OPEN PEER – PROTOCOL SPECIFICATION

Contents

Abstract

The holy grail of communication on the Internet has been to allow peer-to-peer communication without the requirement of any centralized servers or services. A peer-to-peer approach offers some key advantages over a centralized server approach:

1) Greater network resilience – peers can continue to function independent of servers and can operate even if servers are down
2) Increased privacy and security – peers communicate directly thus the data is not centralized in one location where it can be spied upon by corporations, governments, 3rd parties or hackers.
3) Decreased cost – without the need of servers, the cost to host, administer, store and relay data is reduced substantially
4) Scalability – a peer to peer network doesn't require servers to scale as the peers can operate amongst themselves

Unfortunately, the goal of peer-to-peer and the reality of peer-to-peer do not match. Centralization of data into the Internet cloud is prolific and firewalls frequently impede direct peer-to-peer communication making peer-to-peer connection extremely difficult to setup and challenging to architect.

What further reduces the proliferation of peer-to-peer is a lack of standardization, openness and ubiquity of the technology. The standards bodies have been working for years on firewall traversal techniques and standardization of the approaches and a new joint effort called WebRTC between the W3C and IETF on how browsers can directly communication between browsers to move media. This joint effort does not specify how signalling happens between peers so it's not a complete solutions on its own.

Performing peer-to-peer approach to signalling has been notoriously difficult for a variety of reasons:

1) Without a publicly addressable intermediate 'server' machine to initiate communication, two peers behind firewalls are never able to communicate with each other. Thus, a peer network almost always requires some sort of rendezvous and relay servers to initiate contact between peers behind firewalls (and firewalls tend to be used more frequently than not for end users).

2) Automatically promoting the few publically addressable home machines into rendezvous and relay servers is not the best option. Average users tend to not want to have their home/work machines to be automatically promoted to rendezvous and relay servers since it consumes their bandwidth and costs them to relay traffic for others who "leech" off their bandwidth. This cost factor causes end users to intentionally shutdown protocols that promote end user machines into servers. Over time, the number of average users willing to have their machines operate as servers for the benefit of those leeching decreases relative to the number of those whom leech off those servers until the entire system collapses with a too great server/leech ratio. As an example, Skype's network collapsed for this very reason and they were forced to setup their own super nodes to handle the load.

3) Some peer-to-peer networks require ports to be opened on a firewall to operate. Where possible, peers will register themselves with UPnP to open the ports when the firewall automatically. Unfortunately, many firewalls lack the ability to automatically open ports or actively disallow this feature for fear that this opens the network to security holes. If opening ports automatically is not possible then users are required to open ports manually. Thus only the technically savvy can perform this task and such peer networks tend to be limited to those who are technically savvy. This is not a universal solution since it assumes too much technical ability and responsibility of the end user.

4) Many peer networks rely on mutual peers not behaving in an evil manner. These networks can easily be disrupted by peers that do not act in an altruistic fashion. When all peers behave properly there is no problem with such a network; however, the moment an 'evil' node or cluster of 'evil' nodes is injected into the peer network, parts or all of the network can suffer fatal issues and security can be compromised.

Open Peer is peer-to-peer signalling protocol taking advantages of the IETF advances of firewall penetration techniques for moving media and adds a layer to performs the media signalling in a peer-to-peer fashion but does expect that a minimal requirement of rendezvous servers existing. Beyond the initial rendezvous to get past firewalls, the servers should drop out of the protocol flow and are no longer required.

Open Peer was designed with these main goals in mind:

1) Openness – a protocol is freely available for anyone to implement.

2) Greater network resilience – peers can continue to function and interoperate even if servers are down.

3) Increased privacy and security – peers communicate directly in a secure fashion designed to protect against network ease dropping, forged communication or spying by 3rd parties or being a convenient data mining target for hackers as the information does not flow through centralized servers.

4) Federation – the protocol makes it easy for users on one service to communicate with users on another independent service offering.

5) Identity protection – the ability of users to easily provide proof of their identity using existing social platforms while protecting these identities from spoofed by others.

6) Decreased cost – without the need to continuously relay signalling or media through centralized servers, the costs to host, administer, relay, replicate, process and store data on servers while providing 5 9s uptime is decreased.

7) webRTC enabling protocol – designed to be the engine that allows webRTC to function, supporting federation of independent websites and services, provide security and online identity protection and validation, and peer-to-peer signalling bypassing the need for heavy cloud based infrastructure.

8) Scalability – whether starting at 50 users or moving beyond 5,00,000 users, the protocol is designed to allow for easy scalability by removing the complexity of communications out of the servers.

Design Considerations

The Open Peer Protocol has several design considerations to address the realities of the Internet infrastructure while delivering the functionality required:

- Must allow any peer to connect to any other peer (if authorized).
- Must understand firewall principles and to offer an architecture which factors that firewalls are prevalent and within the natural scope of the architecture's basic design.
- Must accept that it's not always desirable to have peer machines automatically promoted to rendezvous servers.
- Must allow additional services to be layered onto of the architecture
- Must enable peers to find each other using directory services.
- Must enable secure peer-to-peer communication without penetration or monitoring by third parties.
- Must allow peers to perform identity validations.
- Must allow anonymous peers, i.e. similar to unlisted and non-guessable phone numbers.
- Must allow for differing server rendezvous architectures, i.e. anywhere from peer-to-peer self-organized models to centralized network layouts are to be abstracted from the protocol.
- Must not require end user signed certificates from a known authority chain for each peers on the network to establish secure communications.
- Must not require end users or administrators to configure firewalls or open ports under normal circumstances.

Key Object Concepts

Identity

An Identity is the persona of a peer contact, be they the representation of a real person or representative entity (much like a corporation is a legal entity but not a real person). An Identity maps to a single Peer Contact although a Peer Contact can have multiple Identities.

Asserted Identity

An Asserted Identity is an identity that can be verified through an identity service as being the legal owner of the persona rather than a fraudulent representation. In other words, a validated asserted identity can be trusted that they are whom they claim to be. Different levels of identity assertion can be claimed for any given identity starting with no provable assertion at all and moving anywhere from weak to strong verification depending on the identity validation service types available.

Identity Lookup Server

A server that looks up and returns the Peer Contact associated with an Identity or a set of Identities and can return the public profile information for Peer Contacts.

Identity Signing Service

A service that provides the Asserted Identities for the various personas that are owned within a particular service offering.

Identity Provider

Any service offering that grants Identity personas, such as Facebook, LinkedIn, Twitter or other 3rd parties that offer their own Identities.

Peer Contact

A Peer Contact is the representation of a single point of contact on the Internet regardless of the personas represented by the peer contact. A peer contact can exist at zero or more Peer Locations at any given time.

Peer

A Peer is the single instance of a peer client application on the Internet, which registers a single Peer Contact in the Peer Domain at a particular Peer Location.

Peer Location

A Peer Location is the representation of where a peer is located. A Peer can only exist at a single location but the Peer Contact for the Peer can register at multiple Peer Locations.

Peer URI

A Universal Resource Identifier (URI) starting with "peer:" offering the ability to locate a specific peer resource, protocol and request type within a peer domain.

Peer Domain
A Peer is always connected to a Peer Domain and the domain is the organization responsible for managing the connected peers.

Peer Finder
A Peer Finder is a rendezvous server that keeps track of connected peers at their peer locations since they are connected in a dispersed fashion through a peer domain. A peer finder will utilize a database (typically distributed) to facilitation the introduction of peer communication on the same domain or across domains.

Bootstrapper
A Bootstrapper is the introductory server where peers first go to be introduced to one (or more) Peer Finders. Peers should attempt to connect to introduced Peer Finders in order to gain entry to the Peer Domain. Once a Peer is connected to a Bootstrapped Network, the Peer should no longer require communication back to the Bootstrapper unless access to previously introduced Peer Finders are no longer accessible.

Bootstrapped Network
A Bootstrapped Network is the representation of the entire peering network that was introduced from a Bootstrapper.

Public Peer File
A file that contains a cryptography public key for secure conversations, information required to locate the Peer Contact within a Peer Domain, information to authorize a connection to that Peer by another Peer and public Identities associated to a peer. Any Peer without the correct Public Peer File for another Peer Contact will be unable to connect to that peer. A directory service can host and offer these Public Peer Files between peers but without this file no communication is possible between peers (thus allowing for "unlisted" peers).

Private Peer File
A file that contains a private key to be the pair of a public key inside the Public Peer file that is used by a Peer to be used to establish secure communications between Peers. The Private Peer File is encrypted and can only be decoded with the correct key.

Peer Pair
A file pairing consisting of both a Public Peer File and a Private Peer File.

Provisioning Service
A service that provides account creation and account profile maintenance.

Peer Service
Any additional services offered to peers are done through what is called a Peer Service. Examples of such services are those that perform identity assertion, TURN or future services like video conferencing mixers.

The "peer:" URI scheme

Syntax:

peer://<domain>/contact-id

[/<resource>][?<query>][#<fragment>][;protocol=<protocol>][;request=<request>]

<domain> - the domain service where the Bootstrapped Network is introduced, e.g. "foo.com" or "bar.com".

<contact-id> - the hash result of the section A of the Public Peer File

Examples:

peer://foo.com/e852191079ea08b654ccf4c2f38a162e3e84ee04
peer://example.org/3b0056498dc7cdd6a4d5373ac0860f9738b071da
peer://<domain>/contact-id

Syntax (future extensions):

peer://foo.com/id[/<resource>][?<query>][#<fragment>][;protocol=<protocol>][;request=<request>]

<resource> - and optional resource within the peer that is being requested.

<query> - an optional component which identifies non-hierarchical information about a resource.

<fragment> - an optional component which identifies direction towards a secondary resource.

<protocol> - the default value of "peer-dialog" is presumed, other extensions like "peer-http" are possible and might be presumed depending on the "lookup-type" requested

<request> - this allows control over the action required which this URI is requested, e.g. "call" might be used to establish an audio/video call to the peer or "get" might be used (or even assumed) in combination with a protocol type of "peer-http" to indicate performing an HTTP request over Open Peer.

Example future extensions:

peer://example.org/3b0056498dc7cdd6a4d5373ac0860f9738b071da/index.php;protocol=peer-http
peer://hookflash.com/3b00564d6a4d5373ac0860f9738b071da/;protocol=peer-http;request=get
peer://foo.com/e852191079ea08b654ccf4c2f38a162e3e84ee04;request=call

The "identity:" URI scheme

Syntax:

identity:[type:][//<domain>/]<identity-string>

If a "//" is not present after the "identity:" scheme, then the identity is assumed to be a specialized registered type that must be resolved in a specialized manner. If the "//" is present then the identity is resolved by the specified domain, with an optional username/password access credentials to the identity lookup service.

<username> - the username used for basic auth to the identity lookup service

<password> - the password used for basic auth to the identity lookup service

<domain> - the domain service where the identity is resolved, e.g. "foo.com" or "bar.com".

<identity-string> - the string that represents the persona of the identity but the interpretation is specific to a particular domain.

The URL characters '?' ';' '#' are reserved characters in the URI scheme and should never be used within an identity.

Examples:

identity:phone:14165551212
identity:email:foo@bar.com
identity://foo.com/alice.78
identity://facebook.com/id3993232
identity://bar.com/linkedin.com/zs39923yf

The Makeup of the Public Peer File

A Public Peer File contains information required to locate, connect and establish a secure channel between peers and contains Identities within the same file. The Public Peer File is made up of three sections, appropriately named Section "A", Section "B" and Section "C". Section "A" can be safely transmitted to any third party allowing any third party to know the Peer Contact's "contact ID" as well as its pubic key to prove ownership (only the owner would have the related private key). Section "B" allows for another peer to find the peer and initiate contact. Section "B" can be withheld from any other peer if the peer does not wish itself to be found by that peer. Section "C" is used to include proven identities of the contact. This section can be given or withheld depending how anonymous the peer wishes to be. The entire file is only given to third parties (i.e. Section A+B+C) allowed to communicate directly to the peer containing where the peer wants to be contacted and wants to expose its identities. At minimal, Section "A" is required to establish a secure channel between peers and Section "B" is required to allow a peer to be found by another peer and Section "C" is required to prove public identities of the peer.

A Public Peer File should contain the extension of ".peer"

Section "A" (packaged and signed by identity's private key)

- Cipher suite to use for all hash computations and encryptions related to contents of the peer file (note: this does not apply to signed XML segments which have their own method to describe algorithms and key selection)
- Public peer file creation date
- Public peer file expiry date
- Salt signed by salt service's key
- Extension authorized-peer data
- Peer's public key (in signature)

Section "B" (packaged and signed by identity's private key)

- Peer Contact's full URI (to know how to locate the peer universally) that do not reveal any identities. Peer's contact ID is calculated as follows: hash value of section "A", i.e. tolower(base16encode(hash("contact:" + <public-peer-section-A>))). When the input <public-peer-file-section-A is used in the hash, the same canonical algorithm method as the signature in section "A". The input into the algorithm is the entire section "A" bundle including the certificate signing the section bundle.
- Find secret (must be known by peer attempting to initiate a finder connection to another peer). This is a simple random string and is not encoded into base-64.
- Extension authorized-peer data

Section "C" (packaged and signed by identity's private key)

- Peer Contact's full URI (to know how to locate the peer universally).
- Any/all asserted public identities
- Extension authorized-peer data

The public key is used as a way to send the peer privately encrypted data from another source. As long as the other source has the correct public key it is possible to establish direct secure communication by exchanging keys using public/private keys as the encryptions method.

The salt is used in Section "A" to establish randomness into the files that is not forgeable or controllable by the creator of the file this ensuring that hashes are dispersed based on randomness being present.

Asserted identities are used to prove the owner of the peer file is whom they claim to be.

Extension data is arbitrary for future extension of the peer file.

The peer's contact ID is used to prove that Section "B" and Section "C" correlates properly to section "A" and isn't two or three distinct files being glued together as a forgery.

Security Considerations

The Section "A" bundle must contain salt that has been signed by the salt service whose certificate is still within the window of validity. Further the Section "A" bundle must be signed by a self-signed certificate whose certificate is included in the signature of the bundle. This ensures the integrity of the Section "A" bundle and ensures anyone who has Section "A" knows the public key for the peer.

Section "B" includes a finder secret that other peers will use to find the peer to which the peer file belongs.

Asserted Identities contained within section "C" can be verified whenever verification is needed. Verification is dependent on the identity assertion type.

The integrity of Section "B" and Section "C" should be verified by ensuring that the public key contained in Section "A" signed these sections. The URIs in these sections are not verified as it's up to the client generating the URIs to generate resources that are accurate to the network and up to other peers to ensure they are contacting identities they should be contacting.

Only elements contained within the signed sections are ever considered as part of the file. All other elements are erroneous and should be discarded or ignored and when present. In Section "A", erroneous elements outside the protection of a signature should never be used as part of the calculation of the contact ID.

Example Public Peer File:

```
<peer version="1">

<sectionBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
 <section id="A">
  <cipher>sha256/aes256</cipher>
  <created>54593943</created>
  <expires>65439343</expires>
  <saltBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
   <salt id="cf9c4688b014e13d8bdd2655912ffd3253f53768">Z3nfnDenen29291mfde…21n</salt>
   <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
    <SignedInfo>
     <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
     <Reference URI="#cf9c4688b014e13d8bdd2655912ffd3253f53768">
      <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
```

```
      <DigestValue>jeirjLrta6skoV5/A8Q38Gj4j323=</DigestValue>
     </Reference>
    </SignedInfo>
    <SignatureValue>DEfGM~C0/Ez=</SignatureValue>
    <KeyInfo><KeyName>DN=example.org, SN=salt, ID=db144bb314f8e018303bba7d52e</KeyName></KeyInfo>
   </Signature>
  </saltBundle>
 </section>
 <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
  <SignedInfo>
   <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
   <Reference URI="#A">
    <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1" />
    <DigestValue>j6lwx3rvEPO0vKtMup4NbeVu8nk=</DigestValue>
   </Reference>
  </SignedInfo>
  <SignatureValue>G4Fwe0E/YT=</SignatureValue>
  <KeyInfo>
   <X509Data>
    <X509Certificate>MIID5jCCA0+gA...lVN</X509Certificate>
   </X509Data>
  </KeyInfo>
 </Signature>
</sectionBundle>

<sectionBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
 <section id="B">
  <contact>peer://example.com/ab43bd44390dabc329192a392bef1</contact>
  <findSecret>YjAwOWE2YmU4OWNlOTdkY2QxNzY1NDA5MGYy</findSecret>
 </section>
 <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
  <SignedInfo>
   <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
   <Reference URI="#B">
    <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
    <DigestValue>UrXLDLBIta6skoV5/A8Q38GEw44=</DigestValue>
   </Reference>
  </SignedInfo>
  <SignatureValue>MC0E~LE=</SignatureValue>
 </Signature>
</sectionBundle>

<sectionBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
 <section id="C">
  <contact>peer://example.com/ab43bd44390dabc329192a392bef1</contact>
  <identities>
   <identityBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
    <identity id="b5dfaf2d00ca5ef3ed1a2aa7ec23c2db">
     <contact>peer://example.com/ab43bd44390dabc329192a392bef1</contact>
     <uri>identity://facebook.com/id48483</uri>
     <created>54593943</created>
     <expires>65439343</expires>
    </identity>
    <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
     <SignedInfo>
      <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
      <Reference URI="#b5dfaf2d00ca5ef3ed1a2aa7ec23c2db">
       <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
       <DigestValue>IUe324koV5/A8Q38Gj45i4jddX=</DigestValue>
      </Reference>
     </SignedInfo>
     <SignatureValue>MDAwMDAwMGJ5dGVzLiBQbGVhc2UsIGQ=</SignatureValue>
     <KeyInfo><KeyName>DN=hookflash.org, SN=identity, ID=b7ef37...4a0d58628d3</KeyName></KeyInfo>
    </Signature>
   </identityBundle>
   <identityBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
    <identity id="0a9b2290343734118469e36d88276ffa6277d196">
     <contact>peer://example.com/ab43bd44390dabc329192a392bef1</contact>
     <uri>identity://twitter.com/booyah</uri>
     <created>54593943</created>
     <expires>65439343</expires>
```

```
    </identity>
    <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
     <SignedInfo>
      <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
      <Reference URI="#b5dfaf2d00ca5ef3ed1a2aa7ec23c2db">
       <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
       <DigestValue>IUe324koV5/A8Q38Gj45i4jddX=</DigestValue>
      </Reference>
     </SignedInfo>
     <SignatureValue>MDAwMDAwMGJ5dGVzLiBQbGVhc2UsIGQ=</SignatureValue>
     <KeyInfo><KeyName>DN=twitter.com, SN=identity, ID=cb231aa9a9...eaf43f</KeyName></KeyInfo>
    </Signature>
   </identityBundle>
  </identities>
 </section>
 <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
  <SignedInfo>
   <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
   <Reference URI="#B">
    <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
    <DigestValue>UrXLDLBIta6skoV5/A8Q38GEw44=</DigestValue>
   </Reference>
  </SignedInfo>
  <SignatureValue>MC0E~LE=</SignatureValue>
 </Signature>
</sectionBundle>

</peer>
```

The Makeup of the Private Peer File

The Private Peer File is never given out to any other peer. However, the peer file can be stored with a trusted service as the contents are encrypted. The contents of the file must be encrypted to prevent unauthorized access to the private key that is the matching pair for the public key in the Public Peer File. This file can be used to prove ownership of the Public Peer File.

