

Internet Futures

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*A personal glimpse into a future
of the internet*

Geoff Huston
APNIC

A quick look back:
20 years ago

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The flagship of Digital's technology of the time, that turned out to be a commercial flop. Anyhow, it's still a true mainframe, in that: the system takes up a whole room, it consumes electricity as if it was free, and generates heat like hell. All this is due the fact that it's built out of ECL components, which are very fast (CMOS wasn't even close to that at that time), but draws significant power (the whole system takes around 20 kW). It was designed to have water-cooling, but that didn't work, so they modified it to air-cooling, the name however remained: "Aquarius". There were different models, with performances varying from 40 to 157 VUPs (125 MFLOPS). The I/O-memory-CPU interconnect is switched (with a frequency of 1 GHz), which was a totally new concept at that time. There were only a few dozen 9000's ever made.

A quick look back: 20 years ago



*The end of the
mainframe dinosaur*

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A quick look back: 10 years ago

Computing meets
consumer electronics:
the rise and rise of
the personal computer

Ugly, aren't they!

Today!

The new iPad



"We are now living in a post-PC world"

With desktop devices the Internet was a dedicated activity

reliable power lighting

privacy

large view
screens

dedicated worktop

wired bandwidth

dedicated chair



PLACED UPON THE HORIZON (CASTING SHADOWS)

Grand Space Design and the Institute without Boundaries

MASSIVE CHANGE

The Future of Global Design

WORLD PREMIERE
October 2, 2004 to January 3, 2005



The Internet is now anywhere and everywhere



hand sized

battery power

Thumb
operated

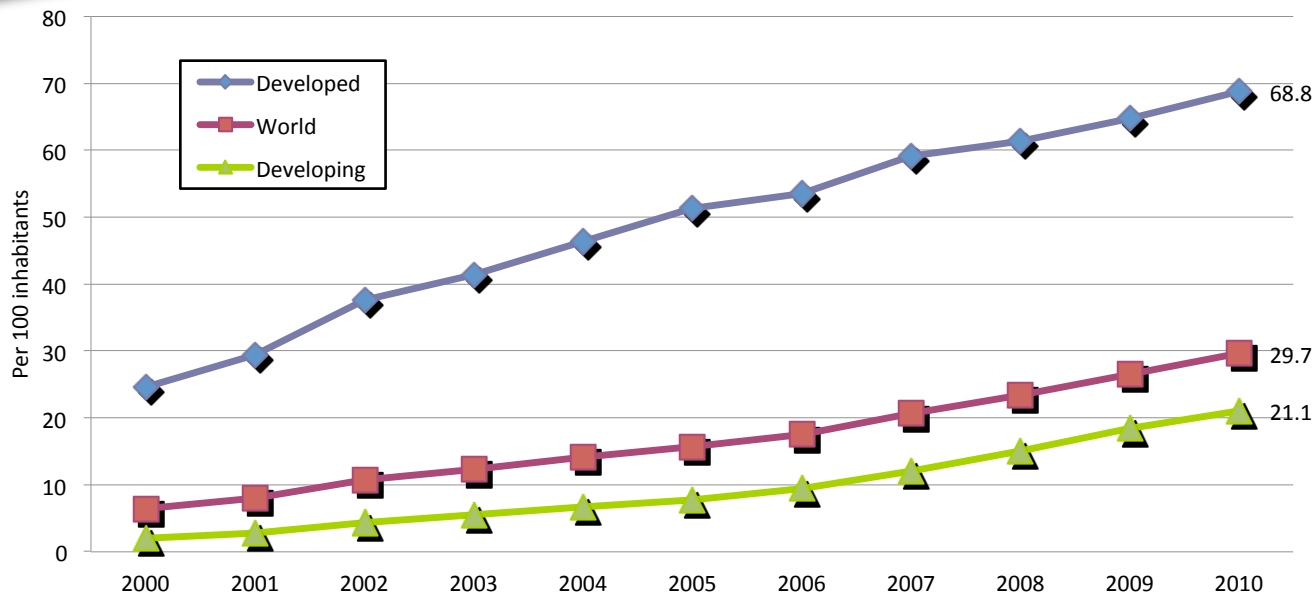
radio connectivity

Its trivial, commonplace and blends into all our activities

Counting Users...

