Zürcher Hochschule Winterthur

SIP Security

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Agenda

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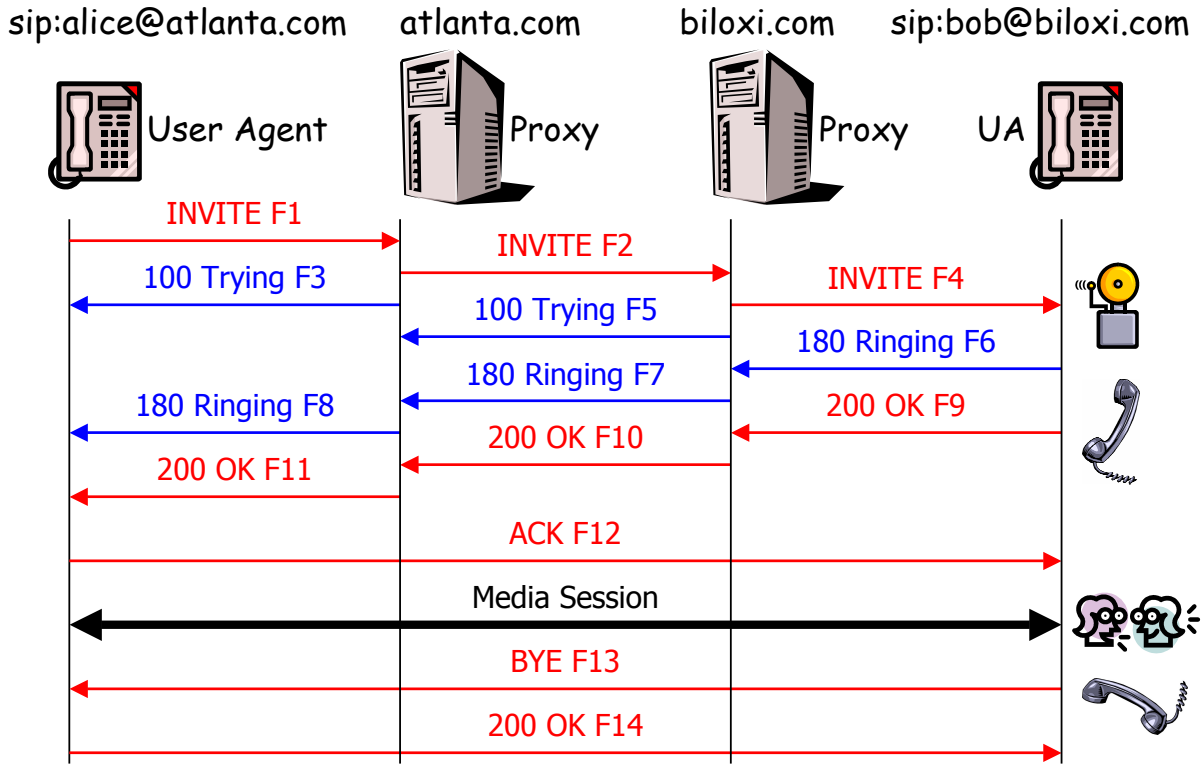
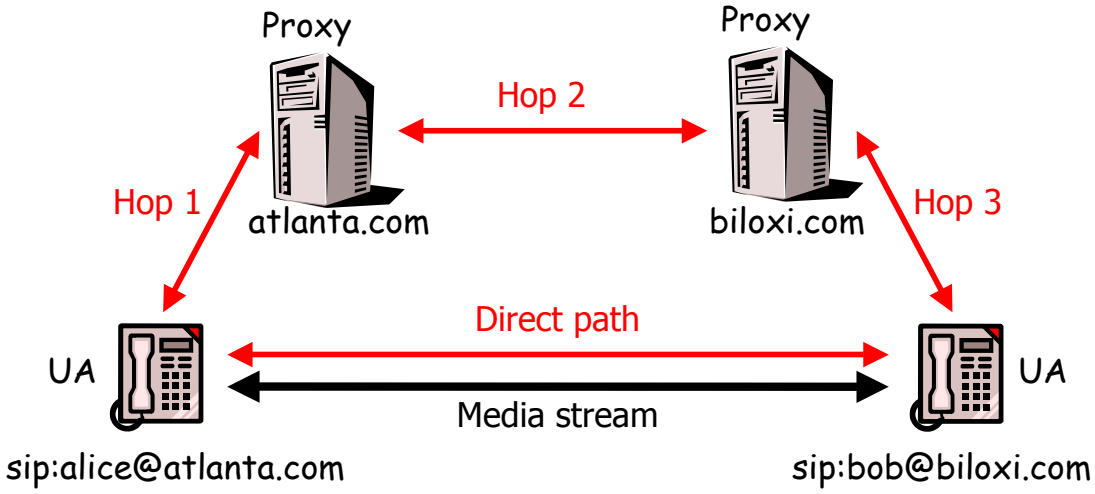
- SIP – The Session Initiation Protocol
- Securing the Session Management
- Securing the Media Streams
- Conclusions

