CSE508 Network Security

11/16/2017 **Spam and Phishing**

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SPAM

Spam Sources

Commercial entities

- Legitimate or "gray" businesses, advertisers, …

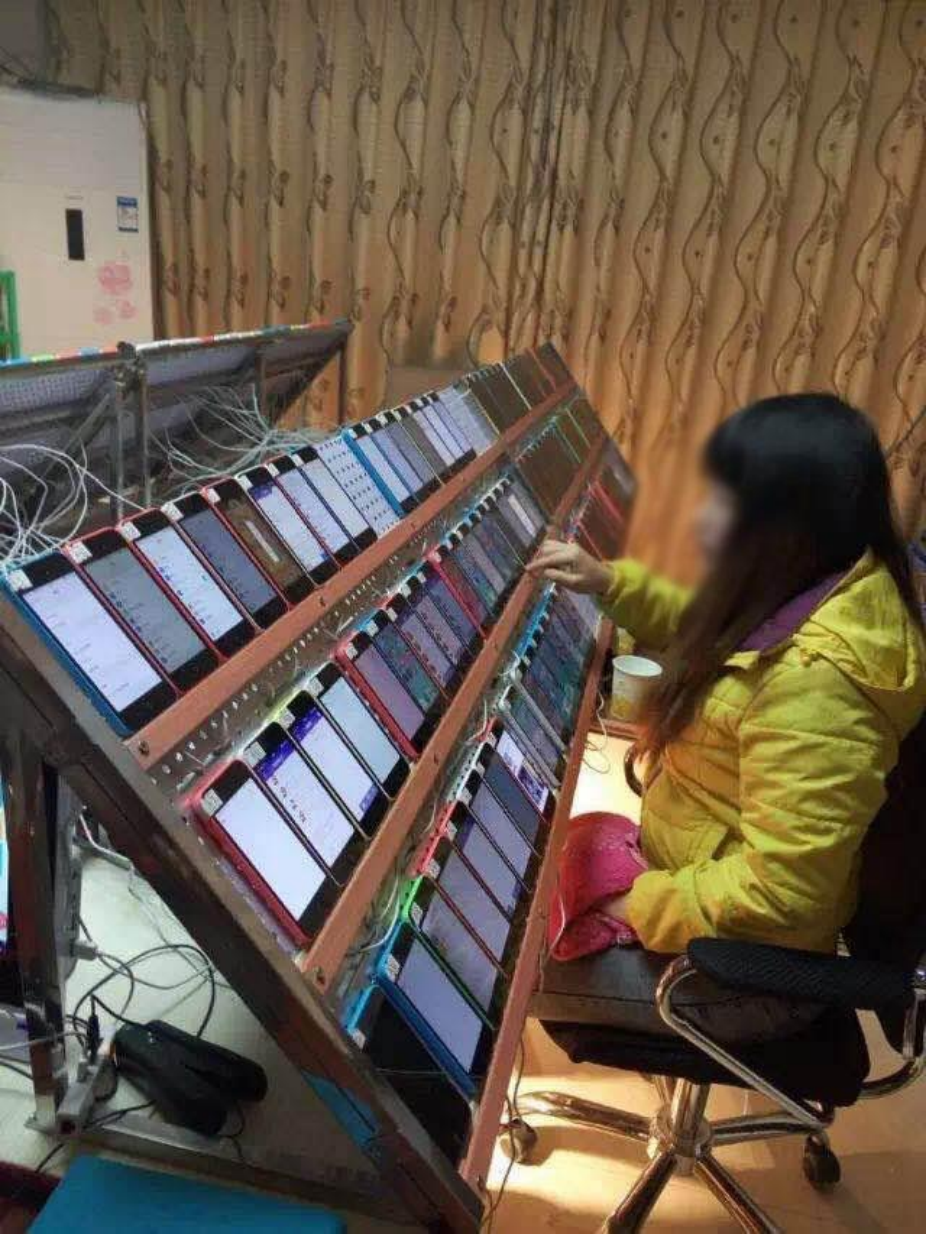
Spammers' own hosts or open relays → easily blocked

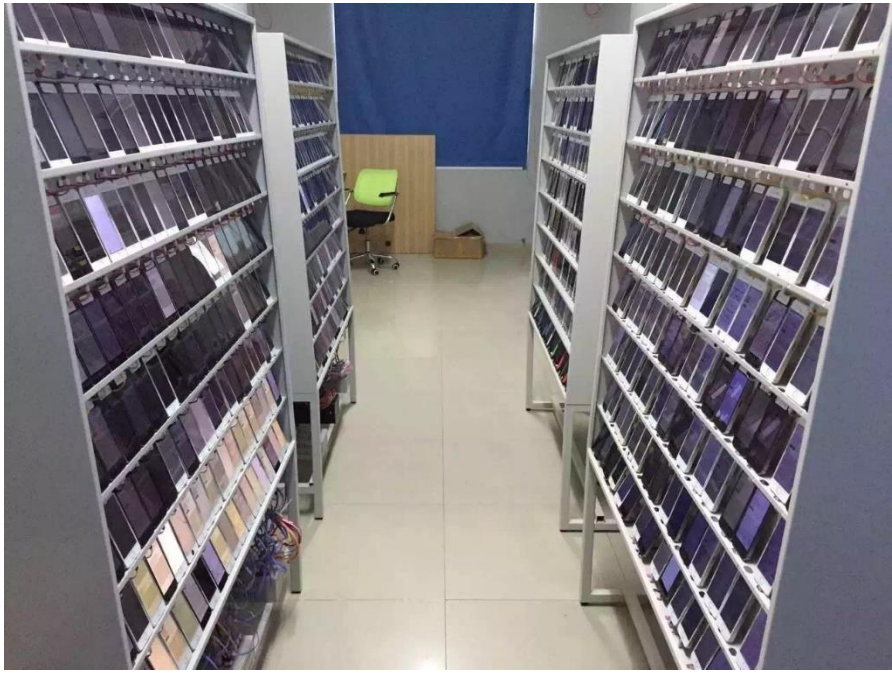
Botnets

- Abuse of ISPs and webmail providers
- Abuse of legitimate user email accounts
- Address harvesting from users' address books

