
# IPv6 the Foundation of IT Transformation

Ciprian Popoviciu

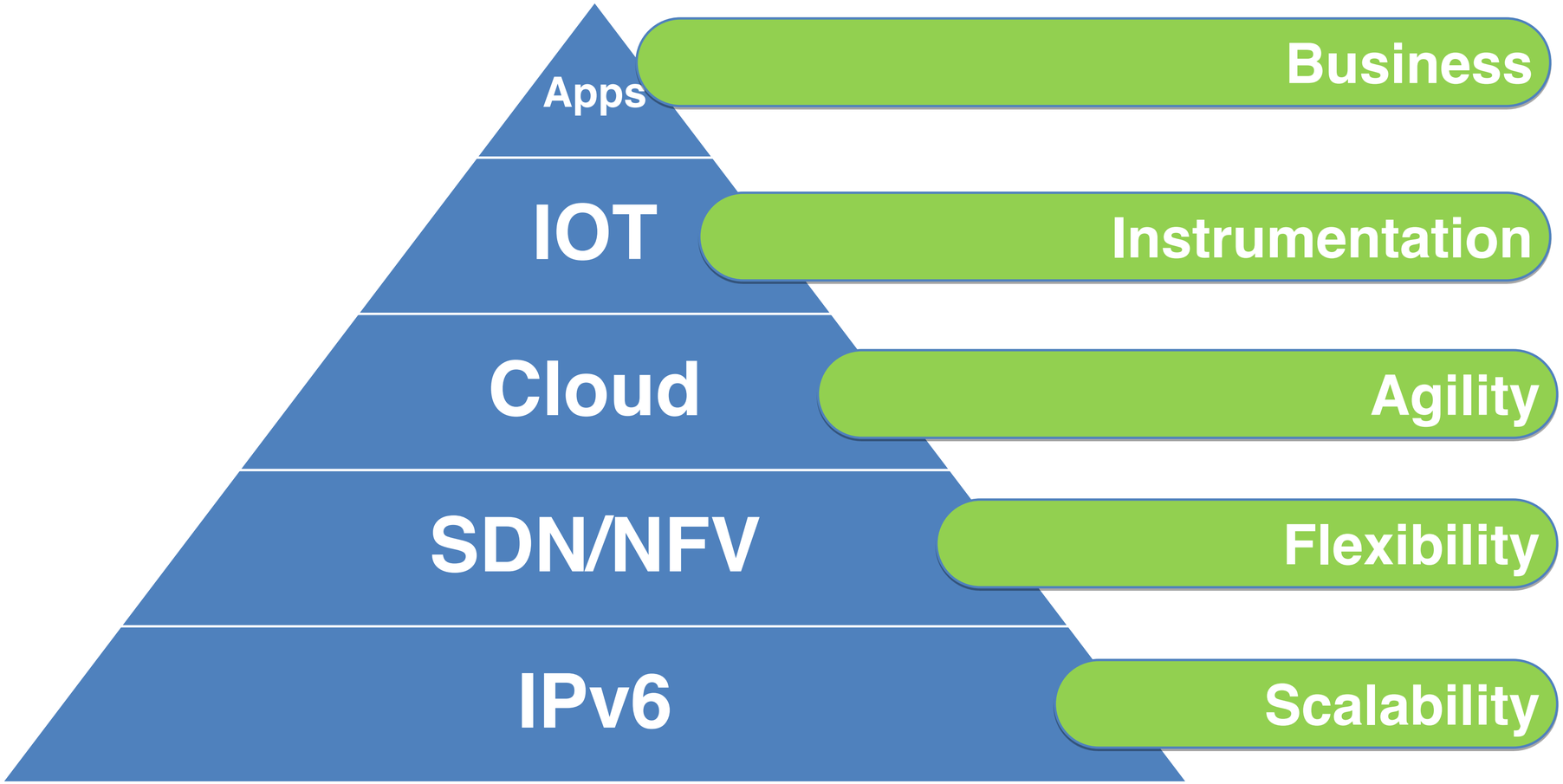
nephos6

# IPv6 – Level Setting

- The Next Generation of the Internet Protocol
- An evolution, not a revolution of IPv4
- Similar to IPv4 yet so much more, some obvious such as the large address space, some less obvious such as protocol optimizations
- IPv6 and IPv4 are not compatible, the two cannot talk directly to each other
- **The protocol is considered the plan of record for the industry**

