# *ARIN & CAIDA Sept 2008 IPv6 survey summary*

kc claffy & Bradley Huffaker
ARIN XXII meeting
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Los Angeles, CA

# our oil crisis: IPv4 exhaustion

- our experiment with consensual treatment of integers has hit a snag: IANA will run out of IPv4 addresses in 'a few' (2-3?) years
  - how do we accommodate continued growth and innovation?

- possible solutions
  - steward transition to IPv6 (w/many hearts, & some .gov.* )
  - NATs all the way down (guarantees a worse world)
  - steward reclamation of IPv4 (our country 'tis of lawyers)
  - steward a market for IPv4 (we vigorously gave up once)
  - magic confluence (what got us ipv4 in the first place)

# measuring IPv6 use: data

- Hurricane: bgp.he.net/ipv6-progress-report.cgi
- Arbor study: .002% of customer traffic, growing
- APNIC: bgp, AS, dns, http queries .02-1%
- MRP: mrp.net/IPv6_Survey.html  <1%
- CAIDA studies: AScore6 posters, .004% traffic
- v6ops ietf mailing list, e.g. Abrahamsson (.se)
- Google, RIPE Oct 08: 0.24% clients 6capable

- DREN met OMB deadline June 08
  - DOD NIC issues v6 prefixes since July 2008
  - copious notes on what works and doesn't
    ( http://www.internet2.edu/presentations/jt2008jul/20080722-broersma.pdf )

# measuring IPv6 use: reality

- measurement in this area pretty unsatisfying
  - no rigorous definition of 'use' means
  - no incentive to provide access to data, if it even exists
  - like so many other critical questions about the Internet..

- alternatives to actually measuring use
  - find marginally related data set+liberal assumptions
  - base opinions on trusted ideology
  - hope for the best
  - work on obstacles to actually measuring use

# measuring IPv6 uptake: survey

- attempt a "census": survey through RIR channels
  - March 2008:  ARIN region (350)
  - Sept 2008: all regions  (1100)
  - start to build some history

- caveats:
  - unknown number respondents per org
  - economic, political and psychological dust on the lens
  - anonymity limits utility
  - survey expanded geographically, so trends may mislead
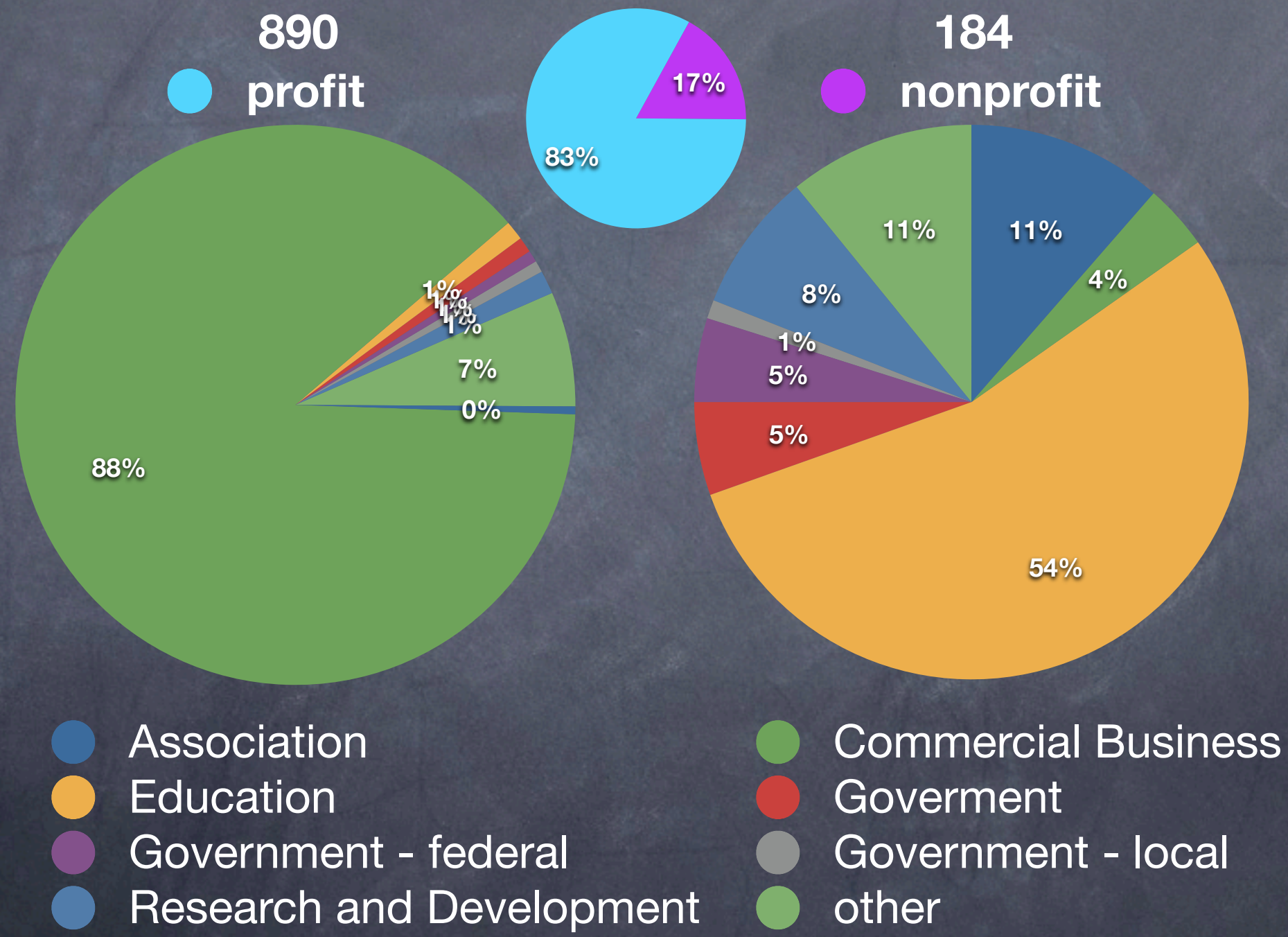  - more caveats on specific slides

# IPv6 sept 2008 survey results

- respondent demographics
  - organization type, size, RIR used, geography
  - people least conscious of IPv6

- IPv6 penetration as a function of above parameters

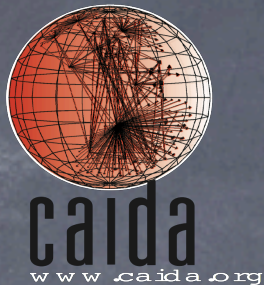- IPv6 motivations, hurdles, plans, expectations

- words to remember
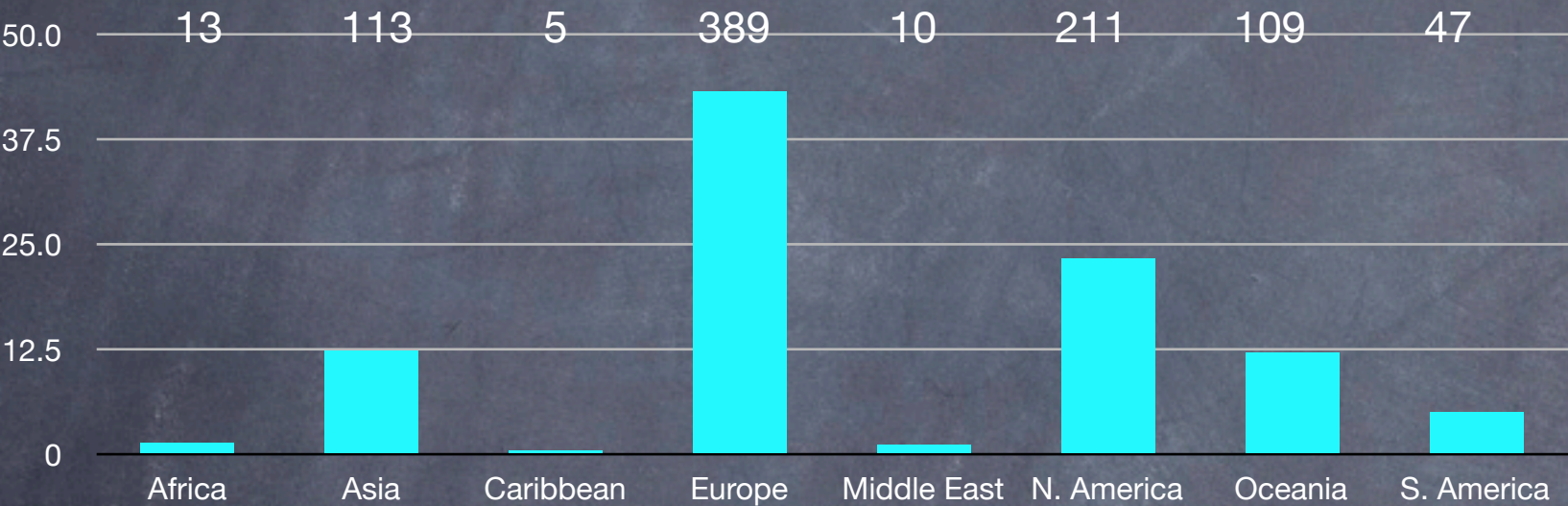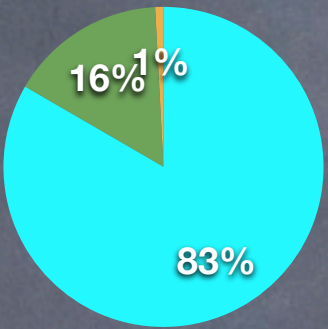
# Geographic Breakdown

