IPv4 Unicast Extensions

“Legacy IPv4 will coexist with IPv6 indefinitely.”

- The Hidden Standards War: Economic Factors Affecting IPv6 Deployment

John Gilmore, Dave Täht
Paul Wouters
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IPv4 Unicast Extensions

“Even if they have deployed IPv6, growing networks must continue to acquire scarce, increasingly expensive IPv4 addresses to interconnect with the rest of the Internet.”

- The Hidden Standards War: Economic Factors Affecting IPv6 Deployment

Unicast Won

- Globally routed Unicast is the success story of the Internet
- Large % of the traffic is globally routed unicast (some translated from behind NAT)
- Global Unicast addresses are the ones we’re running out of
- All other kinds of IPv4 addresses are tiny niches

- Current IPv4 address allocation doesn’t reflect that.

IPv4 Addresses now COST

- An IPv4 address market exists
- Current costs are ~US$20 per addr, and rising
- Why do we care?
  - Innovators need addresses
  - Big incumbents are buying them wholesale
    - So they won't ever run out
    - And so startups won't be able to afford to compete
  - A barrier to competition from startups
- It's all fine if we want Internet innovation to stop
- Or be run by monopolists...

Reducing the Cost

- Land speculators say “They ain’t making more of it” -
  - But we CAN make more IPv4 addresses
  - It’s not hard.
  - It’s just a few patches...
  - A spec change...
  - And 5-7 years to deploy

Who Are We?

- Tech geeks who do protocols & policy sometimes
- We noticed IPv4 addresses are getting expensive and scarce
- Investigating what it would take to make more

- This is a **moonshot** talk.

- This is not a Linux issue. Or a *BSD issue. Or a Windows issue. It’s a protocol issue with both technical and political aspects.

Who Are We?

- John Gilmore
  - BOOTP/DHCP, DNSSEC, IPSEC, crypto, free software, EFF
- Dave Taht
  - CoDel, MakeWifiFast, …
- Paul Wouters
  - IPSEC, Red Hat, ...

The Internet Isn’t Finished

- It’s an experiment
- It’s a success disaster
- ...more quotes from Karl Auerbach...

Some IPv4 Address history

- Class A, B, C addrs. Now known as /8, /16, /24.
- 0/8 was “find my network number” in 1984, but didn’t work on LANs. Oops. Retired in 1989, RFC 1122. Replaced by BOOTP, DHCP
- 127/8 - Loopback got its own Class A network number
- 224/4 and 240/4 reserved in 1984 for future experiments. No experiment ever took place in 240.
- Class A/B/C didn’t fit real networks. CIDR replaced them. Took years to deploy. Required changing every Internet node.
- 224/4 used in 1988 for multicast, but it never scaled like unicast

Make New IPv4 Addrs How?

- A small specification change
- Small patches to kernels, userspaces, configs, routers
- A set of testbeds – local, then global
- Iterate the above until it all works

- Only then tackle politics of how to allocate them
- Make “running code” to enable later “rough consensus”
- “Consensus first” screwed it up 10 years ago. Running code first.

Reserved for Future Use?

- The Future is Now.
- 240/4 as Global Unicast
  - Has worked in Linux, MacOS, Android since ~2010
  - Last nit fix for linux landed in December
  - Patches now available for *BSD.
- 0/8 as Global Unicast
  - Never used except 0.0.0.0.

Underutilized Addresses?

- While updating every node, extend these too.
- 127/8 - Loopback
  - Only tiny numbers of /24s seen in use
  - The other 16 million addresses are unused
  - Let’s make them unicast
- 224/4 - Multicast
  - Currently has 268 million addresses
  - 128m never ever allocated, never used. Make them unicast
  - Reclaiming more is probably feasible.

