Mixtasy:
Remailing on Existing Infrastructure
Anonymized Email Communication Easily Deployable Using SMTP & OpenPGP

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Introduction

- Secure messaging is a big research area
- Plain email did not provide any security or privacy feature
  - But it’s still heavily used
- TLS and openPGP, S/MIME isn’t enough
  - Metadata still readable
- Eavesdroppers/Adversaries are everywhere (attention tinfoil hat carriers!)

Objective

- Build a secure and privacy preserving asynchronous messaging prototype solution
- … With good adoption properties (design on top of existing infrastructure)

Main Parts of the work

- Requirement Definition
- Technologies & Existing Work
- Design Considerations
- Protocol Specification (wire protocol)
- Protocol Implementation (tool, prototype)

Requirements: Security and Privacy

Security

- Confidentiality, integrity and authenticity
  - end-to-end
- Anonymity Preserving
  - conversation security feature must not break transport privacy

Privacy

- Participation Anonymity & Global Adversary Resistance
- Unlinkability
- Sender Anonymity

Requirements: Usability and Adoption

Usability

- Keep Email Properties
  - asynchronicity
  - message drops/delays
- Easy Initialization

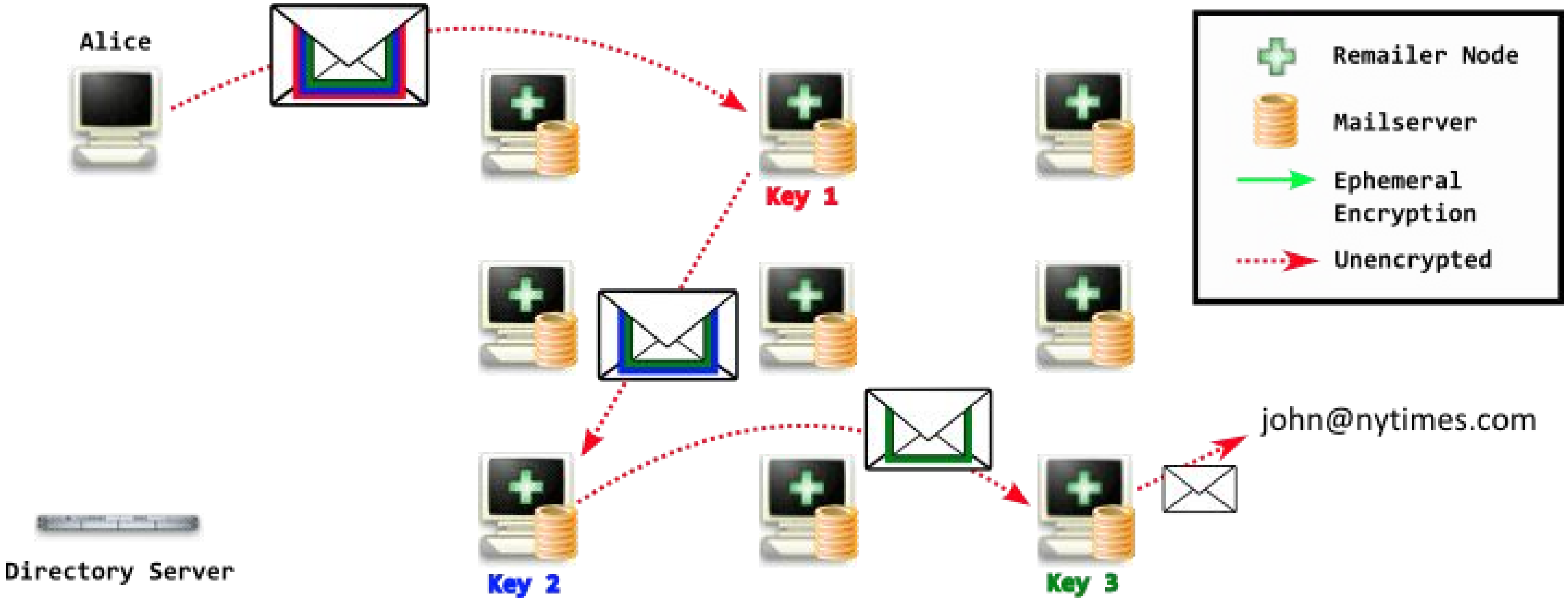
Adoption

- Compatibility to existing Infrastructure
- No Additional Service
- Scalable

Existing Work: Remailer

- Based on mix networks
- Different types (evolution caused)
  - Type 0: Pseudonymous/Nym remailer
    - Just for pseudonymization
  - Type 1: Cypherpunk
    - Encryption not mandatory
  - Type 2: Mixmaster
    - Outdated crypto (RSA-1024, (3DES), MD5, …)
  - Type 3: Mixminion
    - Doesn’t support SMTP

