HIP Extensions for the Traversal of Network Address Translators

draft-schmitt-hip-nat-00

Miika Komu, Vivien Schmitt, Abhinav Pathak,
Lars Eggert and Martin Stiemerling

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Motivation and Goals

- To create a very practical, implementable and deployable draft to support legacy NAT traversal
  - On-going implementation work at NEC and HIIT
- Primary goal: initiator behind NAT
- Secondary goal: responder behind NAT
- Non-goals: firewall + NAT combinations
- Support both base exchange and mobility extensions
- NAT detection using external protocols (no modifications to the base exchange or UPDATE)
  - Benefit: future compatibility with NSIS
  - Drawback: requires a third host and incurs some extra latency

HIP Control Channel Header Format

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Source Port          |       Destination Port        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Length            |           Checksum            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                 HIP Header with zero checksum                 ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

ESP Data Channel Formats: ESP-in-UDP and ESP Channel Keepalive [RFC3948]

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        Source Port            |      Destination Port         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Length              |          Checksum             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                          ESP Header                           ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        Source Port            |      Destination Port         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Length              |          Checksum             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    0xFF       |
+-+-+-+-+-+-+-+-+
```

Base Exchange over UDP

```
+---+    Private Network   +---+    Public Internet   +---+
| I |----------------------|NAT|----------------------| R |
+---+                      +---+                      +---+
  | IP(I)           IP(NAT1) | IP(NAT2)           IP(R) |
  |                          |                          |
  |>>>>>>>>>>>>>>>>>>>>>>>>>>|>>>>>>>>>>>>>>>>>>>>>>>>>>|
  | I1: IP(I):P(I) ->        | I1: IP(NAT2):P(NAT-A) -> |
  |     IP(R):P(50500)       |     IP(R):P(50500)       |
  |                          |                          |
  |<<<<<<<<<<<<<<<<<<<<<<<<<<|<<<<<<<<<<<<<<<<<<<<<<<<<<|
  | R1: IP(R):P(50500) ->    | R1: IP(R):P(50500) ->    |
  |     IP(I):P(I)           |     IP(NAT2):P(NAT-A)    |
  |                          |                          |
  |>>>>>>>>>>>>>>>>>>>>>>>>>>|>>>>>>>>>>>>>>>>>>>>>>>>>>|
  | I2: IP(I):P(I) ->        | I2: IP(NAT2):P(NAT-B) -> |
  |     IP(R):P(50500)       |     IP(R):P(50500)       |
  |                          |                          |
  |<<<<<<<<<<<<<<<<<<<<<<<<<<|<<<<<<<<<<<<<<<<<<<<<<<<<<|
  | R2: IP(R):P(50500) ->    | R2: IP(R):P(50500) ->    |
  |     IP(I):P(I)           |     IP(NAT2):P(NAT-B)    |
```

About the UDP Ports

- Separate UDP ports for receiving packets:
  - Control: 50500, Data: 54500
- UDP ports for sending packets:
  - Same as above or random from the range of 49152-65535
- NAT transforms IP address or ports
- I1-R1 and I2-R2 can arrive on different ports
  - Timeouts
  - Responder is stateless and does not create any (port related) state until I2

Mobility

- Use scenarios:
    1. Host moves behind a NAT into a public network
    2. Host moves within the same NAT
    3. Host moves behind a different NAT
    4. Host moves from a public network behind a NAT
- Detect the presence of NAT before handover and start/stop using UDP encapsulation accordingly
- Hosts must check the HIP control message integrity to protect against reflected packets (with forged ports)

Multihoming

- More complicated than simple mobility
  - For example, one interface can be in public network and another behind a NAT
  - Host should trigger NAT detection simultaneously using multiple interfaces
  - Asymmetric routes
  - UDP tunnels should be distinguished by SPI rather than HIT pairs
- Not (yet) handled in detail in the draft

Firewall Configuration