There are 2.5 billion internet users today

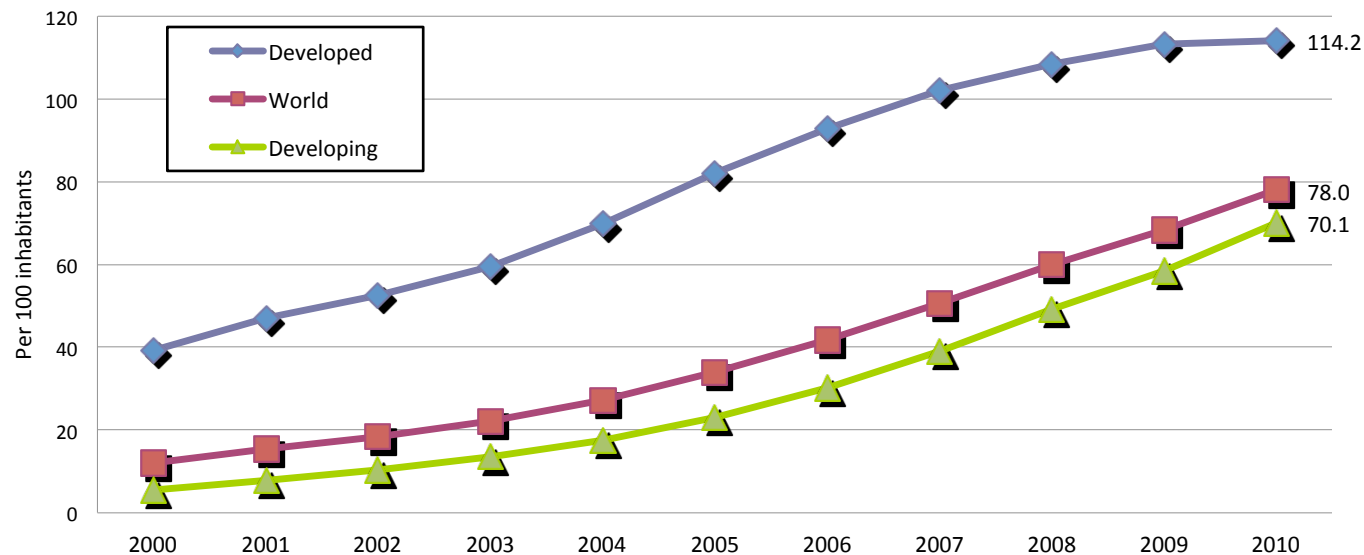
Internet users per 100 inhabitants, 2000-2010



Counting Users....

There are internet users
And 5 billion mobile phone users!

Mobile cellular subscriptions per 100 inhabitants, 2000-2010



The developed/developing country classifications are based on the UN M49, see:
<http://www.itu.int/ITU-D/ict/definitions/regions/index.html>
Source: ITU World Telecommunication /ICT Indicators database

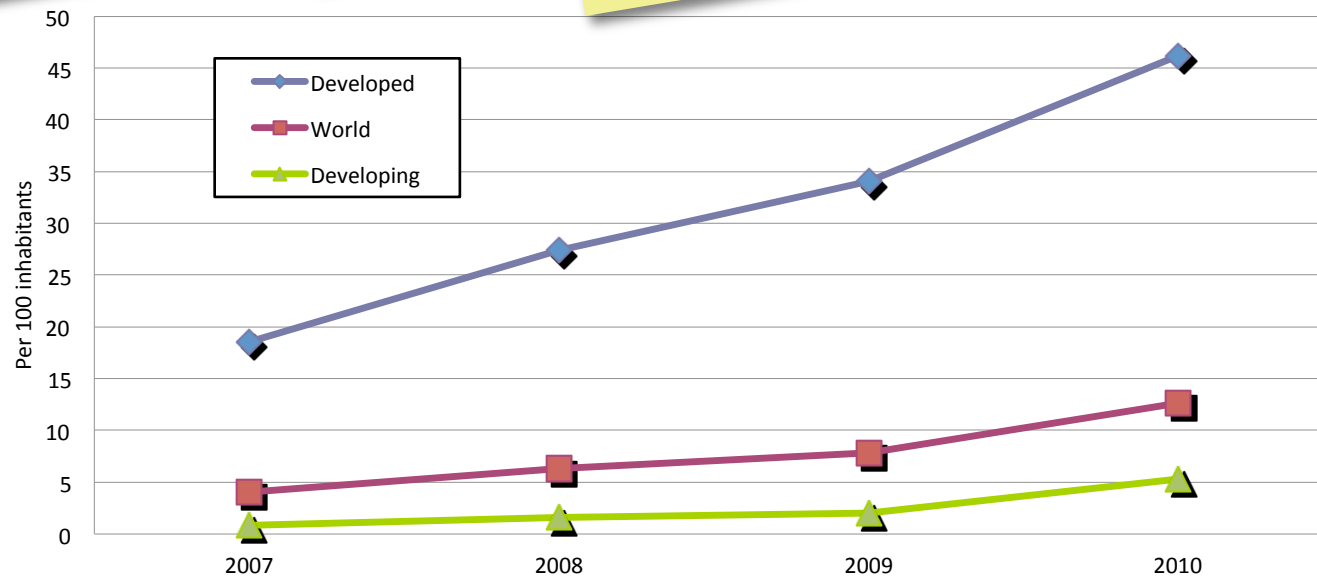
<http://www.itu.int/ITU-D/ict/statistics/>