Mixmaster Remailer



https://crypto.is/blog/remailers_weve_got

The Idea of Mixtasy

- Secure and anonymous emailing
- Reuse existing technologies and infrastructure!

Overview

- Mix Network design
- Data Format: Internet Message Format [RFC-5322]
- Encryption: openPGP [RFC-4880]
- Transport: SMTP [RFC-5321]
- Directory Service: openPGP Key Servers (no additional service!)
- Implementation: Postfix Filter Addon (adoption!) + client to send mails

https://crypto.is/blog/what_is_a_remailer

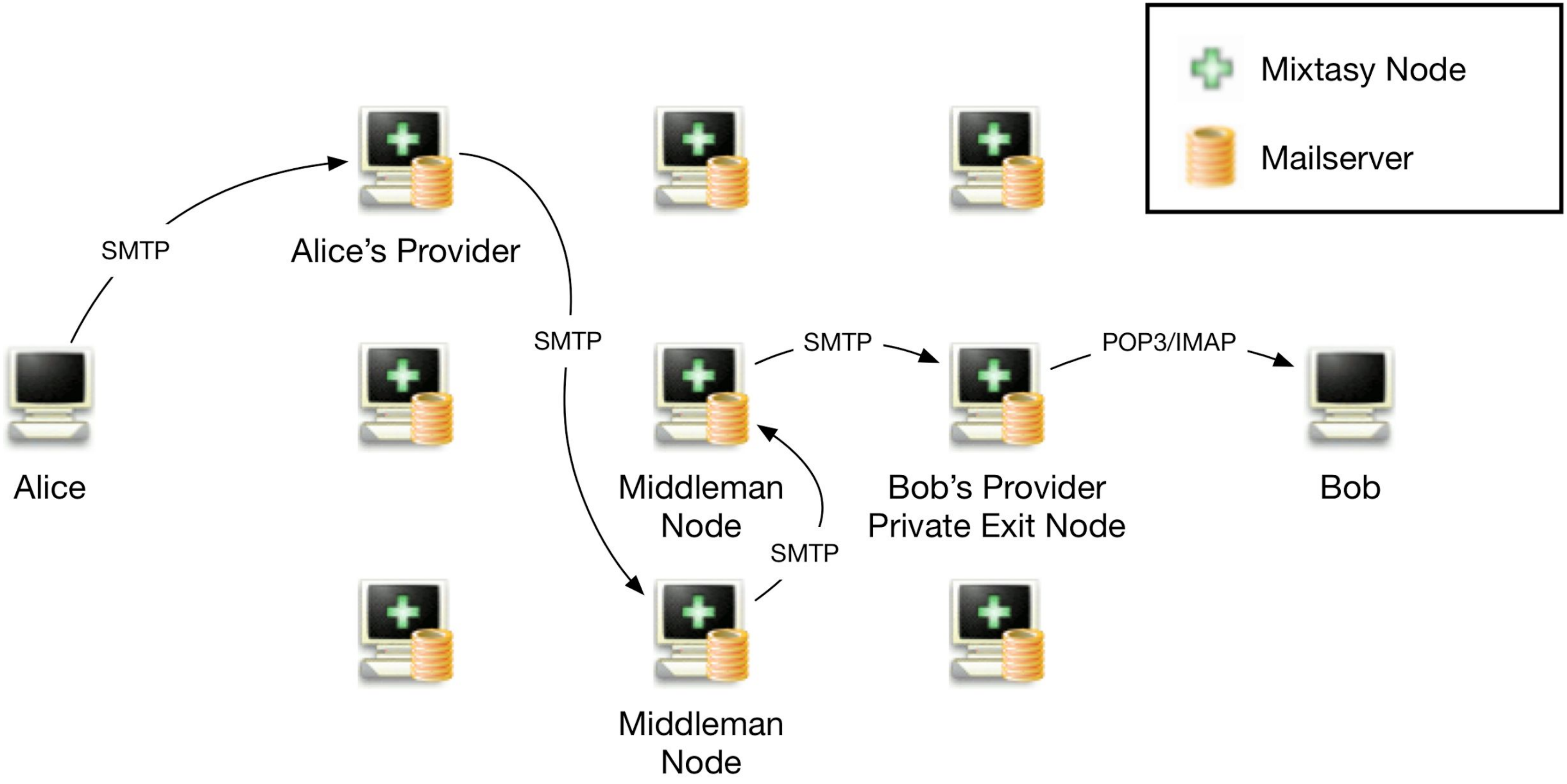
Design Considerations I

- Encryption: confidentiality & prevent tracking by content
