T-Mobile USA IPv6 Deployment

IPv6-only Mobile Perspective

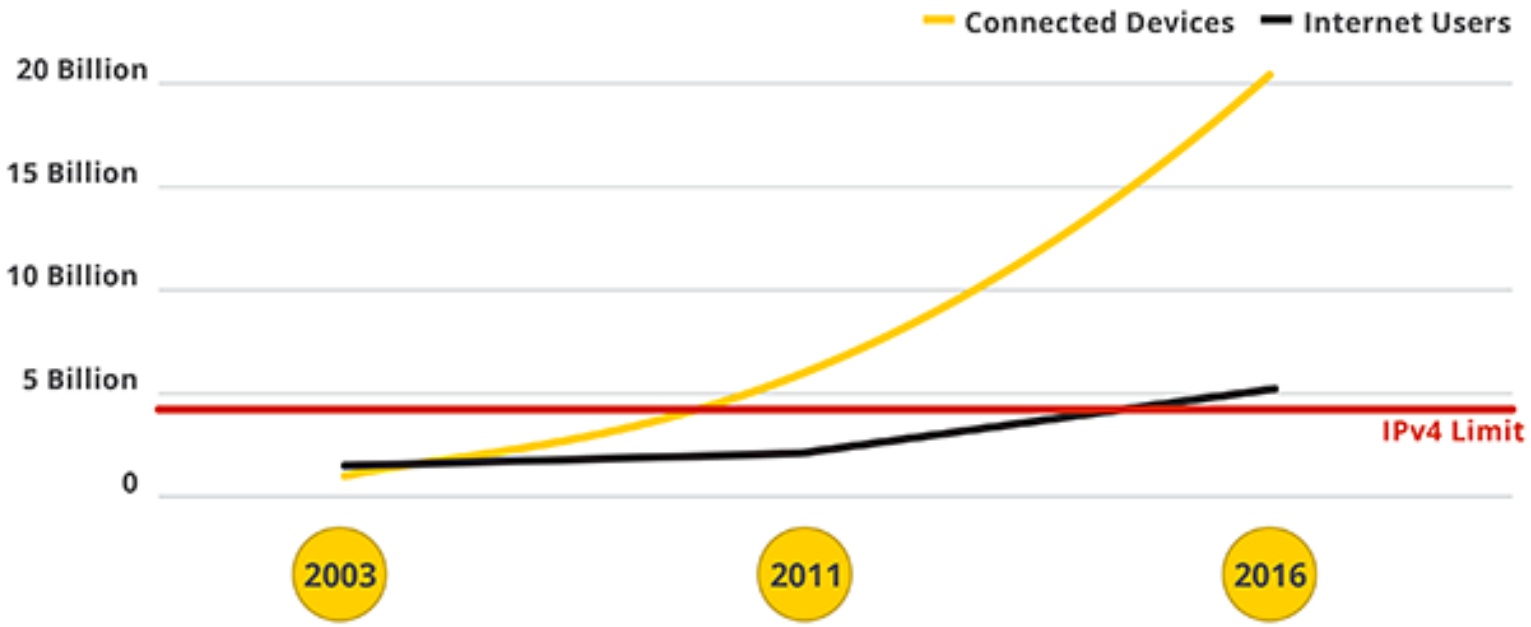
Cameron.Byrne@T-Mobile.com

February 2013

Objectives

- Explain that IPv6 can and must work in mobile networks
  - IPv4 cannot number the world
  - IPv6 is achievable and inexpensive
  - We are all stakeholders in IPv6 adoption
- Business and Technology Strategy for IPv6-only
  - Dual-stack does not solve the IPv4 number problem
  - 464XLAT is a final solution in mobile

Simply more internet devices than internet addresses



http://www.google.com/intl/en/ipv6/

1.1B Global Smartphone Subscribers, 42% Growth, Q4:12 – @ Only 17% of Mobile Subscribers

