

Giving users control

... and why *Unikernels* are the way to do it.

University of Cambridge

Unikernel Systems Ltd.

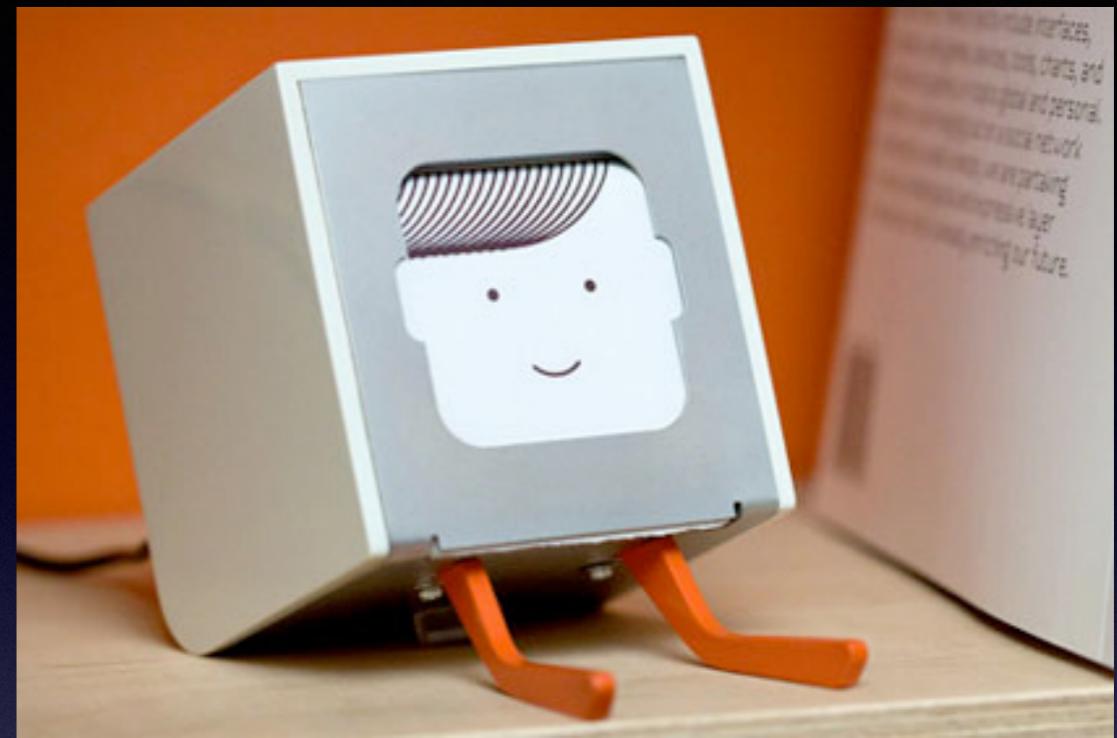
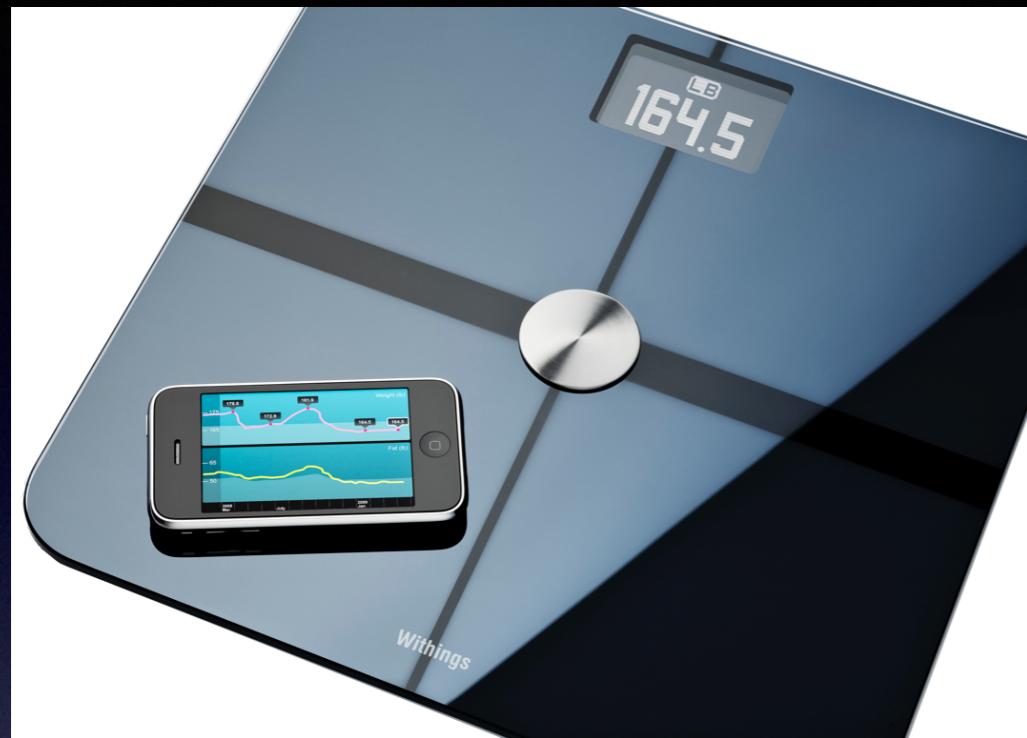
Amir Chaudhry - @amirmc
amc@cantab.net

IoT Summit
May 2015

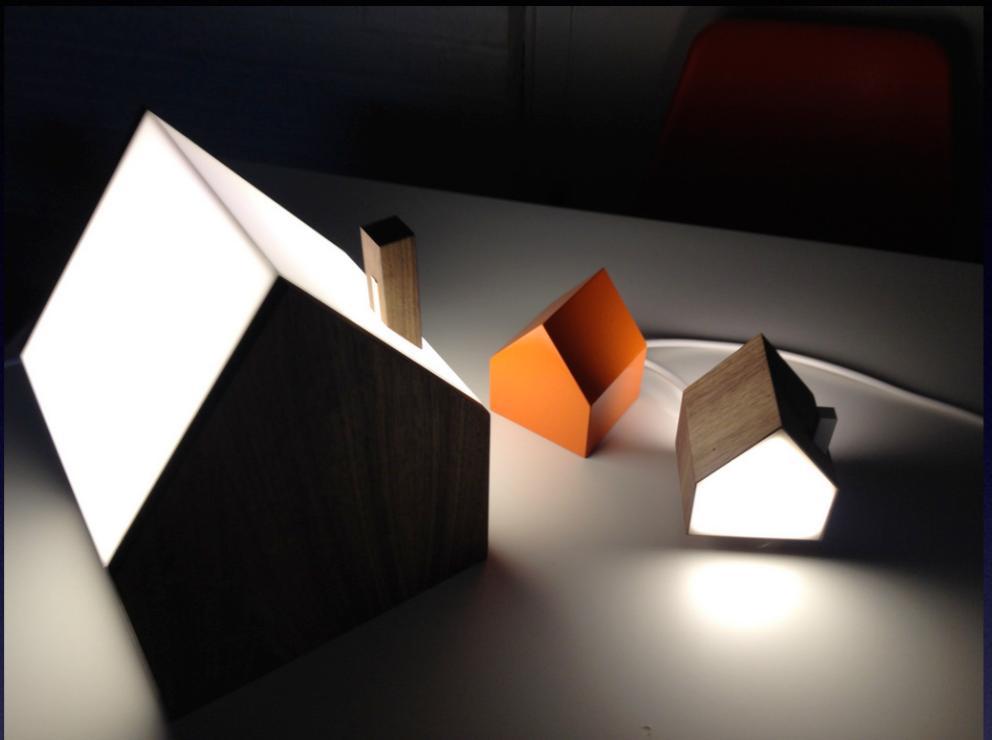


UNIVERSITY OF
CAMBRIDGE

Wave of appcessories

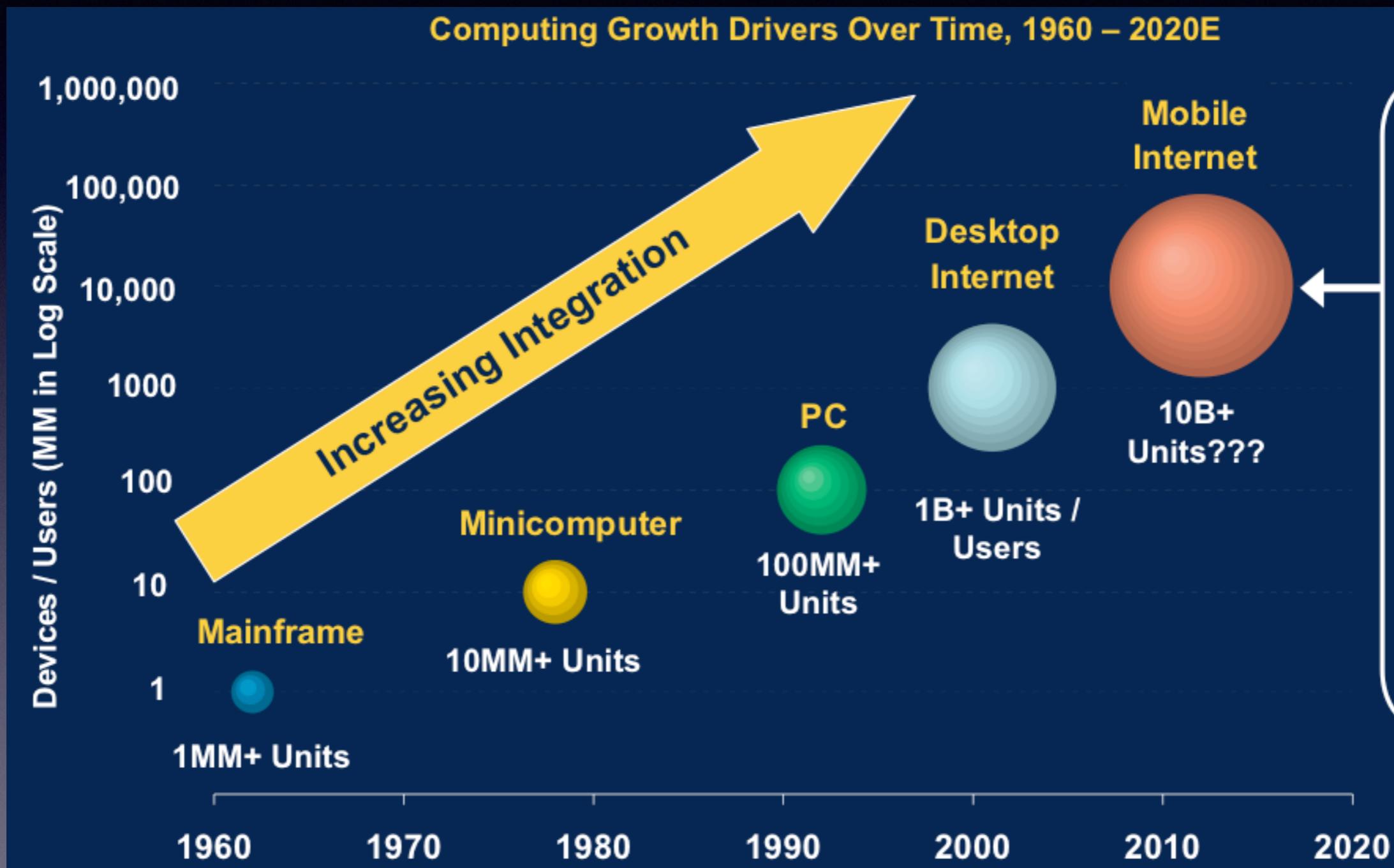


Wave of accessories



Billions of devices

Including in Industry!