# Geographic Breakdown

## Regions of Operation

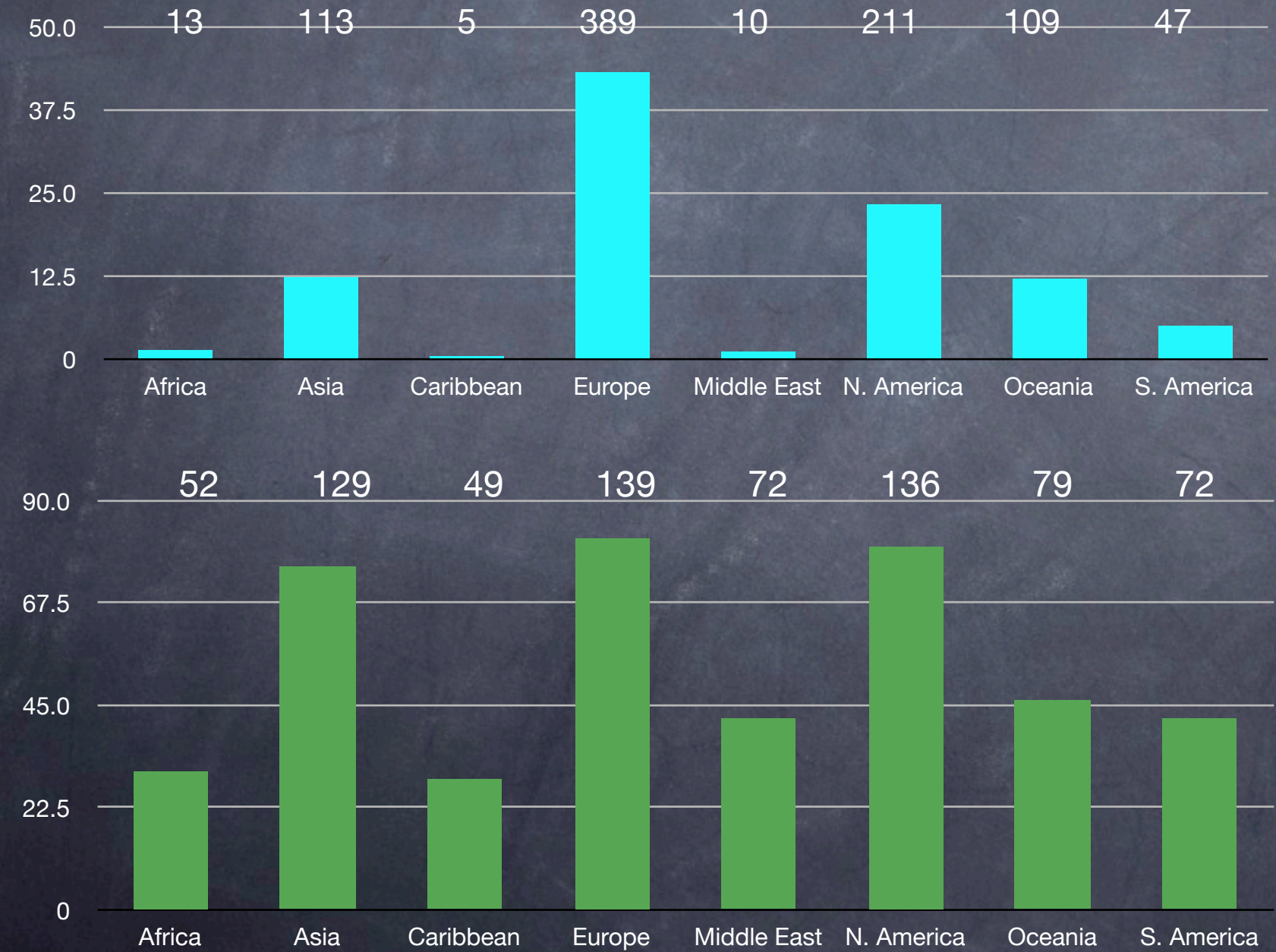● single  ● multiple  ● unknown
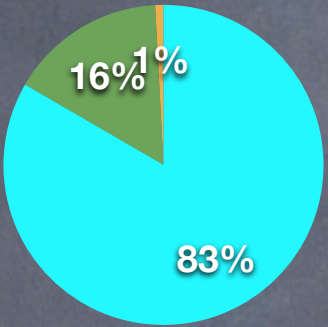
16% 1%
83%

## Operate in single country

| country | total | percentage |
|---|---|---|
| UNITED STATES | 173 | 21.84 |
| AUSTRALIA | 61 | 7.70 |
| GERMANY | 43 | 5.43 |
| UNITED KINGDOM | 40 | 5.05 |
| NEW ZEALAND | 33 | 4.17 |
| RUSSIAN FEDERATION | 25 | 3.16 |
| NETHERLANDS | 24 | 3.03 |
| BRAZIL | 22 | 2.78 |
| ITALY | 19 | 2.40 |
| CANADA | 19 | 2.40 |
| JAPAN | 18 | 2.27 |
| INDIA | 17 | 2.15 |
| FRANCE | 17 | 2.15 |
| THAILAND | 13 | 1.64 |
| MEXICO | 12 | 1.52 |
| SWEDEN | 11 | 1.39 |
| CZECH REPUBLIC | 10 | 1.26 |
| NORWAY | 10 | 1.26 |
| **other** | 83 | 10.48 |

Top chart (single) values:
| Africa | Asia | Caribbean | Europe | Middle East | N. America | Oceania | S. America |
|---|---|---|---|---|---|---|---|
| 13 | 113 | 5 | 389 | 10 | 211 | 109 | 47 |

Bottom chart (multiple) values:
| Africa | Asia | Caribbean | Europe | Middle East | N. America | Oceania | S. America |
|---|---|---|---|---|---|---|---|
| 52 | 129 | 49 | 139 | 72 | 136 | 79 | 72 |

