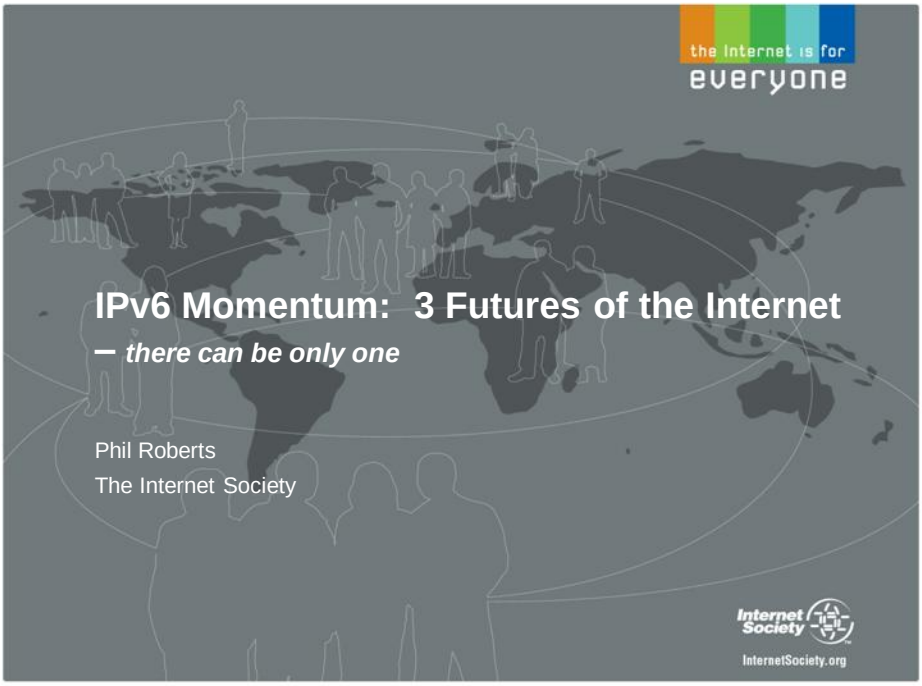

The Internet – A Work in Progress

- Has not reached a point of completion
  - still evolving, changing
  - plenty of loose ends and untidy bits
  - still expanding to reach new users across the globe
- Still has plenty of history to build ahead of it
  - more than just tying up loose ends
  - evolution is constant change
- Deployment of, and ultimately, transition to IPv6 is key to that future

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What Makes the Internet Work

- Rather than prescribing a future, pioneering technologists created the platform which opened the door to the future
- This created a participatory network – not just information delivery
- And that enabled uses and expansion simply not conceivable
  - the World Wide Web
  - Social networking
  - E-commerce, E-gov, E-tcetera
- We now call this the *Internet Model of development*, a term that embodies a common set of operating values shared among many of the key communities and organizations that have been central to the development and ongoing evolution of the Internet.

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Targeting the Future

- Continued growth of reach of Internet
  - users & uses
- Openness and ease of access
  - for (new) users, (new) networks
  - for new types of devices and networking
- Open standards
  - including access to the parameter resources, such as domain names, IP addresses
- Unfettered innovation
  - applications on the network
  - applications of the network
- Global in all dimensions
  - not balkanization or walled gardens
- Resilience, robustness, reliability

The Internet – Experience and Network

- The previous slide outlines the future of the Internet *experience* with expectations of the same kind of growth and openness we know today
- At the same time – the Internet *network* you know today will be gone tomorrow – the only question is what it will be replaced by
  - This is the "plumbing" of the Internet
  - As an *inter*network, it is a collective effort – the choices *you* make will determine the make up of this global infrastructure

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Rumbling in the Plumbing

- Since the identified eventual depletion of IPv4 address space became apparent (over a decade ago)
  - Its replacement has been developed (IPv6)
  - End-of-life of the globally connected IPv4 Internet has happened
- Arguments are still made that there "is no business case for IPv6"
- This presentation covers what you need to know about IPv4 and IPv6 to make those choices informed
  - It does not provide "the" business case
  - It gives you the information to consider yours

