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## Test Vectors for Session Traversal Utilities for NAT (STUN)

### Abstract

The Session Traversal Utilities for NAT (STUN) protocol defines several STUN attributes. The content of some of these -- FINGERPRINT, MESSAGE-INTEGRITY, and XOR-MAPPED-ADDRESS -- involve binary-logical operations (hashing, xor). This document provides test vectors for those attributes.

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## 1. Introduction

The Session Traversal Utilities for NAT (STUN)[RFC5389] protocol defines two different hashes that may be included in messages exchanged by peers implementing that protocol:

FINGERPRINT attribute: a 32-bit Cyclic Redundancy Check.

MESSAGE-INTEGRITY attribute: an HMAC-SHA1 [RFC2104] authentication code.

This document provides samples of properly formatted STUN messages including these hashes, for the sake of testing implementations of the STUN protocol.

## 2. Test Vectors

All included vectors are represented as a series of hexadecimal values in network byte order. Each pair of hexadecimal digits represents one byte.

Messages follow the Interactive Connectivity Establishment (ICE) Connectivity Checks use case of STUN (see [RFC5245]). These messages include FINGERPRINT, MESSAGE-INTEGRITY, and XOR-MAPPED-ADDRESS STUN attributes. These attributes are considered to be most prone to implementation errors. An additional message is provided to test STUN authentication with long-term credentials (which is not used by ICE).

In the following sample messages, two types of plain UTF-8 text attributes are included. The values of certain of these attributes were purposely sized to require padding. Non-ASCII characters are represented as <U+xxxx> where xxxx is the hexadecimal number of their Unicode code point.

In this document, ASCII white spaces (U+0020) are used for padding within the first three messages - this is arbitrary. Similarly, the last message uses nul bytes for padding. As per [RFC5389], padding bytes may take any value.

## 2.1. Sample Request

This request uses the following parameters:

Software name: "STUN test client" (without quotes)

Username: "evtj:h6vY" (without quotes)

Password: "VOkJxbRl1RmTxUk/WvJxBt" (without quotes)

```

00 01 00 58      Request type and message length
21 12 a4 42      Magic cookie
b7 e7 a7 01     }
bc 34 d6 86     } Transaction ID
fa 87 df ae     }
80 22 00 10      SOFTWARE attribute header
53 54 55 4e     }
20 74 65 73     } User-agent...
74 20 63 6c     } ...name
69 65 6e 74     }
00 24 00 04      PRIORITY attribute header
6e 00 01 ff      ICE priority value
80 29 00 08      ICE-CONTROLLED attribute header
93 2f f9 b1     } Pseudo-random tie breaker...
51 26 3b 36     } ...for ICE control
00 06 00 09      USERNAME attribute header
65 76 74 6a     }
3a 68 36 76     } Username (9 bytes) and padding (3 bytes)
59 20 20 20     }
00 08 00 14      MESSAGE-INTEGRITY attribute header
9a ea a7 0c     }
bf d8 cb 56     }
78 1e f2 b5     } HMAC-SHA1 fingerprint
b2 d3 f2 49     }
c1 b5 71 a2     }
80 28 00 04      FINGERPRINT attribute header
e5 7a 3b cf      CRC32 fingerprint

```

## 2.2. Sample IPv4 Response

This response uses the following parameter:

Password: "VOkJxbRl1RmTxUk/WvJxBt" (without quotes)

Software name: "test vector" (without quotes)

Mapped address: 192.0.2.1 port 32853

```
01 01 00 3c      Response type and message length
21 12 a4 42      Magic cookie
b7 e7 a7 01     }
bc 34 d6 86     } Transaction ID
fa 87 df ae     }
80 22 00 0b     SOFTWARE attribute header
74 65 73 74     }
20 76 65 63     } UTF-8 server name
74 6f 72 20     }
00 20 00 08     XOR-MAPPED-ADDRESS attribute header
00 01 a1 47     Address family (IPv4) and xor'd mapped port number
e1 12 a6 43     Xor'd mapped IPv4 address
00 08 00 14     MESSAGE-INTEGRITY attribute header
2b 91 f5 99     }
fd 9e 90 c3     }
8c 74 89 f9     } HMAC-SHA1 fingerprint
2a f9 ba 53     }
f0 6b e7 d7     }
80 28 00 04     FINGERPRINT attribute header
c0 7d 4c 96     CRC32 fingerprint
```

