FLAG's IPv6 Implementation

Bijal Sanghani

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FLAG IP Network Overview

- Multiple STM-16 Backbone links mostly sits on Flag's own Cable System: FA-1, FEA, FNAL, FALCON.
- Diversely routed fully redundant backbone links between CORE POP.
- No congestion/oversubscription under normal circumstances in Network.
- IP network comprise entirely of Juniper routers M320, M160, M20 & M10i
- Upgrade to multiple 10G CORE on Juniper T640 in progress.
- IP transit service is the main drive for capacity growth, typical customer are in countries Carriers & ISPs, strong presence in Middle East & India, especially now with Falcon.
- Big expansion plan:
  - Four new Cable Systems: Spending $1.5 billion on 4 new cable systems to reach 60 countries. http://www.flagtelecom.com/index.cfm?channel=4328&NewsID=27318
  - Yipes Acquisition: http://www.flagtelecom.com/media/PDF_files/Reliance-FLAG-Yipes%20announcement.pdf
  - Watch the space ….

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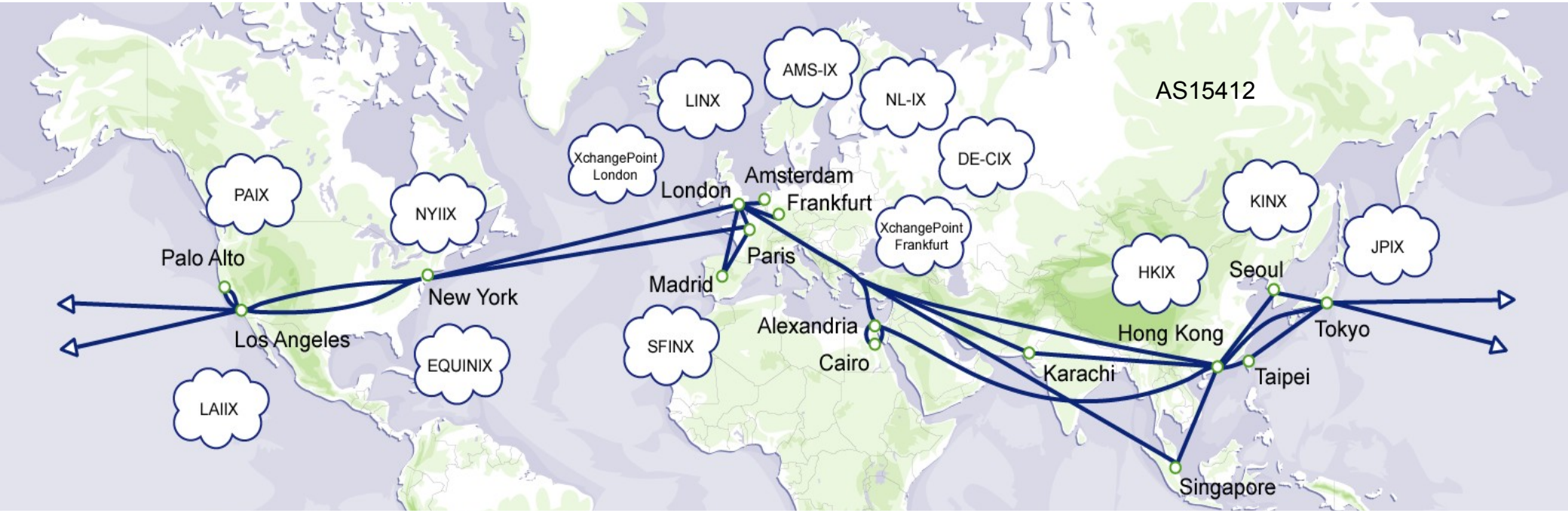
FLAG global MPLS/IP network & peering



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IGP/BGP

- ISIS single area level 2.
- ISIS metric is the primary method to control traffic flow in Network.
- RSVP LSP TE is used to augment exception and for load balancing.
- Single global AS15412.
- Extensive use of BGP communities.
- MBGP is used to support VPN Services.
- Follow best industry practice.
- Flag do prefix-filtering by AS-SET with customers.

MPLS

- Both LDP & RSVP enabled in Network, with LDP track IGP metric.
- All traffic labelled switched and follow IGP metric normally. This includes IP Transit and VPN traffic.
- RSVP LSP typically used for load balancing, special traffic engineering for unique requirement and emergency during cable cut to shift traffic.
- LDP tunnel over RSVP when RSVP LSP is used.
- Use Primary LSP with Fast Reroute but no secondary or standby.
- Link colouring, bandwidth, least fill, adaptive and re-optimise featured used to control LSP placement on multiple links.

Services

- IP Transit
- Direct Route - IP Transit without Upstream, only customers & peer routes.
- Global Ethernet - point-2-point L2VPN with Ethernet Interface plus COS, mainly as lease line replacement.
- VNAP – take customers to IX around the world with one local connection.
- L2VPN base on Kompella, p2p, p2mp, multiple p2p with TCC and COS, also support Q-in-Q.
- L3VPN – On-net or through NNI
- Multicast – joining the Multicast Internet Backbone
- IPv6 – we will talk about this soon.

