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Messaging Malware Mobile
Anti-Abuse Working Group

# SMTP Transport Security: Past, Present, Future

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Atlanta

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For questions, please contact Jerry Upton at: jerry.upton@m3aawg.org

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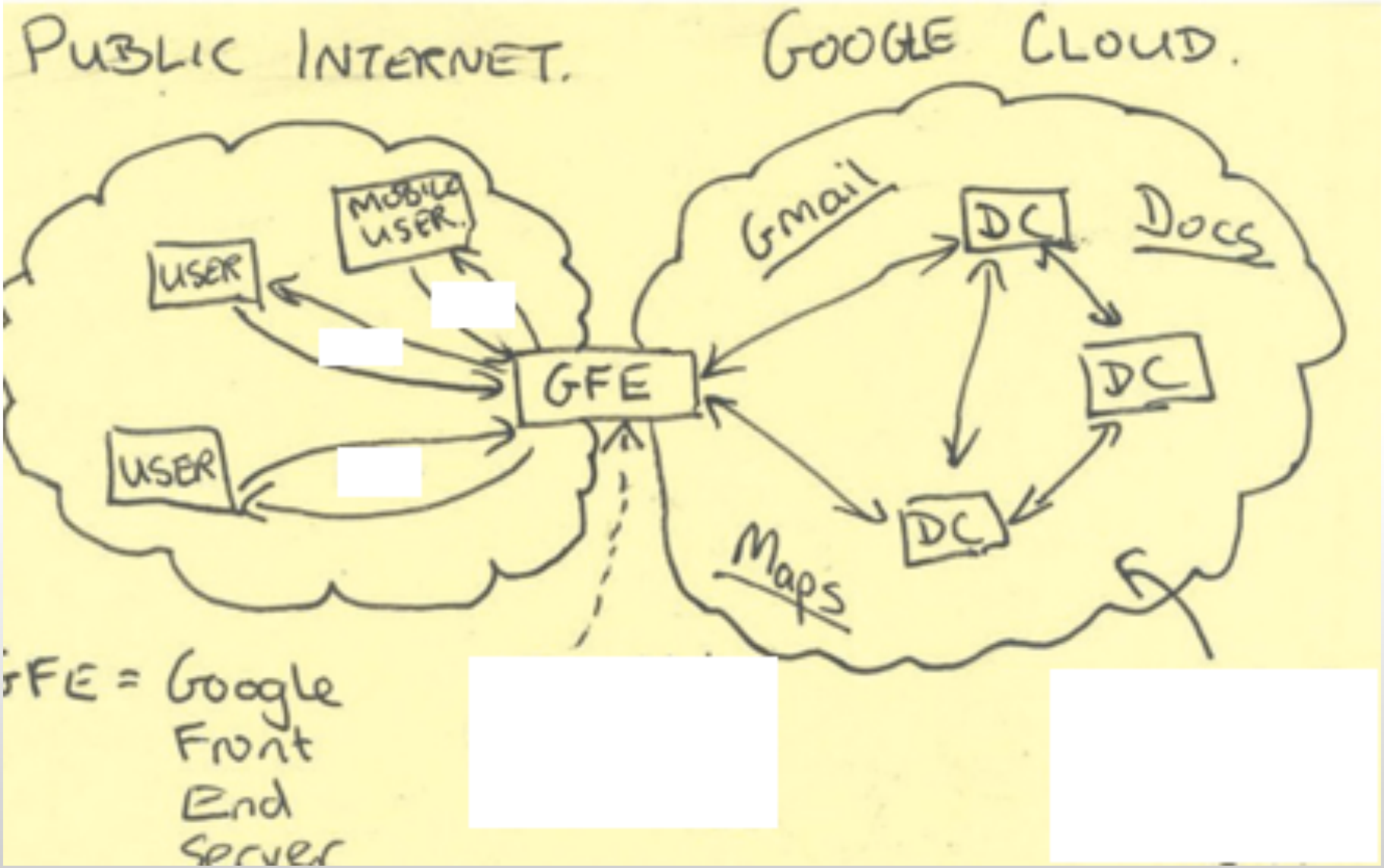
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GOOGLE CLOUD.
USER
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GFE
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Docs
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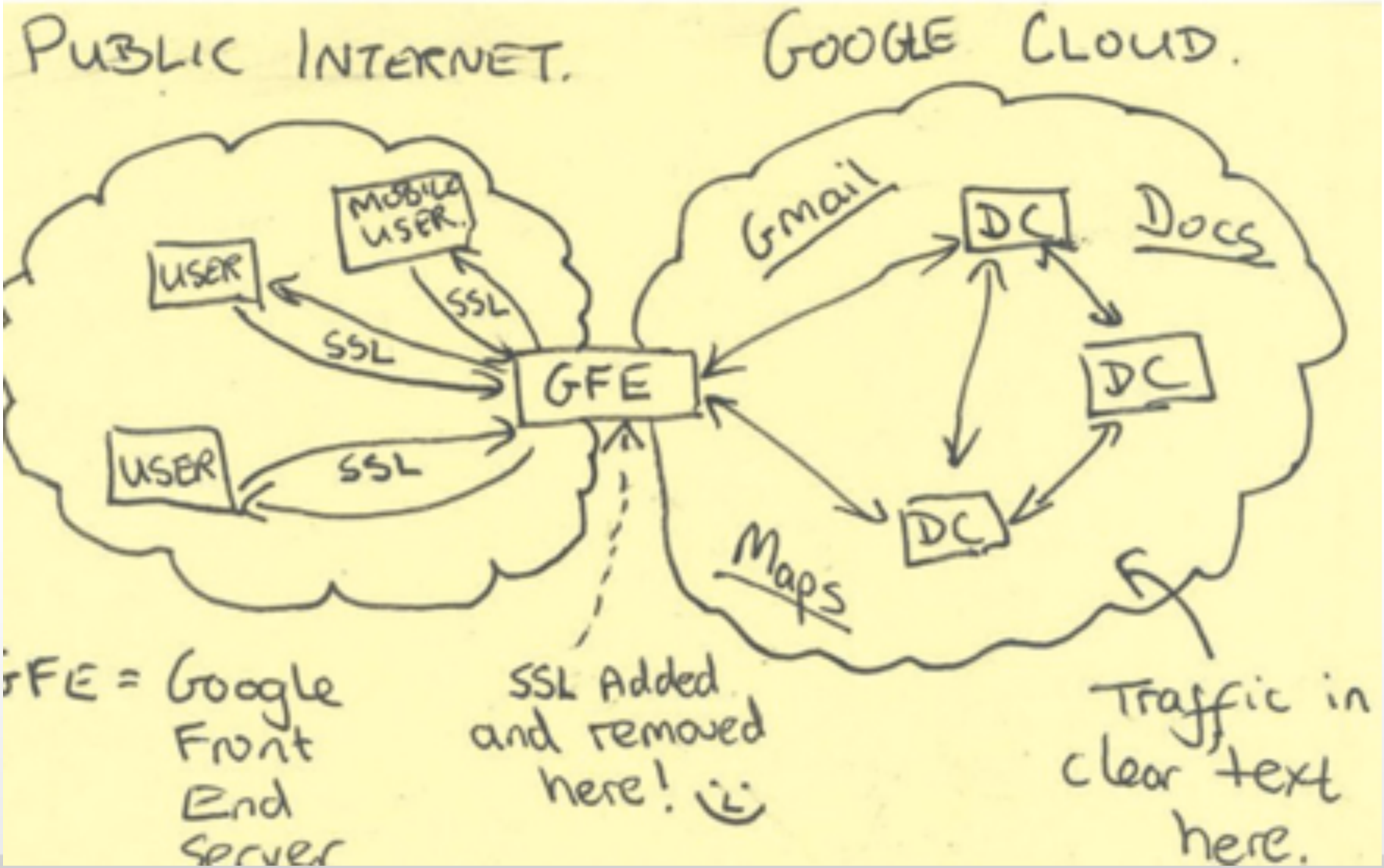
GFE = Google Front End Server