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# Organization Size

Small (<100)
550

Medium (<1,000)
254

Large (<10,000)
167

Very Large (>10,000)
103

Legend:
- Europe
- N. America
- Oceania
- S. America
- unknown
- Middle East
- Caribbean
- Africa
- Asia
- multiple
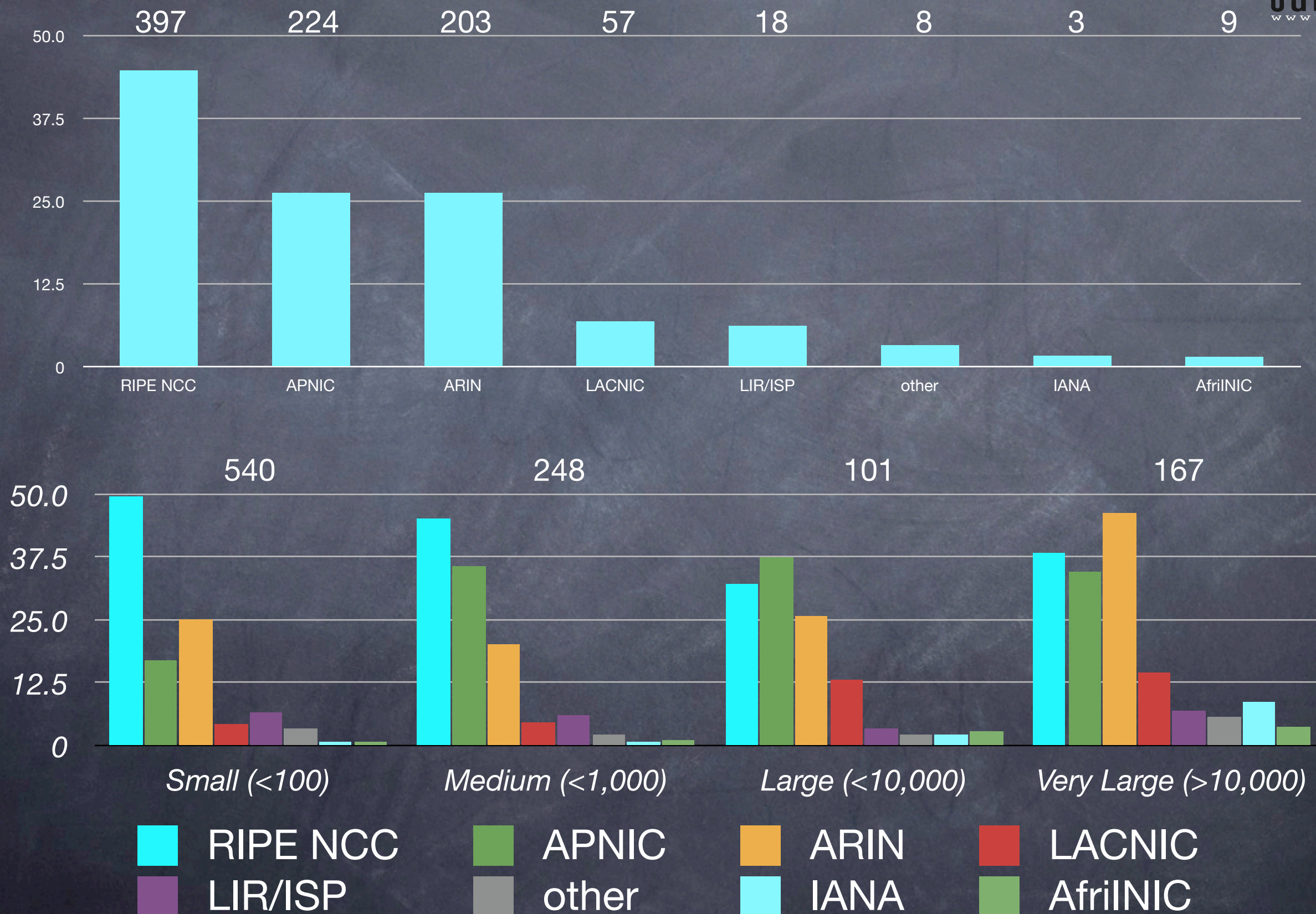
9
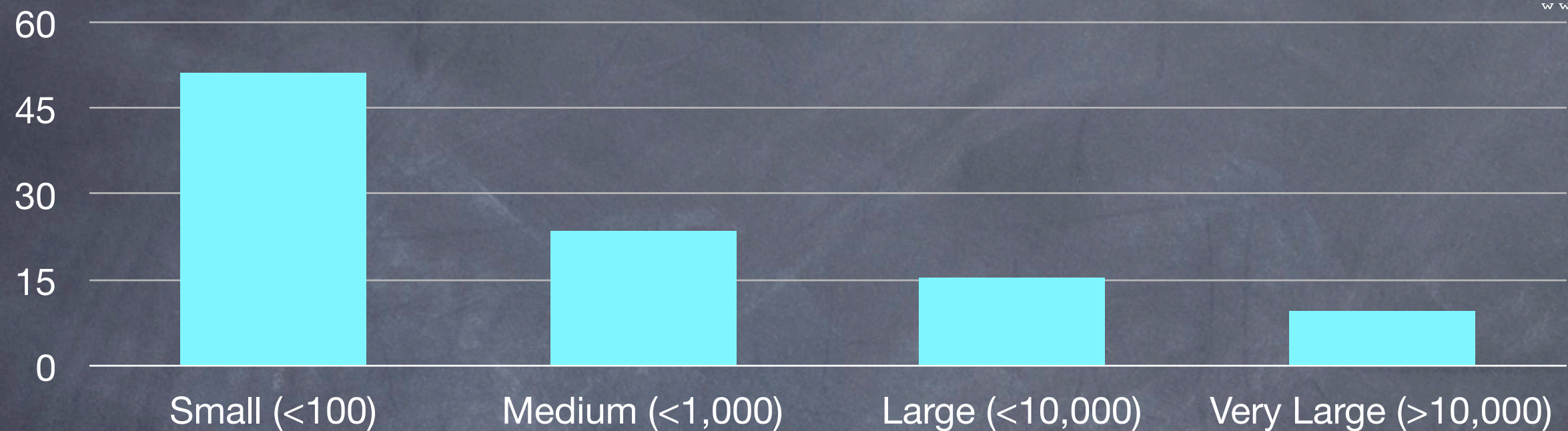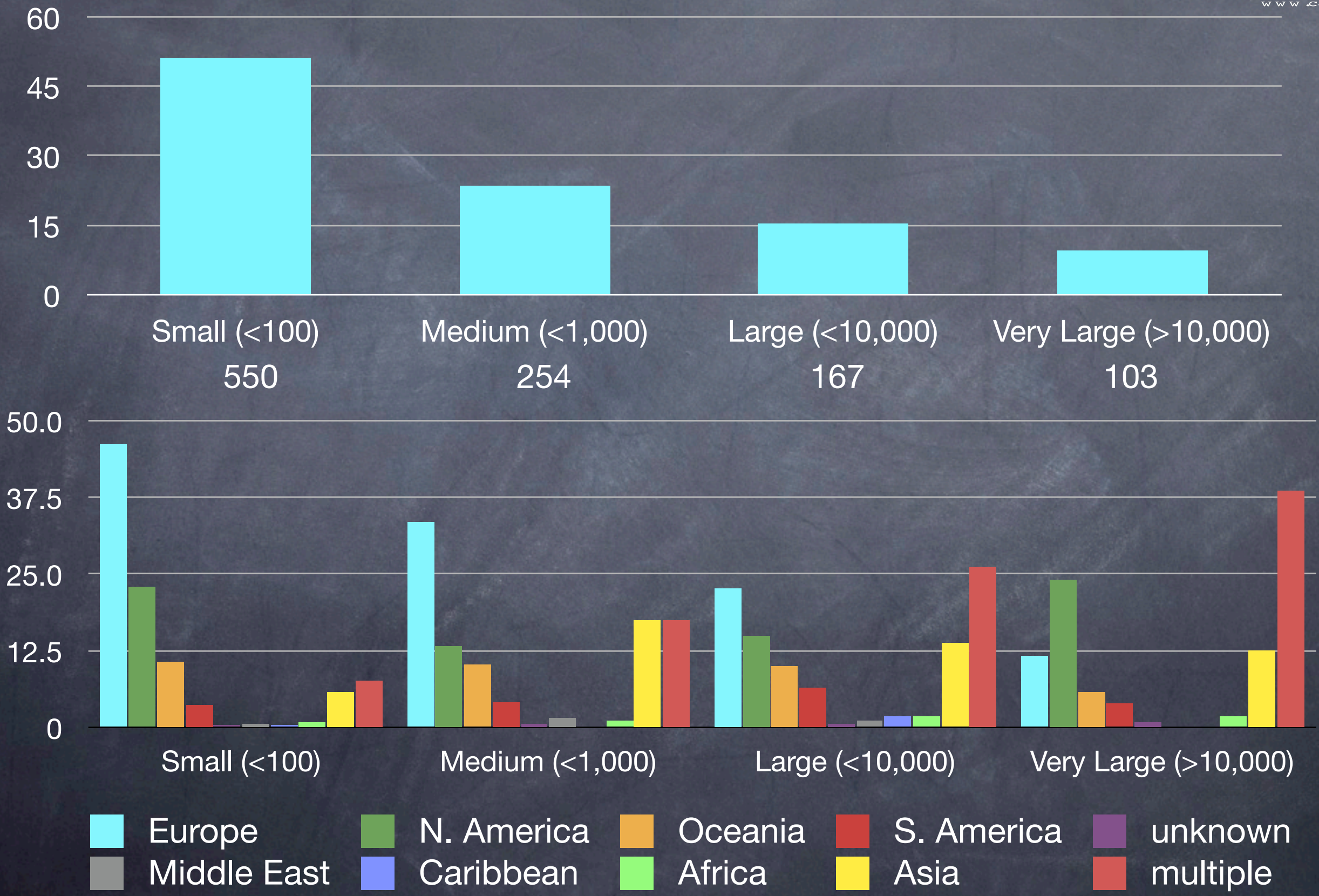
# Source of Allocations