Billions of devices

What will devices be running on?

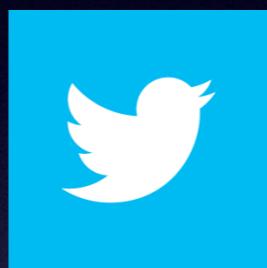
How will devices sync and store data?

How will devices find each other?

What control will users have?

Cloud Computing!

Google

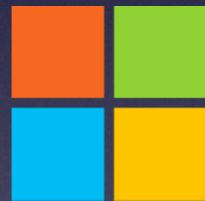


facebook.

SAMSUNG



YAHOO!

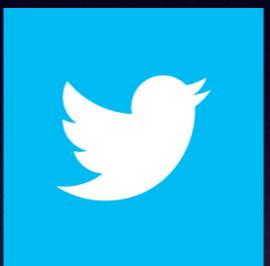


Microsoft

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Cloud Feudal Computing!

Google

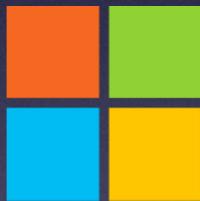


facebook.

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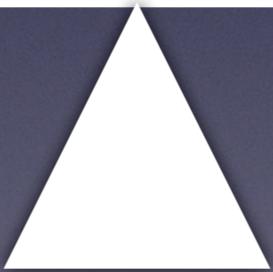
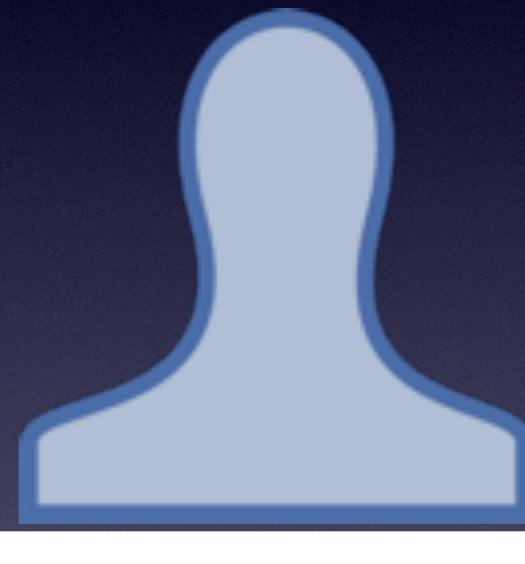


Microsoft

amazon.com®

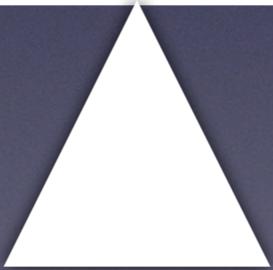
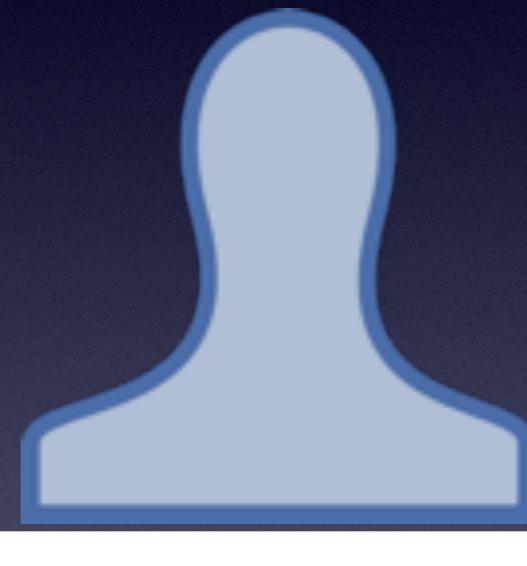
Issues

Ability to influence diminishes



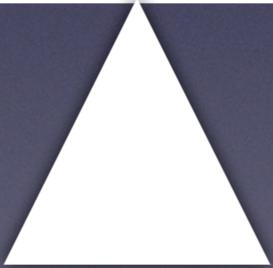
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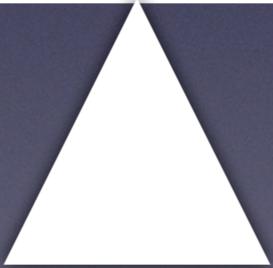
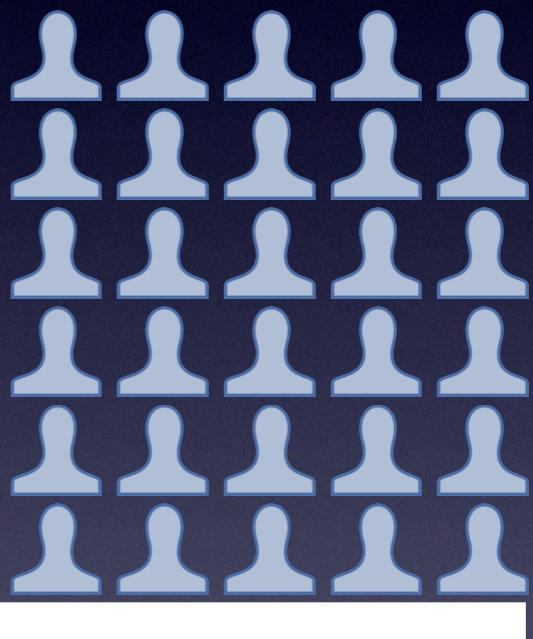
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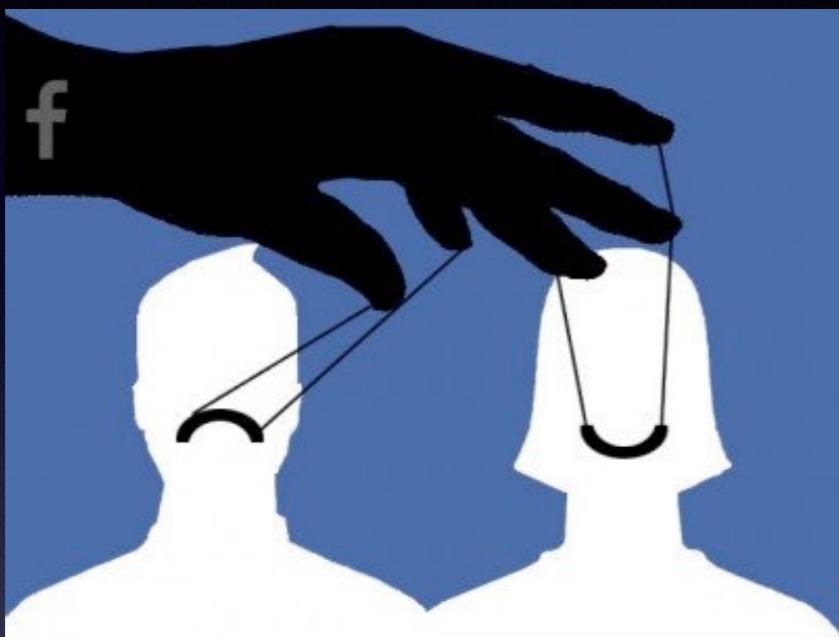
Issues

Ability to influence diminishes



Issues

YOU are the ‘Big Data’



TECH 6/28/2014 @ 2:00PM | 179,355 views

Facebook Manipulated 689,003 Users' Emotions For Science

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SCIENCE THE STATE OF THE UNIVERSE JUNE 28 2014 5:50 PM

Facebook’s Unethical Experiment

It intentionally manipulated users’ emotions without their knowledge.

By Katy Waldman

55.8k 5.4k 531

Everything We Know About Facebook’s Secret Mood Manipulation Experiment

It was probably legal. But was it ethical?

ROBINSON MEYER | JUN 28 2014, 2:51 PM ET

Everything You Need to Know About Facebook’s Controversial Emotion Experiment

BY MICHELLE N. MEYER 06.30.14 | 3:22 PM | PERMALINK

2.8k Tweet 854 854 114 199 1

Issues

Complexity leads to security issues

GIZMODO

Did Path Screw Up and Steal Your Data Again?



Casey Chan

Filed to: PRIVACY 2/01/13 7:16pm

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17 January 2014 Last updated at 17:18



Fridge sends spam emails as attack hits smart gadgets



U B E R

Can We Trust Uber?

A great, long-lived brand begins and ends with trust.

02 accused of sending your phone number to every website you visit

TECHNOLOGY / 25 JANUARY 12 / by MARK BROWN

Issues

Complexity leads to security issues

Heartbleed: 17% of all Internet secure web servers vulnerable to a single bug.

ShellShock: CGI, Web, DHCP all vulnerable to code execution.

Breaches: e.g. JP Morgan and Target

Issues

New threat models?

Advertising? - Pitiful opt-out experience

Multiple services? - Too many passwords

Surveillance? - Who's watching you?