PUBLIC INTERNET.
GOOGLE CLOUD.
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Gmail
DC
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DC
DC
Maps
GFE = Google Front End Server
SSL Added and removed here!
Traffic in clear text here.

# Simple origins

- SMTP: RFC821, Aug 1982
- POP: RFC918, Oct 1984
- POP2: RFC937, Feb 1985
- **MX records**: RFC974, Jan 1986
- IMAP2: RFC1064, Jul 1988
- POP3: RFC1081, Nov 1988

# Beyond username+password

- POP3: RFC1460, Jun 1993 (adds APOP)
- IMAP4: RFC1730, Dec 1994
- IMAP AUTH: RFC1731, Dec 1994
- POP3 AUTH: RFC1734, Dec 1994

# Securing the transport

- DH patent expires Apr 1997
- RSA patent expires Sep 2000
- SUBMIT: RFC2476 Dec 1998
- TLS 1.0: RFC 2246 Jan 1999
- STARTTLS: RFC2487 Jan 1999
- AUTH: RFC2554 Mar 1999
- Widely implemented by end of 2000

# Incremental progress

- AUTH, TLS and STARTTLS: 2006–2011
- Name checks in TLS: RFC6125, Mar 2011
- (Fuss over a citizen named Ed, Jun 2013)
- Prohibit RC4: RFC7465, Feb 2015
- Deprecate SSL 3.0, RFC7568, Jun 2015
- UTA TLS BCP: RFC7525, May 2015
- TLS 1.3: draft-ietf-tls13, Q2 2016?

# New directions

- DANE: RFC6698, Aug 2012
- DANE SMTP: RFC 7671 and 7672, Oct 2015
- UTA drafts: email-tls-cert, deep
- DANE client auth draft?
- End-to-end encryption?

# Multiple Security Models

- Mandatory MUA to Server TLS
  - DNS SRV for SUBMIT, POP, IMAP: RFC6186, Mar 2011
- Mandatory TLS for MTAs
- Islands of security: EMiG
- Opportunistic TLS for MTAs
- Opportunistic DANE TLS for MTAs
- Mandatory DANE TLS for MTAs

# MUA to Server Security

- Simplest TLS use case
- Replace STARTTLS with implicit TLS?
- Use SRVID certificates?
- Security latching ala DEEP?
- Zeroconf ala RFC6186 via SRV records?
  - One time leap of faith?
  - Ongoing with DNSSEC?

# Mandatory TLS for MTAs

- Variable security properties
- Poor scalability
- Weak or fragile peer name checks
- Not a feasible default policy
- UTA draft for cert checks and hosting?

# Islands of Security

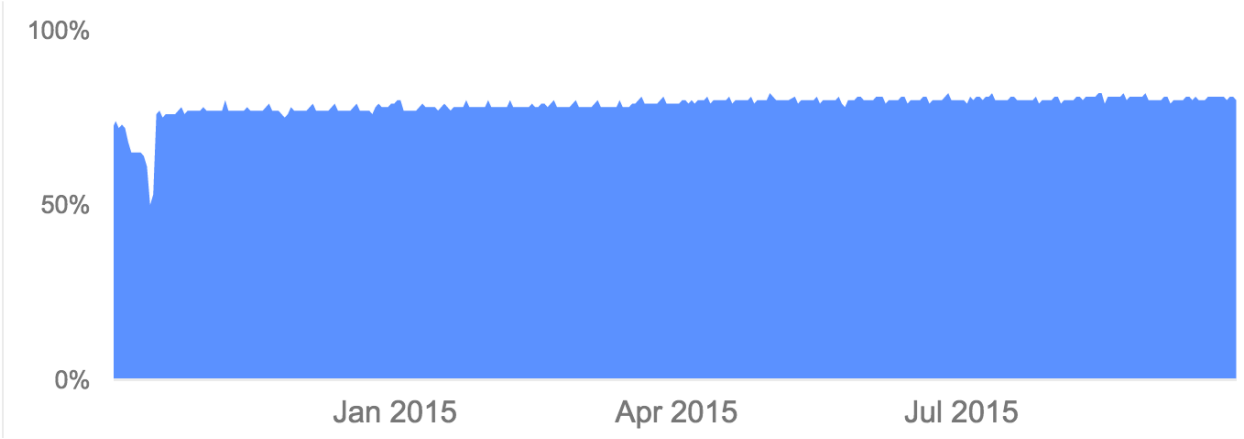
- Out of band ad-hoc TLS downgrade hardening
- Non-scalable
- Tried by "Email Made in Germany" (EMiG) consortium
- Mail to/from outside left unprotected
- EMiG announced DANE support by end 2015
- Let's not repeat this approach

# Opportunistic TLS for MTAs

- Works well as a default policy

80%

Messages from Gmail to other providers.




https://www.google.com/transparencyreport/saferemail/

- Can we get to universal deployment?
- Vulnerable to man-in-the-middle downgrade
- Not widely understood

