Experiences with Large-scale Network Consolidation
or
How I Spent My Summer Vacation

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Overview

- History
- Business drivers
- Our approach
- Preparation for the cut
- The Cut(s)
- Lessons learned

Some History

- Allegiance Telecom acquired the IBI network assets in December of 2001 from WorldCom
- Allegiance Telecom (AS11466) – Nationwide Tier-2 IP Network
- IBI/Digex (AS2548) – Nationwide Tier-1 IP Network

Business Drivers (Why do this?)

- Reduce network expense through consolidation of facilities

- Consolidate operations and support

- Uniform routing policies

- Ability to sell either legacy network's products at any site

Our Approach

- Because we were migrating to the 2548 ASN, we had to tailor the migration to fit within the limitations of the ALGX network
  - IBI Network
    - Well aggregated – easier to migrate POP-by-POP
  - Allegiance Network
    - Not well-aggregated – serious complications in POP-by-POP approach
- The POP-by-POP approach didn't suit our needs, we opted for an overnight AS-merge

Our Approach

- Traditional integrations have consisted of moving the acquired company behind the larger AS
  - Less risky – no significant customer downtime
- By merging the 2 networks into a single ASN we could accomplish all of our goals in one night
  - More risky - requires significant downtime

Some Considerations…

- Network size (~500 routers)
  - Protocols **<u>MUST</u>** scale
- Multi-vendor environments
  - Protocol interaction (especially MPLS)
  - Routing policy can be "tricky" to adapt from one platform to another
- Does network consolidation make sense?
  - Depending on your specific situation, network integration may not be a big issue
    - Allegiance had a brand-new OC48 network with ZERO traffic to migrate which made the task somewhat easier

Preparation for the Cut

- Set an integration strategy
  - Understand the business drivers
  - Set attainable milestones and goals
- Build a team
  - Identify key players from each organization

Preparation for the Cut

- Form a plan
  - Develop new routing policies and test (and test again, and again)
  - Outline all key dependencies and identify risks
  - Task personnel based on core competencies
  - Layout the cutover process, router by router
  - Set hard backout points
  - Practice – use dry runs to make sure everyone understands their role and responsibilities

The Cut(s)

- First cut attempt was unsuccessful
  - Too much work for one night
  - Decision was made to divide the cut into 2 pieces
    - First piece – install new routing policy onto legacy IBI network
    - Second piece – reconfigure legacy Allegiance network with new policy and new ASN

The Cut(s)

- The IBI network was reconfigured the week prior to the Allegiance network
    - All peers were shutdown to minimize the possibility of a route leak and avoid dampening as routers were reloaded
    - Policy bugs were identified and resolved over the next week leading up to the AS-merge

The Cut(s)

- Preparation for the AS-merger
  - A configuration freeze was placed in effect the day before the actual AS merger
  - New configurations were generated and sanity checked for each router on the network
    - Perl script took about 2 seconds for each router
  - All current router configurations were backed up to flash locally in case backout was necessary

The Cut(s)

- AS-merger
  - All peers shutoff and the IBI/ALGX networks were isolated
  - New configurations were loaded on the routers in a single market as a testbed
  - Routers in that market were reloaded with the new configuration

The Cut(s)

- AS-merger
  - Only after those routers were verified to be back up and working did we proceed with additional markets
  - Markets were then done one by one until all routers had been reconfigured and reloaded
  - Once all markets were completed, peers were brought back up and connectivity to the rest of the world was restored

The Cut(s)

- Post-merger issues
  - Policies
    - Different routers on different policies tend to leak routes unexpectedly
    - Different versions of software may:
      - Use a different command to do the same thing
      - Use the same command to do a different thing

The Cut(s)

- Post-merger issues
  - Protocols
    - Scalability
      - A network of 500 routers will test limits that the vendors may not have tested themselves
    - Cross-vendor compatibility issues (MPLS specifically)
    - Policy gap that allowed a massive route-leak was identified and corrected

Lessons Learned

- Nobody's perfect
  - Typos happen
- Equipment can (and will) fail
- You can never plan enough
  - Testing in the lab is invaluable, but not sufficient to prevent all problems from manifesting
  - A problem that arises in 1 out of 25 routers may never appear in a 10-router lab, but show up 20 times in a 500 router network.

Lessons Learned

- Communication is key
  - Make sure you give your customers plenty of notification prior to the work
  - Notify peers about the outage including an explanation about the work being performed
  - Set and manage realistic expectations with both your customers and your corporate management
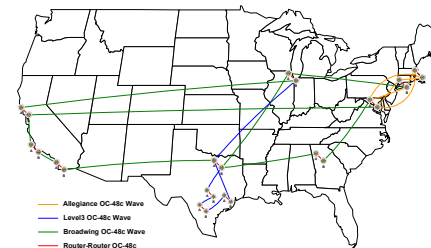- An out-of-band management network is a priceless assett

Lessons Learned

- Don't be afraid to voice any concerns, point out potential problems, or offer alternative solutions