Counting Users...

There are
internet users

And 5

And 750 million
mobile internet
users!



The developed/developing country classifications are based on the UN M49, see:
<http://www.itu.int/ITU-D/ict/definitions/regions/index.html>
Source: ITU World Telecommunication /ICT Indicators database

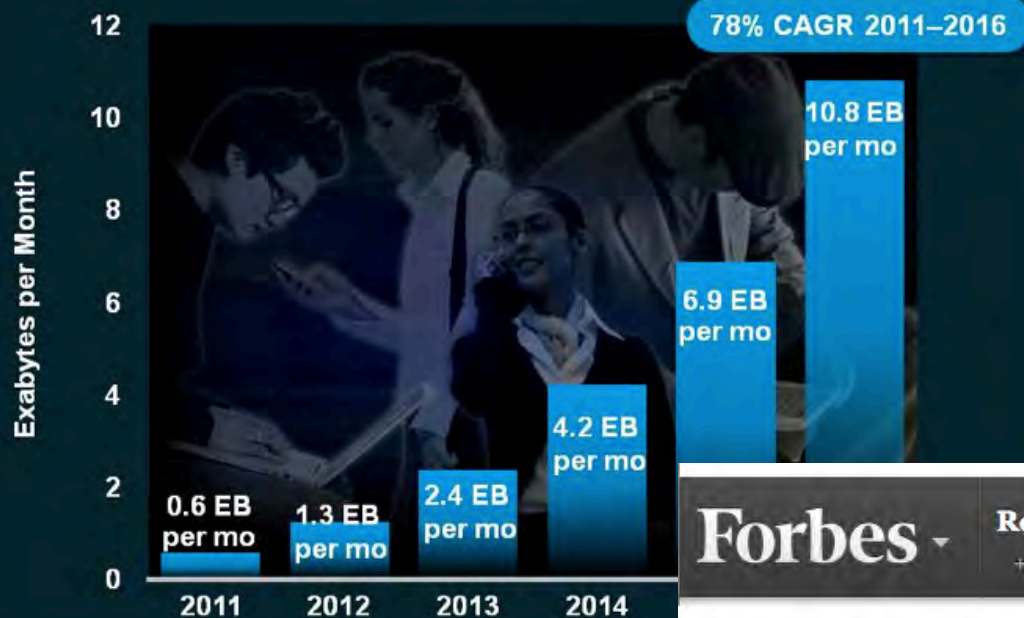
Source: Generator Research

Tomorrow's Users and Usage

Gartner Says Worldwide Media Tablets Sales to Reach 119 Million Units in 2012

Global Mobile Data Traffic Growth / Top-Line

Global Mobile Data Traffic will Increase 18X from 2011 to 2016



Source: Cisco Visual Networking Index (VNI) Global Mobile Data Traf

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for Approximately 35 Percent of Sales

worldwide media tablet sales to end 2012, a 98 percent increase from 2011, according to Gartner, Inc.

tablet operating system (OS), as it is expected to drive media tablet sales to end users in 2012. Software-based devices to this market, and therefore, Apple will continue to be the

Forbes

Real Time

+18 posts this hour

Popular

89 Cliches For MBAs

Lists

The World's Billionaires

Videos

Sell Your

TECH | 4/24/2012 @ 4:40PM | 32,913 views

Apple Results Top Estimates as iPhone Sales Soar

Where to from here?



5 Years Out



it's a mobile world!