Typical Patch (for linux)

- TODO Insert 0.0.0.0 patch

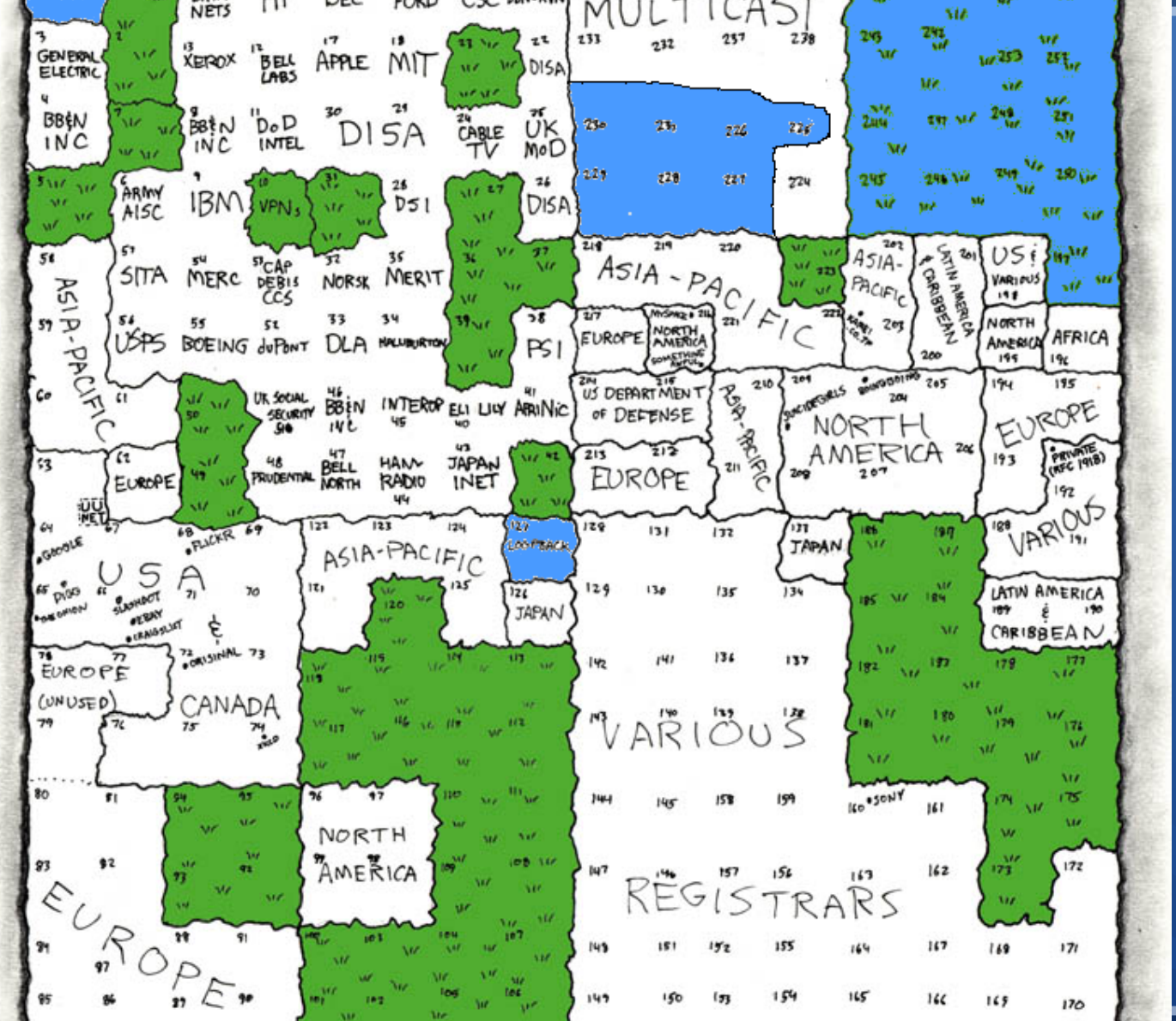
Extend Every Subnet Too

- Zeroth address in subnet: fully usable as ordinary host
  - Was reserved in 1980s due to 4.2BSD using it for Broadcast (Oops)
  - Which made broadcast storms when talking to standard nodes.
  - 4.2BSD long gone; let users put nodes there!
- Final address in subnet: fully usable in Point-to-Point nets
  - In LANs, still reserved for Broadcast
  - Fully usable as ordinary host in non-LAN subnets.
- This extends each /29 from 6 to 7 usable addrs!
- And makes P2P interfaces only consume a /31.

Next Steps

- Keep landing patches, testing, doing interop
- Document and fix all the problems
- Once we can prove everything is working…

- Then deal with IETF, IANA , ICANN, RIRs, etc.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