                        TURN Server Auto Discovery
                    draft-ietf-tram-turn-server-discovery-07

Abstract

   Current Traversal Using Relays around NAT (TURN) server discovery
   mechanisms are relatively static and limited to explicit
   configuration. These are usually under the administrative control of
   the application or TURN service provider, and not the enterprise,
   ISP, or the network in which the client is located. Enterprises and
   ISPs wishing to provide their own TURN servers need auto discovery
   mechanisms that a TURN client could use with no or minimal
   configuration. This document describes three such mechanisms for
   TURN server discovery.

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1. Introduction

      TURN [RFC5766] is a protocol that is often used to improve the
      connectivity of Peer-to-Peer (P2P) applications (as defined in
      section 2.7 of [RFC5128]). TURN allows a connection to be
      established when one or both sides are incapable of a direct P2P
      connection. It is an important building block for interactive, real-
      time communication using audio, video, collaboration etc.

While TURN services are extensively used today, the means to auto
discover TURN servers do not exist. TURN clients are usually
explicitly configured with a well known TURN server. To allow TURN
applications to operate seamlessly across different types of networks
and encourage the use of TURN without the need for manual
configuration, it is important that there exists an auto discovery
mechanism for TURN services. Web Real-Time Communication (WebRTC)
[I-D.ietf-rtcweb-overview] usages and related extensions, which are
mostly based on web applications, need this immediately.

This document describes three discovery mechanisms, so as to maximize
opportunity for discovery, based on the network in which the TURN
client finds itself. The three discovery mechanisms are:

o A resolution mechanism based on straightforward Naming Authority
   Pointer (S-NAPTR) resource records in the Domain Name System
   (DNS). [RFC5928] describes details on retrieving a list of server
   transport addresses from DNS that can be used to create a TURN
   allocation.

o DNS Service Discovery

o A mechanism based on anycast address for TURN.

In general, if a client wishes to communicate using one of its
interfaces using a specific IP address family, it SHOULD query the
TURN server(s) that has been discovered for that specific interface
and address family. How to select an interface and IP address family
is out of the scope of this document.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and
"OPTIONAL" in this document are to be interpreted as described in
[RFC2119].

3. Discovery Procedure

A TURN client that implements the auto discovery algorithm uses the
following mechanisms for discovery:

1. Local Configuration : Local or manual TURN configuration i.e.,
    TURN servers configured at the system level. For example, in
    case of Web Real-Time Communication (WebRTC)
    [I-D.ietf-rtcweb-overview] usages and related extensions, which
    are based on web applications, a Java Script specified TURN
    server MUST be considered as local configuration. An

implementation MAY give the user an opportunity (e.g., by means
of configuration file options or menu items) to specify a TURN
server for each address family.

2.   Service Resolution : The TURN client attempts to perform TURN
     service resolution using the host's DNS domain.

3.   DNS SD: DNS Service Discovery.

4.   Anycast : Send TURN allocate request to the assigned TURN anycast
     request for each combination of interface and address family.

Not all TURN servers may be discovered using NAPTR records or DNS SD;
Similarly, not all TURN servers may support anycast. For best
results, a client SHOULD implement all discovery mechanisms described
above.

The document does not prescribe a strict order that a client must
follow for discovery. An implementation may choose to perform all
the above steps in parallel for discovery OR choose to follow any
desired order and stop the discovery procedure if a mechanism
succeeds.

On hosts with more than one interface or address family (IPv4/v6),
the TURN server discovery procedure has to be performed for each
combination of interface and address family. A client MAY optionaly
choose to perform the discovery procedure only for a desired
interface/address combination if the client does not wish to discover
a TURN server for all combinations of interface and address family.

4. Discovery using Service Resolution

This mechanism is performed in two steps:

1. A DNS domain name is retrieved for each combination of interface
and address family.

2. Retrieved DNS domain names are then used for S-NAPTR lookups as
per [RFC5928]. Further DNS lookups may be necessary to determine
TURN server IP address(es).