nephos6

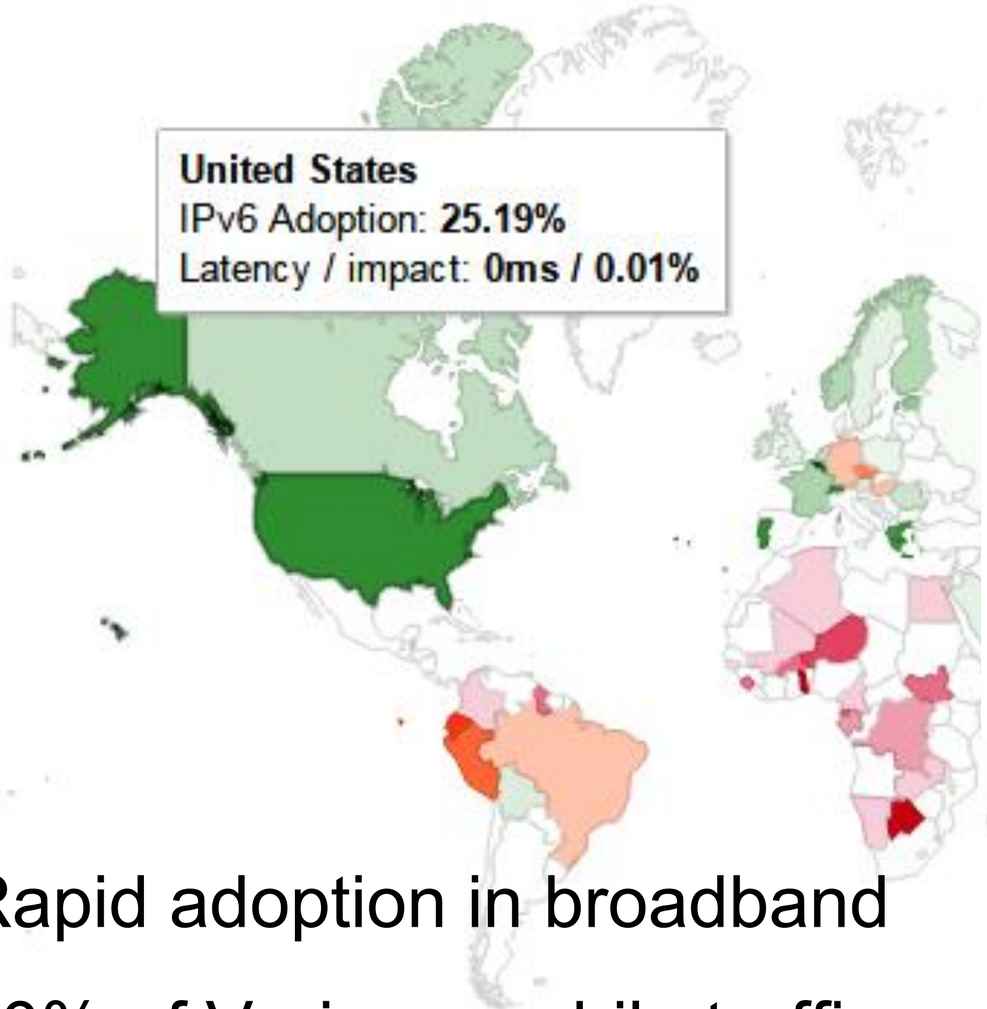
# IPv6 is Supporting The Technology Stack

