The NSA

The only part of government that actually listens.

Don‘t give them anything for free

It‘s your home, you fight

BetterCrypto·org

Applied Crypto Hardening

Who

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Agenda

- Pieces of History
- Introduction to BetterCrypto project
- Symetric Ciphering
- Asymetric Cryptography
- Ciphersuites
- Practical Settings
- Heartbeat
- Conclusion

Pieces of History

- Go for Talk @ULG + Enigma

BetterCrypto

- Crypto is cryptic
- A lot of difficult concepts
- A lot of algorithms
- A lot of parameters
- …

BetterCrypto

- Really difficult for systems administrators
- A “cookbook” can help!
  - That’s BetterCrypo

BetterCrypto is not…

- A crypto course
- A static document

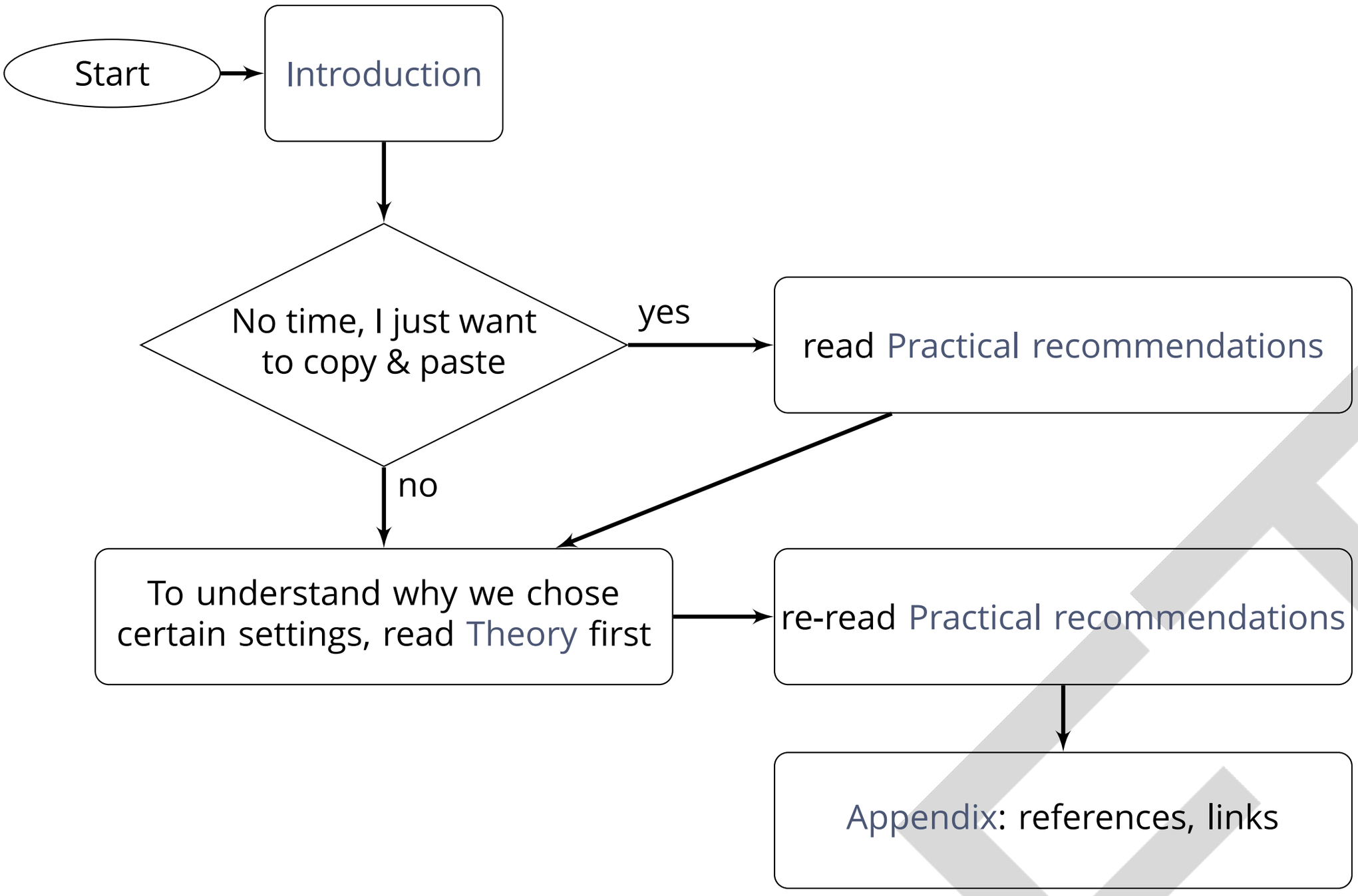
BetterCrypto in short

- Community effort to produce best practices
- Continuous effort
- Mixed expertises
- Open to comments / suggestions / improvements

BetterCrypto in 2 parts

- First part = configurations
  - The most important part
    - Cover as many tools as possible
- Second part = theory
  - Explain and justify choose we made
    - Transparency

How to use?