Beyond email

- Fraudulent messages: Facebook, Twitter, Yelp, Amazon, online comments, forum messages, …
- Fraudulent activities: likes, retweets, clicks, app store rankings, fake reviews, …





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Spam lifecycle

Gathering addresses

- Valid, active addresses are precious
- Stolen address books, web crawling, black market, …

Message content

- Advertising, 419 scams, fraud, phishing, malware, …
- Anti-spam filter evasion: content obfuscation

Spam email delivery

- Valid accounts: newly created (sweatshops), hijacked ones, …
- Fake social media accounts "primed" over time
- Open relays/proxies (not common anymore)
- Malware: most spam comes from infected machines/botnets

Email Address Protection

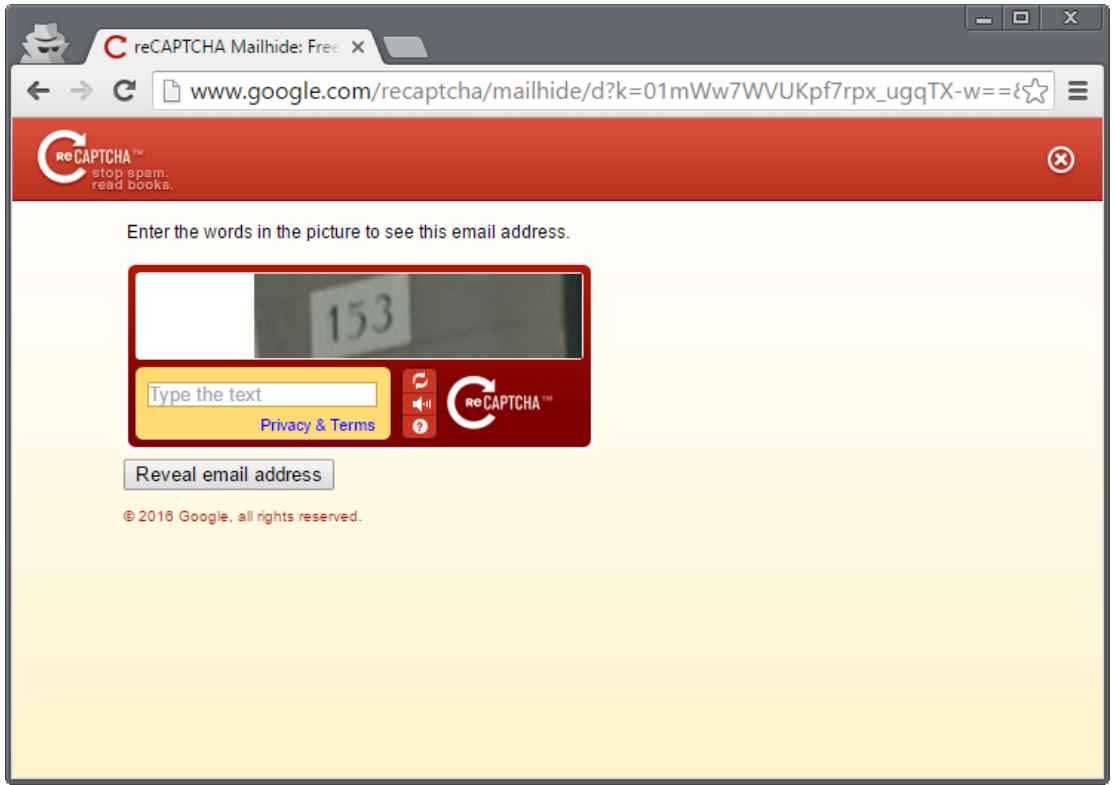
Keep it safe from address harvesting

Munging: `username [at] example.com`

Image instead of text

CAPTCHAs

…



Fighting Spam

Content-based filtering

- False positives vs. false negatives
- Local vs. cloud-based

Blacklisting

- IPs/domains of known spammers, open relays, zombie machines, hosts that shouldn't be sending emails (e.g., ISP DHCP pools), …

Honeypots

- Relays, proxies, spamtraps (fake email addresses)

Outbound filtering (block port 25)

- SMTP authentication is now mandatory by most ISPs

Email authentication

Content-based Filtering

Machine learning

- Training with labeled “spam” and “ham” messages
- Feedback from user activities (e.g., “not spam” button)

Rule-based systems

- Signatures, regular expressions, patterns, …
- Certain keywords, phrases, unusual text, …
- Example: SpamAssassin

Spam authors try to evade filters

- V1agra, Via'gra, Vi@graa, vi*gra, \/iagra
- Intentional spelling mistakes, symbols, weird punctuation, …
- Continuous arms race - example: attackers started using images, defenders started using OCR, …

False positives are a challenging problem

Please do not reply to this email as this email address is not monitored. To ensure delivery to your inbox (not bulk or junk folder) please add noreply@timewarnercable.com to your address book.

For additional information please review our most Frequently Asked Questions at any time.

This information is confidential and intended only for the use of the account owner it is addressed to.
If you are not the account owner, then you have received this message in error and any review, dissemination, copying, or unauthorized use of this message is strictly prohibited and you should delete this message.
Please do not reply to this e-mail.
Please add ConEdCustomerService.com to your address list to ensure future delivery of notifications.
Privacy Policy: This e-mail was sent by Con Edison of New York. To view our privacy policy, please click here.