- Don't dismiss anyone else's concerns, gloss over any potential problems, or fail to consider an alternative solution
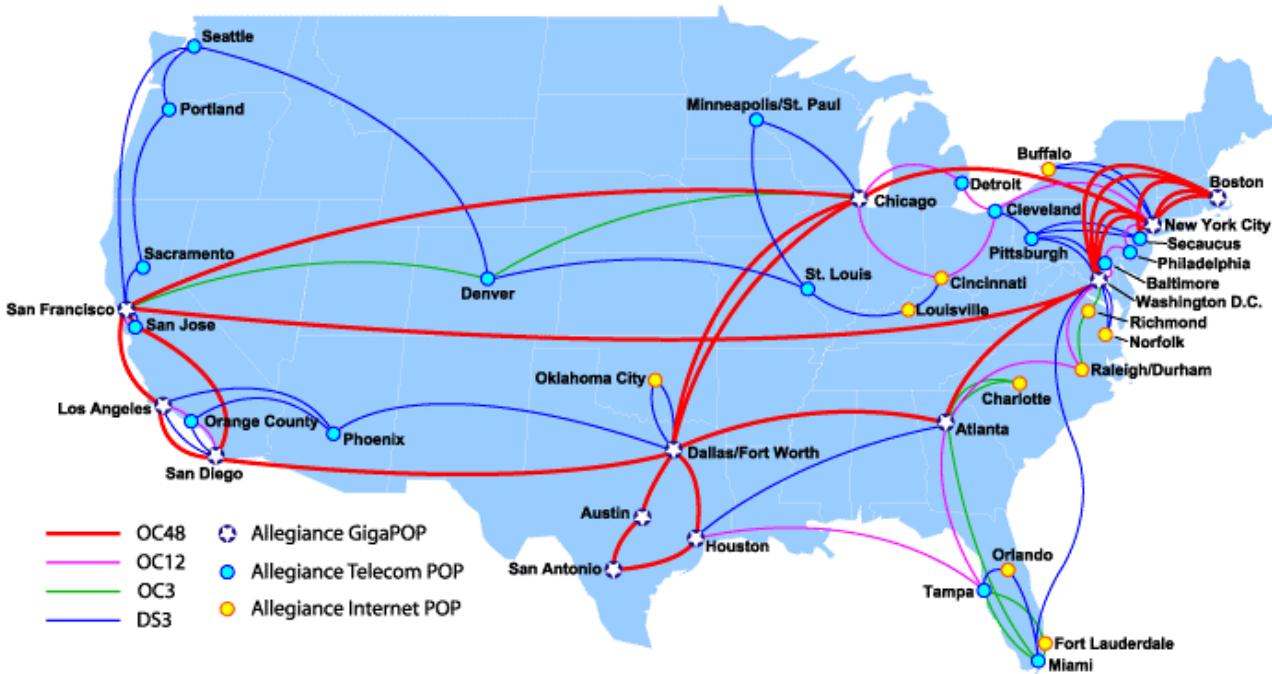
What we started with
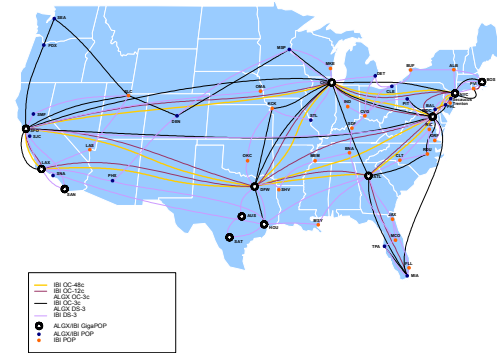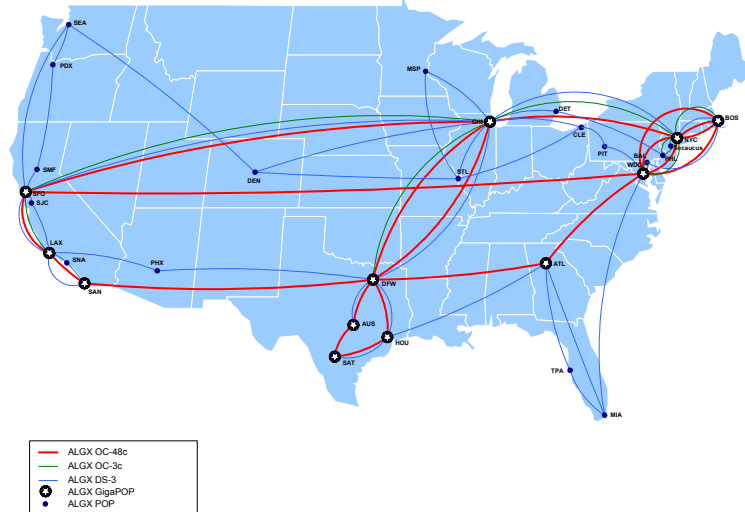
What we finished with

Shout-outs

- Greenbelt Team
- Dallas Team
- Cisco and Juniper TAC

WORLD CHAMPIONS!!!