



T-Mobile

Going IPv6 Only

Stephan Lagerholm,
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Introduction

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@ipv4depletion

Agenda

- T-Mobile's journey to become IPv4 independent
- Retries, Returns and Happy Eyeballs
- Background NAT64, DNS64, 464XLAT, Prefix discovery
- Application level fallback to IPv4
- Some best practices and learnings from rolling out and running an IPv6 only network

T-Mobile Customer Base

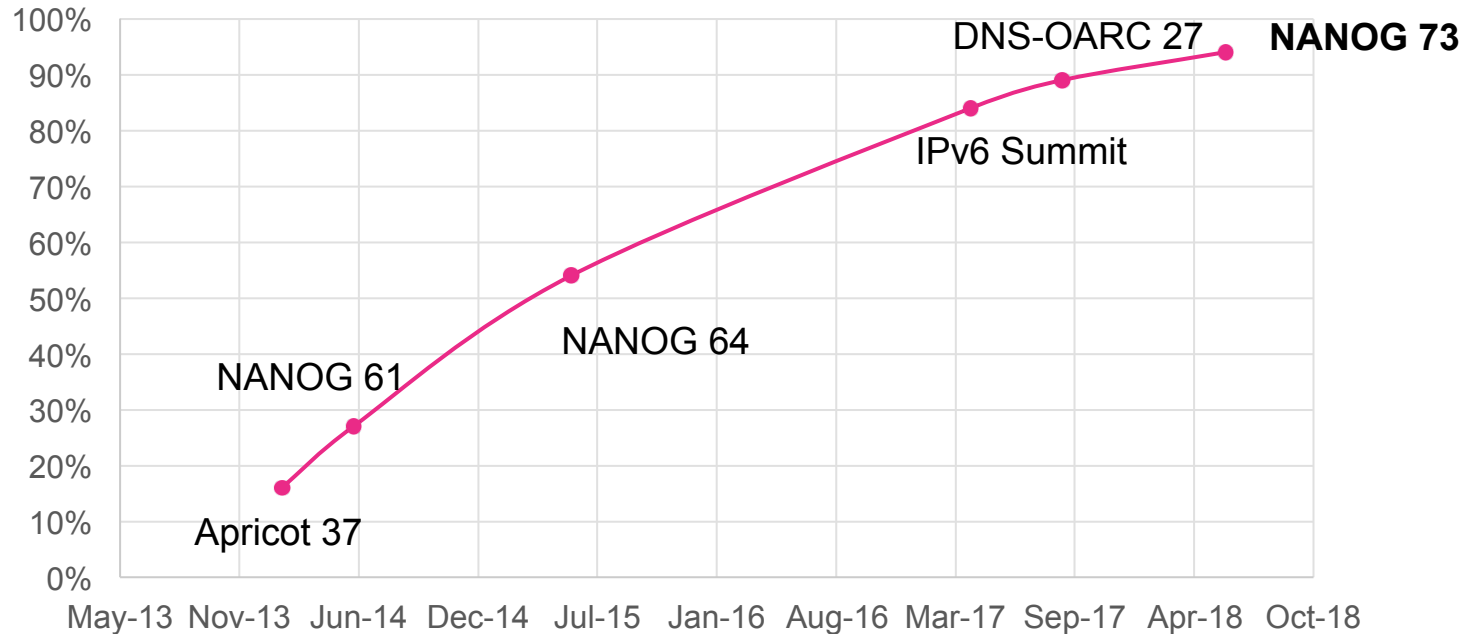


- Android 4.3 + have support for IPv6 + 464XLAT
- At WWDC 2015 Apple announced the transition to IPv6-only network services in iOS 9. Starting June 1, 2016 all apps submitted to the App Store must support IPv6-only networking.
- IOS 10.3 is IPv6 only on the T-Mobile network

