Mitigating Email Attacks with Usable Email Encryption

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HotSec ‘17

How Hackers Broke Into John Podesta and Colin Powell's Gmail Accounts

LORENZO FRANCESCHI-BICCHIERAI
Oct 20 2016, 9:30am

Cock.li e-mail server seized by German authorities, admin announces

The FBI Is Sharing Seized TorMail Data with the DEA

Threat: Compromised email accounts **and** email servers.

- Emails spend **seconds in transit**, but **years in storage**.
- **Problem:** Encrypting email is **hard**.

Why Johnny Can't Encrypt: A Usability Evaluation of PGP 5.0

Alma Whitten
School of Computer Science
Carnegie Mellon University

Why Johnny Still, Still Can't Encrypt: Evaluating the Usability of a Modern PGP Client

Why Johnny Still Can't Encrypt: Evaluating the Usability of Email Encryption Software

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Engineering and Public Policy
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HCI Institute
Carnegie Mellon University

Why Johnny Can't Encrypt: A Usability Study of PGP

Jan Sousedek
Technische Universität Berlin, Germany

Johnny 2: A User Test of Key Continuity Management with S/MIME and Outlook Express

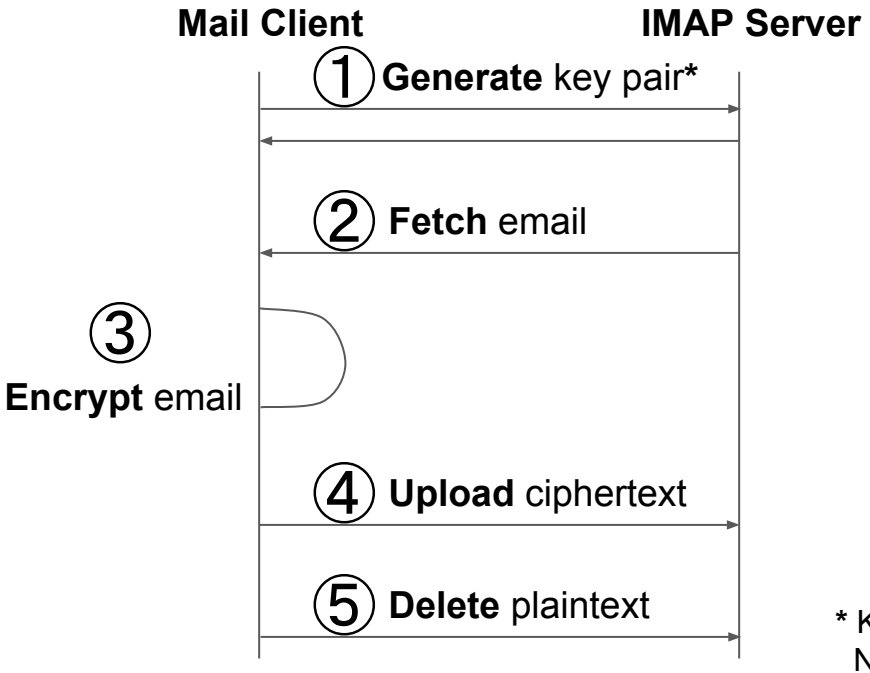
Simson L. Garfinkel
MIT CSAIL

Robert C. Miller
MIT CSAIL

Idea: Automatically encrypt your emails **on receipt**.

- No PGP and no PKI required.
- Done before, but **not usably** (previous approaches need highly technical setup).

How: Leverage IMAP.



* Key-pair is **locally self-generated**.
No PKI and no CA.

Easy Email Encryption (E3)

Why?

- Works with all standard IMAP servers.
- End users control their privacy.

Most importantly:

- It’s **usable** compared to PGP and S/MIME.

Key Management

- **Encrypted** backup of keys in:
  - Your email account (most convenient)
  - Cloud storage
  - … Anything else?

