Teredo Extensions
draft-thaler-v6ops-teredo-extensions-01.txt

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[MS-TERE]: Teredo Extensions

• Last IETF, URL for Microsoft doc posted to the list

• This documented what Windows XP/Vista does

• It contains several things:
  – Security updates:
    • Now in draft-krishnan-v6ops-teredo-update
  – Support for more NAT types:
    • Now in draft-thaler-v6ops-teredo-extensions
  – Efficiency (server load) improvement:
    • Now in draft-thaler-v6ops-teredo-extensions
# NAT Types

<table>
<thead>
<tr>
<th>Dest NAT</th>
<th>Source</th>
<th>Cone</th>
<th>Address Restricted</th>
<th>Port Restricted</th>
<th>Port Rest. +UPnP</th>
<th>Port Sym. +UPnP</th>
<th>Port Sym. (Port-Pres.)</th>
<th>Port Sym. (Non-pres.)</th>
<th>Address Symmetric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone</td>
<td>Cone</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Addr. Rest.</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Port Rest.</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>-</td>
<td>1+3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Port rest + UPnP</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>1+2</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Port sym. + UPnP</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1+2</td>
<td>1+2</td>
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<td>-</td>
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</tr>
</tbody>
</table>
Some statistics on NAT types

• Based on a study in August 2007 on NAT types:
  – ~85% chance a direct connection between two peers would fail
  – ~36% chance a Teredo connection would fail
  – ~16% chance a Teredo+extensions connection would fail
  – With a bit more work, this could get still better

• For multiparty apps, inverse network effect means even worse percentage

• Doesn’t requires data to flow through some server

• Can get 100% if you use a data relay protocol but more expensive to host such relays
  – Goal is to optimize for peer-to-peer to minimize cost
1) Symmetric NAT Example

- Direct Bubble to B: OK
- Indirect Bubble to B: Wrong port!
- Direct Bubble (+Nonce1) to B: OK
- Indirect Bubble (+Nonce2) to B: OK
- Direct Bubble (+Nonce2) to A: OK
- Direct Bubble (+Nonce1) to A: OK
- Indirect Bubble (+Nonce1) to A: Store source port

Client A
Sym. NAT
A’s Server
B’s Server
Rest. NAT
Client B
2) UPnP-Enabled Symmetric NAT

Client A \(\xrightarrow{\text{Get port}}\) Sym. NAT \(\xrightarrow{\text{Get address}}\) A’s Server

Sym. NAT \(\xrightarrow{\text{Get port}}\) B’s Server

B’s Server \(\xrightarrow{\text{Get address}}\) Sym. NAT

Sym. NAT \(\xrightarrow{\text{Get port}}\) Client B

A’s Server \(\xrightarrow{\text{Direct Bubble to B}}\) OK

B’s Server \(\xrightarrow{\text{Direct Bubble (+Nonce) to A}}\) OK

Client A \(\xrightarrow{\text{Direct Bubble (+Nonce) to B}}\) OK

Client B \(\xrightarrow{\text{Indirect Bubble (+Nonce) to B}}\)

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3) Port-Preserving Symmetric NAT

- **Learn NAT type**
- **Bind to random port**
- **Trust B:random OK**

**Client A**
- Get address
- Direct Bubble to B
- Indirect Bubble (+Nonce1 +RandomPortA) to B
- Direct Bubble (+Nonce1 +RandomPortB) to A:random from B:random
- Indirect Bubble (+Nonce2 +RandomPortB) to A
- Direct Bubble (+Nonce2 +RandomPortA) to B:random from A:random
- Indirect Bubble (+Nonce3 +RandomPortA) to B
- Direct Bubble (+Nonce3 +RandomPortB) to A:random from B:random

**Client B**
- Get address
- Bind to random port
- Trust OK
- A:random
4) Hairpinning Example

![Diagram showing hairpinning example with NATs and UPnP devices.]

- Internet
- Outer NAT
  - A’s NAT
    - Client A
  - B’s NAT
    - Client B
- No hairpinning support

UPnP
4) Hairpinning Example (cont.)

Client A
Get mapping

A’s NAT

Client B
Get mapping

B’s NAT

Outer NAT

A’s Server

B’s Server

Indirect Bubble (+LocalA +MappingA) to B

Direct Bubble to B

Indirect Bubble (+LocalB +MappingB) to A

Direct Bubble to B

Direct Bubble to LocalA

Direct Bubble to MappingA

Direct Bubble to A

No hairpin!

No hairpin!

OK

OK
5) Server Load Reduction

Client A

NAT

A’s Server

B’s Server

NAT

Client B

Idle

Optimistic Direct Bubble (+Solicitation) to B

OK

Direct Bubble (+Advertisement) to A

Idle

Indirect Bubble to B

LOAD!