A Cloud in Every Home

Host servers at home with zero sysadmin skills

$ whoami

Nolan Leake

- Linux user/developer since 1995
- Hosted my own email/web/etc since 2001.
- Cumulus Linux – Linux for network switches
  - Debian derived
  - Commercially supported, w/ wide deployment

Poll

- Who here has a home server, a colocated server, or a VM?

Poll

Who runs their own mail server?

or

Uses a mail server run by friends/family?

http://www.iconarchive.com/artist/graphicloads.html

Poll

Who used to run their own mail server, but stopped?

¯_(ツ)_/¯

Poll

- Who would run their own mail server, if it required no OS/software setup and maintenance, and minimal hardware setup and maintenance?

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Motivations/Goals

- Store your data in your own home.
  - Stronger 4th amendment protection
  - Really obvious if criminals or government agents do this:

Photo by US Army (public domain)

Motivations/Goals

- Store your data on hardware you own.
  - No one has an immediate pressing need to do abusive things to "monetize" you to pay for the storage you're using.
  - Even ignoring privacy, eliminating ads, tracking and other “dark pattern” tricks will result in a better experience!

Motivations/Goals

- Must provide similarly easy experience as 3rd party hosted cloud services like gmail.
  - No software administration
  - Absolute minimum hardware administration.
    - Replace failed storage devices
    - Replace failed server
- Must handle this:

Approach

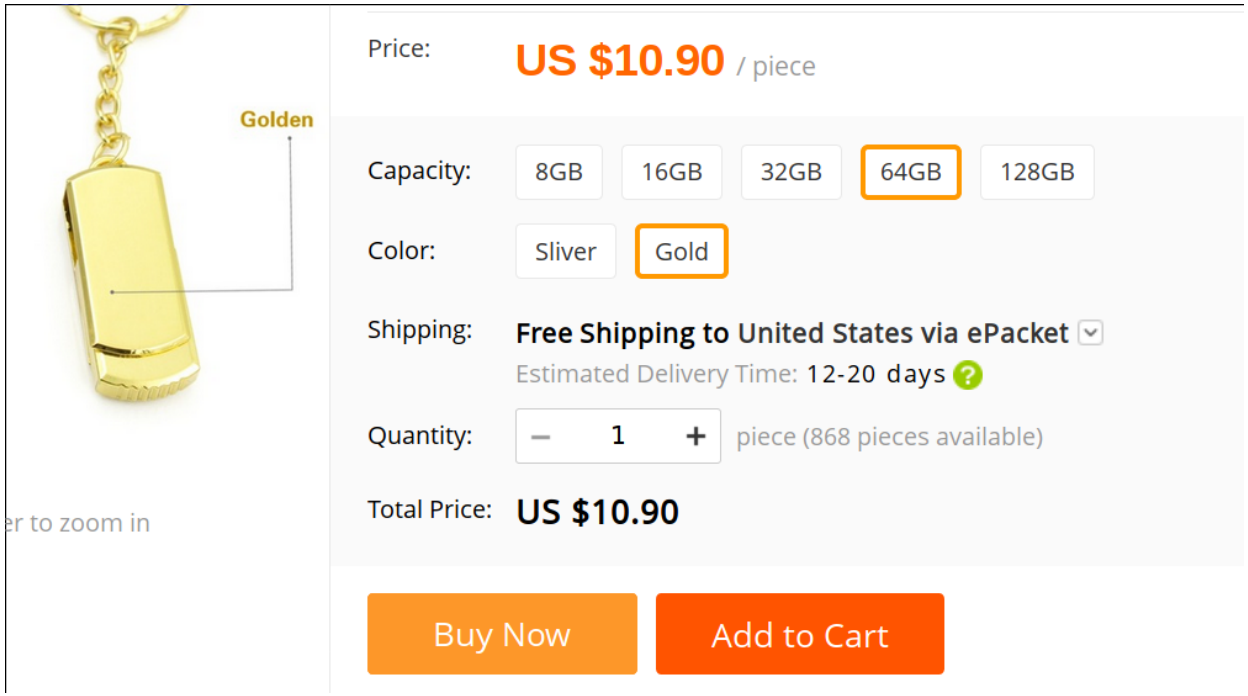
- Use techniques developed by Internet giants that allow <100 people to manage a >100,000 server cluster.
  - These techniques are designed for large companies with huge clusters attacking massive problems.
  - We can adapt them to be both simpler and more appropriate for human/family scale problems.