10

# what did respondents say about:
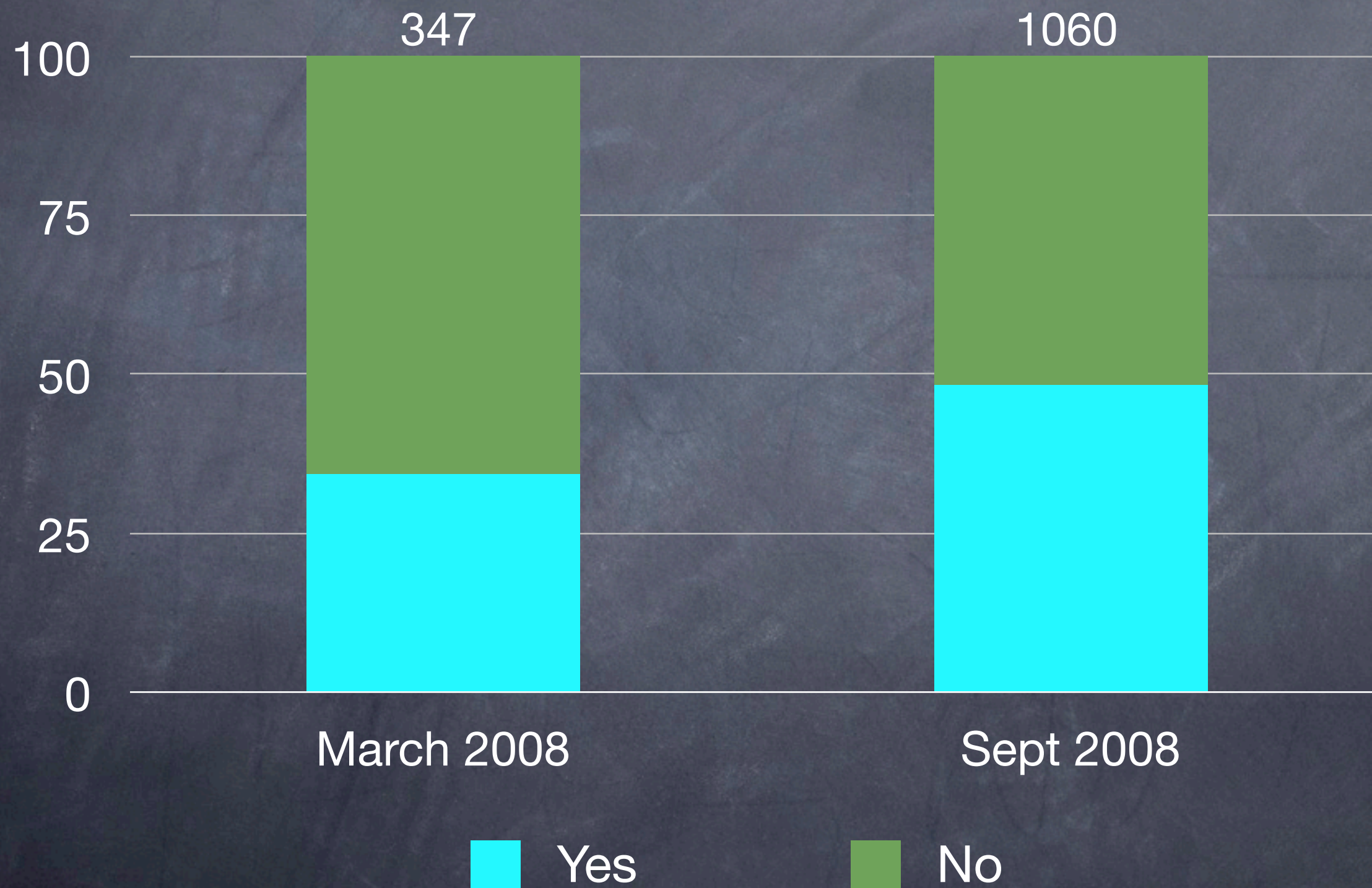
- IPv6 activity, nature of service

- motivation, hurdles

- expected needs next year

- strategy for next phase of growth

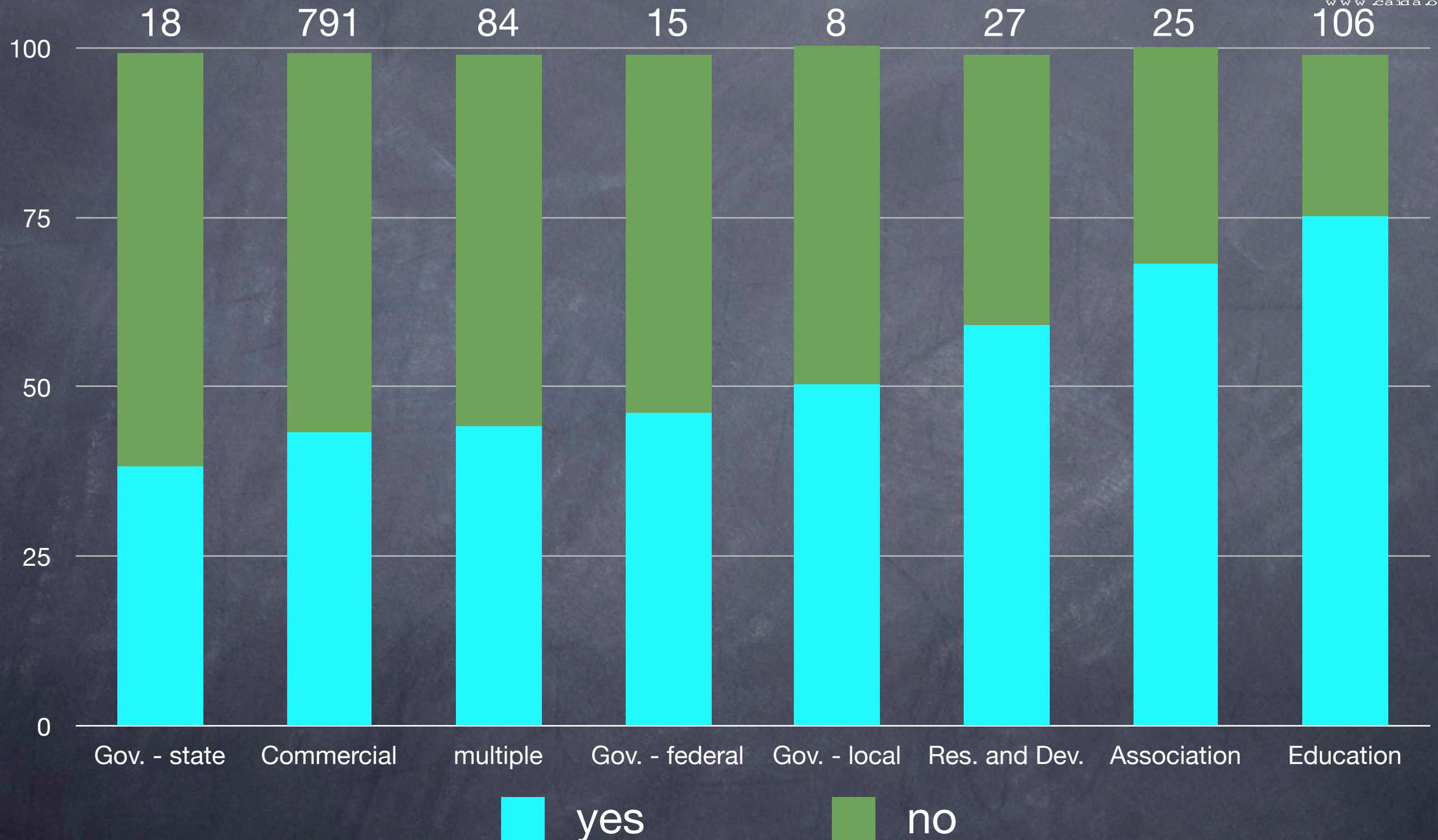IPv6 allocation by organization type

caveat: skewed distribution of orgs. but no observable change:people with resources more likely to have ipv6 resources   13

# IPv6 allocation from which RIR?



caveat: skew, respondent bias, iana doesn't allocate v6...

# motivation for getting IPv6

| Motivation | Value |
|---|---|
| Want to be "ahead of the game" | 446 |
| To make sure IPv6 is supported in our products | 351 |
| Customer demand | 148 |
| other (e.g., research) | 75 |
| Couldn't get enough IPv4 addresses | 64 |
| Government mandate | 40 |

caveat: first two answers squishy, "other" too ambiguous

# hurdles for ipv6



precentage of respondents

| Category | Value |
|---|---|
| Dual support for IPv4 and IPv6 at the application level | 485 |
| Lack of IPv6 expertise | 442 |
| Lack of support from transit providers | 359 |
| other | 312 |
| Lack of support from end users | 291 |
| Problems with legacy applications | 272 |
| Cost of new hardware | 267 |
| Vendor support - routers | 262 |
| Problems with legacy network system | 245 |
| Vendor support - firewalls | 227 |
| Vendor support - server applications | 212 |
| Vendor support - host applications | 161 |
| Multi-home problems | 142 |
| Vendor support - OS | 140 |