2011: 270 million mobile units shipped

Factors:

- **Production volumes are bringing down component unit cost**
- **Android is bringing down software unit cost**
- **No need for new content - leverage off the the existing web universe of content**
- **Shift away from the desktop and the laptop by the production industry seeking new markets for their production capability**

Apple's Numbers

iPhones:

- Q3 2010 : Apple shipped 8.4M iPhones
- Q3 2011 : Apple shipped 20.3M iPhones
 - Added 42 carriers and 15 countries in the quarter!

iPads:

- Q3 2010 : Apple shipped 3.3M iPads
- Q3 2011 : Apple shipped 9.2M iPads
 - “every iPad we could make has been sold”

Q3 2011 profit: \$US 7.3B

Apple's Numbers



Apple's earnings for the last three months of 2011 surpassed all expectations. It racked up a record \$46.3 billion in sales for the quarter and more than doubled its net profit, to \$13.1 billion. Apple's share price jumped on the news, vaulting it once again over Exxon Mobil to become (briefly) the world's most valuable listed company.

Q4 2011 profit: \$US 7.3B

shipped 8.4M iPhones
shipped 20.3M iPhones
in 15 countries in the quarter!

shipped 3.3M iPads

shipped 9.2M iPads

could make has been

And Q4 2011 was
even bigger!

Apple's Numbers



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Q4 2011 profit: \$US 7.3B

\$13.1B profit!

37M iPhones

shipped 8.4M iPhones

shipped 20.3M iPhones

in 15 countries in the quarter!