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Internet Protocol – v4, v6

- IPv4 addresses
  - Enough to accommodate the research network that was being built at the time
    - 32-bit number
    - 2^{32} = 4,294,967,296 IPv4 addresses
  - As of October 18 2010, less than 5% still available to the world (from IANA)
    - Predicted – 8 months until all IPv4 addresses allocated
    - But large allocation requests are already being denied
- IPv6 addresses – defined 1999
  - Enough to accommodate the global Internet, current & future
    - 128-bit number
    - 2^{128} = 340,282,366,920, 938,463,463,374,607,431,768,211,456 IPv6 addresses

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IPv6 – where has it been for 10 years?

- Not interoperable with IPv4
- Need end to end connectivity (or a work around)
- Arguments against beginning deployment have been chicken and egg – demand versus ability; both of these seem to be crumbling in 2010
  - "No business case"
  - "No customer demand"

Future 1: IPv4

What	**The Internet remains entirely IPv4**
Pros	**No IPv6 upgrades** *But, things always change anyway*
Cons	**No new networks** *Even with complete recycling of used addresses, there is a limit* **Network Address Translators (NAT), everywhere** *In the network – not under your control* *Acknowledged to be very complex to manage* **Stifling deployment of new products, services on the Internet** **Degraded performance of existing services** *Patchy, slow Google Maps, for example*
This reflects the past	

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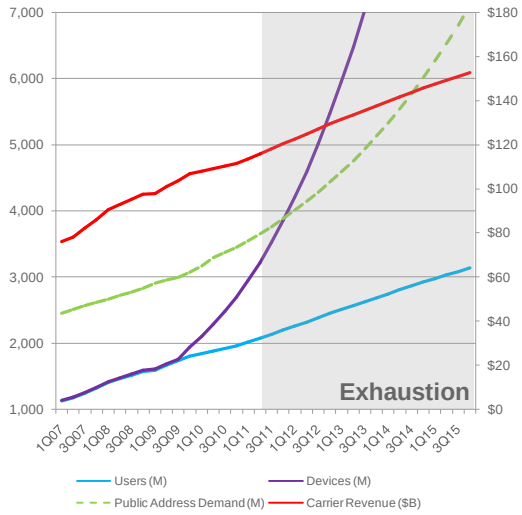
Future 2: IPv4 and IPv6 islands

What	**Current network stays IPv4, new networks are IPv6**
Pros	**Continued deployment of Internet** *New networks*
Cons	**Different networks do not natively interconnect** *Stilted translation* *Cost of translation* **IPv4 island is still failing (Future 1)** **IPv6 islands will grow and outpace IPv4**
This is pretty much where we are today – but it's not stable, and things will go forward (or back)	

Future 3: IPv6

What	**The Internet becomes entirely IPv6**
Pros	**Back to complete connectivity, wide open address space** *For the first time since the 1990's*
Cons	**Requires virtually all systems to support IPv6** **This is years away** *But I won't speculate how many or how few*
	This is an ideal

Breaking the Growth Curve



Exhaustion of public IPv4 space will impact Internet growth

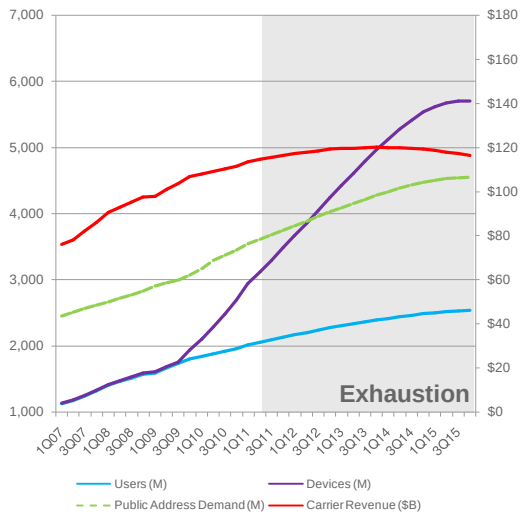
- Increased "friction" and costs are not factored into forecasts