Rank	Country	Q4:12 Smartphone Subs (MM)	Smartphone as % of Total Subs	Smartphone Sub Y/Y Growth	Rank	Country	Q4:12 Smartphone Subs (MM)	Smartphone as % of Total Subs	Smartphone Sub Y/Y Growth
1	China	270	24%	50%	16	Saudi Arabia	15	31%	38%
2	USA	172	48	50	17	Philippines	15	14	38
3	Japan*	78	65	11	18	Mexico	15	14	55
4	Brazil	55	20	35	19	Thailand	14	17	43
5	India	44	4	52	20	Turkey	13	19	52
6	UK	35	45	31	21	Malaysia	12	32	23
7	Korea	32	59	35	22	South Africa	11	18	26
8	Indonesia	27	9	36	23	Argentina	11	19	55
9	France	26	38	33	24	Netherlands	9	47	37
10	Germany	25	23	19	25	Poland	9	16	30
11	Russia	22	9	44	26	Sweden	8	54	24
12	Spain	18	30	14	27	Egypt	7	8	40
13	Italy	16	19	28	28	Iran	7	8	53
14	Australia	16	50	44	29	Taiwan	7	24	80
15	Canada	15	55	38	30	Hong Kong	6	48	48

Global Smartphone Stats:	Subscribers = 1,142MM	Penetration = 17%	Growth = 42%

KPCB

Note: *Japan data per Morgan Stanley Research estimate. Source: Informa. 7

Since we are in Singapore ….

SingTel Group expands mobile customer base to 416 million

SingTel Group expands mobile customer base to 416 million

- *SingTel Singapore achieves another record quarter for postpaid customer additions*
- *Optus grows postpaid customer base*
- *Telkomsel exceeds 100 million mobile customers in Indonesia*

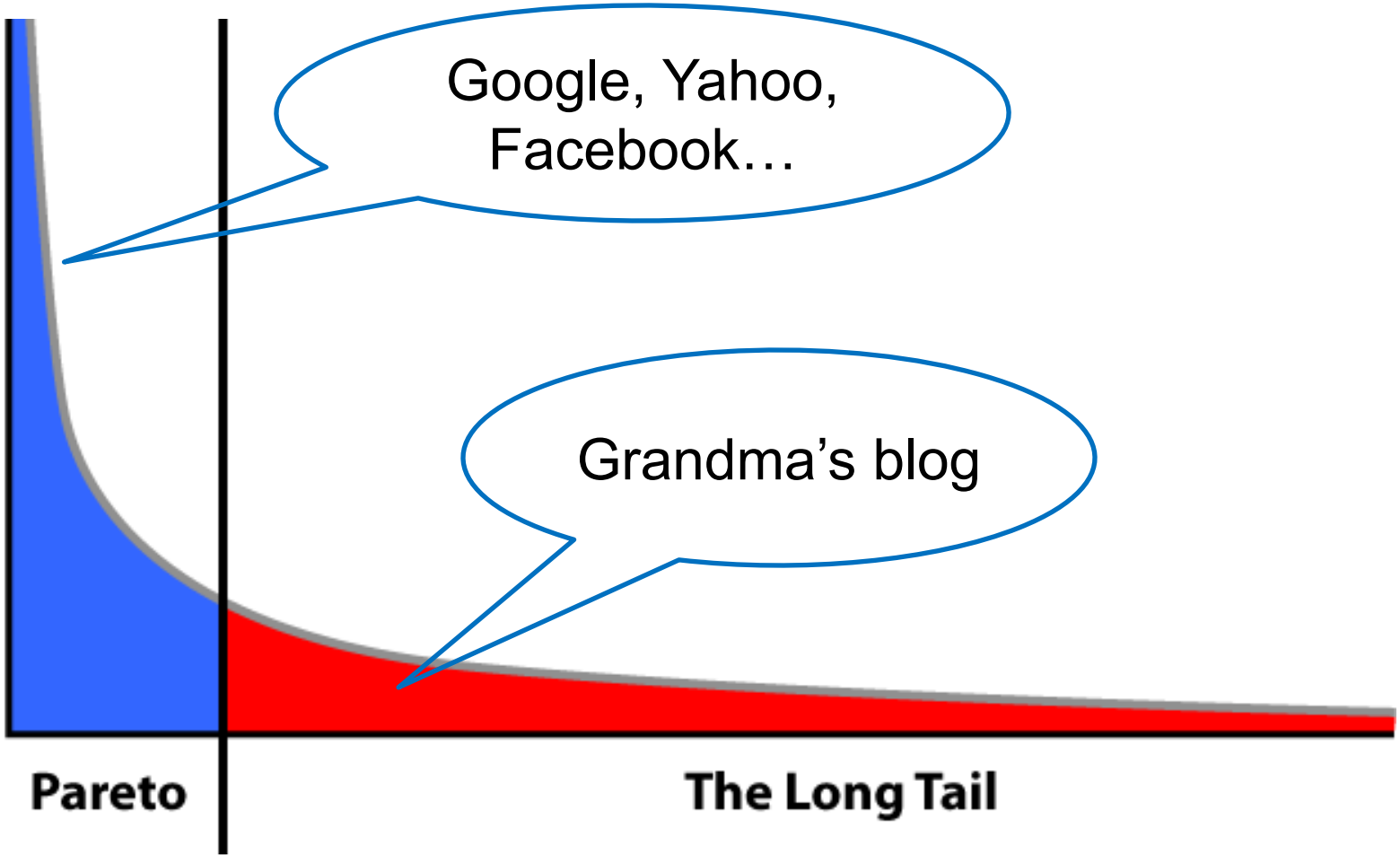
- We must all do IPv6 because IPv4 no longer fits the business needs that drive billions of connected devices
- It is not just more devices, it is more devices holding addresses longer, making more connections (AJAX, always on Apps, …) and VoLTE requiring 2 IP addresses