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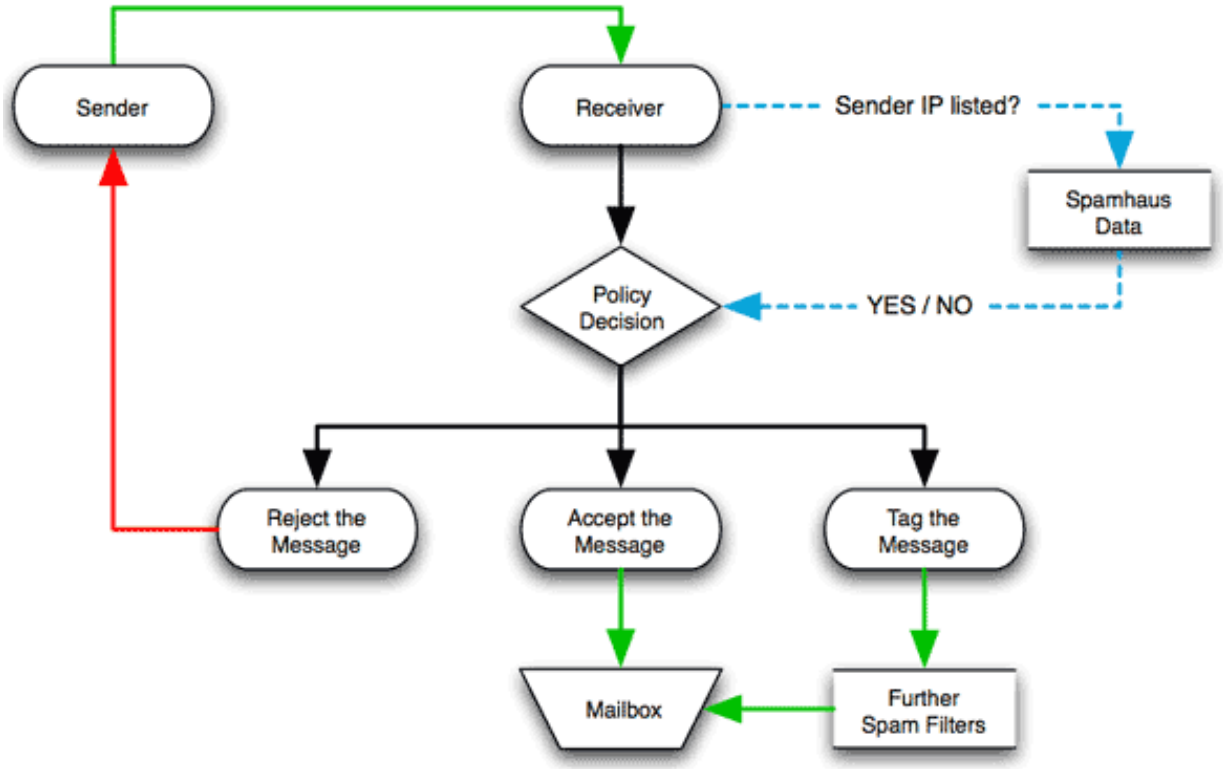
Important program update from MileagePlus.

To ensure delivery to your inbox, please add MileagePlus@news.united.com to your address book.

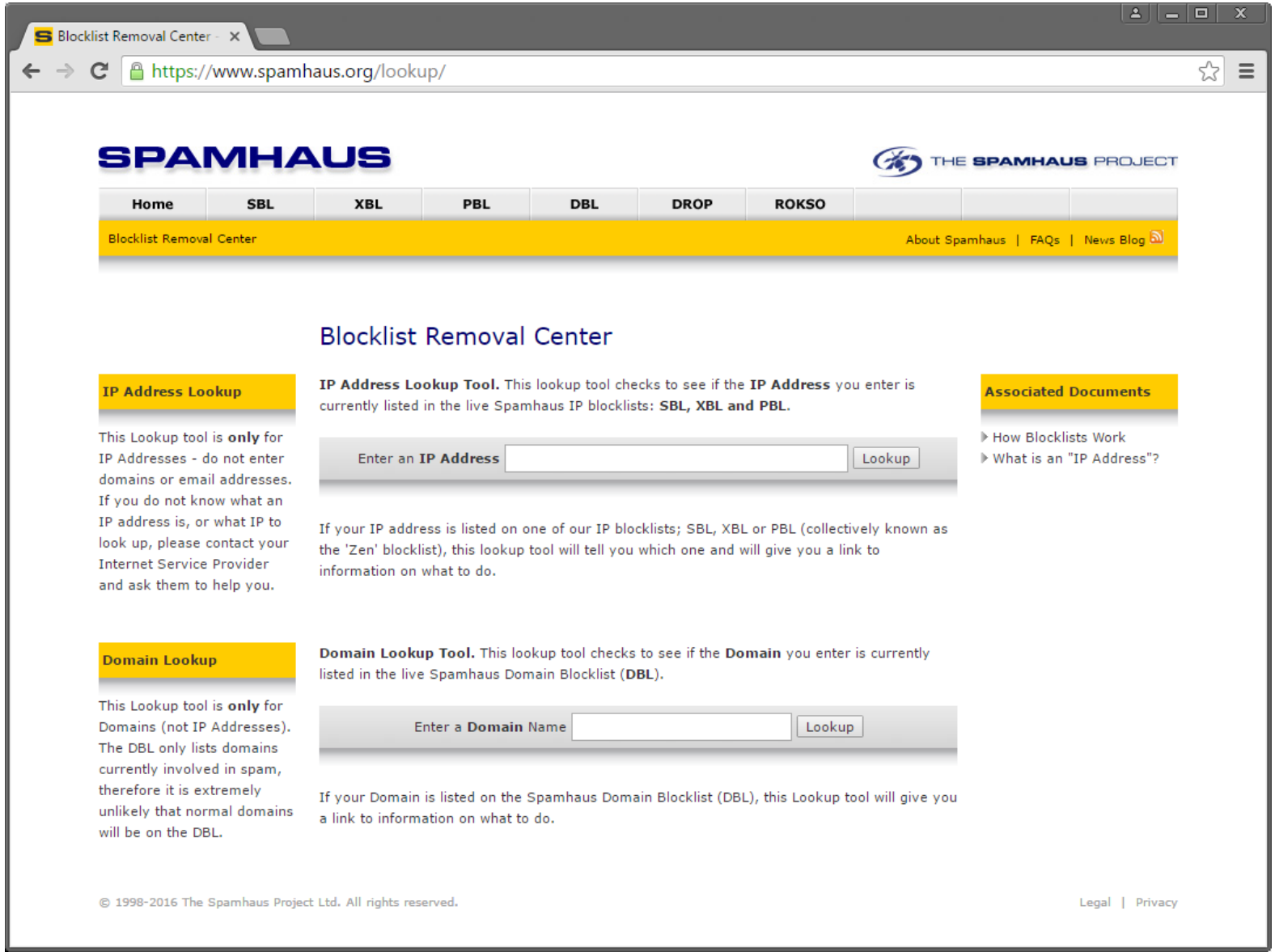
DNSBL Filtering

DNS Block List: IP addresses, domain names, and other information compiled as a DNS zone