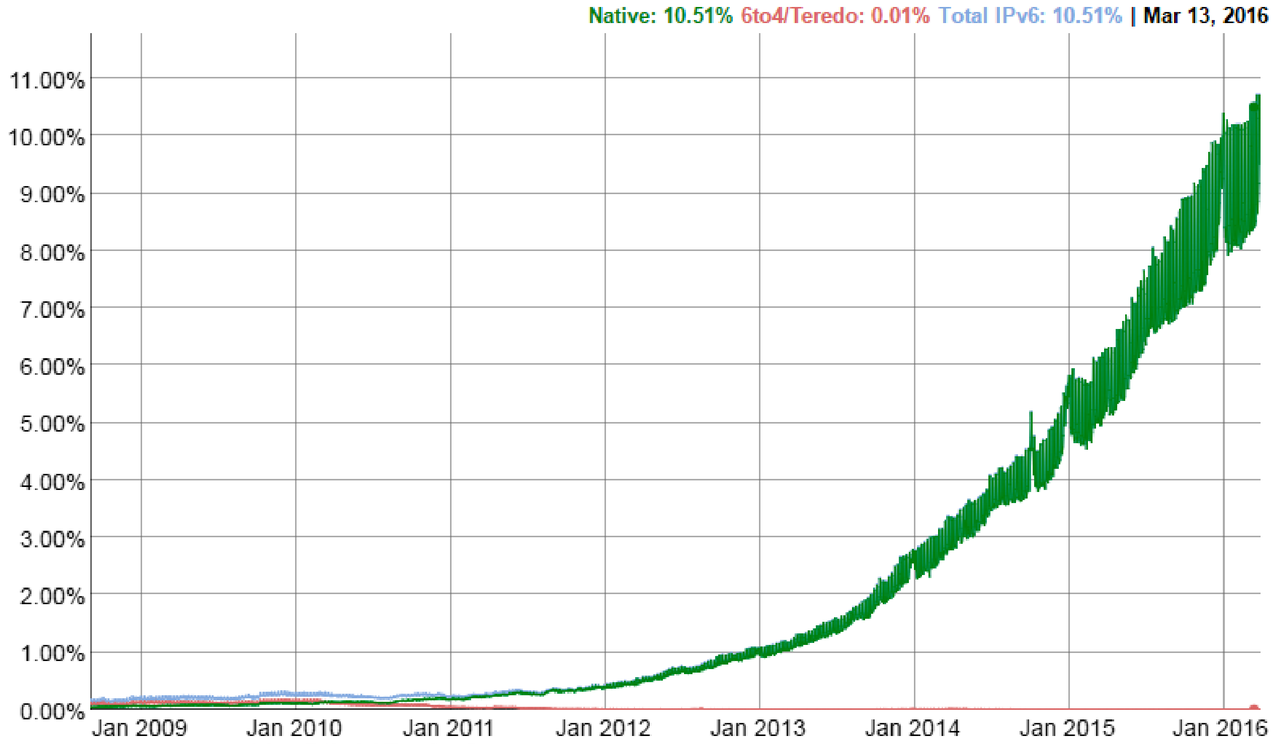



- Transitions touch every aspect of IT, are complex and interdependent

nephos6

# IPv6 is Here




- Rapid adoption in broadband
- 70% of Verizon mobile traffic over IPv6

nephos6

# IPv6 is Here to Stay

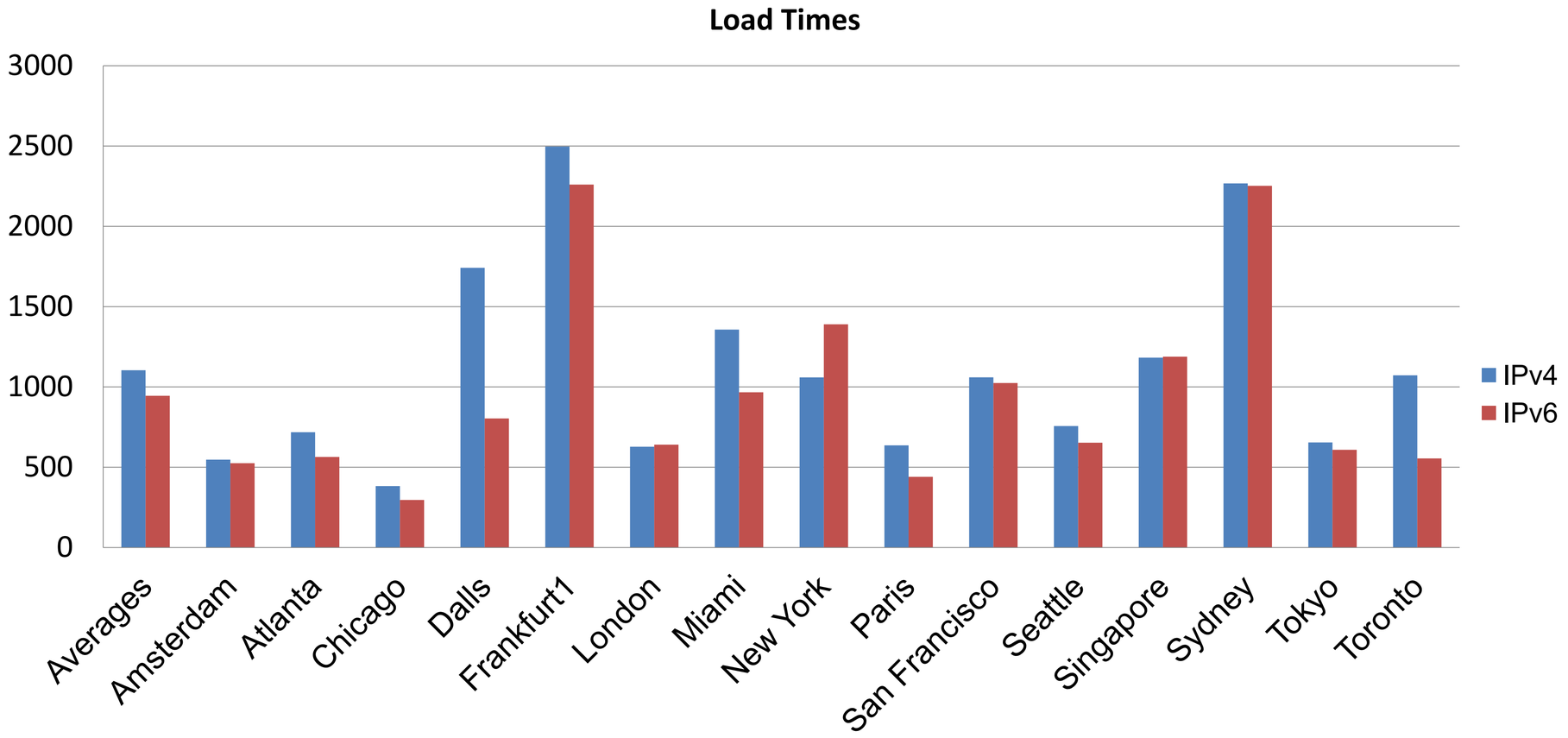
- You cannot grow in IPv4 anymore, there are no more addresses
- Organizations deploy IPv6 for scale, new solutions or for optimizations
- There are explicit mandates for IPv6 adoption at federal level
- Entire new architectures built for and based on IPv6
- Organizations report significantly improved performance and operational optimizations
- **Organizations who deployed IPv6 cannot wait to get off of IPv4**

# IPv6 is Proven

- Facebook has IPv6 only Data Centers
- Facebook sees 15% higher performance
- Verizon sees 15% higher performance
- Deutsch Telekom Terrastream project is IPv6 based
- BC Hydro deployed a greenfield IPv6 based smart metering infrastructure
- IPv6 mandatory with iOS 9
- **Organizations highly experienced in IT services think IPv6**