Approach

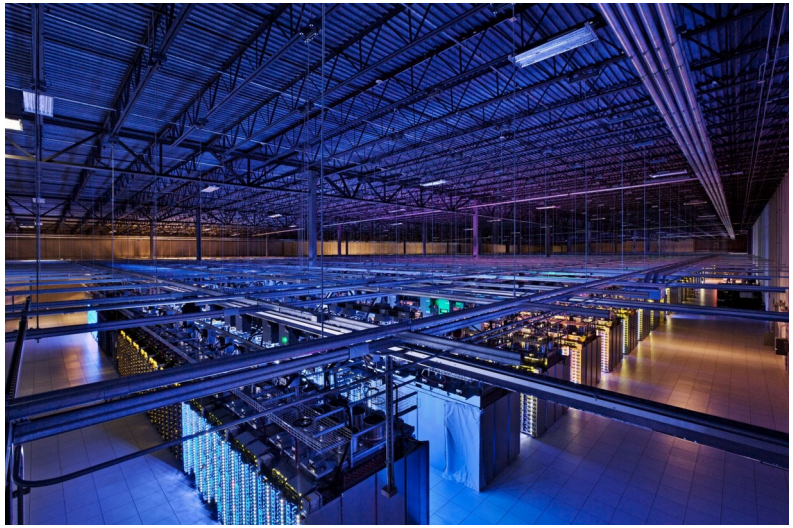
- Use techniques developed for smartphone apps to allow non-technical users to install and use software.
  - Self-contained applications
  - Isolated
  - Automatic updates
  - Simplified config and sane defaults

Approach

- Use cheap hardware.
  - Raspberry Pi 3 is $35. Old laptops are cheap.
  - Even non-tech-nerds have spare USB flash sticks.
    - If you have to buy one, a 64GB stick is ~$10.



Approach



Approach

- Immutable images, with explicit data volumes.
  - Easier updates.
  - Harder to corrupt while running.
  - Filesystems are writable or executable, never both.
- Not just application containers – Host OS too.