Session Initiation Protocol (RFC 3261)



Basic SIP Trapezoid



udp/sip or tcp/sip Session Management

udp/rtp Media Streams

Securing the Session Management

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Authentication methods: PSK Pre-Shared Keys PKI Public Key Infrastructure	Authentication	Data Integrity	Confidentiality	
HTTP 1.0 Basic Authentication	PSK	-	-	Deprecated by SIPv2 Insecure transmission of password
HTTP 1.1 Digest Authentication	PSK	-	-	Challenge/response exchange based on MD5 hash of [strong] password
Pretty Good Privacy (PGP)	PKI	✓	✓	Deprecated by SIPv2
Secure MIME (S/MIME)	PKI	✓	✓	For encryption the public key of the recipient user agent must be known
SIPS URI (TLS)	PKI	✓	✓	SIP application and proxies must tightly integrate TLS
IP Security (IPsec)	PKI	✓	✓	Integration with SIP application not required but proxies must be trusted

Securing the Media Streams

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Authentication methods: PSK Pre-Shared Keys PKI Public Key Infrastructure	Authentication	Data Integrity	Confidentiality	
Secure RTP (SRTP)	PSK	✓	✓	Uses master key which must be distributed by other means
IP Security (IPsec)	PKI	✓	✓	Integration with SIP application not required but peer must be trusted

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Securing the Media Streams

Secure RTP Packet Format (RFC 3711)

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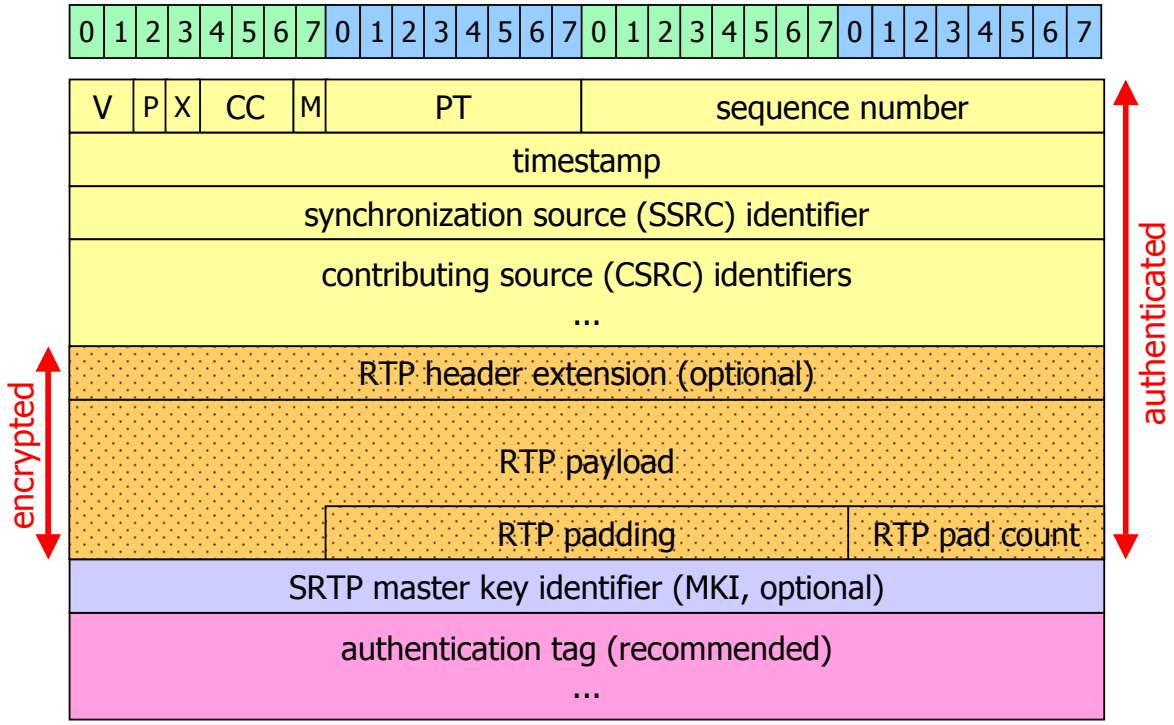

