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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//499k954d6OL34oL9FSTvy64sA" (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\x6a\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\x9e\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 reqltc[] =
  "\x00\x01\x00\x60"
  "\x21\x12\xa4\x42"
  "\x78\xad\x34\x33\xc6\xad\x72\xc0\x29\xda\x41\x2e"
  "\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\x2e\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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