# Using Opportunistic TLS

- Upgrade from cleartext, not fallback from encryption (see RFC7435)
  - Don't expect (or bemoan lack of) valid certs
- Avoid silly downgrades, cleartext is not stronger
  - Accept untrusted certs, expired certs, certs with deprecated signature algorithms, ...
  - Accept weak ciphers while needed to interoperate
  - Disable SSL 2.0, SSL 3.0, EXPORT & 1DES

# Advanced Opportunistic TLS

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- Support server-side session tickets
- Implement client session caches (that work through load-balancers)
- Support ECDHE with sensible curves
- Configure adequate DHE parameters
- Avoid "exotic" cipher suites

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MD5, SRP, PSK, aDSS, kECDH, kDH, SEED, IDEA, RC2, RC5
```

# Opportunistic DANE TLS

- RFC 6698, RFC 7671 and RFC 7672
- Domain publishes signed MX RRset
- MX host operator publishes signed A/AAAA records
- Two operating models
  - Per-server (End-Entity) TLSA records
  - Shared-issuer (Trust-Anchor) TLSA records

# End-Entity TLSA records

- MX host operator publishes TLSA records

_25._tcp.mx.example.net. IN TLSA 3 1 1 ***server-key-digest***
_25._tcp.mx.example.org. IN TLSA 3 1 1 ***server-key-digest***

- Single certificate, no need for SNI
- No surprise expiration
- Key rotation requires prior DNS update

_25._tcp.mx.example.net. IN TLSA 3 1 1 ***current-key-digest***
_25._tcp.mx.example.net. IN TLSA 3 1 1 ***planned-key-digest***

- Then deploy new keys

# Trust Anchor TLSA records

- CA operator publishes TLSA records

  _dane.example.net. IN TLSA 2 0 1 ***ca-cert-digest***

- Servers publish CNAME records once:

  _25._tcp.mx1.example.net. IN CNAME _dane.example.net.
  _25._tcp.mx2.example.net. IN CNAME _dane.example.net.

- CA coordinates TLSA updates for cert rotation
- Server cert replacements with no DNS changes
- Expiration and name checks back in scope
- Can self-issue certificates for client domains!

# Opportunistic DANE TLS

- **Requires DNSSEC**
- No CA "bundles"
- Downgrade resistant
- Scalable policy management
- Scalable TLS virtual hosting
- Scales beyond "islands of security"

# Mandatory DANE TLS

- Require peer domain to publish TLSA RRs
- Much easier to deploy and manage
- Works with 3rd party hosting

# DANE TLS adoption

- 7000+ domains
- 24 "prominent enough" for Google's report

| | | |
|---|---|---|
| conjur.com.br | lrz.de | debian.org |
| mypst.com.br | posteo.de | eu.org |
| registro.br | ruhr-uni-bochum.de | freebsd.org |
| societe.com | tum.de | ietf.org |
| t-2.com | unitymedia.de | isc.org |
| bayern.de | lepartidegauche.fr | openssl.org |
| bund.de | t-2.net | samba.org |
| jpberlin.de | xs4all.nl | torproject.org |

- Large fraction in Germany, most "small"
- EMiG providers announced upcoming support

# DANE implementation timeline

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- Postfix DANE support, 2014
- Adopted by Exim, 2015
- RFC 7671 and 7672, Oct 15th
- Planned in OpenSSL, 2016
- More TLS toolkits?
- More MTAs?
- More providers?

# Email TLS Certs

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- Consistent cert checks for POP, IMAP and Submission
- Recommends SRV-ID altnames (CAs would have to start issuing these)
- Work-around for secure indirection w/o DANE

# Deployable Enhanced Email Privacy

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- DEEP: IMAP, POP and Submission privacy
- Assurance levels for email accounts
- Implicit TLS not STARTTLS (port 465)
- High assurance: Mandatory authenticated TLS
- No assurance: Opportunistic TLS
- Security latching (similar to HSTS)
- New CLNT command reports status to servers
- Certificate checks per email-tls-certs

# End-to-end encryption?

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- DANE WG experimental drafts publish key bindings for each user in DNS
- Proposed UTA WG "addrquery" draft uses SMTP extension
- Phillip Hallam Baker's CryptoMesh
- Real interest in key publication standards?
- Are any of the proposed approaches sound?
- Is E2E viable in the face of spam, malware, and usability requirements?

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## Questions?
## Follow-up?

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rfc7435

rfc7671

rfc7672

draft-moore-email-addrquery

draft-hallambaker-cryptomesh