Secure RTCP Packet Format (RFC 3711)

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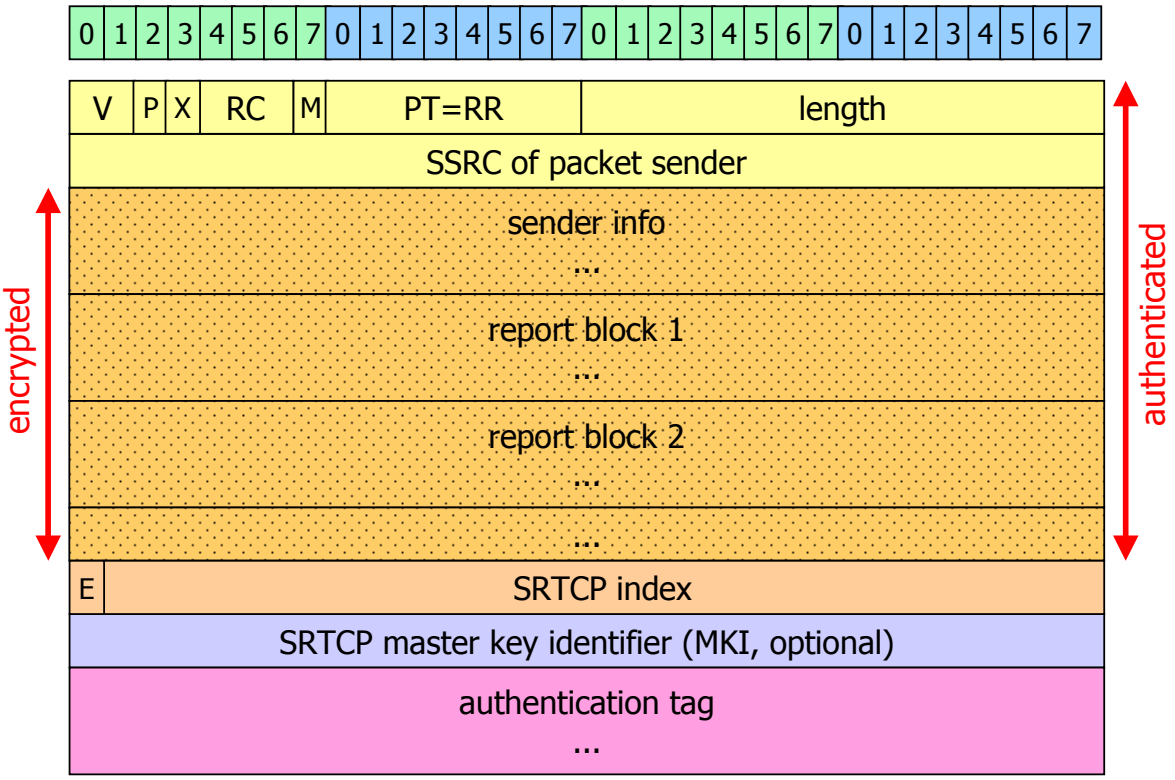