### 2.3. Sample IPv6 Response

This response uses the following parameter:

Password: "VOKJxbRl1RmTxUk/WvJxBt" (without quotes)

Software name: "test vector" (without quotes)

Mapped address: 2001:db8:1234:5678:11:2233:4455:6677 port 32853

```

01 01 00 48      Response type and message length
21 12 a4 42      Magic cookie
b7 e7 a7 01     }
bc 34 d6 86     } Transaction ID
fa 87 df ae     }
80 22 00 0b     SOFTWARE attribute header
74 65 73 74     }
20 76 65 63     } UTF-8 server name
74 6f 72 20     }
00 20 00 14     XOR-MAPPED-ADDRESS attribute header
00 02 a1 47     Address family (IPv6) and xor'd mapped port number
01 13 a9 fa     }
a5 d3 f1 79     } Xor'd mapped IPv6 address
bc 25 f4 b5     }
be d2 b9 d9     }
00 08 00 14     MESSAGE-INTEGRITY attribute header
a3 82 95 4e     }
4b e6 7b f1     }
17 84 c9 7c     } HMAC-SHA1 fingerprint
82 92 c2 75     }
bf e3 ed 41     }
80 28 00 04     FINGERPRINT attribute header
c8 fb 0b 4c     CRC32 fingerprint

```

#### 2.4. Sample Request with Long-Term Authentication

This request uses the following parameters:

Username: "<U+30DE><U+30C8><U+30EA><U+30C3><U+30AF><U+30B9>"  
(without quotes) unaffected by SASLprep [RFC4013] processing

Password: "The<U+00AD>M<U+00AA>tr<U+2168>" and "TheMatrIX" (without quotes) respectively before and after SASLprep processing

Nonce: "f//499k954d60L34oL9FSTvy64sA" (without quotes)

Realm: "example.org" (without quotes)

```

00 01 00 60      Request type and message length
21 12 a4 42      Magic cookie
78 ad 34 33     }
c6 ad 72 c0     } Transaction ID
29 da 41 2e     }
00 06 00 12      USERNAME attribute header
e3 83 9e e3     }
83 88 e3 83     }
aa e3 83 83     } Username value (18 bytes) and padding (2 bytes)
e3 82 af e3     }
82 b9 00 00     }
00 15 00 1c      NONCE attribute header
66 2f 2f 34     }
39 39 6b 39     }
35 34 64 36     }
4f 4c 33 34     } Nonce value
6f 4c 39 46     }
53 54 76 79     }
36 34 73 41     }
00 14 00 0b      REALM attribute header
65 78 61 6d     }
70 6c 65 2e     } Realm value (11 bytes) and padding (1 byte)
6f 72 67 00     }
00 08 00 14      MESSAGE-INTEGRITY attribute header
f6 70 24 65     }
6d d6 4a 3e     }
02 b8 e0 71     } HMAC-SHA1 fingerprint
2e 85 c9 a2     }
8c a8 96 66     }

```

### 3. Security Considerations

There are no security considerations.

### 4. Acknowledgments

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### 5. References

#### 5.1. Normative References

[RFC5389] Rosenberg, J., Mahy, R., Matthews, P., and D. Wing, "Session Traversal Utilities for NAT (STUN)", RFC 5389, October 2008.

[RFC5245] Rosenberg, J., "Interactive Connectivity Establishment (ICE): A Protocol for Network Address Translator (NAT) Traversal for Offer/Answer Protocols", RFC 5245, April 2010.

#### 5.2. Informative References

[RFC2104] Krawczyk, H., Bellare, M., and R. Canetti, "HMAC: Keyed-Hashing for Message Authentication", RFC 2104, February 1997.

[RFC4013] Zeilenga, K., "SASLprep: Stringprep Profile for User Names and Passwords", RFC 4013, February 2005.