The file does not carry any recommended extension and is managed by the client application that must maintain the security and integrity of the file.

The contents of the file are as follows:

Section "A"

- Cipher suite to use for all hash computations and encryptions related to contents of the private peer file and this cipher suite must match the public peer file's cipher suite (note: this does not apply to signed XML segments which have their own method to describe algorithms and key selection)
- Peer Contact's full URI (to know how to locate the peer universally).
- Salt (base-64 encoded binary salt)
- 'Private Peer File secret' proof, hash = hash("proof:" + <peer-contact-id> + ":" + <private-peer-file-secret>))

Section "B" (encrypted using the method described in Section A)

- Encrypted private key, key = hash("privatekey:" + <salt> + ":" + <private-peer-file-secret>), iv=hash("privatekey:" + <salt>)
- Encrypted Public Peer File, key = hash("peer:" + <salt> + ":" + <private-peer-file-secret>), iv=hash("peer:" + <salt>)
- Encrypted contact profile secret, key = hash("profile:" + <salt> + ":" + <private-peer-file-secret>), iv=hash("profile:" + <salt>)
- Encrypted private data, key = hash("data:" + <salt> + ":" + <private-peer-file-secret>), iv= hash("data:" + <salt>)

The format of the Private Peer File is defined so it can be stored on server (should a client desire to do so) with only clients that have the correct "private peer file secret" being able to request download of the file without the server knowing the value of the data contained within the file.

The Peer Contact's URI is used to indicate which Public Peer File the Private Peer File is correlated.

The key salts combined with hash input phrases are used to ensure that the "private peer file secret" is not directly used to encrypt more than one piece of data.

The "private peer file secret" proof is used so a server can verify a client does have the correct information to request download of the Private Peer File. Only a client that knows the "private peer file

secret" would be able to generate the correct key proof in a challenge. The contact ID is combined with the secret to add extra complexity into the secret to ensure no two users have the same stored secret resulting hash should the private peer file is published into a database and two users use the same secret value.

The encrypted private key is the private key pair matching the public key in the Public Peer File.

The encrypted Public Peer File is a complete encryption of the Public Peer File (i.e. all sections), thus requiring only one file to store both the public and private key.

The encrypted contact profile is the secret key used to decrypt a contact profile (which is stored in an encrypted fashion elsewhere).

The encrypted private data is extension data for use for whatever purposes required by a client.

Security Considerations

The contact URI must be the computed hash based on Section "A" of the Public Peer File. The salt must be cryptographically random. Both sections of the private peer file must be signed to ensure the contents of the private peer file have not been modified by another entity and must be verified by the client before the private peer file is used.

All data in this file is considered secure thus all data must be encrypted.

Example Private Peer File

```
<privatePeer version="10">

<sectionBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
 <section id="A">
  <cipher>sha256/aes256</cipher>
  <contact>peer://example.com/ab43bd44390dabc329192a392bef1</contact>
  <salt>YzY4NWUxMGU4M2ZjNzVkZWQzZTljYWMyNzUzZDAwNGM4NzE5Yjg1</salt>
  <secretProof>NDlkZWI0MzFhYmUxOWQzNWJkNDkzMWZhMzFmMw==</secretProof>
 </section>
 <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
  <SignedInfo>
   <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
   <Reference URI="#A">
    <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1" />
    <DigestValue>j6lwx3rvEPO0vKtMup4NbeVu8nk=</DigestValue>
   </Reference>
  </SignedInfo>
  <SignatureValue>G4Fwe0E/YT=</SignatureValue>
 </Signature>
</sectionBundle>

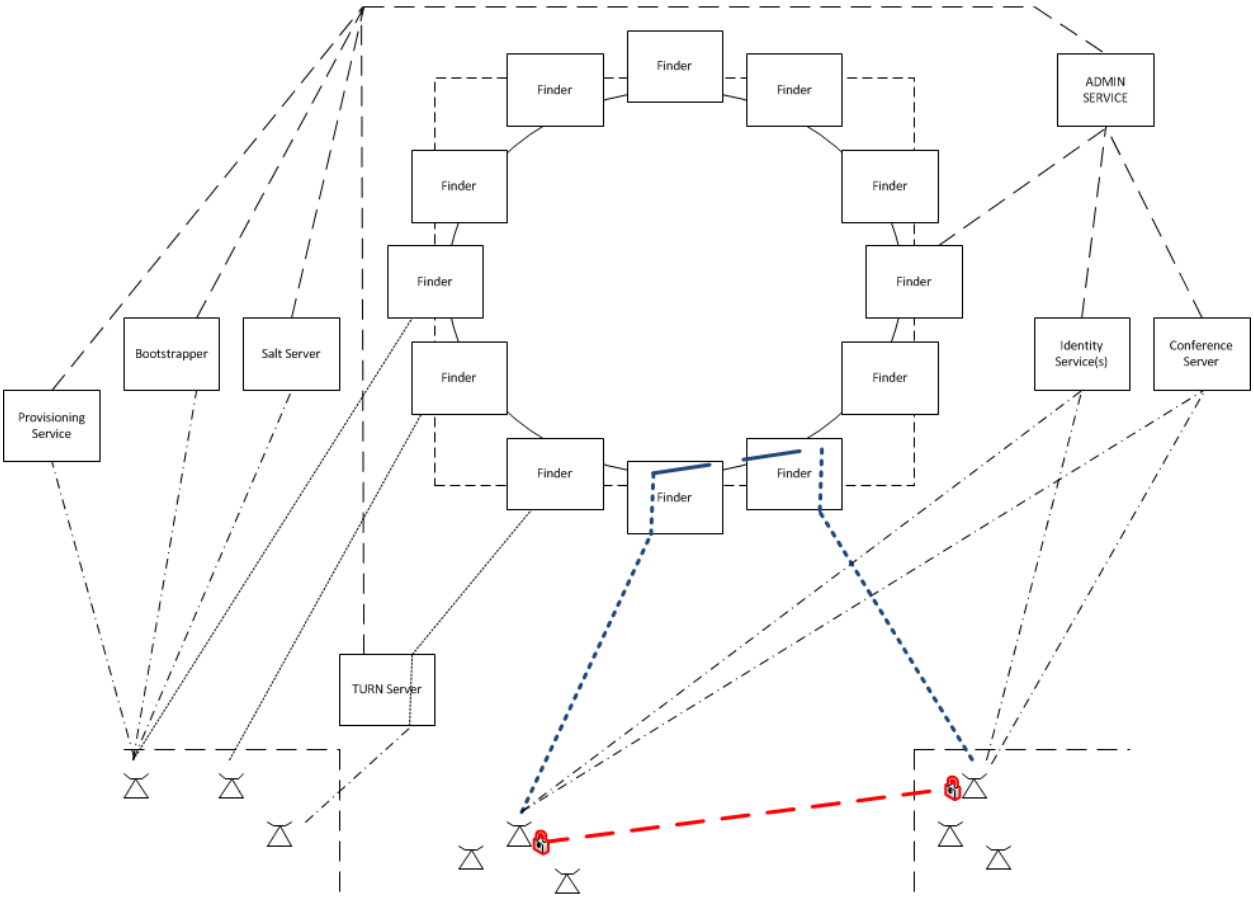
<sectionBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
 <section id="B">
  <encryptedPrivateKey>jk483n2n~3232n/34nk323j...32fsjdneen2311=</encryptedPrivateKey>
  <encryptedPeer>43j2332944bfdss323bjfjweke2dewbub3i...22dnnewne321~nn32n3j2/44=</encryptedPeer>
  <encryptedContactProfileSecret>ZWUxZGQz...NjgzMTU3Y2JhZjhhNA==</encryptedContactProfileSecret>
  <encryptedCaptcha>WkdNME16UXhPRE...JqTVV3WWpNek5tSTROems1T1dVPQ==</encryptedCaptcha>
  <encryptedPrivateData>ZGM0MzQxODBjMTgxMDY2NGQ4MWE...GUwYjMzNmI4Nzk5OWU=</encryptedPrivateData>
 </section>
 <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
  <SignedInfo>
   <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
   <Reference URI="#B">
    <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
```

```
    <DigestValue>UrXLDLBIta6skoV5/A8Q38GEw44=</DigestValue>
   </Reference>
  </SignedInfo>
  <SignatureValue>MC0E~LE=</SignatureValue>
 </Signature>
</sectionBundle>

</privatePeer>
```

Overall Network Architecture

Network Diagram



Network Components

Bootstrapper – a server that acts as an introductory server to the entire peer network. The Bootstrapper exclusively talks over HTTPS to clients which must have a certificate issued from a trusted certificate authority.

Salt Service – a server that generates cryptographically strong salt and signs the salt as having come from the server. This service is useful to ensure cryptographically strong random data has been correctly used whenever it is critically important and especially when a server can't trust a client will generate random data that is intentionally or accidently non-cryptographically random. The salt service exclusively talks HTTPS to clients and the certificate will be signed by the certificate authority as discovered from the Bootstrapper service.

Identity Service(s) – servers that provide Identity Lookup or Asserted Identities for Identities such as LinkedIn, Facebook or other 3rd party Identities. The weak form of an Asserted Identity allows a third party like Hookflash Inc. to assert an Identity is correct when the Identity Provider does not offer an Identity signing service themselves.

TURN server – a server which is used to relay information on an 'as needed' basis when the firewall is of a type where relaying is required to penetrate the firewall. The TURN service will talk the standard TURN protocol.

Finder – a server that keeps information about each Peer Contact's Peer Locations and assists Peers in establishing the initial communication between Peers. The finder may allows a few requests over HTTPS but most request must be directed over Message/RUDP/UDP or Message/SCP protocol. The requests allowed over HTTPS are specifically mentioned with each allowed request.

Conference service – this is an example service that could be utilized as a relay point when communicating between peers in a conference scenario that would typically overwhelm a standalone client's CPU or bandwidth, but no protocol has been yet defined for Open Peer.

Peer – a peer is a client that uses the various services in the architecture to help with the establishment of communication to other Peers. Once peers establish and communicate directly with other peers, they should not required to utilize server infrastructure to maintain the communication (with the exception possibly of using a TURN server). Peers use the Message/RUDP/UDP or Message/SCP protocol as their initial connection and control protocol.

Limitations to Scope of Open Peer Specification

Open Peer defines the communication between the client and the Open Peer services but does not delegate how the servers in the infrastructure communicate amongst each other. Open Peer does not define how peer finders are allocated amongst peers. Open Peer allows Peers to treat servers as potentially untrustworthy from a privacy perspective and thus the protocol was designed to keep sensitive information from flowing through the servers or the servers having access to the keys to decrypt the sensitive data. Open Peer does not dictate how the data contained within and between servers be secured, only that the data must be secure.

RUDP Protocol

Overall Design Goals

RUDP was designed to allow bi-direction FIFO (First-In-First-Out) congestion controlled streamed data between two peers that is modelled after TCP, except that it is highly friendly to firewalls and utilizes firewall friendly protocols and techniques to connect between peers. The RUDP can be used between peers or from server to server.

TCP is a great protocol for signalling as it is reliable and messages are always delivered in order to a report party in a FIFO manner. The major problem with TCP is that it is not firewall friendly for peer to peer scenarios. TCP works great for peer-to-server where one entity is not located behind a firewall (i.e. the server). However, TCP between peers using today's marketed firewalls is virtually impossible.

RUDP uses STUN/ICE/TURN as the basis for establishing peer to peer connections then uses a UDP packaging technique to deliver application data. Additionally because RUDP is a FIFO based protocol like TCP, it can layer protocols such as TLS directly above its transport with little to no change at all being required (other than pumping the data through an RUDP socket instead of a TCP socket).

RUDP uses ICE to perform connectivity probes between peers and utilizes a STUN extension for connecting, teardown, and reliable as well as unreliable data acknowledgements.

RUDP supports vector based acknowledgments and XOR bit parities to prevent malicious clients from being able to pretend a download stream was downloading faster than the server is truly capable of delivering.

RUDP further supports multiple channels with a single point to point connection and multiple connects on a single port between multiple points. This allows for an existing connectivity probe to be reused for sending additional streams of data without performing new connectivity checks.

RUDP does not offer security beyond connectivity security offered with STUN and ICE. However, TLS or other mechanisms can be layered on top of RUDP to provide security and encryption.

RUDP is designed to be firewall friendly with minimal overhead.

Comparison to Other Protocols

DCCP / DTLS

DCCP is a good message based protocol that allows for reliable connecting and tear down and congestion control but offers a lossy data stream. DCCP was not chosen as it was desirable to have a reliable transport protocol between peers. To add security DTLS can be layered on top of DCCP.

DCCP is not readably available on all platforms (requiring a layering over UDP on major platforms like Windows. To utilize DCCP on windows would require manipulating RAW sockets and implementing the full DCCP protocol from scratch. Alternatively, DCCP would have to run on top of UDP, which is an option but adds overhead.

As such to utilize DCCP would have required a layer as:

[application level reliability layer] -> DTLS -> DCCP (optionally over UDP)

Further using DCCP would still require utilizing extension protocols to perform peer to peer firewall probing in a manner like ICE performs.

DCCP was not chosen as the lack of data reliability, overhead and work involved to support all the layers was not considered viable.

TCP

TCP is very similar to RUDP in capabilities with one exception: the ease to penetrate firewalls between peers. TCP does not offer an ICE like mechanism to perform connectivity probes like ICE and thus was not chosen as an acceptable protocol.

SCP

SCP is an alternative TCP like peer to peer communication protocol that messages can be relayed over as an alternative to RUDP protocol should the underlying framework support SCP.

RUDP Protocol Specification

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890


 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Channel Number        |          Data Length          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Flags     |      Lower 24bits of Sequence Number          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Reserved    |             Lower 24bits of GSNR              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
/                      Options and Padding                      /
+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+
/                       Application Data                        /
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
Channel Number - in the same range as allowed by TURN (0x4000 -> 0x7FFF)
Data Length - how much application data is included in this packet after the
              header (0 is a valid length)
Flags - See definition below
Lower 24bits of Sequence Number - lower 24 bits of the 64bit sequence number
Reserved - must be set to "0" on send and ignored upon receipt
Lower 24bits of GSNR - Lower 24bits of the 64bit GSNR (Greatest Sequence
                       Number Received). If no packets have been received this
                       should be set to the NEXT-SEQUENCE-NUMBER as received
                       from the remote party.
Options and padding - If the EQ bit is set to zero in the flags then the
                      vector/GSNFR is included as part of the header.
Application data - Application data at the length of the data length


Flags are defined as follows
 0
```

```
 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+
|P|P|X|D|E|E|A|R|
|S|G|P|P|C|Q|R| |
+-+-+-+-+-+-+-+-+
PS = Parity bit of sending packet (this packet)
PG = Parity of the Greatest Sequence Number Received (if no packets have been
     received yet then this value is "0")
XP = XOR'd parity of all packets received up-to-and-including the GSNFR (if
     no packets have been received then this value is "0")
DP = Duplicate packets have been received since the last ACK packet was sent.
EC = ECN (Explicit Congestions Notification) received on incoming packet
     since last packet in sequence sent. If no packets have been received then
     this value is set to "0".
EQ = GSNR == GSNFR (Greatest Sequence Number Received equals Greatest
     Sequence Number Fully Received). If no packets have been received then
     this value is set to "1".
AR = ACK required (must send a STUN "RELIABLE-CHANNEL-ACK"
     indication/request or another packet with ACK information (i.e.
     header only packet without data is okay).
R  = RFFU (Reserved For Future Use). Must be set to "0" on sending and ignored
     upon receipt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This header is present in packet after the header if EQ flag is "0" (and
therefor cannot be present if no packets were received from the remote party
as the EQ value in this case must be "1").

 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|P|Vector Length|             Lower 24bits of GSNFR             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
/   [0...vector length] vector RLE information                  .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.            [padded RLE to next DWORD alignment (if required)] /
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
P - XOR'ed parity of all packets marked as received in the vector
    (starting at the calculated XORed to-date-up-to-and-including the GSNFR)
Vector Length - Total vector size included after header as expressed in
                DWORDs (if the only packet missing is the GSNFR+1 then
                vector can be zero)
Lower 24 bits of GSNFR - The lower 24 bits of the 64bit GSNFR (Greatest
                         Sequence Number Fully Received).

The entire packet including header cannot be over the PMTU or 512 bytes
if not known.

Sender will estimate the receiver's packet window. The sender will only
send packets that are in the sequence number range from the last reported
GSNFR up to the end of the receiver's
estimated packet window, i.e.:
((sequence_number > GSNFR) &&
 (sequence_number < (GSNFR + estimated_receivers_window)).

The sender will use a fairness algorithm to estimate the receiver's packet
window and adjust the window up and down according to its own policy on how
much data can be outstanding in the path in at half the RTT. The sender
can verify that the receiver has in fact received packets by way of the XOR'd
bit validation in a way that the receiver can't cheat and lie that it has
received packets when it has not. This prevents the receiver from maliciously
pretending it has received packets where it has not and causing the sender
to over-estimate the capacity of the path or miscalculate RTT by the
receiver acknowledging packets faster than it has actually received them.

The sender will cryptographically randomly choose a parity bit for every
packet is sends over the wire.

The sender will include the parity bit of the packet representing the GSNR
packet. The sender will include the XORed parity-to-date up-to-and-including
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the GSNFR packet.

