Integrating Networks

Michael Lyngbøl <lyngbol@wheel.dk>, Nina Bargisen <nihb@tdc.dk>
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Abstract

• In 2004 TDC AS3292 acquired Song Networks AS3246. It was decided relatively fast that the two networks were to be integrated in order to have a common network with products available throughout the area spanned by the two original networks.

• The main product to be supported was RFC4364 VPNs (L3 MPLS VPN) with access connections throughout the area of the two original networks.
Straightforward Integration

• Both networks were using IS-IS as IGP, BGP for VPN and internet routes.
• So:
  • Merge the IS-IS domains
  • Change the AS number on PE and Ps
  • Align configuration

• DONE!
The Facts

• The acquired network consisted of 4 geographically areas – each operated and designed by local groups of engineers. A fact that was not changed by the acquisition

• Each area had a different set of issues to be taken care off. A few examples:
  – two parallel topologies spanning the same area
  – Old equipment needing replacement

• This meant that integration of the whole acquired network in one big operation was not possible
The plan in short

- Split area to be integrated from the rest of the acquired network
- Integrate IS-IS and BGP
- When done start on the next area
RFC4364 jump start

• Use RFC4364 Option-A to connect VRFs in 3292 and 3246 back to back. Don’t do this in a big scale, you’ll feel the pain later on when doing Option-C or full IGP integration.

• Use RFC4364 Option-C to connect MPLS networks.
  – eBGP + send-label on border routers gives you MPLS LSP from end-to-end.
  – eBGP between VPNv4 RRIs to exchange VPNv4 routes.
RFC4364 jump start

VRF Greer
VRF Blue
VRF Rec

GE/ATM Option-A

Option-C mpls forwarding enabled

eBGP session signalling loopbacks and labels
RFC4364 Option-C

• signal loopback addresses and labels for these using eBGP between the two AS’s
• redistribute loopbacks from BGP into ISIS
• enable MPLS forwarding on links between networks
• then LSP’s between PE’s in the two network are set up and can forward traffic.
RFC4364 Option-C

- ISIS-> BGP (IOS)
- router bgp 3292
- address-family ipv4
- redistribute isis level-2 route-map OPTC-ISIS-BGP
- neighbor 1.2.3.2 route-map OPTC-BGP-IN in
- neighbor 1.2.3.2 route-map OPTC-BGP-OUT out
- neighbor 1.2.3.2 send-label explicit-null
- Take care not to redistribute own IS-IS loopbacks into iBGP
RFC4364 Option-C

- route-map OPTC-ISIS-BGP permit 10
  - match ip address prefix-list BB-LOOPBACK
  - set origin igp
- route-map OPTC-BGP-IN permit 20
  - match ip address prefix-list PEER-BB-LOOPBACK
  - match mpls-label
  - set metric 0
  - set community no-advertise
- route-map OPTC-BGP-OUT permit 10
  - match ip address prefix-list BB-LOOPBACK
  - set metric 0
  - set mpls-label
  - set community no-advertise
- ip prefix-list BB-LOOPBACK permit 10.0.0.0/24 ge 32
- ip prefix-list PEER-LOOPBACK permit 192.168.0.0/24 ge 32
RFC4364 Option-C

• **BGP -> ISIS (IOS):**
  - router isis
  - redistribute maximum-prefix 1000 95 withdraw
  - redistribute bgp 3292 route-map OPTC-BGP-ISIS metric-type external
  - 
  - route-map OPTC-BGP-ISIS permit 10
  - match ip address prefix-list PEER-LOOPBACK
  - 
  - ip prefix-list PEER-LOOPBACK permit 192.168.0.0/24 ge 32
RFC4364 Option-C

- router#sh ip bgp 192.168.0.1/32
- BGP routing table entry for 192.168.0.1/32, version 295665
- Paths: (1 available, best #1, not advertised to any peer)
  - Not advertised to any peer
  - 3246
  - 1.2.3.2 from 1.2.3.2 (192.168.0.100)
  - Origin incomplete, localpref 100, valid, external, best
  - Community: no-advertise
- mpls labels in/out 2641/576
RFC2547 Opt-C (BGP signaled MPLS IGP/next-hop labels)

- router#sh ip cef 192.168.0.1
- 192.168.0.1/32, version 137524, epoch 0, cached adjacency 1.2.3.2
- 0 packets, 0 bytes
- tag information set, all rewrites owned
- local tag: 2641
- fast tag rewrite with Gi2/1, 1.2.3.2, tags imposed \{576\}
- via 1.2.3.2, 0 dependencies, recursive
- next hop 1.2.3.2, GigabitEthernet2/1 via 1.2.3.2 /32 (Default)
- valid cached adjacency
- tag rewrite with Gi2/1, 1.2.3.2, tags imposed \{576\}
Splitting 3246 in two using BGP signaled MPLS IGP/next-hop labels