Conclusion #1: IPv4 does not fit today's business needs

- More internet devices than IPv4 numbers
- Growth rate of internet devices in APAC is very high
- APNIC does not have IPv4

Is IPv6 a viable replacement for IPv4 for large edge networks?

A few big fish make IPv6 possible



IPv6 end-to-end is > 50% of total traffic to the Google, Yahoo, and Facebook

Participating website measurements are available here.

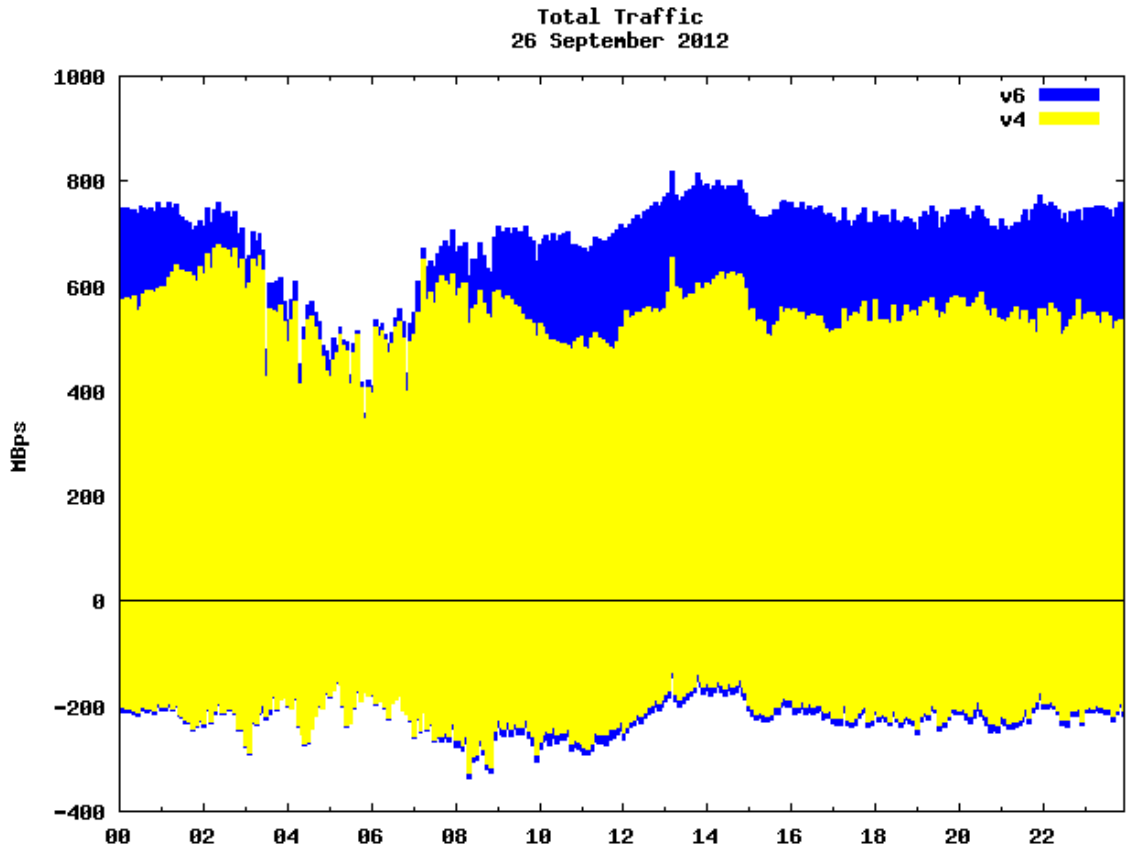
Network operator measurements, 16th November 2012 (notes)