  - layered encryption between sender and mixes/receiver
- Mixing Algorithm: blur the trace of a message (anonymity)
  - Timed dynamic-pool mix
- Message Size: prevent tracking by size (anonymity)
  - Uniformed; repadding at each mix

Design Considerations II

- Replay Attack prevention (anonymity)
  - Cache message hashes
- Tagging attack prevention (anonymity)
  - Message data verification
- Dummy Traffic: complicate blending attacks & reduce message delays
  - inject dummy messages
- Abuse & Spam protection
  - cost based spam protection

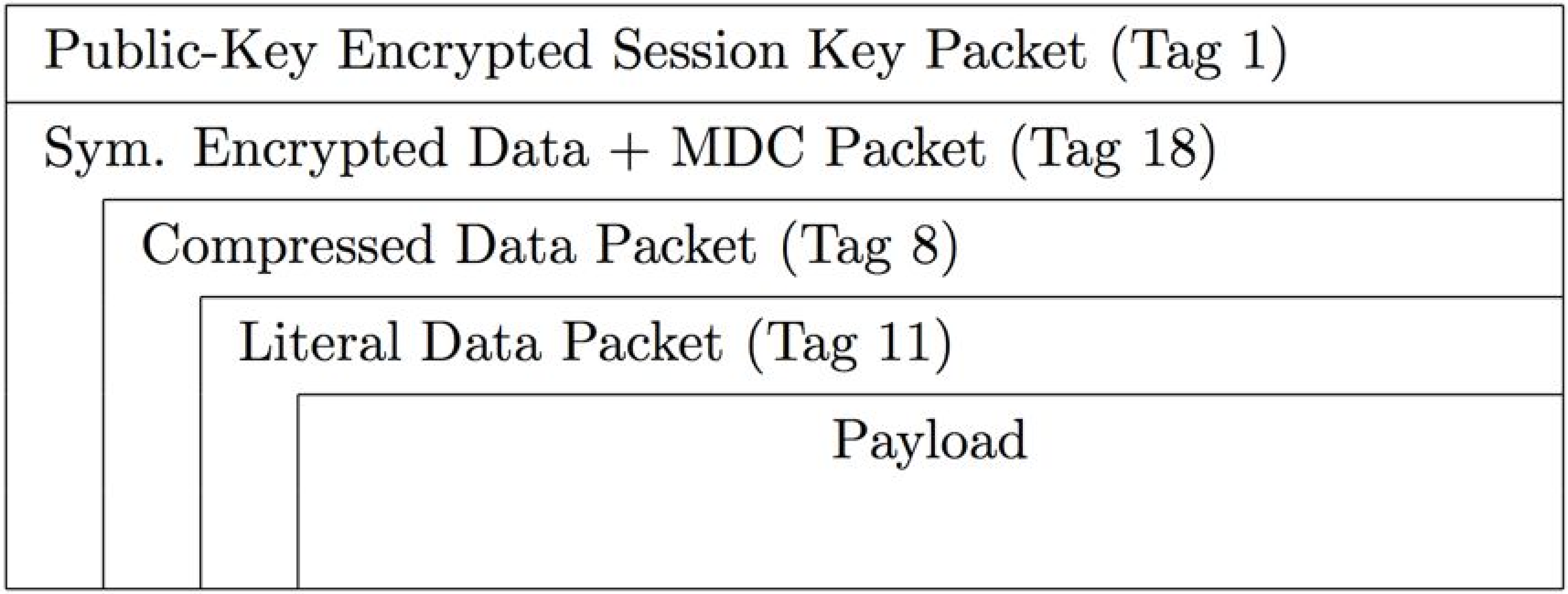
Mixtasy Design: Receiver's Provider supports Mixtasy