4.1. Retrieving Domain Name

A client has to determine the domain in which it is located. The
following sections provide two possible mechanisms to learn the
domain name, but other means of retrieving domain names may be used,
which are outside the scope of this document e.g. local
configuration.

Implementations may allow the user to specify a default name that is
used if no specific name has been configured.

4.1.1. DHCP

DHCP can be used to determine the domain name related to an
interface's point of network attachment. Network operators may
provide the domain name to be used for service discovery within an
access network using DHCP. Sections 3.2 and 3.3 of [RFC5986] define
DHCP IPv4 and IPv6 access network domain name options to identify a
domain name that is suitable for service discovery within the access
network. [RFC2132] defines the DHCP IPv4 domain name option; While
this option is less suitable, it may still be useful if the options
defined in [RFC5986] are not available.

For IPv6, the TURN server discovery procedure MUST try to retrieve
DHCP option 57 (OPTION_V6_ACCESS_DOMAIN). If no such option can be
retrieved, the procedure fails for this interface. For IPv4, the
TURN server discovery procedure MUST try to retrieve DHCP option 213
(OPTION_V4_ACCESS_DOMAIN). If no such option can be retrieved, the
procedure SHOULD try to retrieve option 15 (Domain Name). If neither
option can be retrieved the procedure fails for this interface. If a
result can be retrieved it will be used as an input for S-NAPTR
resolution.

4.1.2. From own Identity

For a TURN client with an understanding of the protocol mechanics of
calling applications, the client may wish to extract the domain name
from its own identity i.e canonical identifier used to reach the
user.

Example

SIP   : 'sip:alice@example.com'
JID   : 'alice@example.com'
email : 'alice@example.com'

'example.com' is retrieved from the above examples.

The means to extract the domain name may be different based on the
type of identifier and is outside the scope of this document.

4.2. Resolution

Once the TURN discovery procedure has retrieved domain names, the
resolution mechanism described in [RFC5928] is followed. An S-NAPTR
lookup with 'RELAY' application service and the desired protocol tag

is made to obtain information necessary to connect to the
authoritative TURN server within the given domain.

In the example below, for domain 'example.net', the resolution
algorithm will result in IP address, port, and protocol tuples as
follows:

```
example.net.
   IN NAPTR 100 10 "" RELAY:turn.udp "" example.net.

   example.net.
   IN NAPTR 100 10 S RELAY:turn.udp "" _turn._udp.example.net.

   _turn._udp.example.net.
   IN SRV   0 0 3478 a.example.net.

   a.example.net.
   IN A        192.0.2.1
   IN AAAA     2001:db8:8:4::2
```

Order	Protocol	IP address	Port
1	UDP	192.0.2.1	3478
2	UDP	2001:db8:8:4::2	3478

If no TURN-specific S-NAPTR records can be retrieved, the discovery
procedure fails for this domain name (and the corresponding interface
and IP protocol version). If more domain names are known, the
discovery procedure may perform the corresponding S-NAPTR lookups
immediately. However, before retrying a lookup that has failed, a
client MUST wait a time period that is appropriate for the
encountered error (NXDOMAIN, timeout, etc.).

5. DNS Service Discovery

DNS-based Service Discovery (DNS-SD) [RFC6763] and Multicast DNS
(mDNS) [RFC6762] provide generic solutions for discovering services
available in a local network. DNS-SD/ mDNS define a set of naming
rules for certain DNS record types that they use for advertising and
discovering services. PTR records are used to enumerate service
instances of a given service type. A service instance name is mapped
to a host name and a port number using a SRV record. If a service
instance has more information to advertise than the host name and

port number contained in its SRV record, the additional information
is carried in a TXT record.

Section 4.1 of [RFC6763] specifies that a service instance name in
DNS-SD has the following structure:

<Instance> . <Service> . <Domain>

The <Domain> portion specifies the DNS sub-domain where the service
instance is registered. It may be "local.", indicating the mDNS
local domain, or it may be a conventional domain name such as
"example.com.". The <Service> portion of the TURN service instance
name MUST be "_turnserver._udp", "_turnserver._tcp".