- 3246area1 and 3246area2 are connected with ISIS links
- 3246area1 is connected to 3292 with a dedicated Option C connection and an IP transit connection.
Splitting 3246 in two using BGP signaled MPLS IGP/next-hop labels

- Split 3246 into two IGP domains in order to integrate one of the domains
  - Necessary to flush unwanted IS-IS LSPs (not to flooded into the other network)
  - IS-IS authentication issues as authentication not possible on all LSPs in 3246

- To minimize time for LSPs to be flushed, configure low LSP lifetime in the network to be integrated (we used default lifetime)
Splitting 3246 in two using BGP signaled MPLS IGP/next-hop labels

- the link between 3292 and 3246area2 is configured with two vlans
- vlan 1 is Option C vlan 2 is IP transit
- 3246area2 loopbacks and loopback labels are signaled on the vlan1 connection from 3246area2 to 3292
- 3246area1 loopbacks and loopback labels are signaled on the vlan1 connection from 3292 to 3246area2
Splitting 3246 in two using BGP signaled MPLS IGP/next-hop labels

- The Option C connection between 3292 and 3246area1 is changed to only signal 3246area1 loopbacks and loopback labels from 3246area1 to 3292
- 3246area2 loopbacks and loopback labels are signaled from 3292 to 3246area1
- Raising the metric on the ISIS link between 3246area1 and 3246area2 causes LSP’s between the two areas to run via 3292.
- ISIS link between the two areas can now be shut
Splitting 3246 in two using BGP signaled MPLS IGP/next-hop labels

- When IS-IS between 3246area1 and 3246area2 is shut and the IS-IS database in 3246area2 is purged, then shut the option C connection between 3292 and 3246area2 and configure IS-IS on the link.
- The IP transit session on the link remain unchanged.
- DONE!
Splitting 3246 in two using BGP signaled MPLS IGP/next-hop labels

- Internet traffic flow between customer in area1 and customers in area2 and 3246 peers connected in area2
- Internet traffic flow between customer in area2 and customers in area1 and 3246 peers connected in area1
Splitting 3246 in two using BGP signaled MPLS IGP/next-hop labels

- Internet traffic flow between customers in area1 and customers in 3292 and rest of Internet
- Internet traffic flow between customer in area2 and customers in 3292 and rest of Internet
Splitting 3246 in two using BGP signaled MPLS IGP/next-hop labels

- Internet traffic flow between customer on a 3292 PE router connected in area2 and customers in 3292 and rest of Internet
- Leaks of more specific 3246area2 prefixes to 3292 PE connected in 3246area2 are necessary in order to avoid traffic to trombone via 3246area1
IS-IS – checklist

• Low LSP lifetime in the domain to be integrated is nice when waiting for IS-IS database to purge

• Authentication (or lack of) must be consistent in the two domains to be integrated
IS-IS size

- 3292 is one flat L2 only network. Before integration ~ 1300 LSP (incl. pseudo nodes) in total.
- 3246 is one flat L2 only network. ~ 600 LSP before integration.
- With the integration of 2/3 of 3246 we now have a L2 only network of ~ 1600 LSPs.
- We’ve seen no need for a split into L1L2.
- No IS-IS issues what so ever.
IS-IS experience platforms and software

- Cisco 7200/7300/7600/GSR/CRS-1
  IOS 12.3/12.2SB/12.2SRA/12.0S/3.4.2
- Juniper M10i/M160/M320
  JUNOS 7.5/8.2E
RFC4364 Opt-A vs. Opt-C

• Opt-A is the easy way to interconnect two VPNs but
  – Configuration is necessary on a per customer per VPN per interface basis
  – Capacity is not easily added
  – QoS mapping is troublesome (no end-to-end QoS)
  – PE interconnect router scalability is an issue as PE needs to carry all interconnected VRFs VPNv4 tables
RFC4364 Opt-A vs. Opt-C

• Opt-C is a better way to interconnect networks as:
  – there is no need for customer configurations on the interconnects between the networks
  – VRFs can be transparently configured on PEs in both networks
  – end-to-end QoS works
  – EoMPLS/VPLS will work by default
  – capacity can be added easily
Route reflector design for RFC4364
Option-C VPNs
Route reflector design for RFC4364 Option-C VPNs
Status for the integration

- Two domains are integrated
- No major issues happened during the integrations
- Last domain will be integrated this fall – preparations are ongoing
Q & A

• nihb@tdc.dk
• lyngbol@wheel.dk