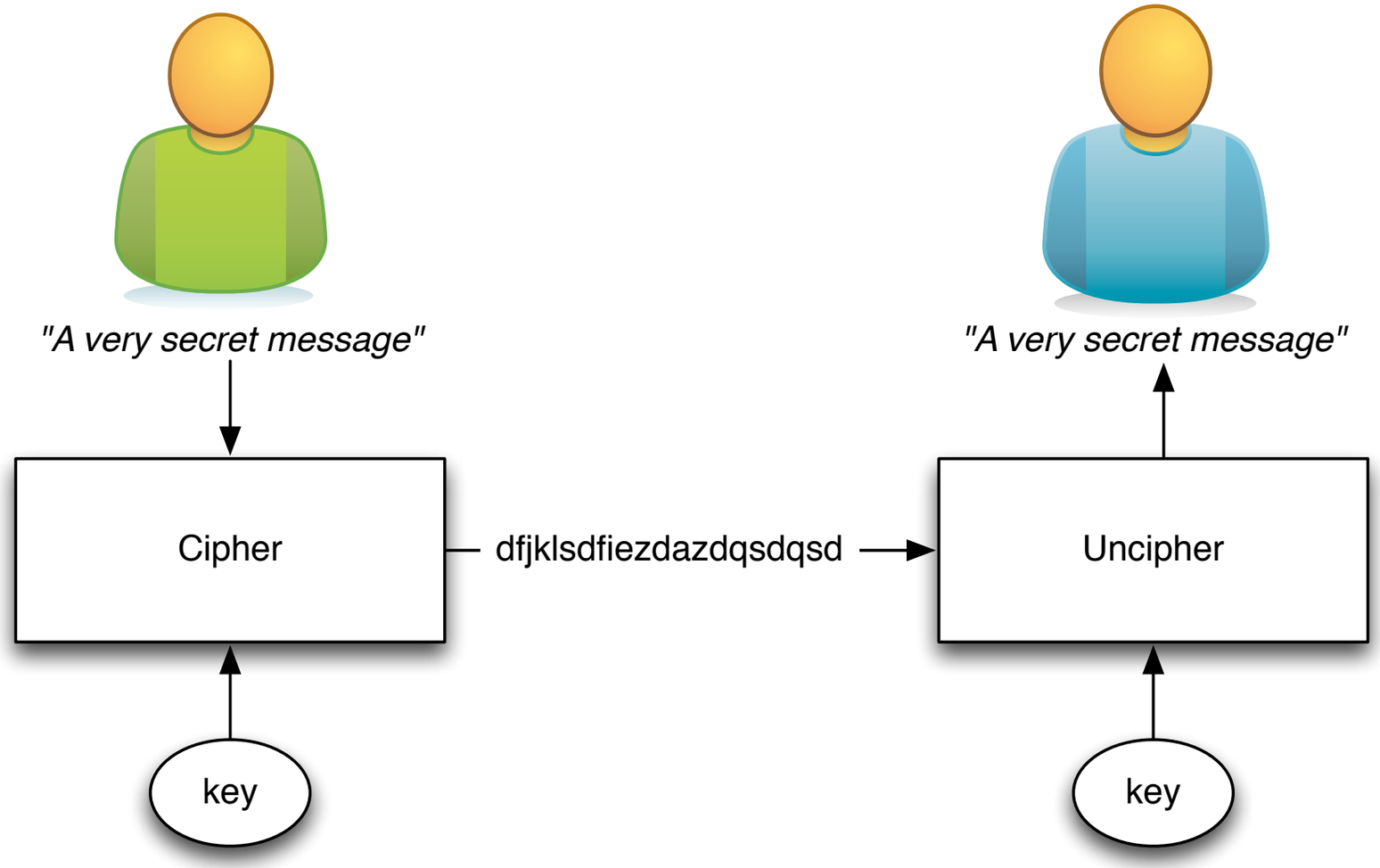

Start
Introduction
No time, I just want to copy & paste
yes
read Practical recommendations
no
To understand why we chose certain settings, read Theory first
re-read Practical recommendations
Appendix: references, links

Crypto in a nutshell

- 2 types of goals:
  - protect the contact of the message
  - identify the author
- Can be combined