nephos6

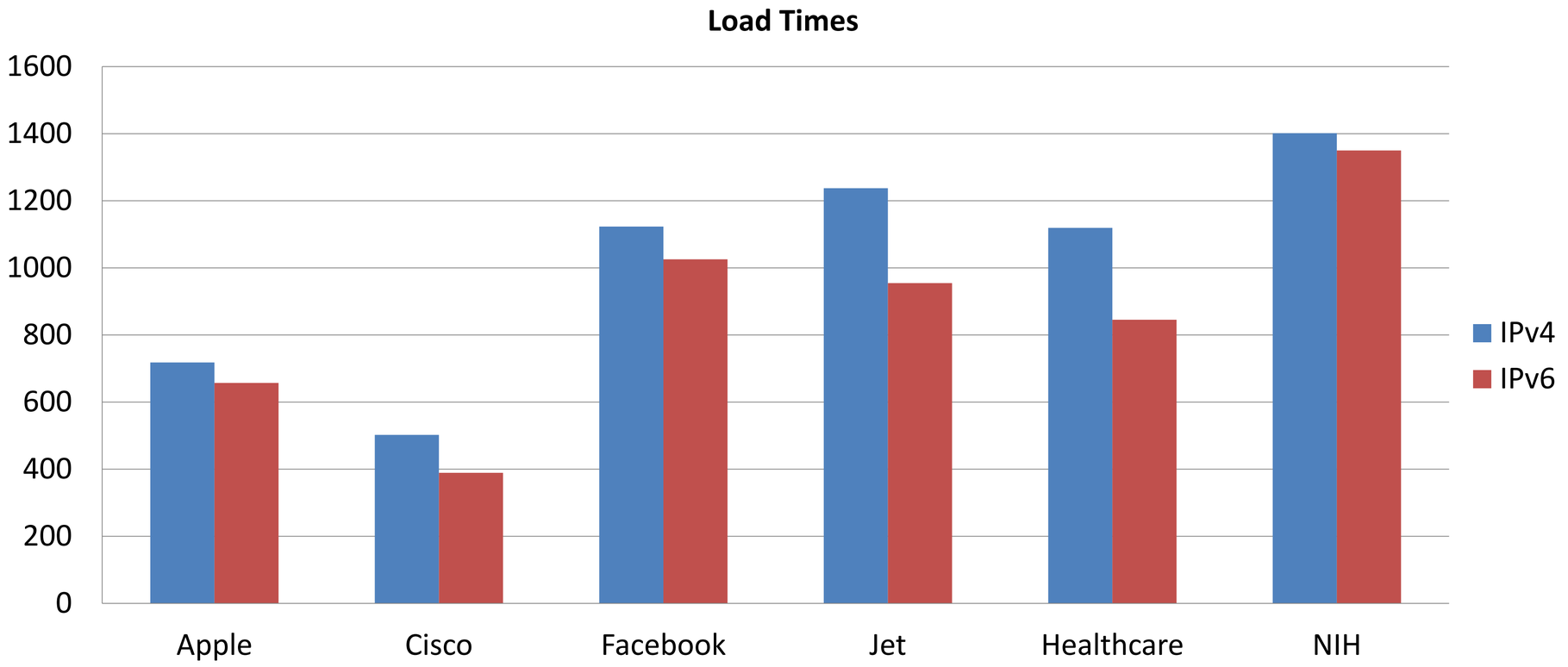
# And We Have Independent Numbers




- **Facebook is faster over IPv6 by 14% on average**

**Data collected with www.v6sonar.com**

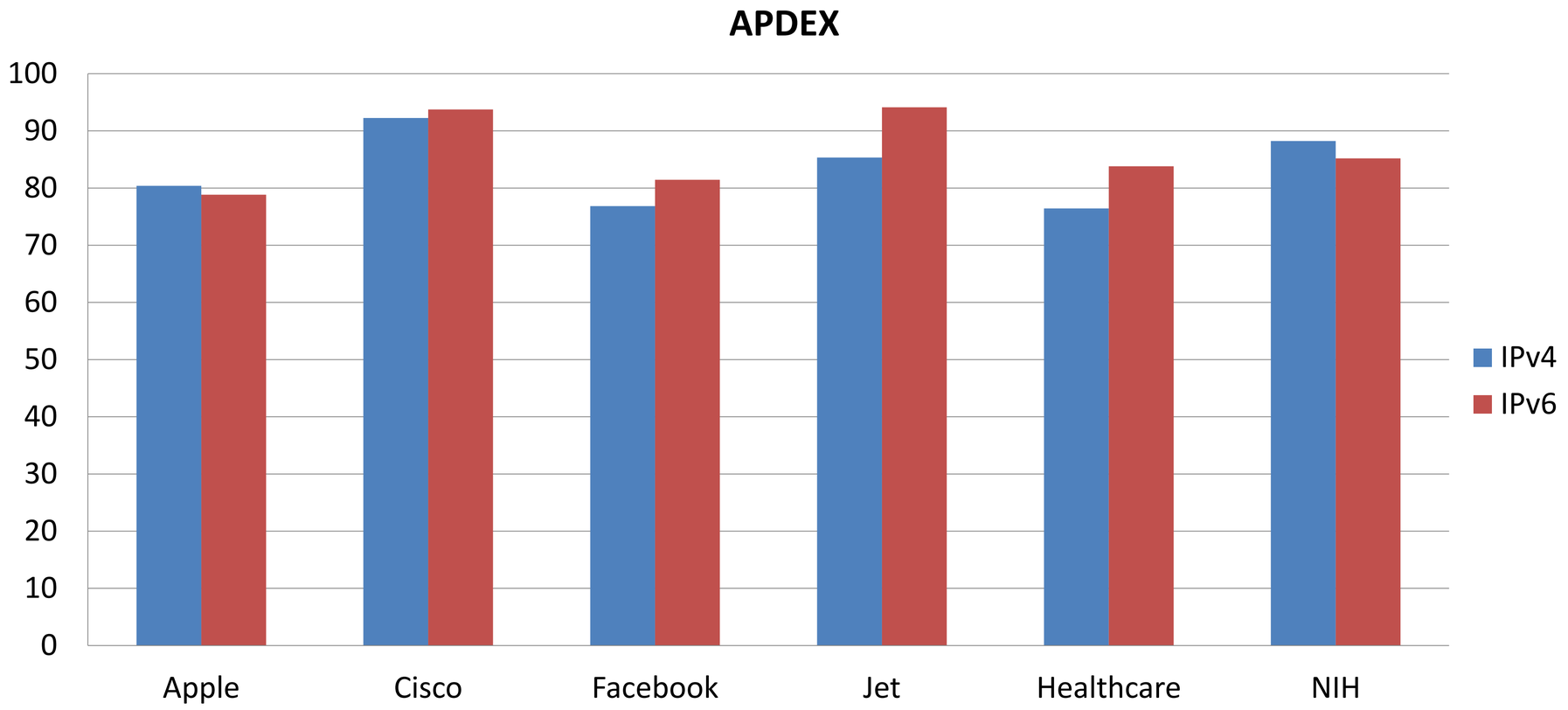
# And Not Just Facebook




- It does make a difference (global averages)