IPV6 – Service Overview

- Talk about doing it for years but the usual excuses prevail - Not enough demand, no business case, no time, too busy, too risky, too hard to do….
- Finally completed implementation in December 2006 due to demand from one Asian customer. Since then, a few more customers connected in Asia with growing interest in Middle East customers.
- IPV6 peering in most of the IXes we connect to: LINX, AMSIX, HKIX, JPNAP, NYIIX, LAIIX, etc.
- Offered as additional features to existing IP Transit customers for free.
- Support relies on a few senior Engineering staff. Best effort with no SLA, support via email to ipv6@flagtelecom.com only.

IPV6 – Implementation Details

- 2001:1a00::/32 allocated by RIPE
- /48 is then further divided into /64 for B-2-B backbone links & customer WAN links.
- All Flag PE routers are dual stacked
- If the directly connected customer router is not dual stacked, tunnel can be supported too.
- Customer can choose to run v6 & v4 in one connection, or run v6 on separate logical connection.
- Same routing policy and BGP communities supported as IPv4
- Trying to keep everything look & feel the same as IPV4.

IPV6 – Implementation Details

- Congruent ISIS topology with IPV4.
- Separate IBGP mesh for v4 & v6
- Current implementation is native IPv6
- New IP NGN expansion with new P layer routers mean going for 6PE in the near future.
- Very limited system support at the moment.
- No automatic tool for prefix filtering or configuration generation.
- Monitoring is using MRTG & CLI interface statistic - Current utilisation is very low.
- Current version of JUNOS in use does not support v6 cflowd export, hence no flow statistic for v6. Arbor is used for flow statistic/analysis & IPv6 is supported in Arbor.
- No IPv6 Content on net and not really sure where it is ☺

IPv6 - Rollout Experience

- Rolled out IPv6 on all routers without any problem.
- A lot of new configuration is needed on routers for new IPv6 interface address, firewall filters, policies, ISIS & BGP configuration, etc.
- Took far longer to write the Design Document & Planned Work Procedure & worrying about it than actually doing it.
- Juniper support IPv6 for a long time. Old JUNOS version before May 2006 had a security bug: http://archive.cert.uni-stuttgart.de/uniras/2006/07/msg00013.html. So we needed to carry out a software upgrade before deploying IPv6 – but v6 was not the only reason for upgrade.

IPv6 - Rollout Experience

- Existing connected upstream router to Sprint not IPv6 enabled, hence need GRE/IPIP tunnel to the nearest IPv6 router for IPv6 BGP.
- Problem with initial BGP session flapping through the tunnel due to MTU size problem even with path-mtu-discovery configured, has to lower the MTU on the tunnel interface.
- With congruent ISIS, adding new backbone links needs IPv6 address configured at the same time, otherwise the packet forwarding for IPv6 will break & the IBGP session will drop.
- Need to allow ICMPv6 on management filters lo0 for Ethernet connection, e.g. the IX LAN address block because of PMTUD.
- Needed to adjust firewall/bogon filters a few times afterward.

IPv6 Roadmap

- Supporting basic IPv6 Transit service at the moment.
- Will keep open peering in all IX's for IPv6.
- Particularly interested to peer with academic communities, hopefully see more v6 traffic through the network.
- Limited resource & time means unlikely to do much more on IPv6, unless demand for IPv6 increase.
- Not a primary company focus area due to non-revenue generating nature of the service.
- Would like to offer SLA on the service eventually & have full NOC support.
- Will keep tracking IPv6 development & keeping filters up to date.
- No plan to offer any transition gateway service – 6to4, tunnel brokers, etc.

IPv6 Challenge in FLAG

- IPv6 still a specialist subject in FLAG
- Not really sure how customer is using it.
- Would like to get v6 connectivity to the corporate IT network
- Resources on actual IPv6 filters & best practice for ISP still hard to find on the Internet.
- I think we were very brave, but we do worry about filters not up to date & new IPv6 bugs & attack, etc.
- Don’t really have enough time to keep track of changes on this on top of everything else

Special Thanks

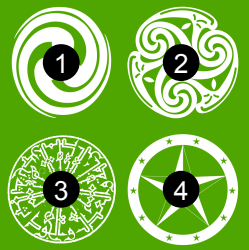
- Special thanks to the following people for making IPv6 a reality in FLAG:

  - George Cheng
  - Lillian Poon
  - Che-Hoo Cheng

Thank You

Individuals and cultures from around the world have, for millennia, expressed and communicated their identities, values and ideas as symbols and diagrams, often within a circular format. By such means, simple but effective communications have been enabled between people.

Similarly, FLAG Telecom is an enabler for international communications, helping people and companies throughout the world to connect, to exchange information, and ultimately to do business with one another. Simply and clearly.



1. A Japanese family crest, defining heritage (Asia)
2. An ancient celtic symbol (Europe)
3. Kufic calligraphy (Middle East)
4. A Texan cattle brand, defining an area of coverage (USA)

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