Solutions?

We already know the answer

- Decentralised services that run near users
- Reduce remote data transmission
- Better security and isolation of edge nodes

Take the cloud to the edge

~~Cloud~~ Feudal Computing!

benefits:



Identity

*Someone has to
provide these*



Connectivity



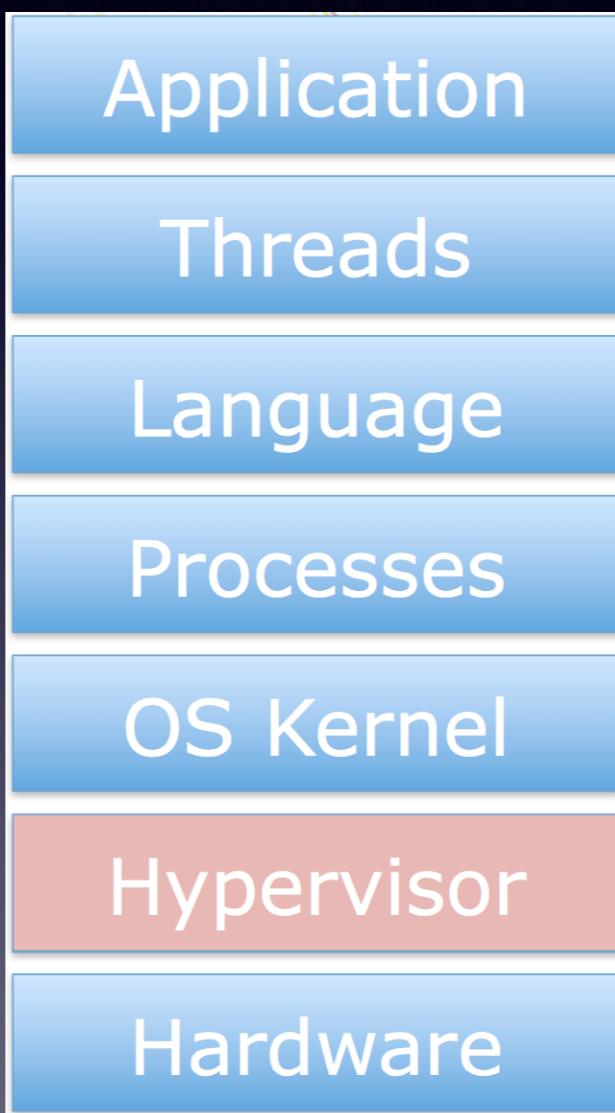
Storage / Sync

The LAMP stack



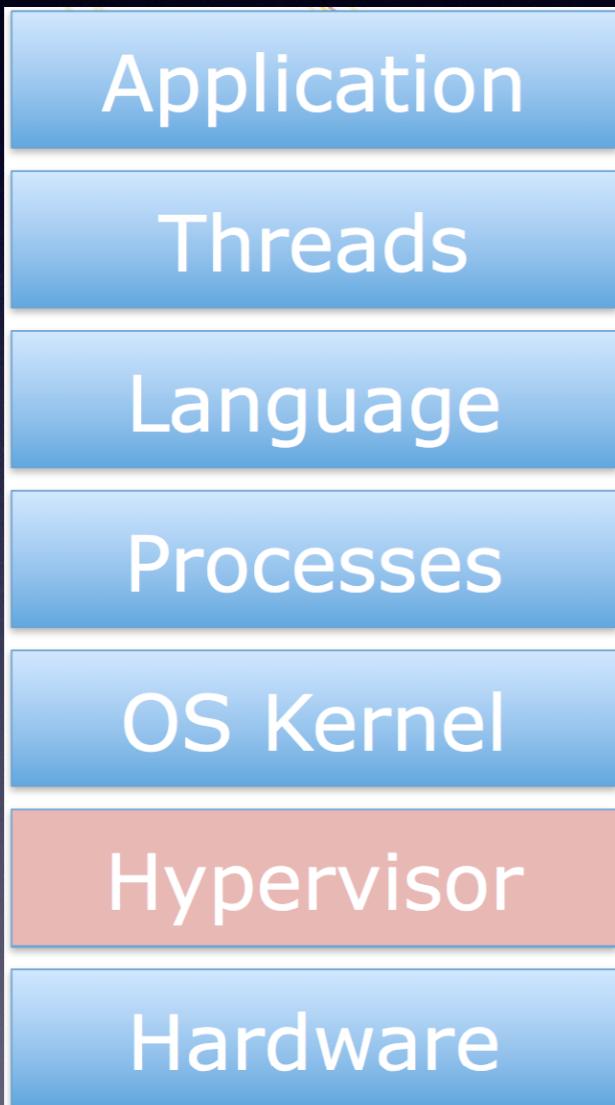
Old Technology

Monolithic OS



Old Technology

Monolithic OS



Millions of lines of code

Inefficient at scale

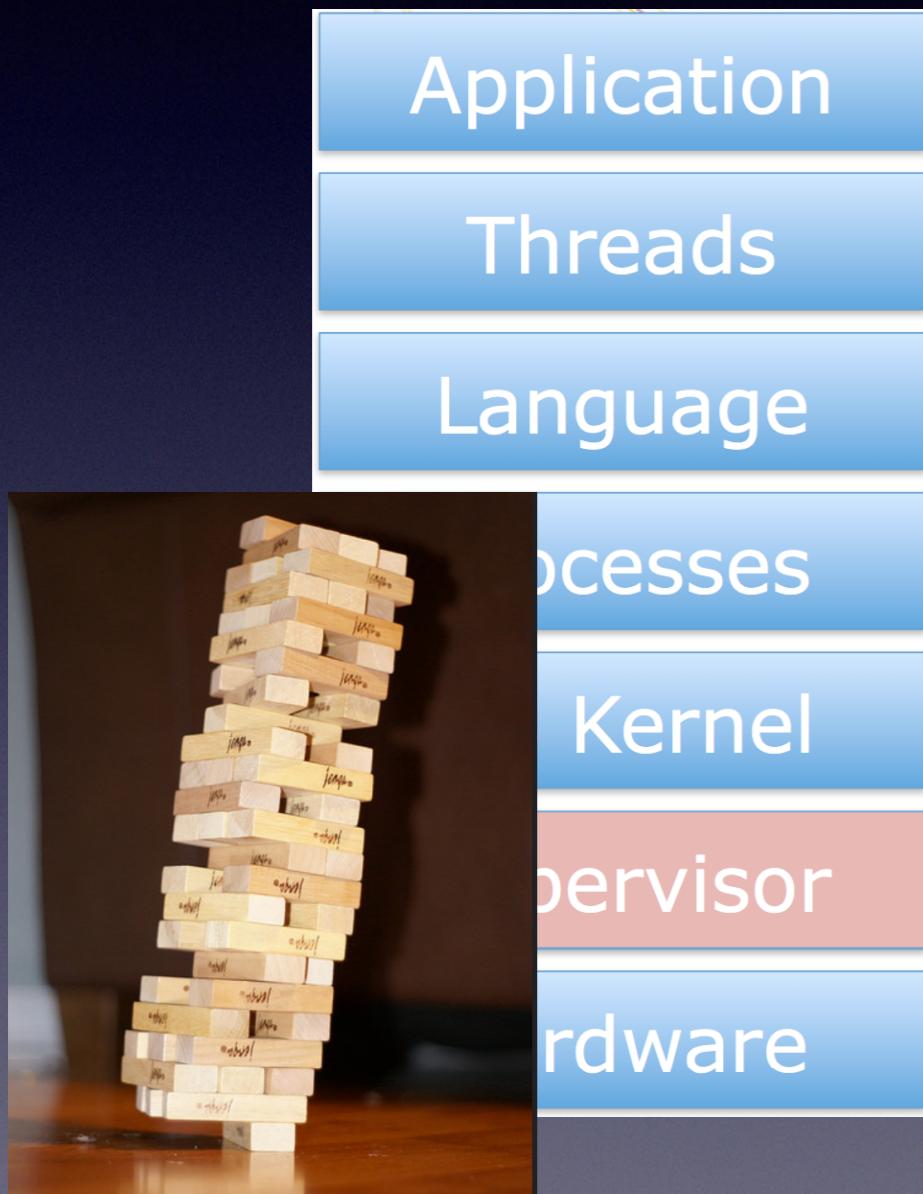
Insecure & leaky layering

Complex to reason about

*Why did we build for clouds
as we do for desktops?*

Old Technology

Monolithic OS



Millions of lines of code

**Inefficient at scale
Insecure & leaky layering
Complex to reason about**

*Why did we build for clouds
as we do for desktops?*

New Technology

Clean-slate approach

Re-evaluate all the old assumptions

What can we come up with?

