

ANDREESSEN HOROWITZ

Mobile is replacing
the PC as the centre
of tech

Change is coming

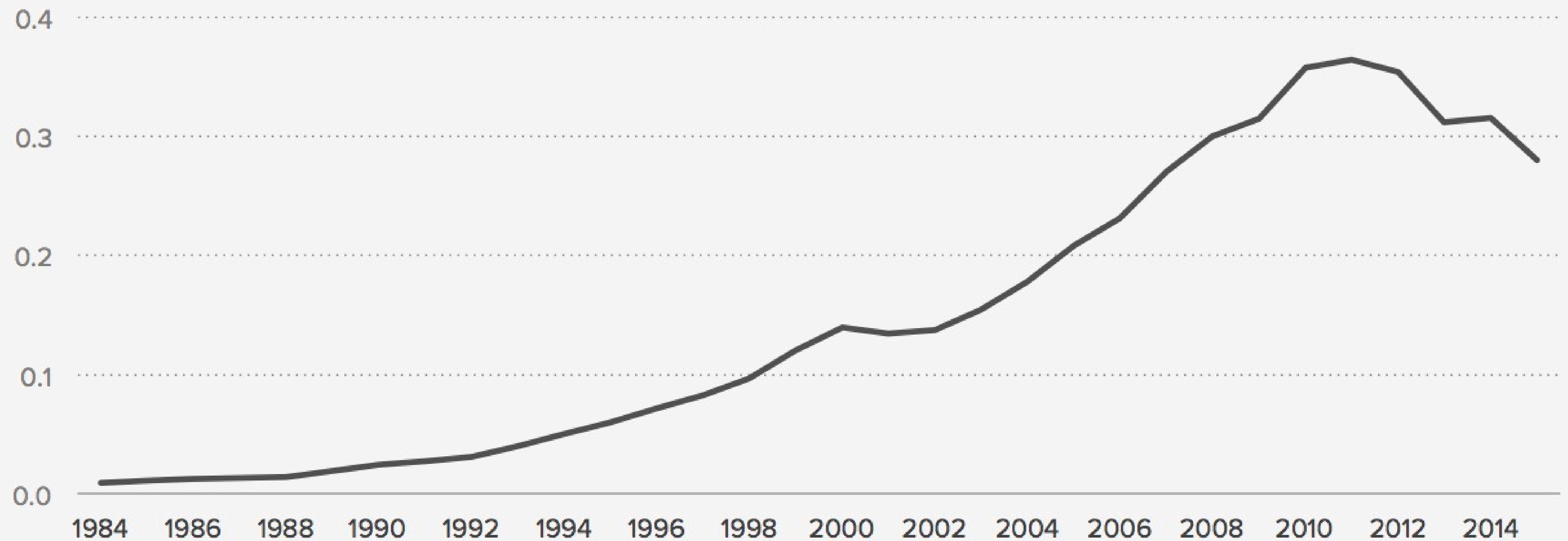
Computing in 1960: everyone in this picture is an Excel cell



Thirty years of the PC

From 8m to 300m units over the past 30 years

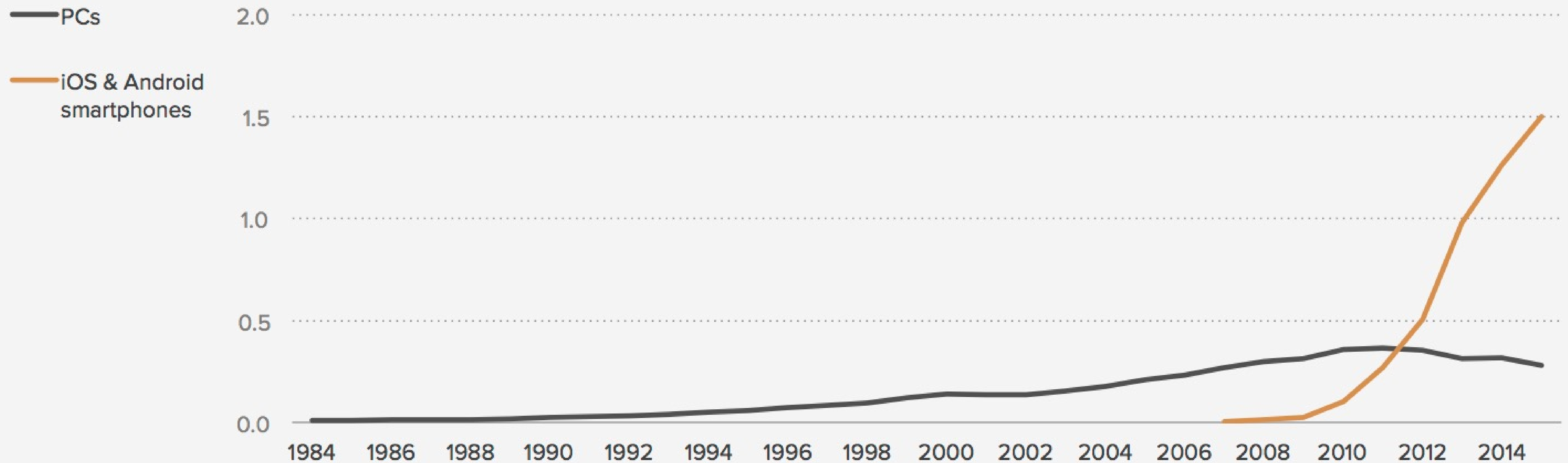
Annual unit sales (bn)



Overtaken by a new ecosystem

Fundamental shift in scale - from 300m+ PC units a year to 1.5bn smartphones and growing

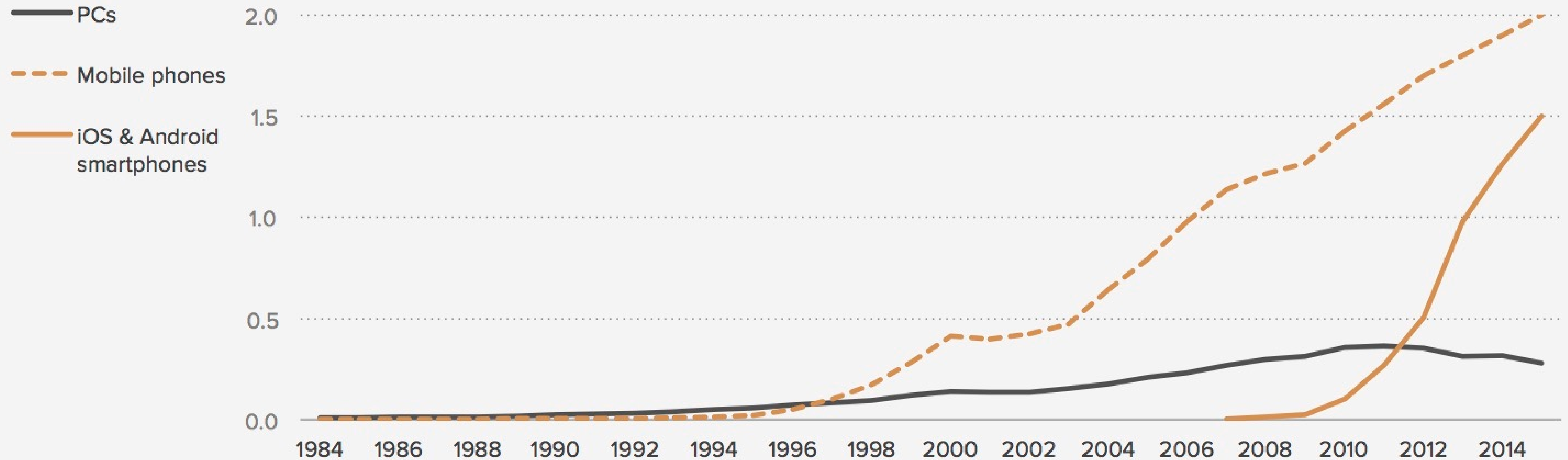
Annual unit sales (bn)



Mobile converts to computing

Mobile was always bigger than PC, but separate – smartphones broke down the wall

Annual unit sales (bn)

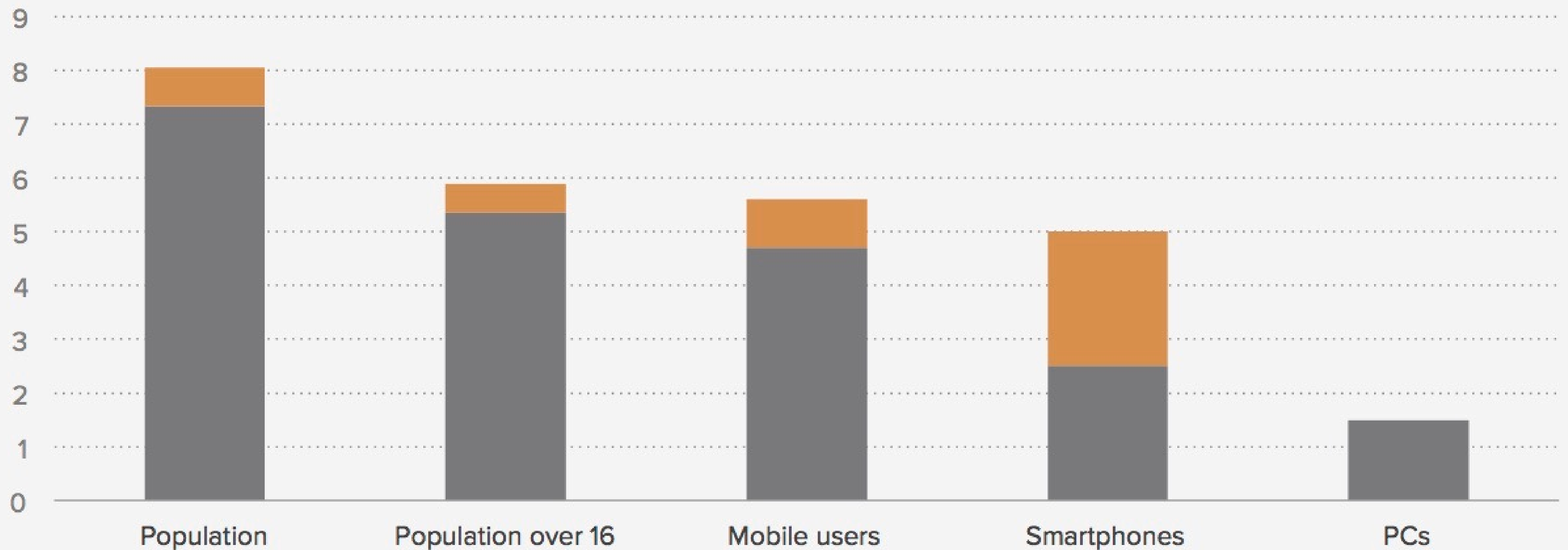


A near-universal product

By 2020 perhaps 5bn people on earth will have a smartphone

Global population (bn)

■ Growth to 2020
■ 2015



An iPhone 6 CPU has 625 times more transistors than a 1995 Pentium.