Data collected with www.v6sonar.com

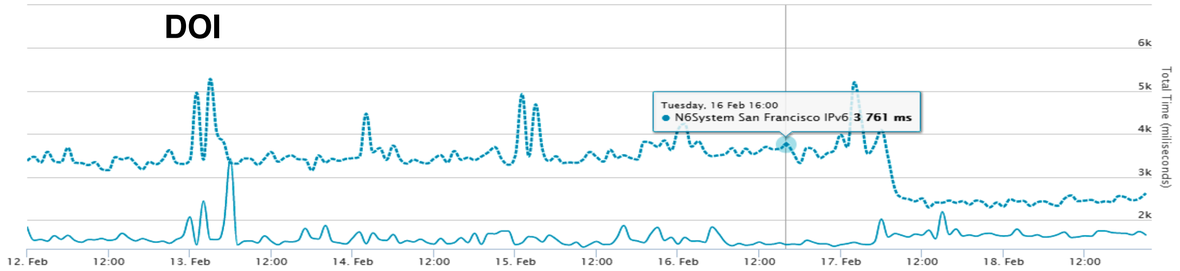
# Satisfaction is Also on Par

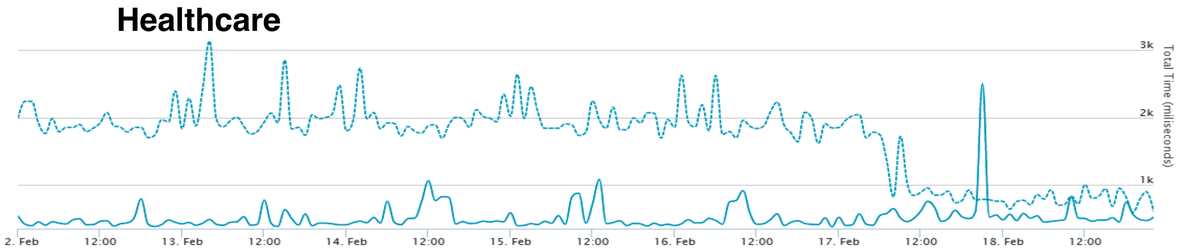


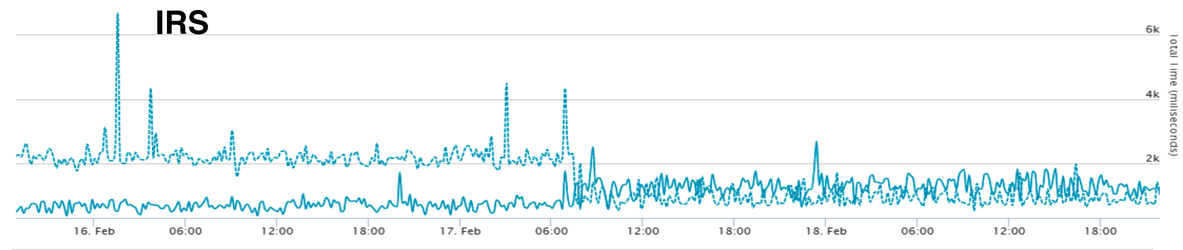

- It does make a difference (global averages)

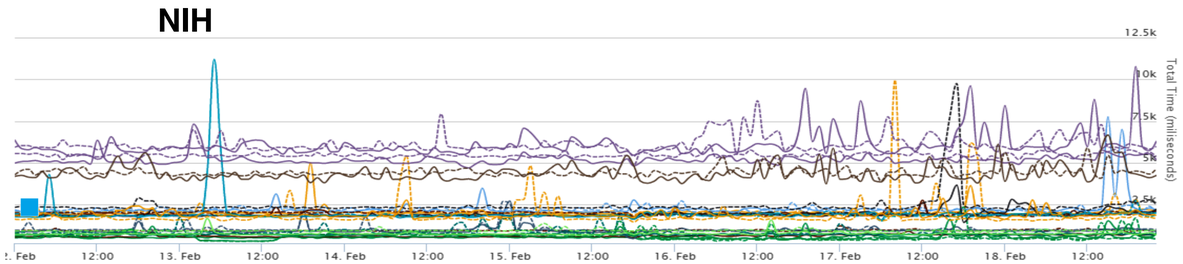
Data collected with www.v6sonar.com

# However … You Must Focus on IPv6 Being Done Right




IPv4 Traceroute

| Hop | ASN | Host | IP Address | Probe #1 | Pro #2 |
|---|---|---|---|---|---|
| 1 | AS14061 | 107.170.207.253 | 107.170.207.253 | 0.369ms | 0.31 |
| 2 | AS14061 | 198.199.99.253 | 198.199.99.253 | 0.328ms | 0.27 |
| 3 | AS2914 | xe-0-0-0-23.r05.plalca01.us.bb.gin.ntt.net | 129.250.204.117 | 2.673ms | 2.65 |
| 4 | AS2914 | ae-15.r01.snjsca04.us.bb.gin.ntt.net | 129.250.5.33 | 2.239ms | 2.39 |
| 5 | AS2914 | ae-15.r01.snjsca04.us.bb.gin.ntt.net | 129.250.5.33 | 2.291ms | 2.07 |

IPv6 Traceroute

| Hop | ASN | Host | IP Address | Probe #1 | Probe #2 | Pr #: |
|---|---|---|---|---|---|---|
| 1 | AS14061 | 2604:a880:1:20:ffff:ffff:ffff:fff1 | 2604:a880:1:20:ffff:ffff:ffff:fff1 | 0.316ms | 0.275ms | 0.. |
| 2 | AS14061 | 2604:a880:1::501 | 2604:a880:1::501 | 0.226ms | 0.261ms | 0.. |
| 3 | * | * | * | N/A | N/A | N/ |
| 4 | AS2914 | ae-15.r02.snjsca04.us.bb.gin.ntt.net | 2001:418:0:2000::172 | 2.244ms | 1.997ms | 2.. |
| 5 | AS2914 | ae-10.r23.snjsca04.us.bb.gin.ntt.net | 2001:418:0:2000::cd | 1.821ms | 1.843ms | 11 |
| 6 | AS2914 | ae-3.r20.sttlwa01.us.bb.gin.ntt.net | 2001:418:0:2000::156 | 21.117ms | 20.052ms | 20 |
| 7 | AS2914 | ae-0.r21.sttlwa01.us.bb.gin.ntt.net | 2001:418:0:2000::e6 | 21.304ms | 21.234ms | 21 |
| 8 | AS2914 | ae-0.r24.nycmny01.us.bb.gin.ntt.net | 2001:418:0:2000::72 | 97.834ms | 98.83ms | 97 |
| 9 | AS2914 | ae-1.r08.nycmny01.us.bb.gin.ntt.net | 2001:418:0:2000::13e | 91.778ms | 99.403ms | 99 |
| 10 | AS2914 | 2001:418:0:5000::1c3 | 2001:418:0:5000::1c3 | 97.771ms | 90.742ms | 98 |
| 11 | AS20940 | 2600:141b:4:188::2d7 | 2600:141b:4:188::2d7 | 90.89ms | 84.774ms | 98 |