Show 10 entries Search:

Participating Network	ASN(s)	IPv6 traffic
Louisiana State University	2055	63.70%
Virginia Tech	1312	61.47%
DreamHost	26347	56.73%
Rensselaer Polytechnic Institute	91	55.57%
US Dept of Transportation	2576	53.85%
Indiana University	87	42.31%
DMZGlobal	17649	39.96%
Gustavus Adolphus College	17234	38.19%
DegNet GmbH	20902	27.87%
University of Iowa	3676	23.96%

Showing 1 to 10 of 79 entries First Previous 1 2 3 4 5 Next Last

Virginia Tech v4 and v6 Traffic



http://www.flickr.com/photos/n3pb/8047086504/sizes/o/in/set-72157629740831445/

Conclusion #2 IPv6 Works Today

- IPv6 is ready and deployed on large mobile networks and content providers
  - Verizon Wireless has IPv6 on by default for nearly all LTE devices
  - T-Mobile USA has IPv6 on GSM/UMTS/LTE optionally, and will have IPv6 by default soon
- When IPv6 is turned on, a large percentage of content is delivered over IPv6
  - Many IPv6 enabled edge networks reporting over 50% of traffic is IPv6 when the network is IPv6 and IPv4
  - Google and Akamai both reporting exponential growth in IPv6 use

IPv6 is great, how do I get there from here?