The growth curve will "break" as operators scramble for addresses

Full impact will include:

- Higher operator costs
- Increased operational complexity
- Delays in new initiatives
- Slowdowns in user growth due to cost increases

Breaking the Growth Curve



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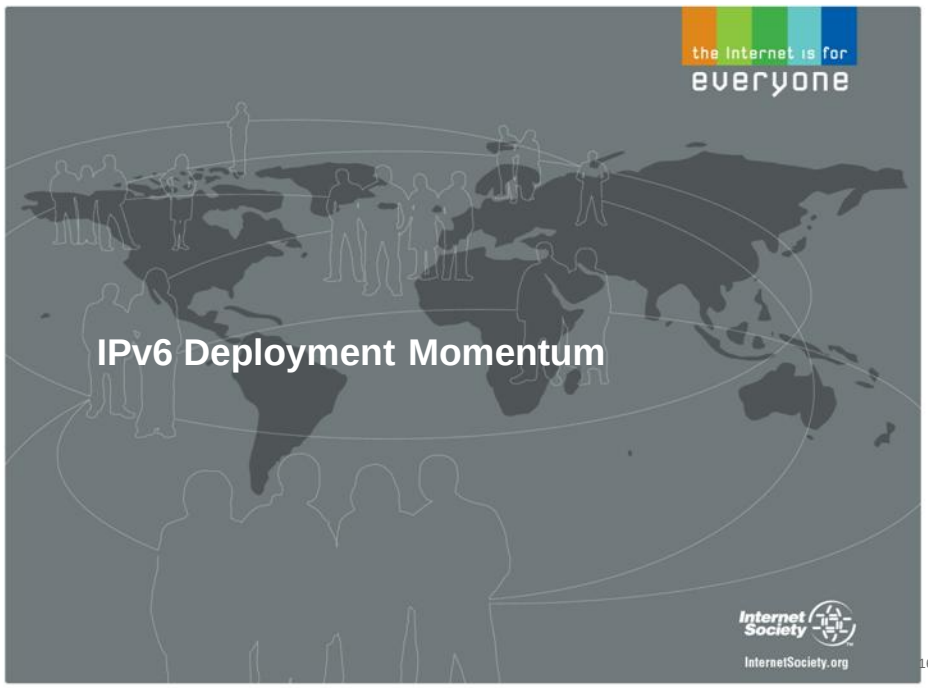
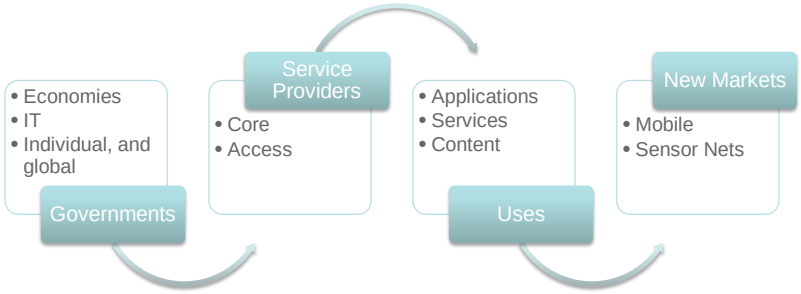


Who is impacted by IPv4/IPv6?



Movement on the Global Stage

- OECD
  - 2008: Internet Address Space: Economic Considerations in the Management of IPv4 and in the Deployment of IPv6, Ministerial Background Report, DSTI/ICCP(2007)20/FINAL, http://www.oecd.org/dataoecd/7/1/40605942.pdf, pp5-6.
  - To create a policy environment conducive to the timely deployment of IPv6, governments should consider:
  - 1) Working with the private sector and other stakeholders to increase education and awareness and reduce bottlenecks
  - 2) Demonstrating government commitment to adoption of IPv6
  - 3) Pursuing international co-operation and monitoring IPv6 deployment
- APEC TEL
  - TELMIN 8 coming up next week with declaration on recommnedations for governments to support IPv6
    - http://www.apectelmin8.go.jp/

