

Assessing the Impact of Carrier-Grade NAT on Network Applications

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CGN Testing

- CableLabs, TWC, and Rogers tested the impacts of NAT444 on common applications in 2010
- CableLabs repeated CGN testing using multiple CGN devices June – Oct, 2011
 - Both NAT444 and DS-Lite co-existence technologies
- Testing focus is on
 - Applications with previously identified issues
 - Optimization of configuration parameters

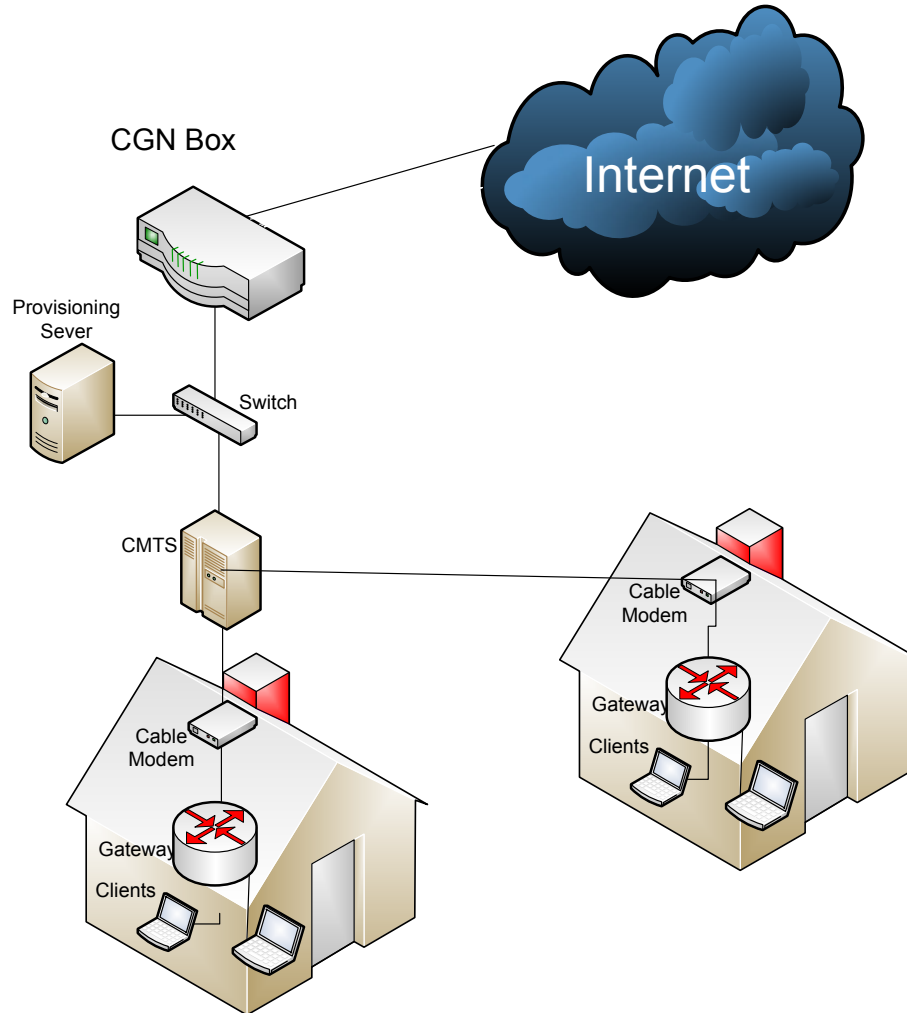
CGN Challenges identified in -01

- Poor quality of experience for advanced services
 - Netflix, peer-to-peer, video streaming, gaming, etc.