IPv4 Traceroute

| Hop | ASN | Host | IP Addr |
|---|---|---|---|
| 1 | AS14061 | 107.170.207.253 | 107.170. |
| 2 | AS14061 | 198.199.99.253 | 198.199. |
| 3 | AS2914 | xe-0-0-0-23.r05.plalca01.us.bb.gin.ntt.net | 129.250. |
| 4 | AS2914 | ae-15.r01.snjsca04.us.bb.gin.ntt.net | 129.250. |
| 5 | AS2914/AS16625/AS22773 | a23-36-57-182.deploy.static.akamaitechnologies.com | 23.36.57 |

IPv6 Traceroute

| Hop | ASN | Host | IP Address | Probe #1 | Probe #2 | Probe #3 |
|---|---|---|---|---|---|---|
| 1 | AS14061 | 2604:a880:1:20:ffff:ffff:ffff:fff1 | 2604:a880:1:20:ffff:ffff:ffff:fff1 | 0.693ms | 0.544ms | 0.494ms |
| 2 | AS14061 | 2604:a880:1::501 | 2604:a880:1::501 | 0.266ms | 0.32ms | 0.358ms |
| 3 | AS14061 | 2604:a880:1::301 | 2604:a880:1::301 | 0.313ms | 0.305ms | 2.308ms |
| 4 | AS1299 | sjo-b21-link.telia.net | 2001:2000:3080:a96::1 | 2.305ms | 2.38ms | 2.503ms |
| 5 | AS1299 | akamai-ic-301048-sjo-b21.c.telia.net | 2001:2000:3080:721::2 | 2.664ms | 2.223ms | 2.531ms |