- Firewall processing can occur before or/and after NAT
- Required firewall policies (firewall before NAT):
  - Source ports 50500, 54500 and 49152 – 65535
  - Destination ports 50500 and 54500
- Further restrictions with “UDP connection tracking”
  - Keepalive interval must be smaller than firewall timeout value
- Firewalls are not in the main focus of the draft

Issue 1: Use Same Port Numbers as IKE

- Share same control/data UDP port numbers as IKE (RFC3947 and 3948)
- Benefit: no extra firewall configuration for firewalls that already allow UDP encapsulated IKE and ESP traffic
- Drawback: requires software modifications in hosts that have both IKE and HIP installations
- Solution: based on feedback from mobike authors, use different port numbers

Issue 2: Random Source Port at Initiator

- Allow the initiator behind NAT to use a random source UDP source port
- Benefits:
  - Basic-NAT devices with only address translation may be supported better because the port varies
  - Multiple UDP tunnels between the same peers are possible
- (Drawback: firewall rules need to based on destination port, not source)
- Originally thought that this would create problems with UDP hole punching but this is not true
- Result: this is useful as an option, so it will stay in the draft

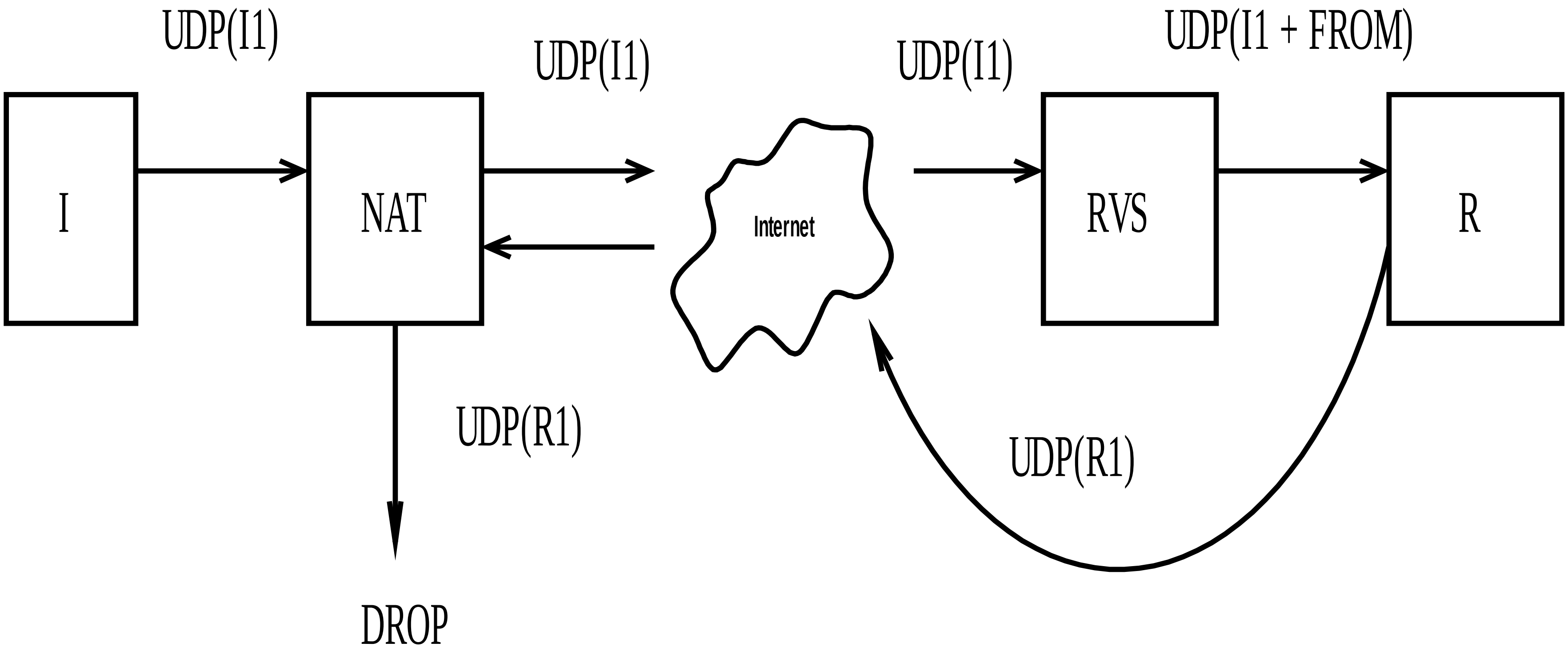
Issue 3: Server behind NAT 1/2

- Allow the responder to be located behind a NAT. The initiator may or may not be located behind a NAT.
- Benefit: nice for P2P applications
- Drawback: additional complexity
- Solution: a NAT rendezvous/relay is anyway required
  - Primary method: assume P2P friendly NAT and avoid triangular routing by UDP hole punching
  - Fallback method: triangular routing using TURN

Issue 3: Server behind NAT 2/2

- Design alternatives
  - ICE (overkill?)
  - Subset of ICE: UDP hole punching + TURN
- Editorial open issues
  - Describe in this or separate draft?
  - WG or RG?
  - In any case, client and server case should be 100 % compatible with each other

Issue 4: NAT and Rendezvous Server



- Problem: NAT drops the R1 if responder is using RVS
- Solution: RVS relays also the R1

Issue 5: LOCATOR and NAT 1/2

- What kind of addresses to use in LOCATOR parameters upon handovers?
- Alternative 1: use the private addresses
  - Works because UDP encapsulation overrides outer addresses both for HIP and ESP packets
  - Benefit: transparent to implement
  - Drawback: privacy problems

Issue 5: LOCATOR and NAT 2/2

- Alternative 2: detect and use the public addresses of NAT
  - Benefit: no privacy problems
  - Drawback: increases the complexity of the mobility implementation
- Alternative 3: filter out the private LOCATORs and just send UPDATE to punch a hole in the NAT
  - Simple to implement
  - The LOCATORs of alternatives 1 and 2 are not very useful anyway?

Issue 6: Inner Address as IPv4

- The draft does not describe the case where inner addresses are IPv4
- Solution: reduce the details of packet en/decapsulation procedures (see issue 7) and take no standpoint to the inner addresses

Issue 7: Editorial Notes

- Server behind NAT: this or other draft
- Generalize and reduce the details of packet en/decapsulation (replace with references)
- Other misc comments

Issue 8: Mobility and Data Channel Reactivation

- Use case:
  - Host moves behind a NAT
  - The control channel punched through the NAT using UPDATE
  - The data channel is punched through the NAT with ESP keepalive
- Problem:
  - The server host in the public network does not know which SA the keepalive is related to
  - As a result, the server cannot learn the new port numbers
- Solution: use the same UDP port for control and data

Issue 9: Hairpin Translation

- Both hosts are behind the same NAT
- STUN server is used for detecting NAT
- Problem: unless NAT supports hairpin translation, the hosts may communicate inefficiently through the NAT instead of directly with each other
- Solution: when the presence of NAT is detected, send first control packets without UDP encapsulation and only then with UDP encapsulation

Questions?

Miika Komu <miika.komu@hiit.fi>

Vivien Schmitt <schmitt@netlab.nec.de>

Abhivav Pathak <abpathak@cse.iitk.ac.in>

Lars Eggert <lars.eggert@netlab.nec.de>

Martin Stiemerling <stiemerling@netlab.nec.de>