Headlines from Governments

- 2008
  - EU issues call to action – target 25% by 2010
  - USG publishes IPv6 profile
- 2009
  - Japan publishes its IPv4 address exhaustion plan in October
    - Almost all Japanese ISPs are following this plan and preparing IPv6 service launch in the April 2011 timeframe
  - USG issues a FAR putting the USGv6 program NIST has been developing into the USG procurement rules.
    - http://edocket.access.gpo.gov/2009/E9-28931.htm
  - Australia moved up their action dates
    - Pursuing whole government deployment by end of 2012 (moved up from 2015)
    - http://www.ipv6.org.au/summit/talks/DBeauchamp_JHillier.pdf
  - Malaysian action plan (2005) is declassified
    - http://www.nav6.usm.my
- 2010
  - US CIO issues directive accelerating IPv6 operational deployment in all federal agencies
    - http://www.cio.gov/Documents/Transition-to-IPv6.pdf

Headlines from Service Providers (core & access)

- 2007
  - Free (France) turns on IPv6 access – available to every subscriber
- 2009
  - Hurricane Electric expands its IPv6 offering
  - Verizon presses requirement of IPv6 in LTE wireless access specs
- 2010
  - Comcast (US) announces IPv6 production trials
  - Verizon (US) announces IPv6 network trials
  - NTT announces worldwide rollout of a dual-stack IP VPN service
  - ATT webcasts IPv6 service offering details for its enterprise customers
  - Quest announces IPv6 offering for all USG customers
  - Verizon announces IPv6 business services
  - XS4ALL offers IPv6 to all subscribers
- Expected by 2011
  - DT has announced it will offer dual-stack service to all its DSL subs
  - Japanese ISPs and access networks are IPv6 capable
- Generally – service providers recognizing that they are in danger of losing government IT contracts without IPv6

Headlines from Content Providers

- 2008 Google begins
  - Building a pilot IPv6 network "was not expensive," said [Lorenzo] Colitti, who recommended rolling out IPv6 in stages. "There's nothing inherently unreliable about IPv6."
  - Google is already reaping the benefits of IPv6. "It's refreshingly simple" to look at a network with globally addressable devices, Colitti said.
    - http://www.networkworld.com/news/2009/032509-google-ipv6-easy.html
- 2009
  - Netflix streaming content over IPv6
  - Limelight providing IPv6 services (content delivery network)
- 2010
  - YouTube accessible over IPv6
- Expected by 2011
  - eBay & Facebook
    - http://www.networkworld.com/news/2010/020410-ipv6-web-sites.html
  - Akamai expects commercial IPv6 service for all customers
    - http://www.networkworld.com/news/2010/091610-akamai-ipv6.html