(The iPad Pro has 1000x.)

Everyone gets a pocket supercomputer.

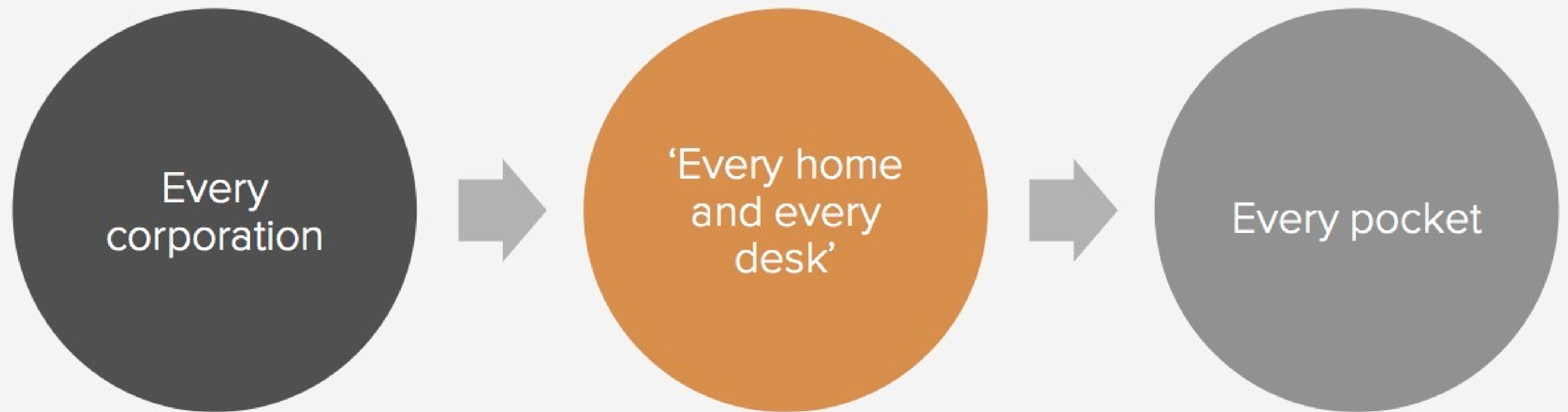
Yes, everyone

With Android now starting under \$50, mobile takes computing to people hardly touched by technology before (though data and power costs are still important issues)



The universal computer

From one computer on earth to a computer in every pocket



Mobile has 10x the scale of PCs

All the investment in tech is shifting from PCs to to the new, larger-scale ecosystem

5x install base

Mobile going to
5bn, PC falling to
1bn

10x unit sales

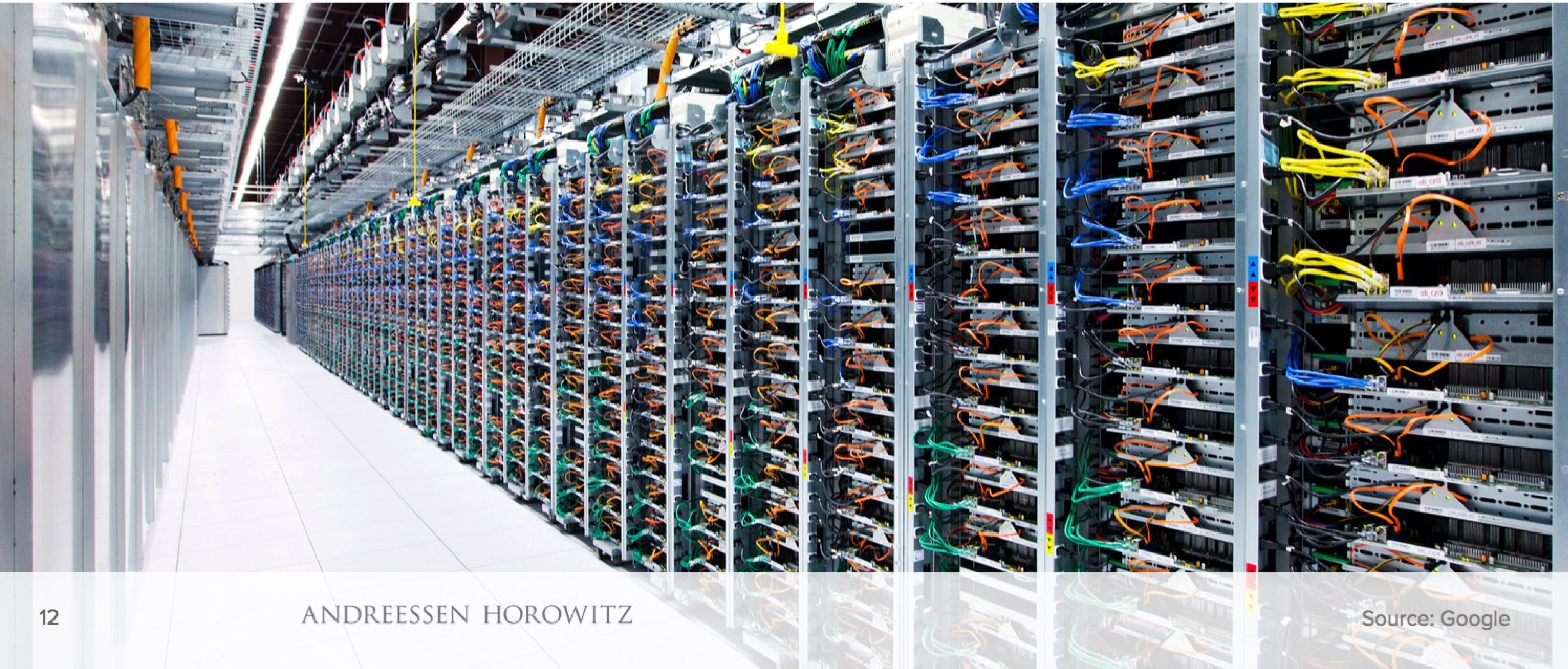
Mobile going to
2bn, PC falling to
200m

2-3x+ usage

Ubiquitous
and richer
computing

Scale drives ecosystems

These are all PCs, but they're not personal – they're the output from the PC ecosystem.
The Mobile ecosystem will play the same role.



‘Mobile’ is an ecosystem, not a screen size

The change isn’t screen size or keyboards – it’s the shift to a new ecosystem with 10x scale



Contract manufacturers plus a firehose of commodity smartphone components

Cambrian explosion of new products:
Tablets, IoT, satellites, wearables, connected cars, connected home, drones, VR etc.

Lego for tech: mobile lego replaces PC lego

A drone is a smartphone that flies

Most of the intelligent components of a drone come from the smartphone ecosystem

‘Smartphone war dividend’

‘Mobile’ components for different use cases



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Mobile is the new
internet

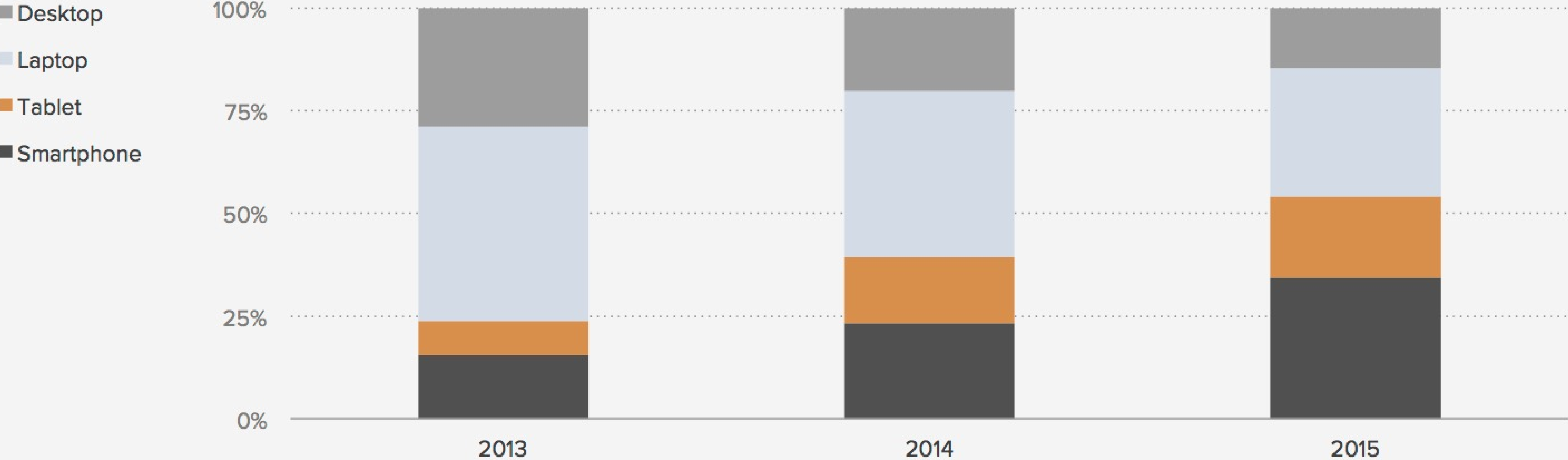
Mobile is not a sub-set of the Internet anymore.

Mobile becomes the Internet - the main way that most people go online.

Saying 'mobile internet' = saying 'color tv'.