"Virtually every box could be checked. Registry policies & procedures are also a serious problem."
"lack of quality support in residential cpe and middleboxes (firewalls, load balancers, ddos mitigation)"
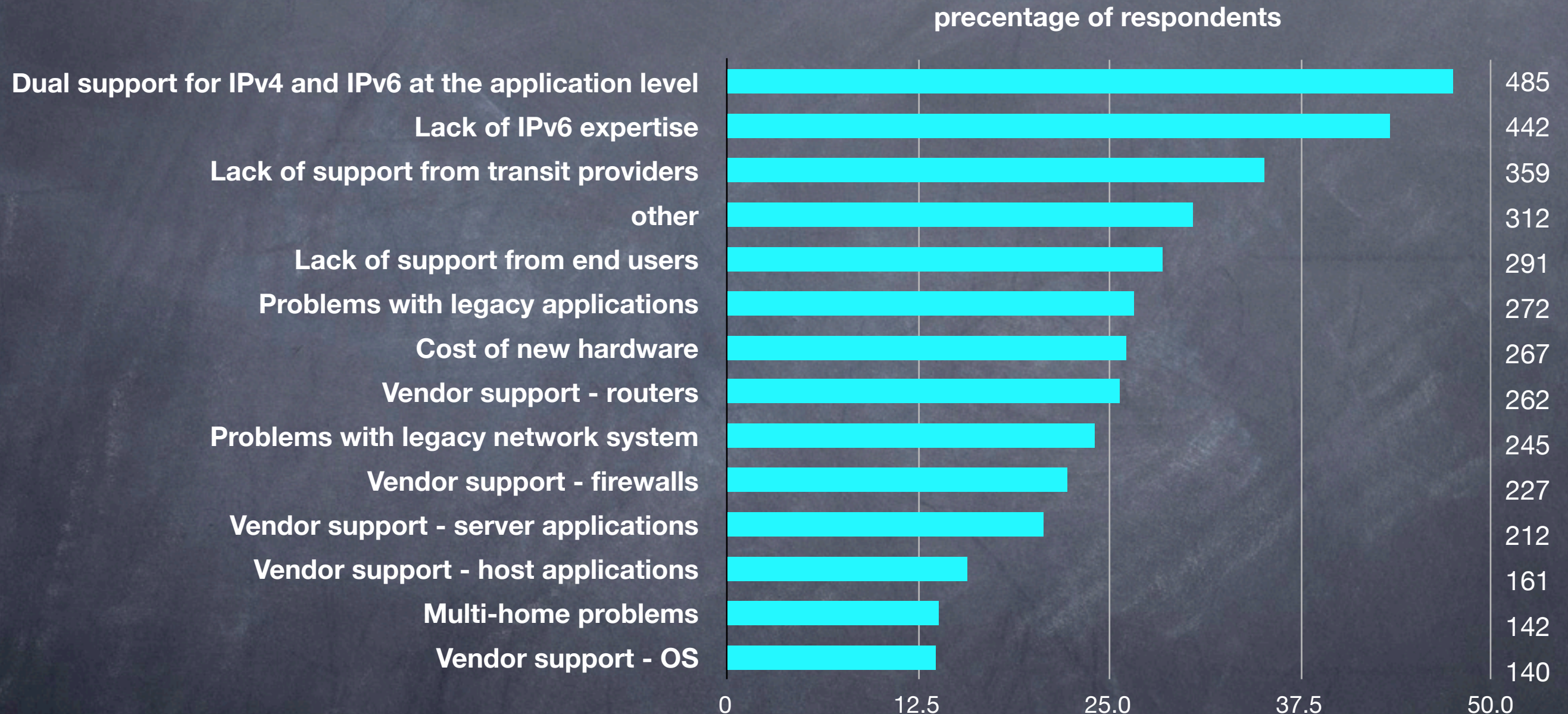
16

# hurdles for ipv6

"Virtually every box could be checked. Registry policies & procedures are also a serious problem."

"lack of quality support in residential cpe and middleboxes (firewalls, load balancers, ddos mitigation)"

"The main part of our business is web hosting and there seems little point putting much effort in to hosting on ipv6 if no content consumers have it and all requests will come in as ipv4 anyway (or am I demonstrating the 'lack of ipv6 expertise' here?)"

"we don't see the point, if you're gonna run dual stack anyway, choose something decent, ipv6 is in our opinion one of the more crappier protocols, just like ipv4, doesn't bring anything to switch from crap to crap."

"Lack of organizational capability to deploy. IT = triage. We only spend time working on things that are "broken". Until IPv4 is "broken" or causes a problem, most IT shops.. probably won't migrate, even if there was reasonable benefit. I also..lack trust that [sysadmins and developers] are sufficiently educated in IPv6. .. These guys still hard-code IPv4 addresses into applications and configuration files. Too many joe-blow admins out here."

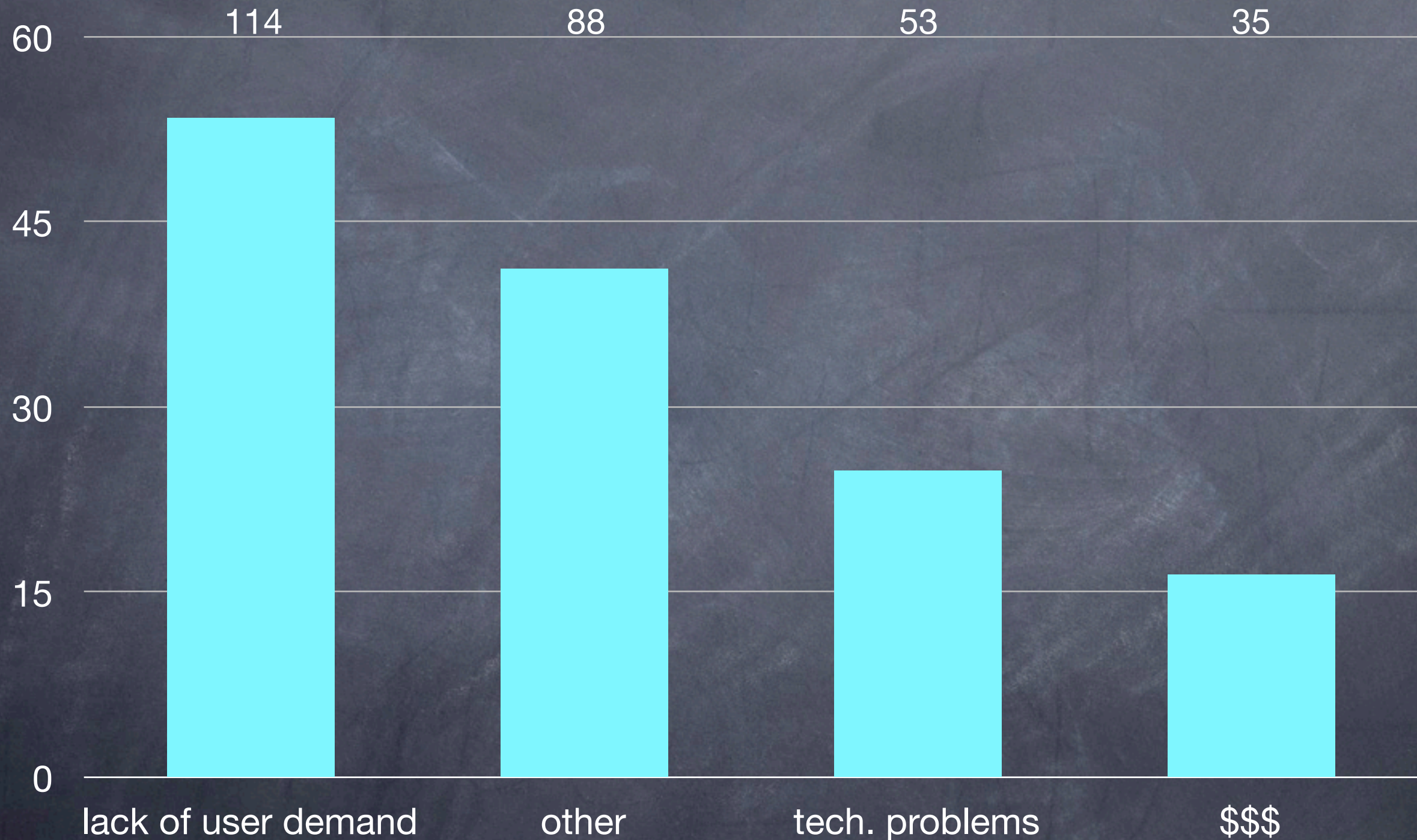**"Why spend the money if there is no extra profit?"**
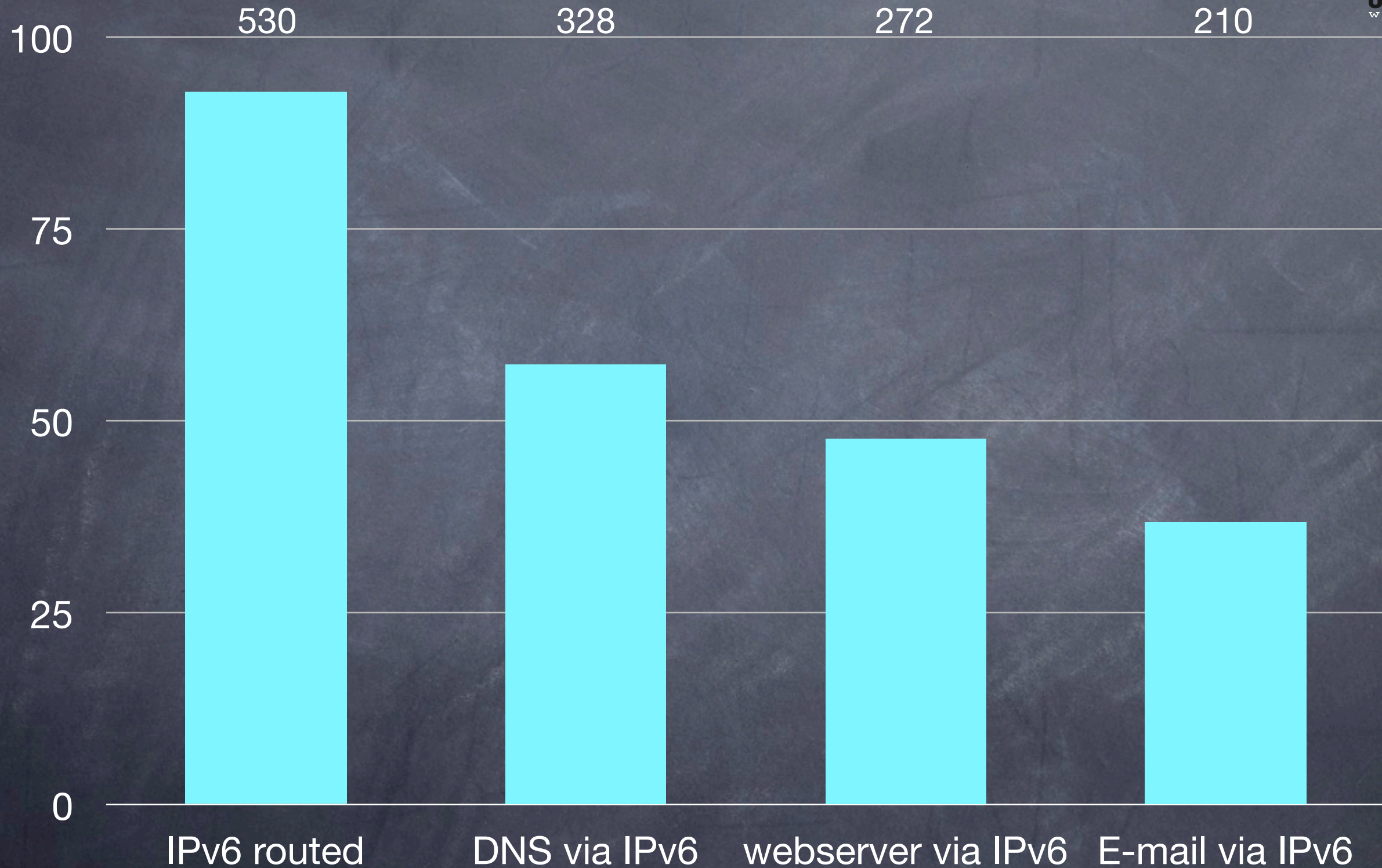
# does size affect what hurdle is?