If the GSNFR equals the GSNR then the sender will set the EQ bit on the packet to 1 otherwise it will set it to 0 and include the vector/GSNFR additional header.

If the network in which the sender receives packets is ECN aware and marks packets with ECN, the sender will set the EC flag on a packet to 1 if the packet

The sender will mark the last packet in a series when no more data is available for sending at the moment with an AR flag.

The sender will automatically resend unacknowledged packets that are beyond haven't been acknowledged in the 2 times the total estimated RTT (Round Trip Time). The estimated RTT must never be lower than the negotiated MINIMUM-RTT.

A receiver can ACK packets received in two ways:
1) Any channel data packet sent in a series acts as an ACK for the channel
2) Send a STUN RELIABLE-CHANNEL-ACK indication or request

The receiver will ignore incoming packets with a sequence number that is less than the receiver's start window (the last fully ACKed packet) plus the receiver's window size. The receiver will ignore packets that have the GSNR parity incorrect for their sent packet. The receiver will close the connection if it receives any packets with the incorrect GP parity or the XP parity wrong from the same source:port:connection bound to the connection as this is an attempt either by a spoofer to inject data into the stream or by a client attempting to fake acknowledgements on packets it never received.

An IP spoofer could attempt to inject data into a stream by randomly flooding a receiver in attempt to hit within the sequence number window but they would have to fake the source IP:port and channel number in order for the attack to succeed. Thus it is recommended that the channel number is randomly chosen to make a spoof flood attack less likely to succeed.

Be aware that an IP spoofer may use the XP flag as an attack to attempt to close a connection to which they don't own by broadcasting packets but they are unlikely to know the correct sequence number window and channel number and thus would have to attempt to broadcast many packets in order to obtain a packet within the window. Obviously if they were sniffing and interfering with the network directly they could launch an attack but they already could interfere on a much deeper level in such situations which no protocol can stop but only detect. Adding security, such as TLS on top of RUDP is recommended to prevent faked data from being injected into a stream.

The receiver will ignore packets that are outside it's own receiving window (i.e. from the last fully ACKed packet to the last valid received packet plus the receiver's window). The receiver will ignore packets beyond its own receiving buffer capacity (i.e. total packets beyond a missing packet is greater than the receiver is willing to buffer).

If the AR flag was set on an accepted incoming packet for a packet with a sequence number greater than the last acknowledged, the sender will send an ACK packet immediately. The receiver can use a data packet for the ACK as long as it doesn't violate its own sending rules.

The receiver must send an ACK packet for packets that it didn't acknowledge yet within the window of the oldest unacknowledged packet plus one calculated RTT time frame. The calculated RTT must never be lower than the negotiated MINIMUM-RTT.

The receiver will acknowledge all packets it can every single data packet it sends out.

The receiver will calculate the latest RTT based on the acknowledgement of its last packet flagged with the AR bit. The calculated RTT must never be set lower than the negotiated MINIMUM-RTT.

With packets the receiver accepts, the receiver will look for

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acknowledgements that it can verify as accurate with the parity bits.
Older packets containing acknowledgements where the data is still available
to validate the parities can be used to acknowledge packets but never be
used to mark already acknowledged packets as having not been received.

Vector format is as follows:
+--------+--------+--------+--------
|SSLLLLLL|SSLLLLLL|SSLLLLLL|  ...
+--------+--------+--------+--------

 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+
|Sta| Run Length|
+-+-+-+-+-+-+-+-+

Sta[te] occupies the most significant two bits of each byte and can
have one of four values, as follows:

State  Meaning
-----  -------
0    Received
1    Received ECN Marked
2    Reserved
3    Not Yet Received

A "0" vector byte is used at the end of a RLE series for padding to the next
DWORD alignment (and if interpreted would be seen as "0" packets received).

NOTE: There is no guarantee that a "0" byte will be contained at the end
      of any vector RLE series as it is only used for padding.


-------------------------------------------------------------------------------
STUN REQUEST: RELIABLE-CHANNEL-OPEN

This STUN request is used to open a channel to a remote party. In an ICE
environment, the requester is always the ICE controlling party.

Will contain following attributes:

If sent over non-ICE to open an anonymous channel:
First send request without any attributes with get 401 back with
NONCE/REALM back.

USERNAME - is set to userRandomFragRemote:userRandomFromLocal. The random frag
           should be globally unique to not cause conflict and unguessable.
PASSWORD - is set to the userRandomFragRemote. The password is not included
           directly but instead used in the MESSAGE-INTEGRITY calculation.
           When the server issues a request it will reverse the fragments
           and use the userRandomFromLocal as the password.

NONCE - as indicated by server
REALM - as indicated by server

If sent over an established ICE channel:
USERNAME - is set to the userFragRemote:userFragLocal of the nominated ICE
           pairing (just like ICE BINDING requests).
PASSWORD - is set to the ICE password of the remote party of the nominated
           ICE pairing (just like ICE BINDING request). The password is not
           included directly but instead used in the MESSAGE-INTEGRITY
           calculation. Short-term credential calculation is used.
NONCE/REALM - not used.

The request will always contain:
LIFETIME - set to how long the channel should remain open before it is
           automatically closed (in seconds). Setting to zero will
           cause the channel to close immediately and there is no need to
           contain NEXT-SEQUENCE-NUMBER, MINUMIM-RTT or CONGESTION-CONTROL.
           Any data received on the channel or RELIABLE-CHANNEL-ACK will
           cause the LIFETIME attribute timeout countdown to be reset to the
           default.
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          If not specified, a LIFETIME of 10 minutes is assumed.
CHANNEL-NUMBER - set to the channel number the local party wishes the remote
                 party to use in all packets the remote party will send to
                 itself.
NEXT-SEQUENCE-NUMBER - set to the first sequence number-1 that
                       will be sent from this location (the first sequence
                       number must be at least 1 but less than 2^48-1)
MINUMIM-RTT - set to the number of milliseconds for the minimum RTT (Round Trip
              Time). The request may contain the MINUMIM-RTT attribute to
              indicate a minimum RTT it wishes to negotiate with the remote
              party.
CONGESTION-CONTROL - A list of congestion control algorithms available to use
                     by the sender with the preferred listed first. There
                     must be two of these attributes, one representing the
                     local (requester) congestion to use and one representing
                     the remote (responder) congestion algorithm.
CONNECTION-INFO - A string representing whatever additional information is
                  required to exchange upon connection.

Response will contain (signed with message integrity):
LIFETIME - The responder can always choose a value lower than the requested
           LIFETIME of the requester but never can respond with "0" unless
           the requester sent "0". This is a negotiated value between requester
           and responder. The channel is kept alive by any channel data being
           sent or by RELIABLE-CHANNEL-ACK requests/indications. If the
           responder wishes to close the channel at a later date the responder
           can chose to issue its own CHANNEL open in the reverse direction
           with a LIFETIME of "0" with the CHANNEL-NUMBER being set to the
           CHANNEL-NUMBER the responder is currently expecting to receive
           from the remote party.

           If not specified, a LIFETIME of what the requester asked is assumed.
NEXT-SEQUENCE-NUMBER - set to the first sequence number-1 that
                       will be sent from this responder (the first sequence
                       number must be at least 1 but less than 2^48-1).
CHANNEL-NUMBER - set to the channel number the responder party wishes the
                 requester to use in all packets it will send to the
                 responder.
MINUMIM-RTT - set to the number of milliseconds for the minimum RTT (Round Trip
              Time) that the response party will accept. If the response
              agrees with the minimum value by the requester it does not
              need to include this attribute. The response may contain this
              attribute value containing a larger than the requester if it
              wishes to negotiate a larger minimum RTT between the two parties
              but can never choose a shorter minimum RTT than the requester.
CONGESTION-CONTROL - A list of congestion control algorithms available to use
                     by the receiver with the selected algorithm listed first.
                     The selected algorithm must be within the list offered
                     by the requester. If the attribute is missing then the
                     responder is assumed to use the algorithm preferred by
                     the requester. Typically, two of these attributes are
                     present in the response, one for the local (i.e.
                     responder) and one for the remote (requester).
CONNECTION-INFO - A string representing whatever additional information is
                  required to exchange upon connection.


When a channel is open for the first time, the responder does not start
sending data until the requester first sends data or sends an ACK. This is
required to ensure the response actually arrived to the requester and thus
proving the negotiation completed.

If either party responds to a renegotiation attempt (i.e. a new
RELIABLE-CHANNEL-OPEN with changed attributes on the same channel, it must
cease sending channel data until a data packet or ACK is received with a
remote sequence number equal or than the sequence number in the request.

If both parties attempt a simutanious renegotiation attempt a
"487 Role Conflict" should result unless the negotiated request from the
remote party is completely compatible with the outstanding negotiated
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request issued from the local party.

If either party was attempting to close the channel but an error was received as a response, the channel should therefor be considered closed (except in the case where the NONCE is reported as stale).

STUN REQUEST/INDICATION: RELIABLE-CHANNEL-ACK

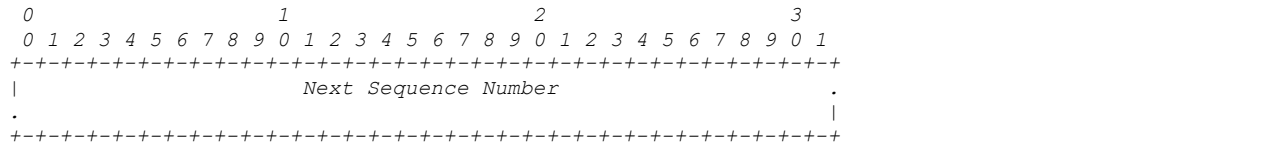
Either party can send this as a request or indication. The NONCE/REALM are only needed on a non-ICE situations. All other attributes must be present in request, except the ACK-VECTOR if it is not needed (i.e. when the only packet sequence number missing is the GSNR-1). If not send as an indication then a response is required and the response must contain the same attributes as listed for the request except the USERNAME, NONCE and REALM.

USERNAME - same logic as RELIABLE-CHANNEL-OPEN
PASSWORD - same logic as RELIABLE-CHANNEL-OPEN
REALM/NONCE - same logic as RELIABLE-CHANNEL-OPEN
CHANNEL-NUMBER - set to the channel number the local party wished the remote party to use in all packets the remote party sent to itself.
NEXT-SEQUENCE-NUMBER - set to the next sequence number the requester will send over the wire (but has not sent yet).
GSNR - set to the greatest sequence number seen from the remote party.
GSNFR - set to greatest sequence number up to which all packets have been received.
RELIABLE-FLAGS - Flags indicating the parity or other useful information
ACK-VECTOR - Vector RLE in the same fashion as in the data packet.

A successful response (MESSAGE-INTEGRITY is not required) will indicate closure is complete. A failure response indicates the request/channel was not understood properly and the client should consider it closed, except a 483 where a packet must be re-issued to satisfy the NONCE being stale.

STUN ATTRIBUTE: NEXT-SEQUENCE-NUMBER

This is a 64bit unsigned integer attribute indicating the next sequence number the requester or responder expects to send (but has not sent).



STUN ATTRIBUTE: GSNR

This is a 64bit unsigned integer attribute indicating the Greatest Sequence Number Received by the requester/responder encoded in the same method as the NEXT-SEQUENCE-NUMBER attribute.

STUN ATTRIBUTE: GSNFR

This is a 64bit unsigned integer attribute indicating the Greatest Sequence Number Fully Received by the requester/responder encoded in the same method as the NEXT-SEQUENCE-NUMBER attribute. In other words, all the packets that have been received to date up to a certain sequence number. If the GSNR is the same value as the GSNFR then this attribute is optional. If this attribute was not received on a RELIABLE-ACK then the GSNFR is assumed to be the same value as the GSNR.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STUN ATTRIBUTE: MINIMUM-RTT

This is a 32bit unsigned integer representing the minimum RTT in milliseconds
negotiated by the two parties.

 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Minimum-RTT                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


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STUN ATTRIBUTE: CONNECTION-INFO

An encoded string used at channel open to add additional information about
the connection. The interpretation is entirely dependant on the context.


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STUN ATTRIBUTE: RELIABLE-FLAGS

The reliable flags are flags needed to indicate the parity bits and other
acknowledgement flags encoded in 4 bytes. The first byte is the only byte used
at this time.

 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|V|P|X|D|E|   R   | RFFU (Reserved For Future Use)                |
|P|G|P|P|C|       | (must be set to "0" on send and ignored)      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

VP - XOR'ed parity of all packets marked as received in the ACK-VECTOR
     attribute (starting with the calculated XORed to-date-up-to-and
     including the GSNFR) - Same meaning as the "P" flag on the vector/GSNFR
     header in the data packet.
PG = Parity of the Greatest Sequence Number Received
XP = XOR'd parity of all packets received up-to-and-including the GSNFR
DP = Duplicate packets have been received since the last ACK packet was sent.
EC = ECN (Explicit Congestions Notification) received on incoming packet
     since last packet in sequence sent
R  = RFFU (Reserved For Future Use). Must be set to "0" on sending and ignored
     upon receipt


--------------------------------------------------------------------------------
STUN ATTRIBUTE: ACK-VECTOR

Has the same meaning and encoding as the optional vector encoded after the
vector/GSNFR header. The "P" flag from the vector header is contained in the
VP flag of the RELIABLE-FLAGS attribute.


--------------------------------------------------------------------------------
STUN ATTRIBUTE: CONGESTION-CONTROL

 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|D|     RFFU    |     RFFU      | Profile preferred or selected |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
/ Profile preferred or selected | Profile preferred or selected /
+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+
/ Profile preferred or selected | [Profile/padding as required] /
+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+

The first byte is reserved for flags with only one flag available at this time.
D = Direction. If "0" the congestion control list applies to the "local"
               party. If "1" the congestion control list applies to the
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                "remote" party.
                When receiving a request, the remote will apply to the responder
                and the local will apply the requester. When receiving a reply
                the remote will apply to the requester and the local will apply
                to the responder.
RFFU - All bits should be set to "0" and ignored upon receipt.

The second byte is RFFU.

This is a list of unsigned 16bit integers representing the congestions
profile algorithms offered or accepted. The preferred or selected algorithm
must be listed first. The order of the algorithms is assumed to be the
preferred order of the requester or responder. The responder must select an
algorithm within the list offered by the remote party.
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Open Peer Signaling Protocol

Non Encrypted XML Signaling Protocol

The signalling protocol used for Open Peer is simple XML based protocol and uses RUDP or SCP as the transport.

The packaging of an XML message for deliver to a peer entity is extremely simple when no encryption is used (known as "text/x-open-peer-xml-plain"):

- Message Size [4 bytes in network order] - The length of the raw XML message about to be received
- XML data – the XML message data to be receive of exactly the message size specified (no NUL termination is required or expected).

Encrypted XML Signalling Protocol Using TLS

Open Peer can utilize standard TLS to connection from a peer to a server. In this mode the messaging is encoded exactly the same except delivered through a TLS pipe over RUDP, also using the RUDP mime type of "text/x-open-peer-xml-tls".

Encrypted XML Signalling Protocol Using Messaging and Not Using TLS

Open Peer has one important expectation difference from the typical TLS scenario and thus offers an an alternative offering to TLS for signalling called "text/x-open-peer-xml-mls", where MLS = Message Layer Security as opposed to TLS which is Transport Layer Security).

TLS is majority used by HTTPS (although not exclusively) under a scenario where an anonymous client without any public/private key connects to a server that has a public/private key whose identity is validated from a trusted authority chain, such as VeriSign or Thawte. In such a situation, TLS requires negotiation to establish a bidirectional channel with known trust chains to verify the servers identity and prevent man-in-the-middle attacks without ever being able to validate the identity of the client (unless prearranged private data is exchanged additionally in the application layer).

In the Open Peer case, all peers have a public and private key, without exception, be it peer to peer or peer to server. In all cases, a peer initiating a connection always knows the public key of the designation peer in advance (thus avoiding man-in-the-middle attacks) of the connection itself. Trust is established via the Bootstrapper's introduction to services as well as Identity Providers that provide Asserted Identities.

Open Peer connections can take advantage of this situation by utilizing the pre-known public key in the initiating side to simplify the negotiation scenario and offer unidirectional encrypted streams.

The format for the unidirectional message is as follows:

- Encryption Key/Algorithm Selected [where 0 = key/algorithm negotiation] – When negotiating, a list of keys and algorithm for use on the receiver's side presented to the receiving party plus mandatory offer of public key of the sender's side. The reverse side will answer with their own "0" algorithm, offering algorithms and keys and of the receiver's side for use by the sender's side (i.e. the peer that initiated the connection).
- Encrypted data bundle size
- Data bundle, consisting of:
    - XML message encrypted using the algorithm/key selected
    - Hash of the data encrypted using the algorithm/key selected

(NOTE: The specifics of the on-the-wire format need to be further defined)

The advantage of pre-knowing the key by the sender allows for unidirectional encryption with different keys being used in each direction and allows for encryption to begin in both directions in a single round trip negotiation.

Message level security is not to be used except for this specific scenario and only when the keys are pre-known by the initiator of the connection and where both parties have public and private keys. Further, this is a message centric encryption and not stream level encryption as offered by TLS. Finally, Asserted Identities must be validated at the application layer by exchanging Asserted Identity information in correlation with Public Peer Files.

General Request, Reply, Notify and Result Formation

All request types and results use a simplified XML format. The messages are sent either over HTTPS/TLS/MLS/Message or over RUDP/UDP or SCP protocols. Alternative protocols are acceptable so long as they maintain the integrity and public/private key aspects of these protocols.

Every request type must include an ID and a method being invoked. Every result message must mirror the request type's ID and include an epoch (whereas the epoch is optional on request types).

XML signatures are used to verify signatures within the XML. The assumed "without comments" canonical form of XML is (unless otherwise specified within the XML signature): http://www.w3.org/TR/xml-c14n

To prevent the requirement the canonical parser from understanding default XML attributes, all default element attributes inside a signed section must be specified by the entity signing the document or in data requested to be signed by that entity in turn and not exclusively defaulted within any DTD (which might not be available to the signing or verifying party).

Where XML namespaces are required, all the namespaces declarations must be specified on the root element being signed (and thus all sub elements are assumed to inherent the same namespaces).

The client may receive an error complaining that a request has expired if the client's clock was set slightly wrong (401). Hence in every result, the epoch of the server will be sent for the client to detect potential clock errors. To reduce issues, the client should use a secure NTP service to set its own clock at some point before initiating contact to a server or another peer.

