneously. A resource
identifier is restricted to 256 bytes in length. A resource
identifier MAY include any Unicode character greater than #x20,
except #xFFFE and #xFFFF; if the Unicode character is a valid XML
character as defined in Section 2.2 of the XML specification [1], it
MUST be suitably escaped for inclusion within an XML stream.
Resource identifiers are case sensitive.

4. **XML Streams**

4.1 **Overview**

   Two fundamental concepts make possible the rapid, asynchronous
   exchange of relatively small payloads of structured information
   between presence-aware entities: XML streams and, as a result,
   discrete units of structured information that are referred to as "XML
   stanzas". (Note: in this overview we use the example of
   communications between a client and server; however XML streams are
   more generalized and may be used for communications from server to
   server and from service to server as well.)

   In order to connect to a server, a client must initiate an XML stream
   by sending a <stream> tag to the server, optionally preceded by a
   text declaration specifying the XML version supported and the
   character encoding. A compliant entity MUST accept any namespace
   prefix on the <stream/> element; however, for historical reasons some
   entities MAY accept only a 'stream' prefix, resulting in use of a
   <stream:stream/> element. The server SHOULD then reply with a second
   XML stream back to the client, again optionally preceded by a text
   declaration.

   Within the context of an XML stream, a sender is able to send a
   discrete semantic unit of structured information to any recipient.
   This unit of structured information is a well-balanced XML stanza,
   such as a message, presence, or IQ stanza (a stanza of an XML
   document is said to be well-balanced if it matches production [43]
   content of the XML specification [1]). These stanzas exist at the
   direct child level (depth=1) of the root <stream/> element. The
   start of any XML stanza is unambiguously denoted by the element start
   tag at depth=1 (e.g., <presence>), and the end of any XML stanza is
   unambiguously denoted by the corresponding close tag at depth=1
   (e.g., </presence>). Each XML stanza MAY contain child elements or
   CDATA sections as necessary in order to convey the desired
   information from the sender to the recipient. The session is closed
   at the client's request by sending a closing </stream> tag to the
   server.

   Thus a client's session with a server can be seen as two open-ended
   XML documents that are built up through the accumulation of the XML
   stanzas that are sent over the course of the session (one from the
   client to the server and one from the server to the client), and the
   root <stream/> element can be considered the document entity for
   those streams. In essence, then, an XML stream acts as an envelope
   for all the XML stanzas sent during a session. We can represent this
   graphically as follows:

```
|------------------|
| <stream>         |
|------------------|
| <message to=''>  |
|    <body/>       |
| </message>       |
|------------------|
| <presence to=''> |
|    <show/>       |
| </presence>      |
|------------------|
| <iq to=''>       |
|    <query/>      |
| </iq>            |
|------------------|
| </stream>        |
|------------------|
```

4.2 Restrictions

XML streams are used to transport a subset of XML. Specifically, XML
streams SHOULD NOT contain processing instructions, non-predefined
entities (as defined in Section 4.6 of the XML specification [1]),
comments, or DTDs. Any such XML data SHOULD be ignored.

4.3 Stream Attributes

The attributes of the stream element are as follows (we now
generalize the endpoints by using the terms "initiating entity" and
"receiving entity"):

o to -- The 'to' attribute SHOULD be used only in the XML stream
   from the initiating entity to the receiving entity, and MUST be
   set to the JID of the receiving entity. There SHOULD be no 'to'
   attribute set in the XML stream by which the receiving entity
   replies to the initiating entity; however, if a 'to' attribute is
   included, it SHOULD be ignored by the receiving entity.

o from -- The 'from' attribute SHOULD be used only in the XML stream
   from the receiving entity to the initiating entity, and MUST be
   set to the JID of the receiving entity granting access to the
   initiating entity. There SHOULD be no 'from' attribute on the XML
   stream sent from the initiating entity to the receiving entity;
   however, if a 'from' attribute is included, it SHOULD be ignored
   by the receiving entity.

o id -- The 'id' attribute SHOULD be used only in the XML stream

from the receiving entity to the initiating entity. This
attribute is a unique identifier created by the receiving entity
to function as a session key for the initiating entity's session
with the receiving entity. There SHOULD be no 'id' attribute on
the XML stream sent from the initiating entity to the receiving
entity; however, if an 'id' attribute is included, it SHOULD be
ignored by the receiving entity. The 'id' attribute is of type ID
as defined in section 3.3.1 of the XML specification [1] and
therefore MUST match the Name production as defined in section 2.3
of the XML specification [1]. Validity contraints on names within
XML documents (but not XML streams) are defined in the XML
specification [1]; however, because the stream in one direction
can be seen as a document that is built up over the length of a
session, at a minimum the value of an 'id' attribute MUST be
unique within that stream.

o   version -- The 'version' attribute MAY be used in the XML stream
from the initiating entity to the receiving entity in order signal
compliance with the protocol defined herein; this is done by
setting the value of the attribute to "1.0". If the initiating
entity includes the version attribute, the receiving entity MUST
reciprocate by including the attribute in its response (if the
receiving entity supports XMPP 1.0).

We can summarize these values as follows:

```
        | initiating to receiving  | receiving to initiating
------------------------------------------------------------
to      | JID of receiver          | ignored
from    | ignored                  | JID of receiver
id      | ignored                  | session key
version | signals XMPP 1.0 support | signals XMPP 1.0 support
```

4.4 Namespace Declarations

The stream element MAY also contain namespace declarations as defined
in the XML namespaces specification [11].

A stream namespace declaration is REQUIRED in both XML streams. A
compliant entity MUST accept any namespace prefix on the
element; however, for historical reasons some entities MAY accept
only a 'stream' prefix, resulting in use of a <stream:stream/>
element as the stream root. The value of the stream namespace MUST
be "http://etherx.jabber.org/streams".

A default namespace declaration ('xmlns') is REQUIRED and is used in
both XML streams in order to scope the allowable first-level children

of the root stream element for both streams. This namespace
declaration MUST be the same for the initiating stream and the
responding stream so that both streams are scoped consistently. The
default namespace declaration applies to the stream and all stanzas
sent within a stream.

XML streams function as containers for any XML stanzas sent
asynchronously between network endpoints. It should be possible to
scope an XML stream with any default namespace declaration, i.e., it
should be possible to send any properly-namespaced XML stanza over an
XML stream. A compliant implementation MUST support the following
two namespaces (for historical reasons, existing implementations MAY
support only these two default namespaces):

o jabber:client -- this default namespace is declared when the
   stream is used for communications between a client and a server

o jabber:server -- this default namespace is declared when the
   stream is used for communications between two servers

The jabber:client and jabber:server namespaces are nearly identical
but are used in different contexts (client-to-server communications
for jabber:client and server-to-server communications for
jabber:server). The only difference between the two is that the 'to'
and 'from' attributes are OPTIONAL on stanzas sent within
jabber:client, whereas they are REQUIRED on stanzas sent within
jabber:server. If a compliant implementation accepts a stream that
is scoped by the 'jabber:client' or 'jabber:server' namespace, it
MUST support all three core stanza types (message, presence, and IQ)
as described herein and defined in the DTD and schema.

4.5 Stream Features

The root stream element MAY contain a features child element (e.g.,
<stream:features/> if the stream namespace prefix is 'stream'). This
is used to communicate generic stream-level capabilities including
stream-level features that can be negotiated as the streams are set
up. If the initiating entity sends a "version='1.0'" attribute in
its initiating stream element, the receiving entity MUST send a
features child element to the initiating entity if there are any
capabilities that need to be advertised or features that can be
negotiated for the stream. Currently this is used for SASL and TLS
negotiation only, but it could be used for other negotiable features
in the future. Examples are shown under Stream Authentication
(Section 5) below.