The <Instance> portion is a DNS label, containing UTF-8-encoded text
[RFC5198], limited to 63 octets in length. It is meant to be a user-
friendly description of the service instance, suitable for a menu-
like user interface display. Thus it can contain any characters
including spaces, punctuation, and non-Latin characters as long as
they can be encoded in UTF-8.

For example, TURN server advertises the following DNS records :

    _turnserver._udp.local. PTR example.com._turnserver._udp.local.

    example.com._turnserver._udp.local. SRV 0 0 5030 example-turn-
    server.local.

    example-turn-server.local. A 198.51.100.2

    example-turn-server.local. AAAA 2001:db8:8:4::2

In addition to the service instance name, IP address and the port
number, DNS-SD provides a way to publish other information pertinent
to the service being advertised. The additional data can be stored
as name/value attributes in a TXT record with the same name as the
SRV record for the service. Each name/value pair within the TXT
record is preceded by a single length byte, thereby limiting the
length of the pair to 255 bytes (See Section 6 of [RFC6763] and
Section 3.3.14 of [RFC1035] for details).

5.1. mDNS

A TURN client tries to discover the TURN servers being advertised in
the site by multicasting a PTR query "_turnserver._udp.local." or
"_turnserver._tcp.local" or the TURN server can send out gratuitous
multicast DNS answer packets whenever it starts up, wakes from sleep,

or detects a chance in network configuration. TURN clients receive
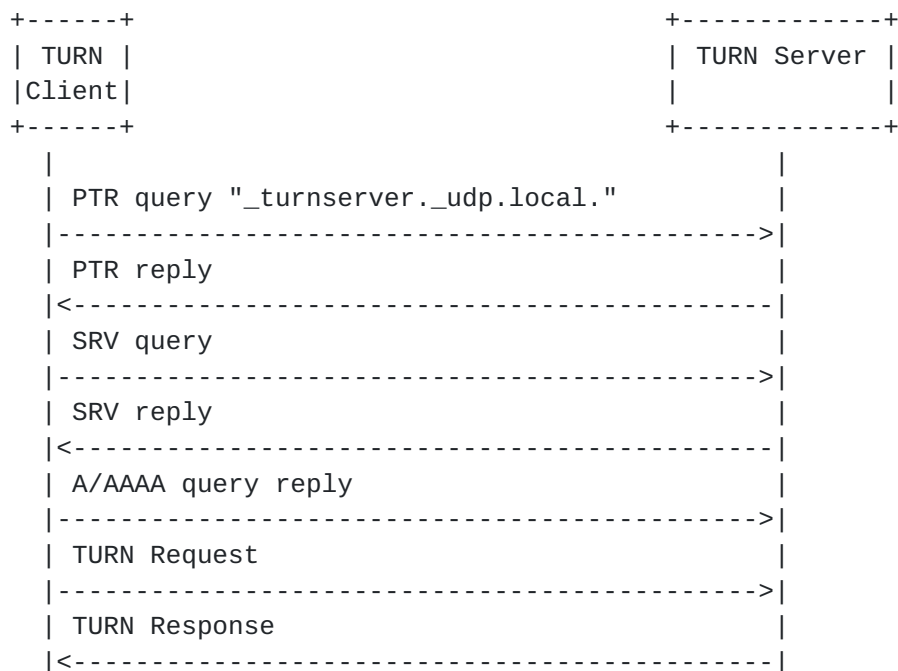these gratuitous packet and cache the information contained in it.

```
    +------+                              +-------------+
    | TURN |                              | TURN Server |
    |Client|                              |             |
    +------+                              +-------------+
       |                                         |
       | PTR query "_turnserver._udp.local."     |
       |---------------------------------------->|
       | PTR reply                               |
       |<----------------------------------------|
       | SRV query                               |
       |---------------------------------------->|
       | SRV reply                               |
       |<----------------------------------------|
       | A/AAAA query reply                      |
       |---------------------------------------->|
       | TURN Request                            |
       |---------------------------------------->|
       | TURN Response                           |
       |<----------------------------------------|
```

                 Figure 1: TURN Server Discovery using mDNS

6. Discovery using Anycast

   IP anycast can also be used for TURN service discovery. A packet
   sent to an anycast address is delivered to the "topologically
   nearest" network interface with the anycast address. Using the TURN
   anycast address, the only two things that need to be deployed in the
   network are the two things that actually use TURN.