15M iPads

shipped 3.3M iPads

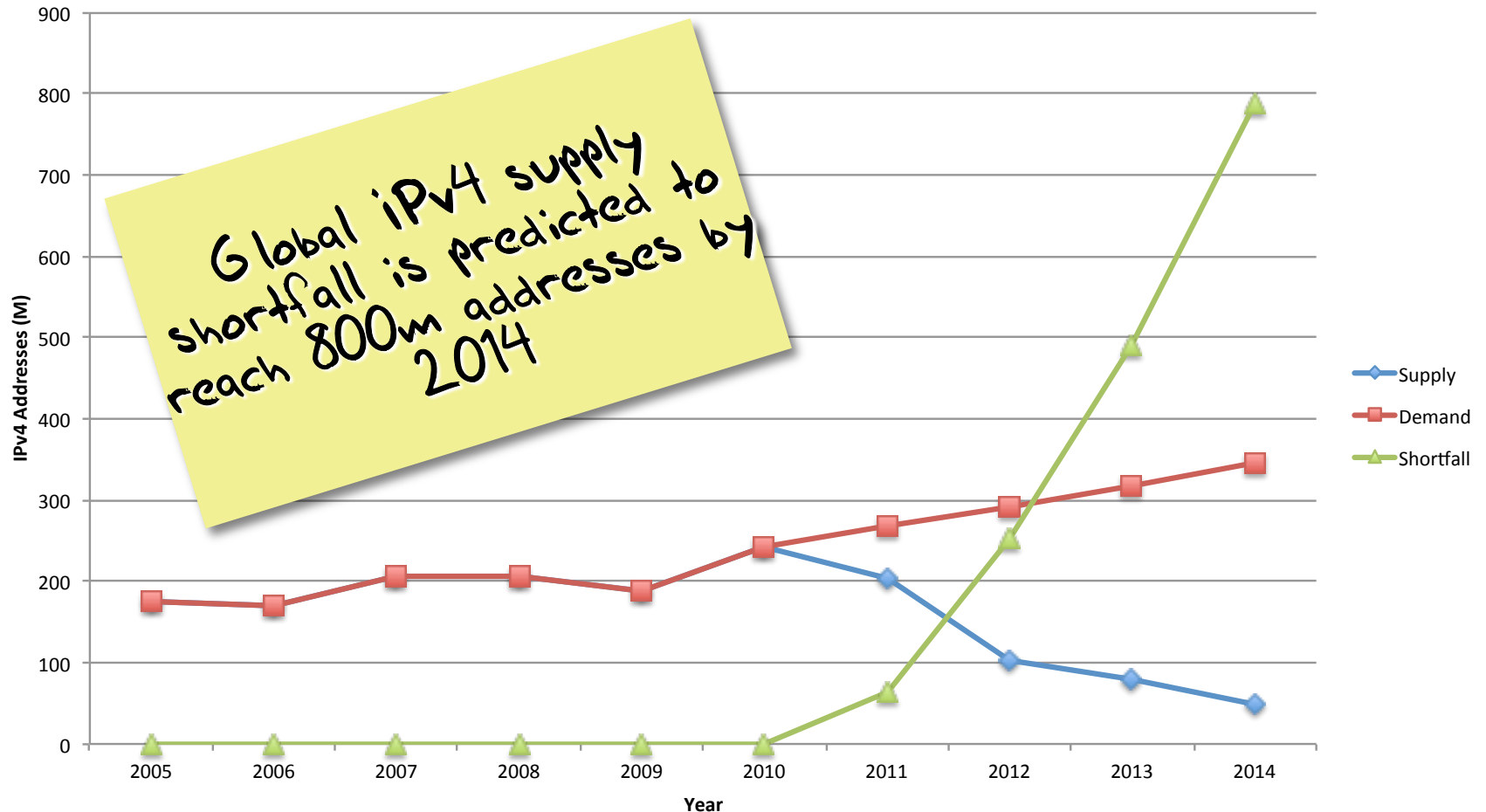
shipped 9.2M iPads

could make has been

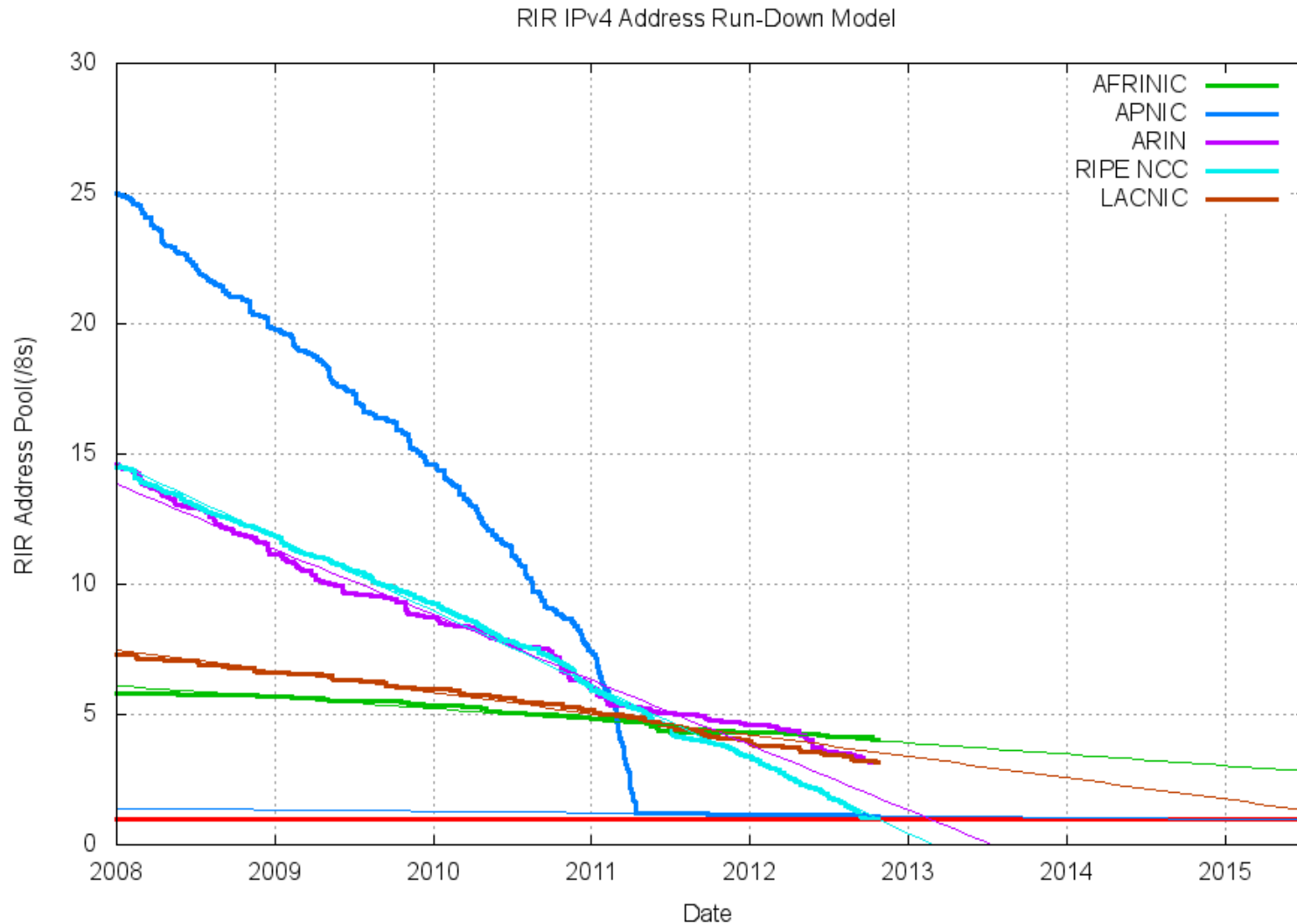
And Q4 2011 was even bigger!