DNS-based: easy to query, light on bandwidth/resources



False positives, IP addresses change hands, …



SPF: Origin Authentication

SMTP allows anyone to send an email with an arbitrary "From" address

Sender Policy Framework

- DNS TXT record pointing to the hosts that are allowed to send email from the domain
- Receiving SMTP servers compare the IP address that attempts to send an email with the allowed addresses of the domain(s) provided in the HELO and MAIL FROM commands
- Helps to block spam at it source

```
mikepo@styx:~> dig google.com TXT
;; ANSWER SECTION:
google.com.             3599    IN      TXT     "v=spf1
include:_spf.google.com ~all"
```

DKIM: Email Validation

DomainKeys Identified Mail: *digitally sign* some email headers and message body

Allows the recipient to verify that

- The message is sent from the domain it claims to be sent from
- The message has not been tampered with

Domain's public key is stored in a DNS TXT record

```
X-Google-DKIM-Signature: v=1; a=rsa-sha256; c=relaxed/relaxed;
d=1e100.net; s=20161025;
h=x-gm-message-state:mime-version:from:date:message-id:subject:to;
bh=0BSnrwLTQ7KblIwINxoPJN40a/K5PZCIV8atL6a1Dvg=;
b=Nch9yEorgibAjkh90ukDL6SU0FYn70qP6AMsWFfpLO+W3iroMoVdKIjKk8Cv6Gc1TW ...

mikepo@styx:~> dig 20161025._domainkey.1e100.net TXT
;; ANSWER SECTION:
20161025._domainkey.1e100.net. 21599 IN TXT     "k=rsa;
p=MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAnOv6+Txyz+SEc7mT719QQtOj6g
2MjpErYUGVrRGGc7f5rmE1cRP1lhwx8PVoHOiuRzyok7IqjvAub9kk9fBoE9u ...
```

SPF + DKIM = DMARC

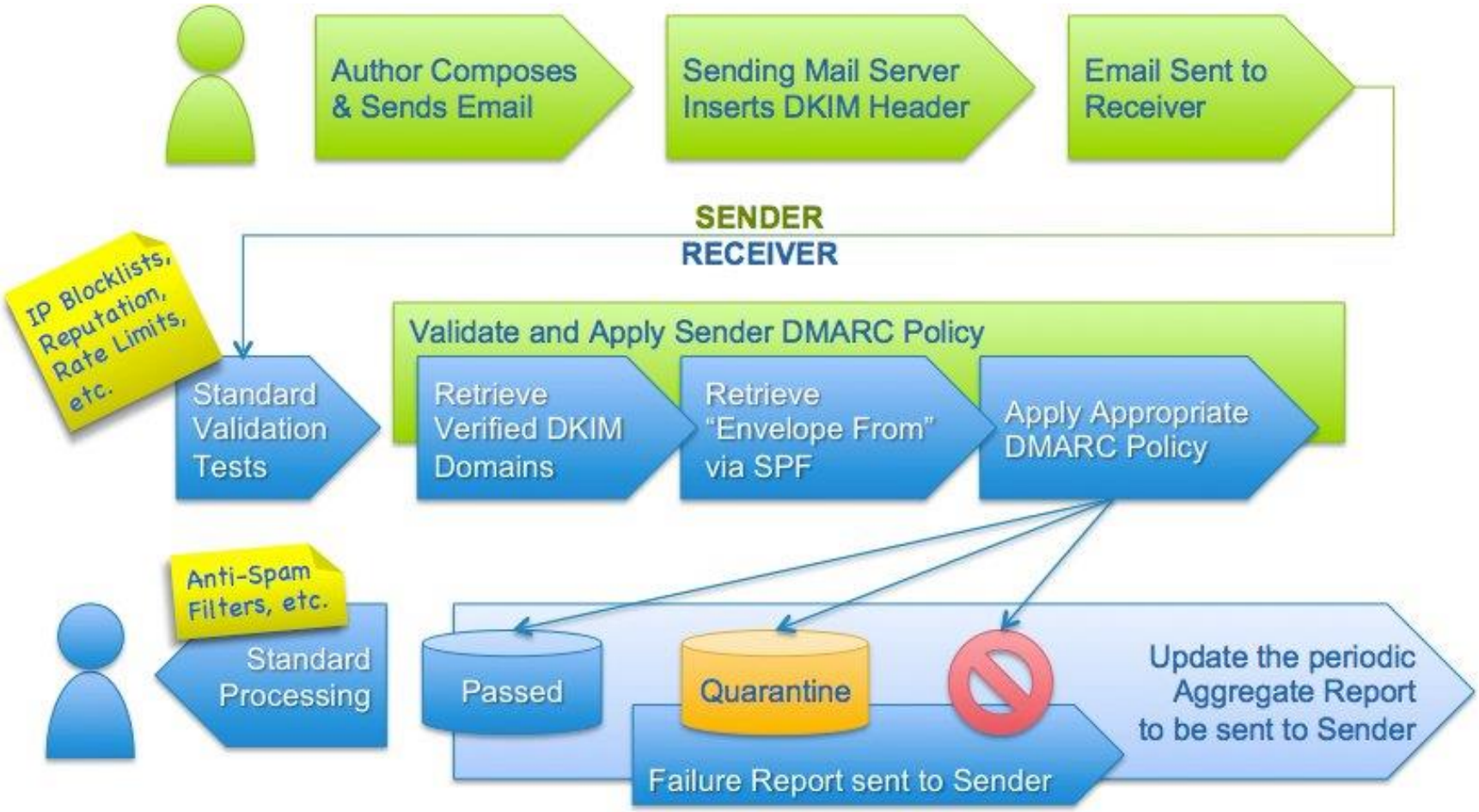
Domain-based Message Authentication, Reporting & Conformance (DMARC)

