

3GOL: Power-boosting ADSL using 3G OnLoading

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3G Offloading

- *Offloading* traffic from the cellular network onto the wired network (DSL)
- Why do we do this:
 - Cellular networks are resource constrained
 - Wired networks are resource rich

What is 3G “OnLoading” (3GOL), anyway?

- *Offloading* traffic from the wired network (DSL) onto the cellular network
- why would we ever do that:
 - Enhance the performance of **certain** applications
 - Enhance the speed of wired networks
- (onloading seems like a silly name to me)

We can't onboard onto cellular networks

- After performing Math:
 - A cellular network is 1-2 orders of magnitude smaller in capacity than its wired counterpart

Sure we can! ... sometimes.

- A cellular network isn't always loaded:
 - Follows a diurnal pattern
- More people use their wired networks at home

Using leftover capacity

- Powerboosting: Delivering files at a much higher speed for a short period of time
- Contribution: Powerboost for ADSL

The 3GOL Architecture

- 3GOL service:
 - Network integrated service
 - Over the top
- 3GOL software:
 1. One runs on a device connected to the cellular network
 2. The other runs on the device that needs “augmentation”
 - Receives connections from applications to be augmented
 - Builds a lists of cellular devices that are willing to carry the load

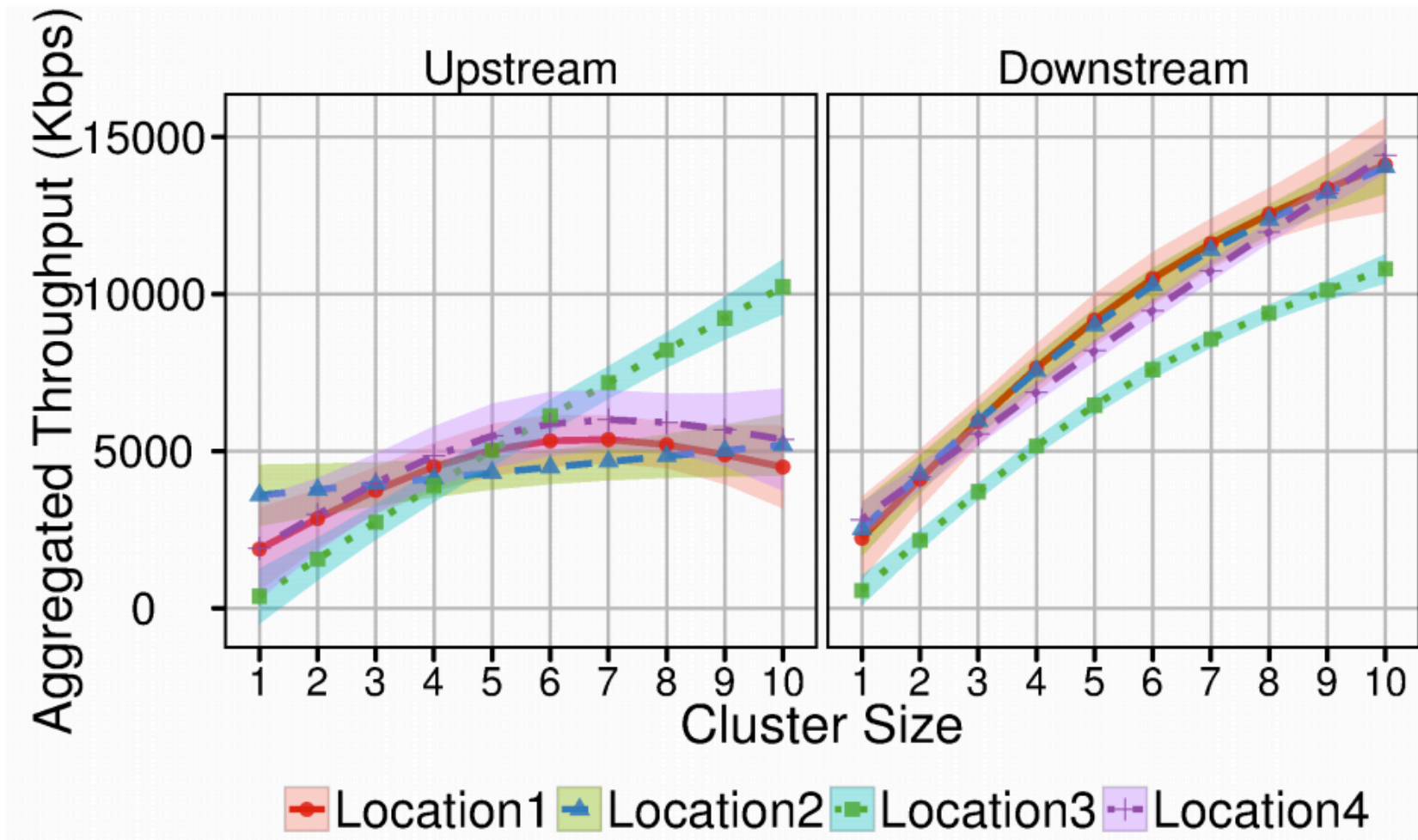
When & Where: DSL throughput (2MB files)