## Is your CDN doing it right?

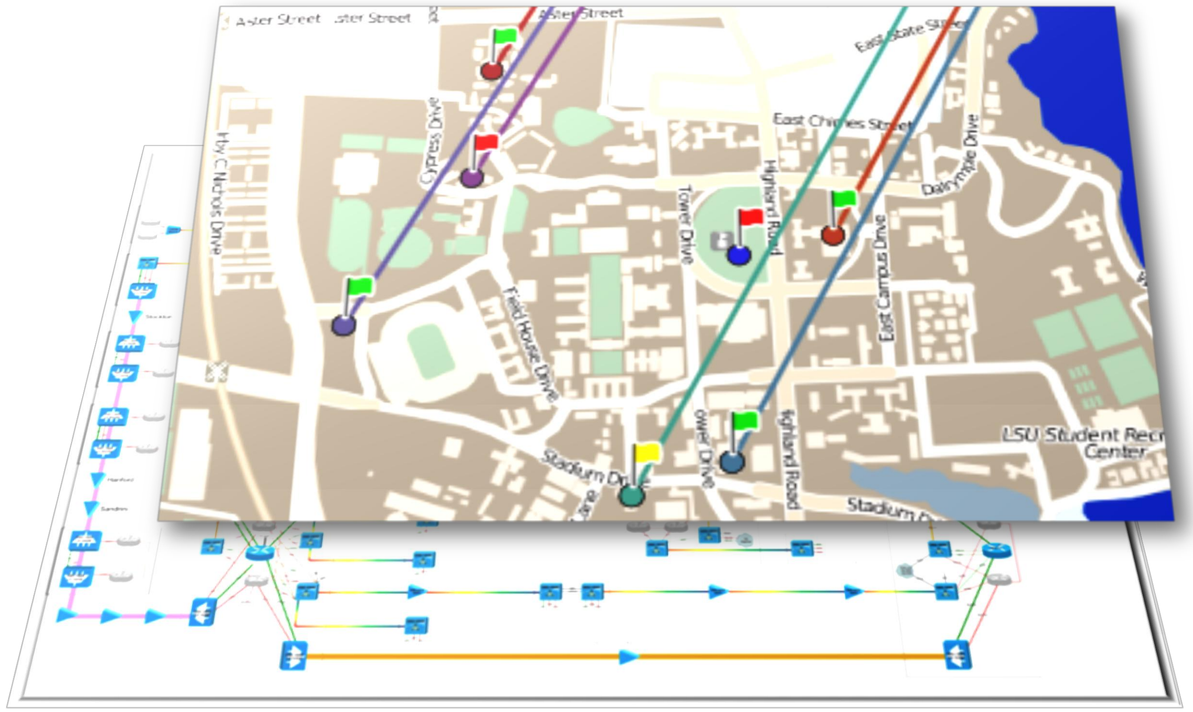
nephos6

# However … You Must Focus on Doing IPv6 Right

## Origin AS's with High IPv6 Failure Rates

**Geoff Huston, Feb 2016**

| AS | Failure Rate | Samples | AS Name |
|---|---|---|---|
| AS13679 | 97.33% | 374 | Centros Culturales de Mexico, A.C.,MX |
| AS201986 | 93.69% | 222 | ARPINET Arpinet LLC,AM |
| AS17660 | 65.14% | 1,374 | DRUKNET-AS DrukNet ISP,BT |
| AS10349 | 60.29% | 763 | TULANE - Tulane University,US |
| AS21107 | 46.97% | 692 | BLICNET-AS Blicnet d.o.o.,BA |
| AS20880 | 42.65% | 762 | TELECOLUMBUS Tele Columbus AG,DE |
| AS12779 | 36.70% | 109 | ITGATE IT.Gate S.p.A.,IT |
| AS46261 | 35.64% | 101 | QUICKPACKET - QuickPacket, LLC,US |
| AS9329 | 35.29% | 119 | SLTINT-AS-AP Sri Lanka Telecom Internet,LK |
| AS52888 | 27.92% | 265 | UNIVERSIDADE FEDERAL DE SAO CARLOS,BR |
| AS30036 | 27.55% | 60,228 | MEDIACOM-ENTERPRISE-BUSINESS - Mediacom Communications Corp,US |
| AS45920 | 25.77% | 163 | SKYMESH-AS-AP SkyMesh Pty Ltd,AU |
| AS210 | 25.04% | 571 | WEST-NET-WEST - Utah Education Network,US |
| AS28343 | 24.57% | 985 | TPA TELECOMUNICACOES LTDA,BR |
| AS7477 | 21.72% | 488 | TEREDONN-AS-AP SkyMesh Pty Ltd,AU |
| AS24173 | 21.48% | 256 | NETNAM-AS-AP Netnam Company,VN |
| AS28580 | 21.48% | 1,341 | CILNET Comunicacao e Informatica LTDA.,BR |
| AS32329 | 20.63% | 126 | MONKEYBRAINS - Monkey Brains,US |
| AS17451 | 19.35% | 248 | BIZNET-AS-AP BIZNET NETWORKS,ID |
| AS5707 | 19.35% | 155 | UTHSC-H - The University of Texas Health Science Center at Houston,US |




- **Google blacklist:** https://www.google.com/intl/en_ALL/ipv6/statistics/data/no_aaaa.txt

UCSC (AS5739), CITI (AS3081), ATT (AS7018), HE (AS6939)

nephos6

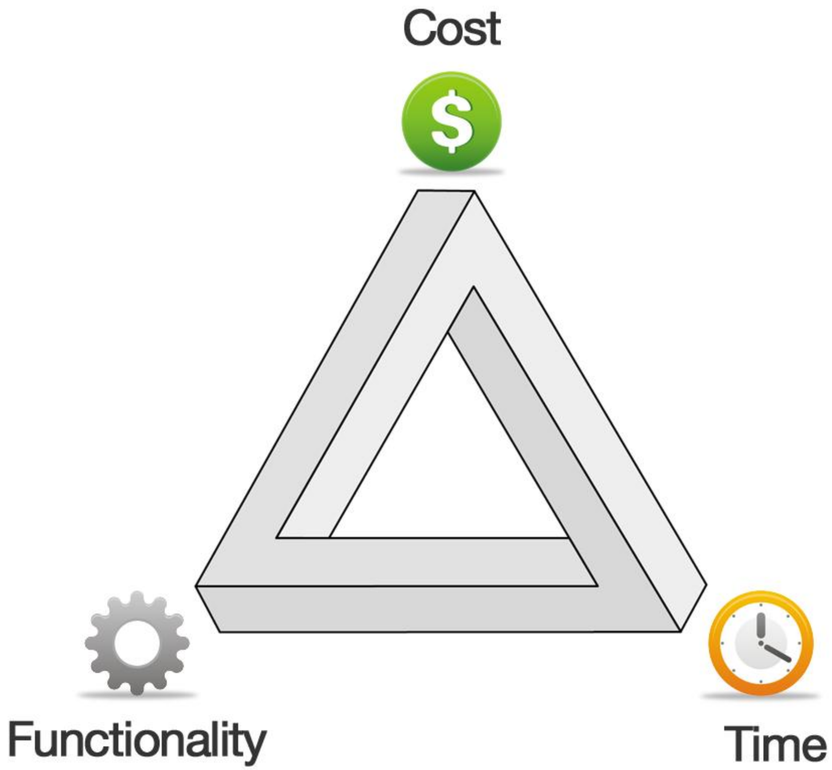
# Taking IPv6 Seriously

- IPv6 transition offers you a once in a career opportunity to redo your network infrastructure … while driving the car
- If you tie together the technological and operational inflexion points into an IPv6 based infrastructure, your IT transformation will be similar to the transition from Model T to Tesla and that can be done in a cost effective way by starting early

- If you don't, then you will likely buy a few cars along the way before you catch up with the rest of your competitors, your industry … the World
- **Anything you do today that is not at least IPv6 ready, preferably IPv6 based, it is legacy from day one.**

nephos6

# You Still Need to Choose Two out of Three




- **The last thing you want to have happen is a rushed transition yet time is running out**

# A Good Approach to IPv6 Enablement

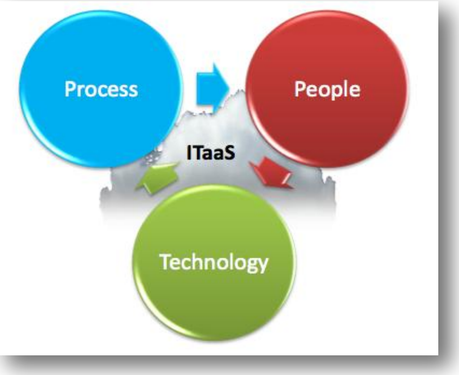
You are enabling a new production infrastructure, deal with it accordingly.