4.6 **Stream Errors**

The root stream element MAY contain an error child element (e.g.,
<stream:error/> if the stream namespace prefix is 'stream'). The
error child SHOULD be sent by a Jabber entity (usually a server
rather than a client) if it perceives that a stream-level error has
occurred. Examples include the sending of invalid XML, the shutdown
of a server, an internal server error such as the shutdown of a
session manager, and an attempt by a client to authenticate as the
same resource that is currently connected. If an error occurs at the
level of the stream, the entity (initiating entity or receiving
entity) that detects the error SHOULD send a stream error to the
other entity specifying why the streams are being closed and then
send a closing </stream> tag. XML of the following form is sent
within the context of an existing stream:

```
<stream:stream ...>
...
<stream:error>
  Error message (e.g., "Invalid XML")
</stream:error>
</stream:stream>
```

4.7 **Simple Streams Example**

The following is a simple stream-based session of a client on a
server (where the "C" lines are sent from the client to the server,
and the "S" lines are sent from the server to the client):

A simple session:

```
C: <?xml version='1.0'?>
   <stream:stream
       to='server'
       xmlns='jabber:client'
       xmlns:stream='http://etherx.jabber.org/streams'
       version='1.0'>
S: <?xml version='1.0'?>
   <stream:stream
       from='server'
       id='id_123456789'
       xmlns='jabber:client'
       xmlns:stream='http://etherx.jabber.org/streams'
       version='1.0'>
... authentication ...
C:   <message from='me@mydomain' to='you@yourdomain'>
C:     <body>Watson come here, I need you!</body>
C:   </message>
S:   <message from='you@yourdomain' to='me@mydomain'>
S:     <body>I'm on my way!</body>
S:   </message>
C: </stream:stream>
S: </stream:stream>
```

These are in actuality a sending stream and a receiving stream, which
can be viewed a-chronologically as two XML documents:

```
C: <?xml version='1.0'?>
   <stream:stream
       to='server'
       xmlns='jabber:client'
       xmlns:stream='http://etherx.jabber.org/streams'
       version='1.0'>
C:    <message from='me@mydomain' to='you@yourdomain'>
C:       <body>Watson come here, I need you!</body>
C:    </message>
C: </stream:stream>

S: <?xml version='1.0'?>
   <stream:stream
       from='server'
       id='id_123456789'
       xmlns='jabber:client'
       xmlns:stream='http://etherx.jabber.org/streams'
       version='1.0'>
S:    <message from='you@yourdomain' to='me@mydomain'>
S:       <body>I'm on my way!</body>
S:    </message>
S: </stream:stream>

A session gone bad:

C: <?xml version='1.0'?>
   <stream:stream
       to='server'
       xmlns='jabber:client'
       xmlns:stream='http://etherx.jabber.org/streams'
       version='1.0'>
S: <?xml version='1.0'?>
   <stream:stream
       from='server'
       id='id_123456789'
       xmlns='jabber:client'
       xmlns:stream='http://etherx.jabber.org/streams'
       version='1.0'>
C: <message><body>Bad XML, no closing body tag!</message>
S: <stream:error>Invalid XML</stream:error>
S: </stream:stream>
```

5. Stream Authentication

   XMPP includes two methods for enforcing authentication at the level
   of XML streams. When one entity is already known to another (i.e.,
   there is an existing trust relationship between the entities such as
   that established when a user registers with a server or an
   administrator configures a server to trust a service), the preferred
   method for authenticating streams between the two entities uses an
   XMPP adaptation of the Simple Authentication and Security Layer
   (SASL) [10]. When there is no existing trust relationship between
   the two entities, such trust MAY be established based on existing
   trust in DNS; the authentication method used when two such entities
   are servers is the server dialback protocol that is native to XMPP.
   Both of these methods are described in this section.

5.1 SASL Authentication

5.1.1 Overview

   The Simple Authentication and Security Layer (SASL) provides a
   generalized method for adding authentication support to connection-
   based protocols. XMPP uses a generic XML namespace profile for SASL
   that conforms to section 4 ("Profiling Requirements") of RFC 2222
   [10] (the namespace identifier for this protocol is http://
   www.iana.org/assignments/sasl-mechanisms). If an entity (client,
   server, or service) is capable of authenticating by means of SASL, it
   MUST include the agreed-upon SASL namespace within the opening root
   stream tag it uses to initiate communications.

   The following example shows the use of SASL in client authentication
   with a server, for which the steps involved are as follows:

   1. The client requests SASL authentication by including the
       appropriate namespace declaration (xmlns:sasl='http://
       www.iana.org/assignments/sasl-mechanisms') in the opening XML
       stream header sent to the server.

   2. The server includes the xmlns:sasl namespace declaration in the
       XML stream header sent in reply to the client.

   3. The server responds with a list of available SASL authentication
       mechanisms, each of which is a <mechanism/> element included as a
       child within a <mechanisms/> container element that is sent as a
       first-level child of the root <stream/> element.

   4. The client selects a mechanism by sending a <sasl:auth/> element
       to the server; this element MAY optionally contain character
       data.

5. If necessary, the server challenges the client by sending a
    <sasl:challenge/> element to the client; this element MAY
    optionally contain character data.

6. The client responds to challenge by sending a <sasl:response/>
    element to the server; this element MAY optionally contain
    character data.

7. If necessary, the server sends more challenges and the client
    sends more responses.

This series of challenge/response pairs continues until one of three
things happens:

o   The client aborts the handshake by sending a <sasl:abort/> element
    to the server.

o   The server reports failure by sending a <sasl:failure/> element to
    the client.

o   The server reports success by sending a <sasl:success/> element to
    the client; this element MAY optionally contain character data.

Any character data contained within these elements MUST be encoded
using base64.

5.1.2 Example

The following example shows the data flow for a client authenticating
with a server using SASL.

Step 1: Client initiates stream to server:

```
<stream:stream
    xmlns='jabber:client'
    xmlns:stream='http://etherx.jabber.org/streams'
    to='capulet.com'
    version='1.0'>
```

Step 2: Server responds with a stream tag sent to the client:

```
<stream:stream
    xmlns='jabber:client'
    xmlns:stream='http://etherx.jabber.org/streams'
    id='12345678'
    version='1.0'>
```

Step 3: Server informs client of available authentication mechanisms:

```
<stream:features>
  <mechanisms xmlns='http://www.iana.org/assignments/sasl-mechanisms'>
    <mechanism>DIGEST-MD5</mechanism>
    <mechanism>PLAIN</mechanism>
  </mechanisms>
</stream:features>
```

Step 4: Client selects an authentication mechanism:

```
<auth
    xmlns='http://www.iana.org/assignments/sasl-mechanisms'
    mechanism='DIGEST-MD5'/>
```

Step 5: Server sends a challenge to the client:

```
<challenge xmlns='http://www.iana.org/assignments/sasl-mechanisms'>
    cmVhbG09ImNhdGFjbHlzbS5jeCIsbm9uY2U9Ik9BNk1HOXRFUUdtMmhoIi
    xxb3A9ImF1dGgiLGNoYXJzZXQ9dXRmLTgsYWxnb3JpdGhtPW1kNS1zZXNz
</challenge>
```

Step 6: Client responds to the challenge:

```
<response xmlns='http://www.iana.org/assignments/sasl-mechanisms'>
    dXNlcm5hbWU9InJvYiIscmVhbG09ImNhdGFjbHlzbS5jeCIsbm9uY2U9Ik
    9BNk1HOXRFUUdtMmhoIixjbm9uY2U9Ik9BNk1IWGg2VnFUclJrIixuYz0w
    MDAwMDAwMSxxb3A9YXV0aCxkaWdlc3QtdXJpPSJqYWJiZXIvY2F0YWNseX
    NtLmN4IixyZXNwb25zZT1kMzg4ZGFkOTBkNGJiZDc2MGExNTIzMjFmMjE0
    M2FmNyxjaGFyc2V0PXV0Zi04
</response>
```

Step 7: Server sends another challenge to the client:

```
<challenge xmlns='http://www.iana.org/assignments/sasl-mechanisms'>
    cnNwYXV0aD1lYTQwZjYwMzM1YzQyN2I1NTI3Yjg0ZGJhYmNkZmZmZA==
</challenge>
```

Step 8: Client responds to the challenge:

```
<response xmlns='http://www.iana.org/assignments/sasl-mechanisms'/>
```

Step 9: Server informs client of successful authentication:

```
<success xmlns='http://www.iana.org/assignments/sasl-mechanisms'/>
```

Step 9 (alt): Server informs client of failed authentication:

```
<failure xmlns='http://www.iana.org/assignments/sasl-mechanisms'/>
```

5.2 Dialback Authentication

XMPP includes a protocol-level method for verifying that a connection
between two servers can be trusted to some degree. The method is
called dialback and is used only within XML streams that are declared
under the "jabber:server" namespace.