   When a client requires TURN services, it sends a TURN allocate
   request to the assigned anycast address. The TURN anycast server
   responds with a 300 (Try Alternate) error as described in [RFC5766];
   The response contains the TURN unicast address in the ALTERNATE-
   SERVER attribute. For subsequent communication with the TURN server,
   the client uses the responding server's unicast address. This has to
   be done because two packets addressed to an anycast address may reach
   two different anycast servers. The client, thus, also needs to
   ensure that the initial request fits in a single packet. An
   implementation may choose to send out every new request to the
   anycast address to learn the closest TURN server each time.

7. Deployment Considerations

7.1. Mobility and Changing IP addresses

   A change of IP address on an interface may invalidate the result of
   the TURN server discovery procedure. For instance, if the IP address
   assigned to a mobile host changes due to host mobility, it may be
   required to re-run the TURN server discovery procedure without
   relying on earlier gained information. New requests should be made
   to the newly learned TURN servers learned after TURN discovery re-
   run. However, if an earlier learned TURN server is still accessible
   using the new IP address, procedures described for mobility using
   TURN defined in [I-D.ietf-tram-turn-mobility] can be used for ongoing
   streams.

7.2. Recursively Encapsulated TURN

   WebRTC endpoints SHOULD treat any TURN server discovered through the
   mechanims described in this specification as an enterprise/gateway
   server, in accordance with Recursively Encapsulated TURN
   [I-D.ietf-rtcweb-return].

8. IANA Considerations

8.1. Anycast

   IANA should allocate an IPv4 and an IPv6 well-known TURN anycast
   address. 192.0.0.0/24 and 2001:0000::/48 are reserved for IETF
   Protocol Assignments, as listed at

   <http://www.iana.org/assignments/iana-ipv4-special-registry/> and

   <http://www.iana.org/assignments/iana-ipv6-special-registry/>

9. Security Considerations

   Use of STUN authentication is OPTIONAL for TURN servers provided by
   the local network or by the access network. A network provided TURN
   server MAY be configured to accept Allocation requests without STUN
   authentication, and a TURN client MAY be configured to accept
   Allocation success responses without STUN authentication from a
   network provided TURN server. In order to protect against man-in-
   the-middle attacks when accepting a TURN allocation response without
   STUN authentication, it is RECOMMENDED that the TURN client use one
   of the following techniques with (D)TLS to validate the TURN server:

   o For certificate-based authentication, a pre-populated trust anchor
      store [RFC6024] allows a TURN client to perform path validation

for the server certificate obtained during the (D)TLS handshake.
If the client used a domain name to discover the TURN server, that
domain name also provides a mechanism for validation of the TURN
server. The client MUST use the rules and guidelines given in
section 6 of [RFC6125] to validate the TURN server identity.

o For TURN servers that don't have a certificate trust chain (e.g.,
   because they are on a home network or a corporate network), a
   configured list of TURN servers can contain the Subject Public Key
   Info (SPKI) fingerprint of the TURN servers. The public key is
   used for the same reasons HTTP pinning [RFC7469] uses the public
   key.

o Raw public key-based authentication, as defined in [RFC7250],
   could also be used to authenticate a TURN server.

An auto-discovered TURN server is considered to be only as trusted as
the path between the client and the TURN server. In order to safely
use auto-discovered TURN servers for sessions with 'strict privacy'
requirements, the user needs to be able to define privacy criteria
(e.g. a trusted list of servers, networks, or domains) that are
considered acceptable for such traffic. Any discovered TURN server
outside the criteria is considered untrusted and is not used for
privacy sensitive communication.