Default Encryption and Authentication Algorithms

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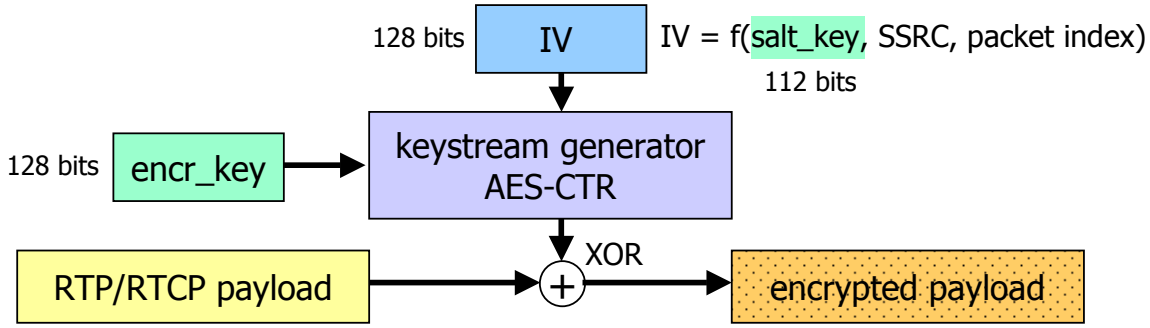
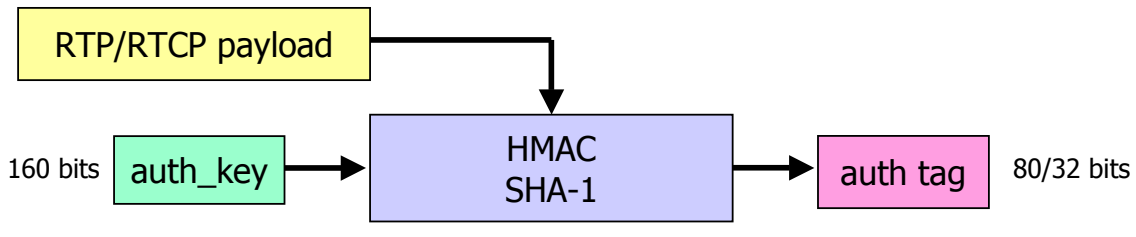
- Encryption uses AES in Counter Mode (AES-CTR) with 128 bit key