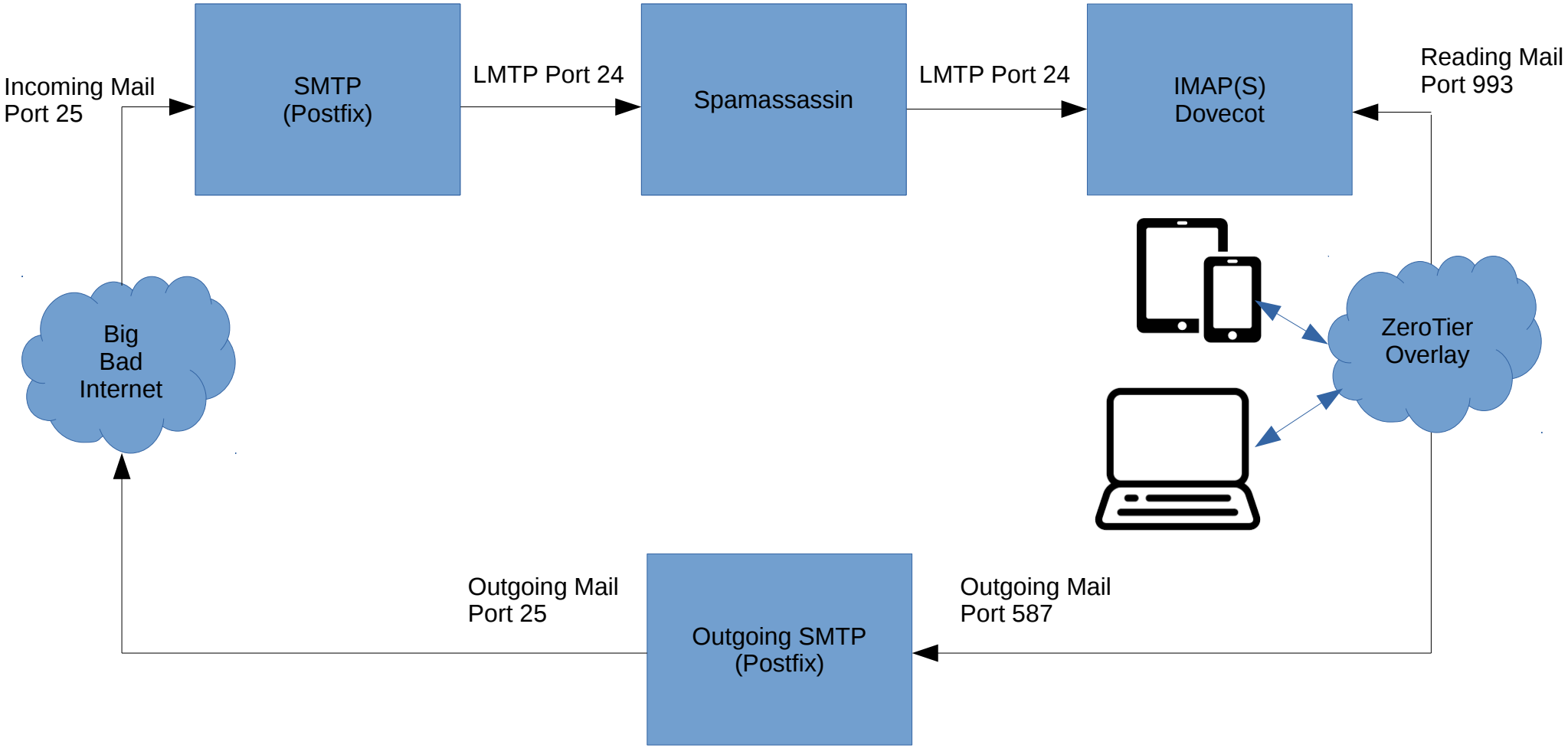
Approach

- Encrypted overlay network: ZEROTIER
- Connects server, laptops, tablets and phones.
  - Punches holes through NATs.
  - Non-public services aren’t exposed on Internet.

Approach

- Isolate different parts of the system, different applications, and parts of applications in separate containers with separate networks.
  - Ephemeral containers like SMTP and Spamassassin can be started on demand and immediately torn down.
  - An email that exploits a Spamassassin bug:
    1) can’t see the mail spool.
    2) can’t see previous or subsequent emails.
    3) can’t attack other internal services, like IMAP.

Approach


Incoming Mail
Port 25
SMTP
(Postfix)
LMTP Port 24
Spamassassin
LMTP Port 24
IMAP(S)
Dovecot
Reading Mail
Port 993
Big
Bad
Internet
ZeroTier
Overlay
Outgoing Mail
Port 25
Outgoing SMTP
(Postfix)
Outgoing Mail
Port 587

Approach

- If you're emailing someone else with this setup, your message is only plaintext on their client, their server, your server and your client.
  - Never plaintext on any network.
  - Never plaintext on any disk.
- Not quite Signal-level end-to-end cryptography, but a lot better than normal email.
  - But of course, all is lost if you’re talking to a gmail user.

Problem One

- Residential ISPs usually block outgoing SMTP.
  - even if they don't recievers ignore mail from residential IPs because of SPAM.
- Run a proxy on a clean IP
  - The TLS session is negotiated from server to server
    - So the proxy never sees the email.
    - It does get some insight into who is emailing whom.

Problem Two

- We've built an open-relay – A SPAM CANNON!

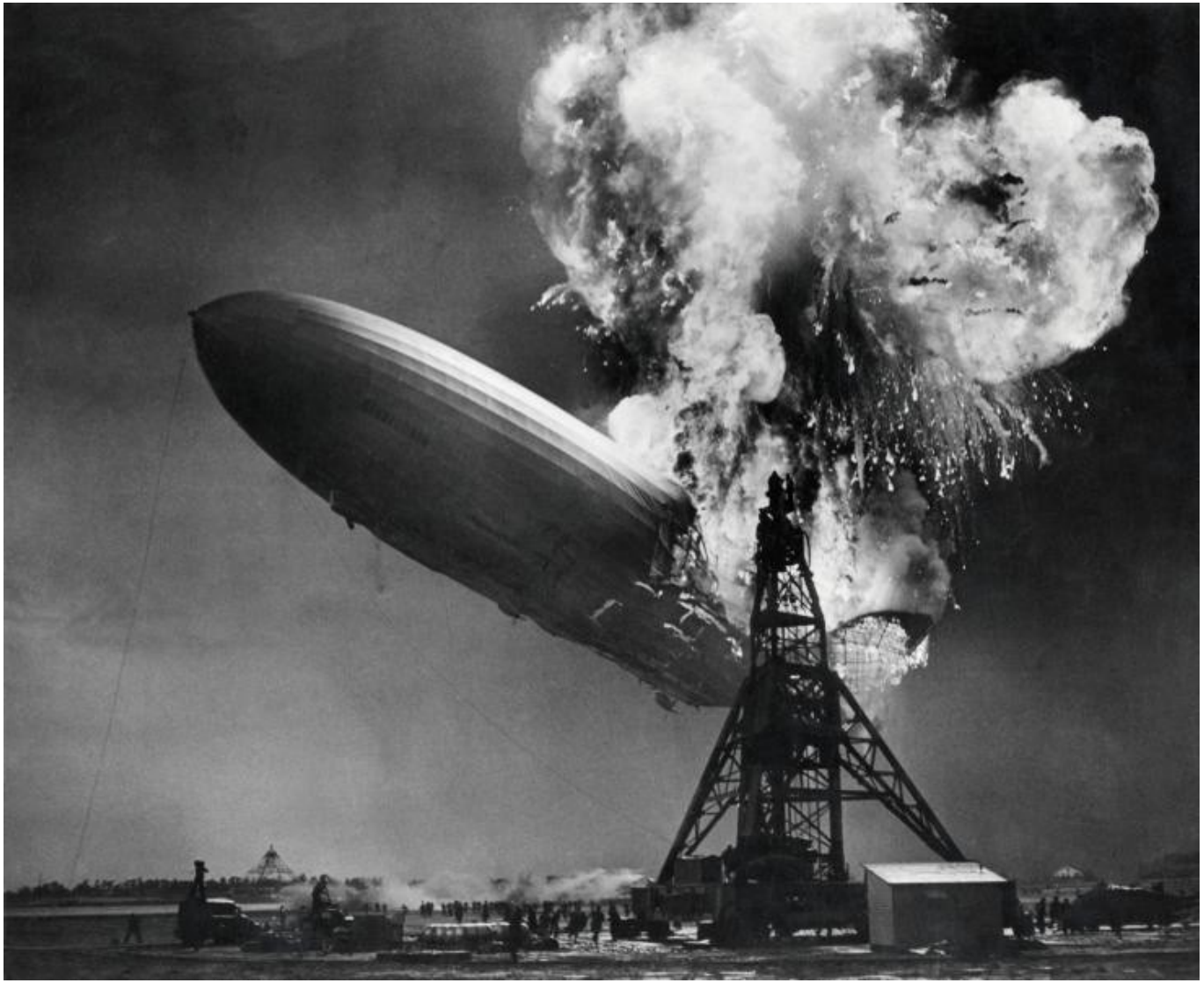
- Must rate limit.
  - But due to mailserver to mailserver TLS, we can't see the message!
    - Is a 10MB SMTP session to gmail one big picture going to one person, or a 1KB spam going to 5000 people?
  - Solution: The replies back from the destination server are proportional in size to the number of recipients.
    - >>> RCPT TO: Whoever <whoever@whereever.com>