- Standardizes how email receivers perform email authentication using SPF and DKIM
- Tells receivers what to do if neither of those authentication methods passes – such as junk or reject the message

DMARC policies are published as DNS TXT records

```
mikepo@styx:~> dig _dmarc.google.com TXT
;; ANSWER SECTION:
_dmarc.google.com.      299     IN      TXT     "v=DMARC1;
p=reject; rua=mailto:mailauth-reports@google.com"
```

DMARC Email Authentication Process



http://dmarc.org/overview/

TorrentLocker spam has DMARC enabled

Use of email authentication technique unlikely to bring any advantage.

Last week, *Trend Micro* researcher Jon Oliver (who presented a paper on *Twitter* abuse at VB2014) wrote an interesting blog post about a spam campaign that was spreading the 'TorrentLocker' ransomware and which, unusually, was using DMARC.

TorrentLocker is one of the most prominent families of encryption ransomware — a worryingly successful kind of malware that first appeared two years ago. The malware initially implemented its cryptography rather poorly, but has since become one of the most successful of its kind.

DMARC is an email technology that builds on both SPF and DKIM. Both these technologies allow a domain owner to take some responsibility for the emails sent from their domain: SPF by listing those IP addresses used to send email; DKIM by digitally signing the emails.

DMARC adds to SPF and DKIM a mechanism that allows a domain owner to advise senders what to do about

SPF, DKIM, DMARC

SPF validates MAIL FROM vs. its source server

- "Envelope" information

DKIM validates the "From:" message header

- Plus other message headers and the message body

Not effective against spammers who

- Use their own domains
- Use legitimate email services, such as webmail
- Pretend to be another user on the same domain

Good for whitelisting and verifying email from trusted sources (.gov, banks, …)

- *Besides spam, we also care about phishing…*

Phishing

Spoofed emails pointing to spoofed webpages

- Financial institutions, could services, and other targets

Asking for credentials, credit card numbers, and other sensitive information

- "Your Fedex package information"
- "Your account has been suspended"
- "Your credit card statement"

Spear phishing

- *Enticing* messages that appear to come from well-known individuals or businesses
- *May even come from real friends/acquaintances through compromised accounts (!)*

Address Obfuscation

Misspelled/similar domain names

`From: info@paypa1.com` `http://www.citybank.com`

Misleading <A> tags

`<a href="http://www.attacker.com">http://www.bank.com</a>`

Seemingly legitimate/complex/long URLs

`http://www.bankofamerica.com.attacker.net/`

`http://www.visa.com:UserSession=2f6q988316484495&usersoption=SecurityUpdate&From@61.252.126.191/verified_by_visa.html`

Homographs, internationalized domain names (IDN), punycode

`http://ebay.com` (`http://xn--eby-7cd.com/`) – Cyrillic "a" vs. Latin "a"

Most browsers display IDNs only for the system's configured language

Punycode if a non-default language or mixed languages are used

Dot-less addresses and other URL encoding tricks

`www.cs.stonybrook.edu` ➔ `http://130.245.27.2` ➔ `http://2197101314`

URL shorteners and redirection chains

Hide the actual destination URL

Recent phishing message targeting SBU users

From: **SBU Team <ebrahle2@kent.edu>**
Date: Tue, Feb 2, 2016 at 8:42 PM
Subject: cyber security
To: XXXXXXXXXXX

We've detected spam-like activity in your webmail account, which is against our Acceptable Use Policy (AUP).

Kindly click on the link below to verify that you're the owner of the account and not a spammer.

http://is.gd/stonybrooksecure

We apologize for any inconvenience this may have cause you.

Thanks,
SBU Team

Legitimate message from an IT department

From: XXXXXXXXXX
Date: XXXXXXXXXX
Subject: Important! You must change your XXXXXXX password
To: XXXXXXXXXXXX

[This is not a spam mail, this email is from me, XXXXXXXXXXX]