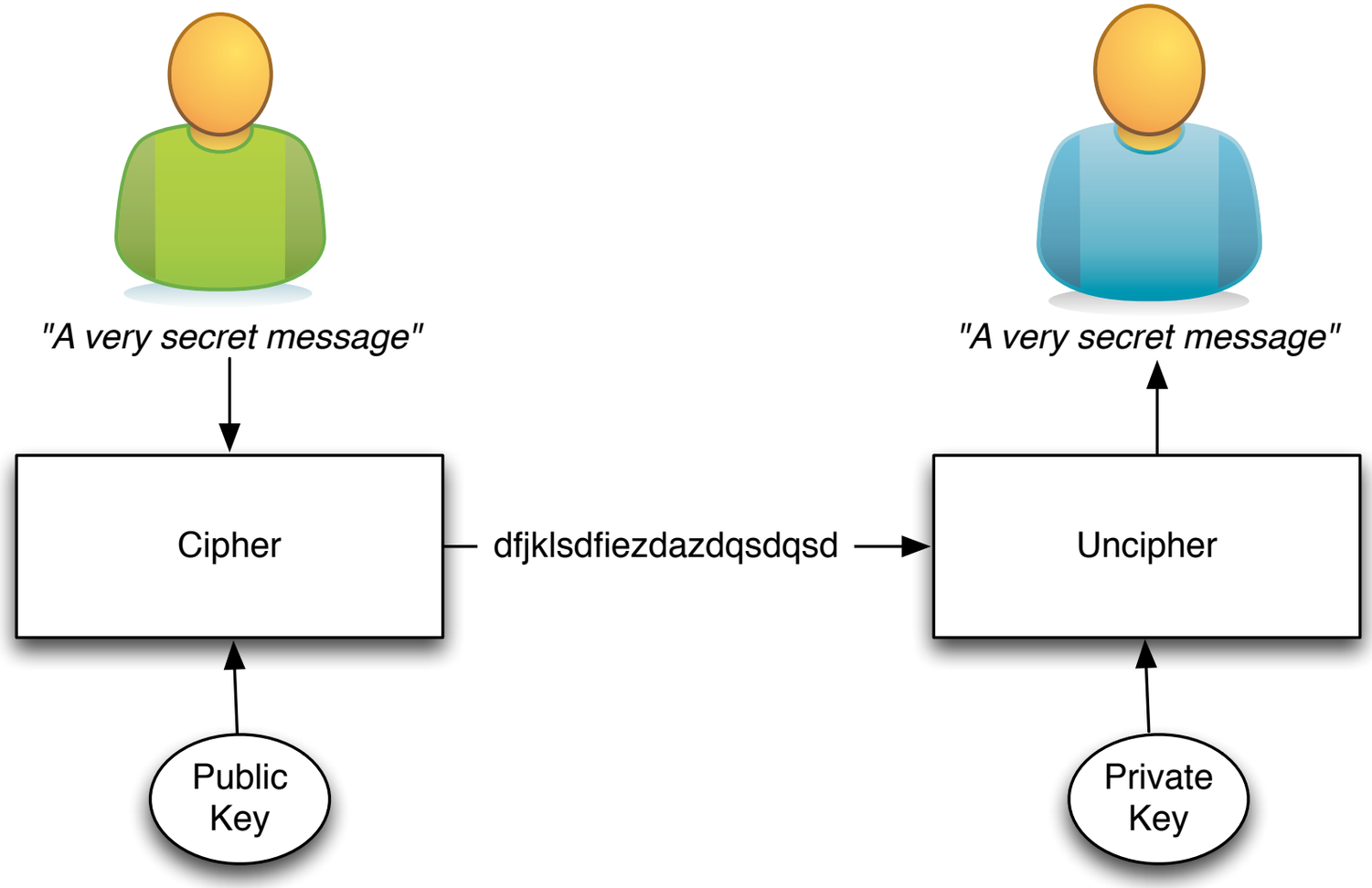
Symetric Ciphering

- The key is shared



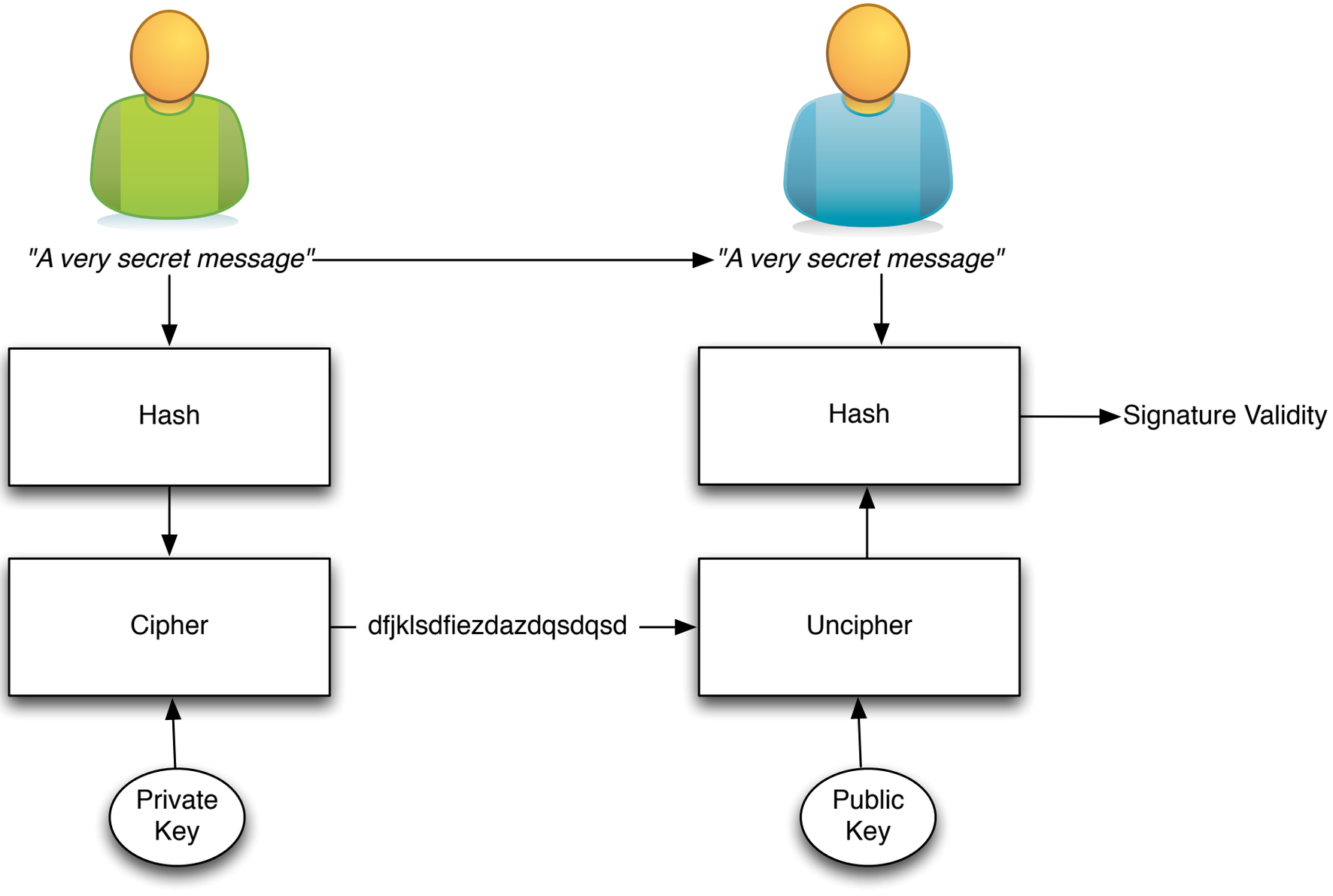
Asymetric Ciphering

- Public key is published