Message Format

- Original Message
  - As composed by the sender
- Final Mix Message
  - Wraps an original message
- Intermediate Mix Message
  - Contains another intermediate or a final mix message

OpenPGP Message Format Example



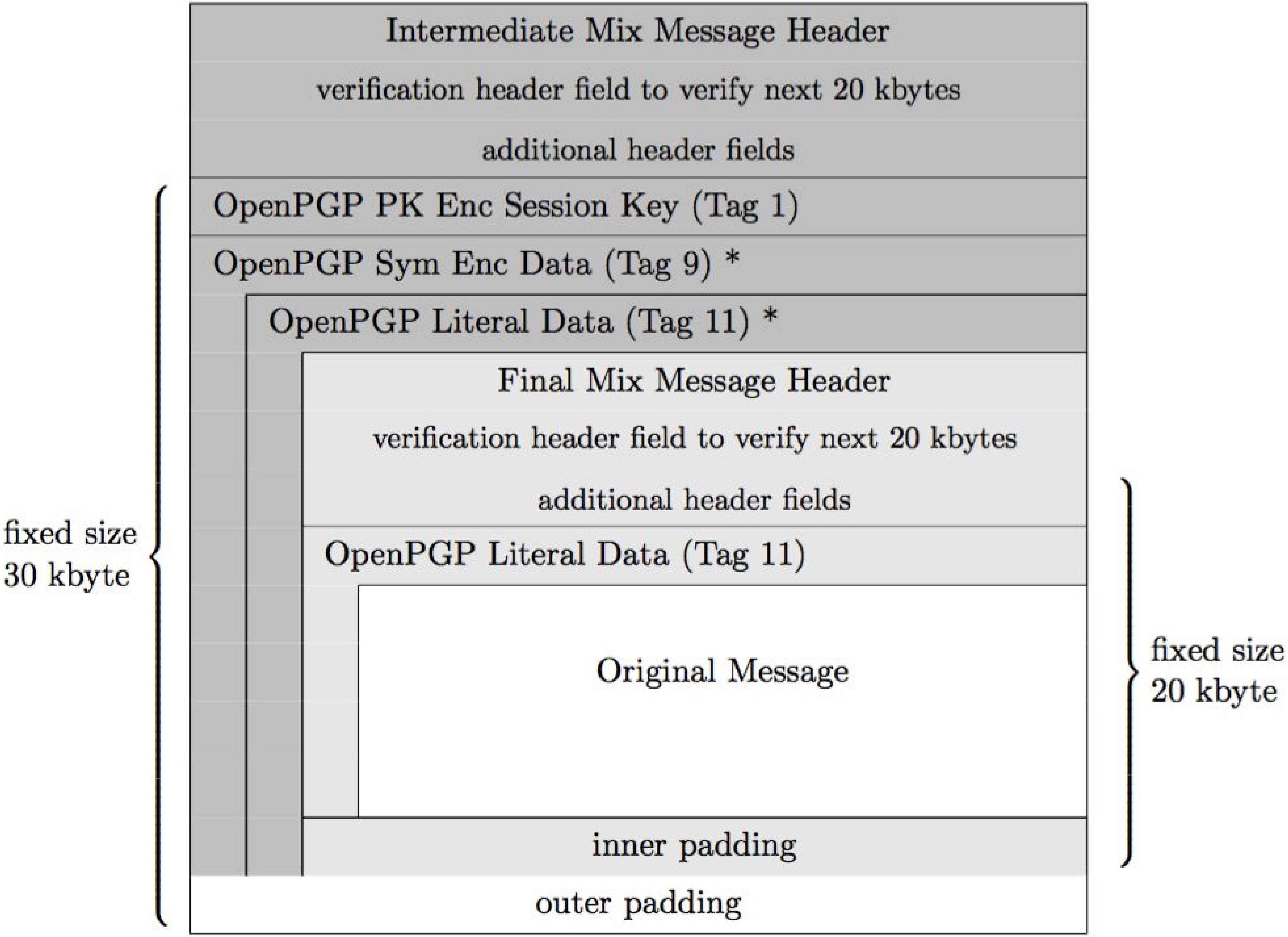
Public-Key Encrypted Session Key Packet (Tag 1)