caveat: "application support" euphemism for demand

18
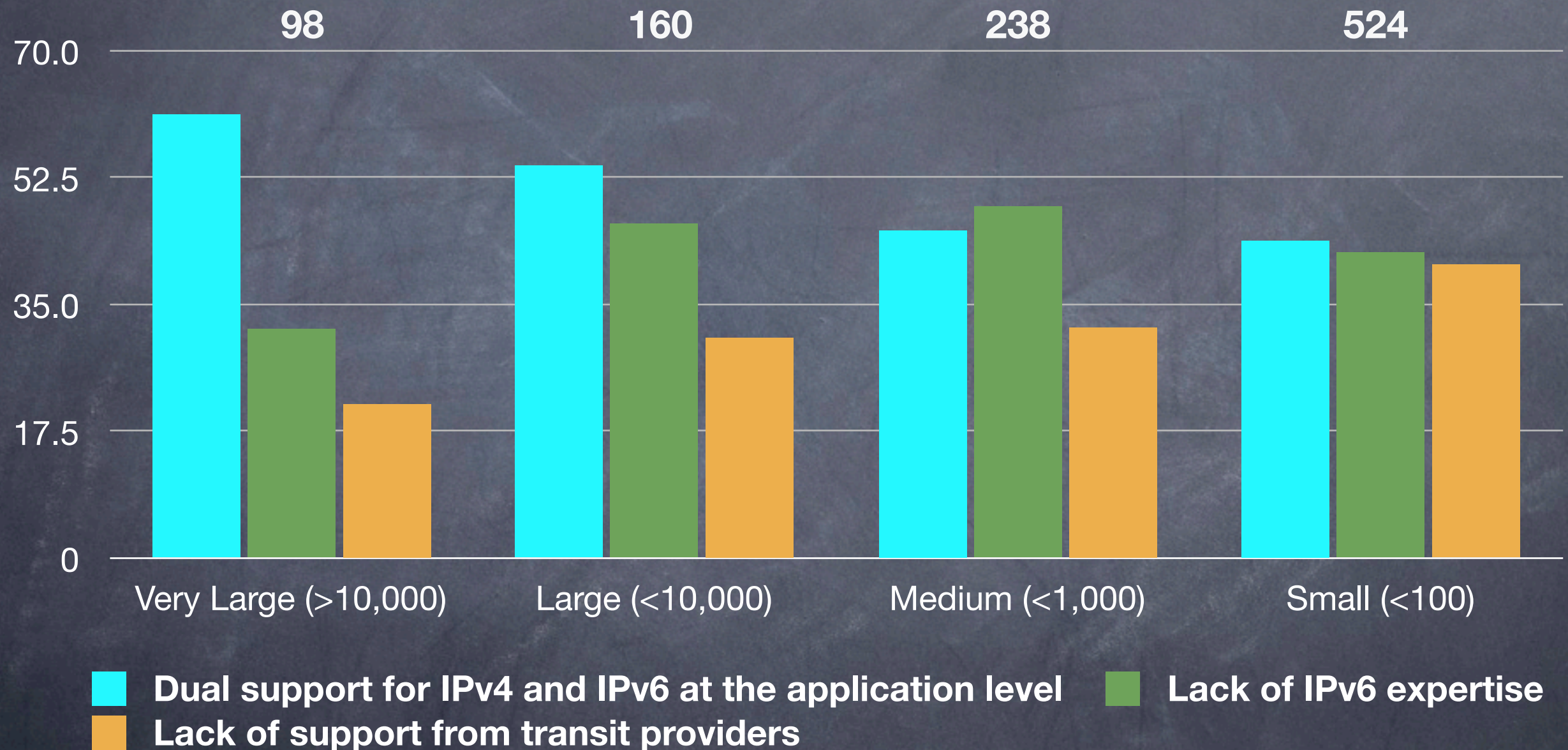
# nature of ipv6 services



caveat: iff you have ipv6 services