Usability Study

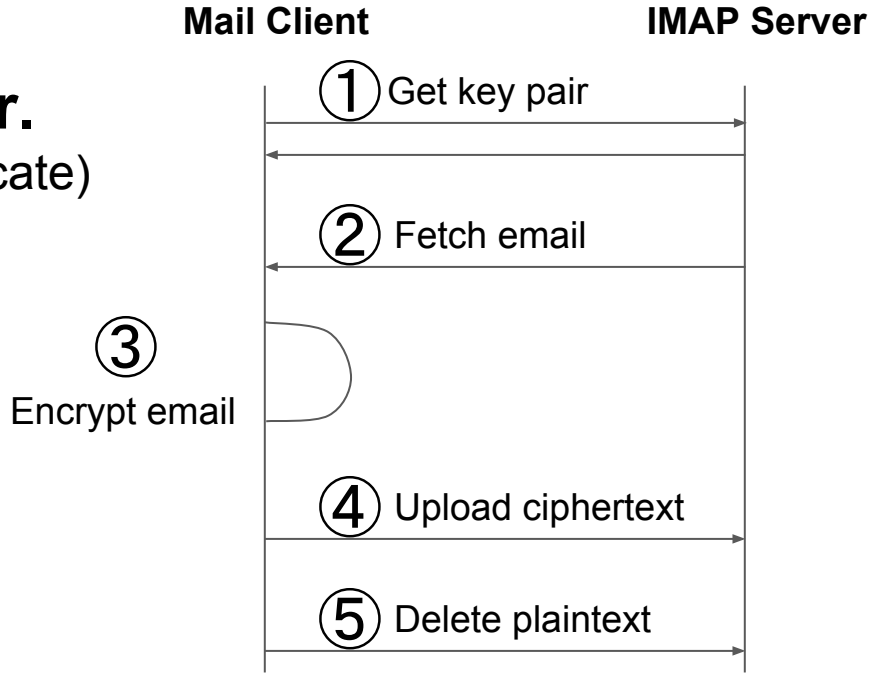
- We performed two usability studies.
- Participants used:
  - **Unmodified** mail client (K-9 Mail)
  - **E3** (our modified K-9 Mail client)
  - **PGP** (K-9 Mail with OpenKeychain)

- All agreed that E3 was **much more usable than PGP.**

Thank you!

(More Detailed) How: Leverage IMAP.

1. **Generate/retrieve key pair.**
   (Locally self-generated X.509 certificate)
2. **Receive plaintext email.**
   (FETCH)
3. **Encrypt it.**
   (S/MIME format without PKI.)
4. **Upload ciphertext.**
   (APPEND)
5. **Delete plaintext.**
   (STORE `\Deleted`, EXPUNGE)



Addendum: Usability Study (1/4)

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Addendum: Usability Study (2/4)

- **Participants' comments on PGP:**
  - "[PGP] is garbage."
  - "[PGP] is wildly impractical."
  - "I've never actually seen [PGP] used."

- **Participants' comments on E3:**
  - "I would probably actually use this."
  - Multiple comments on encrypting important emails (automatically detected using filters).

Addendum: Usability Study (3/4)

Soln.	Count	Mean	Std. Dev	Min.	Q1	Median	Q3	Max
K-9	12	82.12	11.67	65	72.50	82.50	90.00	100
E3	12	81.73	10.82	60	72.50	82.50	90	97.50
PGP	12	34.81	23.09	2.50	18.13	30.50	38.75	47.50

Figure 11. System Usability Scale summarized scores.

Addendum: Usability Study (4/4)

#	Question (1 = Strongly Disagree, 5 = Strongly Agree)	Mean	Std.	Min.	Med.	Max
11	I found it easy to use unmodified K-9 w/o encryption.	4.38	0.96	2	5	5
12	I found it easy to use K-9 w/ E3 encryption.	4.38	0.65	3	4	5
13	I found it easy to use PGP encryption.	2.08	0.95	1	2	4
14	I thought that K-9 w/ E3 was easier to use than PGP.	4.77	0.44	4	5	5
15	The extra security with K-9 w/ E3 encryption is worth the extra steps compared to unmodified K-9 w/o encryption.	4.23	0.73	3	4	5
16	The extra security with PGP encryption is worth the extra steps compared to unmodified K-9 w/o encryption.	2.69	1.44	1	2	5
17	The extra security with PGP is worth the extra steps compared to K-9 w/ E3 encryption.	1.92	0.95	1	2	3

Figure 12. Summarized scores for added survey questions. (Questions are abbreviated for spacing reasons.)