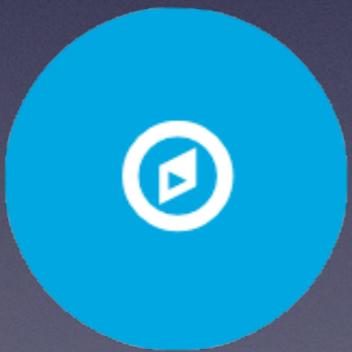
The MISO stack



MirageOS (*OS / application*)



Irmin (*Storage / Sync*)



Signpost (*Identity / Connectivity*)



OCaml (*Safety / Modularity*)



To enable the creation of resilient
decentralised systems that incorporate
privacy from the ground up so that users
retain control of their networks and data

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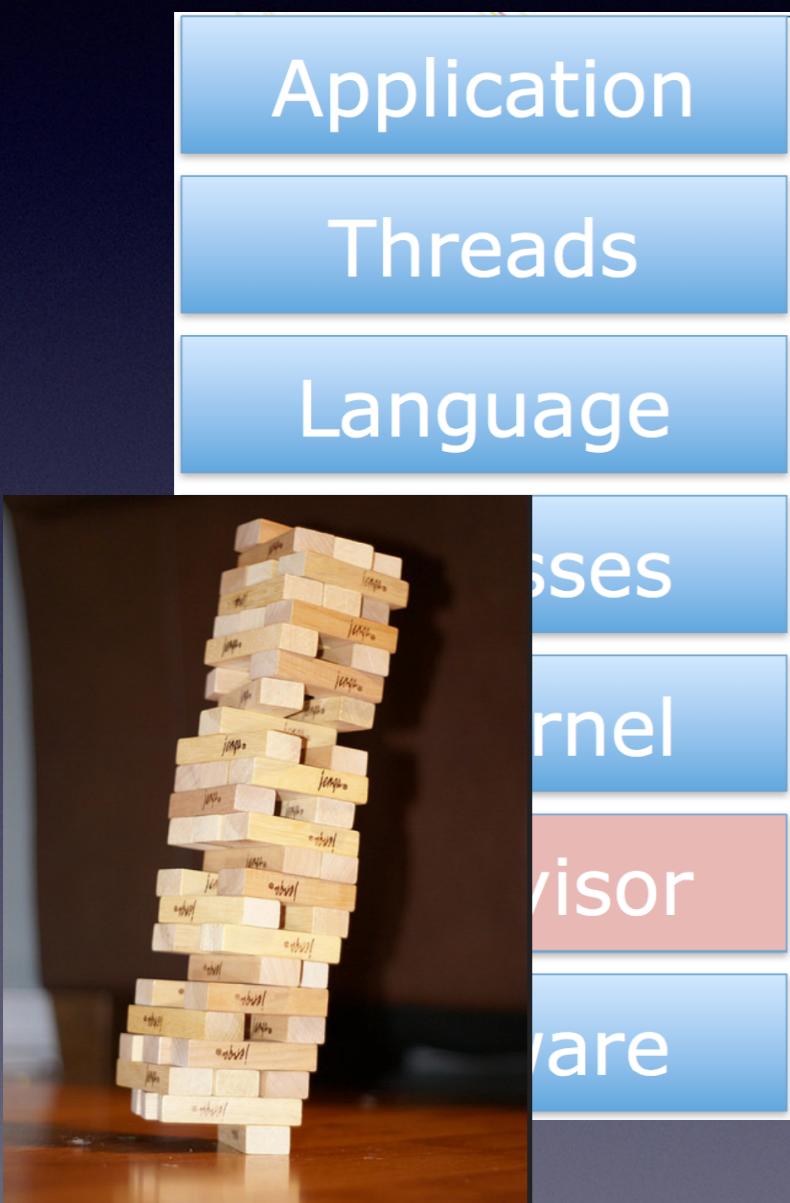
MISO Toolstack

MirageOS - A library OS

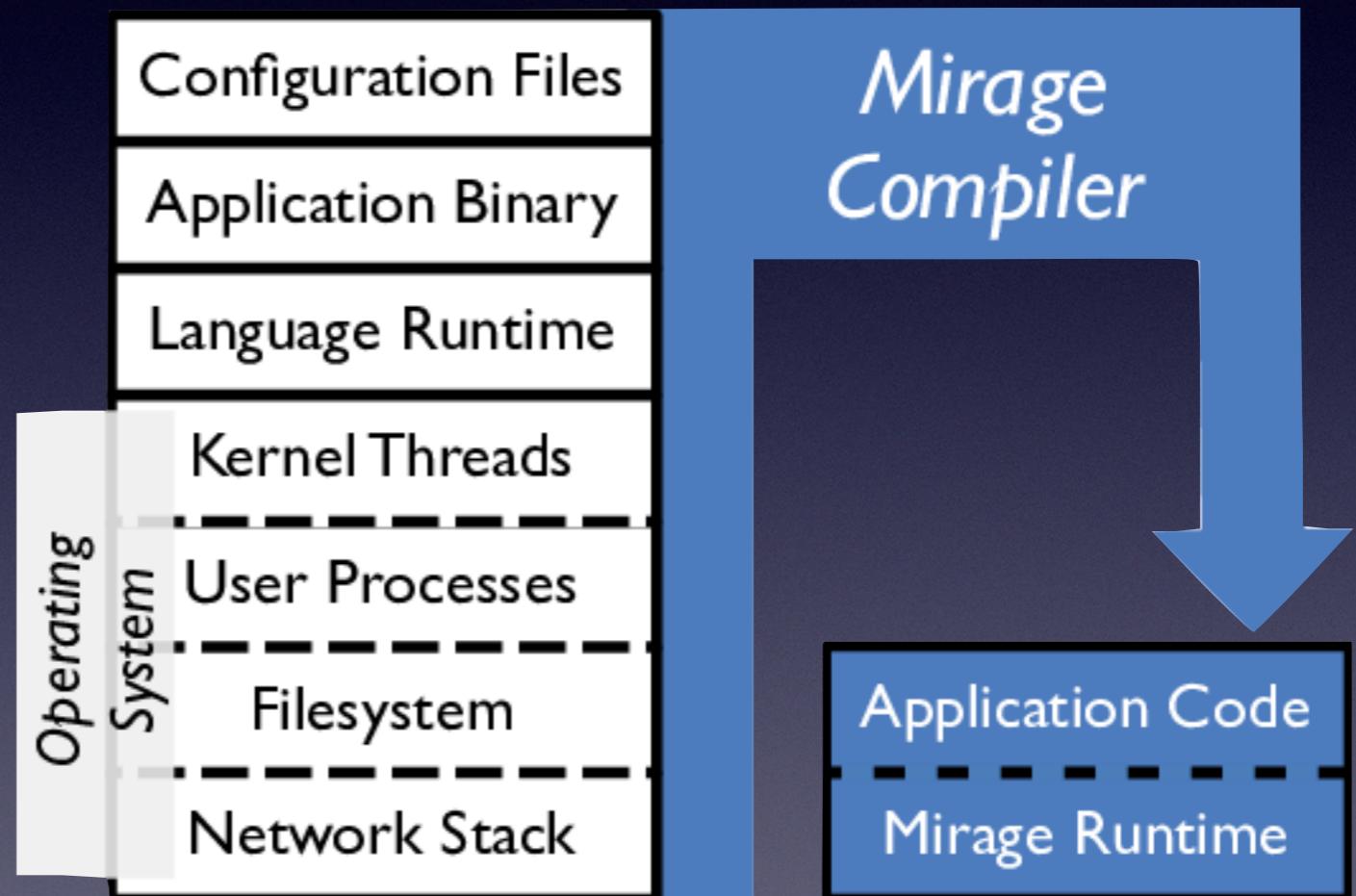
- Lean, mean, clean-slate OS (unikernels)
- Designed for cloud and embedded devices
- Increased safety and resilience

MirageOS

The Old Way



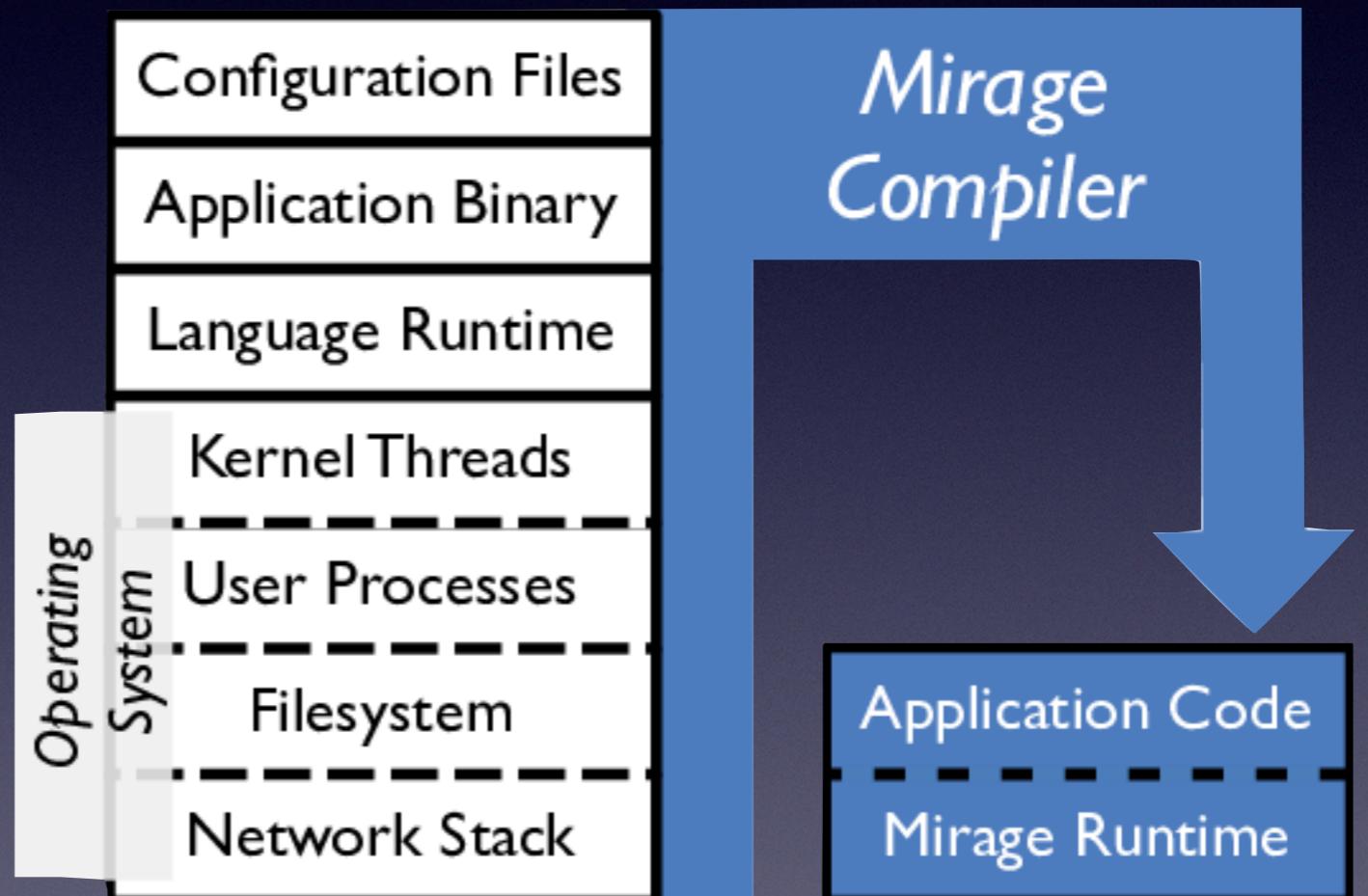
The Unikernel Way



MirageOS

The Unikernel Way

Unikernels are specialised virtual machine images compiled from the full stack of application code, system libraries and config



MirageOS

The Unikernel Way

Unikernels are specialised virtual machine images compiled from the full stack of application code, system libraries and config

Contained, simplifying deployment and management.