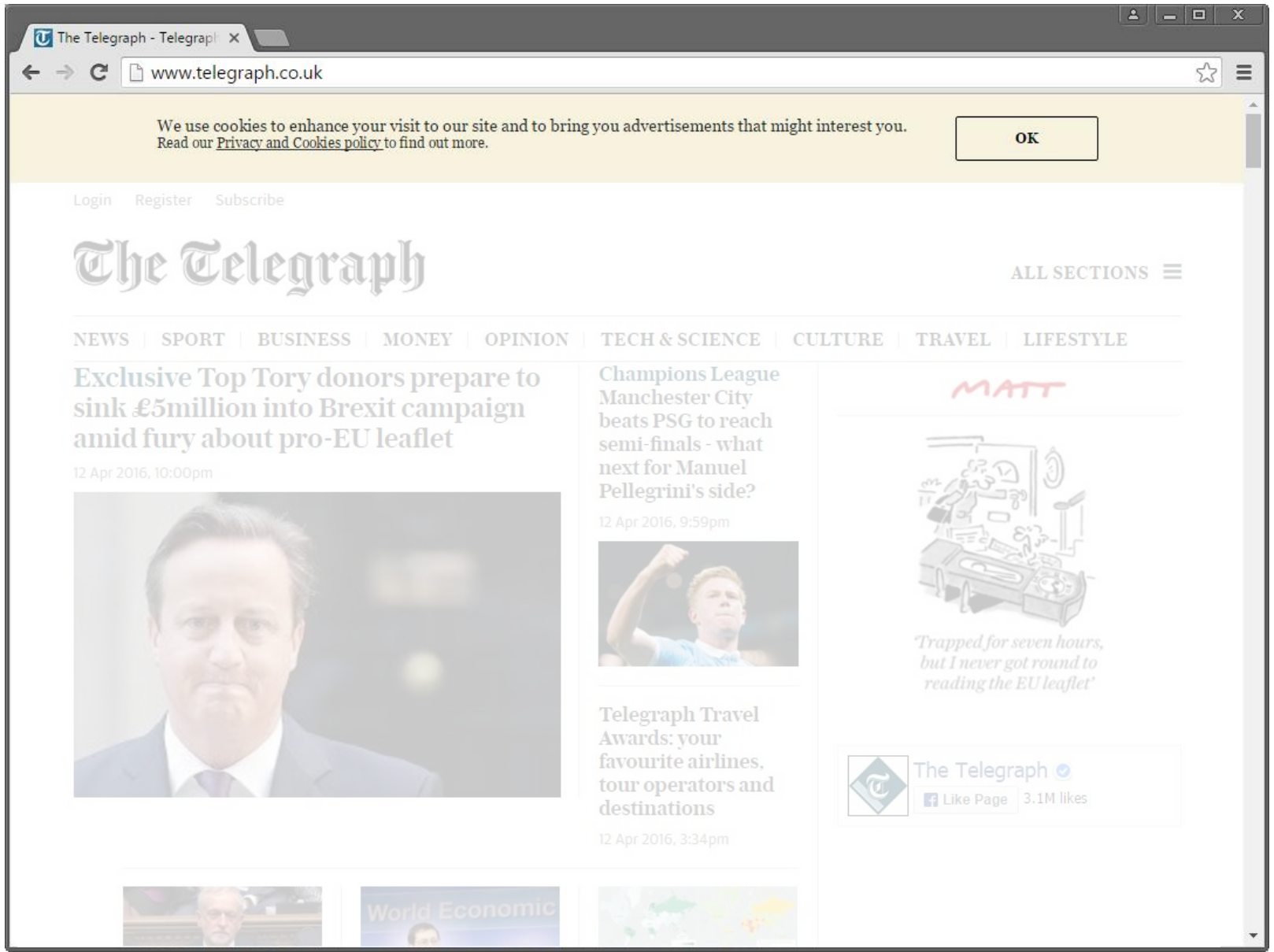
Member of XXXXXXXXX Department,

PLEASE CHANGE YOUR XXXXXX PASSWORD!

We just upgraded the security of XXXXXX. Your current password is no longer working. You must change your password if you want to log into XXXXXX. [...]

To change your XXXXX password:
http://XXXXXXXXX.XXX -> forgot your password -> follow the instructions

More training of users to click on things…



Phishing Countermeasures

Stop confusing users

- Institutions shouldn't include links in emails

User education

- Don't trust links in emails – type the address in your browser
- (analogous to: don't trust phone calls that ask for your info – always call the number at the back of your card)

Augmenting password logins

- Two-step login: show user-specific information before prompting for the password
- Probably too inconvenient

Anti-phishing filters, tools, …

U2F tokens!

Spear Phishing

Well-prepared, personalized, convincing messages targeted to particular individuals

- Seemingly coming from trusted colleagues (may come from real colleagues if their accounts have been compromised)
- Personalized for their target: real names, personal and business information, recent activity (e.g., real purchases), …

Highly effective, used extensively in targeted attacks

- Document attachments exploiting 0day vulnerabilities
- Links to fake login pages for credentials stealing

Many recent incidents

Phish For the Future

TECHNICAL ANALYSIS BY **EVA GALPERIN** AND **COOPER QUINTIN** | SEPTEMBER 27, 2017

This report describes "Phish For The Future," an advanced persistent spearphishing campaign targeting digital civil liberties activists at Free Press and Fight For the Future. Between July 7th and August 8th of 2017 we observed almost 70 spearphishing attempts against employees of internet freedom NGOs Fight for the Future and Free Press, all coming from the same attackers.

This campaign appears to have been aimed at stealing credentials for various business services including Google, Dropbox, and LinkedIn. At least one account was compromised and

Some of the attacks were generic, such as a link to view a Gmail document supposedly sent by a co-worker or a LinkedIn notification message from a colleague.

Another attack pretended to be from a target's husband, sharing family photos; the email was forged to include the husband's name.

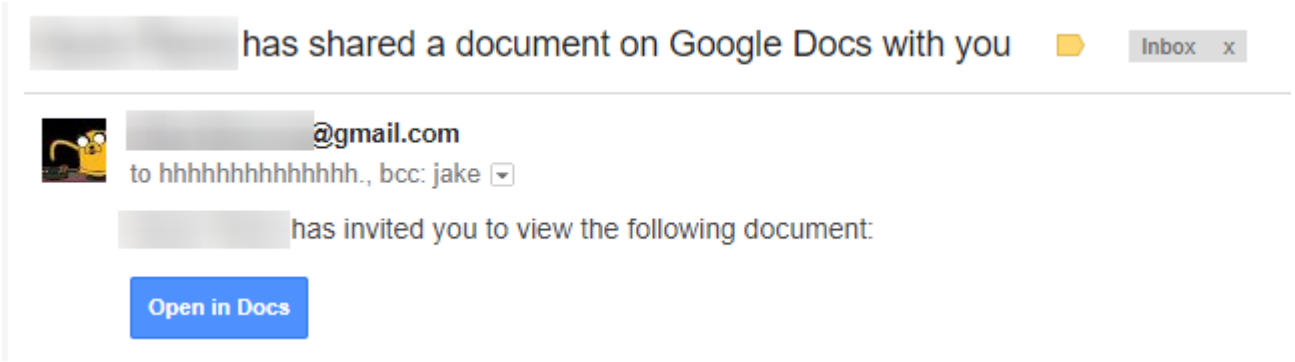
Yet another attack pretended to be a YouTube comment for a real YouTube video that the target had uploaded.

Some of the headlines are designed to appeal to the political interests of the targets, such as: "George W. Bush ON TRUMP'S TWEET: A FREE PRESS IS 'INDISPENSABLE TO DEMOCRACY,'"

The attackers sent emails titled "You have been successfully subscribed to Pornhub.com" and "You have been successfully subscribed to Redtube.com" to the victims. This was followed up minutes later with several emails all disguised as coming from Pornhub or Redtube with explicit subject lines. Each of the emails contained an unsubscribe link which directed the target to a Google credential phishing page.