Coping with Demand

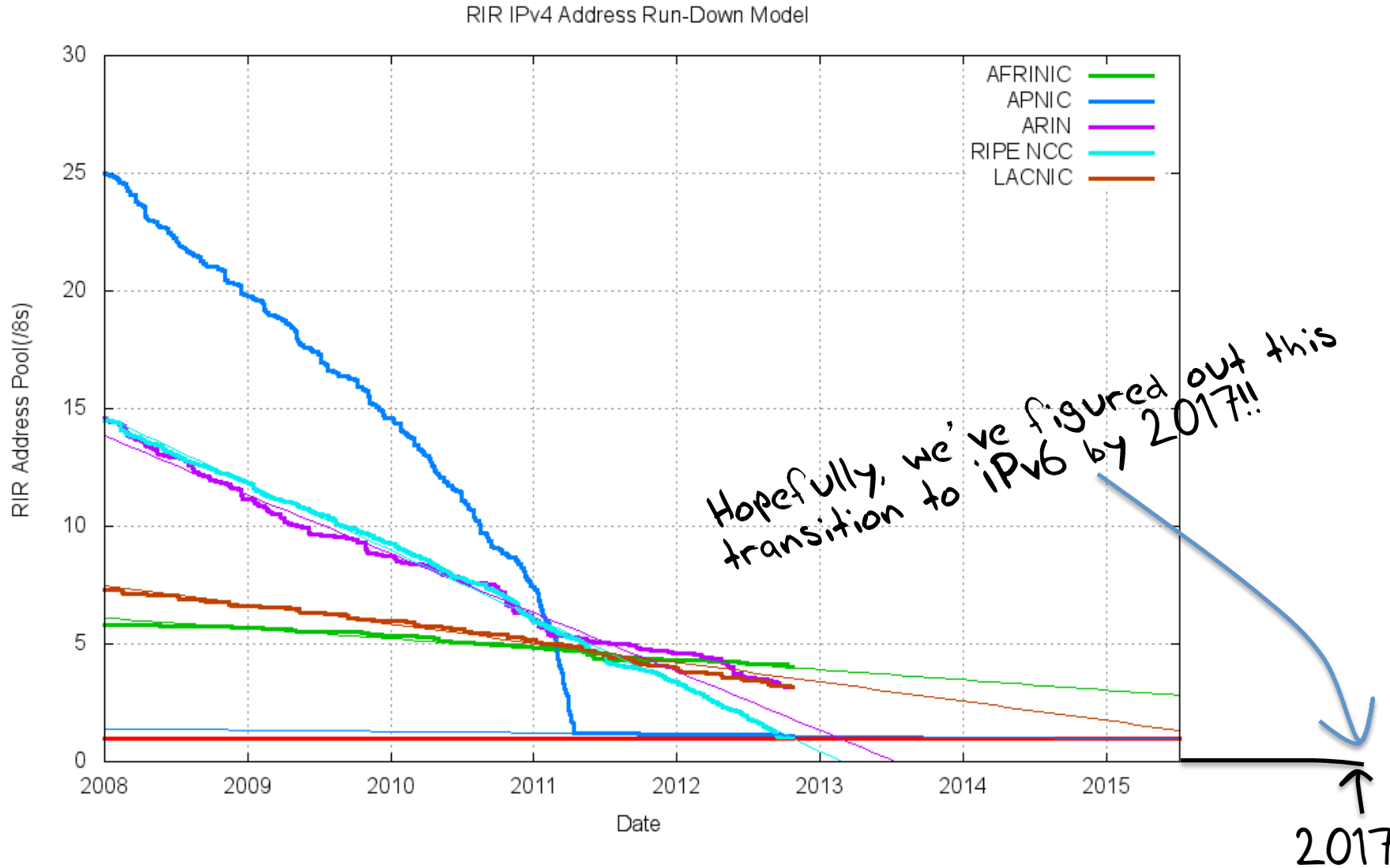
Global IPv4 Address Supply and Demand Estimates



Coping with IPv4 Address Exhaustion



Coping with IPv4 Address Exhaustion



But we're now High Risk!



The emergence of a market in IPv4 addresses is now a certainty.

But the outcomes of this market are by no means assured...

But we're now High Risk!

If the price goes too high then this will generate acute instability and potentially fragment the network



The emergence of a market in IPv4 addresses is now a certainty.

But the outcomes of this market are by no means assured...

If the price is highly volatile this will deter new investors in networked services and entrench the incumbent services and incumbent providers

in the next five years...



we have a choice

in the next five years...