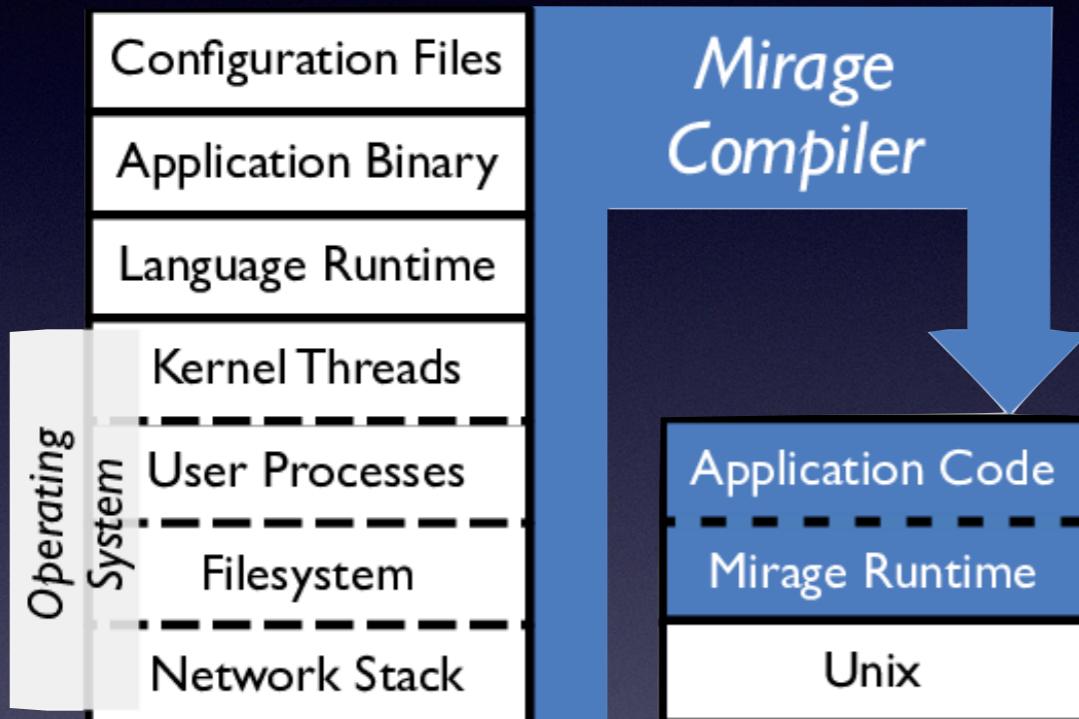
Compact, reducing attack surface and boot times.

Efficient, able to fit 10,000s onto a single host.