- Private key HAS to be secured



Signing

- Author identity is proved



The asymmetric magic

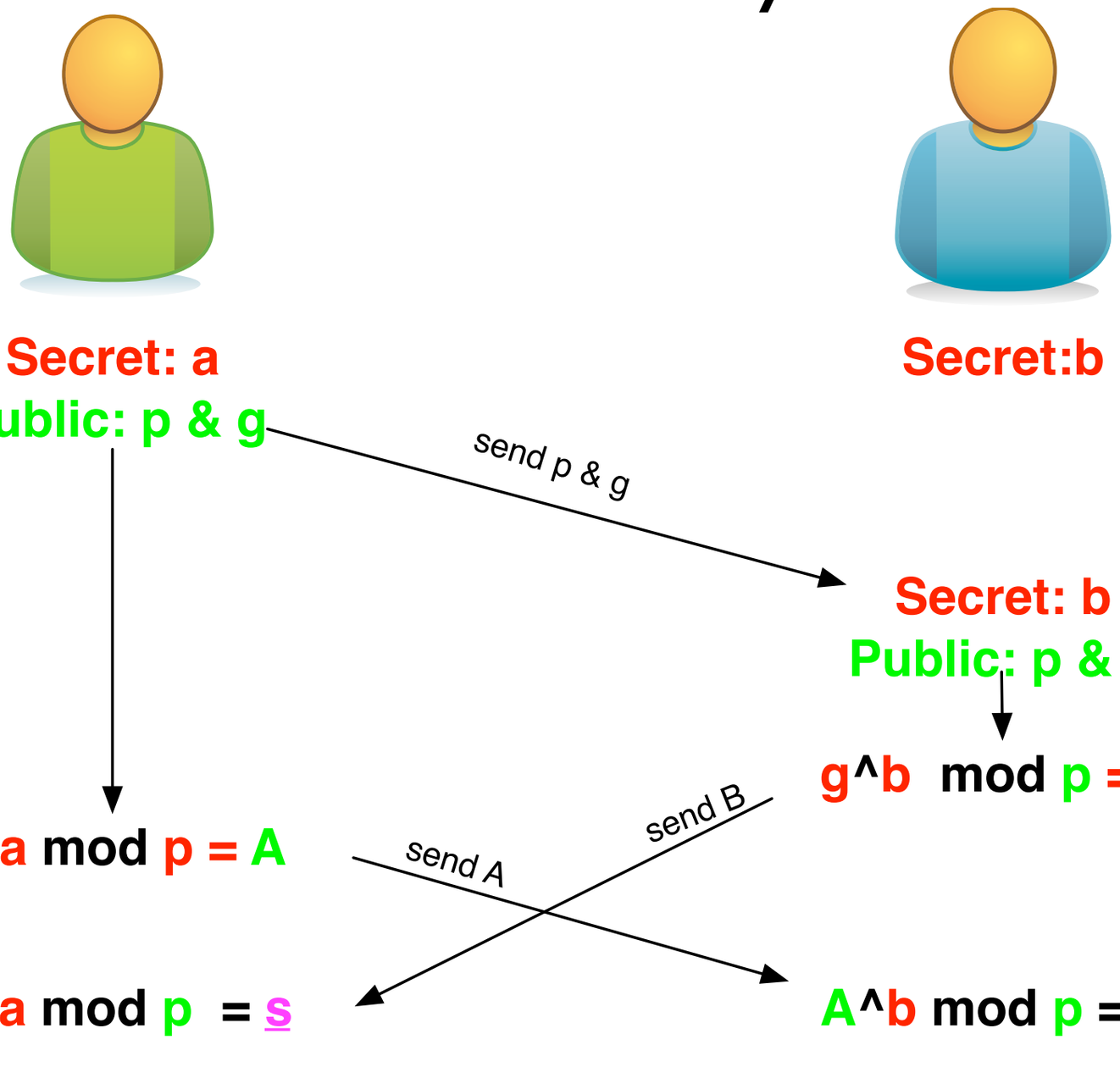
- RSA "formula" : *c = m^e mod n*
    - with
        - c which is the ciphertext
            - m is the cleartext message
            - e and n are the public key
- Uncipher with *m = c^d mod n*
    - d being the private key