And its not yet clear which path the internet will take!

And its not yet clear which
path ~~the internet~~ will take!
market forces

Can we look further out?

10 Years Out?



My personal view...by 2022

The Internet will be all IPv6 by 2022!

The market in IPv4 trading is a short term phase
CGNs also have near term limits under intense
scaling pressure

There is no extended afterlife in store for CGNs +
IPv4 if we make this transition to IPv6

(look at what happened to DECnet, SNA, Appletalk, X.25,...)

My personal view...by 2022

Or there will be no more Internet by then

- because all the CGNs, ALGs, CDNs in the world will not hold the Internet for 10 years of intense growth pressure
- And because one common protocol platform, one common address space, one common name space is a brittle state, it will fracture and splinter under address pressure

My personal view...by 2022

Radio spectrum will become even more of a scarce and highly valuable asset

well it is already, but the competition for spectrum in highly populous areas will continue

Fewer wide area services - more cellular / femtocell services backed by fibre backhaul to improve spectrum efficiency

20 Years Out?



My personal view...by 2032

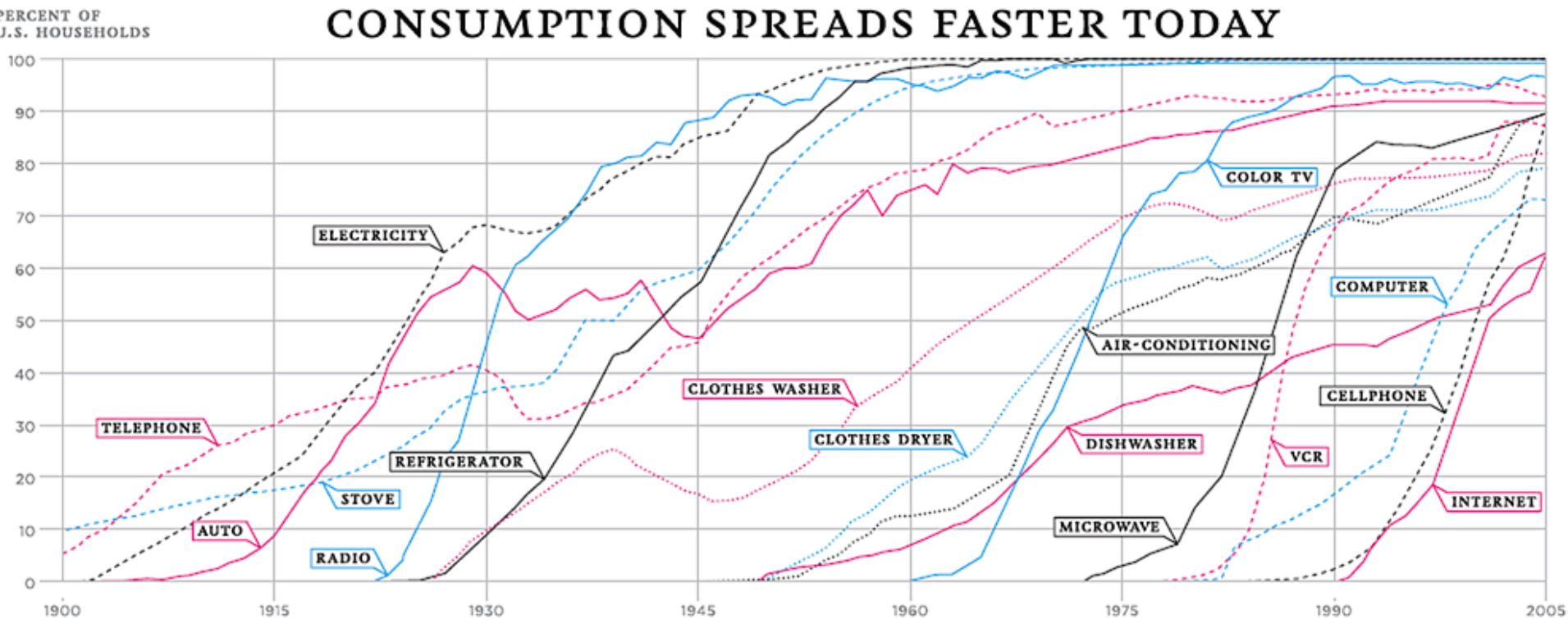
This is extremely tough!

very little from the world of 1992 is still with us today

very little of today's environment will be persistent for the next two decades

Why?