Strategy

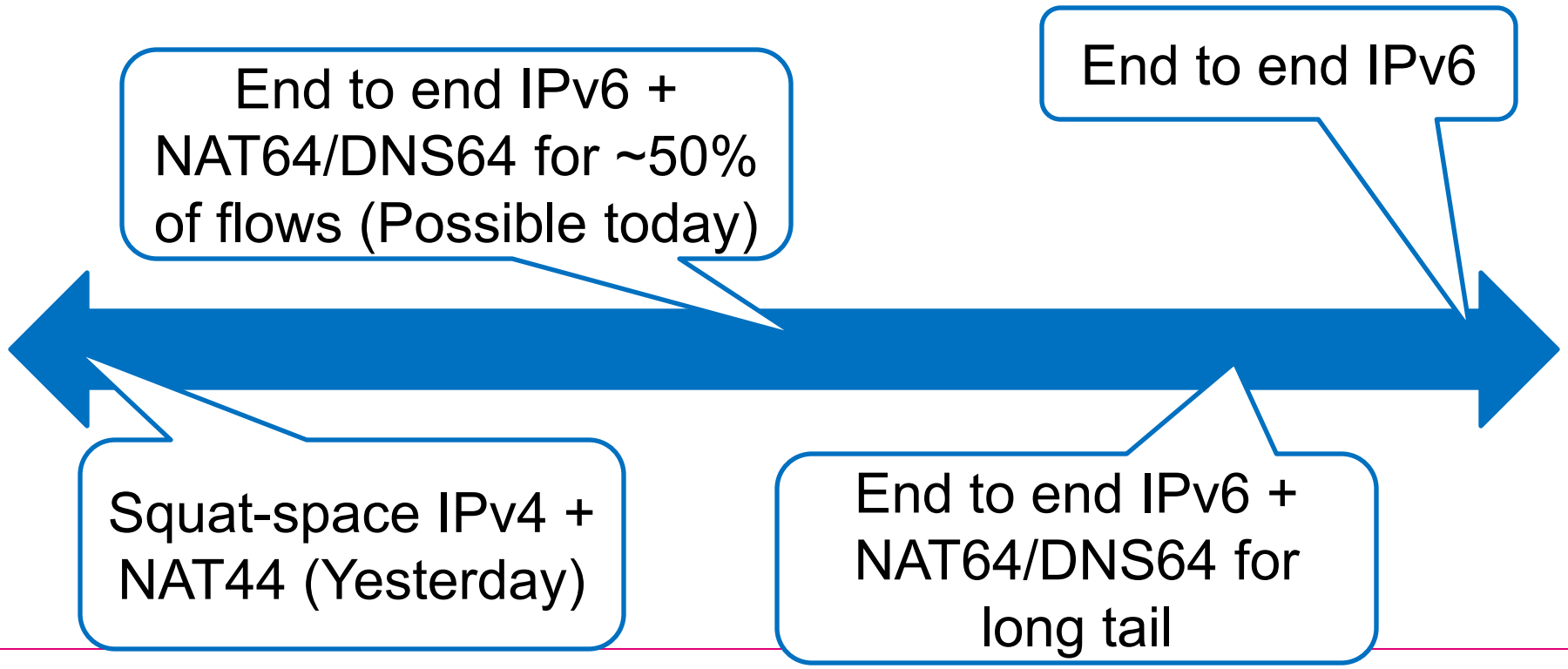
IPv4 Tactical

IPv6
Strategic

Strategy: Define desired result, and then work backwards

Problem: Global IPv4 exhaustion

Target: End to end IPv6

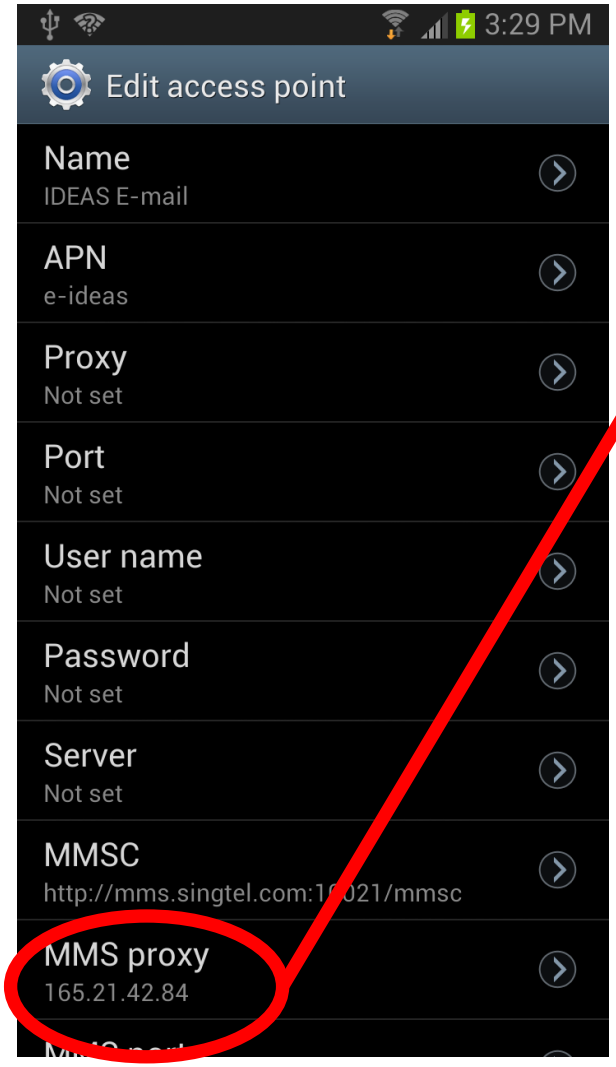


I have personally used IPv6-only + NAT64 for 3 years now

- **Most things works fine with IPv6-only + NAT64**
  - Web, email, … work fine. No user impact
  - ~85% of Android apps work fine, similar general experience with Symbian market (Ovi)
  - Apps are developed in modern SDKs with high-level APIs that work well with IPv6
- **Some things don't work with IPv6-only + NAT64**
  - Peer to peer communication using IPv4 referrals (Skype, MSN, …)
  - IPv4 literals http://10.1.1.1
  - IPv4 sockets APIs

