An Indian depiction of the sun, the source of light and energy

FLAG's IPv6 Implementation

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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

AS15412

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IGP/BGP

- ISIS single area level 2. Metric base on distance and RTT

- ISIS metric is the primary method to control traffic flow in Network. Metric needs adjusting artificially in some cases for desire traffic flow.

- RSVP LSP TE is used to augment exception and for load balancing.

- Single global AS15412.

- Extensive use of BGP communities. All routes are tagged with appropriate communities when entering the network. Pre-defined set of communities for customer to control their traffic. Full set of communities published in RIPE Whois.

- MBGP is used to support VPN Services.

- Follow best industry practice: MD5 authentication, black hole features, route reflectors, anti-spoofing, RPF, etc.

- Flag do prefix-filtering by AS-SET with customers. Customer should register all their route objects with the appropriate Registries and maintain their AS-SET. Routes will not be accepted if not registered.

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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.

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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.

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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. Service available globally, and connect locally without tunnel.

- Support relies on a few senior Engineering staff. Best effort with no SLA, support via email to ipv6@flagtelecom.com only.

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IPV6 – Implementation Details

- Dual Stack on all Juniper routers.

- 2001:1a00::/32 allocated by RIPE, divided into various /48 for internal use & customer assignment.

- /48 is then further divided into /64 for B-2-B backbone links & customer WAN links.

- All Flag PE routers are dual stacked, existing customer can connect without additional physical/logical connection or tunnel.

- 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, apart from no dampening or black hole feature yet.

- Trying to keep everything look & feel the same as IPV4.

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IPV6 – Implementation Details

- Congruent ISIS topology with IPV4.

- Separate IBGP mesh for v4 & v6 - easier to apply different import/export policies to v6 if necessary.

- Current implementation is native IPv6, hence v6 traffic is not labelled switched.

- 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, work in progress. Customer prefix update via email only.

- 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 ☺

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IPv6 - Rollout Experience

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- Rolled out IPv6 on all routers without any problem. The actual work spread over 3 days. Most time consuming piece was putting IPv6 address on all backbone interfaces & establishing all v6 IBGP sessions.

- 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.

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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. Tunnel PIC is needed on Juniper for GRE tunnel.

- 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. e.g. Didn't realise site local address has been replaced by unique local IPv6 address in the last IETF meeting before deployment.

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IPv6 Roadmap

- Supporting basic IPv6 Transit service at the moment.

- Will keep open peering in all major IX 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. Ready to serve customers when they need it.

- No plan to offer any transition gateway service – 6to4, tunnel brokers, etc.

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IPv6 Challenge in FLAG

- IPv6 still a specialist subject, very hard to train everyone to support IPv6 in the NOC, even though a lot of effort put in to make configuration/routing policy as close to IPv4 as possible.

- Not really sure how customer is using it, whether it is just a regulatory requirement or actually needing it for some real application.

- Would like to get v6 connectivity to the corporate IT network, but that would probably be a bigger challenge than rolling out IPv6 in the Production 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

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Thank You

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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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