The purpose of the dialback protocol is to make server spoofing more
difficult, and thus to make it more difficult to forge XML stanzas.
Dialback is not intended as a mechanism for securing or encrypting
the streams between servers, only for helping to prevent the spoofing
of a server and the sending of false data from it. Dialback is made
possible by the existence of DNS, since one server can verify that
another server which is connecting to it is authorized to represent a
given server on the Jabber network. All DNS hostname resolutions
MUST first resolve the hostname using an SRV [13] record of
_jabber._tcp.server. If the SRV lookup fails, the fallback is a
normal A lookup to determine the IP address, using the jabber-server
port of 5269 assigned by the Internet Assigned Numbers Authority [6].

Note that the method used to generate and verify the keys used in the
dialback protocol MUST take into account the hostnames being used,
along with a secret known only by the receiving server and the random
id per stream. Generating unique but verifiable keys is important to
prevent common man-in-the-middle attacks and server spoofing.

In the description that follows we use the following terminology:

o Originating Server -- the server that is attempting to establish a
   connection between the two servers

o Receiving Server -- the server that is trying to authenticate that
   the Originating Server represents the Jabber server which it
   claims to be

   o Authoritative Server -- the server which is given when a DNS
      lookup is performed on the name that the Originating Server
      initially gave; for simple environments this will be the
      Originating Server, but it could be a separate machine in the
      Originating Server's network

   The following is a brief summary of the order of events in dialback:

   1. Originating Server establishes a connection to Receiving Server.

   2. Originating Server sends a 'key' value over the connection to
       Receiving Server.

   3. Receiving Server establishes a connection to Authoritative
       Server.

   4. Receiving Server sends the same 'key' value to Authoritative
       Server.

   5. Authoritative Server replies that key is valid or invalid.

   6. Receiving Server tells Originating Server whether it is
       authenticated or not.

   We can represent this flow of events graphically as follows:

```
      Originating                 Receiving
         Server                     Server
      -----------                 ---------
           |                          |
           |   establish connection   |
           | ---------------------->  |
           |                          |
           |     send stream header   |
           | ---------------------->  |
           |                          |
           |   establish connection   |
           | <---------------------   |
           |                          |
           |     send stream header   |
           | <---------------------   |
           |                          |                  Authoritative
           |                          |                      Server
           |     send dialback key    |                  ------------
           | ---------------------->  |                      |
           |                          |                      |
           |                          |   establish connection   |
           |                          | ---------------------->  |
           |                          |                      |
           |                          |     send stream header   |
           |                          | ---------------------->  |
           |                          |                      |
           |                          |     send stream header   |
           |                          | <---------------------   |
           |                          |                      |
           |                          |     send dialback key    |
           |                          | ---------------------->  |
           |                          |                      |
           |                          |   validate dialback key  |
           |                          | <---------------------   |
           |                          |
           |   report dialback result |
           | <---------------------   |
           |                          |
```
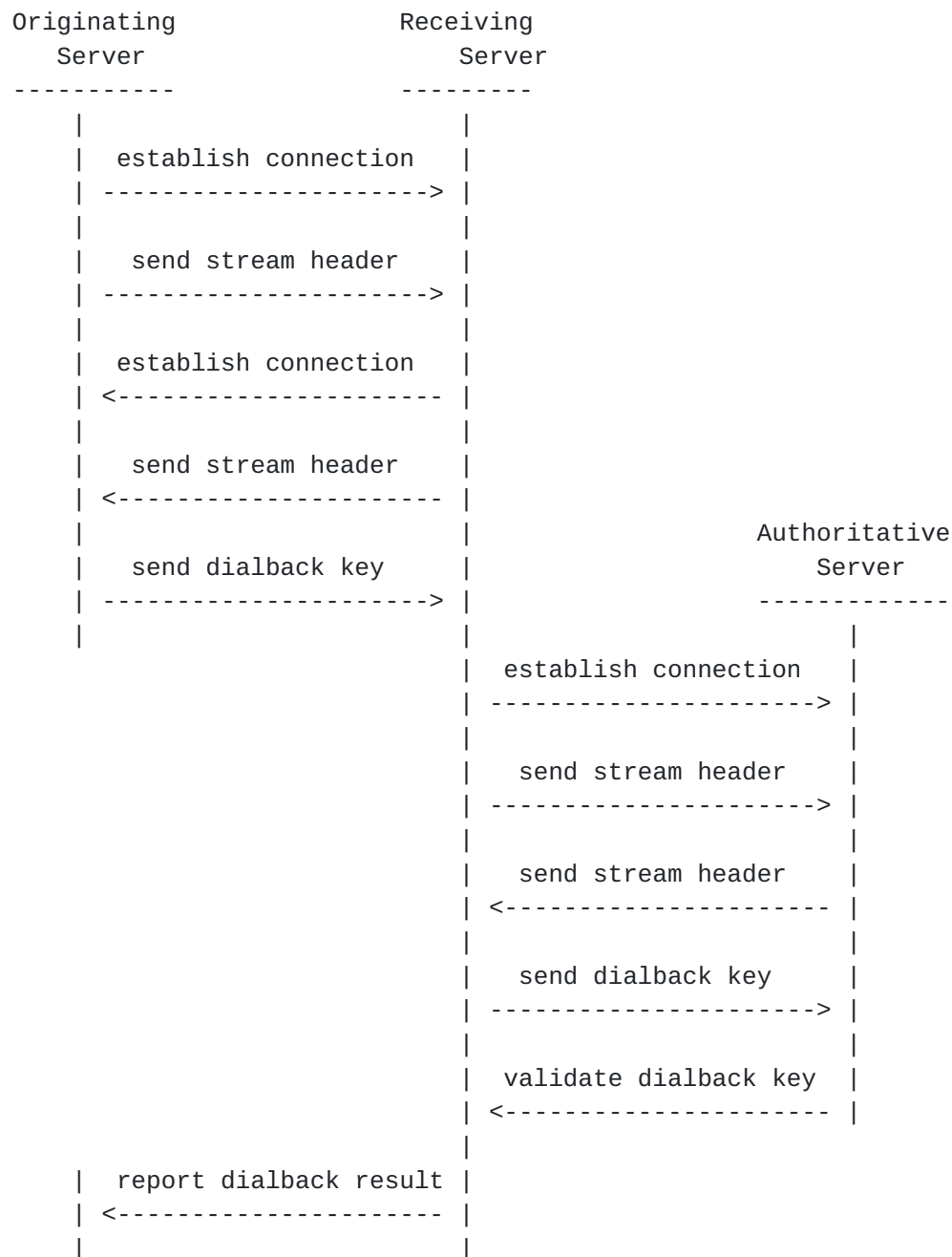
5.2.1 Dialback Protocol

The traffic sent between the servers is as follows:

1.   Originating Server establishes connection to Receiving Server

2.   Originating Server sends a stream header to Receiving Server
     (the 'to' and 'from' attributes are NOT REQUIRED on the root
     stream element):

```
<stream:stream
    xmlns:stream='http://etherx.jabber.org/streams'
    xmlns='jabber:server'
    xmlns:db='jabber:server:dialback'>
```

       Note: the value of the xmlns:db namespace declaration indicates
       to Receiving Server that the Originating Server supports
       dialback.

   3.   Receiving Server sends a stream header back to Originating
        Server (the 'to' and 'from' attributes are NOT REQUIRED on the
        root stream element):

```
<stream:stream
    xmlns:stream='http://etherx.jabber.org/streams'
    xmlns='jabber:server'
    xmlns:db='jabber:server:dialback'
    id='457F9224A0...'>
```

   4.   Originating Server sends a dialback key to Receiving Server:

```
<db:result
    to='Receiving Server'
    from='Originating Server'>
  98AF014EDC0...
</db:result>
```

       Note: this key is not examined by Receiving Server, since the
       Receiving Server does not keep information about Originating
       Server between sessions.