But with 464XLAT, all things work with IPv6-only

Singtel Example of IPv4 Literals

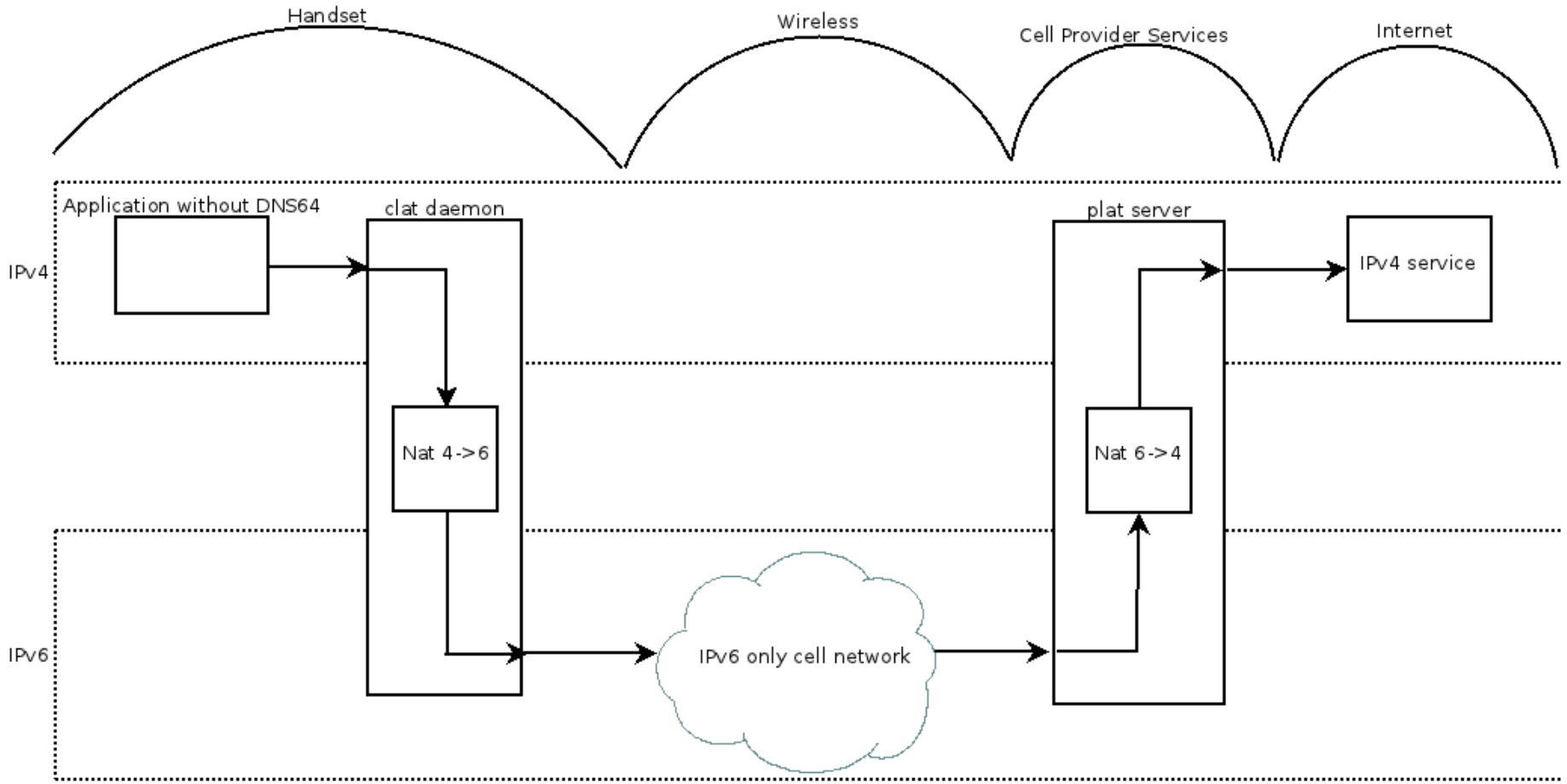


- When IPv4 addresses are specified, there is no chance of using IPv6
- Please use FQDN

4.1 Avoid any design that requires addresses to be hard coded
--RFC1958

How to make EVERYTHING work on IPv6-only?