Recent Google Docs Phishing Campain

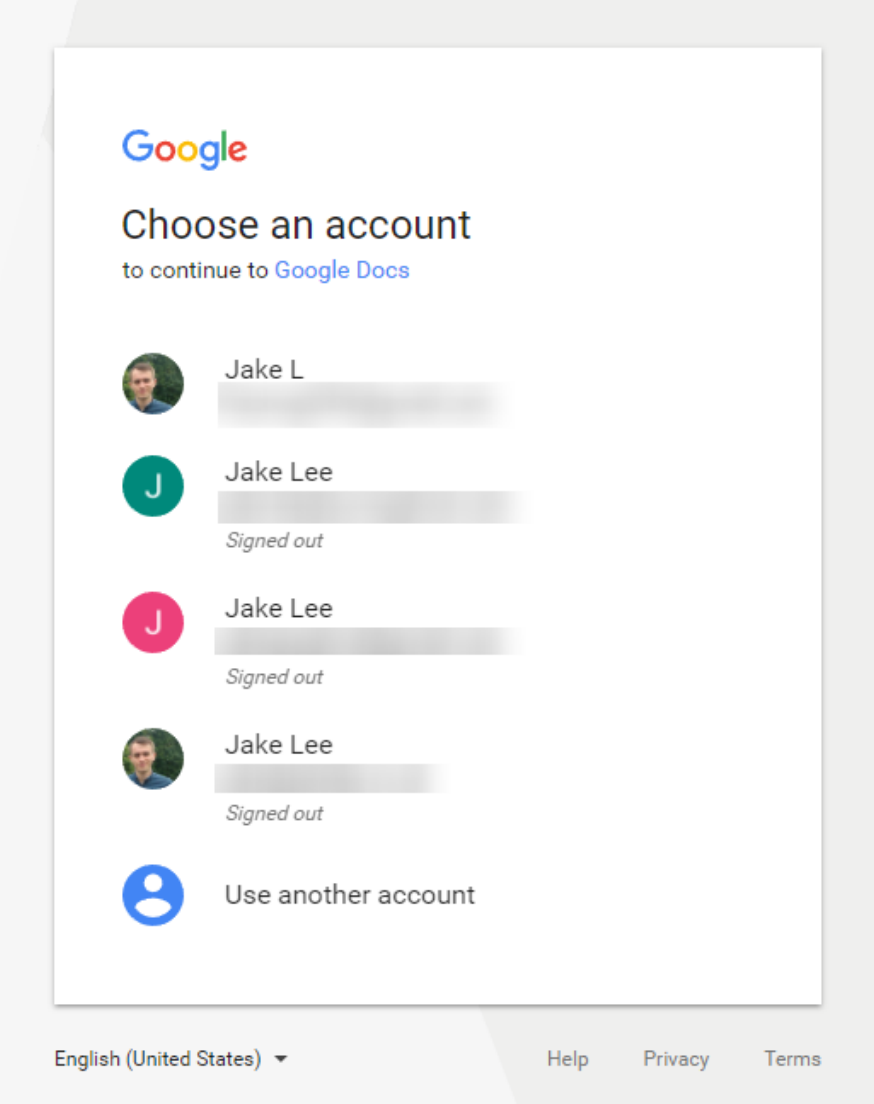
1) Fake "Google doc has been shared with you" email



