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KONTAKTER FÖR INTERNETDAGARNA

För mer information eller intresseanmälan för Internetdagarna 2008, kontakta Lennart Bonnevier, projektledare för Internetdagarna, tel. 08-62 35 62 eller 0702-19 01 86, e-post lennart.bonnevier@iis.se





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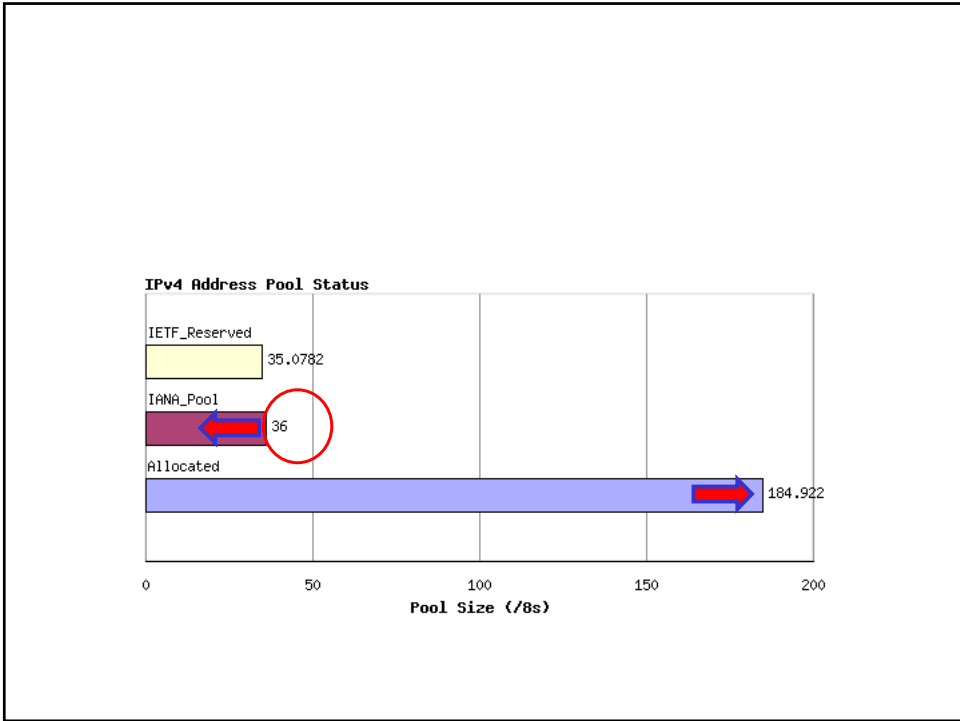
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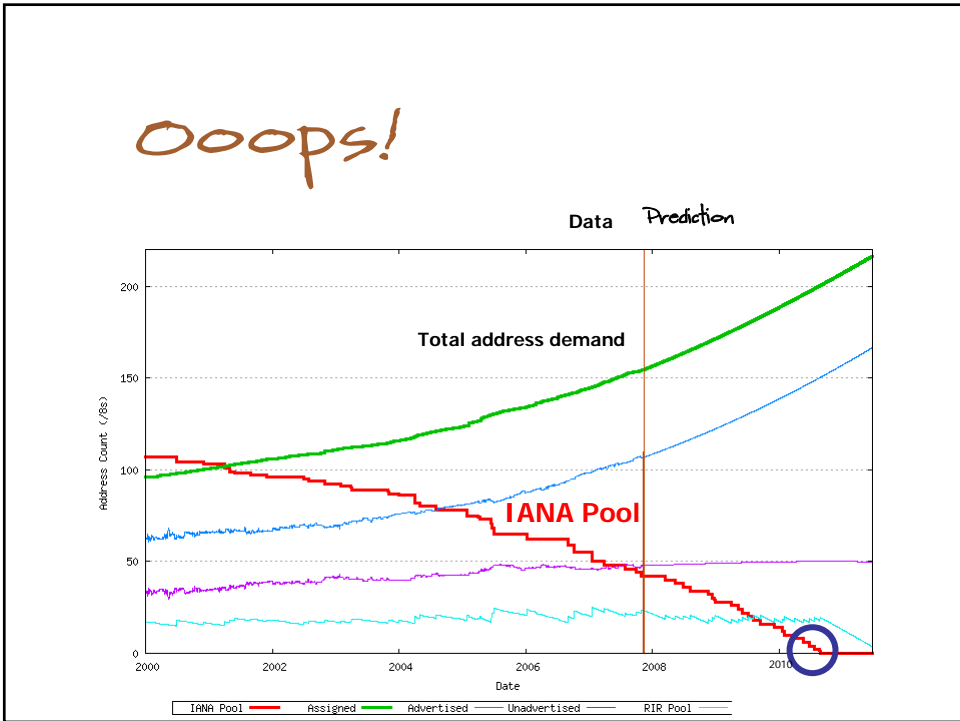
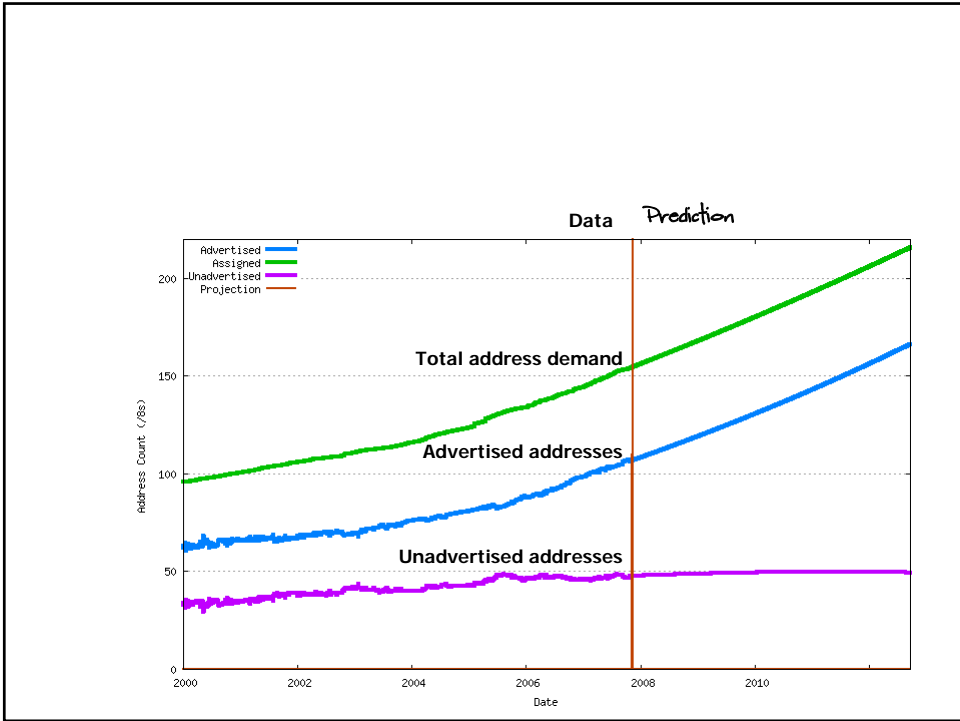
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Any good ideas that snuck in were probably stolen from someone else!