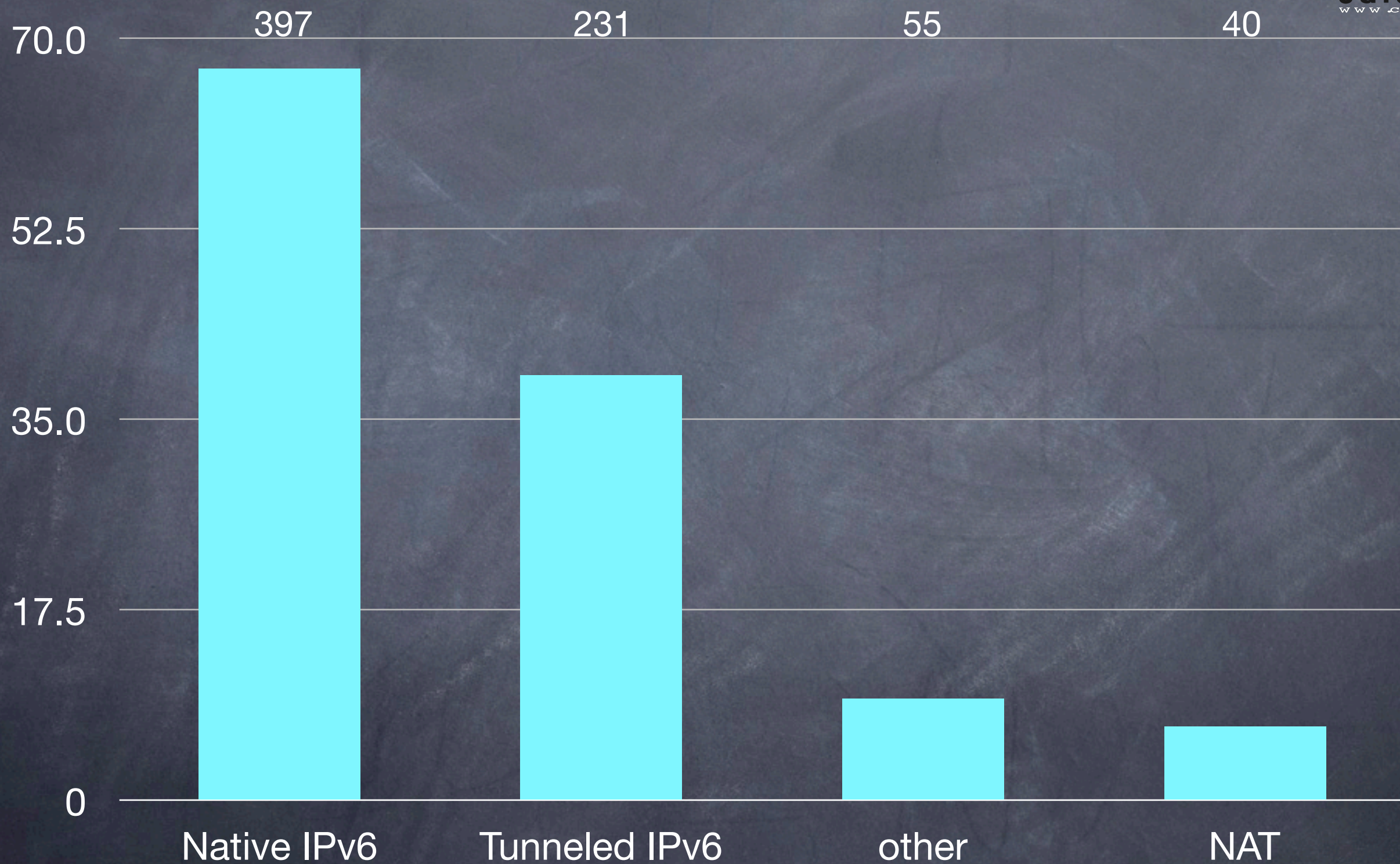
20
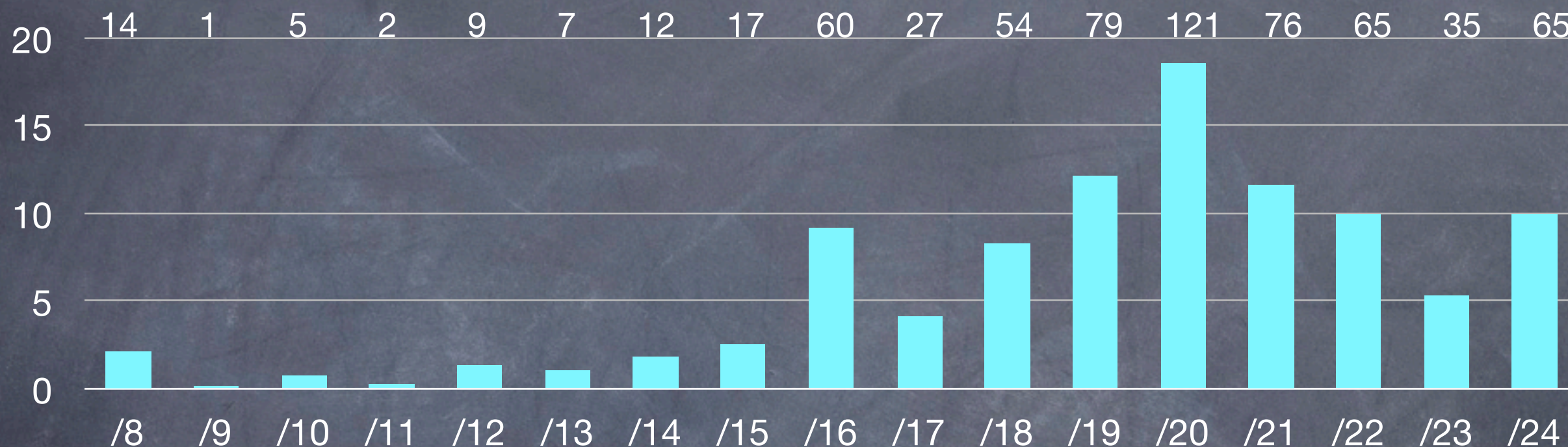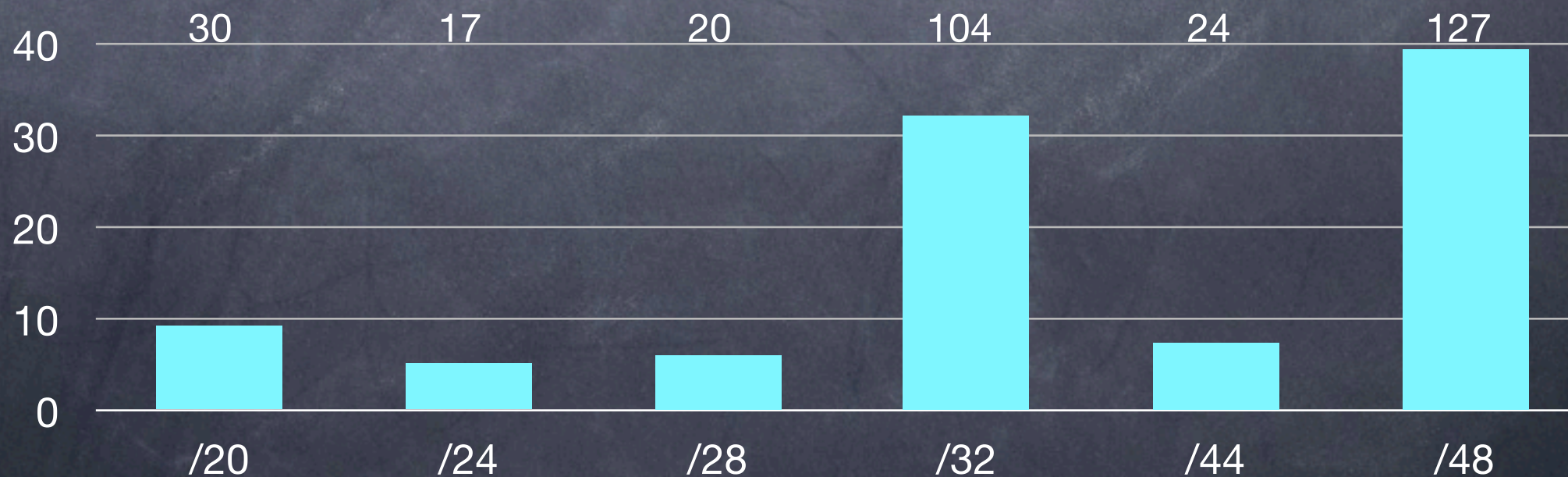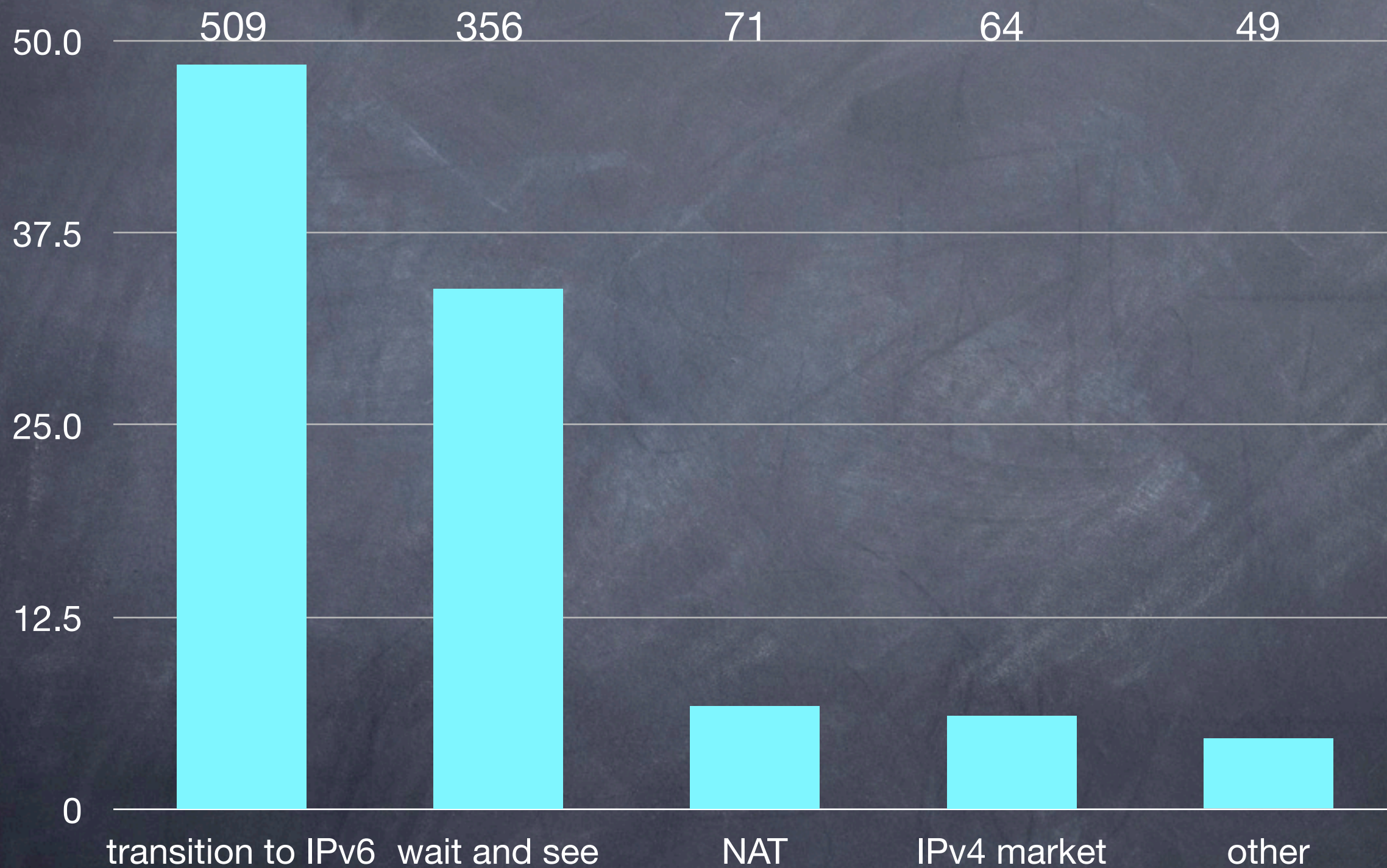
plans for next phase