Location	Time	DSL (d/u) Mbps
1. Densely populated residential area (city center)	1 a.m	3.44/0.30
2. Office area at rush hour	4 p.m	4.51/0.47
3. Residential area in tourist hotspot	10 p.m	6.72/0.84
4. Sparsely populated residential area (suburbs)	1 a.m	2.84/0.45
5. Densely populated residential area (city center)	n/a	8.57/0.63
6. Densely populated residential area (city center)	n/a	55.48/11.35

Additional throughput when using 3GOL+DSL

Location	Time	DSL (d/u) Mbps	3GOL/DSL (d/u)
1. Densely populated residential area (city center)	1 a.m	3.44/0.30	2.67/12.93
2. Office area at rush hour	4 p.m	4.51/0.47	1.65/4.23
3. Residential area in tourist hotspot	10 p.m	6.72/0.84	1.31/2.54
4. Sparsely populated residential area (suburbs)	1 a.m	2.84/0.45	2.60/5.82
5. Densely populated residential area (city center)	n/a	8.57/0.63	1.45/5.17
6. Densely populated residential area (city center)	n/a	55.48/11.35	1.04/1.14

Wired capacity is augmented in uplinks and downlinks



Implementation + Wi-Fi is the worst

- 3GOL is implemented under the worst case scenario:
 - all 3GOL software-running devices connected to: Wi-Fi
- Wi-Fi is awful:
 - packet loss
 - Interference from overlapping Wi-Fi networks

The Scheduler

- Greedy scheduler
 - Initial items are assigned to different paths
 - (how are they assigned?)
 - Remaining items are scheduled by order on the first available path
 - If all items are scheduled and a path becomes idle before the transaction is complete?
 - Reassign oldest scheduled item by the other $N-1$ paths