The client is responsible for disconnecting at all times from the server. In the case of peer to peer, the initiating peer is considered the client role and the receiving peer plays the server role.

There are exceptions to this rule. The server will close a connection without warning based on two inactivity time-outs. The larger timeout is based upon an expiry window when the entity is known or "registered" to the server. The smaller timeout window of inactivity (chosen and unspecified at the discretion of the server) is based on not having received any request or notification on a channel within that defined timeframe. If either of those two timeouts occurs, the server may disconnect which is typically the responsibility of the client. The server may disconnect any client it sees as likely malicious behaviour.

If a client disconnects without sending the unregister request, the server should assume the client disconnected prematurely and will discard any associated sessions.

Other disconnection rules are specified whenever they are exceptions to the rule or the exceptions.

General Result Error Code Reasons

Error replies appear as follows:

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="method"
epoch="439439493">
 <error>
  <reason id="404">Not Found</reason>
 </error>
</result>
```

The reasons codes closely match the HTTP error code specification for familiarity. Error results may contain additional information depending on the error and requirements of the error result.

301 – Moved Permanently

The requested Peer Contact has changed and is now registering itself under a new Peer Contact. The client's response should be to resolve again the Identity that pointed to the original Peer Contact in an attempt to locate the new Peer Contact.

400 – Bad Request

The method in the request is not valid.

401 – Unauthorized

One of the security checks has failed to pass in the request. The server may issue information on what exactly failed to authorize to assist debugging the issue.

403 – Forbidden

The data specified is invalid and fixing any security check issues will not fix the situation. The server may issue information on what exactly was the issue with the data to assist debugging the issue.

404 – Not Found

This error is returned if the requested Peer Contact, session or other resource is not found. This error is also returned from any request where the session or Peer Contact was valid but is no longer valid, e.g. situations where requests have been made to sessions which have already been unregistered yet unknown to the connected client due to the nature of asynchronous eventing.

A 404 error does not mean the resource never existed or will not exist in the future. The contact may not be registered at this time and that would cause a 404 error even though in the past it may have been registered.

409 - Conflict

A conflict has occurred, such as an edit conflict with version numbers.

426 - Upgrade Required

A client has requested a method that is not accessible since an upgrade is required. This will be sent if a client's certificates have expired and attempt to access a method or may be sent if a client is using an out-dated request.

480 – Temporarily Unavailable

The request may optionally include an expiry when the request can be tried again.

Bootstrapper Service Requests

The communication to the Bootstrapper is done over HTTPS exclusively whose HTTPS server certificate was signed by one of the trusted root Internet certification authorities. For security purposes, the Bootstrapper is the introducer to all other services within the network including appropriate security credentials to connect to each network component.

Locating the Boostrapper

Overview – DNS SRV

The Bootstrapper is the introductory service into the domain responsible for a Peer Contact and DNS is used to locate the Bootstrapper.

A peer contact is written in the following form:
peer://domain.com/e433a6f9793567217787e33950211453582cadff

And an identity is written in the following form:
identity://domain.com/alice

In both cases, an SRV request is this performed on "domain.com", using the SRV prefix of "_bootstrapper._tls":
_bootstrapper._tls.domain.com

Should the SRV record fail to resolve, a follow up DNS A-record lookup is assumed to be the domain directly:
domain.com

The subsequent resulting A-record results are used in the HTTPS request lookup:
https://a-record.domain.com/services-get

Clients must confirm the A-record comes from the same domain as the original SRV request and reject any records that do not and they must also ensure that only one level of prefix has been added to the domain for the A-record, i.e. for 'domain.com', "dogs.domain.com" would be legal but "cats.dogs.domain.com" would not be considered legal.

Services Get Request

Purpose

This request is required to obtain a list of services available on the peer network as well as establish a hierarchy of certificate trust.

Inputs

None.

Returns

- Service ID
- Service Type
- URL
- API Version
- Public key information [optional when protocol used is not based on a root certificate authority]

Security Considerations

The client must ensure the server has an HTTPS certificate that was issued by a root certificate authority and that the certificate offered by the server is still within the X.509 validity date. The certificate authority for some Bootstrapped Networks may be pre-built into a client application and verified as accurate and can respond to mismatch as deemed appropriate by the client. The client may issue more than one certificate per service should an overlap window of X.509 certificate validity be required.

The server does not need to know or verify a client's intentions.

The request nor the response should have an ID associated with the request/response and should not include an epoch. This is the only request in the system that has this exception. This allows for a hard-coded file to be uploaded on a server as the response to any request on the system to allow for easy service delegation without installing any server side scripting.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="example.com"
method="services-get">
</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="example.com"
method="services-get">

 <services>
  <service id="9bdd14ddad8465b6ee3fdd174b5d5bd2">
   <type>bootstrapper</type>
   <uri>https://bootstrapper.example.com/</uri>
   <version>1.0</version>
  </service>
  <service id="596c4577a4efb2a13ded43a3851b7e51577ad186">
   <type>bootstrapped-finders</type>
   <uri>https://finders.example.com/</uri>
   <version>1.0</version>
  </service>
  <service id="596c4577a4efb2a13ded43a3851b7e51577ad186">
   <type>certificates</type>
   <uri>https://certificates.example.com/</uri>
   <version>1.0</version>
  </service>
  <service id="0c16f792d6e0727e0acdd9174ae737d0abedef12">
   <type>peer-contact</type>
   <uri>https://peer-contact.example.com/</uri>
   <version>1.0</version>
  </service>
  <service id="d0b528b3f8e66455d154b1deac1e357e">
   <type>identity-lookup</type>
   <uri>https://identity-lookup.example.com</uri>
   <version>1.0</version>
  </service>
  <service id="f98b4d1ff0f1acf3054fefc560866e61">
   <type>identity</type>
```

```
    <uri>https://identity-login.example.com</uri>
    <version>1.0</version>
   </service>
   <service id="db144bb314f8e018f103033cbba7d52e">
    <type>salt</type>
    <uri>https://salt.example.com/</uri>
    <version>1.0</version>
   </service>

   <service id="db144bb314f8e018f103033cbba7d52e">
    <type>example</type>
    <uri>peer://example.com/5ff106c7db894b96a1432c35c246f36d8414bbd3</uri>
    <version>1.0</version>
    <KeyInfo><KeyName>DN=example.com, SN=something, ID=8cd14dda3fddd5bd2</KeyName></KeyInfo>
   </service>
  </services>

 </result>
```

Bootstrapped Finder Service Requests

Finders Get Request

Purpose

This request returns a list random possible peer finders that a client can attempt a connection for the sake of registering or finding other peers.

Inputs

The total number of server entries desired (which the server can choose to ignore and return less servers than requested, but never more).

Returns

Returns a list of Finders containing the following information for each Finder:

- Transport
- SRV record [or pre-resolved comma separated IP:port pair locations]
- Public key for the finder – Can be either the full X.509 certificate or a key name lookup for certificates returned from the certificate server
- Weight / priority - default values for SRV like weight/priority when SRV entry is pre-resolved IP:port pairs
- Geographic region ID – (optional) each server belongs to a logical geographic region (clients can organize servers into geographic regions for fail over reasons)

Security Considerations

The client must ensure the server has an HTTPS certificate that was issued by a root certificate authority and that the certificate offered by the server is still within the X.509 validity date. The client should check the validity of each finder by verifying each finder was signed by a "Finder" service for the same domain as the requested Bootstrapper. The server does not need to verify a client's intentions.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="example.com"
method="finders-get" id="abd23">

 <servers>2</servers>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="example.com"
method="finders-get" id="abc123" epoch="439439493">

 <finders>
  <finderBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
   <finder id="4bf7fff50ef9bb07428af6294ae41434da175538">
    <transport>rudp/udp</transport>
    <srv>finders.example.com</srv>
    <KeyInfo><X509Data><X509Certificate>MIIDCCA0+gA...lVN</X509Certificate></X509Data></KeyInfo>
    <weight>1.0</weight>
```



```
    <priority>1.0</priority>
    <region>1</region>
   </finder>
   <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
    <SignedInfo>
     <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
     <Reference URI="#4bf7fff50ef9bb07428af6294ae41434da175538">
      <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
      <DigestValue>jeirjLrta6skoV5/A8Q38Gj4j323=</DigestValue>
     </Reference>
    </SignedInfo>
    <SignatureValue>DEfGM~C0/Ez=</SignatureValue>
    <KeyInfo><KeyName>DN=example.com, SN=finder, ID=9bdd14dda3fdd174b5d5bd2</KeyName></KeyInfo>
   </Signature>
  </finderBundle>
  <finderBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
   <finder id="a7f0c5df6d118ee2a16309bc8110bce009f7e318">
    <transport>rudp/udp</transport>
    <srv>100.200.100.1:4032,5.6.7.8:4032</srv>
    <KeyInfo><X509Data><X509Certificate>MIID5A0+gA...lVN</X509Certificate></X509Data></KeyInfo>
    <priority>10</priority>
    <weight>0</weight>
    <region>1</region>
   </finder>
   <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
    <SignedInfo>
     <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
     <Reference URI="#a7f0c5df6d118ee2a16309bc8110bce009f7e318">
      <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
      <DigestValue>YTdmMGM1ZGY2ZDExOGVlMmExNjMwJjZTAwOWY3ZTMxOA==</DigestValue>
     </Reference>
    </SignedInfo>
    <SignatureValue>OjY2OjZlOjZhOjcyOjY2OjcyOjcyIChsZW5ndGg9OSk=</SignatureValue>
    <KeyInfo><KeyName>DN=example.com, SN=finder, ID=9bdd14dda3fdd174b5d5bd2</KeyName></KeyInfo>
   </Signature>
  </finderBundle>
 </finders>

</result>
```


Certificates Service Requests

Certificates Get Request

Purpose

This request returns a list of public key X509 certificates used for signing in the domain for every service.

Inputs

None.

Returns

Returns a list of service certificates containing the following information for each certificate:

- Certificate ID
- Service name
- Expiry
- X.509 public key certificate

Security Considerations

The client must ensure the server has an HTTPS certificate that was issued by a root certificate authority and that the certificate offered by the server is still within the X.509 validity date. The server does not need to verify a client's intentions. The client should verify that each key was signed correctly from the Bootstrapper service key. This allows the clients to cache the certificate bundles while avoiding potential tampering.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="example.com" id="abd23"
method="certificates-get">
</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="example.com" id="abc123"
method="certificates-get" epoch="439439493">

 <certificates>
  <certificateBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
   <certificate id="4bf7fff50ef9bb07428af6294ae41434da175538">
    <service>finder</service>
    <expires>48348383</expires>
    <KeyInfo><X509Data><X509Certificate>MIIDCCA0+gA...lVN</X509Certificate></X509Data></KeyInfo>
   </certificate>
   <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
    <SignedInfo>
     <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
     <Reference URI="#4bf7fff50ef9bb07428af6294ae41434da175538">
      <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
      <DigestValue>jeirjLrta6skoV5/A8Q38Gj4j323=</DigestValue>
     </Reference>
    </SignedInfo>
    <SignatureValue>DEfGM~C0/Ez=</SignatureValue>
    <KeyInfo><KeyName>DN=example.com, SN=boostrapper, ID=9bdd14dda3fddd5bd2</KeyName></KeyInfo>
   </Signature>
  </certificateBundle>
```

```
  <certificateBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
   <certificate id="9bdd14dda3fddd5bd2">
    <service>bootstrapper</service>
    <expires>48348383</expires>
    <KeyInfo><X509Data><X509Certificate>OWJkZD...GQ1YmQy=</X509Certificate></X509Data></KeyInfo>
   </certificate>
   <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
    <SignedInfo>
     <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
     <Reference URI="#9bdd14dda3fddd5bd2">
      <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
      <DigestValue>jeirjLrta6skoV5/A8Q38Gj4j323=</DigestValue>
     </Reference>
    </SignedInfo>
    <SignatureValue>DEfGM~C0/Ez=</SignatureValue>
    <KeyInfo><KeyName>DN=example.com, SN=boostrapper, ID=9bdd14dda3fddd5bd2</KeyName></KeyInfo>
   </Signature>
  </certificateBundle>
  <certificateBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
   ...
  </certificateBundle>
 </certificates>

</result>
```


Peer Contact Service Requests

Public Peer Files Get Request

Purpose

This request retrieves the information needed to perform a social sign-in request for a particular domain and identity.

Inputs:

List of peer contacts to fetch containing:

- Contact URI
- Contact profile secret proof - (Required or option) proof that the information about the contact was obtained legally. If server wishes to allow the contact to completely public, it can opt to not require the contact profile secret. Proof = hash("proof:" + <contact-id> + ":" + <contact-profile-secret>)

Returns:

List of public peer files for each valid Peer Contact URI, returned in the same order of the request, leaving out any peer files that fail to pass the proof when required.

Security Considerations

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="domain.com" id="abd23"
method="public-peer-files-get">

 <peers>
  <peer>
   <contact>peer://domain.com/dd281431f43a760ac1cf903fd63e14072b1cfd58</contact>
   <contactProfileSecretProof>bc33bd66f2d827c53056a3f7b27dd329ef7afe9c</contactProfileSecret>
  </peer>
  <peer>
   <contact>peer://domain.com/36c63b229bd9351e2f5bf2a14118139c0ea923e0</contact>
   <contactProfileSecretProof>45a88e124c55b45a69bf969372a07d0306426368</contactProfileSecret>
  </peer>
   ...
 </peers>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="public-peer-files-get" epoch="439439493">

 <peers>
  <peer version="1">...</peer>
  <peer version="1">...</peer>
   ...
 </peers>

</result>
```

Peer Contact Login Request

Purpose

This request allows user access to an account based on proving that the private peer file secret is known or by proving a login via a previously associated identity.

Inputs:

- Contact URI
- Client nonce – one time use cryptographically randomly generated string
- Either:
    - Proof of 'private peer file secret' – proof that the private peer file secret is known by the client, proof = hash("private-peer-file-get:" + <client-nonce> + ":" + <expires> + ":" + hash("proof:" + <peer-contact-id> + ":" + <private-peer-file-secret>))
    - Expiry of proof for 'private peer file secret' – window in which this proof is considered valid
- Or:
    - Identity ID – which identity is being logged in to this peer contact
    - Identity provider – which provider is providing service for this identity
    - Identity access token
    - Identity access secret proof – proof = hash("identity-login-validate:" + <identity> + ":" + <client-nonce> + ":" + <expires> + ":" + <access-token> + ":" access-secret)
    - Identity access secret proof expiry – window in which access secret proof is considered valid

Returns:

- Contact access token – token tied to account allocated to peer contact
- Contact access secret – secret required to prove access to peer contact account
- Contact access expiry – when the contact access will expire
- Peer file (re)generation requested – (1=true, 0 = false), if the server wants the client to generate or regenerate a public/private peer file pair the value is set to 1

Security Considerations

If login is done by identity, the identity must be previously associated to the peer contact and proof of the identity login must be validated via the associated identity provider.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="domain.com" id="abd23"
method="peer-contact-login">

 <contact>peer://domain.com/dd281431f43a760ac1cf903fd63e14072b1cfd58</contact>
 <clientNonce>79d4c3381537a19c9aacfcf77d4c3c19675f4654</clientNonce>

 <-- either this -->
 <privatePeerFileSecretProof>7f3fd482949a665558e86cafa80dcd81756b5997</proof>
 <privatePeerFileSecretProofExpires>699594594</privatePeerFileSecretProofExpires>

 <-- or this -->
 <uri>identity://domain.com/alice</uri>
```



```
 <identityAccessToken>a913c2c3314ce71aee554986204a349b</identityAccessToken>
 <identityAccessSecretProof>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</identityAccessSecretProof>
 <identityAccessSecretProofExpires>43843298934</identityAccessSecretProofExpires>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="peer-contact-login" epoch="439439493">

 <contactAccessToken>a913c2c3314ce71aee554986204a349b</contactAccessToken>
 <contactAccessSecret>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</contactAccessSecret>
 <contactAccessExpires>8483943493</contactAccessExpires>
 <peerFilesRegenerate>0</peerFilesRegenerate>

</result>
```

Private Peer File Get Request

Purpose

This request retrieves a private peer file stored on the server, provided correct proof of the key to decrypt the peer file is provided.

Inputs:

- Client nonce – one time use cryptographically randomly generated string
- Contact access token – as returned from the peer "peer contact login" request
- Contact access secret proof – proof of the contact secret calculated from value returned from "peer contact login" request, proof = hash("private-peer-file-get:" + ":" <client-nonce> + ":" + expires + ":" + <client-access-token> + ":" <client-access-secret>)
- Expiry of 'contact access secret proof' – window in which the proof provided is considered valid
- Proof of 'private peer file secret' – proof that the private peer file secret is known by the client, proof = hash("private-peer-file-get:" + <client-nonce> + ":" + <expires> + ":" + hash("proof:" + <peer-contact-id> + ":" + <private-peer-file-secret>))
- Expiry of proof for 'private peer file secret' – window in which this proof is considered valid

Returns:

Private peer file associated to peer contact.

Security Considerations

As the private peer file is encrypted, the client must prove it knows the correct private peer file secret before even being able to download this file. Unless the client has the correct private peer file secret, the client will be unable to decrypt the private peer file. The additional proof is required as the client did not have to login to the account using the private peer file secret and the client must never be allowed to download the private peer file without correct proof of the private peer file secret (i.e. in case an identity provider that was used for login was compromised).