   5.   Receiving Server now establishes a connection back to
        Originating Server, getting the Authoritative Server.

   6.   Receiving Server sends Authoritative Server a stream header (the
        'to' and 'from' attributes are NOT REQUIRED on the root stream
        element):

```
<stream:stream
    xmlns:stream='http://etherx.jabber.org/streams'
    xmlns='jabber:server'
    xmlns:db='jabber:server:dialback'>
```

   7.   Authoritative Server sends Receiving Server a stream header:

```
<stream:stream
    xmlns:stream='http://etherx.jabber.org/streams'
    xmlns='jabber:server'
    xmlns:db='jabber:server:dialback'
    id='1251A342B...'>
```

8.   Receiving Server sends Authoritative Server a stanza indicating
     it wants Authoritative Server to verify a key:

```
<db:verify
    from='Receiving Server'
    to='Originating Server'
    id='457F9224A0...'>
  98AF014EDC0...
</db:verify>
```

         Note: passed here are the hostnames, the original identifier
         from Receiving Server's stream header to Originating Server in
         step 2, and the key Originating Server gave Receiving Server in
         step 3. Based on this information and shared secret information
         within the 'Originating Server' network, the key is verified.
         Any verifiable method can be used to generate the key.

9.   Authoritative Server sends a stanza back to Receiving Server
     verifying whether the key was valid or invalid:

```
<db:verify
    from='Originating Server'
    to='Receiving Server'
    type='valid'
    id='457F9224A0...'/>
```

           or

```
<db:verify
    from='Originating Server'
    to='Receiving Server'
    type='invalid'
    id='457F9224A0...'/>
```

10. Receiving Server informs Originating Server of the result:

```
<db:result
    from='Receiving Server'
    to='Originating Server'
    type='valid'/>
```

    Note: At this point the connection has either been validated via
    a type='valid', or reported as invalid. Once the connection is
    validated, data can be sent by the Originating Server and read
    by the Receiving Server; before that, all data stanzas sent to
    Receiving Server SHOULD be dropped. As a final guard against
    domain spoofing, the Receiving Server MUST verify that all XML
    stanzas received from the Originating Server include a 'from'
    attribute and that the value of that attribute includes the
    validated domain. In addition, all XML stanzas MUST include a
    'to' attribute.

6. **XML Stanzas**

6.1 Overview

   There are three core data elements for XMPP communications:, , and . These elements are sent as direct
   (depth=1) children of the root element and are scoped by
   one of the default namespaces identified in Section 4.4. Any such
   direct child element of the root stream element is called an "XML
   stanza".

6.2 Common Attributes

   Four attributes are common to message, presence, and IQ stanzas.
   These are defined below.

6.2.1 to

   The 'to' attribute specifies the JID of the intended recipient for
   the stanza. In the 'jabber:client' namespace, a stanza SHOULD
   possess a 'to' attribute, although a stanza sent from a client to a
   server for handling by that server (e.g., presence sent to the server
   for broadcasting to other entities) MAY legitimately lack a 'to'
   attribute. In the 'jabber:server' namespace, a stanza MUST possess a
   'to' attribute.

6.2.2 from

   The 'from' attribute specifies the JID of the sender.

   In the 'jabber:client' namespace, a client MUST NOT include a 'from'
   attribute on the stanzas it sends to a server; if a server receives a
   stanza from a client and the stanza possesses a 'from' attribute, it
   MUST ignore the value of the 'from' attribute. In addition, a server
   MUST stamp stanzas received from a client with the user@domain/
   resource (full JID) of the connected resource that generated the
   stanza. In the 'jabber:server' namespace, a stanza MUST possess a
   'from' attribute.

   A server MUST include a 'from' attribute on stanzas it routes to
   other servers. The domain identifier of the JID contained in the
   'from' attribute MUST match the hostname of the server as
   communicated in the dialback negotiation (or a subdomain thereof).

6.2.3 id

   The optional 'id' attribute MAY be used to track stanzas sent and
   received. The 'id' attribute is generated by the sender. An 'id'

attribute included in an IQ request of type "get" or "set" SHOULD be
returned to the sender in any IQ response of type "result" or "error"
generated by the recipient of the request. A recipient of a message
or presence stanza MAY return that 'id' in any replies, but is NOT
REQUIRED to do so.

The 'id' attribute is of type ID as defined in section 3.3.1 of the
XML specification [1] and therefore MUST match the Name production as
defined in section 2.3 of the XML specification [1]. Validity
constraints on names within XML documents (but not XML streams) are
defined in the XML specification [1]; however, because the stream in
one direction can be seen as a document that is built up over the
length of a session, at a minimum the value of an 'id' attribute MUST
be unique within that stream.

6.2.4 type

The 'type' attribute specifies detailed information about the purpose
or context of the message, presence, or IQ stanza. The particular
allowable values for the 'type' attribute vary depending on whether
the stanza is a message, presence, or IQ, and thus are specified in
the following sections.

6.2.5 xml:lang

Any message or presence stanza MAY possess an 'xml:lang' attribute
specifying the default language of any CDATA sections of the stanza
or its child elements. An IQ stanza SHOULD NOT possess an 'xml:lang'
attribute, since it is merely a vessel for data in other namespaces
and does not itself contain children that have CDATA. The value of
the 'xml:lang' attribute MUST be a NMTOKEN and MUST conform to the
format defined in RFC 3066 [12].

6.3 Message Stanzas

Message stanzas in the 'jabber:client' or 'jabber:server' namespace
are used to "push" information to another entity. Common uses in the
context of instant messaging include single messages, messages sent
in the context of a chat conversation, messages sent in the context
of a multi-user chat room, headlines, and errors. These messages
types are identified more fully below.

6.3.1 Types of Message

The 'type' attribute of a message stanza is optional and specifies
the conversational context of the message. The sending of a message
stanza without a 'type' attribute signals that the message stanza is
a single message. However, the 'type' attribute MAY also have one of

the following values:

o chat -- The message is sent in the context of a one-to-one chat
   conversation.

o groupchat -- The message is sent in the context of a multi-user
   chat environment.

o headline -- The message is generated by an automated service that
   delivers content (news, sports, market information, etc.).

o error - A message returned to a sender specifying an error
   associated with a previous message sent by the sender (for a full
   list of error messages, see error codes (Appendix A))

For detailed information about these message types, refer to XMPP IM
[2].

6.3.2 Children

If a message stanza in the 'jabber:client' or 'jabber:server'
namespace has no 'type' attribute or has a 'type' attribute with a
value of "chat", "groupchat", or "headline", it MAY contain any of
the following child elements (which MUST NOT contain mixed content):

o body -- The textual contents of the message; normally included but
   NOT REQUIRED. The <body/> element MUST NOT possess any
   attributes, with the exception of the 'xml:lang' attribute.
   Multiple instances of the <body/> element MAY be included but only
   if each instance possesses an 'xml:lang' attribute with a distinct
   language value.

o subject -- The subject of the message. The <subject/> element
   MUST NOT possess any attributes, with the exception of the
   'xml:lang' attribute. Multiple instances of the
   element MAY be included but only if each instance possesses an
   'xml:lang' attribute with a distinct language value.

o thread -- A random string that is generated by the sender and that
   MAY be copied back in replies; it is used for tracking a
   conversation thread between two entities. If used, it MUST be
   unique to that conversation thread within the stream and MUST be
   consistent throughout that conversation. Only one
   element MAY be included in a message stanza, and it MUST NOT
   possess any attributes.

If the message stanza is of type "error", it MUST include an
child, which in turn MUST possess a 'code' attribute corresponding to

one of the standard error codes (Appendix A), MAY possess an
'xml:lang' attribute, and MAY also contain PCDATA corresponding to a
natural-language description of the error. An <error/> child MUST
NOT be included if the stanza type is anything other than "error".

As described under extended namespaces (Section 6.6), a message
stanza MAY also contain any properly-namespaced child element (other
than the core data elements, stream elements, or defined children
thereof).

6.4 Presence Stanzas

Presence stanzas are used in the 'jabber:client' or 'jabber:server'
namespace to express an entity's current availability status (offline
or online, along with various sub-states of the latter) and to
communicate that status to other entities. They are also used to
negotiate and manage subscriptions to the presence of other entities.

6.4.1 Types of Presence

The 'type' attribute of a presence stanza is optional. A presence
stanza that does not have a 'type' attribute is used to signal that
the sender is online and available for communication. If included,
the 'type' attribute specifies the availability state of the sender,
a request to manage a subscription to another entity's presence, a
request for another entity's current presence, or an error related to
a previously-sent presence stanza. The 'type' attribute MAY have one
of the following values:

o unavailable -- Signals that the entity is no longer available for
   communication.

o subscribe -- The sender wishes to subscribe to the recipient's
   presence.

o subscribed -- The sender has allowed the recipient to receive
   their presence.

o unsubscribe -- A notification that an entity is unsubscribing from
   another entity's presence.

o unsubscribed -- The subscription request has been denied or a
   previously-granted subscription has been cancelled.

o probe -- A request for an entity's current presence.

o error -- An error has occurred regarding processing or delivery of
   a previously-sent presence stanza.