Mobile becomes the default device

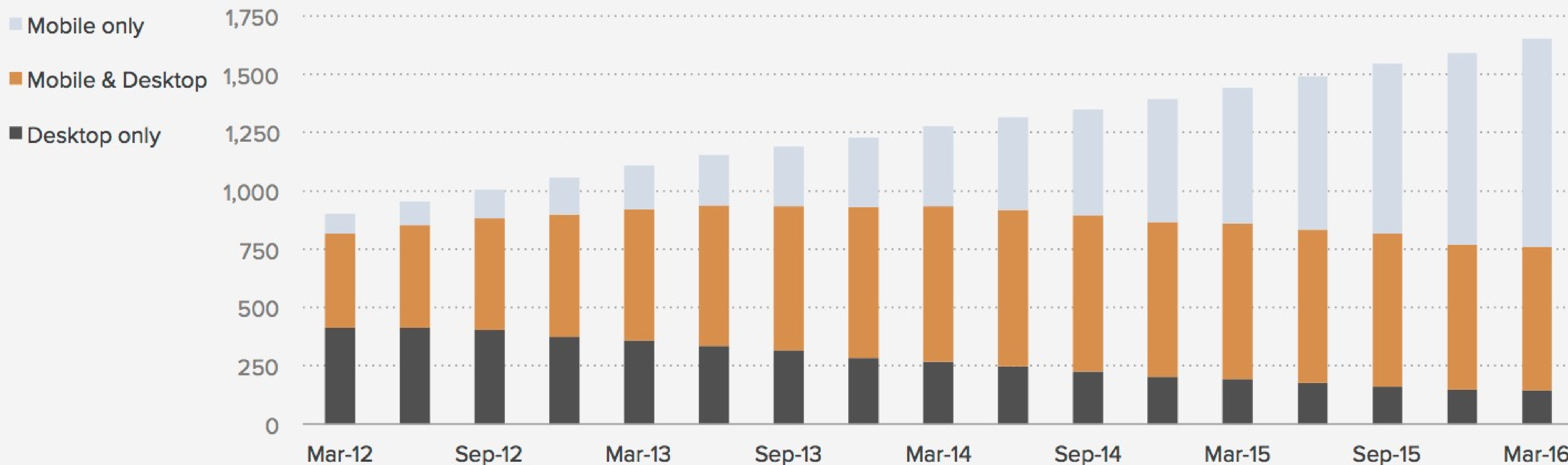
‘What’s your most important device for accessing the internet?’ (UK)



Half of Facebook's base is mobile-only

54% of Facebook's 1.7bn monthly active users only use it on mobile

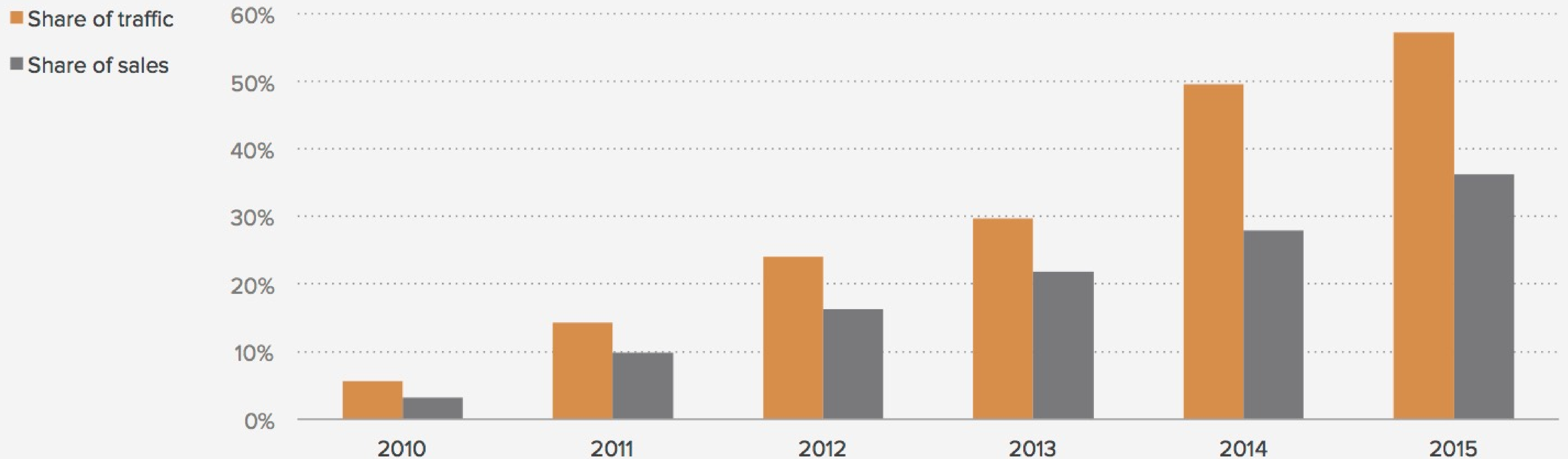
Facebook MAUs by platform (bn)



Ecommerce is shifting

Mobile can now be over half of ecommerce traffic and a third of revenue

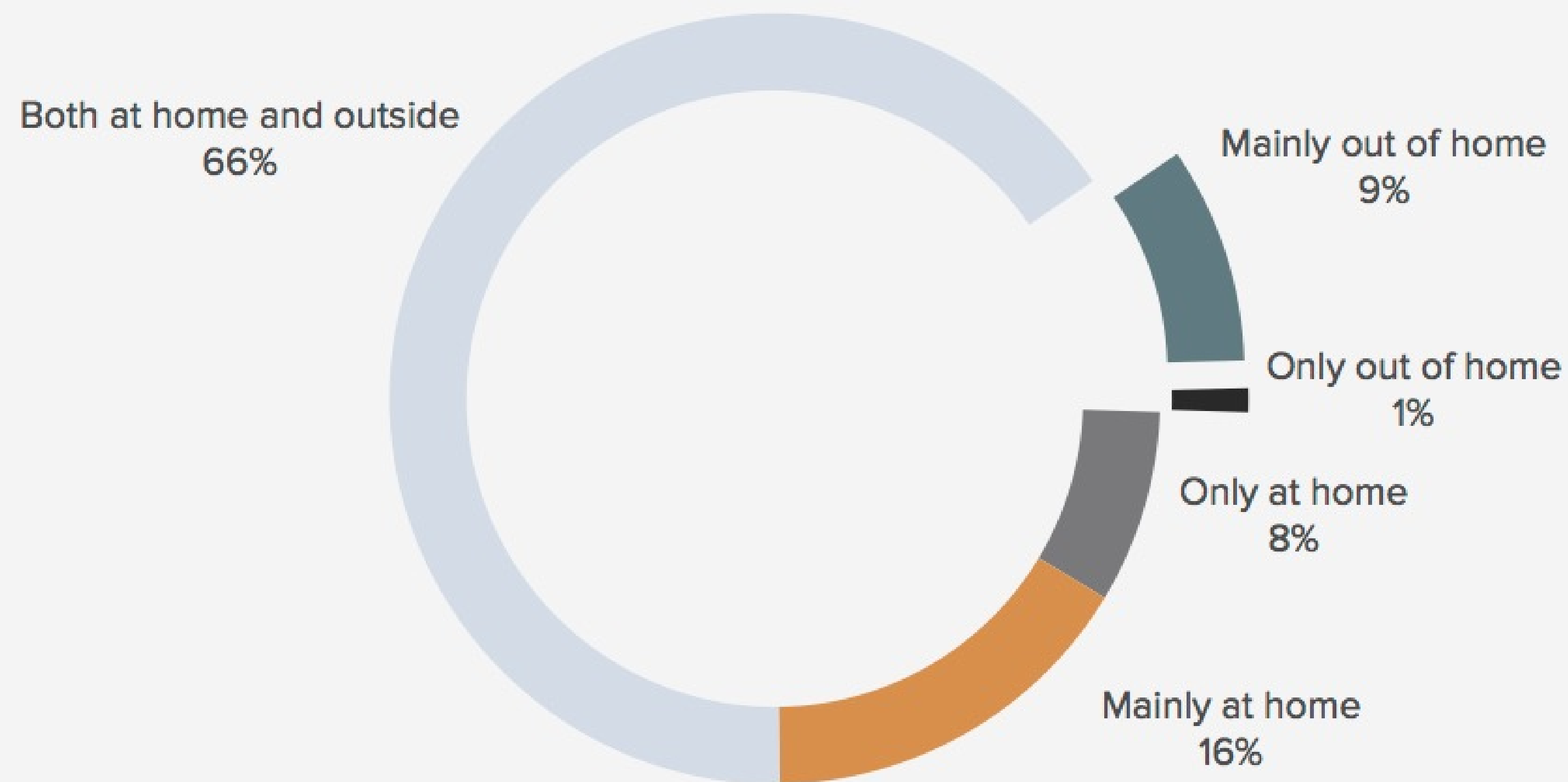
Mobile share of US 'Black Friday' ecommerce



Mobile doesn't mean 'mobile'

People don't use the internet on their phone when they're mobile – they use it everywhere.
40-50% of all smartphone traffic happens on wifi*

Where do you use the internet on your phone? (UK, 2014)



Mobile means richer, not limited

Smartphone are now more sophisticated internet platforms than the PC



Personal

Touch

Sensors

Cameras

Location

Payment

Social
integration

Security

And much
easier to
use...

For 20 years, PC internet mostly meant web browser + mouse + keyboard.

Search (and later Facebook) dominated.

Mobile blows all of that apart.

From stability to rapid, ongoing change.

Mobile is richer, but harder

Mobile breaks the PageRank
model for many services, and
hasn't yet been replaced.

Looking for new search and
discovery models.



[Get Local](#) [Weekly Picks](#)

[Search](#) [Options](#)

[Yellow Pages](#) - [People Search](#) - [City Maps](#) - [Stock Quotes](#) - [Sports Scores](#)

- [Arts and Humanities](#) - [Architecture](#), [Photography](#), [Literature](#)...
- [Business and Economy \[Xtra!\]](#) - [Companies](#), [Investments](#), [Classifieds](#)...
- [Computers and Internet \[Xtra!\]](#) - [Internet](#), [WWW](#), [Software](#), [Multimedia](#)...
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[Yahooligans!](#) - [Yahoo! Shop](#) - [Yahoo! Internet Life](#)

[Daily Picks](#) - [Random Yahoo! Link](#) - [Weekly Picks](#)