- Understand it – If you or your team do not understand IPv6 your deployment will look like IPv4 and you would have missed the opportunity
- Plan it – IPv6 touches every aspect of IT so planning is important in order to maximize gains and to minimize cost and impact
- Measure it – You will need metrics! You need to make sure IPv4 is not impacted, IPv6 does at least as good as IPv4 and if something breaks you have the proof that it was not IPv6
- **Execute along the three dimensions: People, Technology, Process**

nephos6

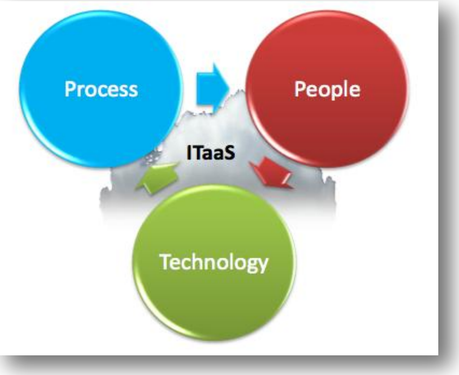
# People

- Education is one of the most important yet underrated and underfunded steps towards a good IPv6 transition
- You make the most out of the IPv6 transition by having your team think in IPv6 terms, solve existing problems in the context of the new infra
- Different areas might transition at different speeds so different people will need to be trained at different times
- Make sure you combine architects and operations teams for new
- **Right training for the right person at the right time**

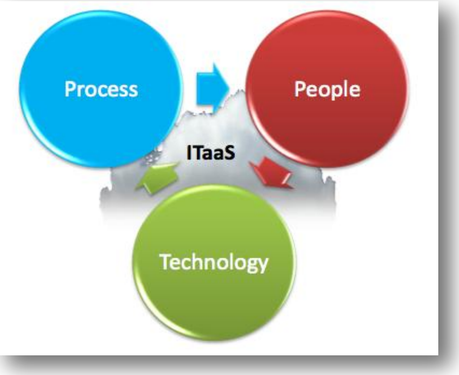
# Technology

- IPv6 appears similar to IPv4 but a deeper look shows fundamental differences that can lead to new architectures and deployment models
- The key asset and the main driver for adoption is the IPv6 address space. Do not underestimate the power of the address space in enabling and driving new architectures. Invest the time and resources to build the right IPv6 address plan
- New provisioning mechanisms enable new deployment options
- This is the opportunity to test new routing protocols
- Must secure the protocol and the transition
- **Managing two networks is hard**

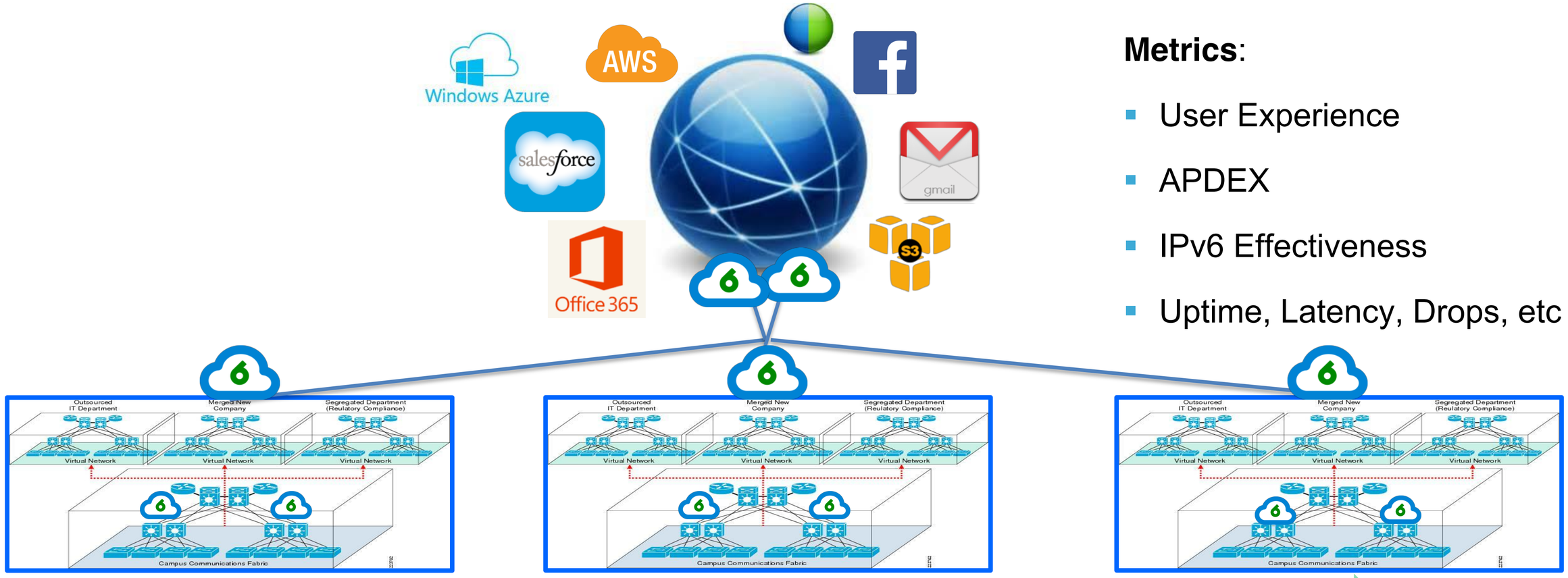


# Process

- Set up a transition office to orchestrate effort and report to leadership
- Leverage all existing lifecycle and partner management processes to drive IPv6 readiness of products, service and partners. The success of your transition depends on the readiness of other organizations (Manufacturers, ISVs, SPs, MSPs, etc)
- If you have time, drive readiness through every project which typically means up to an additional cost of 5% per project
- Update all operational processes to support IPv6 and maintain consistency of IPv6 support
- **Focus on metrics and constantly communicate**



# A Deterministic Enablement




**Metrics**:

- User Experience
- APDEX
- IPv6 Effectiveness
- Uptime, Latency, Drops, etc

Instrument Environment → Baseline Services and Network over IPv4 → Monitor IPv4 during IPv6 enablement → Baseline Services and Network over IPv6 → Monitor → Optimize

**Continuously Report on IPv6 Metrics**

nephos6

# Summary of the Process

# Conclusions

- IPv6 is the plan of record for IT industry
- IPv6 touches every aspect of IT and a good transition takes time
- None of the other cool IT trends cannot fully deliver without IPv6
- If you do not build it at least IPv6 ready, you build legacy from day one
- If you do not build it IPv6 based you are behind the state of the art
- This is a unique opportunity to build the next generation infrastructure without a flag day
- **Start today!**


Raleigh, North Carolina

April 12, 2016

nephos6

chip@nephos6.com, @nephos6