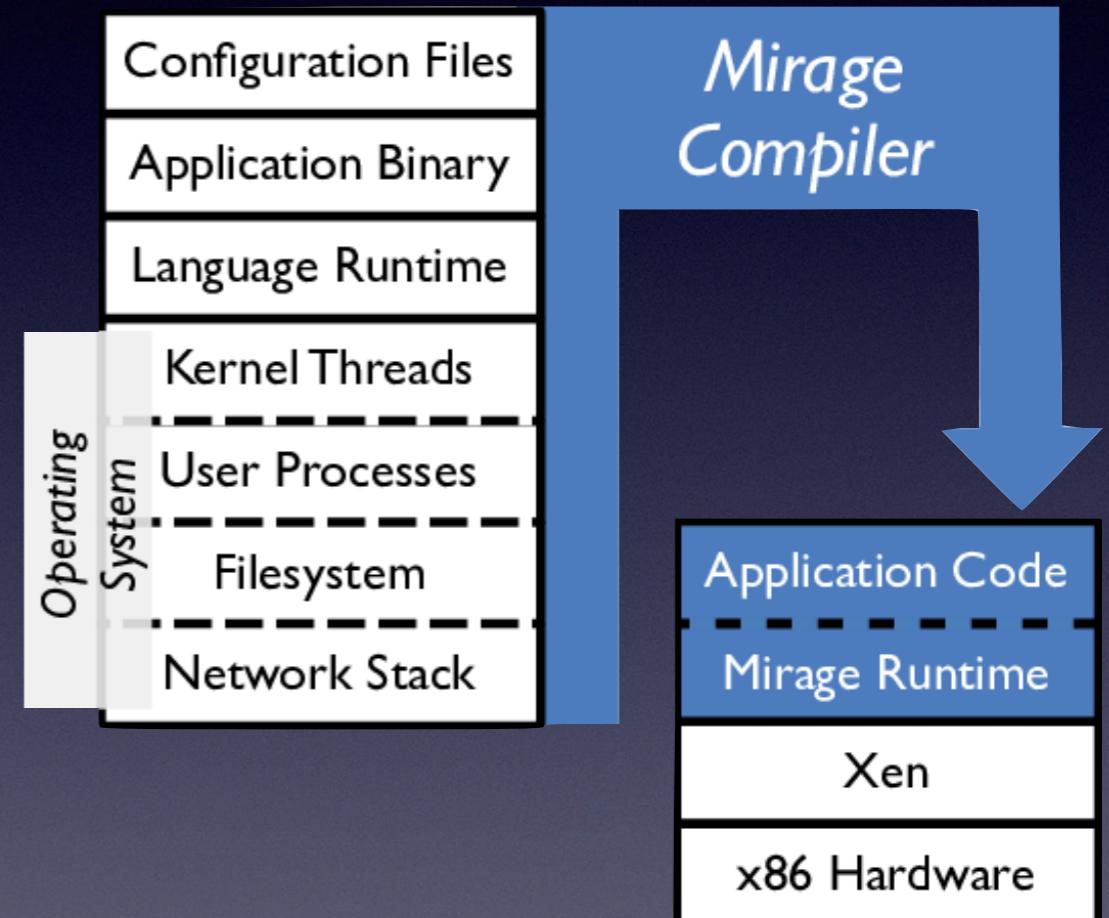


MirageOS

Unix



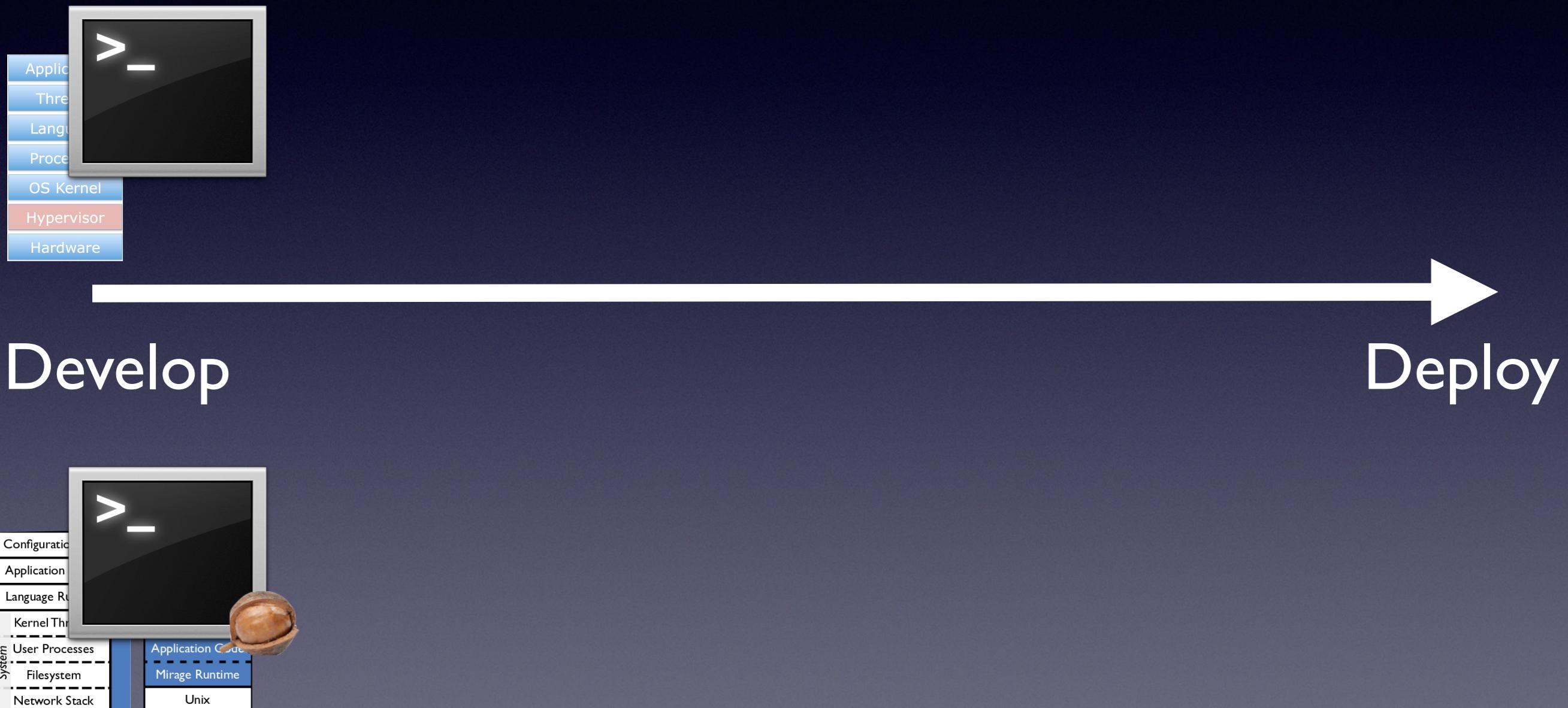
Xen



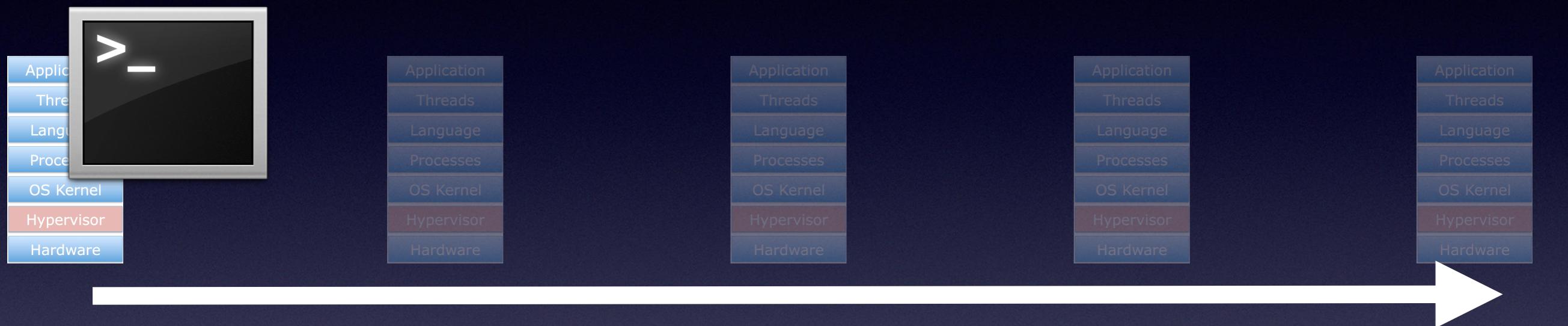
Familiar development cycle

Broad deployment scenarios

MirageOS

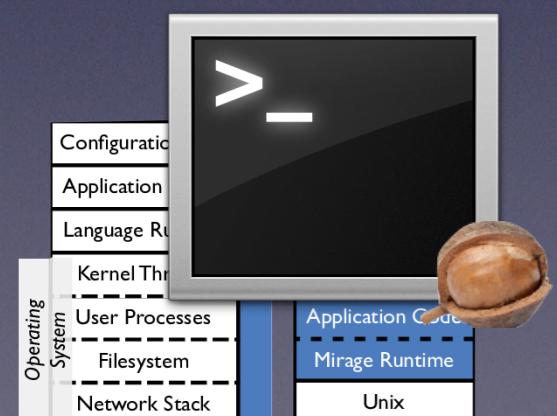


MirageOS



Develop

Deploy

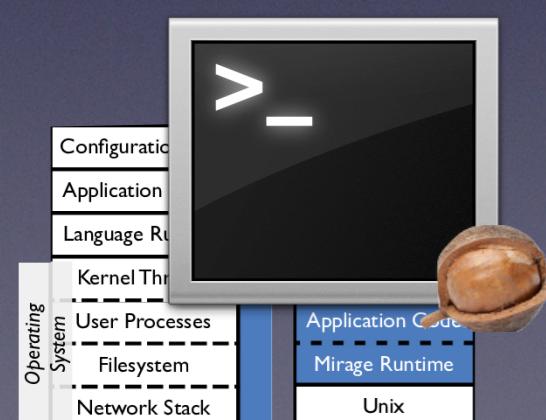


MirageOS



Develop

Deploy



MirageOS

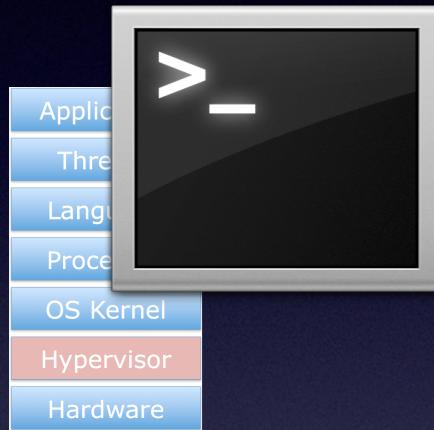


Develop

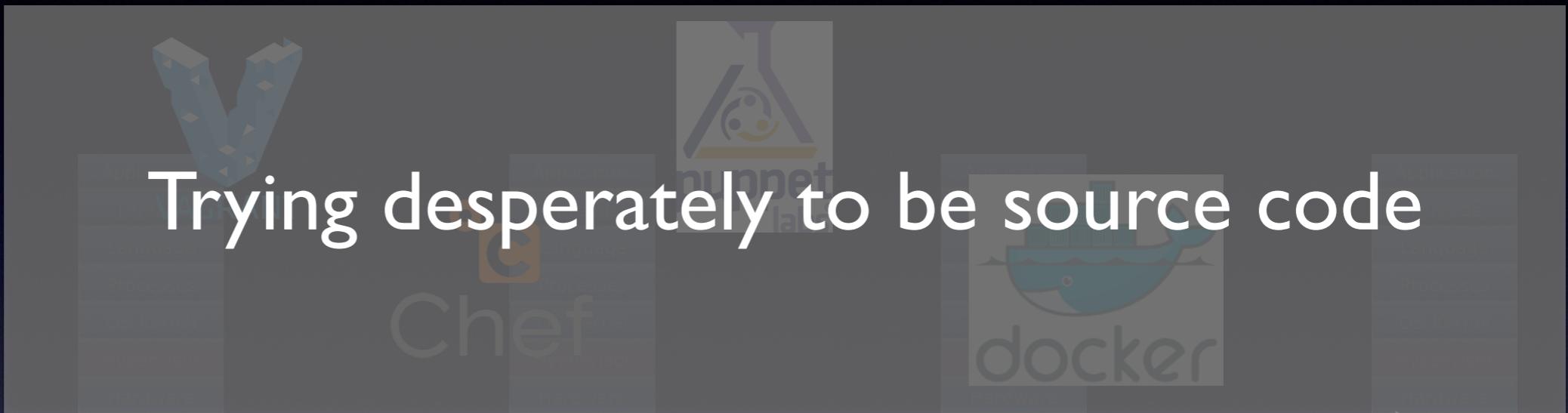
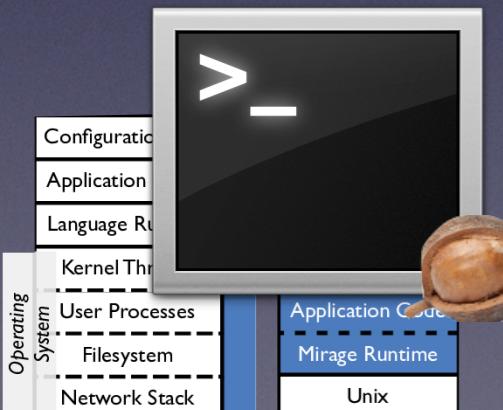
Deploy