      <<< 250 2.1.5 <whoever@whereever.com>... Recipient ok
    - So we rate limit based on the number of bytes coming back.

Problem Three

- A few ISPs block *incoming* SMTP, either due to misguided policy or CGNAT.
  - Also, some people will be unable or unwilling to enable port forwarding of port 25 on their home router.
- Need a reverse version of the proxy, that determines which home server IP the incoming mail is for using the "EHLO" name.
  - EHLO sends the MX server’s name before STARTTLS starts encrypting the session.

DEMO



What’s missing

- What you just saw is between a proof-of-concept and Alpha.
- What remains to be done to make this Beta?

DNS and DynDNS

- Right now I used a 3rd party DynDNS
  - Would be better to bring this in-house to reduce the number of accounts to create.
- Internal services on the overlay must be referred to by IP.
  - It is straightforward to setup automatic DNS.
  - But Let’s Encrypt doesn’t support wildcard certs yet.
    - Supposedly coming March 5th
    - That’s 5 days ago.

Better integration with ZeroTier

- Must specify API key in file on SDCard.
- Must manually install app on phones/laptops.
- Must manually authorize new phones/laptops.
- Automate all this!

App Store

- I baked the email app into the OS.
  - This is obviously not scalable.
- Need to build an app store
  - Simple UI (Web, iOS app, Android app) to choose apps.
  - Server downloads application containers.

Supply-chain Security/Transparency

- Reproducable Builds
  - Thanks to basing on Debian, we’re ½ way there.
- Open Source firmware
  - Almost there for Raspberry Pi3
  - Still a ways to go on most x86 PC platforms.

Package More Apps!

- Email is just the start
- Backend services for various IoT devices
- Seafile, SyncThing, or NextCloud (Dropbox)
- Wordpress
- Mastodon instance (Twitter)
- Gitlab (Github)
- Mattermost (Slack)
- More! There is lots of great Open Source software.

Backup/Restore

- Now, if your house burns down, you're screwed.
  - I mean, you have no email. This is an emergency!
- Global backup scheme.
  - Encrypt, stripe, and redundantly encode files.
  - Spread the encrypted fragments to thousands of other users.
    - In return, you store fragments for them.
  - Encryption key never leaves your house.
    - Well, actually, you should probably have a few copies, perhaps at a trusted family member's house or in a safe-deposit box.

Sound Interesting?

- Gitlab: https://git.sigbus.net/projectx/os
- IRC: #prjx on Freenode
- Want to be notified when there are pre-built images that are more fully baked?
  - Email prjx@sigbus.net and I'll let you know.