Information about the subscription model used within XMPP can be
found in XMPP IM [2].

6.4.2 **Children**

If a presence stanza possesses no 'type' attribute, it MAY contain
any of the following child elements (note that the <status/> child
MAY be sent in a presence stanza of type "unavailable" or, for
historical reasons, "subscribe"):

o show -- Describes the availability status of an entity or specific
   resource. Only one <show/> element MAY be included in a presence
   stanza, and it MUST NOT possess any attributes. The value SHOULD
   be one of the following (values other than these four MAY be
   ignored; additional availability types could be defined through a
   properly-namespaced child element of the presence stanza):

   * away -- The entity or resource is temporarily away.

   * chat -- The entity or resource is actively interested in
      chatting.

   * xa -- The entity or resource is away for an extended period (xa
      = "eXtended Away").

   * dnd -- The entity or resource is busy (dnd = "Do Not Disturb").

o status -- An optional natural-language description of availability
   status. Normally used in conjunction with the show element to
   provide a detailed description of an availability state (e.g., "In
   a meeting"). The <status/> element MUST NOT possess any
   attributes, with the exception of the 'xml:lang' attribute.
   Multiple instances of the <status/> element MAY be included but
   only if each instance possesses an 'xml:lang' attribute with a
   distinct language value.

o priority -- A non-negative integer representing the priority level
   of the connected resource, with zero as the lowest priority. Only
   one <priority/> element MAY be included in a presence stanza, and
   it MUST NOT possess any attributes.

If the presence stanza is of type "error", it MUST include anchild, which in turn MUST possess a 'code' attribute corresponding
to one of the standard error codes (Appendix A) and MAY contain
PCDATA corresponding to a natural-language description of the error.
An child MUST NOT be included if the stanza type is anything
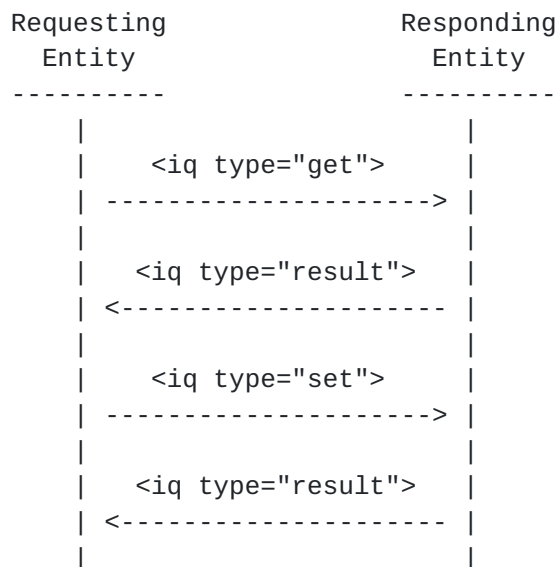other than "error".

As described under extended namespaces (Section 6.6), a presence
stanza MAY also contain any properly-namespaced child element (other
than the core data elements, stream elements, or defined children
thereof).

6.5 IQ Stanzas

6.5.1 Overview

Info/Query, or IQ, is a simple request-response mechanism. Just as
HTTP is a request-response medium, IQ stanzas in the 'jabber:client'
or 'jabber:server' namespace enable an entity to make a request of,
and receive a response from, another entity. The data content of the
request and response is defined by the namespace declaration of a
direct child element of the iq element.

Most IQ interactions follow a common pattern of structured data
exchange such as get/result or set/result:

```
Requesting                  Responding
  Entity                      Entity
----------                  ----------
    |                           |
    |      <iq type="get">      |
    | --------------------> |
    |                           |
    |     <iq type="result">    |
    | <-------------------- |
    |                           |
    |      <iq type="set">      |
    | --------------------> |
    |                           |
    |     <iq type="result">    |
    | <-------------------- |
    |                           |
```

An entity that receives a request of type 'get' or 'set' MUST reply
with a response of type 'result' or 'error'.

6.5.2 Types of IQ

The 'type' attribute of an IQ stanza is REQUIRED. The 'type'
attribute specifies a distinct step within a request-response
interaction. The value SHOULD be one of the following (all other
values MAY be ignored):

o get -- The stanza is a request for information.

   o set -- The stanza provides required data, sets new values, or
      replaces existing values.

   o result -- The stanza is a response to a successful get or set
      request.

   o error -- An error has occurred regarding processing or delivery of
      a previously-sent get or set.

6.5.3 Children

   An IQ stanza contains no children in the 'jabber:client' or
   'jabber:server' namespace since it is a vessel for XML in another
   namespace. As described under extended namespaces (Section 6.6), an
   IQ stanza MAY contain any properly-namespaced child element (other
   than the core data elements, stream elements, or defined children
   thereof).

   If the IQ stanza is of type "error", it MUST include an
   child, which in turn MUST possess a 'code' attribute corresponding to
   one of the standard error codes (Appendix A) and MAY contain PCDATA
   corresponding to a natural-language description of the error. An
   child MUST NOT be included if the stanza type is anything
   other than "error".

6.6 Extended Namespaces

   While the core data elements defined in this document provide a basic
   level of functionality for messaging and presence, XMPP uses XML
   namespaces to extend the core data elements for the purpose of
   providing additional functionality. Thus a message, presence, or IQ
   stanza MAY house one or more optional child elements containing
   content that extends the meaning of the message (e.g., an encrypted
   form of the message body). This child element MAY be any element
   (other than the core data elements, stream elements, or defined
   children thereof). The child element MUST possess an 'xmlns'
   namespace declaration (other than the stream namespace and the
   default namespace) that defines all data contained within the child
   element.

   Support for any given extended namespace is OPTIONAL on the part of
   any implementation. If an entity does not understand such a
   namespace, it MUST ignore the associated XML data. If an entity
   receives an IQ stanza in a namespace it does not understand, the
   entity SHOULD return an IQ stanza of type "error" with an error
   element of code 400 (bad request). If an entity receives a message
   or presence stanza that contains XML data in an extended namespace it

does not understand, the portion of the stanza that is in the unknown
namespace SHOULD be ignored. If an entity receives a message stanza
without a <body/> element but containing only a child element bound
by a namespace it does not understand, it MUST ignore that stanza.

7. XML Usage within XMPP

7.1 Overview

   In essence, XMPP core consists of three interrelated parts:

   1. XML streams (Section 4), which provide a stateful means for
       transporting data in an asynchronous manner from one entity to
       another

   2. stream authentication using SASL authentication (Section 5.1) or
       the dialback protocol (Section 5.2)

   3. core data elements (Section 6) (message, presence, and iq), which
       provide a framework for communications between entities

   XML [1] is used to define each of these protocols, as described in
   detail in the following sections.

   In addition, XMPP contains protocol extensions (such as extended
   namespaces) that address the specific functionality required to
   create a basic instant messaging and presence application; these non-
   core protocol extensions are defined in XMPP IM [2].

7.2 Namespaces

   XML Namespaces [11] are used within all XMPP-compliant XML to create
   strict boundaries of data ownership. The basic function of
   namespaces is to separate different vocabularies of XML elements that
   are structurally mixed together. Ensuring that XMPP-compliant XML is
   namespace-aware enables any XML to be structurally mixed with any
   data element within XMPP. Mainly for historical reasons, the default
   namespace for XMPP data stanzas MUST be one of the namespaces
   identified in Section 4.4.

   Additionally, XMPP is more strict about namespace prefixes than the
   XML namespace specification requires.

7.3 Validation

   A server is not responsible for validating the XML elements forwarded
   to a client; an implementation MAY choose to provide only validated
   data elements but is NOT REQUIRED to do so. Clients SHOULD NOT rely
   on the ability to send data which does not conform to the schemas,
   and SHOULD ignore any non-conformant elements or attributes on the
   incoming XML stream. Validation of XML streams and stanzas is NOT
   REQUIRED or recommended, and DTDs and schemas are included herein for
   descriptive purposes only.