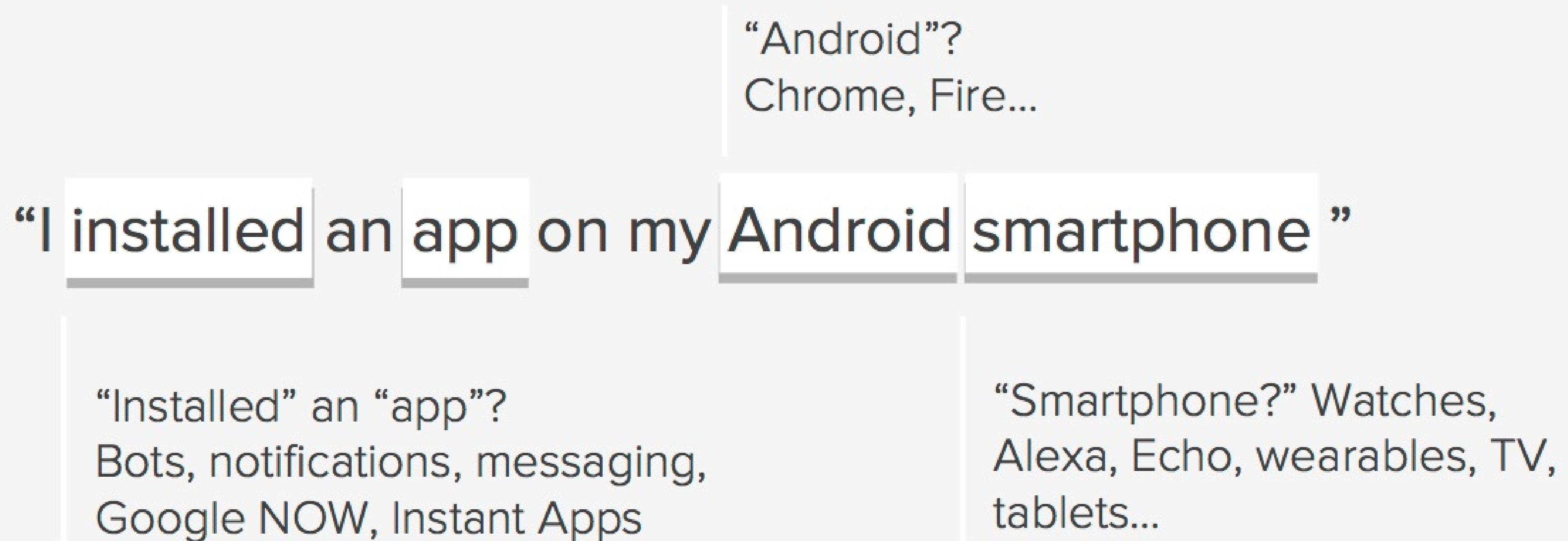
National Yahoos - [Canada](#) - [France](#) - [Germany](#) - [Japan](#) - [U.K. and Ireland](#)

Yahoo! Metros - [Chicago](#) - [Los Angeles](#) - [New York](#) - [San Francisco Bay Area](#)

[How to Include Your Site](#) - [Company Information](#) - [Community Outreach Calendar](#)

Rapid change

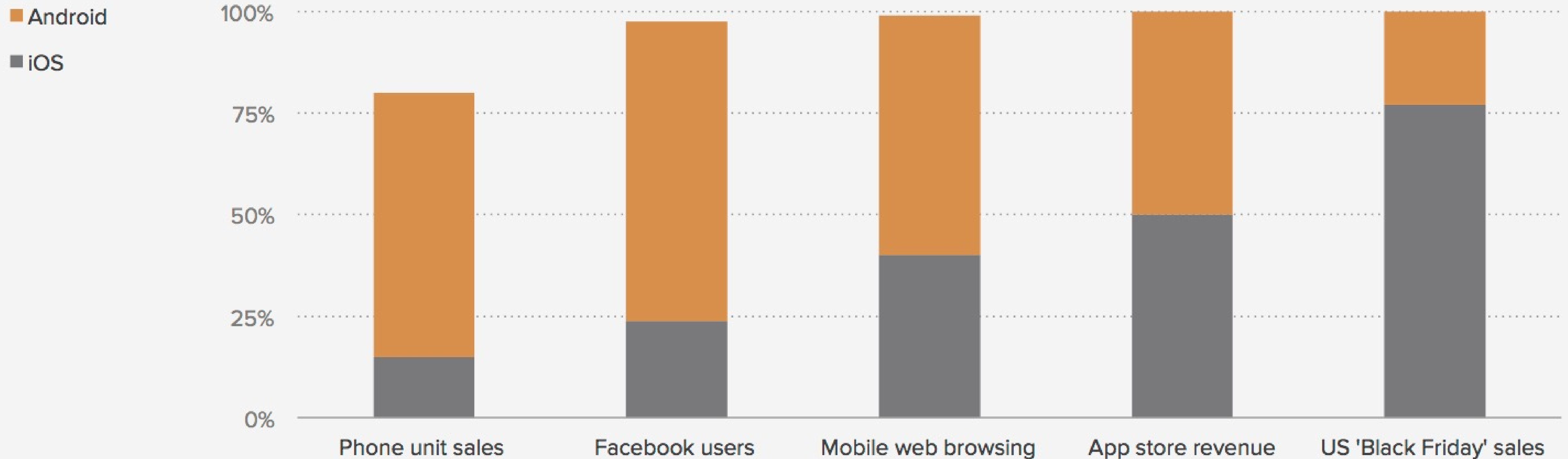
If I say ‘I installed an app on my Android smartphone’, what will that mean in 5 years’ time?



OS competition drives continuous change

Apple and Google both won the mobile OS wars, in different ways
Both keep innovating

Global mobile market share, Q4 2015



A smartphone OS is an Internet platform

Smartphones are internet platforms. On PC you built for web: on mobile you build for the OS.

Interaction moves down the stack from apps and the browser into the OS itself.

And Apple and Google keep changing things for everyone.

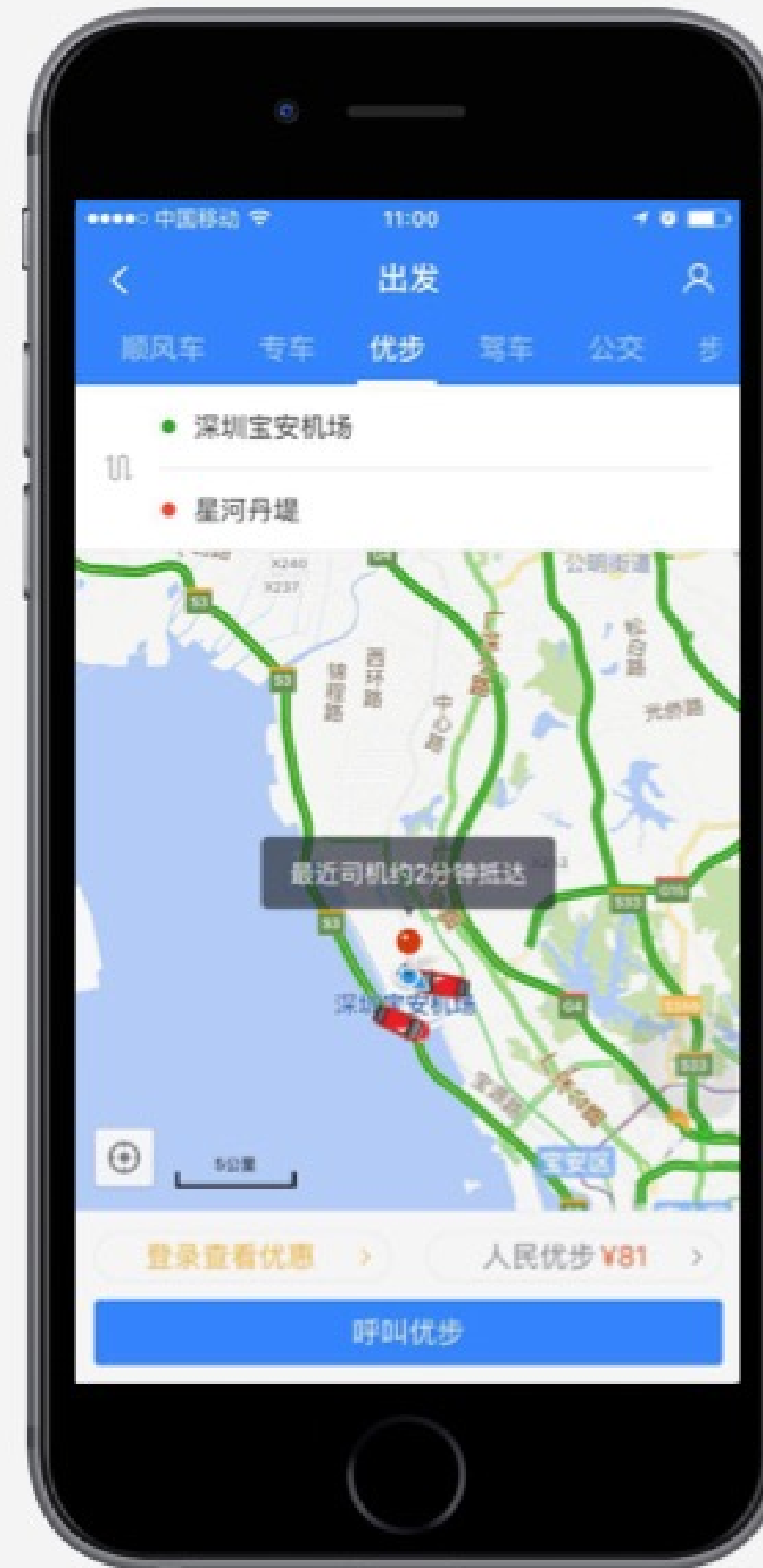


And more platforms from maps and social

New discovery, engagement and user acquisition models.

Moving up the stack.

Baidu Maps (screenshots) and WeChat have achieved this in China – Facebook and others trying to follow.