Today



Tomorrow



That's 29th January 2011

<http://ipv4.potaroo.net>

That's 29th January 2011

YAWN - seen all this before
It's now **BORING!**

<http://ipv4.potaroo.net>

That's a highly uncertain
prediction - it could be out
by as much as 18 months



I can't model changes in demand due to:

Panic — last minute rush

New Policies — “reservations” of remaining address space

Change of relative Ipv4 / IPv6 demands

And modeling uncertainty due to:

highly skewed data used to make projections



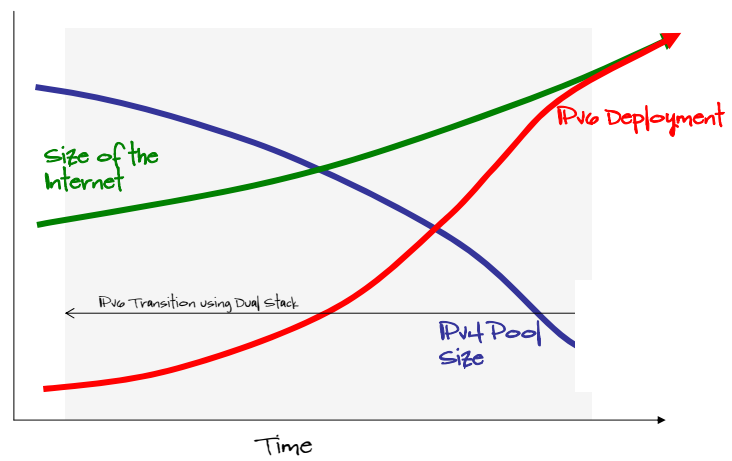
Let's say some time between
late 2009 and early 2011

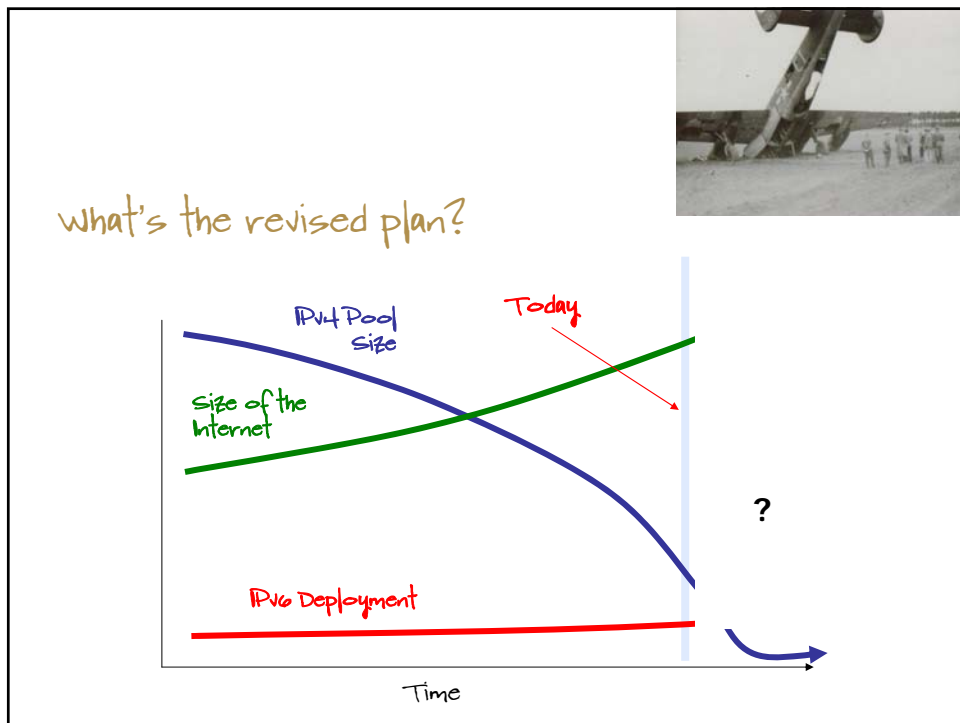
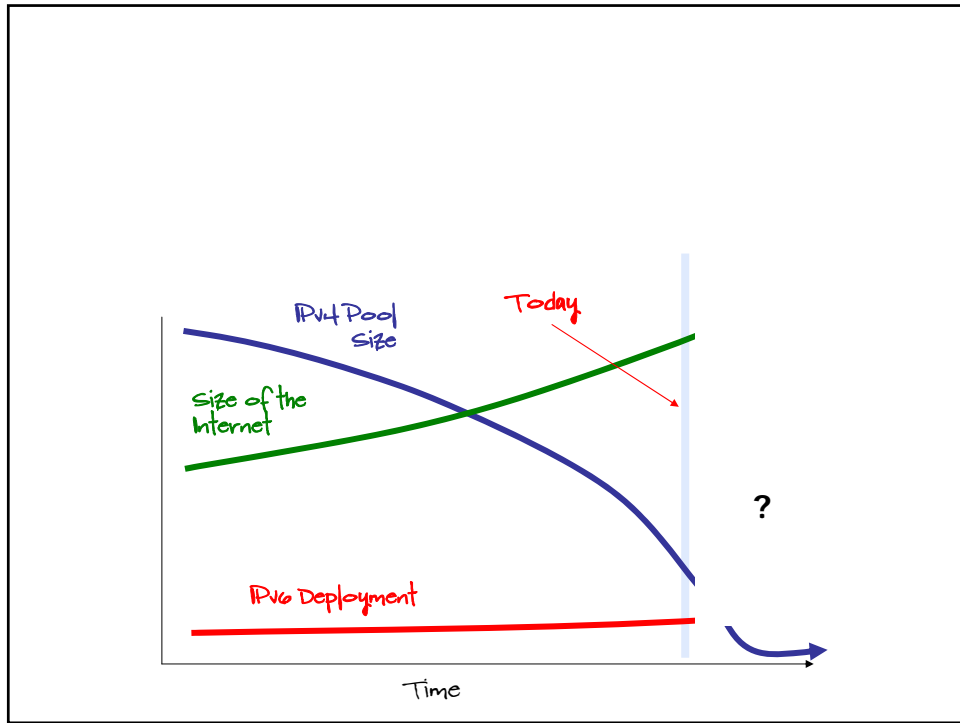
what then?