- Negative impact to targeted advertising/geo-location
- Overlapping Addressing / NAT Zones
- Impacts network architecture/traffic engineering

Sample Topology



Overview of test scenarios

- Single and dual ISP networks with one or more users on multiple home networks
- Test applications include
 - Video services – e.g. Netflix, YouTube, iClips, Silverlight
 - Audio streaming – e.g. Pandora, Internet Archive
 - Peer-to-peer – e.g. on line gaming, uTorrent
 - FTP – large file transfers
 - SIP calls – e.g. X-Lite, Skype
 - Video chat – e.g. Skype, OoVoo
 - Social networking – e.g. Facebook, Webkinz
 - Web conferencing – e.g. GoToMeeting

Client devices and gateways used for testing

- Laptops running Vista, XP, Win 7 and MAC OS
- X-box gaming consoles
- iPad
- iPhone and Android smartphones
- CE devices
 - LG Blu Ray player
- CPE routers
 - Netgear, Linksys, Cisco, D-Link, Apple Airport Express

CGN Results Summary

- NAT444
 - Significant improvement since last year
 - Some issues still exist with peer-to-peer and streaming services
 - Performance dependent on home gateway
- DS-Lite
 - Performance comparable to NAT444
 - Possible MTU issues impact throughput



NAT444



DS-Lite

CGN Testing Issue #1 – SIP Call

- Test Scenario
 - SIP client to client call is initiated
 - Across two home networks on single ISP
 - Across dual ISPs, each supporting a single home network
 - P2P client used was PJSIP User Agent
 - X-Lite client used for SIP Proxy
- Observed Behavior
 - Peer-to-peer calls cannot be initiated or received (PJSIP)
 - In cases where a proxy is given, there is no issue (X-Lite)
 - Inside device needs to initiate traffic first

A blue rectangular box with a darker blue horizontal bar at the top. The text "NAT444" is written in white, bold, sans-serif font in the center.A purple rectangular box with a darker purple horizontal bar at the top. The text "DS-Lite" is written in white, bold, sans-serif font in the center.

CGN Testing Issue #2 – Console P2P Gaming

- Test Scenario
 - Console gaming sessions are initiated for two users
 - Across two home networks on single ISP (hairpinning)
 - Behind same public IPv4 address
- Observed Behavior
 - Cannot start game between connected users
 - Console displays error message:
“Game session no longer available”

The logo for NAT444 consists of a dark blue horizontal bar at the top, followed by a light blue rectangular box containing the text "NAT444" in white, bold, sans-serif font.The logo for DS-Lite consists of a dark purple horizontal bar at the top, followed by a light purple rectangular box containing the text "DS-Lite" in white, bold, sans-serif font.

CGN Testing Issue #3 – Video Streaming

- Test Scenario
 - Netflix video streaming sessions are initiated using a variety of client devices
- Observed Behavior
 - Slower buffering times were noted for most client devices
 - On one home router, the first session was degraded after the second session was started (excessive rebuffering)
 - Video streaming was smooth behind other home routers
 - This occurred for Microsoft Smooth Streaming as well
 - Improvement since last year

The logo for NAT444 consists of a dark teal horizontal bar at the top, followed by a light blue rectangular box containing the text "NAT444" in white, bold, sans-serif font.The logo for DS-Lite consists of a dark purple horizontal bar at the top, followed by a light purple rectangular box containing the text "DS-Lite" in white, bold, sans-serif font.

CGN Testing Issue #4 – uTorrent

- Test Scenario
 - uTorrent seeding initiated on client inside CGN
 - uTorrent leeching initiated on client on internet
 - Across two home networks on single ISP
- Observed Behavior
 - uTorrent peer-to-peer seeding does not work before seed initiates traffic
 - Succeeds using proxy server
 - Can succeed if seed initiates traffic through CGN
 - Behavior improves by increasing CGN timeouts

CGN Testing Issue #5 – Slower Download Rates

- Test Scenario
 - Downloads are initiated using multiple types of clients
 - FTP of large size file
 - Internet Archive audio/video files are downloaded
- Observed Behavior
 - Download rate is noticeably slower for some OS's
 - 250Kbps for one vs. 120Kbps for another

Conclusion

- Getting better
 - CGNs
 - Applications
 - Home routers
- Same types of problems identified last year still exist
- DS-Lite similar to NAT444
- IPv6 still offers a better experience
 - But not widely available in consumer equipment