Car services



Hotels



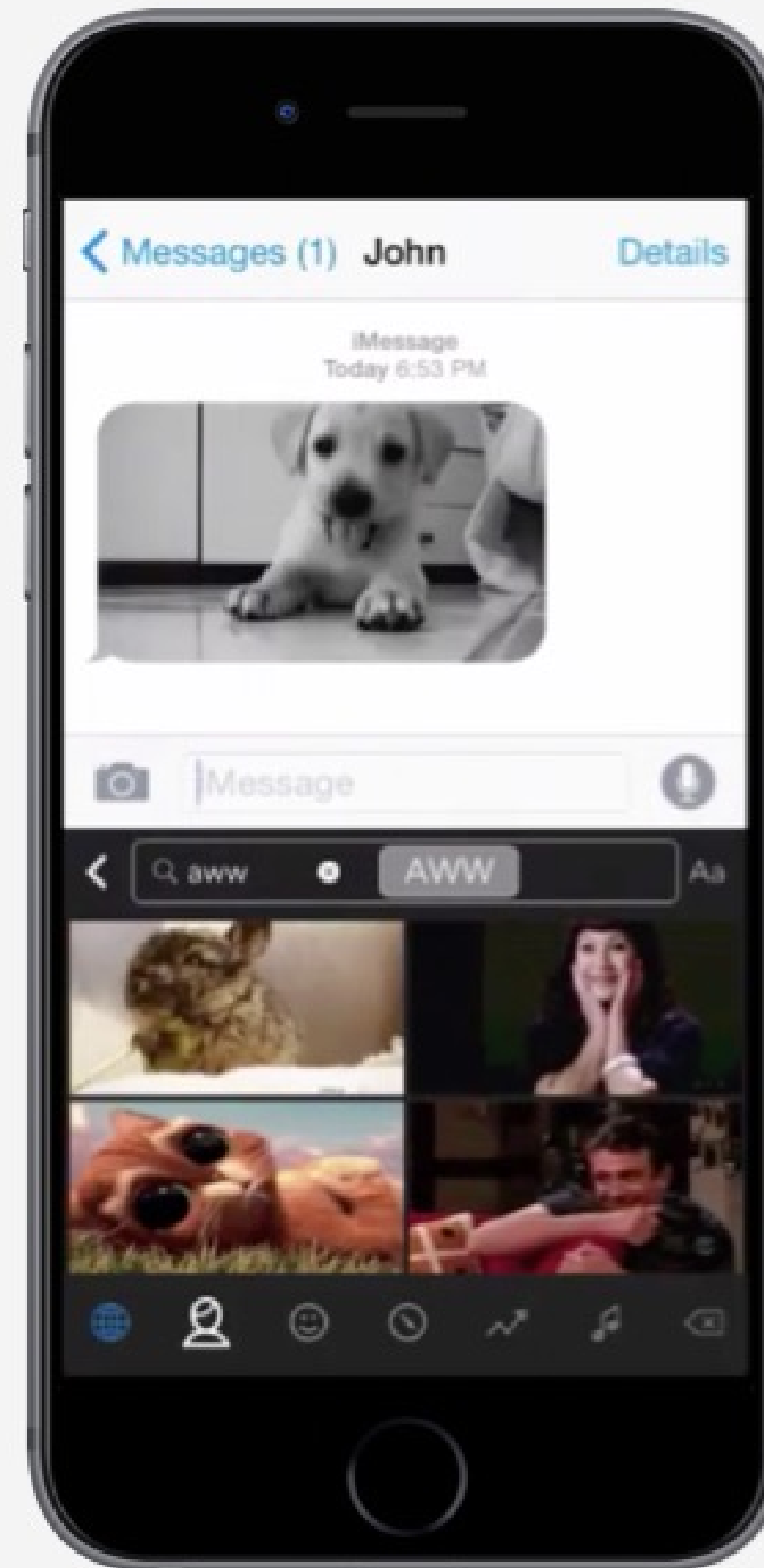
Local services

More platform experiments, more layers

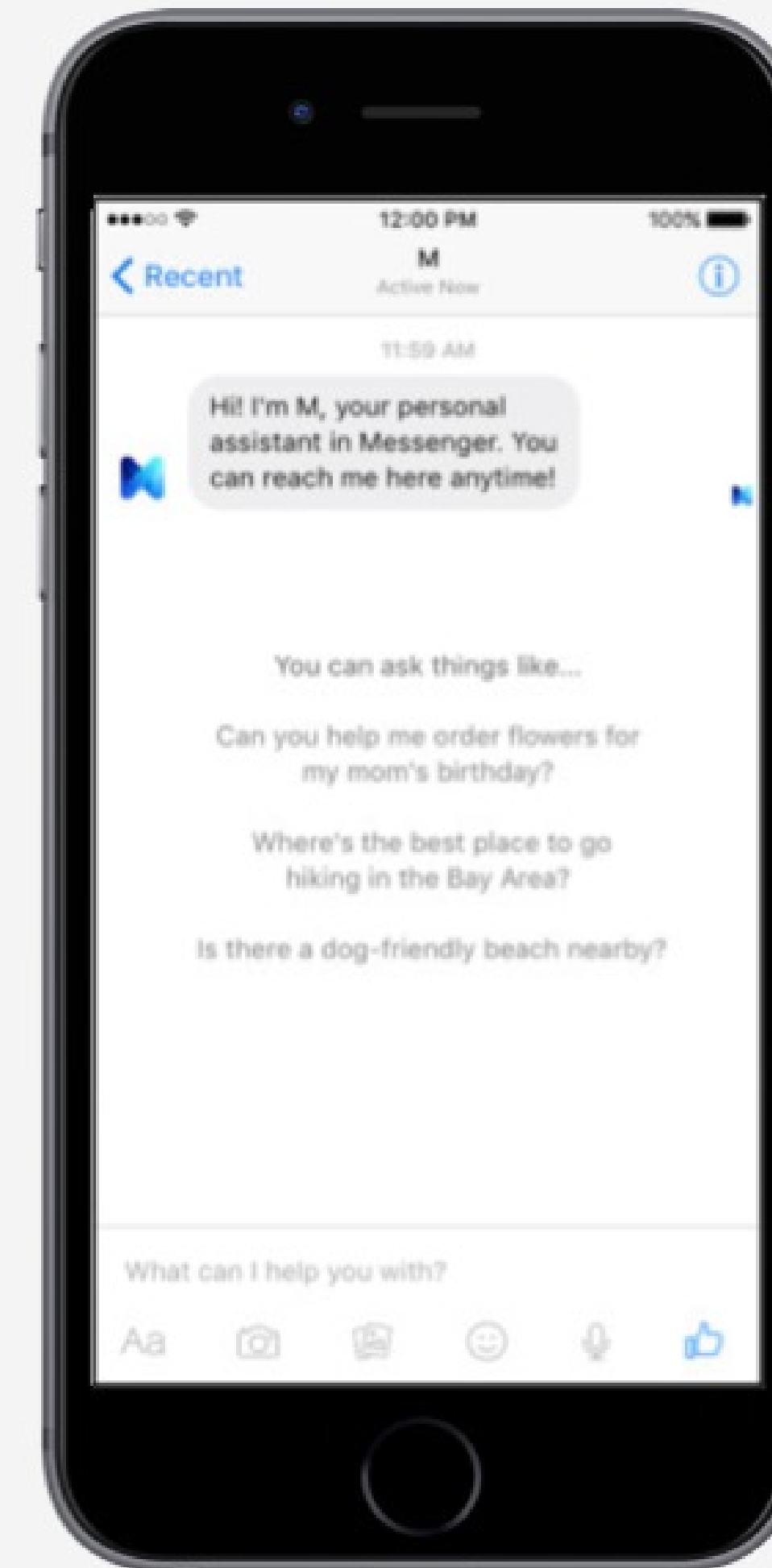
Huge scale opportunities and low entry costs mean endless experiments.

New interaction, content and interaction models all the time.

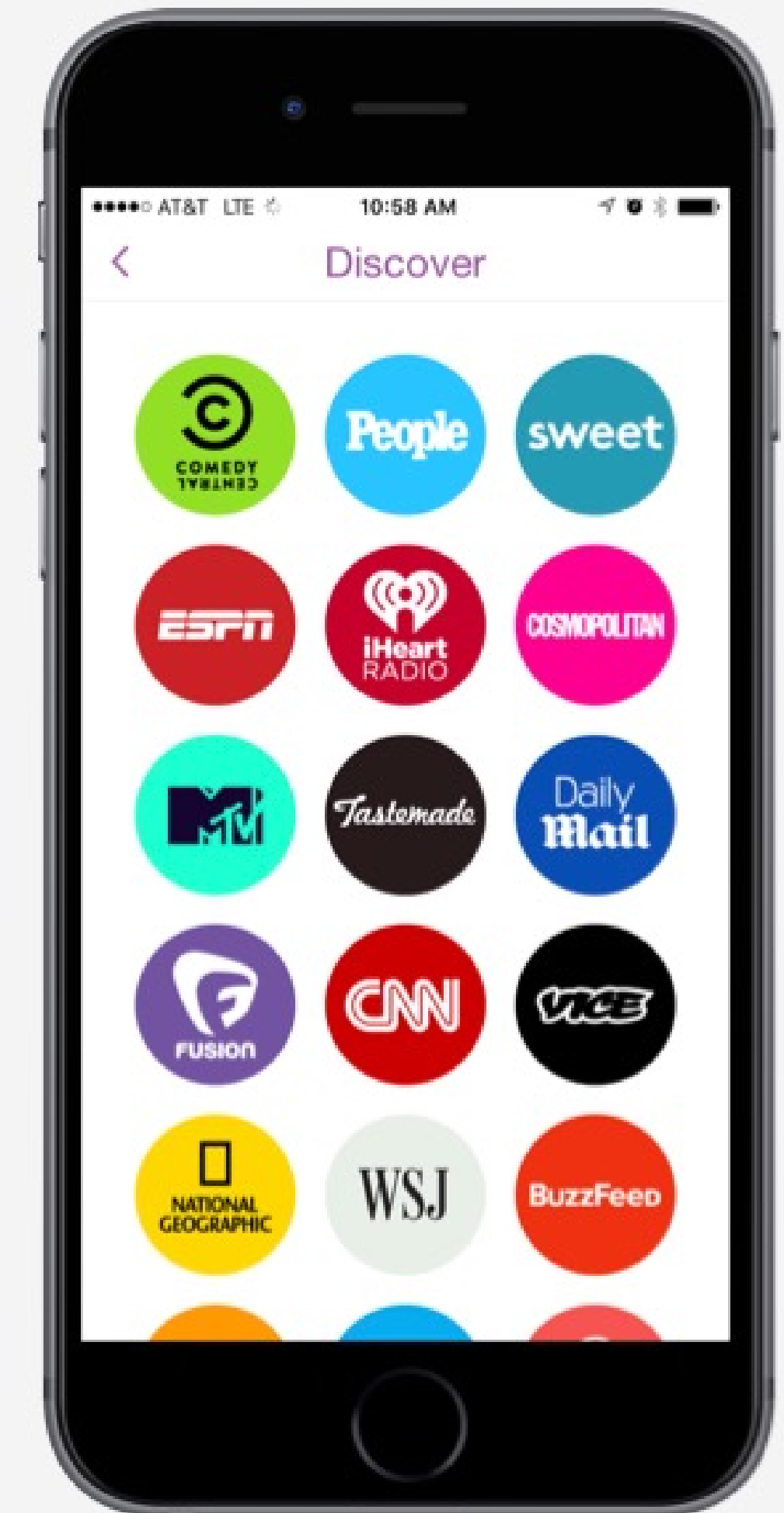
How to get usage, and who to send (or sell) it to?