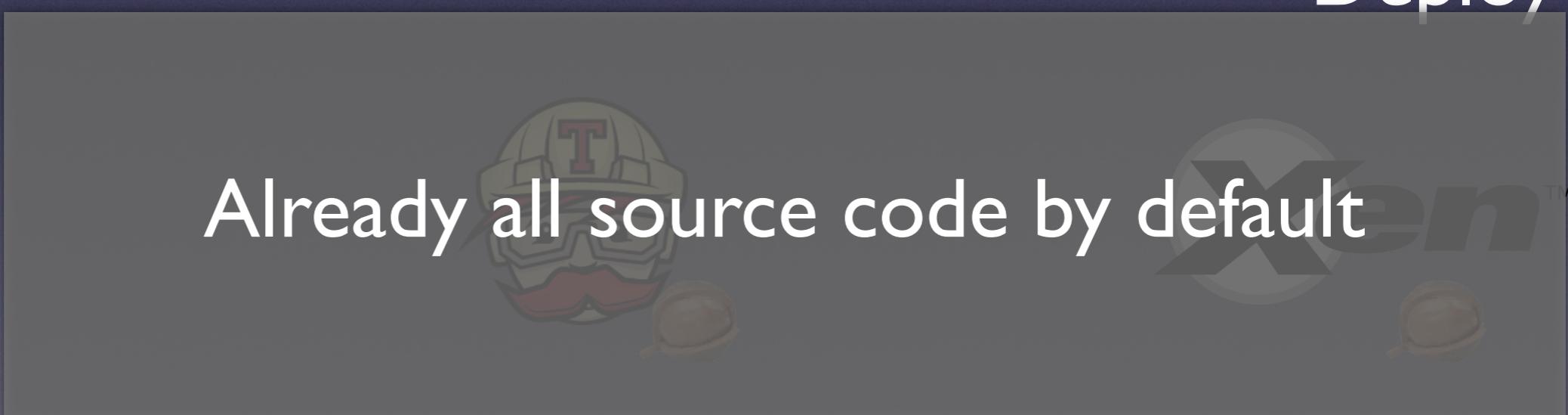
MirageOS



Develop

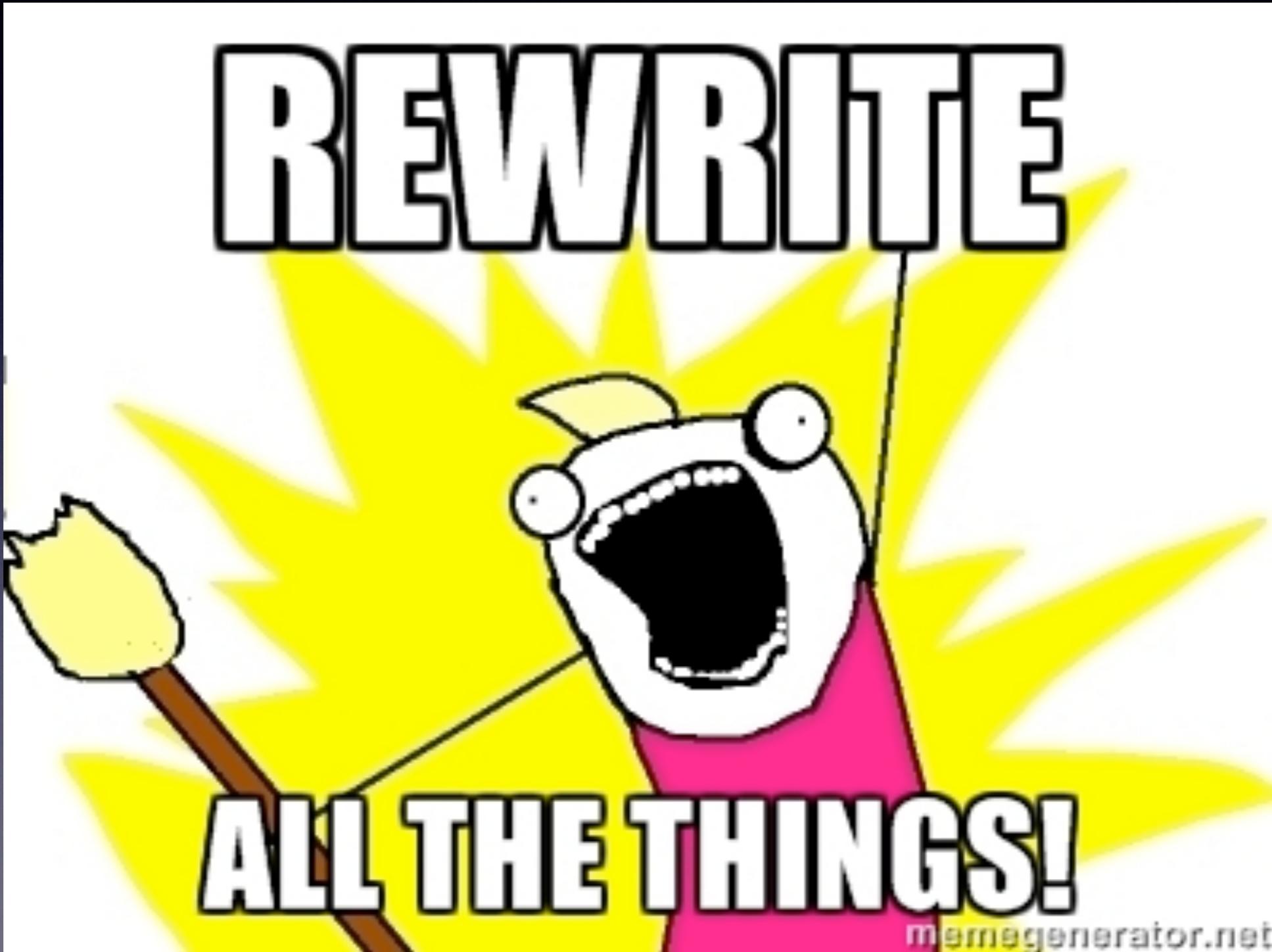


Deploy



MirageOS

Trade-offs!





MISO Toolstack

Irmin - Distributed Storage

- Distributed Database that never forgets
- Everything is version controlled
- Synchronisation for ‘free’



MISO Toolstack

Irmin - Distributed Storage



Analogy: Accounting ledger

Uses Branches for data.
Records all transactions.
Immensely Scalable.

Sync becomes easier

<https://www.youtube.com/watch?v=DSzvFwlVm5s>



MISO Toolstack

Signpost - Identity, Connectivity

- Stable names for devices (e.g phone.amirmc.io)
- Incorporates security and key management
- Mediates connectivity across devices



MISO Toolstack

Signpost - Identity, Connectivity

Why can't I have a personal cloud of devices?

- Lack of end-to-end connectivity
- No identity online
- Security infrastructure for lay-people