As the pace of technology adoption gets faster
we cycle through successive generations of
technologies at ever faster rates



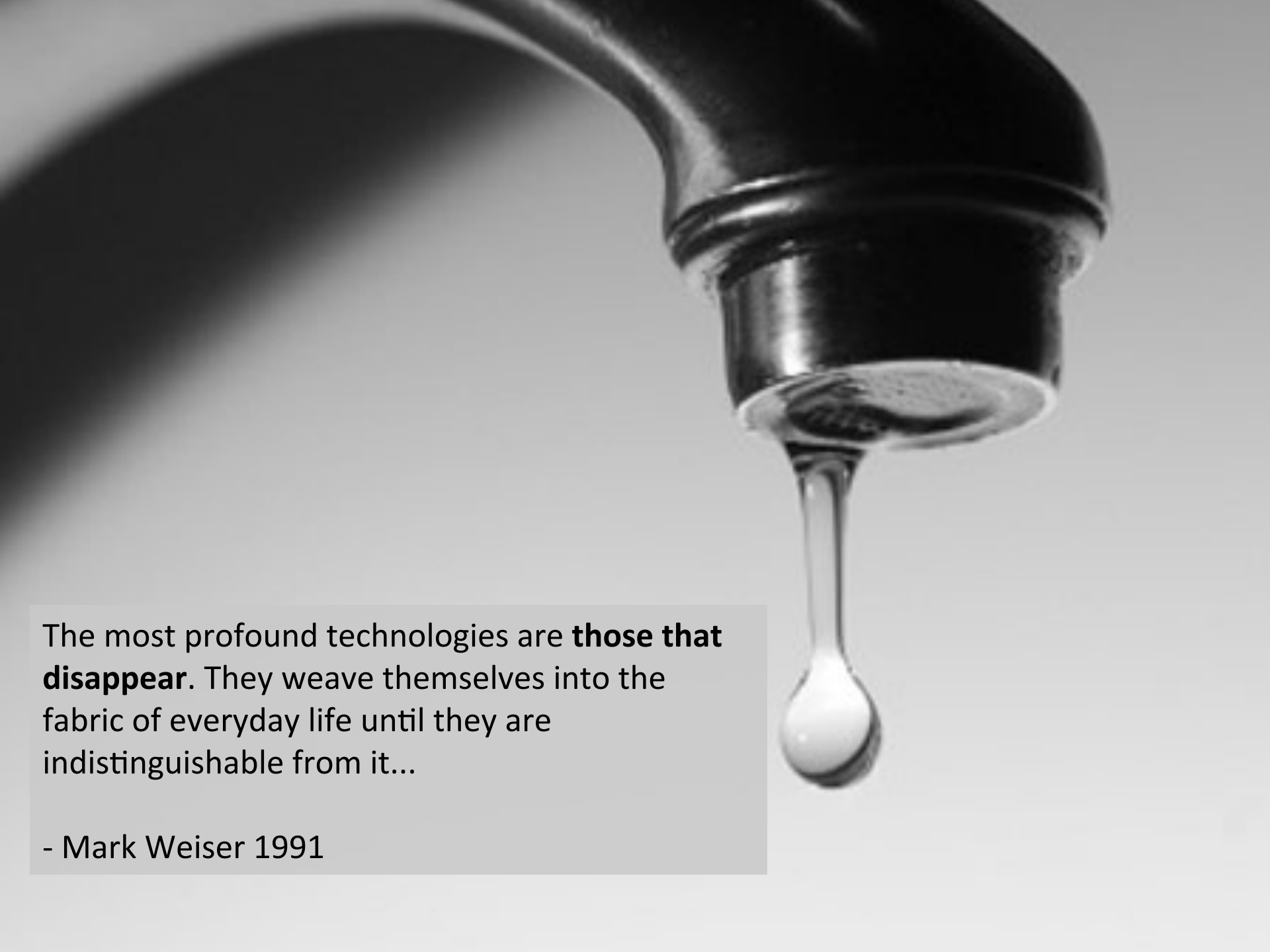
What's shaping our future?

You and i!

What's shaping our future?

You and i!

We need to think about a post-PC world where computation, storage and communications are abundant commodities. It's innovative mass-produced consumer devices and services that will shape much of the Internet's future. And the innovative force here is one of constant technology refinement and evolution!

A black and white photograph of a faucet. A single, large drop of water is falling from the spout, creating a clear, elongated shape. The background is a plain, light color.

The most profound technologies are **those that disappear**. They weave themselves into the fabric of everyday life until they are indistinguishable from it...

- Mark Weiser 1991