Keyboards



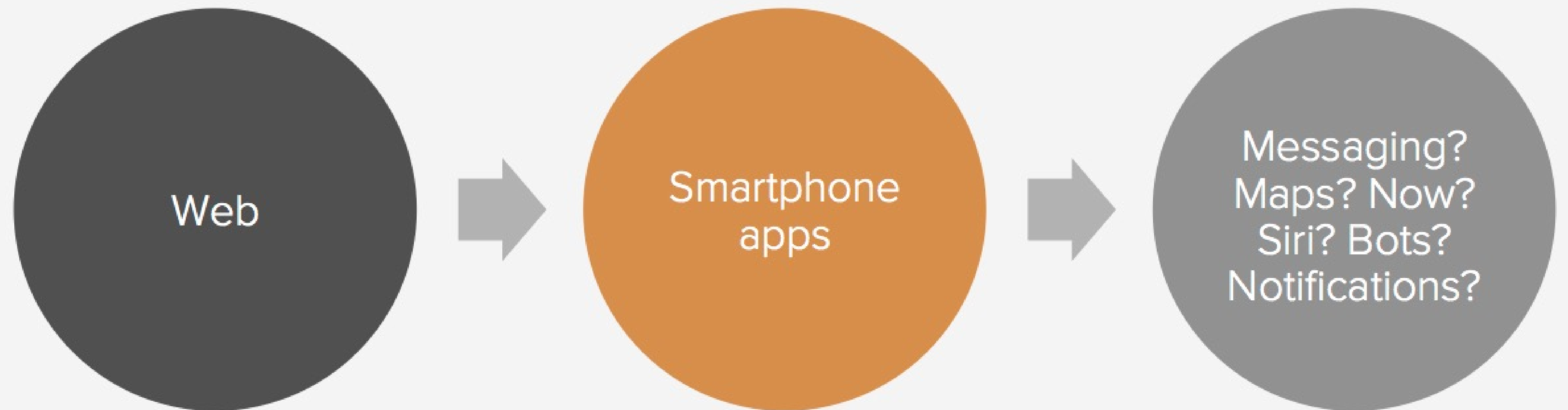
'AI' chat bots



SnapChat

Looking for a 3rd run-time, with acquisition

We unbundled the web into apps – now we try to unbundle or rebundle again, creating new ways to provide services, generally focused on new ways to acquire users

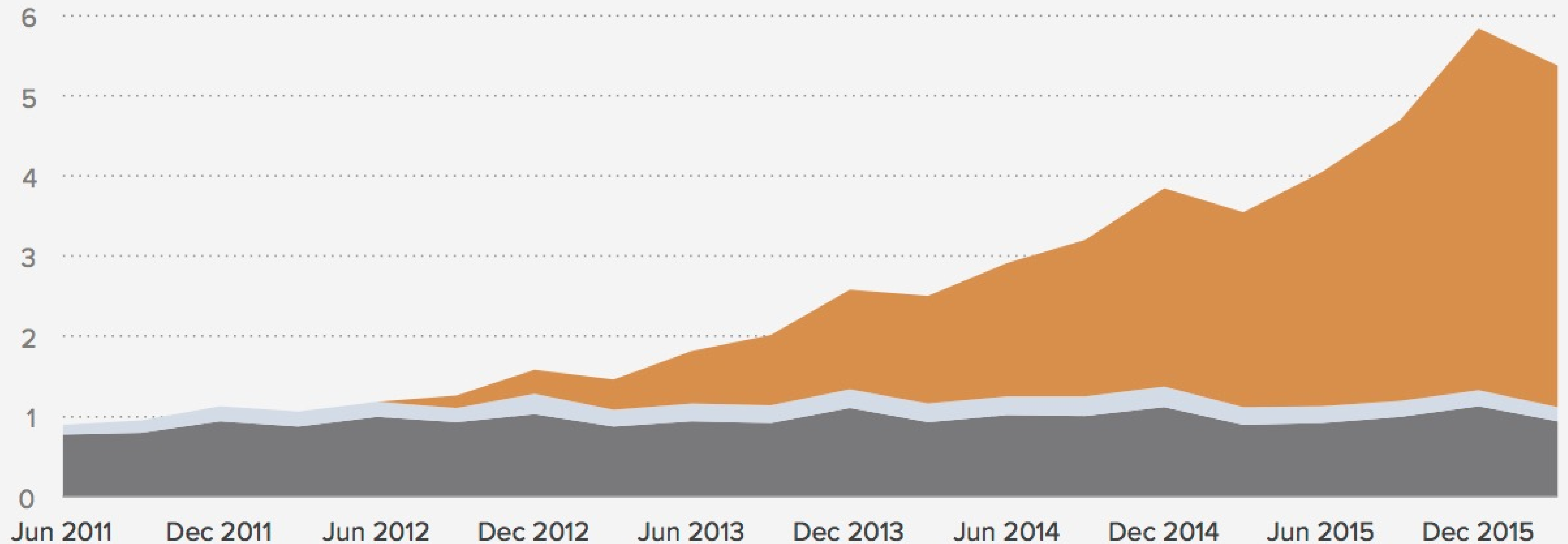


Interim solution: give Facebook \$15bn

How do you get traffic or get your app installed? Well...

Facebook revenue by source (\$bn)

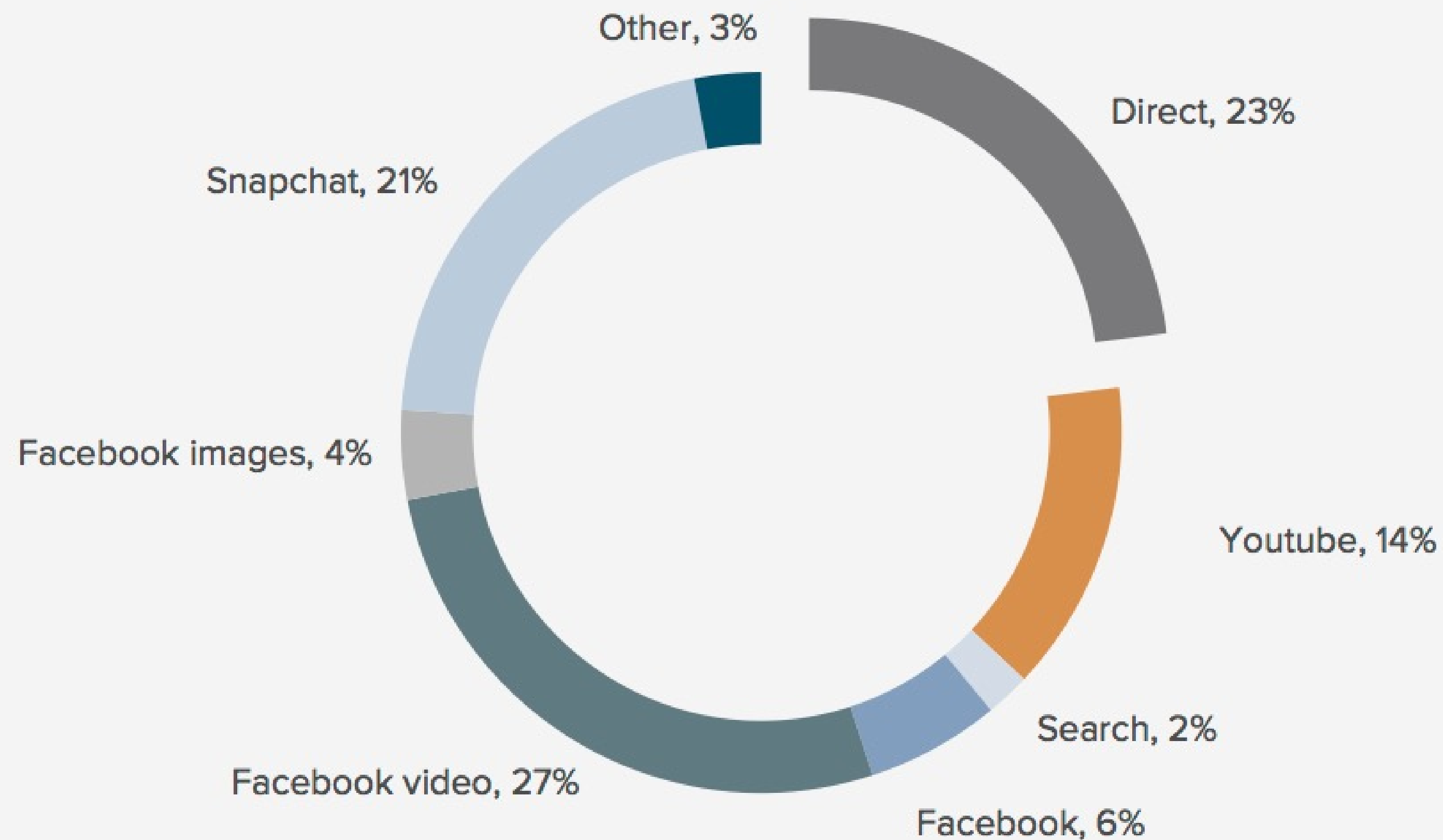
- Mobile ads
- Payments & Other
- Desktop ads



New models for both content and distribution

Each platform is both a different content model and a different acquisition model
'Video is the new HTML'

Buzzfeed content views by platform, Q3 2015



Mobile's multiplier effect

More devices, used more, in more places, in more ways

4-5x more
smartphones
than PCs

×

Used everywhere
Used much more
Used in more
sophisticated ways

=

Bigger
opportunities
(and bigger
challenges)

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Next — VR and AR

“You can divide the world into people think VR is part of the future and people who haven’t had the demo”

Better, faster, cheaper...

The VR experience will get good, fast and cheap – but it'll take a while



Professional capture and workflow

Capture + workflow + post-production all being created now



Consumer 3D/VR capture on smartphones

Multi-sensor array cameras are on 2016-2017 roadmaps for high-end smartphones.

Low-light, DSLR-style depth of field.

... and 3D image capture.



What do you watch? New storytelling

VR is not a new version of 3D – it's a whole new form

New grammar

'Pre-Eisenstein': movies started by filming plays, but then we moved the camera

How do you frame a shot? Zoom? Pan? Cut? Shift focus? Direct the attention?

New storytelling

How do you tell a story when the audience can look around?

Is this for 'games' people or 'movie' people? Or both?

“No-one will wear that on their face”

“No-one will wear that on their face”

“No-one will stare at a glowing box in the corner of the room”

“No-one will make a call in the street”

Can we make the content (and device) that makes this a product with wide appeal?

Fall back / pessimist case – VR is the new games console – huge, but not universal

And then, augmented reality

2018-2020 onwards?



Hyper-reality – really, an AI challenge

If you can show anything, what should you show?



“We will move from mobile-first to AI-first”

Sundar Pichai, Google, 2016

“In from three to eight years we will have a machine with the general intelligence of an average human being.”

