Assessing the Impact of Carrier-Grade NAT on Network Applications

Chris Donley, Victor Kuarsingh, Lee Howard, John Berg, Jinesh Doshi
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
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. online 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
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
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”
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
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

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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