IPV6!

We had this plan ...





If IPv6 is the answer then...



Plan A: its time to move!

The global internet adopts IPv6
universally, and completely quits **all**
use of IPv4, well before address pool
exhaustion occurs



If IPv6 is the answer then..

Plan A: its time to move!

The global Internet

If IPv6 is the answer then..

Plan A: its time to move!

The global Internet, with more than 1.7 billion users

If IPv6 is the answer then..

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The global Internet, with more than 1.7 billion users, a similar population of end hosts

If IPv6 is the answer then..

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The global Internet, with more than 1.7 billion users, a similar population of end hosts, and hundreds of millions of routers, firewalls

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If IPv6 is the answer then..

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The global Internet, with more than 1.7 billion users, a similar population of end hosts, and hundreds of millions of routers, firewalls, and billions of lines of configuration codes, and hundreds of millions of ancillary support systems

If IPv6 is the answer then..

Plan A: its time to move!

The global Internet, with more than 1.7 billion users, a similar population of end hosts, and hundreds of millions of routers, firewalls, and billions of lines of configuration codes, and hundreds of millions of ancillary support systems, where only a very small proportion are IPv6 aware today.

If IPv6 is the answer then..

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Really



BIG and FAST don't go together!



If IPv6 is the answer then...



Plan B: Dual Stack

Leisurely IPv6 deployment

and

Persist with IPv4 networks (using more NATs to keep it going)

If IPv6 is the answer then...



Plan B: Dual Stack

Make IPv4 keep on working across an ever-larger Internet, using more intense levels of NAT deployment in new products and services, for as long as the existing deployed networks continue to use IPv4 as part of a Dual Stack transition

This may take a decade

or even two!



Plan B: Dual Stack

So if IPv4 is a necessity for the next 10 or 20 years, what exactly is IPv6's role here?

What immediate marginal benefit is obtained from the additional cost of deploying IPv6 in a dual stack?

Its just not looking very good is it?



Its just not looking very good is it?

why are we here?

Its just Business ...



This entire network is customer funded

Its just Business ...



This entire network is customer funded:

- Every vendor is intensely focussed on meeting customer needs

Its just Business ...



This entire network is customer funded:

- Every vendor is intensely focussed on meeting customer needs
- Customers have absolutely no clue what this IPv6 stuff is about - so they are not paying extra for IPv6!

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Its just Business ...



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- And vendors and service providers are not about to build IPv6 for free

We appear to be seriously wedged!

Or just another Business
Failure?

IPv6 adoption offers all the marginal benefit of a pretty minor technology change change

Or just another Business Failure?