Marvin Minsky, 1970*

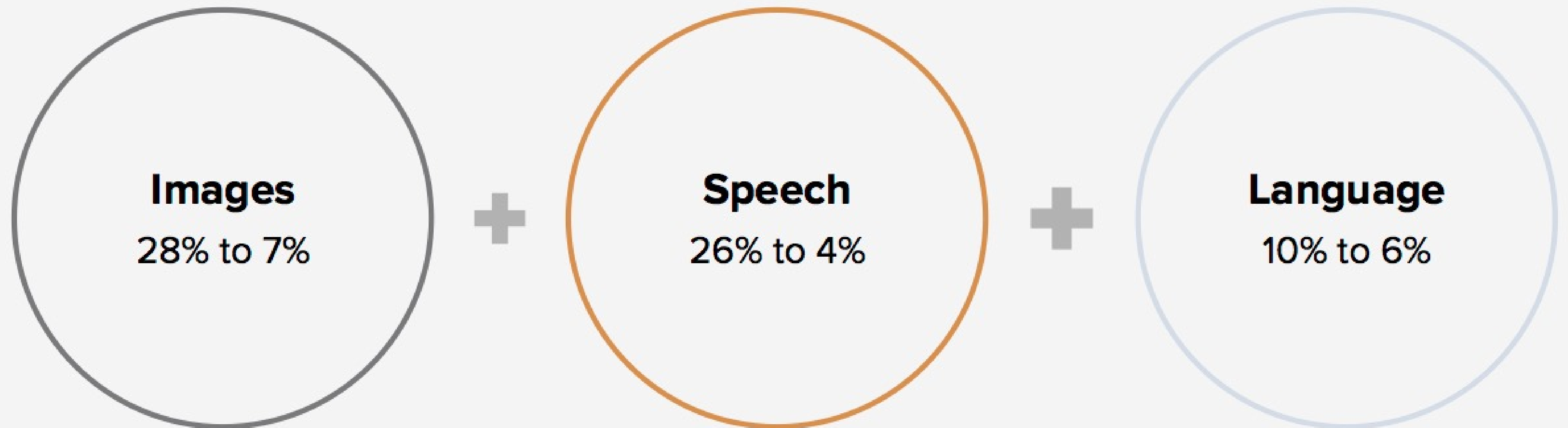
What changed? AI started working

Power, data and new techniques



Some apps now close to human accuracy

In the last few years some error rates have dropped to similar levels to humans



“Is there a dog in this picture?”

Humans tend to have an error rate around 5% for this test

Image recognition is at 7%

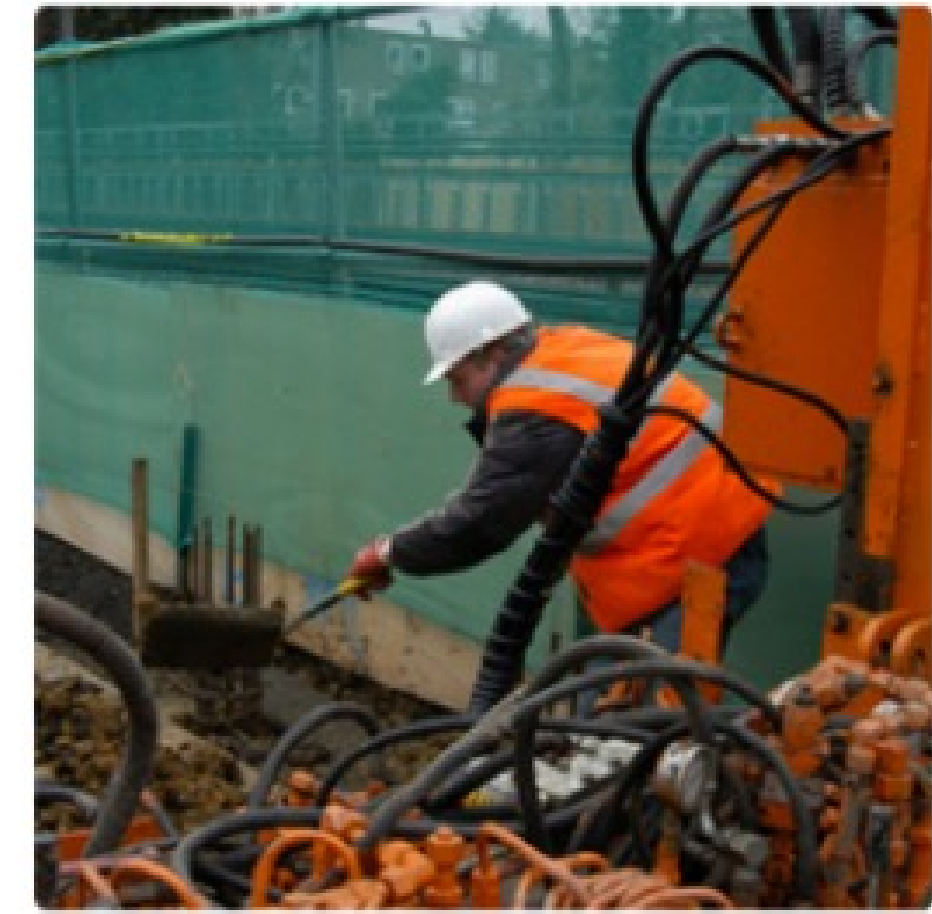


“What is in this picture?”

Automatically generate image descriptions



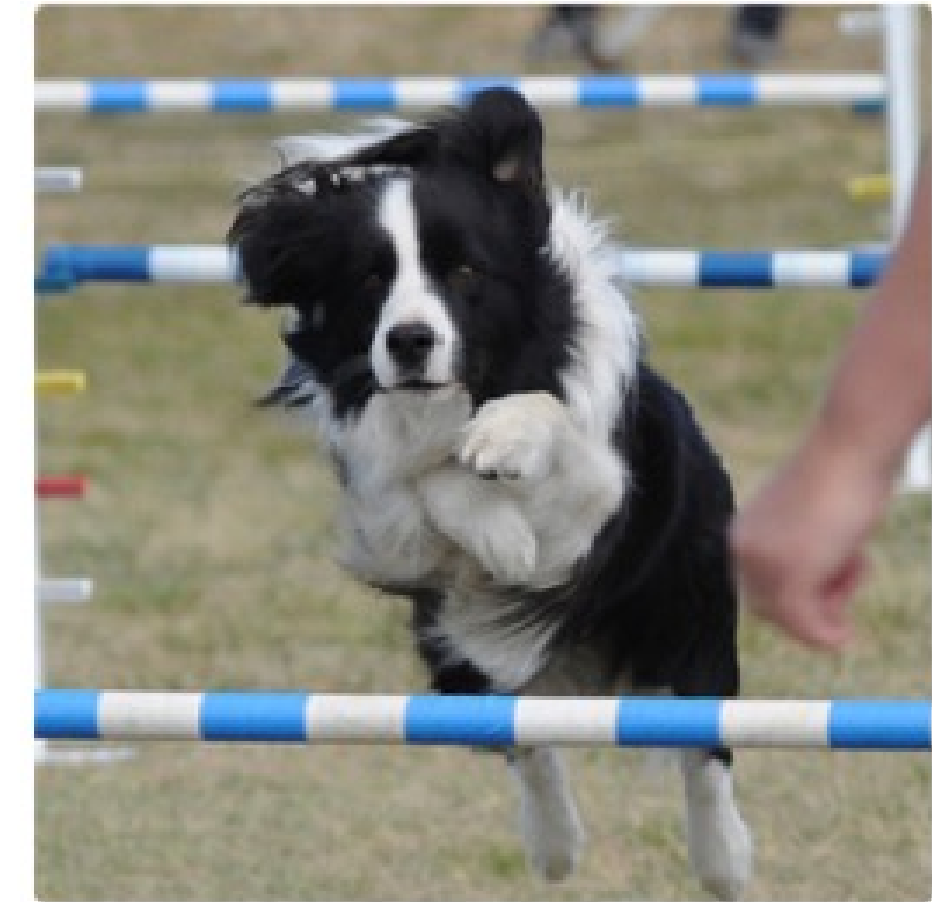
"man in black shirt is playing guitar."



"construction worker in orange safety vest is working on road."



"girl in pink dress is jumping in air."



"black and white dog jumps over bar."

“What food is in this picture?”

(Note the parsley)

Model: food-items-v0.1



Tags

sauce

pasta

basil

penne

meat

What's actually working: machine learning.

Analyse a data set and find the pattern.

A thousand images labeled 'dog' and a thousand labeled 'no dog' – autogenerate a mathematical model that fits the data.

Drop new data onto that model for answers.

“It’s all just maths”

A simple example: data set for training handwriting recognition



Image or speech recognition are just use cases – learning is the point

“Is there a dog in this picture?”

“Is that car letting me merge?”

“Which customers are about to churn?”

Google using AlphaGo to get 15% energy savings in data centres

Note: this isn't HAL 9000

ML works when you have the right
training data – preferable lots of it

One model per data set – not
general purpose

Still changing very fast

We haven't built common sense
(and we don't know what it is)



‘Every time we figure out a piece of AI, it stops being magical. We say, 'Oh, that's just a computation.’ - Rodney Brooks

“AI is whatever isn’t working yet”

Software is eating the world

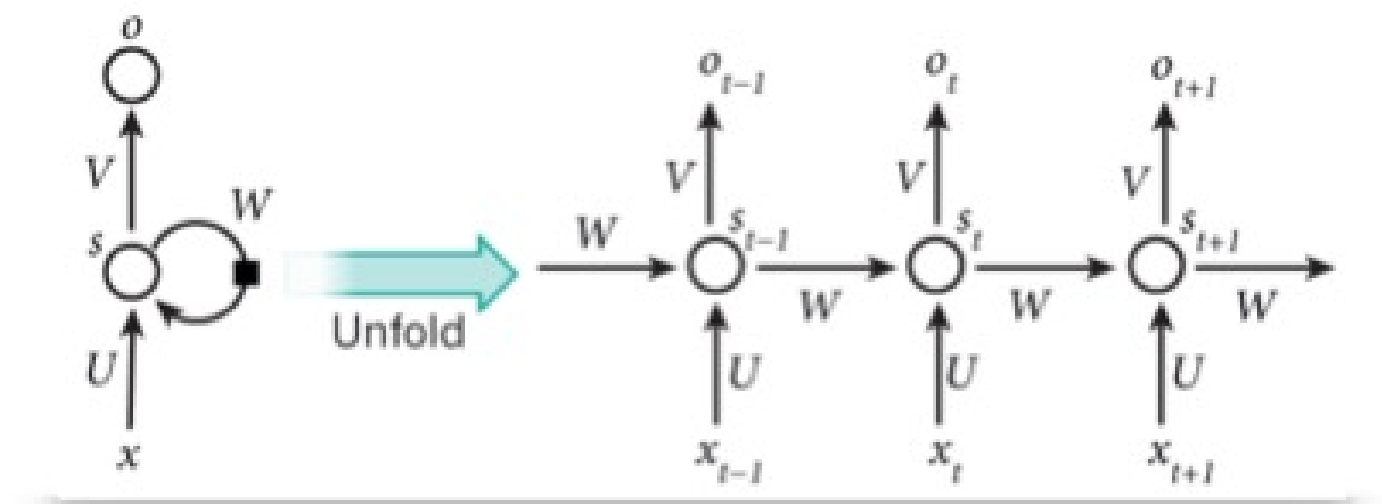
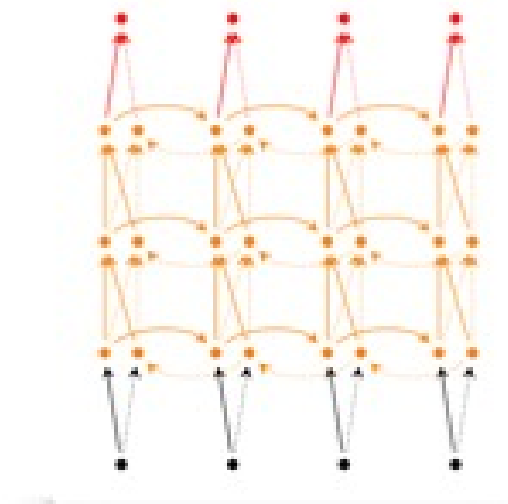
Mobile supply chain will power many of the sensors and the applications