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="domain.com" id="abd23"
method="private-peer-file-get">

 <clientNonce>79d4c3381537a19c9aacfcf77d4c3c19675f4654</clientNonce>
```

```
 <contactAccessToken>a913c2c3314ce71aee554986204a349b</contactAccessToken>
 <contactAccessSecretProof>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</contactAccessSecretProof>
 <contactAccessSecretProofExpires>699594594</contactAccessSecretProofExpires>

 <privatePeerFileSecretProof>7f3fd482949a665558e86cafa80dcd81756b5997</proof>
 <privatePeerFileSecretProofExpires>699594594</privatePeerFileSecretProofExpires>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="private-peer-file-get" epoch="439439493">

 <privatePeer ...>...</privatePeer>

</result>
```

Private Peer File Set Request

Purpose

This request retrieves a private peer file stored on the server, provided correct proof of the key to decrypt the peer file is provided.

Inputs:

- Client nonce – one time use cryptographically randomly generated string
- Contact access token – as returned from the peer "peer contact login" request
- Contact access secret proof – proof of the contact secret calculated from value returned from "peer contact login" request, proof = hash("private-peer-file-set:" + ":" + <client-nonce> + ":" + <expires> + ":" + <client-access-token> + ":" + <client-access-secret>)
- Expiry of 'contact access secret proof' – window in which the proof of the contact access secret is considered valid
- Public peer file – as generated by the client
- Private peer file – as generated by the client

Returns:

Success or failure.

Security Considerations

The peer contact can set a new private peer file at any time by generating a new public/private peer file pair. If a previous private peer file was not set, expired, or became compromised, a new public/private peer file pair can be set.

If a new private peer file is set then all the relogin access information associated to each identity is discarded since that relogin information will no longer be able to be decrypted (since no two private peer files should ever share the same private peer file secret and the relogin information was encrypted using this secret). The client should update all the associated identities to reset the relogin access key associated with each identity by encrypting the relogin access key information with the new private peer file secret.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="domain.com" id="abd23"
method="private-peer-file-set">

 <clientNonce>79d4c3381537a19c9aacfcf77d4c3c19675f4654</clientNonce>
 <contactAccessToken>a913c2c3314ce71aee554986204a349b</contactAccessToken>
 <contactAccessSecretProof>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</contactAccessSecretProof>
 <contactAccessSecretProofExpires>699594594</contactAccessSecretProofExpires>

 <peer ...>...</peer>
 <privatePeer ...>...</privatePeer>


</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="private-peer-file-set" epoch="439439493">

</result>
```

Peer Contact Identity Associate Request

Purpose

This request causes identities to become associated (or to be removed from association) to a peer contact.

Inputs:

- Client nonce – one time use cryptographically randomly generated string
- Contact access token – as returned from the peer "peer contact login" request
- Contact access secret proof – proof of the contact secret calculated from value returned from "peer contact login" request, proof = hash("peer-contact-associate:" + ":" + <client-nonce> + ":" + <expires> + ":" + <client-access-token> + ":" <client-access-secret>)
- Expiry of the 'contact access secret proof' – window in which the contact access secret proof is considered valid
- List of identities to be associated containing:
    - Disposition ("update" or "remove")
    - Original identity
    - Identity provider – which provider is providing service for this identity
    - Relogin access key (encrypted) – (optional), the access key to relogin as this identity, key = hash("relogin:" + <identity> + ":" + ":" + <private-peer-file-secret>), iv=hash(<identity-secret-salt> + ":" + <private-peer-file-salt>)

Returns:

List of identities remaining associated containing:

- Original identity
- Provider of the identity
- Identity last reset – (optional), when the identity was last reset; if the timestamp is updated the client must relogin as this identity

- Relogin access key (encrypted) – (optional), the access key to relogin as this identity, key = hash("relogin:" + <identity> + ":" + ":" + <private-peer-file-secret>), iv=hash(<identity-secret-salt> + ":" + <private-peer-file-salt>)

Security Considerations

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="peer-contact-identity-associate">

 <clientNonce>79d4c3381537a19c9aacfcf77d4c3c19675f4654</clientNonce>
 <contactAccessToken>a913c2c3314ce71aee554986204a349b</contactAccessToken>
 <contactAccessSecretProof>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</contactAccessSecretProof>
 <contactAccessSecretProofExpires>699594594</contactAccessSecretProofExpires>

 <identities>
  <identity disposition="update">
   <uri>identity://domain.com/alice</uri>
   <provider>domain.com</provider>
   <identityLastReset>74374737283</identityLastReset>
   <identityReloginAccessKeyEncrypted>WVRreE1...PR0poTlQwPQ==</identityReloginAccessKeyEncrypted>
  </identity>
  <identity disposition="update">
   <uri>identity:phone:16045551212</uri>
   <provider>example.com</provider>
   <identityLastReset>74374737293</identityLastReset>
   <identityReloginAccessKeyEncrypted>YTkxMTQrY...mY4OGJhNT0=</identityReloginAccessKeyEncrypted>
  </identity>
  <identity disposition="remove">
   <uri>identity://example.com/alice</uri>
   <identityLastReset>74374737243</identityLastReset>
   <provider>domain.com</provider>
  </identity>
  ...
 </identities>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="peer-contact-identity-associate" epoch="439439493">

 <identities>
  <identity>
   <uri>identity://domain.com/alice</uri>
   <provider>domain.com</provider>
   <identityReloginAccessKeyEncrypted>WVRreE1...PR0poTlQwPQ==</identityReloginAccessKeyEncrypted>
  </identity>
  <identity>
   <uri>identity:phone:16045551212</uri>
   <provider>example.com</provider>
   <identityReloginAccessKeyEncrypted>YTkxMTQrY...mY4OGJhNT0=</identityReloginAccessKeyEncrypted>
  </identity>
  ...
 </identities>

</result>
```

Peer Contact Identity Association Update Request

Purpose

This request updates an identity association with a peer contact by an identity provider.

Inputs:

- Original identity URI
- Identity provider
- Action – the action to take, one of following:
  - "credentials-reset" – request the credentials associated to this identity be forgotten (thus causing a relogin of the identity)
  - "regenerate-peer-files" – request the client regenerate it's private / public peer files
  - "disassociate" – remove the association to this identity
- Proof containing:
  - Nonce – onetime use key
  - Expiry of proof – when the proof is no longer considered valid
  - Signed by identity service

Returns:

Success or failure.

Security Considerations

The proof must be signed by the same domain as the identity provider and the certificates must be validated to prove this validation.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="peerservice.com"
id="abd23" method="peer-contact-identity-association-update">

 <identity>
  <uri>identity://domain.com/alice</uri>
  <provider>domain.com</provider>
 </identity>

 <action><type>regenerate-peer-files<type></action>

 <proofBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
  <proof id="b5dfaf2d00ca5ef3ed1a2aa7ec23c2db">
   <nonce>bddbfd70e0ff7d61d50092d4631e744be0c5de6c</nonce>
   <expires>65439343</expires>
  </proof>
  <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
   <SignedInfo>
    <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
    <Reference URI="#b5dfaf2d00ca5ef3ed1a2aa7ec23c2db">
     <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
     <DigestValue>IUe324koV5/A8Q38Gj45i4jddX=</DigestValue>
    </Reference>
   </SignedInfo>
   <SignatureValue>MDAwMDAwMGJ5dGVzLiBQbGVhc2UsIGQ=</SignatureValue>
   <KeyInfo><KeyName>DN=provider.com, SN=identity, ID=b7ef37...4a0d58628d3</KeyName></KeyInfo>
  </Signature>
 </proofBundle>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="peer-contact-identity-association-update" epoch="439439493">

</result>
```


Peer Contact Services Get Request

Purpose

This request retrieves gets a list of peer contact services available to the peer contact.

Inputs:

- Client nonce – one time use cryptographically randomly generated string
- Contact access token – as returned from the peer "peer contact login" request
- Contact access secret proof – proof of the contact secret calculated from value returned from "peer contact login" request, proof = hash("peer-contact-services-get:" + ":" + <client-nonce> + ":" + <expires> + ":" + <client-access-token> + ":" + <client-access-secret>)
- Expiry of the 'contact access secret proof' – window in which the contact access secret proof is considered valid

Returns:

List of services available to peer contact services, typically:

- STUN server to use (SRV record or comma separated IP address records)
- TURN server (SRV record or comma separated IP address records), TURN username, and TURN password

Security Considerations

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="domain.com" id="abd23"
method="peer-services-get">

 <clientNonce>79d4c3381537a19c9aacfcf77d4c3c19675f4654</clientNonce>
 <contactAccessToken>a913c2c3314ce71aee554986204a349b</contactAccessToken>
 <contactAccessSecretProof>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</contactAccessSecretProof>
 <contactAccessSecretProofExpires>699594594</contactAccessSecretProofExpires>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="peer-services-get" epoch="439439493">

 <stun>
  <srv>server.com</srv>
 </stun>
 <turn>
  <srv>server.com</srv>
  <username>id39392</username>
  <password>bdaaba26fa8ccac7807a786156b1f0fc87b2e28a</password>
 </turn>

</result>
```


Identity Lookup Service Requests

The communication to the Identity Lookup is done over HTTPS exclusively whose HTTPS server certificate was signed by one of the trusted root Internet certification authorities.

Identity Lookup Request

Purpose

This request resolves the identities to Peer Contacts. Request will only return identities that resolve and they are returned in the same order they were requested.

Inputs:

List of providers containing:

- Identity lookup base URI
- Separator (default is ",")
- List of:
    - Identities separated by "separator"

Returns:

List of resulting identities which resolve in the order requested as follows:

- Original identity URI
- Provider – service responsible for this identity
- Peer Contact URI – (optional), peer contact associated to the identity
- Public peer file find secret – (optional), secret required to private proof to find this user so the public peer file can be downloaded from the peer contact's service
- TTL expiry timestamp - when must client do a recheck on the identity as the associated information might have changed
- Priority / weight – SRV like priority and weighting system to gauge which identity discovered to be associated to the same peer contact have highest priority
- Last profile update timestamp – when the profile information associated to the identity was last updated
- Identity display name – (optional), the display name to use with the identity
- Identity rendered public profile URL – (optional), a webpage that can be rendered by the browser to display profile information about this identity
- Programmatic public profile URL – (optional), a machine readable vcard like webpage that can be used to extract out common profile information
- Optional list of avatars containing:

- Avatar name – (optional), name representing subject name of avatar (note: avatars with the same name are considered identical and thus are used to distinguish between varying sizes for the same avatar)
- Avatar URL – URLs to download the avatar(s) associated with the identity
- Avatar pixel width – (optional), pixel width of the avatar image
- Avatar pixel height – (optional), pixel height of avatar image

Security Considerations

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="test.com" id="abd23"
method="identity-lookup">

 <providers>
  <provider>
   <base>identity://domain.com/</base>
   <separator>,</separator>
   <identities>alice,bob,fred</identities>
  </provider>
  <provider>
   <base>identity:phone:</base>
   <separator>;</separator>
   <identities>16045551212;3814445551212</identities>
  </provider>
  <provider>
   ...
  </provider>
 </providers>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="test.com" id="abc123"
method="identity-lookup" epoch="439439493">

 <identities>

  <identity>
   <uri>identity://domain.com/alice</uri>
   <provider>domain.com</provider>
   <contact>peer://service.com/09f11f1cba7a911c6c89992951743ae025918714</contact>
   <contactFindSecret>1c7f0a0677455d55f532b1887186f99e66fb4464</contactFindSecret>
   <expires>58843493</expires>
   <priority>5</priority>
   <weight>1</weight>
   <updated>5949594</updated>
   <name>Alice Applegate</name>
   <profile>http://domain.com/user/alice/profile</profile>
   <vprofile>http://domain.com/user/alice/vcard</vprofile>
   <avatars>
    <avatar>
     <url>http://domain.com/user/alice/p<url>
    </avatar>
   <avatars>
  </identity>

  <identity>
   ...
  </identity>

  <identity>
   <uri>identity:phone:16045551212</uri>
   <provider>example.com</provider>
   <contact>peer://service.com/3ad0fe9b4e3de80cf3bbc0f2a34ed9b7570a09dd</contact>
   <findSecret>b8764d26adf389bf7010ebf538b5924588229c1a</findSecret>
```

```
    <expires>5584854</expires>
    <priority>1</priority>
    <weight>1</weight>
    <updated>5849594</updated>
   </identity>

   <identity>
    ...
   </identity>

   <identity>
    <uri>identity:email:alice@domain.com</uri>
    <provider>provider.com</provider>
    <contact>peer://service.com/09f11f1cba7a911c6c89992951743ae025918714</contact>
    <findSecret>31bb5ddf5cd482f2bfe9934ecb57fa8269dbcd79</findSecret>
    <expires>5584856</expires>
    <priority>1</priority>
    <weight>1</weight>
    <updated>574443</updated>
    <profile>http://www.gravatar.com/205e460b479e2e5b48aec07710c08d50</profile>
    <avatars>
     <avatar>
      <name>1</name>
      <url>http://www.gravatar.com/avatar/205e460b479e2e5b48aec07710c08d50?size=1<url>
      <width>100</width>
      <height>100</height>
     </avatar>
     <avatar>
      <name>1</name>
      <url>http://www.gravatar.com/avatar/205e460b479e2e5b48aec07710c08d50?size=2<url>
      <width>200</width>
      <height>200</height>
     </avatar>
    <avatars>
   </identity>

  </identities>

 </result>
```

Identity Service Requests

Identity Login Start Request

Purpose

This request retrieves the information needed to perform a social sign-in request for a particular domain and identity.

Inputs:

- Base identity URI – base URI for identity (or full identity if known in advance)
- Client token – client must generate a cryptographically randomly token

Returns:

- Server token – server must be generate a onetime use token for this login sequence
- Method
    - "immediate" – the login complete method is ready now with no login displayed
    - "browser-window" – the method requested to perform the login inside a browser window
- Hidden iframe URL page – (optional-if "browser-window" method used), a hidden iframe JavaScript page to be loaded from the identity provider and placed inside the context of an outer page previously loaded by the client making the login request. This inner identity provider hidden page will be used to receive information contained within the outer page provided by the client by way of a JavaScript message posted to the inner iframe window (if login page is required to validate identity). If no URL page is provided then the client does not need to login using a webpage the "login-complete" URL can be called immediately.
- URL for "login-complete" request – the URL to fetch resulting access credential information
- Login expiry - when the login URLs or login pages will expire

Security Considerations

If the method uses is "browser-window", an outer webpage must be loaded by the client that contains the "client token", "server token", "client login secret", and an optional "identity relogin access key". The outer page must loaded via HTTPS (or rendered from a local page if inside an 'app'). Care must be taken to never pass these values as parameters on a URL to a GET or POST request as this would violate security should an HTTP proxy be used. Further, the "client login secret" and "identity relogin access key" should never be sent to a server and instead should be passed between pages locally in the browser by way of cookies or other mechanisms. See the "Identity Login Notification" for more details.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-login-start">

 <identity><base>identity://provider.com/</base></identity>
 <clientToken>a913c2c3314ce71aee554986204a349b</clientToken>
```

```
</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-login-start" epoch="439439493">

 <serverToken>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</serverToken>
 <method>
  <type>browser-window</type>
  <identityLoginURL>https://provider.com/login?session=b40083375f94e7d98900ac</identityLoginURL>
 </method>
 <identityLoginCompletionURL>https://provider.com/login-complete</identityLoginCompletionURL>
 <expires>85848493</expires>

</result>
```

Identity Login Notification (webpage/IFrame)

Purpose

This webpage is loaded as a hidden inner iframe by the browser and receives information via the outer JavaScript via a message posted to the identity provider's inner JavaScript hidden iframe window page. The URL for this page to render in a browser is returned from the "Identity Login Start" page. Normally the inner page receives the private posted information and immediately redirects the outer page to the identity provider's login page allowing the user to enter their identity credentials. This the outer page is typically rendered inside a browser window and contains sufficient display size to allow an identity provider to enter their credential information (unless relogin is used in which case there will be no rendered page for entering credential information).

Inputs:

- Client token – as passed into start
- Server token – as passed into start
- Visibility – the browser window is being shown in what state
    - "visible" – the browser window is visible
    - "hidden" – the browser window is hidden
    - "visible-on-demand" – the browser window is hidden but can be rendered visible via a request posted to the outer frame (note: if rendered inside an application, the application can show the window in a hidden state to start and the browser window can become visible on demand)
- Post login redirection URL – URL the rendered login webpage must redirect to after login completion
- Client login secret – cryptographically random key generated by the client performing the login
- Identity relogin access key – (optional but must be specified in present in the original "identity-login-start" request), if specified the a login webpage does not be displayed as the user is presumed to have the credential information needed to login as the identity by extracting the login information required out of the relogin access key rather than asking the user for their credential information. The outer/inner webpage mechanism will still be used and the outer webpage will still be redirected to the "redirect" page after completion of the login process

regardless if the "relogin access key" is still valid. If the relogin key is no longer valid, the "identity-login-complete" request will fail when subsequently called and thus the client will know the automatic relogin attempt failed. The relogin access key should be self-validating and include the keying information needed to decrypt the "identity secret" associated with the identity.

Returns:

None.

Security Considerations

This request can use the "client login secret" as a key to encrypt information at the browser level and allow the encrypted information to be relayed through intermediate servers in an encrypted fashion without the servers having access to that private information.

Once the information is received by the inner hidden iframe, the inner iframe's JavaScript should store the information into a cookie or local storage in the browser in the identity provider's domain then immediately redirect the outer frame page to the identity provider's login page. This allows the login page to read the cookie or local storage for its own domain and have access to the information sent to this request without ever having the highly sensitive "client login secret" pass through an intermediate server.

Upon successful login, if the end user doesn't already have an "identity secret" assigned to their logged-in identity, the end user must be assigned an "identity secret" at that time (and "identity secret salt" must be generated too simultaneously). This "identity secret" should be generated once only by browser's JavaScript and encrypted using the end user's credentials (e.g. password combined with other information like the username). The identity secret then be sent and stored into the identity provider's server for decryption later upon other successful logins.

If upon successful login the end user already has an "identity secret" assigned to their identity from a previous login, the previously stored "identity secret" should be used rather than generated a new "identity secret".

Should an end user's credentials that was used to encrypt the "identity secret" become 'changed' or 'reset', the encrypted "identity secret" associated with the end user's identity must be discarded and all information subsequently encrypted using the "identity secret" must be discarded too since that previously encrypted information can no longer be decrypted. After the next successful login, the "identity secret" will be regenerated and thus an end user will obtain a new "identity secret" at some point. The biggest issue arising will be the private peer file secret might become lost and thus the private peer file might no longer be downloadable or decryptable. This is merely an inconvenience as a new private peer file can be generated at any time by the client application replacing the old private peer file that was rendered useless.

In any case, the identity provider's login page's JavaScript will have access to a decrypted "identity secret" upon successful login.

As the "identity secret" is used to encrypt/decrypt other information, such as the "private peer file password", the "identity secret" is must be sent to the client application performing the login request. The key to decrypt the "identity secret" is encrypted using the "client login secret" and returned as part of the "identity-login-complete" request to the client application in an encrypted fashion that only the client application could decrypt. Thus the client can have access to the "identity secret" to encrypt other information for later storage within the identity provider's service without the identity provider containing the sensitive information on its servers, like the "private peer file secret".

If the identity doesn't have a username/password (or other type of secret information) or the webpage that displays the username / password is from a third party traditional oath provider service, like Facebook or LinkedIn, there is no password upon which to encode or decode the associated identity's "identity secret". This poses a considerable challenge and prevents the identity from having anything private enough to build effective security upon.

One recommended solution would be to ask the use for protective question they must answer about themselves, similar to that used by online banking for secondary validation. Another method is to use a secondary passphrase sentence to protect the "identity secret".

Another method is to split the key to encrypt/decrypt the identity secret encoded into two halves (one half being entirely cryptographically random) and store these halves into two distinct servers that will only release each half upon providing proof of identity ownership by a client requesting the half of the "identity secret". Search phrase "one time pad" for algorithms. This is considerably more complicated for the identity provider but easier for the user since it doesn't require an additional password to be input by the user. This solution is also considered potentially less secure since the sensitive keys are stored on servers (which isn't recommended) and care must be taken to harden each server from hacker attack. The reason to split the key into two (or more) servers is to ensure that an individually compromised server would be insufficient to gain access to the sensitive information. Should the identity provider providing the identity proof to download the parts become compromised, splitting the key into two distinct parts offers no security (but a compromised identity provider can provide attacks in other simpler ways, like using the login page to capture usernames/passwords). Thus, the trust is only as good as the identity provider's security.

Example