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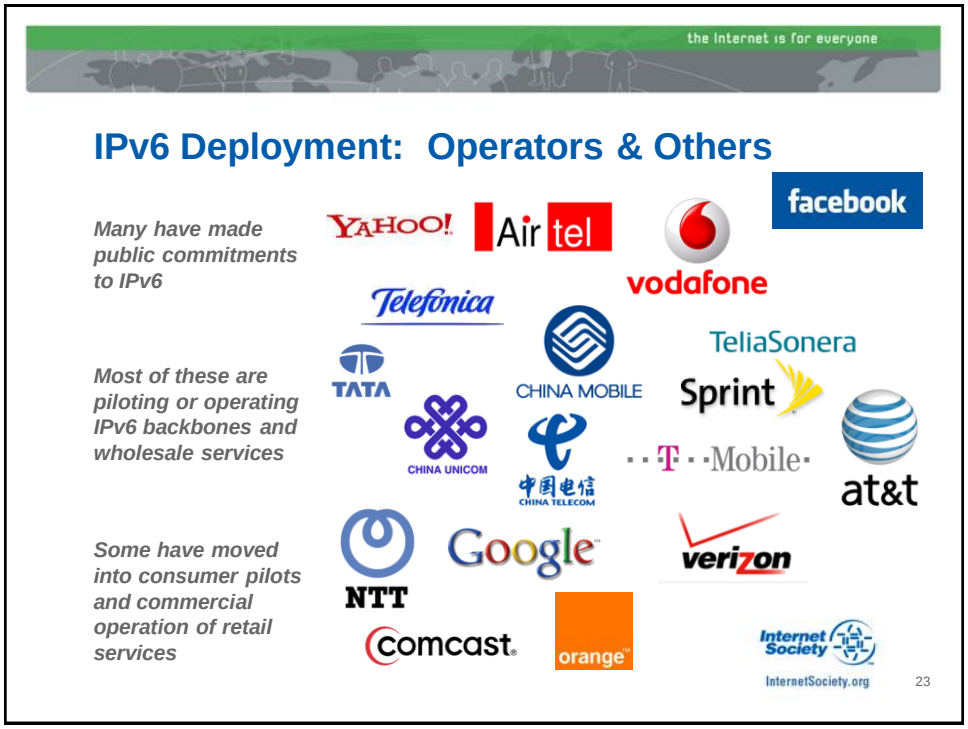
Future Network Scale

- China Mobile added 88M new subscribers in 2008, expecting similar growth in 2009
- IPv6 addresses are the only option for networks of this scale
- ☛ As networks of this scale are built, there will be more IPv6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IPv6 Deployment: Operators & Others
Many have made public commitments to IPv6
Most of these are piloting or operating IPv6 backbones and wholesale services
Some have moved into consumer pilots and commercial operation of retail services
YAHOO!
Airtel
facebook
vodafone
Telefónica
TATA
CHINA MOBILE
TeliaSonera
Sprint
CHINA UNICOM
中国电信
CHINA TELECOM
T-Mobile
at&t
NTT
Google
verizon
comcast
orange
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Conclusions
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What does this momentum mean, if you are…

Relying on "web presence"	Increased demand for IPv6 access to you – consumers out there that want to use IPv6 to access your *DNS servers* *Web, any other Internet services*
Content Provider	Future consumers will only reach your content through IPv6 *or else translation (IPv4 heavy NAT, or IPv6 translation etc)*
Service Provider	Increased interest in and availability of IPv6 internetworking *Perhaps, suddenly.*
Application or service developer	Expect more constraints in IPv4 networks Opportunities to exploit IPv6 vast address space
Building expanding networks	May not be able to get adequate IPv4 addresses for new networks *Includes mobile and sensor networks*
Government	Increased citizen awareness and demand for action

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Recognition of an Important Crossroad

- The choice is not between today's Internet or an IPv6 one
  - There is no option to "stand still"
- The open, innovative, accessible Internet we've been nurturing for 20 years is changing
  - the longer it stays with IPv4, the more "coping mechanisms" will be introduced, breaking uniform global accessibility
  - the sooner we get more IPv6 deployed, the more open and innovative the Internet will remain: Global Addressing
- There is no turning back the clock.
- As more companies take that decision, all companies must re-evaluate their own decisions in the face of the momentum towards IPv6

Documents, feedback

- IP Address Affinity
  - http://www.isoc.org/educpillar/resources/docs/ipv6_200905.pdfAddress sharing
- Issues with Address Sharing
  - http://www.ietf.org/id/draft-ietf-intarea-shared-addressing-issues-01.txt
- Issues
  - Will impact subscribers
    - NAT and ALGs in the core => subscribers apply to their network provider to get incoming ports opened as necessary
    - Operators won't necessarily support this
  - Potential impact for law enforcement
  - Users get crippled Internet functionality (near term) and/or architecture fundamentally imperiled

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ISOC's IPv6 Resources Page

- Link here:
  - http://www.isoc.org/ipv6
- Reports of activities we have conducted
- Pointers to ISOC IPv6 Resources
- Pointers to important IPv6 Resources from the various regional registries, ICANN and policy materials on related IPv6 matters

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