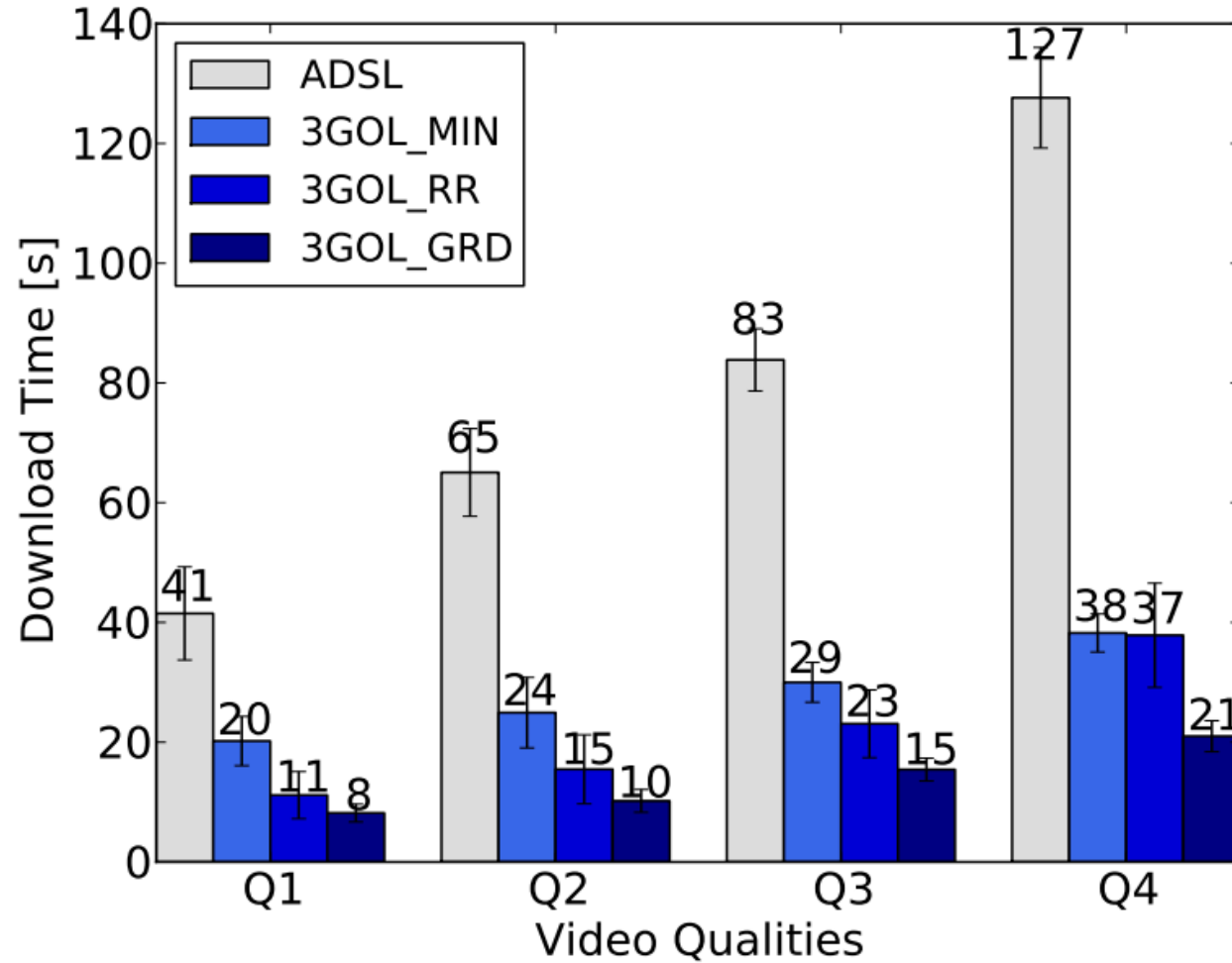
Application 1: Video-on-Demand (downlink)

- VoD application that uses Apple's HTTP Live Streaming (HLS) protocol
 - HLS divides the video in segments of short size
 - Segments are separately requested by the player with one HTTP GET request for each segment
 - The list of segments is retrieved through an M3U playlist
 - Finally, the player sequentially requests the segments, one at a time
 - There is a pre-buffering phase (application dependent)

Application 2: Picture uploading (uplink)

- Picture uploading to Facebook, Flickr, and Picasa
 - They use multipart HTTP POST requests
 - They perform sequential uploads
- What they had to implement to get this to work:
 - A proxy that serves requests coming from the Wi-Fi using the 3G interface
 - An HLS aware HTTP Proxy
 - An HTTP uploader
 - The scheduler to perform parallel multi-part HTTP POST requests