10 Million IPv6 only clients on the T-Mobile network today!

Our path to become independent of IPv4

% IPv6



<http://www.worldipv6launch.org/measurements/>

The remaining 6%

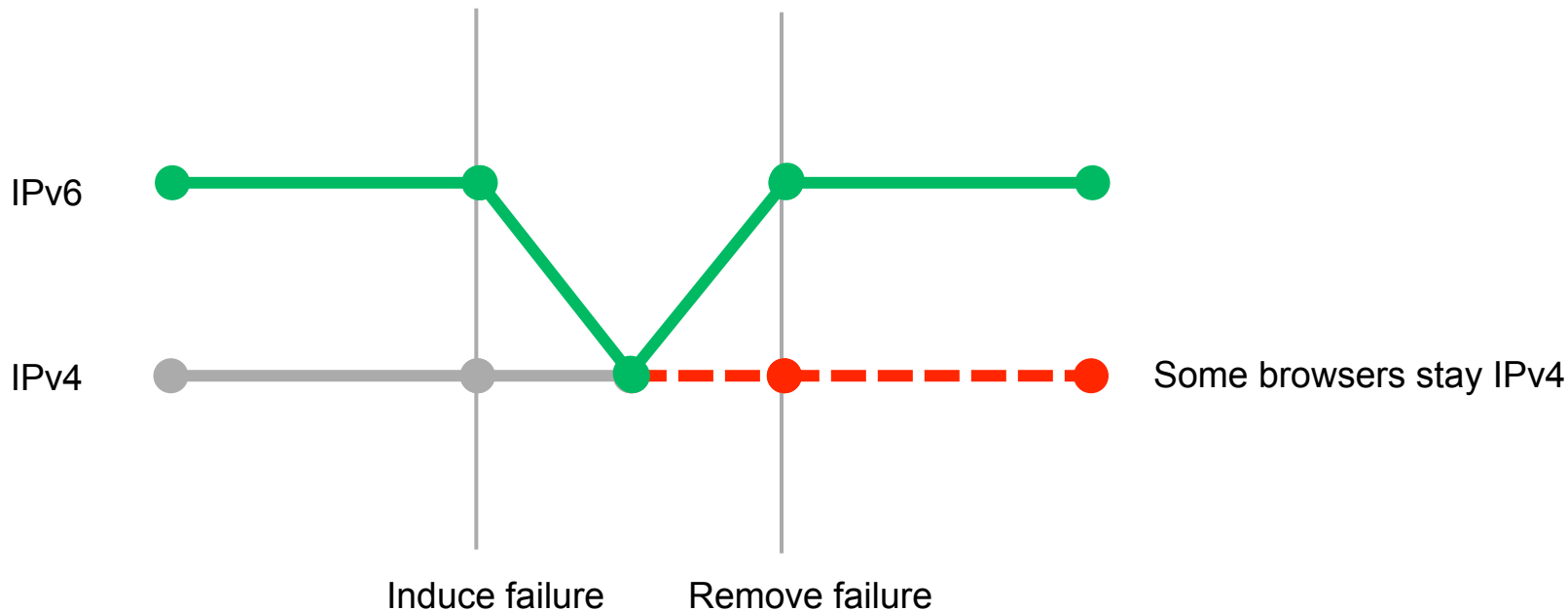


- TMUS Enterprise clients
 - Guests are dual stack
- Really old handsets
 - <https://developer.android.com/about/dashboards/>
- Retries over IPv4 for one or another reason *
- Tethering (for some devices)
- Roaming
 - APN roaming protocol is IPv4