In some auto-discovery scenarios, it might not be possible for the
TURN client to use (D)TLS authentication to validate the TURN server.
However, fall-back to clear text in such cases could leave the TURN
client open to on-path injection of spoofed TURN messages. For this
reason, it is beneficial for the TURN client to make use of
'opportunistic privacy', analogous to SMTP opportunistic encryption
[RFC7435], where one does not require privacy but one desires privacy
when possible. In this scenario, a TURN client attempts (D)TLS with
authentication and encryption, falling back to encryption-only if the
TURN server cannot be authenticated via (D)TLS. If the TURN server
does not support unauthenticated (D)TLS, then the client falls back
to clear text. Fallback to clear text is NOT RECOMMENDED because it
makes the client more susceptible to man-in-the-middle attacks and
on-path packet injection. A TURN client SHOULD fall-back to
encryption-only (D)TLS when (D)TLS authentication is not available in
order to protect against on-path attackers who might attempt to
inject fake TURN messages.

9.1. Service Resolution

The primary attack against the methods described in this document is
one that would lead to impersonation of a TURN server. An attacker

could attempt to compromise the S-NAPTR resolution. Security
considerations described in [RFC5928] are applicable here as well.

In addition to considerations related to S-NAPTR, it is important to
recognize that the output of this is entirely dependent on its input.
An attacker who can control the domain name can also control the
final result. Because more than one method can be used to determine
the domain name, a host implementation needs to consider attacks
against each of the methods that are used.

If DHCP is used, the integrity of DHCP options is limited by the
security of the channel over which they are provided. Physical
security and separation of DHCP messages from other packets are
commonplace methods that can reduce the possibility of attack within
an access network; alternatively, DHCP authentication [RFC3188] can
provide a degree of protection against modification. When using DHCP
discovery, clients are encouraged to use unicast DHCP INFORM queries
instead of broadcast queries which are more easily spoofed in
insecure networks.

9.2. DNS Service Discovery

Since DNS-SD is just a specification for how to name and use records
in the existing DNS system, it has no specific additional security
requirements over and above those that already apply to DNS queries
and DNS updates. For DNS queries, DNS Security Extensions (DNSSEC)
[RFC4033] should be used where the authenticity of information is
important. For DNS updates, secure updates [RFC2136][RFC3007] should
generally be used to control which clients have permission to update
DNS records.

For mDNS, in addition to what has been described above, a principal
security threat is a security threat inherent to IP multicast routing
and any application that runs on it. A rogue system can advertise
that it is a TURN server. Discovery of such rogue systems as TURN
servers, in itself, is not a security threat if there is a means for
the TURN client to authenticate and authorize the discovered TURN
servers.

9.3. Anycast

In a network without any TURN server that is aware of the TURN
anycast address, outgoing TURN requests could leak out onto the
external Internet, possibly revealing information.

Using an IANA-assigned well-known TURN anycast address enables border
gateways to block such outgoing packets. In the default-free zone,
routers should be configured to drop such packets. Such

   configuration can occur naturally via BGP messages advertising that
   no route exists to said address.

   Sensitive clients that do not wish to leak information about their
   presence can set an IP TTL on their TURN requests that limits how far
   they can travel into the public Internet.

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   Adam Roach for his detailed review and suggesting DNS Service
   Discovery as an additional discovery mechanism.

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Appendix A. Change History

   [Note to RFC Editor: Please remove this section prior to
   publication.]

A.1. Change from draft-patil-tram-serv-disc-00 to -01

   o Added IP address (Section 4.1.2) and Own identity (4.1.3) as new
      means to obtain domain names

   o New Section 4.2.1 SOA (inspired by draft-kist-alto-3pdisc)

   o 300 (Try Alternate) response for Anycast

A.2. Change from draft-ietf-tram-turn-server-discovery-01 to 02

o Removed sections that describe reverse IP lookup

o Added DNS Service Discovery as an additional discovery mechanism

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