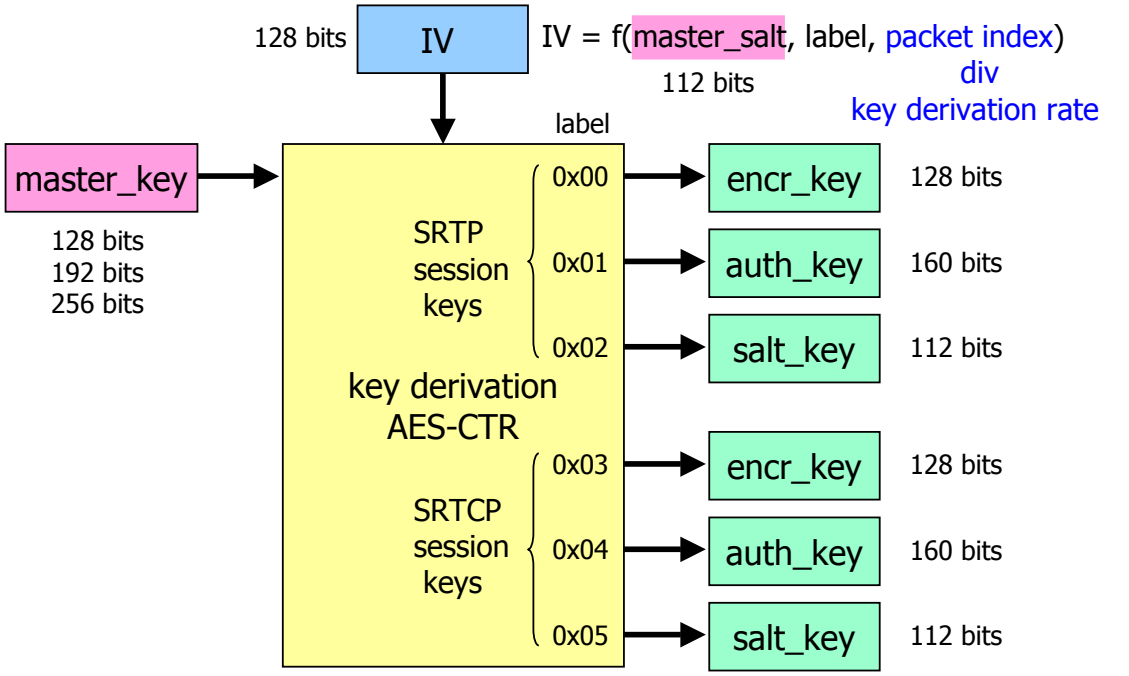


- Authentication uses HMAC-SHA-1 with truncated 80 bit MAC



Session Key Derivation

- Key Derivation uses AES in Counter Mode (AES-CTR)



Securing the Session Management

SIP INVITE Request

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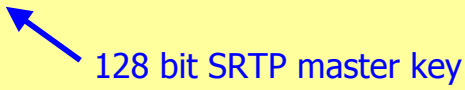
```
INVITE sip:bob@zhwin.ch SIP/2.0
Via: SIP/2.0/UDP 160.85.170.139:5060;branch=z9hG4bK4129d28b8904
To: Bob <sip:bob@zhwin.ch>
From: Alice <sip:alice@zhwin.ch>;tag=daa21162
Call-ID: 392c3f2b568e92a8eb37d448886edd1a@160.85.170.139
CSeq: 1 INVITE
Max-Forwards: 70
Contact: <sip:alice@dskt6816.zhwin.ch:5060>
Content-Type: application/sdp
Content-Length: 239

v=0
o=alice 3157331353 3157331353 IN IP4 160.85.170.139
s=DA SIP Security 2003
c=IN IP4 160.85.170.139
t=0 0
k=clear:910bc4defa71eb6190008762fca6ae2f1d959e87cdf3c0c5c5076ad38ee8
m=audio 10000 RTP/AVP 0
a=ptime:20
a=rtpmap:0 PCMU/8000
```



S/MIME based Authentication and Encryption

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```
INVITE sip:bob@zhwin.ch SIP/2.0
Via: SIP/2.0/UDP 160.85.170.139:5060;branch=z9hG4bK4129d28b8904
To: Bob <sip:bob@zhwin.ch>
From: Alice <sip:alice@zhwin.ch>;tag=daa21162
Call-ID: 392c3f2b568e92a8eb37d448886edd1a@160.85.170.139
CSeq: 1 INVITE
Max-Forwards: 70
Contact: <sip:alice@dskt6816.zhwin.ch:5060>
Content-Type: multipart/signed;boundary=992d915fef419824;
micalg=sha1;protocol=application/pkcs7-signature
Content-Length: 3088
--992d915fef419824
Content-Type: application/pkcs7-mime;
smime-type=envelopeddata; name=smime.p7m
Content-Disposition: attachment;handling=required;filename=smime.p7m
Content-Transfer-Encoding: binary
<envelopedData object encapsulating encrypted SDP attachment not shown>
--992d915fef419824
Content-Type: application/pkcs7-signature;name=smime.p7s
Content-Disposition: attachment;handling=required;filename=smime.p7s
Content-Transfer-Encoding: binary
<signedData object containing signature not shown>
--992d915fef419824--
```

Practical Results and Conclusions

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- Practical Results
  - ZHW diploma thesis in 2003 demonstrated feasability of S/MIME protected session management and SRTP secured media streams.
  - reSIPprocate available from www.resiprocate.org implements a SIPv2 stack and offers basic S/MIME support using OpenSSL.
  - TinyCA available from tinyca.sm-zone.net was used as a graphical interface on top of OpenSSL for X.509 certificate generation.
  - libsrtp library available from srtp.sourceforge.net implements SRTP.
- Conclusions
  - S/MIME encrypted and/or signed attachments in SIP messages are an attractive alternative to the hop-by-hop security offered by TLS and allow the secure transfer of secret SRTP master keys via end-to-end encryption.
  - Similar to S/MIME protected email, the verification of peer certificates on a global scale remains one of the open problems yet to be solved.