Artificial intelligence lights everything up

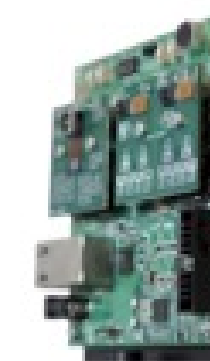
Applications



Deep learning



Sensors



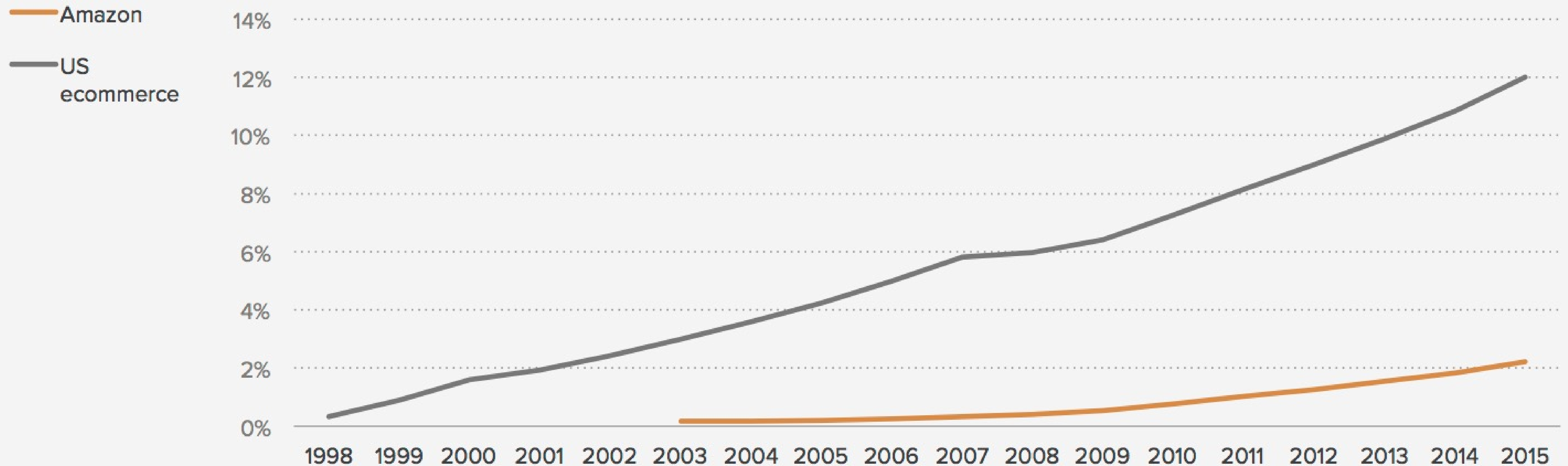
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Software is eating
the world

Ecommerce is only 12% of the way there

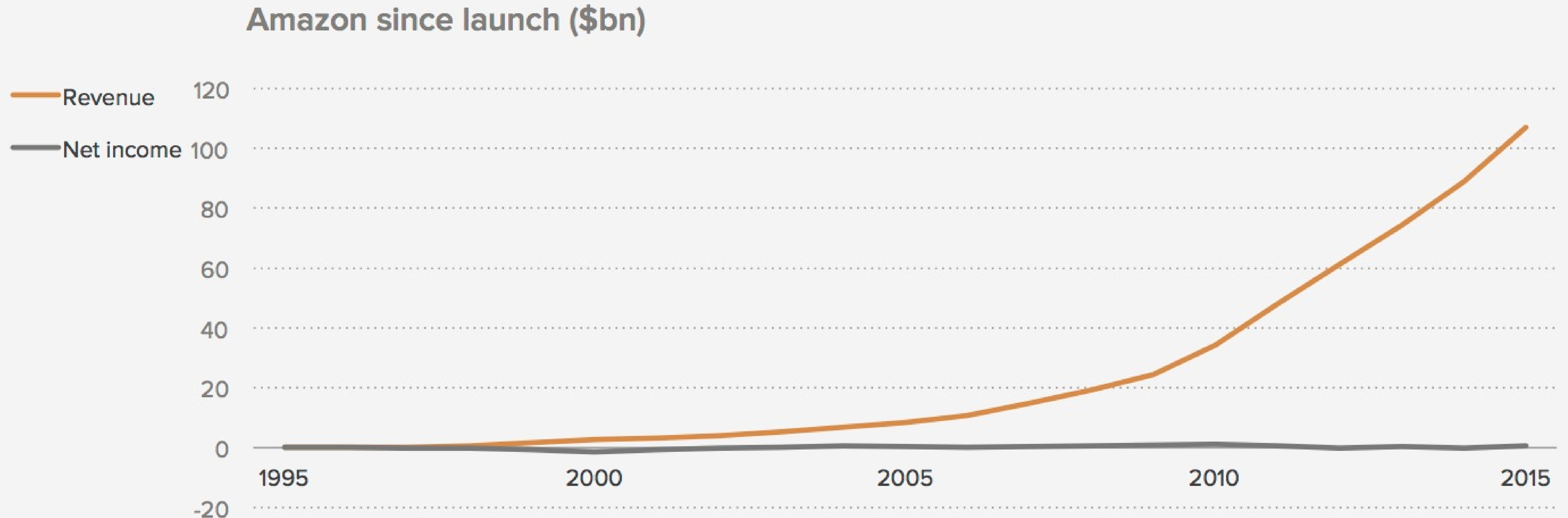
Inexorable expansion of online retail covers more and more segments

Ecommerce as % US retail revenue*



With 2% of the market, why take profits?

Amazon manages net income to zero, reinvesting as much as possible back into growth



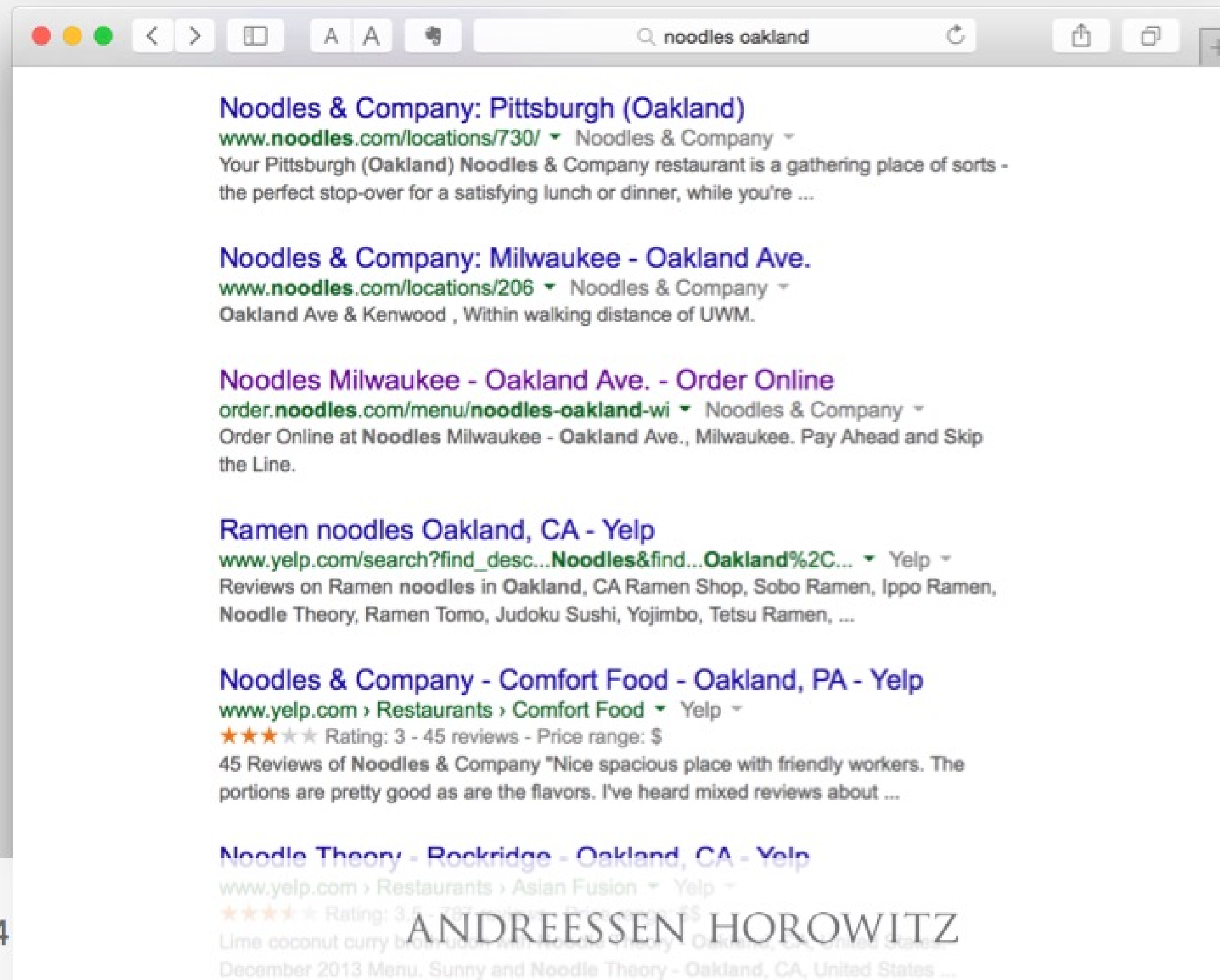
“What happened to media, happens to retail”

From one computer on earth to a computer in every pocket



How do I find what I don't know I want?

The channel shapes what's bought, and the channel is changing



The channel is the product

Amazon Dash is subscription soap

Walker & Co: new routes to market



Newspapers thought the 'information super-highway' would cut printing costs. It did, but...

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(Thank you)