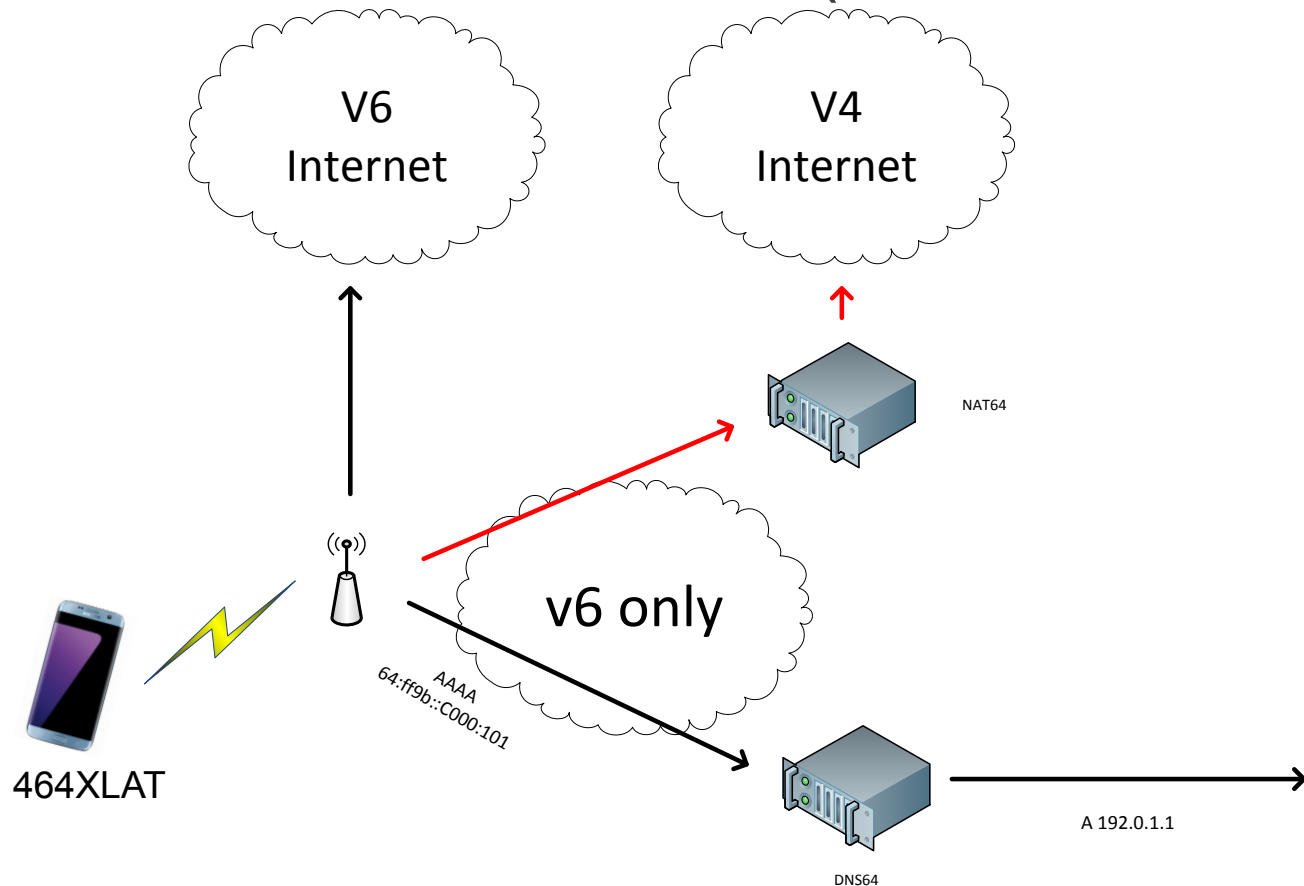
* See next slide

Retries, Returns and Happy Eyeballs

Check Happy Eyeballs:
<http://he.test-ipv6.com/>



DNS64/NAT64/464XLAT (RFC6146,6147,6877)

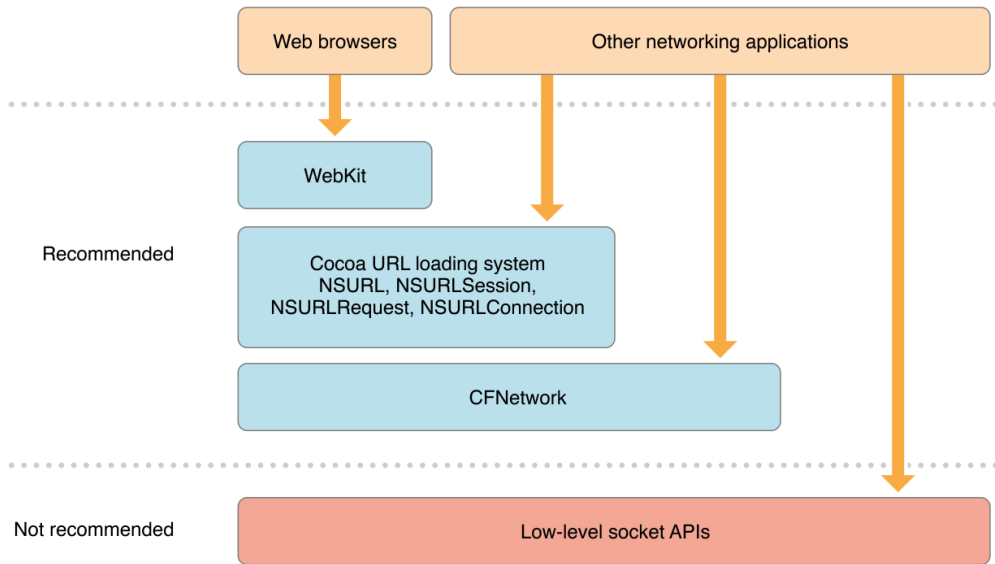


Discovery of IPv6 Prefix (RFC 7050)

- Alternative to hardcoded pref64
- Sends DNS query for ipv4only.arpa AAAA
- Extract the pref64

Application level fallback

- NSURLSession on IPv6 Only Apple devices handles IPv4 literals and Happy Eyeballs at the application level



IPv4 fallback mechanisms are moved from
The OS to the Application level.