BACKGROUND: EDGE COMPLEXITY

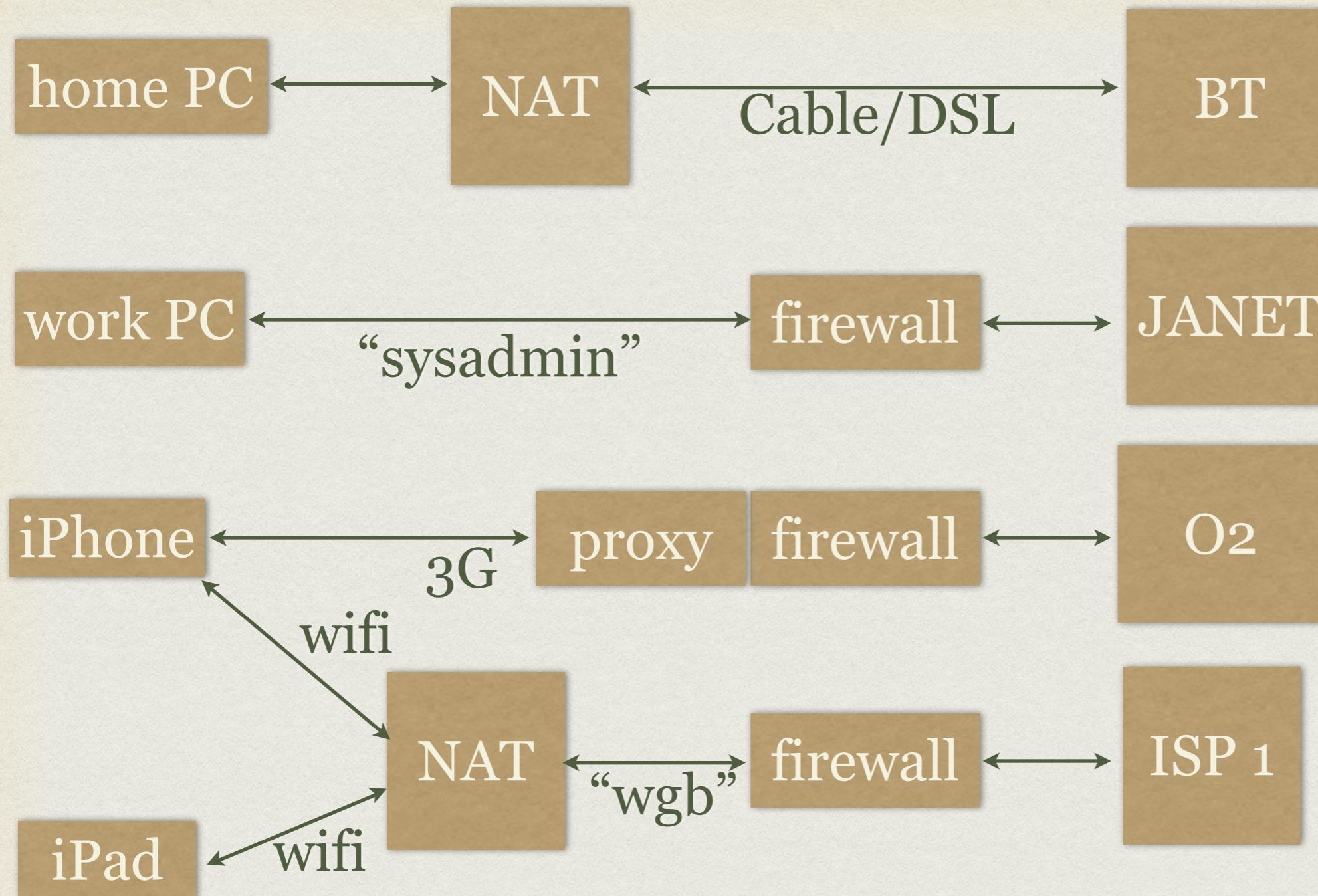
home PC

work PC

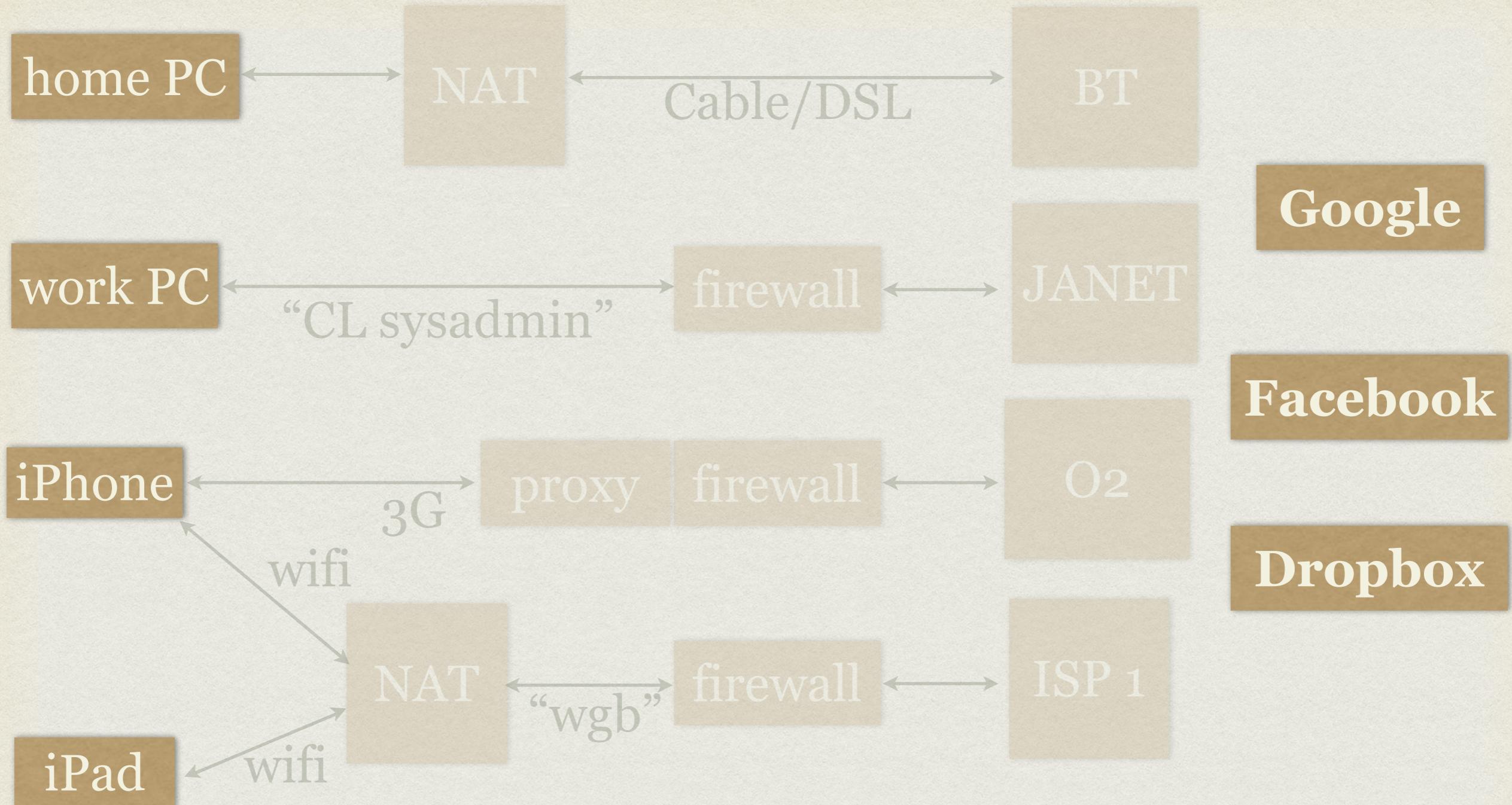
iPhone

iPad

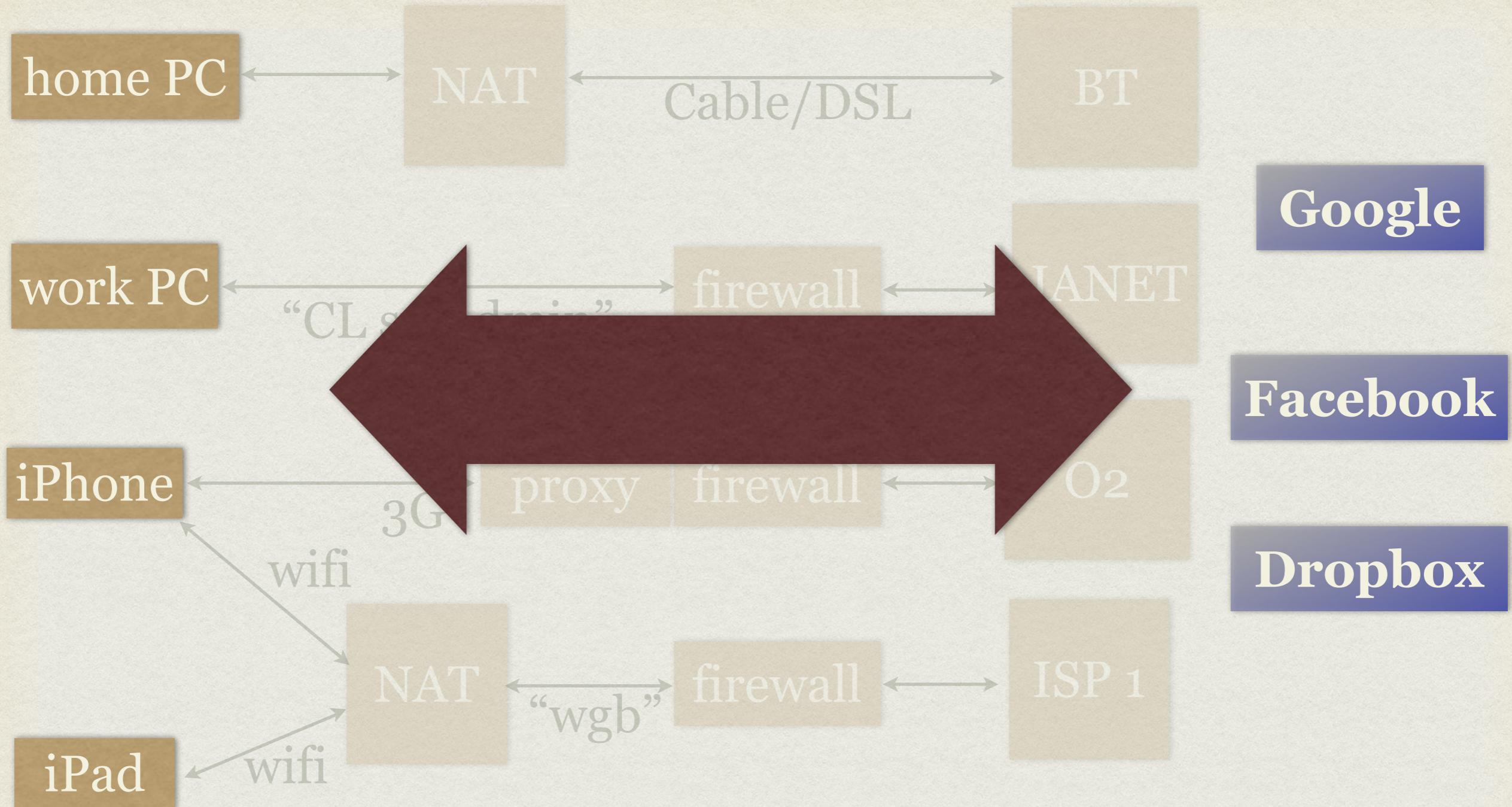
BACKGROUND: EDGE COMPLEXITY



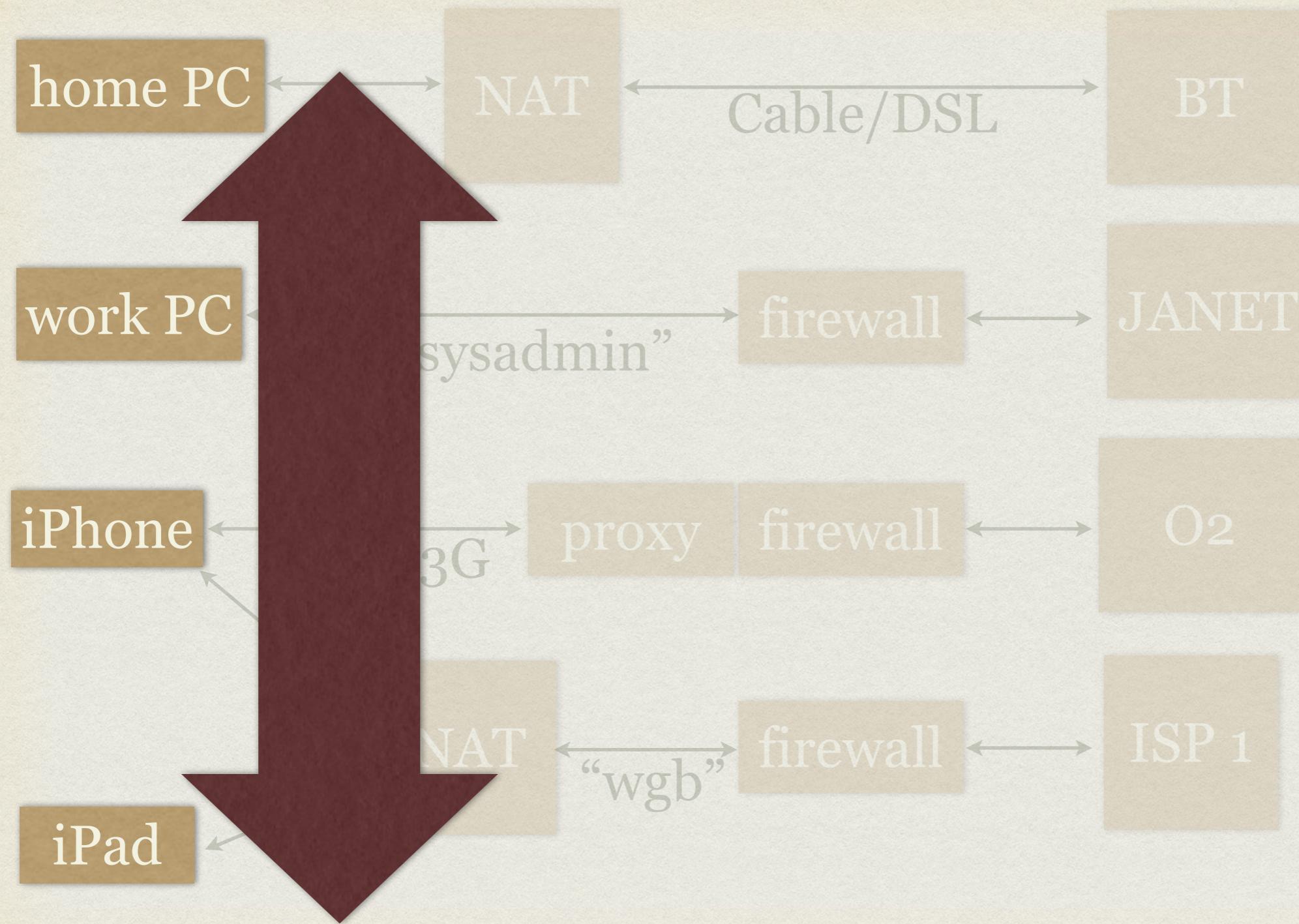
BACKGROUND: THE CLOUD



BACKGROUND: THE CLOUD



BACKGROUND: EDGE COMPLEXITY





MISO Toolstack

Signpost - Identity, Connectivity

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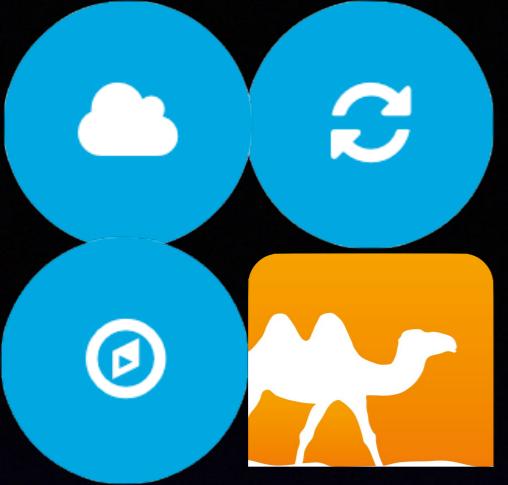
Answer to “How will devices find each other?”



MISO Toolstack

OCaml - Safety, Modularity

- 30 year heritage
- Strongly statically typed
compiler can surface problems
- Powerful module system
- Interoperability with legacy code



MISO Toolstack

Use cases

- Distributed Personal Clouds
- IoT and embedded devices



To enable the creation of resilient
decentralised systems that incorporate
privacy from the ground up so that users
retain control of their networks and data

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VIEW

4 COMMENTS



Emerging Technology From the arXiv
January 26, 2015

How a Box Could Solve the Personal Data Conundrum

Software known as a Databox could one day both safeguard your personal data and sell it, say computer scientists.

A personal cloud for your private data could become a reality thanks to Nymote

By CambridgeNews | Posted: February 24, 2015

By Matthew Gooding



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Data protection
The networker

Fightback against internet giants' stranglehold on personal data starts here
John Naughton

With the Databox concept, scientists at British universities have begun an attempt to win back control of information about us



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