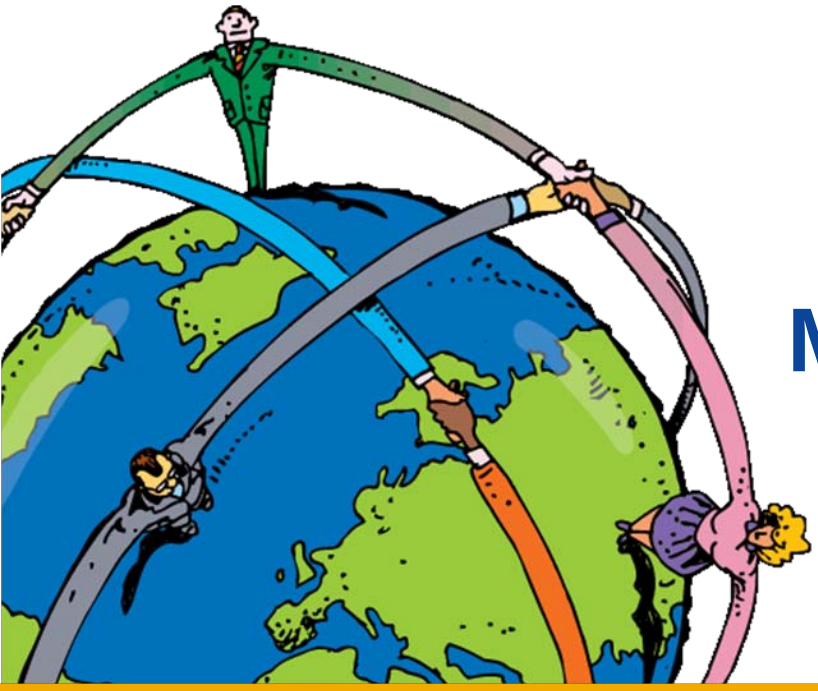

Rethinking Internet Routing Architecture: Motivation and Response

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The Status Quo

- **For the most part, Internet routing works well**
  - Availability – we are surprised when things go wrong
  - Convergence – fast enough to satisfy most applications
  - Scalability – millions and millions of sites connected
  - Stability – Route churn is acceptably low
- **Operators are averse to architectural change**
  - Cost
  - Risk
- **Stress motivates change**
  - If it ain't broke, don't fix it!!
  - If it's bleeding, call the doctor!

Sources of Stress: Real And Imagined

- IPv4 Address Pool Exhaustion
- Routing Table Growth
- Locator/Identifier Semantics
- Aging Routing Protocols

IPv4 Address Pool Exhaustion

- **Geoff Huston projects**
  - IANA pool of unallocated address space will be exhausted on May 22, 2011
  - RIR pools of unallocated address space will be exhausted on September 7, 2012
  - Source: http://www.potaroo.net/tools/ipv4/index.html
- **This is a significant source of stress!**
- **It will motivate change**
- **Economic factors determine how exactly how the Internet will change**

Possible Responses to IPv4 Address Space Exhaustion

- **Cataclysmic implosion of the Internet**
  - Mentioned for shock-value only
- **Rapid, universal deployment of IPv6**
- **Continued use of the current, IPv4 infrastructure**
  - Adapt business and operational procedures to compensate for shortage of IPv4 address space
- **Gradual transition from IPv4 to IPv6**
  - Some migrate, some don't

Rapid Transition to IPv6

- **Problematic but possible**
- **High operational investment required**
  - By ISPs
  - By end-users
- **Translation mechanisms not widely deployed**
  - Required for IPv4-only devices to communicate with IPv6 only devices
  - Especially important during transition period
- **Need to settle on a single tunneling mechanism**
  - Address islands of connectivity

Continued Use of IPv4 infrastructure

- **Possible**
- **Address space trading**
  - Address space for sale
  - Holders of large, sparsely populated address blocks will be motivated to renumber and sell unused space
  - May change the economics of the Internet
- **More IPv4-to-IPv4 NAT**
  - Breaks some things
  - But these things are well-known as NAT is widely deployed
- **More L3VPNs with NAT gateways to the Internet**

Gradual transition from IPv4 to IPv6

- **In the short term, continue use of the current, IPv4 infrastructure**
  - Adapt business and operational procedures to compensate for shortage of IPv4 address space
- **In the long term, transition to IPv6**

Routing Table Growth

- **Given that Internet routing tables continue to grow at their current rates, this problem is less immediate than that of IPv4 address space exhaustion**
  - Most vendors produce hardware that will support significant table growth and plan next-generation hardware that will support additional growth
- **Each solution to the problem of IPv4 address space exhaustion suggests a different solution to the problem of routing table growth**

Locator/Identifier Semantics

- In and of itself, not a problem
- Only a problem inasmuch as it contributes to routing table growth

Aging Routing Protocol

- **In and of itself, not a problem**
- **Only a problem inasmuch as old protocols cannot be extended to support new requirements**
  - Significant instances of non-extensibility yet to be found
- **When 99.999% availability is required, old is good!**

Conclusion

- Solve the most pressing problem first
- Gain operational experience in the new environment that emerges
- Solve less pressing problems with the benefit of that operational experience
- Ignore non-problems