[7.4](#) Character Encodings

Software implementing XML streams MUST support the UTF-8 and UTF-16
encodings for received data. Software MUST NOT attempt to use any
other encoding for transmitted data. The encodings of the transmit
and receive streams are independent. Software MAY select either UTF-
8 or UTF-16 for the transmitted stream, and SHOULD deduce the
encoding of the received stream as described in the XML specification
[[1](#)].

[7.5](#) Inclusion of Text Declaration

An application MAY send a text declaration. Applications MUST follow
the rules in the XML specification [[1](#)] concerning the circumstances
in which a text declaration is included.

8. IANA Considerations

The IANA registers "jabber-client" and "jabber-server" as GSS-API
[15] service names, as specified in Section 6.1.1; these service
names are associated with TCP ports 5222 and 5269 respectively.

9. Internationalization Considerations

o If a client sends an xml:lang attribute on a stanza, the server
   MUST NOT modify or delete it.

10. Security Considerations

10.1 Client-to-Server Communications

   The SASL protocol for authenticating XML streams negotiated between a
   client and a server (defined under Section 5.1 above) provides a
   reliable mechanism for validating that a client connecting to a
   server is who it claims to be.

   The IP address and method of access of clients MUST NOT be made
   available by a server, nor are any connections other than the
   original server connection required. This helps protect the client's
   server from direct attack or identification by third parties.

   End-to-end encryption of message bodies and presence status
   information MAY be effected through use of OpenPGP [14].

10.2 Server-to-Server Communications

   It is OPTIONAL for any given server to communicate with other
   servers, and server-to-server communications MAY be disabled by the
   administrator of any given deployment.

   If two servers would like to enable communications between
   themselves, they MUST form a relationship of trust at some level,
   either based on trust in DNS or based on a pre-existing trust
   relationship (e.g., through exchange of certificates). If two
   servers have a pre-existing trust relationship, they MAY use SASL
   Authentication (Section 5.1) for the purpose of authenticating each
   other. If they do not have a pre-existing relationship, they MUST
   use the Dialback Protocol (Section 5.2), which provides a reliable
   mechanism for preventing the spoofing of servers.

10.3 Minimum Security Mechanisms

   Although service provisioning is a policy matter, at a minimum, all
   implementations MUST support the SASL DIGEST-MD5 mechanism for
   authentication.

10.4 Firewalls

   Communications using XMPP occur over TCP sockets on port 5222
   (client-to-server) or port 5269 (server-to-server), as registered
   with the IANA [6]. Use of these well-known ports allows
   administrators to easily enable or disable XMPP activity through
   existing and commonly-deployed firewalls.

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[Appendix A](). Standard Error Codes

   A standard error element is used for failed processing of XML
   stanzas. This element is a child of the failed stanza and MUST
   include a 'code' attribute corresponding to one of the following
   error codes.

   o 302 (Redirect) - Whereas HTTP contains eight different codes for
      redirection, XMPP contains only one (which is intended to stand
      for any redirection error). However, code 302 is being reserved
      for future functionality and is not implemented at this time.

   o 400 (Bad Request) - Code 400 is used to inform a sender that a
      request could not be understood by the recipient. This might be
      generated when, for example, an entity sends a message that does
      not have a 'to' attribute.

   o 401 (Unauthorized) - Code 401 is used to inform clients that they
      have provided incorrect authorization information, e.g., an
      incorrect password or unknown username when attempting to
      authenticate with a server.

   o 402 (Payment Required) - Code 402 is being reserved for future
      use.

   o 403 (Forbidden) - Code 403 is used to inform an entity that the
      its request was understood but that the recipient is refusing to
      fulfill it, e.g., if a user attempts to set information associated
      with another user.

   o 404 (Not Found) - Code 404 is used to inform a sender that no
      recipient was found matching the JID to which an XML stanza was
      sent, e.g., if a sender has attempted to send a message to a JID
      that does not exist. (Note: if the server of the intended
      recipient cannot be reached, an error code from the 500 series
      must be sent).

   o 405 (Not Allowed) - Code 405 is used when the action requested is
      not allowed for the JID identified by the 'from' address, e.g., if
      a client attempts to set the time or version of a server.

   o 406 (Not Acceptable) - Code 406 is used when an XML stanza is for
      some reason not acceptable to a server or other entity. This
      might be generated when, for example, a user attempts to register
      with a server using an empty password.

   o 407 (Registration Required) - Code 407 is used when a message or
      request is sent to a service that requires prior registration,

      e.g., if a user attempts to send a message through a gateway to a
      foreign messaging system without having first registered with that
      gateway.

   o 408 (Request Timeout) - Code 408 is returned when a recipient does
      not produce a response within the time that the sender was
      prepared to wait.

   o 500 (Internal Server Error) - Code 500 is used when a server or
      service encounters an unexpected condition which prevents it from
      handling an XML stanza from a sender, e.g., if an authentication
      request is not handled by a server because the password could not
      be retrieved.

   o 501 (Not Implemented) - Code 501 is used when the recipient does
      not support the functionality being requested by a sender, e.g.,
      if a user attempts to register with a server that does not allow
      registration.

   o 502 (Remote Server Error) - Code 502 is used when delivery of an
      XML stanza fails because of an inability to reach the intended
      remote server or service, e.g., because a remote server's hostname
      could not be resolved.

   o 503 (Service Unavailable) - Code 503 is used when a sender
      requests a service that a recipient is temporarily unable to
      offer.

   o 504 (Remote Server Timeout) - Code 504 is used when attempts to
      contact a remote server timeout, e.g., if an incorrect hostname is
      specified.

[Appendix B](#). Formal Definitions

[B.1](#) **streams namespace**

The namespace declaration for the root stream element is 'http://
etherx.jabber.org/streams'.

[B.1.1](#) **DTD**

```
<?xml version='1.0' encoding='UTF-8'?>
<!ELEMENT stream (#PCDATA | error?)*>
<!ATTLIST stream
  to        CDATA   #IMPLIED
  from      CDATA   #IMPLIED
  id        ID      #IMPLIED
  version   CDATA   #IMPLIED
>
<!ELEMENT error (#PCDATA)>
<!ELEMENT features (#PCDATA)>
```

B.1.2 **Schema**

```
<?xml version='1.0' encoding='UTF-8'?>
<xsd:schema
    xmlns:xsd='http://www.w3.org/2001/XMLSchema'
    targetNamespace='http://etherx.jabber.org/streams'
    xmlns='http://etherx.jabber.org/streams'
    elementFormDefault='qualified'>

  <xsd:element name='stream'>
    <xsd:complexType mixed='true'>
      <xsd:element ref='error' minOccurs='0' maxOccurs='1'/>
      <xsd:choice>
        <xsd:any
              namespace='jabber:client'
              maxOccurs='1'/>
        <xsd:any
              namespace='jabber:server'
              maxOccurs='1'/>
      </xsd:choice>
      <xsd:attribute name='to' type='xsd:string' use='optional'/>
      <xsd:attribute name='from' type='xsd:string' use='optional'/>
      <xsd:attribute name='id' type='xsd:ID' use='optional'/>
      <xsd:attribute name='version' type='xsd:decimal' use='optional'/>
    </xsd:complexType>
  </xsd:element>

  <xsd:element name='error' type='xsd:string'/>

</xsd:schema>
```

B.2 **SASL namespace**

The namespace declaration for SASL-related elements is 'http://
www.iana.org/assignments/sasl-mechanisms'.