http://tools.ietf.org/html/draft-ietf-v6ops-464xlat
http://dan.drown.org/android/clat/



Conclusion #3: 464XLAT allows for full functionality on IPv6-only network

- Dual-stack does not solve the IPv4 number scarcity issue
- IPv6-only + NAT64/DNS64 is very good, but not good enough for full IPv4 replacement (web and email work, but Skype does not work)
- IPv6-only + 464XLAT
  - Solves IPv4 numbering issue by not assigning IPv4 to edge nodes
  - Decouples edge growth from IPv4 availability
  - IPv4-only applications like Skype work on an IPv6-only network because 464XLAT translated IPv4 on the phone to IPv6 on the network

Finally, IPv6 deployment is easy

- T-Mobile USA did not spend any CapEx on IPv6
- Introducing the feature to handsets is a slow and careful process, one ***new*** phone model at a time
- Innovative thinking helps reduce deployment costs (hash 128 bit numbers into 32 bit fields in billing records)
- IPv6 will save money in your network (less NAT/CGN, no need to buy IPv4 addresses, …)

Summary of Conclusions

- IPv4 does not fit the business need
- IPv6 works today and is deployed on some the largest edge networks
- 464XLAT allows networks to grow without IPv4
- IPv6 deployment in 3GPP is easy

Big Picture: We must avoid the Internet's largest growth engine (mobile) from being indefinitely tied to scarce IPv4 and fragile stateful NAT44.

Backup slides

Next Steps:

Need to finalize these RFCs:

http://tools.ietf.org/html/draft-ietf-v6ops-464xlat (in RFC editor queue)

http://tools.ietf.org/html/draft-ietf-v6ops-64share-03

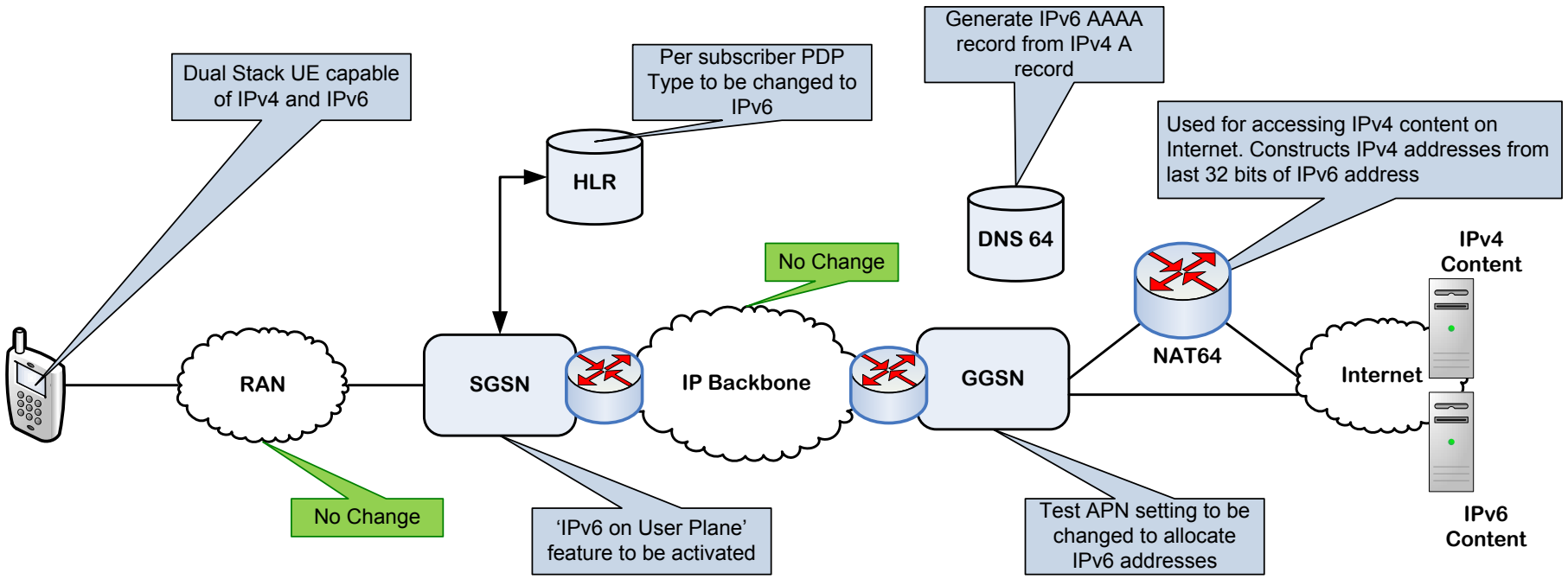
Need Android to release this code:

https://android-review.googlesource.com/#/c/38380/ (merged, but not yet released)

