



Google IPv6: Why and How

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Why?

- When the day comes that users only have IPv6, Google needs to be there.
 - IPv4 runout.
 - AJAX applications break behind excessive NAT.
 - Connections exhaust public IP port space.
 - NAT traversal complicates apps like Google Talk.
 - Developer time better spent elsewhere.
- IPv6 is good for the Internet, and we want to help.

What we have done so far

- IPv6 network, systems and software.
- IPv6 websites.
 - ipv6.google.com (Mar 2008)
 - ipv6.google.cn (Aug 2008)
 - ipv6.google.co.jp (Oct 2008)
- IPv6 evangelism
 - Google IPv6 conference (Jan 2008)
 - IETF panels, blackout sessions, ...

The root of the problem

- We are all waiting for someone else to do something about the problem.
 - (Particularly if doing something costs money.)
- Chicken and egg problem!
 - ISPs say there is no content.
 - Content providers say there are no users.
- All the same, the writing is on the wall...
- How do we break the cycle?

Creating a chicken

- Provide content over IPv6.
- Operational/deployment vicious cycle:
 - Low adoption => low traffic
 - Low traffic => bad connectivity
- Basic problem: how do we offer IPv6 content without harming user experience?

No www.google.com AAAA

- We can't enable IPv6 for www.google.com today.
 - Our figures show ~1 in 10000 broken users.
 - Not awful, but too much for Google.
 - Our figures show ~150ms of RTT penalty.
 - Like going from Europe to the West coast!

So what's the problem exactly?

- Symptoms:
 - Slowness, failure to connect
- Only deployment problems
 - IPv6 not inherently any less reliable than IPv6
- Causes:
 - Long paths
 - Non-optimal routing
 - Broken middleboxes
 - MTU issues

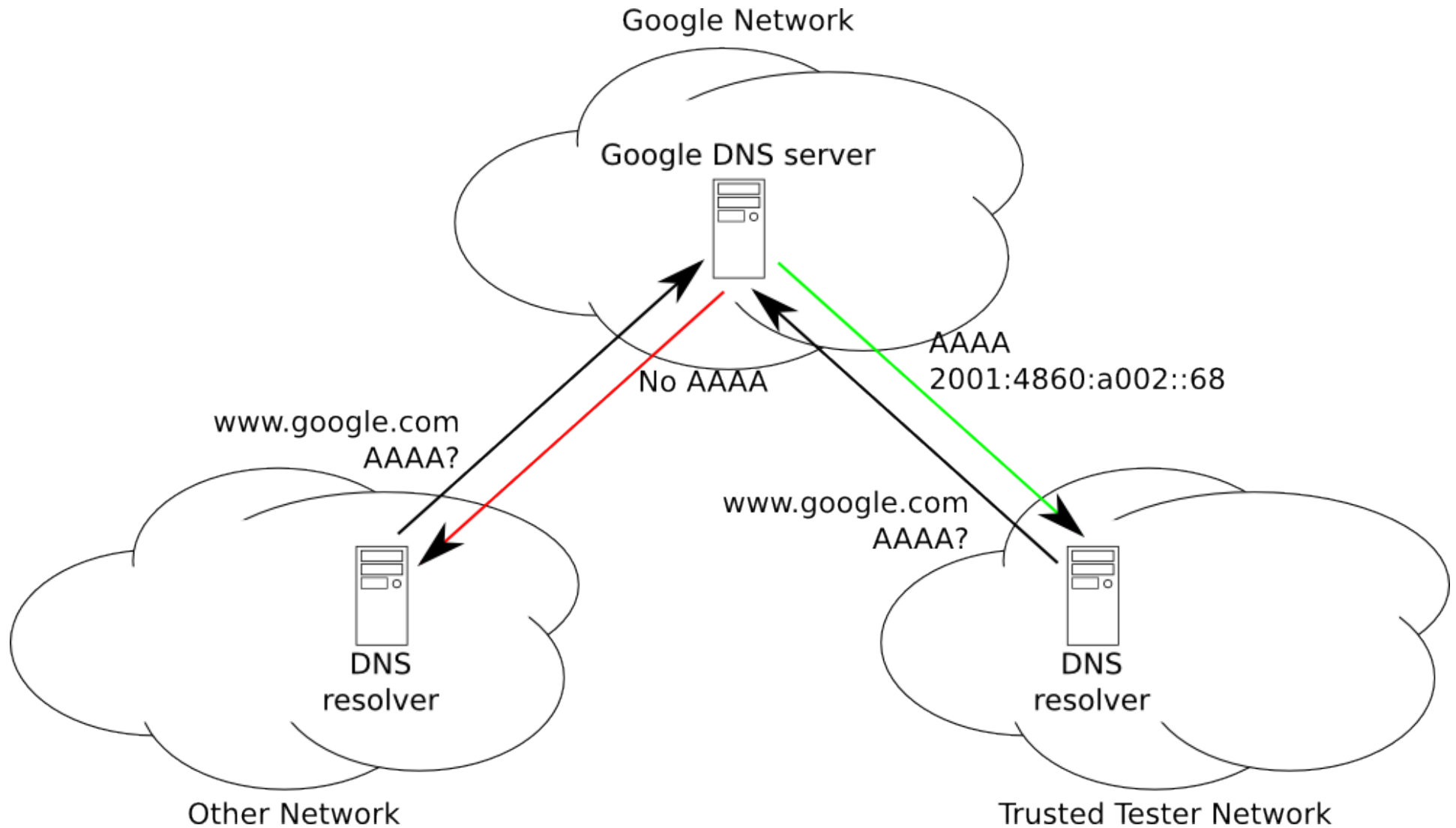
Peering instead of transit

- Avoid bad routes by not taking transit.
 - We don't have an IPv6 transit provider.
 - But we peer with almost everybody.
- Avoid suboptimal routing by peering with user networks directly.
 - Guarantees better service and low latency.
 - Since both networks care, IPv6 issues get fixed.

IPv6 Trusted Tester program

- Enables IPv6 access to Google for selected networks.
- IPv6 access to most Google web properties.
 - www, mail, calendar, docs, ... (no youtube yet)
 - Which ones do *you* and your users want?
- Works by DNS resolver IPv4 address.
 - If the user's DNS resolver is in a whitelist, it will receive AAAA answers.
- Discussions underway with HEAnet.

IPv6 Trusted Tester program



A few more thoughts

On IPv6 Costs

- Some vendors charge separately for IPv6 support.
 - Red tape blocks initial experimentation / deployment.
- Charging separately for IPv6 *will* hinder adoption.
 - Absorb cost by raising price of base image or HW.
 - The Internet will thank you!
 - The same goes for ISPs, exchanges, ...
- "Carrier-grade NAT" is not a business or operational model.
 - IPv4-only entities are a small part of deployment.
 - The proportion will only get smaller.

On porting applications

- Problem: many applications don't support IPv6.
- Not as bad as you might think.
 - IPv6 supported in all browser apps, bittorrent, ...
 - NAT-PT can take care of many of the rest.
- But mostly:
 - IPv6-capable applications will only emerge when users and developers get IPv6 connections.
 - If you want IPv6 support in applications, roll out IPv6 to users...



Questions?