Sym. Encrypted Data + MDC Packet (Tag 18)

Compressed Data Packet (Tag 8)

Literal Data Packet (Tag 11)

Payload



Intermediate Mix Message Header

verification header field to verify next 20 kbytes

additional header fields

OpenPGP PK Enc Session Key (Tag 1)

OpenPGP Sym Enc Data (Tag 9) *

OpenPGP Literal Data (Tag 11) *

Final Mix Message Header

verification header field to verify next 20 kbytes

additional header fields

OpenPGP Literal Data (Tag 11)

Original Message

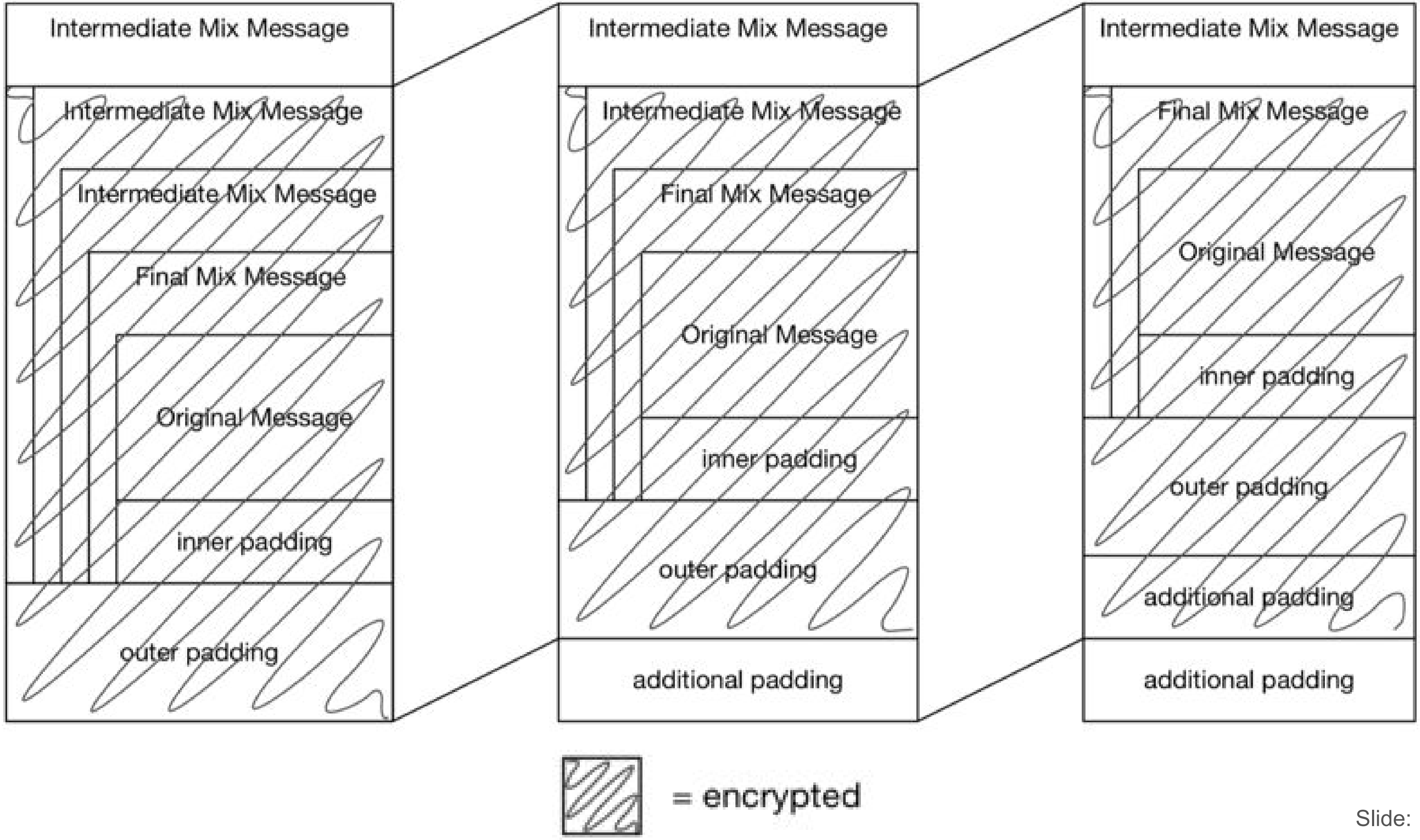
inner padding

outer padding

fixed size 30 kbyte

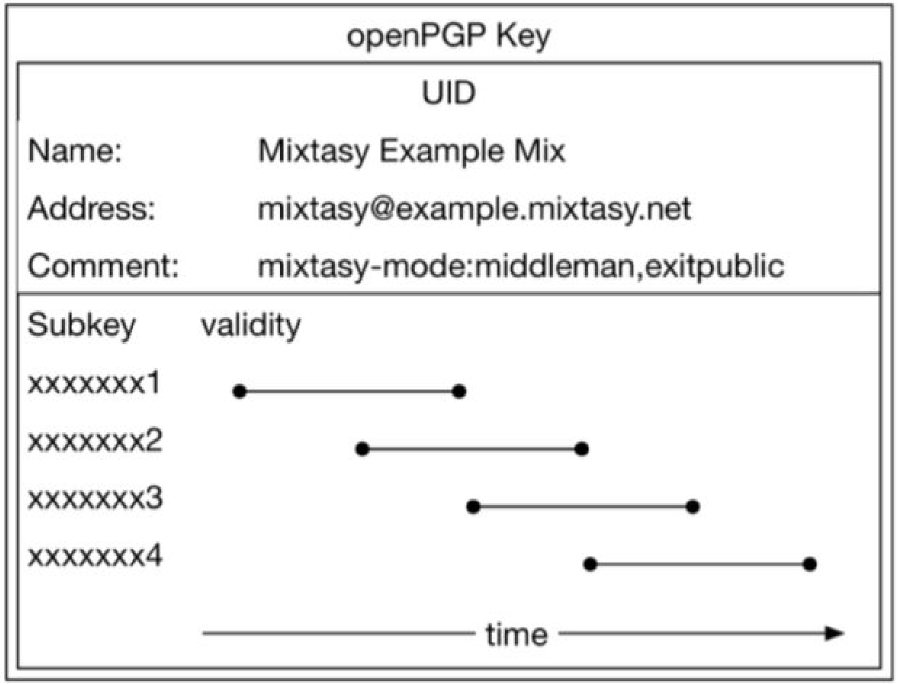
fixed size 20 kbyte

Decryption and re-padding



Keys

- Long-term OpenPGP key (trust establishment)
- Short-term sub-keys (encryption)
- Distribution over public PGP key server
- Discovery via search for “mixtasy@”



openPGP Key

UID

Name: Mixtasy Example Mix

Address: mixtasy@example.mixtasy.net

Comment: mixtasy-mode:middleman,exitpublic

Prototype

Available on GitHub

- Written in Python, makes use of GnuPG
- CLI Client to create mails
    - Including: Mix discovery and key retrieval, Path selection, constructing single part messages, sending via SMTP
- Postfix Filter to operate a mix node
    - Including: Strip of encryption layer, Verification check, Re-padding to fixed message size
- Not implemented yet:
    - multi part and dummy messages, mixing algorithm, replay attack prevention

Conclusion

- Remailer protocol design and prototype created
  - Mostly specified by composing existing technologies
  - Deployable by upgrading existing MTAs
  - Receiver just needs OpenPGP software

- Future work
  - Implement full specification
  - Detailed evaluation/auditing
  - Research on dynamically change timed dynamic-pool mix parameters
  - Extend the protocol by an anonymous reply feature

Download Slides and Master’s Thesis, Try out or Contribute

- http://mixtasy.net/
- https://github.com/jojoob/mixtasy/