# The Role of NRENs in Today's Internet

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# I have two stories today:

- A quick review of the NREN history
- Some thoughts about internet technology and its evolution
- And then we'll try to stitch them together!

# My Background

- I took up a position in the Australian University sector at the start of 1989 to set up a national academic and research computer network
  - By “set up” I mean design, build, manage, cajole, sell, persuade and do whatever was necessary to get it done!
- Some 5 ½ years later I was sold, along with the entire national network and its customers to the then dominant domestic telco, Telstra
- I spent the next decade pushing within Telstra to set up a national consumer and enterprise internet services and re-position the Internet from an overlay application to a basic component of telco infrastructure
- For the past 15 years I’ve been the Chief Scientist at APNIC, watching the telcos and NRENs evolve further

# I - A quick history of NRENs

# The NSFNET (the NREN Poster Child)

- The NSFNET was a runaway success
- Originally intended as a feeder platform for the US supercomputer effort, it gathered its own momentum within a couple of years
- It is extremely rare for just $40M of research funding over just 6 years to generate such a massive return of trillions of dollars of wealth to the US national economy in subsequent years!
- Everyone wanted to emulate some small part of this outstanding success - NRENs appeared in many countries
- Australia's path in NRENs was pretty typical of the NREN evolution

# AARNet in the early 90's

- Australia started on the NREN path in 1989, initially prompted by US research funding agencies
- Australian Universities and research institutions were unused to working in concert on a single project up until that time
- The network was constructed to provide the entire sector with communications services that were otherwise unobtainable at the time
  - If the sector wanted to use a national X.25 service network it could buy it from the telco
  - But if it wanted to use anything else it had to build its own
  - So it did
  - It started as a multi-protocol network, modelled on Nordunet, but quickly shifted to IP only
- As it turned out the sector's technology needs were not far removed from enterprise and public sector needs
  - The true value proposition of IP was to escape from vendor-based communications solutions
  - Demand for IP access blossomed from many other sectors

# AARNet in the mid 90's

The Academic and Research Network was having trouble sticking to a limited A&R mission and quickly become a massive service network

- No other internet service was available
- The research sector could use commercial services income to defray the costs of the network
- A larger platform had access to higher capacity and lower unit costs of carriage services
- AARNet did everything: transit, access, wholesale, DNS, file stores, email relays
- At its peak AARNet had 650 ISPs as retail customers of AARNet’s wholesale service

# AARNet in the mid 90's

But AARNet's rapid growth meant that:

- it quickly became too big to be a customer of any carriage provider
- The sector was unwilling to borrow capital to make large scale infrastructure investments, so the network continued to be a cash flow business without capital assets
- The network was owned and managed by the academic sector, not drawn from the comms sector, so decision making was often slow and fraught with angst over uncertainties
- It was big enough to stifle competitive offerings, so it was now in the way of conventional ISP enterprises
- It had out-performed its original objectives and it was time to let it go!

# The Commercial Internet

- The sector sold AARNet's customers to Telstra in 1995
  - In many ways it was a forced decision – AARNet was finding it hard to be a national ISP and an NREN at the same time, while the telco was finding it hard to enter the ISP market while AARNet existed
- If AARNet was a collective effort to provide a service that was otherwise unavailable then the rationale for this disappeared with the sale
  - Internet access was now a commercial product
- The universities regrouped to become a sector-wide purchasing cartel

# Early Naughties: Boom and Bust

- The Great Internet Bust of 2001 – 2003 created a collection of distressed infrastructure assets that could be picked up for cents in the dollar
- AARNet was no exception when it picked up fibre assets at firesale prices to form a national fibre backbone
- At this point AARNet transformed from being a constantly frustrated customer to become an infrastructure operator once again
- But this time it was not implementing a unique service, but attempting to operate a conventional IP carriage service at a competitive price point

# 2010's - Role Erosion

- Today's Internet is a content delivery platform, not a connectivity fabric
- The role of NRENs as unique providers of very high capacity connectivity was falling out of step with the sector's requirements
- So the NRENs changed gear and concentrated on a role as a platform for specialized applications and services
  - which strongly resembled a solution looking for a problem!

# 2020 - Wither NRENs?

It’s not looking good!

