# Total Cost of Ownership of Carrier-Grade NAT

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# Introduction

- Does not reflect Time Warner Cable work
- Thought experiment: How to quantify the total cost of CGN?
  - CapEx
  - OpEx
  - Breakage
- What are the implications of that cost?

# What Does CGN Cost?

| | |
|---|---|
| **$70,000** | CGN hardware |
| **$10,000** | Logging systems |
| **$10,000** | Software development |
| **$90,000** | CAPEX per 10,000 users |

| | |
|---|---|
| $10,000 | Space, power, cooling, monitoring, maintenance, etc. |
| **$10,000** | OPEX per 10,000 users |

# What Does CGN Cost?

For each 10,000 users, many have devices or applications that break behind CGN (draft-donley-nat444-impacts)

| Use | Number of Potential Users | Number Affected | Number of Support Calls | Number of Lost Users |
|---|---|---|---|---|
| **Xbox** | 2100 | 1050 | 262 | 262 |
| **PS3** | 1100 | 550 | 137 | 137 |
| **P2P** | 1500 | 1200 | 300 | 300 |
| **Netflix** | 1200 | 60 | 15 | 15 |
| **Misc.** | 800 | 800 | 200 | 200 |
| | 6,700 | 3,660 | 914 | 914 |

- For each 10,000 users:
- If support call cost is $20, the increased support cost is
  $20 * 914 = $18,280.
- If (ARPU) is $400/year, the total revenue lost to CGN is
  $400 * 914 = $365,600 per year.

# Total Costs

| Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | |
|---|---|---|---|---|---|
| $18,000 | $18,000 | $18,000 | $18,000 | $18,000 | CAPEX (depreciation) |
| $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | OPEX |
| $18,280 | 0 | 0 | 0 | 0 | Customer support |
| $365,600 | $365,600 | $365,600 | $365,600 | $365,600 | Lost revenue |
| $411,880 | $393,600 | $393,600 | $393,600 | $393,600 | TOTAL: $1,986,280 |

# Conclusion #1

CGN costs $2 million for every 10,000 users it's used for, or $40 per user per year

# Would it be cheaper to buy addresses?

- From $12 - $40 per address, IPv4 addresses look cheaper than CGN
- Above $40, CGN is cheaper than each address

# When is CGN too expensive?

- According to annual reports of major US ISPs, ARPU is $400 for Internet access, and margin is about $140 per user

- If you have to spend $70 to make $140, it's more profitable to sell addresses than to turn up customers
  - At least in the 1-year ROI
  - 5-year customer worth $700; could prices reach $350?

# Conclusion #2

# Maybe CGN is okay for some people?

- IPv6 is coming RSN
- Web and email work fine through CGN
- How do you know who would be okay with CGN?
  - DPI
  - Customer self-selection

# How will prices be affected?

- CGN costs $40 per year more than old-fashioned Internet access
- Native IPv4 costs $12-70 more than old-fashioned Internet access
- But wait—commercial companies don't sell anything at cost

# Conclusion #3

| Price before scarcity | Basic Internet (CGN) | Advanced Internet (status quo) |
|---|---|---|
| **$33/month** | $37.83/month | $40.88/month |
| **$400/year** | $454/year | Up to $495/year |
| | +13% | +21% |

# How far can we take this thought experiment?

- As an ISP runs out it must conserve IPv4 for the most profitable customers
- The rational ISP deploys IPv6 with CGN
- Can't change service until contract renewal
  - "Your contract term is ending, and we have new service tiers: Standard and Advanced"
  - "But here, we're giving you a new modem (which supports IPv6)"

# Conclusion #4

- One $contract_term after IPv4 runout, everyone will have IPv6.
- With ARIN run out mid-2013, the prudent ISP will make sure all of their customers and services are running IPv6 by the end of 2014.

# Conclusions

1. CGN costs $2 million over five years for every 10,000 users it's used for, or $40 per user per year.

2. 


3.

| Price before scarcity | Basic Internet (CGN) | Advanced Internet (status quo) |
|---|---|---|
| **$33/month** | $37.83/month | $40.88/month |
| **$400/year** | $454/year | Up to $495/year |

4. The rational network will have 100% IPv6 by end of 2014.

# Draw your own conclusions

Slides, spreadsheet, and paper available at http://www.asgard.org