B.2.1 **DTD**

```
<?xml version='1.0' encoding='UTF-8'?>
<!ELEMENT mechanisms (mechanism)*>
<!ELEMENT mechanism (#PCDATA)>
<!ELEMENT auth (#PCDATA)>
<!ATTLIST auth mechanism CDATA #REQUIRED>
<!ELEMENT challenge (#PCDATA)>
<!ELEMENT response (#PCDATA)>
<!ELEMENT abort (#PCDATA)>
<!ELEMENT success (#PCDATA)>
<!ELEMENT failure (#PCDATA)>
```

B.2.2 **Schema**

```
<?xml version='1.0' encoding='UTF-8'?>
<xsd:schema
    xmlns:xsd='http://www.w3.org/2001/XMLSchema'
    targetNamespace='http://www.iana.org/assignments/sasl-mechanisms'
    xmlns='http://www.iana.org/assignments/sasl-mechanisms'
    elementFormDefault='qualified'>

  <xsd:element name='mechanisms'>
    <xsd:complexType>
      <xsd:sequence minOccurs='0' maxOccurs='unbounded'>
        <xsd:element ref='mechanism'/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>

  <xsd:element name='mechanism'/>

  <xsd:element name='auth'>
    <xsd:complexType mixed='true'>
      <xsd:attribute name='mechanism' type='xsd:string' use='optional'/>
    </xsd:complexType>
  </xsd:element>

  <xsd:element name='challenge' type='xsd:string'/>
  <xsd:element name='response' type='xsd:string'/>
  <xsd:element name='abort' type='xsd:string'/>
  <xsd:element name='success' type='xsd:string'/>
  <xsd:element name='failure' type='xsd:string'/>

</xsd:schema>
```

B.3 **jabber:client namespace**

B.3.1 **DTD**

```
<?xml version='1.0' encoding='UTF-8'?>
<!ELEMENT message (( body* | subject* | thread? |
                     error? | (#PCDATA) )*)>

<!ATTLIST message
    to        CDATA    #IMPLIED
    from      CDATA    #IMPLIED
    id        ID       #IMPLIED
    xml:lang  NMTOKEN  #IMPLIED
    type ( chat | groupchat | headline | error ) #IMPLIED
```

```
    >

    <!ELEMENT body (#PCDATA)>
    <!ATTLIST body xml:lang NMTOKEN #IMPLIED>
    <!ELEMENT subject (#PCDATA)>
    <!ATTLIST subject xml:lang NMTOKEN #IMPLIED>
    <!ELEMENT thread (#PCDATA)>

    <!ELEMENT presence (( show? | status* | priority? | error? )*)>

    <!ATTLIST presence
      to         CDATA     #IMPLIED
      from       CDATA     #IMPLIED
      id         ID        #IMPLIED
      xml:lang   NMTOKEN   #IMPLIED
      type ( subscribe | subscribed | unsubscribe |
             unsubscribed | unavailable | error ) #IMPLIED
    >

    <!ELEMENT show (#PCDATA)>
    <!ELEMENT status (#PCDATA)>
    <!ATTLIST status xml:lang NMTOKEN #IMPLIED>
    <!ELEMENT priority (#PCDATA)>

    <!ELEMENT iq ( error | (#PCDATA) )*>

    <!ATTLIST iq
      to         CDATA     #IMPLIED
      from       CDATA     #IMPLIED
      id         ID        #IMPLIED
      type ( get | set | result | error ) #REQUIRED
    >

    <!ELEMENT error (#PCDATA)>
    <!ATTLIST error
      code       CDATA     #REQUIRED
      xml:lang   NMTOKEN   #IMPLIED
    >
```

B.3.2 **Schema**

```
    <?xml version='1.0' encoding='UTF-8'?>
    <xsd:schema
        xmlns:xsd='http://www.w3.org/2001/XMLSchema'
        targetNamespace='http://www.jabber.org/protocol'
        xmlns='http://www.jabber.org/protocol'
        elementFormDefault='qualified'>
```

```
    <xsd:element name='message'>
      <xsd:complexType mixed='true'>
        <xsd:choice>
            <xsd:element ref='body' minOccurs='0' maxOccurs='unbounded'/>
            <xsd:element ref='subject' minOccurs='0' maxOccurs='unbounded'/>
            <xsd:element ref='thread' minOccurs='0' maxOccurs='1'/>
            <xsd:element ref='error' minOccurs='0' maxOccurs='1'/>
            <xsd:any
                namespace='##other'
                minOccurs='0'
                maxOccurs='unbounded'/>
        </xsd:choice>
        <xsd:attribute name='to' type='xsd:string' use='optional'/>
        <xsd:attribute name='from' type='xsd:string' use='optional'/>
        <xsd:attribute name='id' type='xsd:ID' use='optional'/>
        <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
        <xsd:attribute name='type' use='optional'>
          <xsd:simpleType>
            <xsd:restriction base='xsd:NCName'>
              <xsd:enumeration value='chat'/>
              <xsd:enumeration value='groupchat'/>
              <xsd:enumeration value='headline'/>
              <xsd:enumeration value='error'/>
            </xsd:restriction>
          </xsd:simpleType>
        </xsd:attribute>
      </xsd:complexType>
    </xsd:element>

    <xsd:element name='body' type='xsd:string'>
      <xsd:complexType>
        <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
      </xsd:complexType>
    </xsd:element>

    <xsd:element name='subject' type='xsd:string'>
      <xsd:complexType>
        <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
      </xsd:complexType>
    </xsd:element>

    <xsd:element name='thread' type='xsd:string'/>

    <xsd:element name='presence'>
      <xsd:complexType>
        <xsd:choice>
          <xsd:element ref='show' minOccurs='0' maxOccurs='1'/>
          <xsd:element ref='status' minOccurs='0' maxOccurs='unbounded'/>
```

```
      <xsd:element ref='priority' minOccurs='0' maxOccurs='1'/>
      <xsd:element ref='error' minOccurs='0' maxOccurs='1'/>
      <xsd:any
          namespace='##other'
          minOccurs='0'
          maxOccurs='unbounded'/>
    </xsd:choice>
    <xsd:attribute name='to' type='xsd:string' use='optional'/>
    <xsd:attribute name='from' type='xsd:string' use='optional'/>
    <xsd:attribute name='id' type='xsd:ID' use='optional'/>
    <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
    <xsd:attribute name='type' use='optional'>
      <xsd:simpleType>
        <xsd:restriction base='xsd:NCName'>
          <xsd:enumeration value='subscribe'/>
          <xsd:enumeration value='subscribed'/>
          <xsd:enumeration value='unsubscribe'/>
          <xsd:enumeration value='unsubscribed'/>
          <xsd:enumeration value='unavailable'/>
          <xsd:enumeration value='error'/>
        </xsd:restriction>
      </xsd:simpleType>
    </xsd:attribute>
  </xsd:complexType>
</xsd:element>

<xsd:element name='show'>
  <xsd:simpleType>
    <xsd:restriction base='xsd:NCName'>
      <xsd:enumeration value='away'/>
      <xsd:enumeration value='chat'/>
      <xsd:enumeration value='xa'/>
      <xsd:enumeration value='dnd'/>
    </xsd:restriction>
  </xsd:simpleType>
</xsd:element>

<xsd:element name='status' type='xsd:string'>
  <xsd:complexType>
    <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
  </xsd:complexType>
</xsd:element>

<xsd:element name='priority' type='xsd:nonNegativeInteger'/>

<xsd:element name='iq'>
  <xsd:complexType mixed='true'>
    <xsd:choice>
```

```
            <xsd:element ref='error' minOccurs='0' maxOccurs='1'/>
            <xsd:any
                namespace='##other'
                minOccurs='0'
                maxOccurs='unbounded'/>
        </xsd:choice>
        <xsd:attribute name='to' type='xsd:string' use='optional'/>
        <xsd:attribute name='from' type='xsd:string' use='optional'/>
        <xsd:attribute name='id' type='xsd:ID' use='optional'/>
        <xsd:attribute name='type' use='required'>
          <xsd:simpleType>
            <xsd:restriction base='xsd:NCName'>
              <xsd:enumeration value='get'/>
              <xsd:enumeration value='set'/>
              <xsd:enumeration value='result'/>
              <xsd:enumeration value='error'/>
            </xsd:restriction>
          </xsd:simpleType>
        </xsd:attribute>
      </xsd:complexType>
    </xsd:element>

    <xsd:element name='error'>
      <xsd:complexType>
        <xsd:attribute
            name='code'
            type='xsd:nonNegativeInteger'
            use='required'/>
        <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
      </xsd:complexType>
    </xsd:element>

  </xsd:schema>
```