- NRENs are not a critical and unique provider for specialised networking services any more
  - Most of the component technologies are now available in the market
  - There is more innovation in high speed equity trading networks than can be found in most NRENS today!
- NRENs don’t lead the way in content delivery services
- Like the telcos of 40 years ago, NRENs are now caught up in established service delivery and are unwilling to take on the risks and disruption of dramatic innovation
  - As a purchasing cartel they lack volume and find it increasingly hard to be cost competitive for the bulk of their client service portfolio

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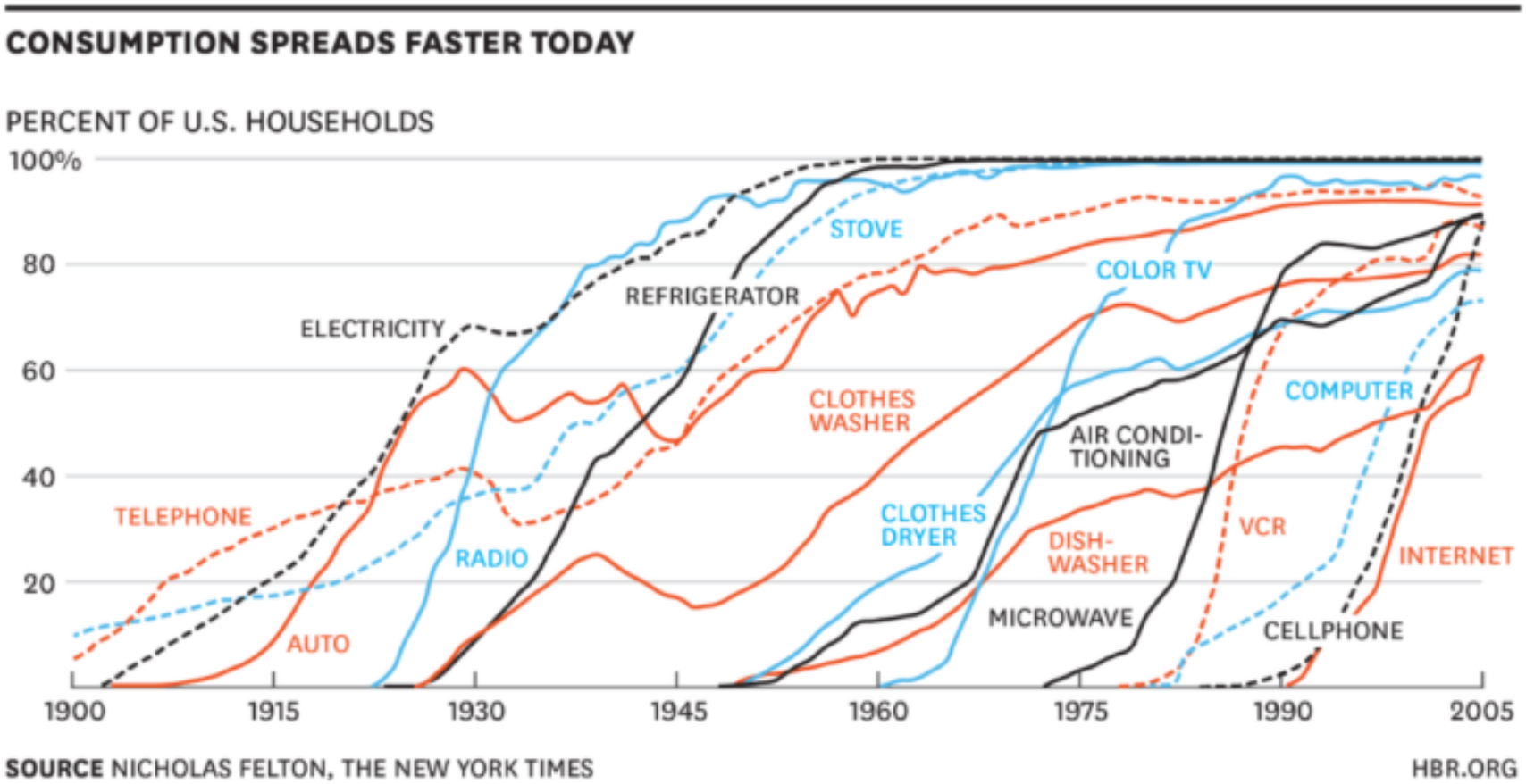
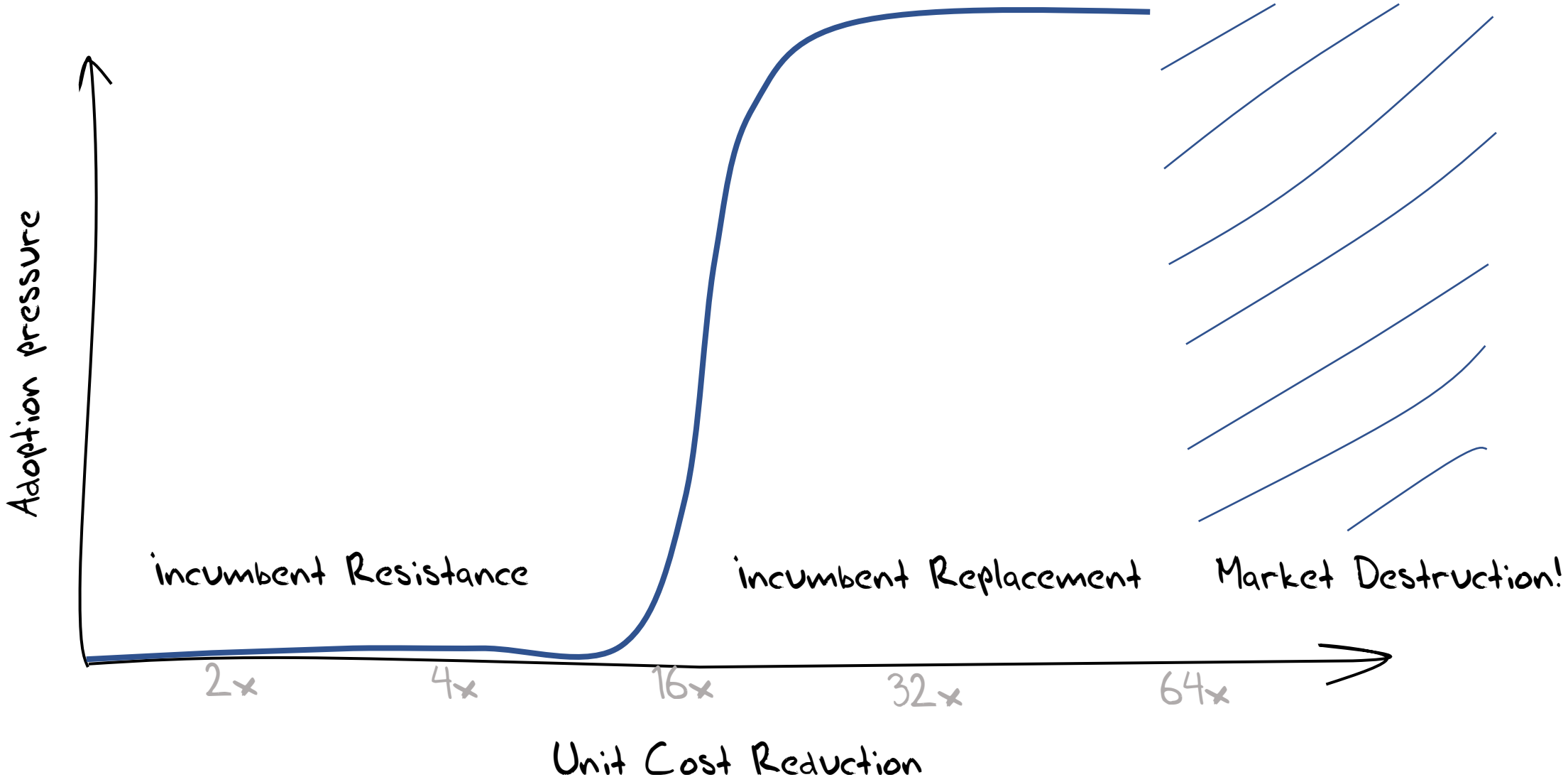
Can we change this?