```
<notify xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-login">

 <clientToken>a913c2c3314ce71aee554986204a349b</clientToken>
 <serverToken>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</serverToken>
 <browser><visibility>visible-on-demand</visibility></browser>
 <postLoginRedirectURL>https://example.com/completed?session=abcdef1456789</postLoginRedirectURL>
 <clientLoginSecret>4833678fd5d3edd4341e524f32fe923119b7a856</clientLoginSecret>
 <identityReloginAccessKey>af74...cedf16</identityReloginAccessKey>

</notify>
```


Identity Login Complete Request

Purpose

This request retrieves the result of a successful login process for a particular domain.

Inputs:

- Client token (as passed into start)
- Server token (as passed into start)

Returns:

- Identity access token – a verifiable token that is linked to the logged-in identity
- Identity access secret – a secret that can be used in combination to the "identity access token" to provide proof of previous successful login
- Identity access expiry – the window in which the access key is valid
- Relogin access key (encrypted) – (optional), a key that can be used to relogin to the account from other devices without requiring the user to re-enter their credential information, key = hash("relogin-access-key:" + <client-login-secret>), iv=hash(<client-login-secret> + ":" + <client-token> + ":" + <server-token>)
- Identity profile last updated – timestamp of when profile was last updated
- Identity secret salt – base 64 encoded cryptographically random salt generated by server at the same time when identity secret was created
- Identity secret (encrypted) – the secret key used to encrypt other information for storing sensitive information within the identity provider, which is encrypted using key = hash("identity-secret:" + <identity-secret-decryption-key>), iv=hash(<identity-secret-salt>)
- Identity secret decryption key (encrypted) – a key used for the sole purpose of decrypting the "identity secret" which is encrypted using key=hash("identity-secret-decryption-key:" + <client-login-secret>), iv=hash(<client-login-secret> + ":" + <client-token> + ":" + <server-token>)
- Associated Peer Contact – (optional), if any is associated
- Peer Contact find secret – (optional), if peer contact is associated
- Private peer file salt – the base64 encoded cryptographic generated random salt from section 'A' of the 'private peer file'
- Private peer file secret (encrypted) – (optional), if associated this is the key needed to decrypt the 'private peer file', which is encrypted using key=hash("private-peer-file-secret:" + <identity-secret>), iv=hash(<private-peer-file-salt>)

Security Considerations

The "identity secret" is encrypted using the "identity secret decryption key". The "identity secret decryption key" is generated from JavaScript then encrypted in turn using the "client login secret".

The method for generating the "identity secret decryption key" is specific to the provider but can be done using an algorithm like key=hash("fixed-magic-string:" + normalized(<username>) + ":" + <password>).

The server token must be validated as being the 'onetime use key' originally obtained from the "identity login start" request.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-login-complete">

 <clientToken>a913c2c3314ce71aee554986204a349b</clientToken>
 <serverToken>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</serverToken>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-login-complete" epoch="439439493">

 <uri>identity://domain.com/alice</uri>
 <identityAccessToken>a913c2c3314ce71aee554986204a349b</identityAccessToken>
 <identityAccessSecret>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</identityAccessSecret>
 <identityAccessExpires>8483943493</identityAccessExpires>
 <identityReloginAccessKeyEncrypted>YTkxM2MyY...zMzMTRjZTcx</identityReloginAccessKeyEncrypted>
 <identityProfileUpdated>487757474</identityProfileUpdated>
 <identitySecretSalt>ZnNkbmtqYWtmanNka2Zrc2FramZzZGFm</identitySecretSalt>
 <identitySecretEncrypted>NDRiYzQwZTYuLi5lMTZl...MjdhNTBmNzA=</identitySecretEncrypted>
 <identitySecretDecryptionKeyEncrypted>ZmRqbmV...mnFldw0K</identitySecretDecryptionKeyEncrypted>
 <contact>peer://example.com/a14ab05164c9044660l7de9098f1e41061e70ba9</contact>
 <contactFindSecret>1c7f0a0677455d55f532b1887186f99e66fb4464</findSecret>
 <privatePeerFileSalt>YjQ2ZjQzZWJiM...iZQ==</privatePeerFileSalt>
 <privatePeerFileSecretEncrypted>N...jIzMA==</privatePeerFileSecretEncrypted>

</result>
```

Identity Login Validate Request

Purpose

This request proves that an identity login is valid and can be used to validate an identity login is successful by way of a 3rd party.

Inputs:

- Original identity URI
- Client nonce - a onetime use nonce, i.e. cryptographically random string
- Identity access token – as returned from the "identity login complete" request
- Proof of 'identity access secret' – proof required to validate that the 'identity access secret' is known, proof = hash("identity-login-validate:" + <identity> + ":" + <client-nonce> + ":" + <expires> + ":" + <identity-access-token> + ":" + <identity-access-secret>)
- Expiry of the proof for the 'identity access secret' – a window in which access secret proof is considered valid

Returns:

Success or failure.

Security Considerations

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-login-validate">

 <uri>identity://domain.com/alice</uri>
 <clientNonce>ed585021eec72de8634ed1a5e24c66c2</clientNonce>
 <identityAccessToken>a913c2c3314ce71aee554986204a349b</identityAccessToken>
 <identityAccessSecretProof>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</identityAccessSecretProof>
 <identityAccessSecretProofExpires>43843298934</identityAccessSecretProofExpires>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-login-validate" epoch="439439493">

</result>
```

Identity Associate Request

Purpose

This request causes a peer contact to become associated to an identity.

Inputs:

- Original identity
- Client one time use nonce (cryptographically random string)
- Identity access token – as returned from the "identity login complete" request
- Proof of 'identity access secret' – proof required to validate that the 'identity access secret' is known, proof = hash("identity-associate:" + <identity> + ":" + <client-nonce> + ":" + <expires> + ":" + <identity-access-token> + ":" + <identity-access-secret>)
- Expiry of the proof for the 'identity access secret' – a window in which access secret proof is considered valid
- Peer Contact URI – (optional), the URI of the associated peer contact. If not specified, the association is removed.
- Peer Contact find secret – (optional), the find secret contained within the public peer file for the peer contact and this secret is required if peer contact URI is specified.
- Priority / weight – SRV like priority and weighting system to gauge which identity discovered to be associated to the same peer contact have highest priority
- Identity secret salt – the salt associated with the identity secret which the private peer file secret was encrypted (if this does not match the identity secret salt on file, the request must be rejected)
- Private peer file salt – (optional), base64 encoded cryptographic generated random salt from section 'A' of the 'private peer file', if a peer contact is associated.
- Private peer file secret (encrypted) – (optional), the private peer file secret needed to decrypt the private peer file, which is encrypted using key = hash("private-peer-file-secret:" + <identity-secret>), iv=hash(<private-peer-file-salt>), if peer contact is associated.

Returns:

Success or failure.

Security Considerations

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-associate">

 <uri>identity://domain.com/alice</uri>
 <clientNonce>ed585021eec72de8634ed1a5e24c66c2</clientNonce>
 <identityAccessToken>a913c2c3314ce71aee554986204a349b</identityAccessToken>
 <identityAccessSecretProof>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</identityAccessSecretProof>
 <identityAccessSecretProofExpires>43843298934</identityAccessSecretProofExpires>
 <contact>peer://example.com/a14ab05164c904466017de9098f1e41061e70ba9</contact>
 <contactFindSecret>1c7f0a0677455d55f532b1887186f99e66fb4464</findSecret>
 <priority>5</priority>
 <weight>1</weight>
 <identitySecretSalt>ZnNkbmtqYWtmanNka2Zrc2FramZzZGFm</identitySecretSalt>
 <privatePeerFileSecretSalt>YjQ2ZjQzZWJiM...iZQ==</privatePeerFileSecretSalt>
 <privatePeerFileSecretEncrypted>N...jIzMA==</privatePeerFileSecretEncrypted>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-associate" epoch="439439493">

</result>
```

Identity Sign Request

Purpose

This request requests a signed identity a given proof of a successful identity login.

Inputs:

- Original identity
- Client one time use nonce (cryptographically random string)
- Identity access token – as returned from the "identity login complete" request
- Proof of 'identity access secret' – proof required to validate that the 'identity access secret' is known, proof = hash("identity-sign:" + <identity> + ":" + <client-nonce> + ":" + <expires> + ":" + <identity-access-token> + ":" + <identity-access-secret>)
- Expiry of the proof for the 'identity access secret' – a window in which access secret proof is considered valid

Returns:

Signed identity bundle by the identity service.

Security Considerations

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-sign">

 <uri>identity://domain.com/alice</uri>
```



```
 <clientNonce>ed585021eec72de8634ed1a5e24c66c2</clientNonce>
 <identityAccessToken>a913c2c3314ce71aee554986204a349b</identityAccessToken>
 <identityAccessSecretProof>b7277a5e49b3f5ffa9a8cb1feb86125f75511988</identityAccessSecretProof>
 <identityAccessSecretProofExpires>43843298934</identityAccessSecretProofExpires>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="provider.com" id="abd23"
method="identity-sign" epoch="439439493">

   <identityBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
    <identity id="b5dfaf2d00ca5ef3ed1a2aa7ec23c2db">
     <contact>peer://example.com/ab43bd44390dabc329192a392bef1</contact>
     <uri>identity://domain.com/alice</uri>
     <created>54593943</created>
     <expires>65439343</expires>
    </identity>
    <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
     <SignedInfo>
      <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
      <Reference URI="#b5dfaf2d00ca5ef3ed1a2aa7ec23c2db">
       <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
       <DigestValue>IUe324koV5/A8Q38Gj45i4jddX=</DigestValue>
      </Reference>
     </SignedInfo>
     <SignatureValue>MDAwMDAwMGJ5dGVzLiBQbGVhc2UsIGQ=</SignatureValue>
     <KeyInfo><KeyName>DN=provider.com, SN=identity, ID=b7ef37...4a0d58628d3</KeyName></KeyInfo>
    </Signature>
   </identityBundle>

</result>
```


Peer to Salt Service Protocol

Signed Salt Get Request

Purpose

This request returns random salt as derived from a server and signed to prove authenticity of the salt.

Inputs:

- Number of signed salts

Returns:

- Total number of salts, where each salt has
  - Salt id – each salt is given a unique ID within the system
  - Salt – base 64 encoded cryptographically random binary salt
  - Signed by salt service's private key

Return one or more signed salt blobs for use in the peer files.

Security Considerations

The client should verify signature was generated by the certificate was issued by the salt service if the same domain.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="example.com" id="abd23"
method="signed-salt-get">
 <salts>2</salts>
</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="signed-salt-
get" epoch="439439493">

 <salts>
  <saltBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
   <salt id="f2e2ba4ba900e3b78d0d8524f0888f2b57d1bf91">fdjfdsE2443lfkXEnek..343o=</salt>
   <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
    <SignedInfo>
     <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
     <Reference URI="#f2e2ba4ba900e3b78d0d8524f0888f2b57d1bf91">
      <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
      <DigestValue>IUe324koV5/A8Q38Gj45i4jddX=</DigestValue>
     </Reference>
    </SignedInfo>
    <SignatureValue>DEfGM~C0/Ez=</SignatureValue>
    <KeyInfo><KeyName>DN=example.com, SN=salt, ID=db144bb314103033cbba7d52e</KeyName></KeyInfo>
   </Signature>
  </saltBundle>
  <saltBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
   <salt id="35959a33d4eafac97b9d068cba32a8c6c6fd463a">prfd+dsE243lfkXEnek..8rz==</salt>
   <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
    <SignedInfo>
     <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
     <Reference URI="#35959a33d4eafac97b9d068cba32a8c6c6fd463a">
      <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
      <DigestValue>4Jee4kfd/oV5Af8Q3g48Gjg4n5iw4jzd8k=</DigestValue>
     </Reference>
```

```
    </SignedInfo>
    <SignatureValue>Ttzfeky5D/GM~C0=</SignatureValue>
    <KeyInfo><KeyName>DN=example.com, SN=salt, ID=db144bb314103033cbba7d52e</KeyName></KeyInfo>
   </Signature>
  </saltBundle>
 </salts>

</result>
```

Common Peer-to-"other" Protocol

Peer Publish Request

Purpose

This method allows a peer to publish a document into the network where it can be subscribed to by other peers or groups.

Inputs

- Document name – full path, including namespace
- Document version – first version must start at 1 and all others must be +1 from previous
- Document base version – (optional), must be present if sending an "xml-diff" document; the base version must be included to know what the base version was used to compute the differences. This base version must match the last published version by the receiver of the publish request or a 409 conflict will be returned.
- Document lineage – for v1 documents, it is recommend to use the epoch but the server may replace with its own value in the result (which must be used in subsequent updates); the lineage must match between updates to the same document; the lineage value is to prevent conflicts when performing document deletions
- Chunk number – (optional), "1/1" is assumed – to allow upload of multiple chunks of the document (note: not all documents support chunking)
- Scope of where the document resides – associated to "location", or "contact"; the "location" scope is a private namespace only writable to the current session location; the "contact" scope is a namespace shared by all locations for the same contact (or through a special processer is shared amongst all users
- Lifetime of document – i.e. "session" or "permanent"
- Expiry of document – (optional), epoch of when document must expire
- Encoding – (optional), "xml" is assumed, options are "xml", "xml", "binary-base64"
- "Publish to relationships" – list of:
    - Relationships contact file name (e.g. "/hookflash.com/authorization-list/1.0/whitelist" or "/hookflash.com/authorization-list/1.0/adhoc-subscribers"). The scope for relationship documents is always "location". However, specialized document processors can generate "on-the-fly" relationship lists.
    - Permission – one of:
        - "all" – allow all users on the list to subscribe, fetch and receive notification about this document;
        - "none" – do not allow any users on the list to fetch and receive notification about this document;
        - "some" – allow only specific users listed within the relationship list to subscribe and receive notification about this document;

Outputs

The document meta information as passed into the publish without the data itself, including an updated lineage should the server replace the lineage for version 1 documents.

Security Considerations

The lineage value can only be changed and must be changed after a previous document of the same name has been deleted. The server must verify the lineage is identical to the current lineage for versions other than version 1 chunk 1. For version 1 chunk 1 documents, the server can replace the proposed lineage with its own value that must be used in subsequent updates of the document. The lineage value must increase in value from the previous value when the lineage changes.

Clients and servers should consider the document "newer" if it has a greater lineage value regardless if the version number is smaller.

The server must delete the document at the end of the lifetime.

When the client is delivering multiple chunks, the chunks must arrive in sequence. Any other document requests mid update will fail with error code 409 until the entire document has been delivered.

If using the xml or xml-diff scheme, the document chunks are post-pended together into a single document until all chunks are delivered and then processed as a whole. If using binary-base64 then the documents are merged together with white space removed and then decoded to binary when all chunks have arrived.