IPV6 adoption offers all the marginal benefit of a pretty minor technology change change with all the costs and disruption of a major forklift upgrade

on the other hand

there are more options...

What options for the Internet's future exist that do not necessarily include the universal adoption of IPv6?

Failure Options



What if IPv6 doesn't happen?

Existing network deployments continue
to use IPv4

Existing network deployments continue
to use IPv4 — no change there from the
Dual Stack plan

New networks will have to use IPv4

New networks will have to use IPv4 -
but they would have to do that under the Dual
Stack plan anyway, so no change there either

We are going to have to make IPv4 last
past exhaustion, coupled with intense
use of NATs

We are going to have to make IPv4 last past exhaustion, coupled with intense use of NATs — no change there either from what is needed with the Dual Stack transition!

Failure Options



What if IPv6 doesn't happen?

Existing network deployments continue to use IPv4 — no change there

New networks will have to use IPv4 — no change there either

We are going to have to make IPv4 last past exhaustion, coupled with intense use of NATs — no change there either!

If IPv6 is NOT the answer then...



Plan X: IPv4 for ever

~~Leisurely IPv6 deployment~~

~~and~~

Persist with IPv4 networks using more
NATs

Making IPv4 Last Longer



Redeploy "idle" IPv4 addresses?

Not every address is "in use"

End host utilization levels of addresses are estimated to
be around 5% — 20% of the address pool

Making IPv4 Last Longer



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So could we flush more addresses back into circulation?

Making IPv4 Last Longer



Redeploy "idle" IPv4 addresses?

Not every address is "in use"

End host utilization levels of addresses are estimated to be around 5% — 20% of the address pool

So could we flush more addresses back into circulation?

Yes, but it will take money (and maybe markets) to flush them out!

NATs on Steroids?



We need to get **really** good at NATs ...

Fun new products to play with:
*carrier scale NATs deep in the network
coupled with port-rationing of end
customers?*

Standardise NAT behaviours to full
cone behaviour allow application
determinism and maximum address / port
utilization

Smarter applications with greater
levels of context discovery, multi-party
rendezvous, and adaptive parallelism

NAT Futures



Are NATs just more of the same?

Is this the "safe" option of changing almost nothing?

How far can NATs scale?

How complex can we get with this network?

NAT Futures



Are NATs just more of the same?

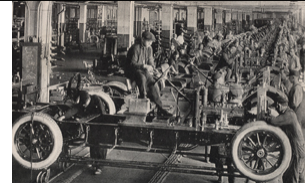
Is this the "safe" option of changing almost nothing?

How far can NATs scale?

How complex can we get with this network?

Are we willing to find out?

Numbers, numbers, numbers



Assume that:

- dual stack transition will take a further 10 years
- the growth pressure for network connectivity will average 200 million new connections per year
- All growth will be using IPv4
- Carrier Grade Nats achieve average of 50% address utilization efficiency with allowance of 600 ports per customer

Then the IPv4 requirements for the next 10 years of Internet growth would be possible within a pool of 4 /8s !

But what about the next 10 years?

And the next 10?

And ...

Maybe that's pushing NATs a bit too far



what other options do we have?



If IPv6 is NOT the answer then...

Plan Z: end-to-end IP is NOT the
answer either!

huh?

Application Level Gateways!

Remember them?



They're what we used to do in the 80's!



Is there something about
networking architecture
evolution lurking here?



circuit networking

*shared capable network with embedded applications
simple 'dumb' peripherals*



Is there something about
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circuit networking

shared capable network with embedded applications
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packet networking

simple datagram network
complex host network stacks
simple application model



Is there something about
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circuit networking

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packet networking

simple datagram network
complex host network stacks
simple application model

identity networking?

sets of simple datagram networks
locator-based host network stacks
identity-based application overlays



huh?

Do we understand enough to bet the entire future of the Internet on scaling the network based on this theory of the evolution of network architectures?

Possibly.

And we may be heading down this path already.