Need APAC networks to deploy IPv6:

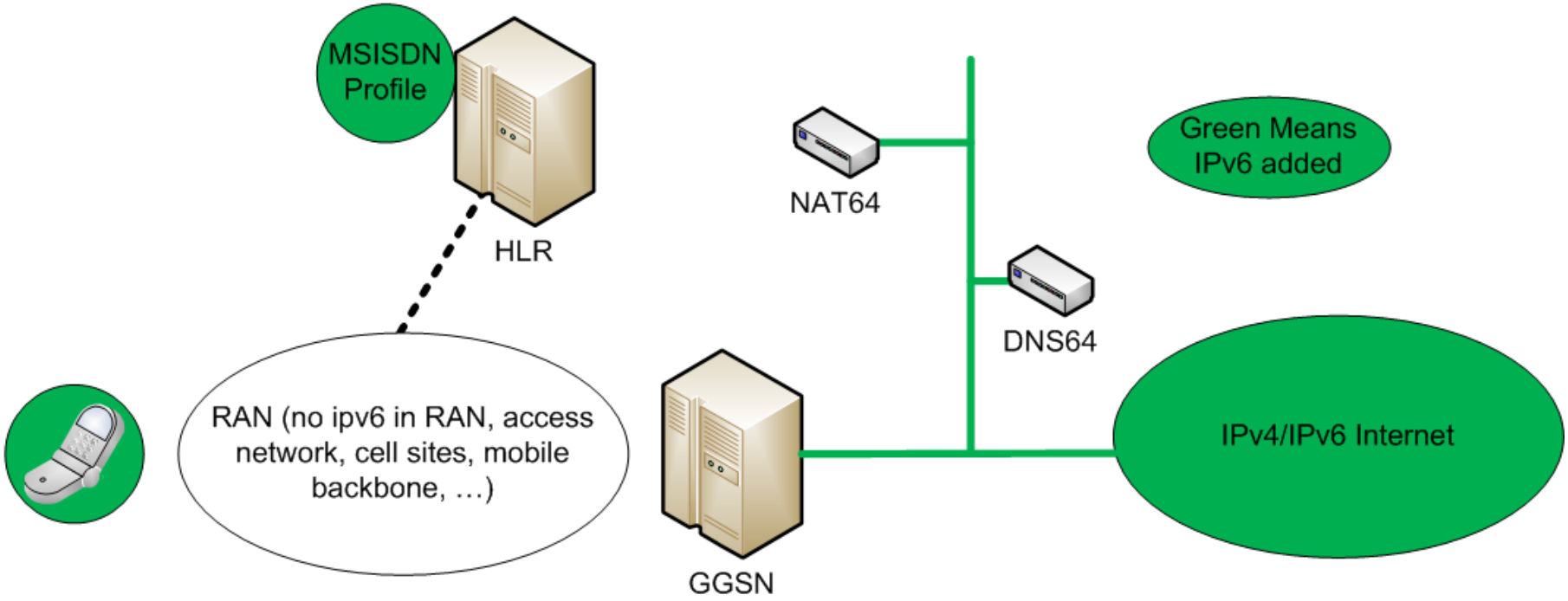
- Gap analysis
- Feature roadmap
- Test and release

Impact to Network Entities



High Level View of IPv6 deployment:

Phone, HLR profile, GGSN, NAT64, IPv6 ISP



References

[1] 464 IETF Draft http://tools.ietf.org/html/draft-ietf-v6ops-464xlat

[2] T-Mobile USA IPv6 Beta http://goo.gl/HGmsy or https://sites.google.com/site/tmoipv6/lg-mytouch

[3] Open Source 464XLAT CLAT implementation on Android http://dan.drown.org/android/clat/