The "all" or "some" permissions for relationships that allow a contact to receive the published documents takes precedence over the "none" or implied "deny" if they the listed contact is not contained within the "some" list.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-publish">

 <document>
  <details>
   <name>/hookflash.com/presence/1.0/bd520f1dbaa13c0cc9b7ff528e83470e/883fa7...9533609131</name>
   <version>12</version>
   <!-- <baseVersion>10</baseVersion> -->
   <lineage>5849943</lineage>
   <chunk>1/12</chunk>
   <scope>location</scope>
   <lifetime>session</lifetime>
   <expires>2002-01-20 23:59:59.000</expires>
   <mime>text/xml</mime>
   <encoding>xml</encoding>
  </details>
  <publishToRelationships>
   <relationships name="/hookflash.com/authorization-list/1.0/whitelist" allow="all" />
   <relationships name="/hookflash.com/authorization-list/1.0/adhoc" allow="all" />
   <relationships name="/hookflash.com/shared-groups/1.0/foobar" allow="all" />
  </publishToRelationships>
  <data>
   ...
  </data>
 </document>

</request>
```



```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-publish"
epoch="13494934">

 <document>
  <details>
   <name>/hookflash.com/presence/1.0/bd520f1dbaa13c0cc9b7ff528e83470e/883fa7...9533609131</name>
   <version>12</version>
   <lineage>5849943</lineage>
   <chunk>1/12</chunk>
   <scope>location</scope>
   <lifetime>session</lifetime>
   <expires>2002-01-20 23:59:59.000</expires>
   <mime>text/xml</mime>
   <encoding>xml</encoding>
  </details>
  <publishToRelationships>
   <relationships name="/hookflash.com/authorization-list/1.0/whitelist" allow="all" />
   <relationships name="/hookflash.com/authorization-list/1.0/adhoc" allow="all" />
   <relationships name="/hookflash.com/shared-groups/1.0/foobar" allow="all" />
  </publishToRelationships>
 </document>

</result>
```

Peer Get Request

Purpose

This method allows a peer to fetch a previously publish a document from the network.

Inputs

- Document name – full path, including namespace
- Document version in cache – (optional), if available
- Document lineage in cache – (optional), if available
- Scope of where the document resides – associated to "location", or "contact"; the "location" scope is a private namespace only readable from the current session location; the "contact" scope is a namespace shared by all locations for the same contact; the "global" namespace is shared by all contacts on the system globally
- Contact ID from which to load the document – (optional), if "location" or "contact" is used
- Location ID from which to load the document – (optional), if "location" is used
- Chunk number – (optional), "1/1" is assumed; to allow upload of multiple chunks of the document, the server may decide to split the result into multiple chunks for easier transport. The client should respect the server's splitting and use this value instead of its own "1/x" value.

Outputs

Previously published document split into chunks when appropriate.

Security Considerations

The server must ensure the document is published to the contact that is requesting the document otherwise the server must return a 403 Forbidden.

The server can return any version and lineage greater than the cached version. If the latest version is equal to the cached version, the document result will contain the document meta information without the data.

The server will return any version number it choses equal or greater to the request version number but must adhere to the "xml-diff" mechanism and give only the differences between the versions or "xml" to give the latest version only without performing the differences.

The server will ignore the chunking denominator for chunk requested for the "1/1" chunk and require the denominator to be a value it expects instead for all other chunks requested.

If using the xml or xml-diff scheme, the document chunks are post-pended together into a single document until all chunks are delivered and then processed as a whole. If using binary-base64 then the documents are merged together with white space removed and then decoded to binary when all chunks have arrived.

The "publish to relationships" section is only returned if the contact requesting the document is the publisher of the document.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-get">

 <document>
  <details>
   <name>/hookflash.com/presence/1.0/bd520f1dbaa13c0cc9b7ff528e83470e/883fa7...9533609131</name>
   <version>12</version>
   <lineage>39239392</lineage>
   <scope>location</scope>
   <contact id="ea00ede4405c99be9ae45739ebfe57d5" />
   <location id="524e609f337663bdbf54f7ef47d23ca9" />
   <chunk>1/1</chunk>
  </details>
 </document>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="document-get"
epoch="13494934">

 <document>
  <details>
   <name>/hookflash.com/presence/1.0/bd520f1dbaa13c0cc9b7ff528e83470e/883fa7...9533609131</name>
   <version>12</version>
   <!-- <baseVersion>10</baseVersion> -->
   <lineage>39239392</lineage>
   <chunk>1/10</chunk>
   <scope>location</scope>
   <contact id="ea00ede4405c99be9ae45739ebfe57d5" />
   <location id="524e609f337663bdbf54f7ef47d23ca9" />
   <lifetime>session</lifetime>
   <expires>2002-01-20 23:59:59.000</expires>
   <mime>text/xml</mime>
   <encoding>xml</encoding>
  </details>
  <publishToRelationships>
   <relationships name="/hookflash.com/authorization-list/1.0/whitelist" allow="all" />
   <relationships name="/hookflash.com/authorization-list/1.0/adhoc" allow="all" />
   <relationships name="/hookflash.com/shared-groups/1.0/foobar" allow="all" />
  </publishToRelationships>
```

```
  <data>
   ...
  </data>
 </document>

</result>
```

Peer Delete Request

Purpose

This method allows a peer delete a previously publish a document from the network.

Inputs

- Document name – full path, including namespace
- Document version – (optional), if specified the version number must match the last published version number or a conflict is returned
- Document lineage – (optional), if specified the lineage number must match the lineage of the last published version of the document or a conflict is returned
- Scope of where the document resides – associated to "location", or "contact"; the "location" scope is a private namespace only readable from the current session location; the "contact" scope is a namespace shared by all locations for the same contact; the "global" namespace is shared by all contacts on the system globally

Outputs

Success or failure.

Security Considerations

The contact owner of the document is the only entity allowed to delete the document.

If the document version or lineage is specified then the document version and lineage must match the last published version or the request is rejected with a 409 Conflict error.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-delete">

 <document>
  <details>
   <name>/hookflash.com/presence/1.0/bd520f1dbaa13c0cc9b7ff528e83470e/883fa7...9533609131</name>
   <version>12</version>
   <lineage>39239392</lineage>
   <scope>location</scope>
  </details>
 </document>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="document-
delete" epoch="13494934"></result>
```

Peer Subscribe Request

Purpose

This method allows a peer to subscribe to all documents it is authorized to fetch within a namespace and within its relationships.

Inputs

- Documents base path/name – full path base to monitor with optional "*" for partial paths
- Relationships to subscribe, containing:
    - Name of relationships document
    - Which contacts within the relationships to subscribe
        - "all" – subscribe to all relationships
        - "none" – remove all subscriptions to any relationship
        - "some" – change relationships to subscribe to the listed contacts
        - "add" – add some contacts to subscribe within the relationships
        - "remove" – remove some contacts to subscribe with the relationships

Outputs

Returns the resulting merged active subscription.

Security Considerations

The server only allows subscriptions where permissions allow.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-
subscribe">

 <document>
  <name>/hookflash.com/presence/1.0/</name>
  <subscribeToRelationships>
   <relationships name="/hookflash.com/authorization-list/1.0/whitelist" subscribe="all" />
   <relationships name="/hookflash.com/authorization-list/1.0/adhoc" subscribe ="add">
    <contact id="bd520f1dbaa13c0cc9b7ff528e83470e" />
   </relationships>
   <relationships name="/hookflash.com/shared-groups/1.0/foobar" subscribe ="all" />
  </subscribeToRelationships>
 </document>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="document-
subscribe" epoch="13494934">

 <document>
   <name>/hookflash.com/presence/1.0/</name>
   <subscribeToRelationships>
    <relationships name="/hookflash.com/authorization-list/1.0/whitelist" subscribe ="all" />
    <relationships name="/hookflash.com/authorization-list/1.0/adhoc" subscribe ="some">
     <contact id="bd520f1dbaa13c0cc9b7ff528e83470e" />
     <contact id="8d17a88e8d42ffbd138f3895ec45375c" />
    </relationships>
    <relationships name="/hookflash.com/shared-groups/1.0/foobar" subscribe ="all" />
   </subscribeToRelationships>
 </document>

</result>
```


Peer Publish Notify

Purpose

This method notifies a peer that a document has been updated.

Inputs

- Document name – full path, including namespace
- Document version – if "0" then the document for the lineage is deleted
- Document lineage
- Scope of where the document resides – associated to "location", or "contact" or "global"; the "location" scope is a private namespace only writable to the current session location; the "contact" scope is a namespace shared by all locations for the same contact; the "global" namespace is shared by all contacts on the system globally
- Contact id – the contact that published the document
- Location id – the location where the document was published
- Lifetime of document – i.e. "session" or "permanent"
- Expiry of document – (optional)
- Data – (optional), at the discretion of the server, the document can be delivered as part of the notify or held back which will require the client to fetch later if the client wishes to update manually

Outputs

None.

Security Considerations

If a client wants to download a document about which notification was received, a client should attempt to use the documents from their cache rather than asking fetching the document again if the version of the document has already been fetched.

Clients should consider documents with newer lineage to be "newer" regardless of the version number. Documents of the same lineage are considered newer if they have the version number is greater.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-publish-notify">

 <documents>
  <document>
   <details>
    <name>/hookflash.com/presence/1.0/bd520f1dbaa13c0cc9b7ff528e83470e/883fa7...9533609131</name>
    <version>12</version>
    <lineage>43493943</lineage>
    <scope>location</scope>
    <contact id="ea00ede4405c99be9ae45739ebfe57d5" />
    <location id="524e609f337663bdbf54f7ef47d23ca9" />
    <lifetime>session</lifetime>
    <expires>2002-01-20 23:59:59.000</expires>
    <mime>text/xml</mime>
    <encoding>xml</encoding>
   </details>
  </document>
```



```
  <!-- <data> ... </data> -->
 </documents>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="document-
publish-notify" epoch="13494934">
</result>
```

Peer to Finder Protocol

Session Create Request

Purpose

Obtain a session token that represents the peer on the finder server so continuous proof of identity is not required for each request.

Inputs

- One time use token bundle, consisting of
  - Token ID
  - Finder ID – where this request is to be processed
  - Peer contact making the request
  - Client nonce – cryptographically random one time use key
  - Expiry for the one time use token
  - User agent connecting, e.g. "application/major.minor[.build] (information)"
  - Public peer file
  - Signed by peer private key
- Location details
  - Location ID
  - Device ID
  - IP
  - User agent
  - OS
  - System
  - Host

Outputs

- Expiry epoch (when next a keep alive must be sent by)

Security Considerations

The server must validate that the token bundle has not expired.

The server must verify that the request has been signed by the peer's private peer file. The contact id specified in the bundle must match the calculated contact ID based on the included public peer file Section "A". The one time key is used to prevent replay attacks to the server by ensuring the registration can only be used once on the server.

If a Section-B of the public peer file is not present, the peer does not wish to be found in the network.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" domain="domain.com" id="abc123"
method="session-create">
```

```
 <tokenBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
  <token id="6fc5c4ea068698ab31b6b6f75666808f">
   <finder id="a7f0c5df6d118ee2a16309bc8110bce009f7e318" />
   <contact>peer://domain.com/920bd1d88e4cc3ba0f95e24ea9168e272ff03b3b</contact>
   <clientNonce>09b11ed79d531a2ccd2756a2104abbbf77da10d6</clientNonce>
   <expires>4848343494</expires>
   <userAgent>hookflash/1.0.1001a (iOS/iPad)</userAgent>
   <peer version="1">
    <sectionBundle xmlns="http://www.hookflash.com/openpeer/1.0/message"><section id="A"> ...
contents ...</section> ... </sectionBundle> ...
   </peer>
  </token>
  <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
   <SignedInfo>
    <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
    <Reference URI="#6fc5c4ea068698ab31b6b6f75666808f">
     <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
     <DigestValue>IUe324koV5/A8Q38Gj45i4jddX=</DigestValue>
    </Reference>
   </SignedInfo>
   <SignatureValue>MDAwMDAwMGJ5dGVzLiBQbGVhc2UsIGQ=</SignatureValue>
  </Signature>
 </tokenBundle>

 <location id="5a693555913da634c0b03139ec198bb8bad485ee">
  <details>
   <device id="e31fcab6582823b862b646980e2b5f4efad75c69" />
   <ip>28.123.121.12</ip>
   <userAgent>hookflash/1.0.1001a (iOS/iPad)</userAgent>
   <os>iOS v4.3.5</os>
   <system>iPad v2</system>
   <host>foobar</host>
  </details>
 </location>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="session-create"
epoch="13494934">

 <expires>483949923</expires>

 <peerInformation>
  <services>
   <service id="5a9e910341b8863592c981eb151579f8" version="14">
    <provider>hookflash.com</provider>
    <name>turn</name>
   </service>
   <service id="52aaaadf97cbece5d73b49be65382c3b" version="3">
    <provider>thirdparty.com</provider>
    <name>foo</name>
   </service>
  </services>
 </peerInformation>

</result>
```

Session Delete Request

Purpose

This request destroys an established session gracefully.

Inputs

- Locations – (optional), if specified without any sub location ID elements, then all locations including this will be unregistered (i.e. a complete system wide unregister), if the location element is missing then the current location associated with the session is unregistered
    - Location ID – (optional), for each location to unregister

Outputs

- The list of locations which were in fact unregistered, each listed by location ID

Security Considerations

The client must have an established session to issue this request.

If the client is done with the current session it may immediately disconnect after receiving the response.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="session-
delete">

 <locations>
  <location id="99609d8b1eb4c413813cbeb7c15137837d4037e9" />
  <location id="c8062df29e62d42a3dad60e57d9e84ba38e5ba47" />
 </locations>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="session-delete"
epoch="13494934">

 <locations>
  <location id="99609d8b1eb4c413813cbeb7c15137837d4037e9" />
  <location id="c8062df29e62d42a3dad60e57d9e84ba38e5ba47" />
 </locations>

</result>
```

Session Keep-Alive Request

Purpose

This request keeps a previous registered location alive in the location database.

Inputs

None.

Outputs

- Expiry epoch (when next a keep alive must be sent by)

Security Considerations

The client must have an established session to issue this request.

Since the client and server are the only entities that know the session ID, the session can only be kept alive between machines without additional security. The Session Keep-Alive Request must arrive on the same Internet connection as the initial Session Create Request.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="session-keep-alive">
</request>
```

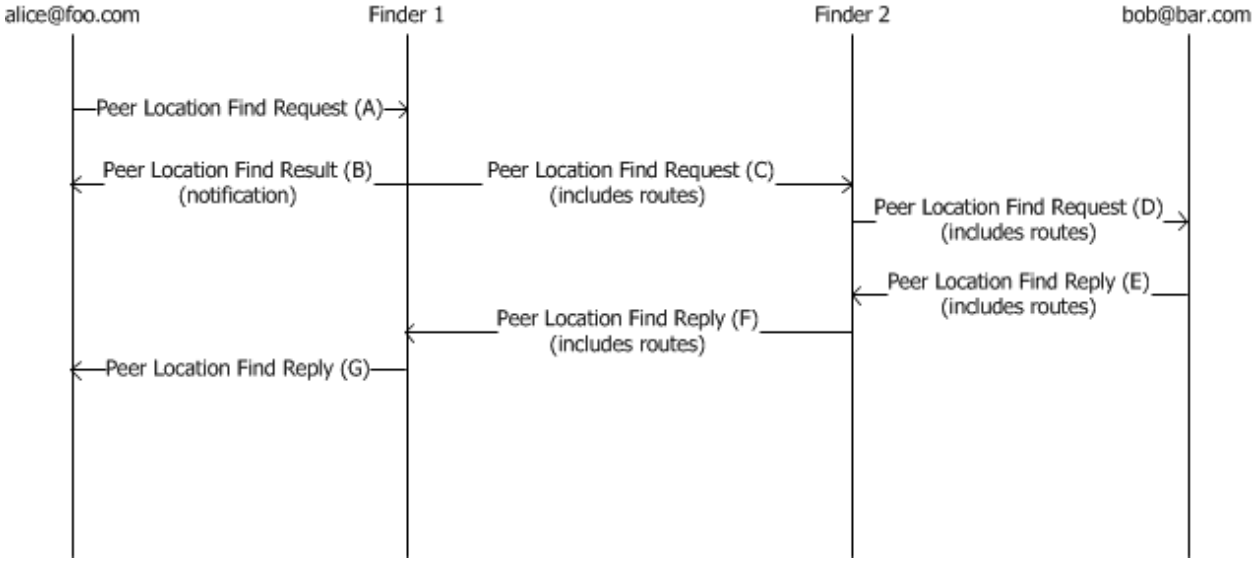
```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="session-keep-alive" epoch="13494934">

 <expires>483949923</expires>

</result>
```

Peer Location Find Request (single point to single point)

Request Flow



Peer Location Find Request (A)

Purpose

This is the request to find a peer that includes the proof of permission to contact the peer and the location information on how to contact the contacting peer.

Inputs

- Client nonce – cryptographically random onetime use string
- Find proof – i.e. hash("proof:" + <clien-nonce> + ":" + expires + ":" + <find-secret [from public-peer-file-section-B]>))
- Find proof expires
- Peer secret (encrypted) – using the public key of the peer receiving the find request
- Location identifier of contacting peer – can be anonymous by generating a new unique id
- Contact id of contact requesting a connection
- Location details

- Location candidate contact addresses for peer location, each containing transport, IP, port, usernameFrag, password and priority (note: password is encrypted using the peer secret and the IV is the hash of the username frag)

Security Considerations

The server must verify the server find secret proof is correct according to the information provided in the public peer file. At this point the one time key should be verified that it has only been seen this one time.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-find">

 <contact>peer://domain.com/900c9cb1aeb816da4bdf58a972693fce20e</contact>
 <clientNonce>7a95ff1f51923ae6e18cdb07aee14f9136afcb9c</clientNonce>
 <findSecretProof>85d2f8f2b20e55de0f9642d3f14483567c1971d3</findSecretProof>
 <findSecretProofExpires>9484848</findSecretProofExpires>
 <peerSecretEncrypted>ODVkMmY4ZjJiMjBlNTVkZ...0MmQzZjE0NDgzNTY3YzE5NzFkMw==</peerSecretEncrypted>

 <exclude>
  <locations>
   <location id="c52591f27deab5cd48bc515e61a3df4d" />
   <location id="59d090f7fdd43a2a59beb2018609e2f2" />
  </locations>
 </exclude>

 <location id="5a693555913da634c0b03139ec198bb8bad485ee">
  <contact>peer://domain.com/541244886de66987ba30cf8d19544b7a12754042</contact>
  <details>
   <device id="e31fcab6582823b862b646980e2b5f4efad75c69" />
   <ip>28.123.121.12</ip>
   <userAgent>hookflash/1.0.1001a (iOS/iPad)</userAgent>
   <os>iOS v4.3.5</os>
   <system>iPad v2</system>
   <host>foobar</host>
  </details>
  <candidates>
   <candidate>
    <transport>rudp/udp</transport>
    <ip format="ipv4">100.200.10.20</ip>
    <port>9549</port>
    <usernameFrag>7475bd88ec76c0f791fde51e56770f0d</usernameFrag>
    <passwordEncrypted>ZWJiOGM1ZTll...TY0ODRkYzZiZTg0YWZmYWExNDQ4OWMxZTU1Nw==</passwordEncrypted>
    <priority>43843</priority>
   </candidate>
   <candidate>
    <transport>rudp/udp</transport>
    <ip format="ipv4">192.168.10.10</ip>
    <port>19597</port>
    <usernameFrag>398ee0fca8badd89927efc52f0db0f2</usernameFrag>
    <passwordEncrypted>ZDJkNWY1YjU...OWZkOGE2MTM2MWM4NzJmOWQ3YzJjMDgxZTU3Nw==</passwordEncrypted>
    <priority>32932</priority>
   </candidate>
  </candidates>
 </location>

</request>
```

Peer Location Find Result (B)

Purpose

This is the result to the request and it returns a list of locations that the peer finder will attempt to contact.

Outputs

- List of locations being searched
- Additional information about the locations (as applicable)

Security Considerations

Since the request was successfully challenged, the information contained in the details section of the Peer Location Register Request of the peer being contacted is returned to the requester. The requester will then know how many locations will be contacted and where to expect a reply.

Example

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-find" epoch="13494934">

 <locations>
  <location id="170f5d7f6ad2293bb339e788c8f2ff6c">
   <details>
    <device id="e31fcab6582823b862b646980e2b5f4efad75c69" />
    <ip>28.123.121.12</ip>
    <userAgent>hookflash/1.0.1001a (iOS/iPad)</userAgent>
    <os>iOS v4.3.5</os>
    <system>iPad v2</system>
    <host>foobar</host>
   </details>
  </location>
  <location id="5a693555913da634c0b03139ec198bb8bad485ee">
   ... details ...
  </location>
 </locations>

</result>
```

Peer Location Find Request (C)

Purpose

This is the forwarded request to the finder responsible for the contacted peer.