Some algorithms

- Hash
  - SHA1
  - SHA256
  - SHA512
- Key Exchange
  - Diffie Elleman

Diffie-Helleman

- How to share a secret key?



Ephemeral Diffie-Helleman

- Regular mode
  - Public and private keys are kept
- Ephemeral mode
  - New keys are generated each time
    - By one of the parties at least

SSL

- Explain

Stream vs Block Cipher

- Stream cipher
  - Generate an “infinite” key stream
  - Difficult to correctly use
    - Re-use of keys
  - Faster
- Block cipher
  - Cipher by block with padding
  - Could include integrity protection

Some algorithms

- Symetric
  - AES (Rijndael)
  - Camellia
- Asymetric
  - GPG / PGP
  - RSA

Algorithm vs Implementation!

- Heartbeat

Heartbeat

BetterCrypto CipherSuite

- 2 cipher suites
  - version A
    - stronger
    - less supported client
  - version B
    - weaker
    - more “universal”

Cipher Suite A

- TLS 1.2
- Perfect forward secrecy / ephemeral Diffie Hellman
- Strong MACs (SHA-2) or
- GCM as Authenticated Encryption scheme

ID	OpenSSL Name	Version	KeyEx	Auth	Cipher	MAC
0x009F	DHE-RSA-AES256-GCM-SHA384	TLSv1.2	DH	RSA	AESGCM(256)	AEAD
0x006B	DHE-RSA-AES256-SHA256	TLSv1.2	DH	RSA	AES(256) (CBC)	SHA256
0xC030	ECDHE-RSA-AES256-GCM-SHA384	TLSv1.2	ECDH	RSA	AESGCM(256)	AEAD
0xC028	ECDHE-RSA-AES256-SHA384	TLSv1.2	ECDH	RSA	AES(256) (CBC)	SHA384