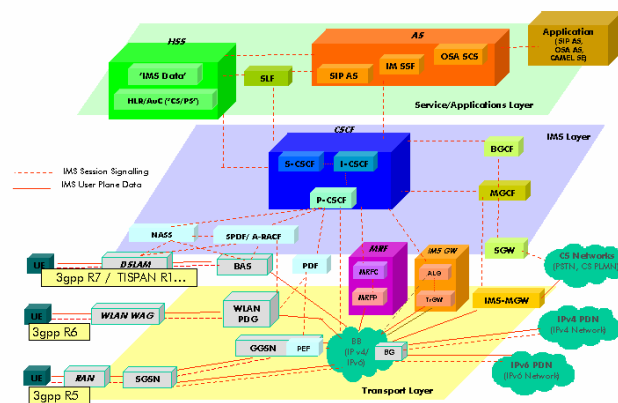


For example:
Use the 3G approach - IMS

- IMS is an architecture of application level gateways
- front-end proxies act as agents for local clients
- applications are relayed through the proxy
- no end-to-end IP at the packet level



Yes, it's ugly!



But it has its fans!

The true technical solution to the challenge of convergence comes as we make the move to IMS, or IP Multimedia Subsystems, which will provide the common control and protocols for applications to work across our networks. We've been involved in the push for IMS since its inception. In 2006, we drove an initiative called "Advances in IMS", which was executed by a task force of companies, whose purpose was to catalyze closure on worldwide standards for IMS which would make its deployment pragmatic in the near-term for operators. I'm happy to say that we succeeded. With IMS, the customer will no longer be stranded on separate islands of technology for things like messaging, voice, or video. Instead, we'll be able to build an application once and have the network deliver it to customers wherever they need it.

Dick Lynch CTO Verizon, 20 August 2008

The motivation for the IMS and NGN efforts include building a bright shiny future where:

- the focus is on application coherence,
- convergence is realized through integration of delivery systems with services
- services are provided via managed delivery channels
- integration of security and service quality
- control of the user experience by the network operator
- a return to the bountiful economics of vertically integrated carrier monopolies

Put Another Way...

- "We just build the highway. We don't fix your car."
 - Randy Bush, INET '96
- Well, IMS attempts to build parts of your car's engine, brakes, and navigational system(s) into the highway
 - And has a billing model based on where you are going and who/what is in your car
 - Which BTW means that the system needs this information too
- In short: IMS has as a primary design goal to couple higher-layer services to packet transport
 - Note that coupling is one of the primary sources of complexity in dynamical systems (such as the Internet)
 - See <http://www.1-4-5.net/~dmm/talks/SANOGV> for a little more on this topic

Dave Meyer, NANOG 33

So if its NOT going to be IPv6, then we have these alternate options...

But they all appear to represent a pretty lousy future of:
escalating network cost,

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the demise of innovation in communications services*

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escalating application complexity and fragility,
massively reduced flexibility of networks and their use,
the demise of innovation in communications services
massively increased risks of failure
user capture by the carrier
a return to the dismal economics of vertically integrated carrier monopolies

Is this what we want to see
for the Internet?

Not me!

I hope that I've shown you that there **are** options for this industry that do not include the universal deployment of IPv6

And some sectors of this industry may well prefer to see alternative outcomes here that rebuild their past ~~greed~~ glory

Right now individual short term interests are leading the Internet towards collective long term sub-optimal outcomes

At some point very soon the Internet will need some external impetus to restate short term interests to align with common longer term objectives

If we want IPv6 to happen we might need a large kick in the rear to get us there!

But what could be useful
right now is ...



- An appreciation of the broader context of business imperatives and technology possibilities
- An understanding that leaving things to the last millisecond may not be the wisest choice for anyone
- An appreciation IPv6 still represents the lowest risk option of all the potential futures

Failure to adopt IPv6 really is an option here

But failure is not an option that will serve our longer term interests of operating a capable, effective and innovative communications sector

Failure to adopt IPv6 really is an option here

Fully deregulated environments do not necessarily make the wisest choices - this industry may need some additional applied impetus to get there.

Thank You

gih@apnic.net