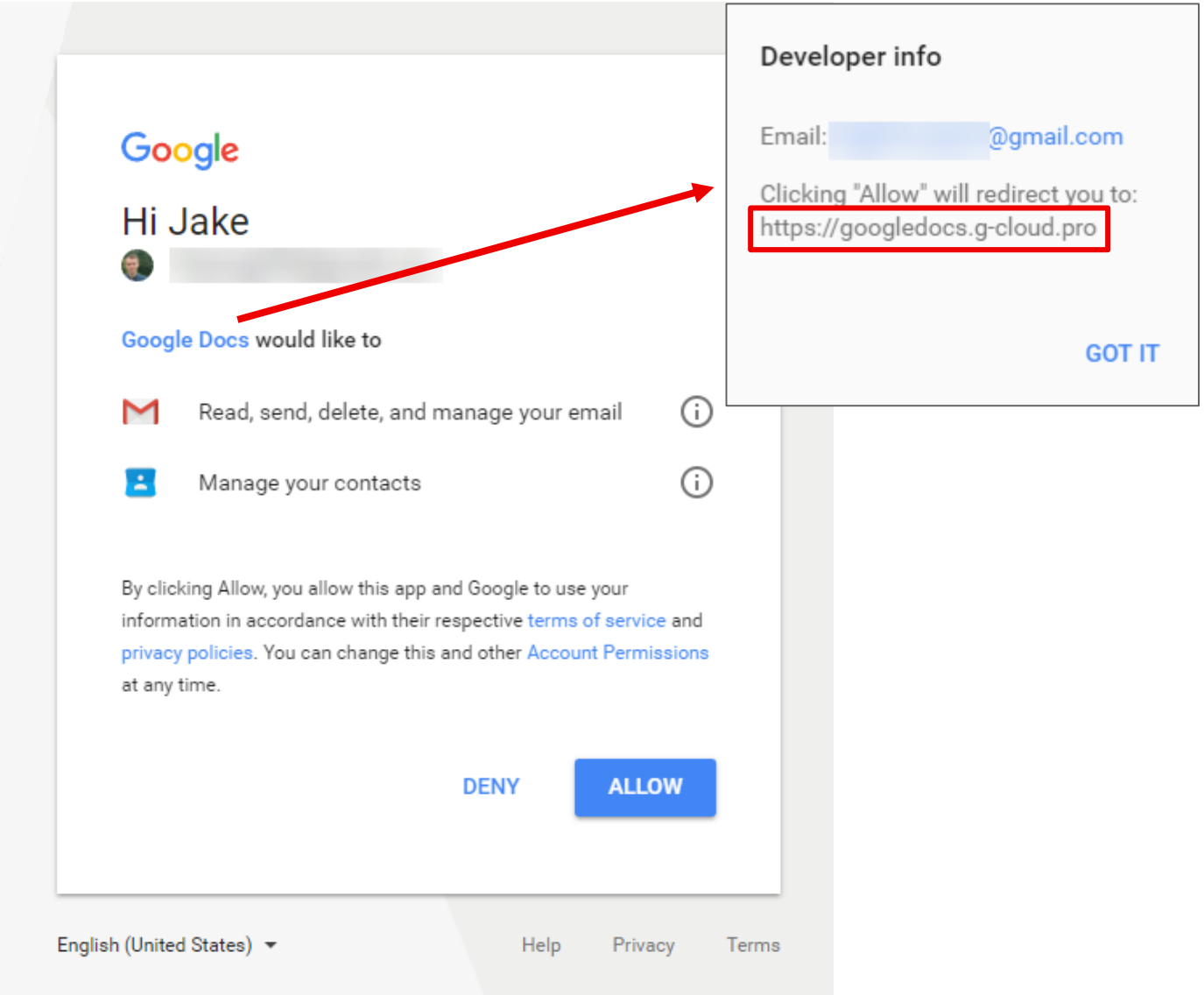
2) Button's URL looks legit

https://accounts.google.com/o/oauth2/auth?client_id=346348828325-vlpb3e70lp89pd823qrcb9jfsmu556t8.apps.googleusercontent.com&scope=https%3A%

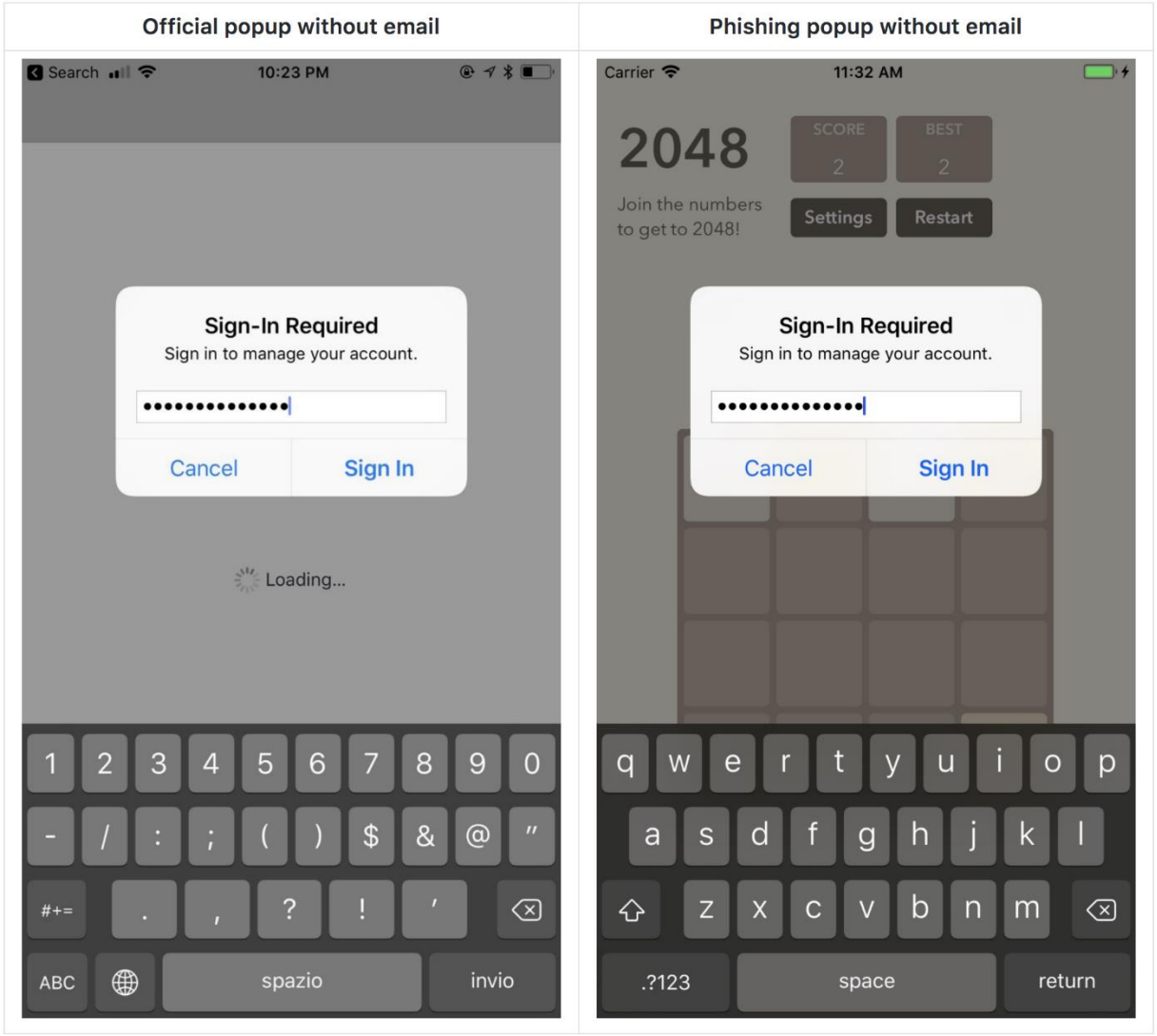
3) Real Google account selection prompt



4) *"Google Docs would like to…"*



Phishing beyond email



Maybe rethink email altogether?

Recent secure messaging apps offer many benefits

- True end-to-end encryption: the provider shouldn't be able to read message contents
- User-friendly verification of contacts' identities
- Forward security: ensure past communications will be secure even if private keys are stolen
- Open-source design and implementation, code audits
- **No spam!** Only approved contacts can send messages

Many encouraging efforts

- Signal, OTR, Pond, …
- Proprietary, but better than nothing: WhatsApp, iMessage

Metadata is still there!