## Appendix A. Source Code for Test Vectors

```
const unsigned char req[] =
  "\x00\x01\x00\x58"
  "\x21\x12\xa4\x42"
  "\xb7\xe7\xa7\x01\xbc\x34\xd6\x86\xfa\x87\xdf\xae"
  "\x80\x22\x00\x10"
  "STUN test client"
  "\x00\x24\x00\x04"
  "\x6e\x00\x01\xff"
  "\x80\x29\x00\x08"
  "\x93\x2f\xf9\xb1\x51\x26\x3b\x36"
  "\x00\x06\x00\x09"
  "\x65\x76\x74\xa6\x3a\x68\x36\x76\x59\x20\x20\x20"
  "\x00\x08\x00\x14"
  "\x9a\xea\xa7\x0c\xbf\xd8\xcb\x56\x78\x1e\xf2\xb5"
  "\xb2\xd3\xf2\x49\xc1\xb5\x71\xa2"
  "\x80\x28\x00\x04"
  "\xe5\x7a\x3b\xcf";
```

Request message

```

const unsigned char respv4[] =
  "\x01\x01\x00\x3c"
  "\x21\x12\xa4\x42"
  "\xb7\xe7\xa7\x01\xbc\x34\xd6\x86\xfa\x87\xdf\xae"
  "\x80\x22\x00\x0b"
  "\x74\x65\x73\x74\x20\x76\x65\x63\x74\x6f\x72\x20"
  "\x00\x20\x00\x08"
  "\x00\x01\xa1\x47\xe1\x12\xa6\x43"
  "\x00\x08\x00\x14"
  "\x2b\x91\xf5\x99\xfd\xe9\x90\xc3\x8c\x74\x89\xf9"
  "\x2a\xf9\xba\x53\xf0\x6b\xe7\xd7"
  "\x80\x28\x00\x04"
  "\xc0\x7d\x4c\x96";

```

IPv4 response message

```

const unsigned char respv6[] =
  "\x01\x01\x00\x48"
  "\x21\x12\xa4\x42"
  "\xb7\xe7\xa7\x01\xbc\x34\xd6\x86\xfa\x87\xdf\xae"
  "\x80\x22\x00\x0b"
  "\x74\x65\x73\x74\x20\x76\x65\x63\x74\x6f\x72\x20"
  "\x00\x20\x00\x14"
  "\x00\x02\xa1\x47"
  "\x01\x13\xa9\xfa\xa5\xd3\xf1\x79"
  "\xbc\x25\xf4\xb5\xbe\xd2\xb9\xd9"
  "\x00\x08\x00\x14"
  "\xa3\x82\x95\x4e\x4b\xe6\x7b\xf1\x17\x84\xc9\x7c"
  "\x82\x92\xc2\x75\xbf\xe3\xed\x41"
  "\x80\x28\x00\x04"
  "\xc8\xfb\x0b\x4c";

```

IPv6 response message

```
const unsigned char req1tc[] =
  "\x00\x01\x00\x60"
  "\x21\x12\xa4\x42"
  "\x78\xad\x34\x33\xc6\xad\x72\xc0\x29\xda\x41\xe"
  "\x00\x06\x00\x12"
  "\xe3\x83\x9e\xe3\x83\x88\xe3\x83\xaa\xe3\x83\x83"
  "\xe3\x82\xaf\xe3\x82\xb9\x00\x00"
  "\x00\x15\x00\x1c"
  "\x66\x2f\x2f\x34\x39\x39\x6b\x39\x35\x34\x64\x36"
  "\x4f\x4c\x33\x34\x6f\x4c\x39\x46\x53\x54\x76\x79"
  "\x36\x34\x73\x41"
  "\x00\x14\x00\x0b"
  "\x65\x78\x61\x6d\x70\x6c\x65\xe\x6f\x72\x67\x00"
  "\x00\x08\x00\x14"
  "\xf6\x70\x24\x65\x6d\xd6\x4a\x3e\x02\xb8\xe0\x71"
  "\x2e\x85\xc9\xa2\x8c\xa8\x96\x66";
```

Request with long-term credentials

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