CiperSuite B

- TLS 1.2,TLS 1.1,TLS 1.0
- Allowing SHA-1

Cipher Suite B

ID	OpenSSL Name	Version	KeyEx	Auth	Cipher	MAC
0x009F	DHE-RSA-AES256-GCM-SHA384	TLSv1.2	DH	RSA	AESGCM(256)	AEAD
0x006B	DHE-RSA-AES256-SHA256	TLSv1.2	DH	RSA	AES(256)	SHA256
0xC030	ECDHE-RSA-AES256-GCM-SHA384	TLSv1.2	ECDH	RSA	AESGCM(256)	AEAD
0xC028	ECDHE-RSA-AES256-SHA384	TLSv1.2	ECDH	RSA	AES(256)	SHA384
0x009E	DHE-RSA-AES128-GCM-SHA256	TLSv1.2	DH	RSA	AESGCM(128)	AEAD
0x0067	DHE-RSA-AES128-SHA256	TLSv1.2	DH	RSA	AES(128)	SHA256
0xC02F	ECDHE-RSA-AES128-GCM-SHA256	TLSv1.2	ECDH	RSA	AESGCM(128)	AEAD
0xC027	ECDHE-RSA-AES128-SHA256	TLSv1.2	ECDH	RSA	AES(128)	SHA256
0x0088	DHE-RSA-CAMELLIA256-SHA	SSLv3	DH	RSA	Camellia(256)	SHA1
0x0039	DHE-RSA-AES256-SHA	SSLv3	DH	RSA	AES(256)	SHA1
0xC014	ECDHE-RSA-AES256-SHA	SSLv3	ECDH	RSA	AES(256)	SHA1
0x0045	DHE-RSA-CAMELLIA128-SHA	SSLv3	DH	RSA	Camellia(128)	SHA1
0x0033	DHE-RSA-AES128-SHA	SSLv3	DH	RSA	AES(128)	SHA1
0xC013	ECDHE-RSA-AES128-SHA	SSLv3	ECDH	RSA	AES(128)	SHA1
0x0084	CAMELLIA256-SHA	SSLv3	RSA	RSA	Camellia(256)	SHA1
0x0035	AES256-SHA	SSLv3	RSA	RSA	AES(256)	SHA1
0x0041	CAMELLIA128-SHA	SSLv3	RSA	RSA	Camellia(128)	SHA1
0x002F	AES128-SHA	SSLv3	RSA	RSA	AES(128)	SHA1

Key Length

On the choice between AES256 and AES128: I would never consider using AES256, just like I don't wear a helmet when I sit inside my car. It's too much bother for the epsilon improvement in security."

— Vincent Rijmen in a personal mail exchange Dec 2013

- Symetric
  - 128 bits
- Aysmetric
  - 3248 bits (RSA)

Choose a Method

- Lenstra and Verheul Equations (2000)
- Lenstra Updated Equations (2004)
- ECRYPT II Recommendations (2012)
- NIST Recommendations (2012)
- ANSSI Recommendations (2010)
- Fact Sheet NSA Suite B Cryptography (2013)
- Network Working Group RFC3766 (2004)
- BSI Recommendations (2014)

Compare all Methods

1 Reference for the comparison

You can enter the year until when your system should be protected and see the corresponding key sizes or you can enter a key/hash/group size and see until when you would be protected.

Enter an elliptic curve key size: 256 bits

2 Compare

Method	Date	Symmetric	Asymmetric	Discrete Logarithm Key	Discrete Logarithm Group	Elliptic Curve	Hash
[1] Lenstra / Verheul	2084	135	7813 6816	241	7813	257	269
[2] Lenstra Updated	2090	128	4440 6974	256	4440	256	256
[3] ECRYPT II	2031 - 2040	128	3248	256	3248	256	256
[4] NIST	> 2030	128	3072	256	3072	256	256
[5] ANSSI	> 2020	128	4096	200	4096	256	256
[6] NSA	-	128	-	-	-	256	256
[7] RFC3766	-	136	3707	272	3707	257	-
[8] BSI (signature only)	> 2020	-	1976	256	2048	250	256

