**ZFONE**
- Philip Zimmermann’s new secure VOIP application
- Interoperates with SIP signaling
- Communication with AES by SRTP
- Successor of PGPfone
- Does not rely on a PKI
- Authentication by ZRTP

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**SRTP**
- Secure Real Time Transport Protocol
- Goals
  - Confidentiality
  - Message Authentication/Integrity
  - Replay Protection
  - Key Refresh / Master Key Expiration
  - Entire Packet is MACed
  - Payload is encrypted

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**ZRTP**
- Alice
  - Hello(A’s Zid, Hash, Enc, SAS…)
  - Commit(B’s Zid, HVI, …)
  - DH1(pvr, Hash(secret), …)
  - DH2(pvi, Hash(secret), …)

  -------SRTP with AES begins-------
  - SAS(spoken Hash(Master Key))
  - SAS(spoken Hash(Master Key))

- Bob

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**ZFONE**
- Secrecy between 2 parties
- Forward Secrecy
- Authentication (untraditional)
  - No PKI
  - Replay protection
  - Parties can *distinguish* voices

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**Hash Commitment**
- Resourceful adversary can pose as anyone
- Adversary can force a re-SAS
- Privacy
  - ZID’s are public
- DOS

- Hash collision attack on authentication
- Small SAS read aloud
- Attacker needs only to find collision on first 4 bytes of hash(master key)
- Attacker cannot deterministically influence hash(Master Key)
**Shared Secrets**

- Parties perform SAS once
  - Cache shared secret s1
- Master Secret – s0
  - Based on DH exchange and shared secret
  - Becomes s1 (s1 -> s2, etc…)
- Initiator sends HMAC(s1, “Initiator”)
- Responder sends HMAC(s1, “Responder”)

**Attack Tensor**

- Attacker can simulate Initiator's voice
- Attacker can simulate Responder's voice
- Attacker can convert voice to his own in real time
- Initiator knows Responder's voice in advance
- Responder knows Initiator's voice in advance
- Initiator remembers voice from one session to the next
- Responder remembers voice from one session to the next

**Results of Murphi Modeling**

- 61 parameter assignments yielded attacks
- After reduction, 5 independent attacks found!
  - SAS Voice Forgery Attack
  - Bill Clinton Attack
  - 6 Month Attack
  - Court Reporter Attack
  - Hybrid Clinton-Court Reporter Attack

**ZRTP Modeled**

Really Really Ridiculously Good Looking

**Court Reporter Attack**

**Six Month Attack**

A and B don’t remember voices between sessions
Bill Clinton Attack
MitM can imitate the president’s voice
Bill doesn’t know Alice’s voice

Solution: The Chrono-Gambit
- Interpolate Hash(Master Key) between 0 and N seconds
  - N is negotiated in Hello and HashCommit
- Conversation must start ~N seconds from first message exchange
- Probabilistically foils every attack
  - Idea: Hard to interleave conversations starting at different times!

Conclusion
* In normal use cases, ZFone is secure
* In abnormal, but reasonable cases, ZFone can be attacked
  - To mount attacks, adversary needs to be powerful and resourceful
* Questions?