# II - Internet Technology Evolution

# The Pace of Consumer Technology Adoption



# Economics of Innovation



# Examples of Transformations

## Circuits to Packets

- 100x unit cost reduction in network service
- The change was large enough to destroy the existing telco market

## Hardware to Cloudware

- 2x – 4x unit cost reduction
- Moderate pace of change that has allowed some incumbents to ride the change while others have had a harder time

## Domain Name Certificates

- From luxury good to free commodity resulting in market destruction

# Tougher Examples

IPv6

- No marginal unit cost improvement
- Incumbents feel no major pressure to adopt
- 25 year transition with no end in sight

DNSSEC

- Increased unit cost without clear incremental benefits
- Another protracted transition with no end in sight

# What's going on?

- Why was IPv4 a runaway success while IPv6 has been a slow motion train wreck of prevarication and delay?
- Why is security a market failure?
- Is Google now so entrenched that it is beyond all but the most disruptive of competitive technology pressures?

# What drives change?

Fear and Greed!

- Incumbency breeds risk aversion and increasing inertia
- This breeds increasing barriers to market entry by competitive actors
- This means that the cost of risk rises
  - Venture capital funds increasingly uninterested in small cap ventures – its either billions or nothing, because underfunded exercises in disruptive competition are increasingly likely to fail

# III - Putting it back together

# What do NRENS have to do with technology evolution?

- If NRENs aspire only to be mini telco's then the answer is "nothing!"
- But if that's all that the NREN is trying to achieve then maybe the NREN has failed already as a platform for applied research into advanced network technology
- NRENs should be focussed at the leading edge of innovation and change in networking technologies

# What should NRENs do?

- NRENs should be confident enough in themselves to operate with a much higher risk appetite for innovation
- NRENs should be able crystallise what makes communications technologies both disruptive and transformative
- NRENs should be focussed on research into networking, not merely a networking platform for researchers

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But the internet is a solved problem isn't it?

# Drilling down…

So far this is all rather abstract

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Let's take a more detailed look
at some specific technologies

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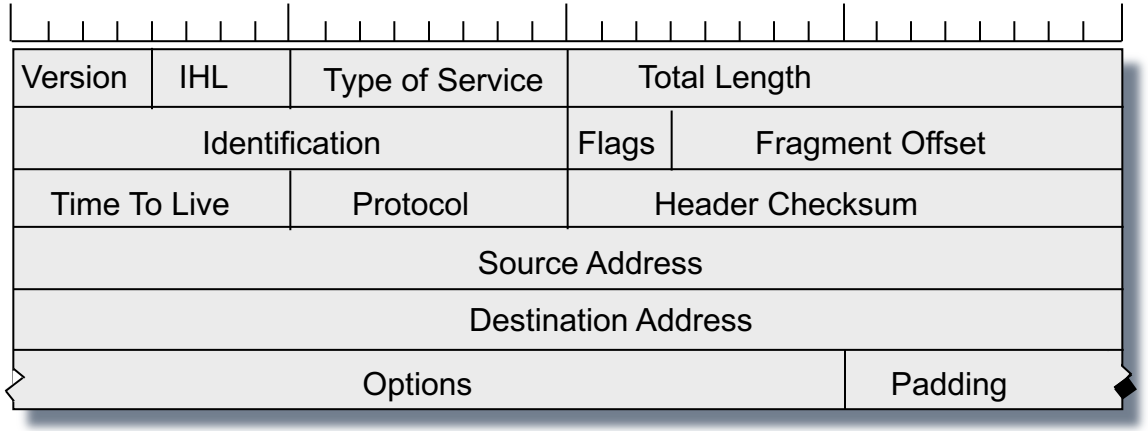
Lets take a more detailed look at some specific technologies

And bear in mind that the shape of the future can often be found in the mistakes of the past!

# IP was just so simple…




Hop-by-Hop stateless forwarding

Datagram transmission

End-To-End data integrity

Decoupled resource management, topology management

What could possibly go wrong?

# What don't we understand…

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Multicast

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MPLS

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# What we really need to understand…

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What's giving us some grief is the shift into large scale CDN platforms

What 'worked' for the Internet was the shift of control from network to edge

And if we want to scale further we need to understand flow dynamics and feedback control systems to pack the elephants and mice into the same wavelengths or into the same spectrum frequency

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In thinking about a future Internet

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Nor to forget everything we've learned about packet networks so far

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But there are only a few entities have the license to embrace this much risk and innovation all at once

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Nor to forget everything we've learned about packet networks so far

But you do!

But we need to think about a future that is way beyond today's Internet

But few entities have the license to try and embrace this much risk and innovation all at once