Compatibility (B suite)

Handshake Simulation

Bing Oct 2013	TLS 1.0	TLS_DHE_RSA_WITH_AES_256_CBC_SHA (0x39) FS	256
Chrome 31 / Win 7	TLS 1.2	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014) FS	256
Firefox 10.0.12 ESR / Win 7	TLS 1.0	TLS_DHE_RSA_WITH_CAMELLIA_256_CBC_SHA (0x88) FS	256
Firefox 17.0.7 ESR / Win 7	TLS 1.0	TLS_DHE_RSA_WITH_CAMELLIA_256_CBC_SHA (0x88) FS	256
Firefox 21 / Fedora 19	TLS 1.0	TLS_DHE_RSA_WITH_CAMELLIA_256_CBC_SHA (0x88) FS	256
Firefox 24 / Win 7	TLS 1.0	TLS_DHE_RSA_WITH_CAMELLIA_256_CBC_SHA (0x88) FS	256
Googlebot Oct 2013	TLS 1.0	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014) FS	256
IE 6 / XP No FS [1] No SNI [2]			Fail[3]
IE 7 / Vista	TLS 1.0	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014) FS	256
IE 8 / XP No FS [1] No SNI [2]			Fail[3]
IE 8-10 / Win 7	TLS 1.0	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014) FS	256
IE 11 / Win 7	TLS 1.2	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014) FS	256
IE 11 / Win 8.1	TLS 1.2	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014) FS	256
Java 6u45 No SNI [2]			Fail[3]
Java 7u25			Fail[3]
OpenSSL 0.9.8y	TLS 1.0	TLS_DHE_RSA_WITH_AES_256_CBC_SHA (0x39) FS	256
OpenSSL 1.0.1e	TLS 1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 (0xc030) FS	256
Opera 17 / Win 7	TLS 1.2	TLS_DHE_RSA_WITH_AES_256_CBC_SHA256 (0x6b) FS	256
Safari 5.1.9 / OS X 10.6.8	TLS 1.0	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014) FS	256
Safari 6 / iOS 6.0.1	TLS 1.2	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384 (0xc028) FS	256
Safari 6.0.4 / OS X 10.8.4	TLS 1.0	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014) FS	256
Safari 7 / OS X 10.9	TLS 1.2	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384 (0xc028) FS	256
Tor 17.0.9 / Win 7	TLS 1.0	TLS_DHE_RSA_WITH_CAMELLIA_256_CBC_SHA (0x88) FS	256
Yahoo Slurp Oct 2013	TLS 1.0	TLS_DHE_RSA_WITH_CAMELLIA_256_CBC_SHA (0x88) FS	256

Tools covered

- Webservers
  - Apache
  - lighttpd
  - nginx
  - Microsoft IIS

Tools covered

- SSH
- Open SSH
- Cisco ASA
- Cisco IOS

Tools covered

- Mail servers
  - Dovecot
  - cyrus-imapd
  - Postfix
  - Exim

Tools covered

- VPN
  - IPSec
  - CheckPoint Firewall-1
  - OpenVPN
  - PPPTP
  - Cisco ASA
  - OpenSWAN
  - tinc

Tools covered

- PGP/GPG
- IPMI/ILO
- Instant Messaging
  - ejabberd
  - OTR
  - Charybdis
  - SILC

Tools covered

- Database systems
  - Oracle
  - MySQL
  - DB2
  - PostgreSQL

Tools covered

- Proxy
  - squid
  - Bluecoat
  - Pound
- Kerberos

Futur / Idea

- Configuration Generator (online)
- A friendly copy/paste version
- Other tools

Conclusion

References

- BetterCrypto.org
- https://git.bettercrypto.org/ach-master.git
- http://lists.cert.at/cgi-bin/mailman/listinfo/ach

- Contact
  - david@autopsit.org
  - @ddurvaux