B.4 **jabber:server namespace**

B.4.1 **DTD**

```
<?xml version='1.0' encoding='UTF-8'?>
<!ELEMENT message (( body* | subject* | thread? |
                     error? | (#PCDATA) )*)>

<!ATTLIST message
  to        CDATA    #REQUIRED
  from      CDATA    #REQUIRED
  id        ID       #IMPLIED
  xml:lang  NMTOKEN  #IMPLIED
```

```
   type ( chat | groupchat | headline | error ) #IMPLIED
>


<!ELEMENT body (#PCDATA)>
<!ATTLIST body xml:lang NMTOKEN #IMPLIED>
<!ELEMENT subject (#PCDATA)>
<!ATTLIST subject xml:lang NMTOKEN #IMPLIED>
<!ELEMENT thread (#PCDATA)>

<!ELEMENT presence (( show? | status* | priority? | error? )*)>

<!ATTLIST presence
  to        CDATA     #REQUIRED
  from      CDATA     #REQUIRED
  id        ID        #IMPLIED
  xml:lang  NMTOKEN   #IMPLIED
  type ( subscribe | subscribed | unsubscribe |
        unsubscribed | unavailable | error ) #IMPLIED
>

<!ELEMENT show (#PCDATA)>
<!ELEMENT status (#PCDATA)>
<!ATTLIST status xml:lang NMTOKEN #IMPLIED>
<!ELEMENT priority (#PCDATA)>

<!ELEMENT iq ( error | (#PCDATA) )*>

<!ATTLIST iq
  to        CDATA     #REQUIRED
  from      CDATA     #REQUIRED
  id        ID        #IMPLIED
  type ( get | set | result | error ) #REQUIRED
>

<!ELEMENT error (#PCDATA)>
<!ATTLIST error
  code      CDATA     #REQUIRED
  xml:lang  NMTOKEN   #IMPLIED
>
```

B.4.2 **Schema**

```
<?xml version='1.0' encoding='UTF-8'?>
<xsd:schema
    xmlns:xsd='http://www.w3.org/2001/XMLSchema'
    targetNamespace='http://www.jabber.org/protocol'
    xmlns='http://www.jabber.org/protocol'
```

```
      elementFormDefault='qualified'>

    <xsd:element name='message'>
      <xsd:complexType mixed='true'>
        <xsd:choice>
          <xsd:element ref='body' minOccurs='0' maxOccurs='unbounded'/>
          <xsd:element ref='subject' minOccurs='0' maxOccurs='unbounded'/>
          <xsd:element ref='thread' minOccurs='0' maxOccurs='1'/>
          <xsd:element ref='error' minOccurs='0' maxOccurs='1'/>
          <xsd:any
              namespace='##other'
              minOccurs='0'
              maxOccurs='unbounded'/>
        </xsd:choice>
        <xsd:attribute name='to' type='xsd:string' use='required'/>
        <xsd:attribute name='from' type='xsd:string' use='required'/>
        <xsd:attribute name='id' type='xsd:ID' use='optional'/>
        <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
        <xsd:attribute name='type' use='optional'>
          <xsd:simpleType>
            <xsd:restriction base='xsd:NCName'>
              <xsd:enumeration value='chat'/>
              <xsd:enumeration value='groupchat'/>
              <xsd:enumeration value='headline'/>
              <xsd:enumeration value='error'/>
            </xsd:restriction>
          </xsd:simpleType>
        </xsd:attribute>
      </xsd:complexType>
    </xsd:element>

    <xsd:element name='body' type='xsd:string'>
      <xsd:complexType>
        <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
      </xsd:complexType>
    </xsd:element>

    <xsd:element name='subject' type='xsd:string'>
      <xsd:complexType>
        <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
      </xsd:complexType>
    </xsd:element>

    <xsd:element name='thread' type='xsd:string'/>

    <xsd:element name='presence'>
      <xsd:complexType>
        <xsd:choice>
```

```
        <xsd:element ref='show' minOccurs='0' maxOccurs='1'/>
        <xsd:element ref='status' minOccurs='0' maxOccurs='unbounded'/>
        <xsd:element ref='priority' minOccurs='0' maxOccurs='1'/>
        <xsd:element ref='error' minOccurs='0' maxOccurs='1'/>
        <xsd:any
            namespace='##other'
            minOccurs='0'
            maxOccurs='unbounded'/>
      </xsd:choice>
      <xsd:attribute name='to' type='xsd:string' use='required'/>
      <xsd:attribute name='from' type='xsd:string' use='required'/>
      <xsd:attribute name='id' type='xsd:ID' use='optional'/>
      <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
      <xsd:attribute name='type' use='optional'>
        <xsd:simpleType>
          <xsd:restriction base='xsd:NCName'>
            <xsd:enumeration value='subscribe'/>
            <xsd:enumeration value='subscribed'/>
            <xsd:enumeration value='unsubscribe'/>
            <xsd:enumeration value='unsubscribed'/>
            <xsd:enumeration value='unavailable'/>
            <xsd:enumeration value='error'/>
          </xsd:restriction>
        </xsd:simpleType>
      </xsd:attribute>
    </xsd:complexType>
  </xsd:element>

  <xsd:element name='show'>
    <xsd:simpleType>
      <xsd:restriction base='xsd:NCName'>
        <xsd:enumeration value='away'/>
        <xsd:enumeration value='chat'/>
        <xsd:enumeration value='xa'/>
        <xsd:enumeration value='dnd'/>
      </xsd:restriction>
    </xsd:simpleType>
  </xsd:element>

  <xsd:element name='status' type='xsd:string'>
    <xsd:complexType>
      <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
    </xsd:complexType>
  </xsd:element>

  <xsd:element name='priority' type='xsd:nonNegativeInteger'/>

  <xsd:element name='iq'>
```

```
      <xsd:complexType mixed='true'>
        <xsd:choice>
          <xsd:element ref='error' minOccurs='0' maxOccurs='1'/>
          <xsd:any
              namespace='##other'
              minOccurs='0'
              maxOccurs='unbounded'/>
        </xsd:choice>
        <xsd:attribute name='to' type='xsd:string' use='required'/>
        <xsd:attribute name='from' type='xsd:string' use='required'/>
        <xsd:attribute name='id' type='xsd:ID' use='optional'/>
        <xsd:attribute name='type' use='required'>
          <xsd:simpleType>
            <xsd:restriction base='xsd:NCName'>
              <xsd:enumeration value='get'/>
              <xsd:enumeration value='set'/>
              <xsd:enumeration value='result'/>
              <xsd:enumeration value='error'/>
            </xsd:restriction>
          </xsd:simpleType>
        </xsd:attribute>
      </xsd:complexType>
    </xsd:element>

    <xsd:element name='error'>
      <xsd:complexType>
        <xsd:attribute
            name='code'
            type='xsd:nonNegativeInteger'
            use='required'/>
        <xsd:attribute name='xml:lang' type='xsd:NMTOKEN' use='optional'/>
      </xsd:complexType>
    </xsd:element>

  </xsd:schema>
```

Appendix C. Revision History

   Note to RFC editor: please remove this entire appendix, and the
   corresponding entries in the table of contents, prior to publication.

C.1 **Changes from draft-miller-xmpp-core-02**

   o Brought Streams Authentication section into line with discussion
      on list and at IETF 55 meeting.

   o Added information about the optional 'xml:lang' attribute per
      discussion on list and at IETF 55 meeting.

   o Specified that validation is neither required nor recommended, and
      that the formal definitions (DTDs and schemas) are included for
      descriptive purposes only.

   o Specified that the response to an IQ stanza of type 'get' or 'set'
      must be an IQ stanza of type 'result' or 'error'.

   o Specified that compliant server implementations must process
      stanzas in order.

   o Specified that for historical reasons some server implementations
      may accept 'stream:' as the only valid namespace prefix on the
      root stream element.

   o Clarified the difference between 'jabber:client' and
      'jabber:server' namespaces, namely, that 'to' and 'from'
      attributes are required on all stanzas in the latter but not the
      former.

   o Fixed typo in Step 9 of the dialback protocol (changed db:result
      to db:verify).

   o Removed references to TLS pending list discussion.

   o Removed the non-normative appendix on OpenPGP usage pending its
      inclusion in a separate I-D.

   o Simplified the architecture diagram, removed most references to
      services, and removed references to the 'jabber:component:*'
      namespaces.

   o Noted that XMPP activity respects firewall administration
      policies.

   o Further specified the scope and uniqueness of the 'id' attribute

in all stanza types and the <thread/> element in message stanzas.

o Nomenclature changes: (1) from "chunks" to "stanzas"; (2) from
   "host" to "server" and from "node" to "client" (except with regard
   to definition of the addressing scheme).

Full Copyright Statement

Acknowledgement