Inputs

- Same information as Peer Location Find Request (A)
- Routes (stack of routes for reversing the request)

Security Considerations

The server attaches a route message to know which peer connection to send any reply back. The route identifier for the peer connection should be cryptographically random.

In theory, a malicious peer later responding the Peer Location Find Request could change the route in the Peer Location Find Reply and cause the message to erroneously be delivered to the wrong peer attached to a finder. However, even if the malicious peer managed to misdirect to the wrong peer the

reply would get dropped since request never matched any request previously sent out by that peer. The worst-case scenario is a malicious client could waste the bandwidth and processing power of another peer. Since the only way to possibly know this route in advance is by the malicious peer having established communication with targeted peer previously, the offending malicious peer already could waste the processing power and bandwidth of the targeted peer by sending bogus Peer Location Find Requests. Hence adding protection against this attack does not achieve any lessening in vulnerability.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-find">

 ...

 <location id="5a693555913da634c0b03139ec198bb8bad485ee">
  ...
 </location>
 <routes>
  <route id="27f2e2cfc87d1f77d44afde730bfa15a" />
 </routes>
</request>
```

Peer Location Find Request (D)

Purpose

This is the forwarded request to the contacted peer.

Inputs

- Same information as Peer Location Find Request (C)
- Additional route(s) (stack of routes for reversing the request)

Security Consideration

The peer finder will add the route where it received the Peer Location Find Request from before sending it to the peer receiving the request. Thus when the reply comes in the reply will be directed back alone the path it was sent.

A malicious peer in theory could change the route in the Peer Location Find Reply to another peer finder on the way back by inserting a misdirected route thus wasting the peer finder's bandwidth and CPU (if this happen the Peer Location Find Reply would eventually get dropped thus is not a security whole). Protecting against this attack is not worth while since a malicious peer could waste the peer's bandwidth and CPU by sending requests to the attacked peer finder directly.

A peer finder should keep track of the request to response ratio (i.e. the number of Peer Location Find Requests sent to a peer versus the number of Peer Location Find Replies received from a peer) within windows in which requests were sent. If Peer Location Find Replies are received outside the normal boundaries or outside the window of Peer Location Find Requests, this could be a peer attempting to attack another peer finder using a its peer finder as a proxy by sending bogus Peer Location Find Replies that never had requests.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-find">

 ...

 <location id="5a693555913da634c0b03139ec198bb8bad485ee">
  ...
 </location>
 <routes>
  <route id="27f2e2cfc87d1f77d44afde730bfa15a" />
  <route id="79434b37a8bb8408fca8c16b89e4faca" />
 </routes>

</request>
```

Peer Location Find Reply (E)

Purpose

This is the reply from the contacted peer to the contacting peer.

Outputs

- Location identifier of location being contacted
- Candidates
    - Candidate transport
    - Candidate IP
    - Candidate port
    - Candidate username fragment
    - Candidate password encrypted
    - Candidate priority
- Route(s) given in request (stack of routes for reversing the request)

Security Considerations

The client does not need to worry that the username and password fields are not encrypted from the view of the finder. Since these usernames and passwords are used exclusively for the sake of discovering contactable addresses between peers in an ICE fashion, the worse a malicious finder could do would be to misdirect a peer to contact a wrong address. Since a malicious finder could already misdirect peers there is no additional protection provided by securing these credentials.

In theory a malicious finder could respond to the Peer Location Find Request directing a peer initiating a connection to malicious host. However, since the peer initiating a connection to another must validate the X.509 certificate belongs to the peer where communication was requested the attack would not allow for a successful connection.

Example

```
<reply xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-find" epoch="4344333232">

 <location id="1f77425b06b33bfc1d9932a0716f3f2c92ec0e5">
  <details>
   <device id="e31fcab6582823b862b646980e2b5f4efad75c69" />
   <ip>28.123.121.12</ip>
```

```
    <userAgent>hookflash/1.0.1001a (iOS/iPad)</userAgent>
    <os>iOS v4.3.5</os>
    <system>iPad v2</system>
    <host>foobar</host>
   </details>
   <candidates>
    <candidate>
     <transport>rudp/udp</transport>
     <ip format="ipv4">100.200.10.20</ip>
     <port>9549</port>
     <usernameFrag>7475bd88ec76c0f791fde51e56770f0d</usernameFrag>
     <passwordEncrypted>MmY4MzgzMz...NWFkN2E1NDM0OTk2YzYwMDU2YjhkYzA2MmYxZA==</passwordEncrypted>
     <priority>4388438</priority>
    </candidate>
    <candidate>
     <transport>rudp/udp</transport>
     <ip format="ipv4">192.168.10.10</ip>
     <port>19597</port>
     <username>398ee0fca8badd89927efc52f0db0f2</username>
     <passwordEncrypted>ZDg4MDNhM...dlYmEzYmFiNmE0YzNhMGQ1OGQ1MzMxZWFmNWJmYg==</passwordEncrypted>
     <priority>43923293</priority>
    </candidate>
   </candidates>
  </location>
  <routes>
   <route id="27f2e2cfc87d1f77d44afde730bfa15a" />
   <route id="79434b37a8bb8408fca8c16b89e4faca" />
  </routes>

</reply>
```

Peer Location Find Reply (F)

Purpose

This is the forwarded reply from the contacted peer to the contacting peer.

Outputs

- Same information as Peer Location Find Reply (E)
- One less route popped off the stack as stack is reversed

Security Considerations

This is an internal communication from peer finder to peer finder. The receiving peer finder must ensure the final route maps to a connection and drop the message if it does not match an active connection.

Example

```
<reply xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-
find" method="peer-location-find" epoch="4344333232">

 <location id="1f77425b06b33bfc1d9932a0716f3f2c92ec0e5">
  ...
 </location>
 <routes>
  <route id="27f2e2cfc87d1f77d44afde730bfa15a" />
 </routes>

</reply>
```

Peer Location Find Reply (G)

Purpose

This is the forwarded reply from the contacted peer to the contacting peer.

Outputs

- Same information as Peer Location Find Reply (F)
- All routes are now popped of stack

Security Considerations

The client will receive location candidates that it believes will belong to the peer which it desires to connect. The client will issue ICE requests to discover which or the candidates are valid. Upon successful ICE discovery, the client will issue a Message/RUDP/UDP connection to the receiving peer. The client must validate the certificate offered in the X.509 connection matches its copy of the certificate located in the public peer of the peer it is initiating a connection to. This ensures the peer isn't mislead by the peer finder to connecting to a client it believes is the desired peer only to be directed to a malicious peer.

Example

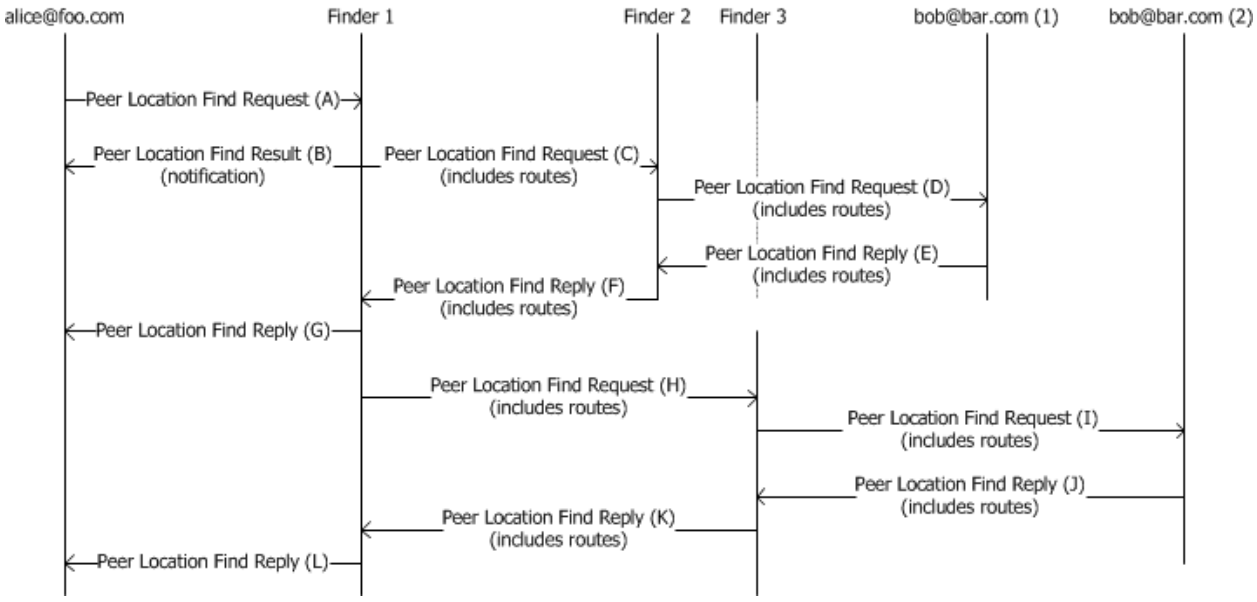
```
<reply xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-find" epoch="4344333232">

 <location id="1f77425b06b33bfc1d9932a0716f3f2c92ec0e5">
  ...
 </location>

</reply>
```

Peer Location Find Request (single point to multipoint when challenged)

Request Flow



The request is identical to "single point to single point" except the request would fork to the two Finders responsible for the two different locations of "bob@bar.com". While above shows one request fork completing before the other request fork begins, in reality the requests would fork simultaneously.

Given that another location exists for "bob@bar.com", the request start out identical but the routes would diverge and the resulting reply would be complete different.

For the sake of simplicity, Peer Location Find Request/Reply A-H are not repeated.

Peer Location Find Request (H)

Purpose

This is the forked forwarded request to the finder responsible for the secondary location of contacted peer.

Inputs

- Same information as Peer Location Find Request (A)
- Routes (stack of routes for reversing the request) – the route would probably have same identifiers as Peer Location Find Request (C) as the contacting peer exists at the same routable location.

Security Considerations

Same as Peer Location Find Request (C)

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-find">

 ...
 <location id="5a693555913da634c0b03139ec198bb8bad485ee">
  ...
 </location>
 <routes>
  <route id="27f2e2cfc87d1f77d44afde730bfa15a" />
 </routes>

</request>
```

Peer Location Find Request (I)

Purpose

This is the forwarded request to the contacted peer.

Inputs

- Same information as Peer Location Find Request (H)
- Additional route(s) (stack of routes for reversing the request) – the additional route would be different since the route to reverse from Finder 3 to Finder 1 is different than the route from Finder 2 to Finder 1.

Security Considerations

Same as Peer Location Find Request (D)

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-find">
```

```
 <findPermission>
  ...
 </findPermission>
 <location id="5a693555913da634c0b03139ec198bb8bad485ee">
  ...
 </location>
 <routes>
  <route id="27f2e2cfc87d1f77d44afde730bfa15a" />
  <route id="c173cc0e1653a64f31b0bf12a1f72d1d" />
 </routes>

</request>
```

Peer Location Find Reply (J)

Purpose

This is the reply from the contacted peer at the secondary location to the contacting peer. This looks very much like Peer Location Find Reply (E) except the identifiers would be completely different.

Outputs

- Same username as provided in Peer Location Find Request (A)
- Same information as applicable in Peer Location Find Reply (E) but with different identifiers since these identifiers come from a different contacted peer location.
- Same routes as provided in Peer Location Find Request (I)

Security Considerations

Same as Peer Location Find Reply (E)

Example

```
<reply xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-
find" epoch="4344333232">

 <location id="d0866fe404867a94949771bfd606f68c3c3c5bd1">
  <candidates>
   <candidate>
    <transport>rudp/udp</transport>
    <ip format="ipv4">75.43.32.12</ip>
    <port>43432</port>
    <salt>NTE1OGEyMjFhOTVmOWQxZjU3NzYzZjgzNzM4NzU4MDc3MzI5OTJiMA==</salt>
    <usernameFrag>5158a221a95f9d1f57763f83738758077329 92b0</usernameFrag>
    <passwordEncrypted>NTg1MjFjZmUyMDc...NzhjMDcxYzZlZDY2NDQzNDNiZGIwNmQ4Nw==</passwordEncrypted>
    <priority>39932</priority>
   </candidate>
   <candidate>
    <transport>rudp/udp</transport>
    <ip format="ipv4">192.168.10.200</ip>
    <port>20574</port>
    <salt>NDNmY2UyNWU2OWZkMTAyM2FiYjAyYWY0OGU5MDQ0NmQ3YWRkMWJl</salt>
    <usernameFrag>643fce25e69fd1023abb02af48e90446d7add1be</usernameFrag>
    <passwordEncrypted>NmU5Zj...NTAzZWNlOTc4YWQ4Njc5ZTcwNGUzNzA1Yzg5NjNiNw==</passwordEncrypted>
    <priority>488323</priority>
   </candidate>
  </candidates>
 </location>
 <routes>
  <route id="27f2e2cfc87d1f77d44afde730bfa15a" />
  <route id="c173cc0e1653a64f31b0bf12a1f72d1d" />
 </routes>

</reply>
```


Peer Location Find Reply (K)

Purpose

This is the forwarded reply from the contacted peer at the secondary location to the contacting peer.

Outputs

- Same information as Peer Location Find Reply (J)
- One less route popped off the stack as stack is reversed

Security Considerations

Same as Peer Location Find Reply (F)

Example

```
<reply xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-
find" epoch="435848548434">

 <location id="d0866fe404867a94949771bfd606f68c3c3c5bd1">
  ...
 </location>
 <routes>
  <route id="27f2e2cfc87d1f77d44afde730bfa15a" />
 </routes>

</reply>
```

Peer Location Find Reply (L)

Purpose

This is the forwarded reply from the contacted peer to the contacting peer.

Outputs

- Same information as Peer Location Find Reply (K)
- All routes now popped of stack

Security Considerations

Same as Peer Location Find Reply (G)

Example

```
<reply xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="peer-location-
find" epoch="4344333232">

 <location id="d0866fe404867a94949771bfd606f68c3c3c5bd1">
  ...
 </location>

</reply>
```


Peer To Peer Protocol

Peer Identify Request

Purpose

This request notifies the connected peer of the peer's identity. This request must be the first request sent from the peer that initiated the connection (i.e. the initiating peer) to the peer that received the connection (i.e. the receiving peer).

Inputs

- Contact of the initiating contact peer
- The location of the initiating peer – can be random if the initiating peer wishes to remain private
- Find secret as obtained from the Section "B" of the public peer file for the receiving peer – peer should reject peer unless this is present or unless the peer is in a common conversation thread with the peer)
- User agent connecting – e.g. "application/major.minor[.build] (information)"
- The public peer file of the contacting peer – section A at minimal
- Signed by initiating peer's private key

Outputs

- The contact of the receiving peer
- The location ID of the receiving peer
- The user agent of the receiving peer

Security Considerations

The initiating peer must send this request over a secure channel. The public certificate of the secure channel must match the receiving peer's certificate otherwise contact has been initiated to the wrong peer and the connection must be terminated immediately by the initiating peer.

The initiating peer must choose an expiry window long enough as reasonable for the receiving peer to verify that it wants to allow the initiating peer to connect but no longer. The window must allow for the time to fetch contact information about the peer and verify the identities of the peer from a 3rd party as well as potential access rights. Without this window, if the Peer Identify Request was accidently sent to the wrong receiving peer (which happens to be malicious) by the initiating peer, the malicious receiving peer could contact the real receiving peer and replay the Peer Identify Request message. However, as long as the initiating peer verifies the receiving peer's public certificate matches what is expected then this replay attack should not be possible unless the receiver's private key has already been compromised.

The receiving peer must verify this is the first request it receives from the initiating peer. The receiving peer may disallow anonymous connections and require a verifiable connection ID. The receiving peer

must verify the find secret matches the find secret in its own Section "B" of its public peer file (to insure this was not a replay of a request sent to a different peer file).

If the contact ID was specified then the signature on the proof bundle must be verified by the receiving peer otherwise the signature element in the proof bundle will be absent in the case of an anonymous connection. The receiving peer must verify the request has not expired and should verify the one time key has not been used before. If the initiating peer did not remain anonymous the signature on the bundle must be verified to ensure it was signed by the initiating peer properly.

Example

```
<request xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="p2p-peer-
identify">

 <proofBundle xmlns="http://www.hookflash.com/openpeer/1.0/message">
  <proof id="ec065f4b46a22872f85f6ba5addf1e2">
   <contact>peer://domain.com/db9e3a737c690e7cdcfbacc29e4a54dfa5356b63</contact>
   <location id="5c5fdfab4bbf8cc8345555172914b9733b2034a4" />
   <findSecret>YjAwOWE2YmU4OWNlOTdkY2QxNzY1NDA5MGYy</findSecret>
   <clientNonce>759cef14b626c9bacc9a52253fd68da29d5b6491<clientNonce/>
   <expires>574732832</expires>
   <userAgent>hookflash/1.0.1001a (iOS/iPad)</userAgent>
   <peer><sectionBundle xmlns="http://www.hookflash.com/openpeer/1.0/message"><section id="A">...
contents ...</section> ...</sectionBundle></peer>
  </proof>
  <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">
   <SignedInfo>
    <SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1" />
    <Reference URI="#ec065f4b46a22872f85f6ba5addf1e2">
     <DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
     <DigestValue>ZGZrbnNua2pmZXdraiBlYnJlcnJmZXJl</DigestValue>
    </Reference>
   </SignedInfo>
   <SignatureValue>WkdacmJuTnVhMnBtWlhkcmFpQmxZbkpsY25KbVpYSmw=</SignatureValue>
  </Signature>
 </proofBundle>

</request>
```

```
<result xmlns="http://www.hookflash.com/openpeer/1.0/message" id="abc123" method="p2p-peer-
identify" epoch="43848328432">

   <contact>peer://domain.com/8da6e36f8a86ba4210c008e0f0d1ba76<contact/>
   <location id="9e02827c0f43c511c30bd410bacf9a83" />
   <userAgent>hookflash/1.0.1001a (Win32/Windows)</userAgent>

</result>
```


Document Specifications

The published document specifications are outside the scope of this particular document. Please refer to the "Open Peer Conversation Thread Specification" as a proposal for multiparty peer hosted conversations for chat, audio and video (and other media).