# so what now?

unlike gravity, which (to the best of our knowledge) operates independently of what we believe about it, the evolution of the Internet will be a function of -- among other less important factors -- what we *believe* about it.

so we should be anxious to believe things about it that are true.

but we need a way of weeding out false from true.

"*If scientific reasoning were limited to the logical processes of arithmetic, we should not get very far in our understanding of the physical world. One might as well attempt to grasp the game of poker entirely by the use of the mathematics of probability.*"

*Vannevar Bush (recommended NSF to Congress)*

# capital shifts from 2005->2008

## (the ones who need to innovate in the core have more capital now)

| INNOVATOR | EPS ($) | MKT CAP ($B) |
|---|---|---|
| MCIW (->VZ) | -11.22 (2) | 6.5 (82) |
| SPRNT/NXTL | -0.31 (-10.6) | 34 (11.5) |
| VERIO/NTT | 1.98 (4) | 71.6 (27) |
| LEVEL3 | -0.74 (-.3) | 1.9 (2.4) |
| SBC/T | 1.41 (2) | 78 (157) |
| QWEST | -0.45 (1.5) | 7.7 (5) |
| COGENT | -7.42 (-.6) | 0.2 (.2) |
| GLBC | -13.84 (-5) | 0.3 (.6) |
| SAVVIS | -0.9 (-.05) | 0.12 (.4) |
| ABOVENET | n/a | n/a |
| WILTEL | n/a | n/a |
| TELEGLOBE ->? | -0.74 (n/a) | 0.2 (n/a) |
| C&W -> ? | 0.70 | 4.7B |
| TWTELCOM | -1.12 (-.12) | 1.0 (1.0) |
| TWCABLE | 0.48 (1.1) | 82 (22) |
| XO -> ? | -2.18 | 0.4 |

| INNOVATOR | EPS ($) | MKT CAP ($B) |
|---|---|---|
| CISCO | 0.87 (1.31) | 108 (109) |
| GOOGLE | 3.41 (15) | 97 (114) |
| AMAZON | 1.25 (1.4) | 19 (24) |
| YAHOO | 1.07 (.7) | 49 (17.5) |
| EBAY | 0.73 (.4) | 51 (23) |
| JUNIPER | 0.53 (.78) | 13 (10) |
| APPLE | 1.56 (5.1) | 47 (92) |
| INTEL | 1.33 (1.2) | 141 (90) |
| VERISIGN | 0.93 (-1.2) | 6.15 (4.6) |
| DELL | 1.27 (1.34) | 76.3 (28) |
| MICROSOFT | 1.12 (1.87) | 269B (220) |

# Breakdown by Num Allocations per Organization of ARIN IPv4 Space

ARIN whois data (20050831); excluding DoDNIC, JPNIC, and pre-RIR /8 allocations; stacked plot

space of orgs with 1 total allocation
2
3
4-7
8-15
16-31
32+

total allocated space

http://www.caida.org/research/id-consumption/
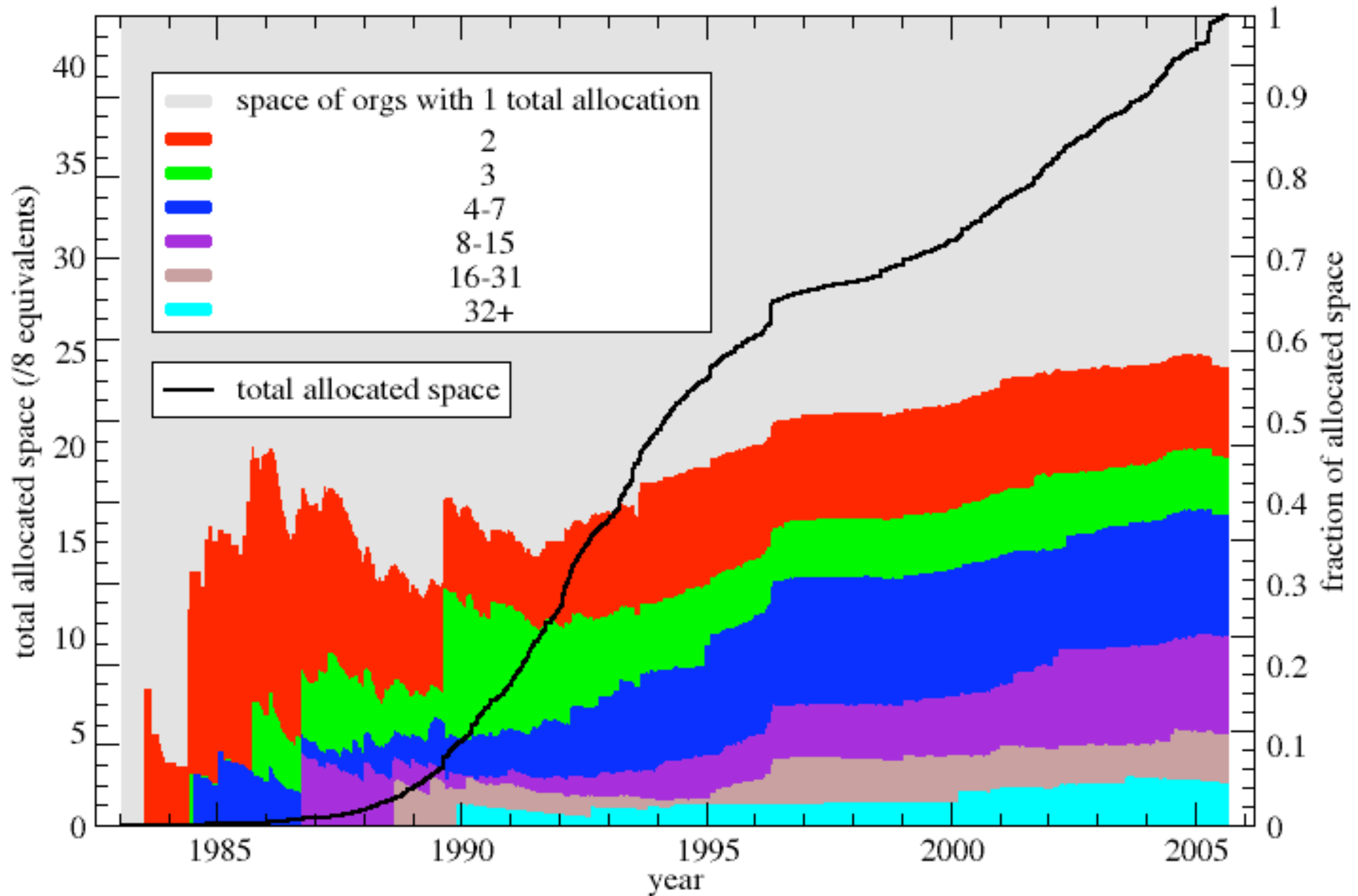
- more analysis of survey data
- solicit feedback from you on next survey
- follow up with those willing to donate measurements
- increase ipv6 active probe capabilities (ascore6)
- increase traffic analysis of ipv6 vs v4 (rsa, legacy)
- economic/ownership analysis
- scenario planning workshops re address policy

# scenario planning

Peter Schwartz, *The Art of the Long View*

- of course we should try to change the future: it's the only thing we can change.
- goal: not an accurate picture of tomorrow, but rather making better decisions about the future
- formalize (or at least write down) what we know: what are long term forces and how do they interact? who is measuring them, and how? what tradeoffs do they imply?
- are we leaving a better future than we found?
  - are we net gaining or net losing freedom/autonomy?

*Many are stubborn in pursuit of the path they have chosen, few in pursuit of the goal.* -- Friedrich Nietzsche