

# 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?

<b>\$70,000</b>	CGN hardware
<b>\$10,000</b>	Logging systems
<b>\$10,000</b>	Software development
<b>\$90,000</b>	CAPEX per 10,000 users

<b>\$10,000</b>	Space, power, cooling, monitoring, maintenance, etc.
<b>\$10,000</b>	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
<b>Xbox</b>	2100	1050	262	262
<b>PS3</b>	1100	550	137	137
<b>P2P</b>	1500	1200	300	300
<b>Netflix</b>	1200	60	15	15
<b>Misc.</b>	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

```
graph LR; A["$0 - $40  
Buy  
Addresses"] --> B["$40 - $70  
Deploy CGN"]; B --> C["$71 +  
CGN + Sell  
IPv4"]
```

\$0 - \$40  
Buy  
Addresses

\$40 - \$70  
Deploy CGN

\$71 +  
CGN + Sell  
IPv4

# 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)
<b>\$33/month</b> <b>\$400/year</b>	\$37.83/month \$454/year	\$40.88/month 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.



3.

Price before scarcity	Basic Internet (CGN)	Advanced Internet (status quo)
<b>\$33/month</b>	\$37.83/month	\$40.88/month
<b>\$400/year</b>	\$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>