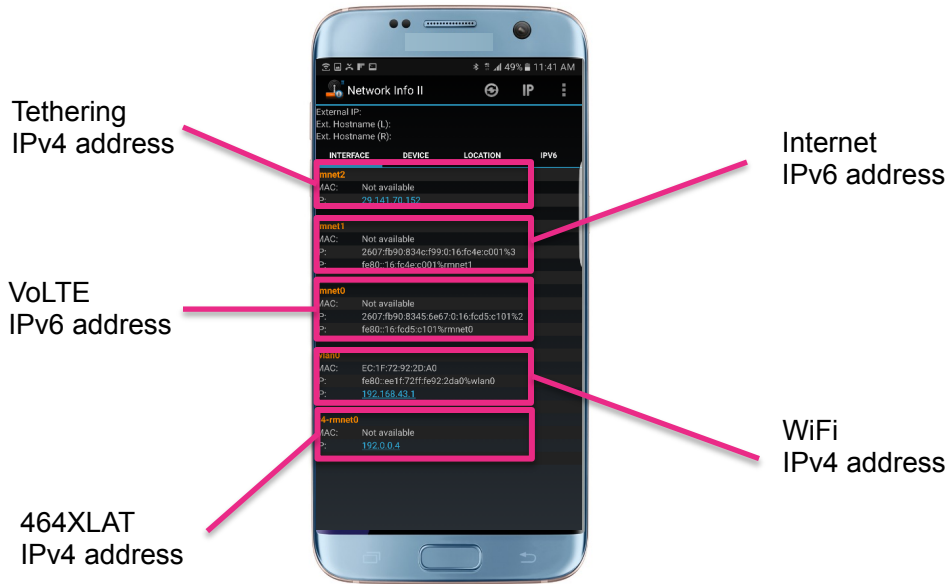
https://developer.apple.com/library/content/documentation/NetworkingInternetWeb/Conceptual/NetworkingOverview/UnderstandingandPreparingfortheIPv6Transition/UnderstandingandPreparingfortheIPv6Transition.html#//apple_ref/doc/uid/TP40010220-CH213-SW13

IPv6 Only Learnings

- Invest in IPv6 like you do with your retirement plan
- Determine what sites/apps are important
- Proactively scan top sites
- Reach out to broken sites
- Don't try to fix things with local overrides
- Scan social media for direct customer feedback
- Don't try to change the world and keep things in perspective

Questions?

Android Interfaces



Network Info II app can be found
In Google/Apple Store

Failure scenarios

Network related failures

Special use – Special use AAAA record such as ::1, link-local, etc (common)

Pks.fi

Routing – AAAA returned, but unable to connect to the IP, :: (very common)

Airtel.in

DNS Related failures

RCODE – Does not return EMPTY NOERROR or NXDOMAIN (rare)

Flag – Does not return the AA flag in the empty answer (rare)

Major cloud storage app

SOA – Does not provide SOA for the same domain as asked for (somewhat common)

Photo site

Timeout – Simply does not return anything when asked for AAAA (common)

www.sky.com.mx

<http://www.employees.org/~dwing/aaaa-stats/>

Testbed for failure scenarios

example:

```
dig @2001:4860:4860::6464 soa.dns64.lagerholm.com AAAA
dig @2001:4860:4860::6464 flag.dns64.lagerholm.com AAAA
dig @2001:4860:4860::6464 rcode.dns64.lagerholm.com AAAA
dig @2001:4860:4860::6464 timeout.dns64.lagerholm.com AAAA
```

Expected result:

```
timeout.dns64.lagerholm.com. 3      IN      AAAA      64:ff9b::6464:6464
```

Results response to failure scenarios

	Google DNS64 As of 6/10/2018	Secure64 CEM 3.2.4 A	Bind	Unbound 1.7.1
Soa	SERVFAIL	OK	SERVFAIL	OK
Timeout	OK	SERVFAIL	TIMEOUT	TIMEOUT *
Flag	SERVFAIL	SERVFAIL	SERVFAIL	OK
Rcode (RFC required)	OK	OK	SERVFAIL	OK

* On first try and after TTL expire