Evaluation of 3GOL: The Scheduler

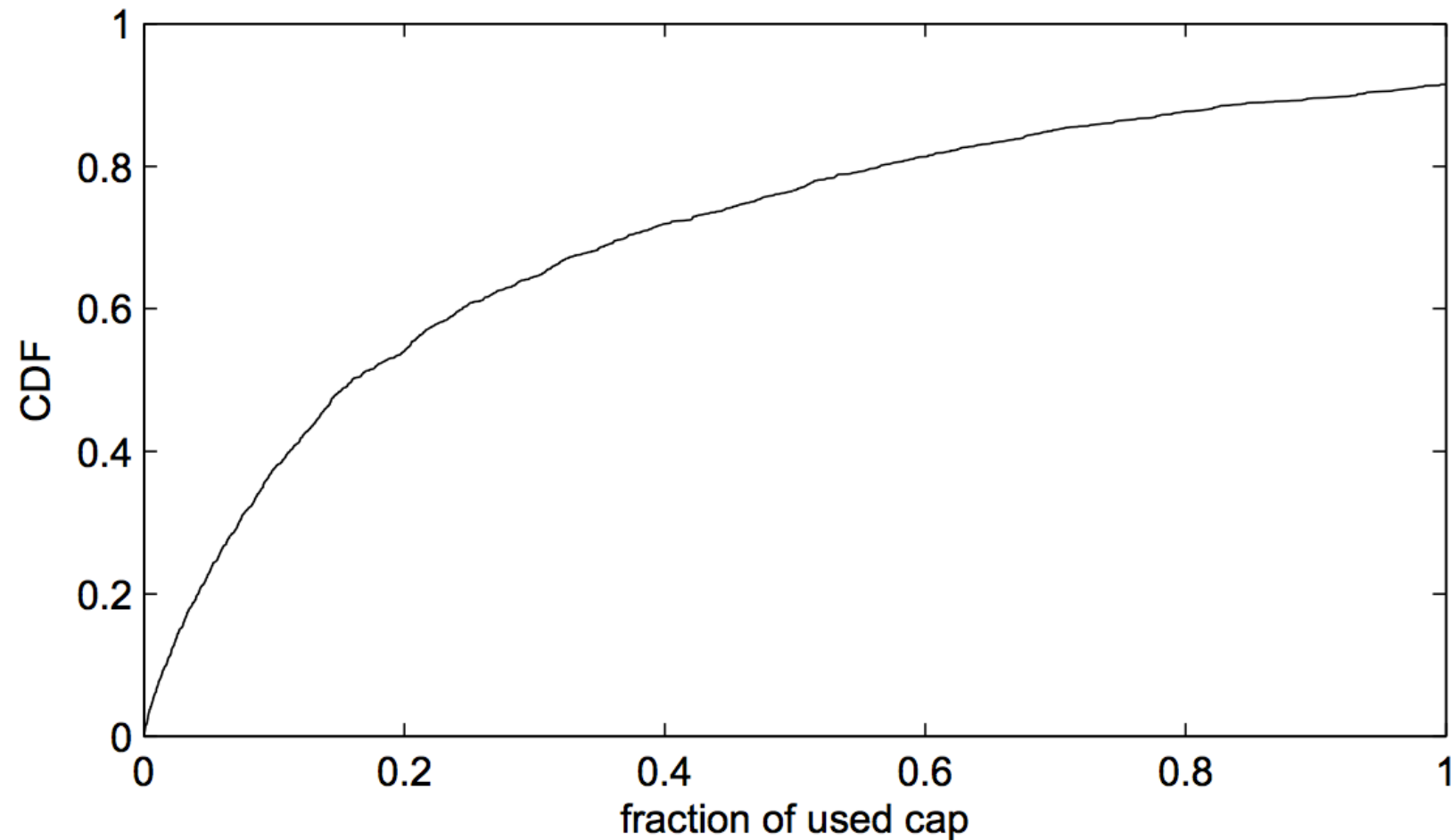


3GOL and Multiple Providers

- There exist a scenario in life where you have different cellular and wired network providers
- Providers will enforce data plans
- 3GOL must deal with:
 - Volume caps
 - Allocating volume to 3GOL
 - Its load on the cellular network

Who cares about volume caps

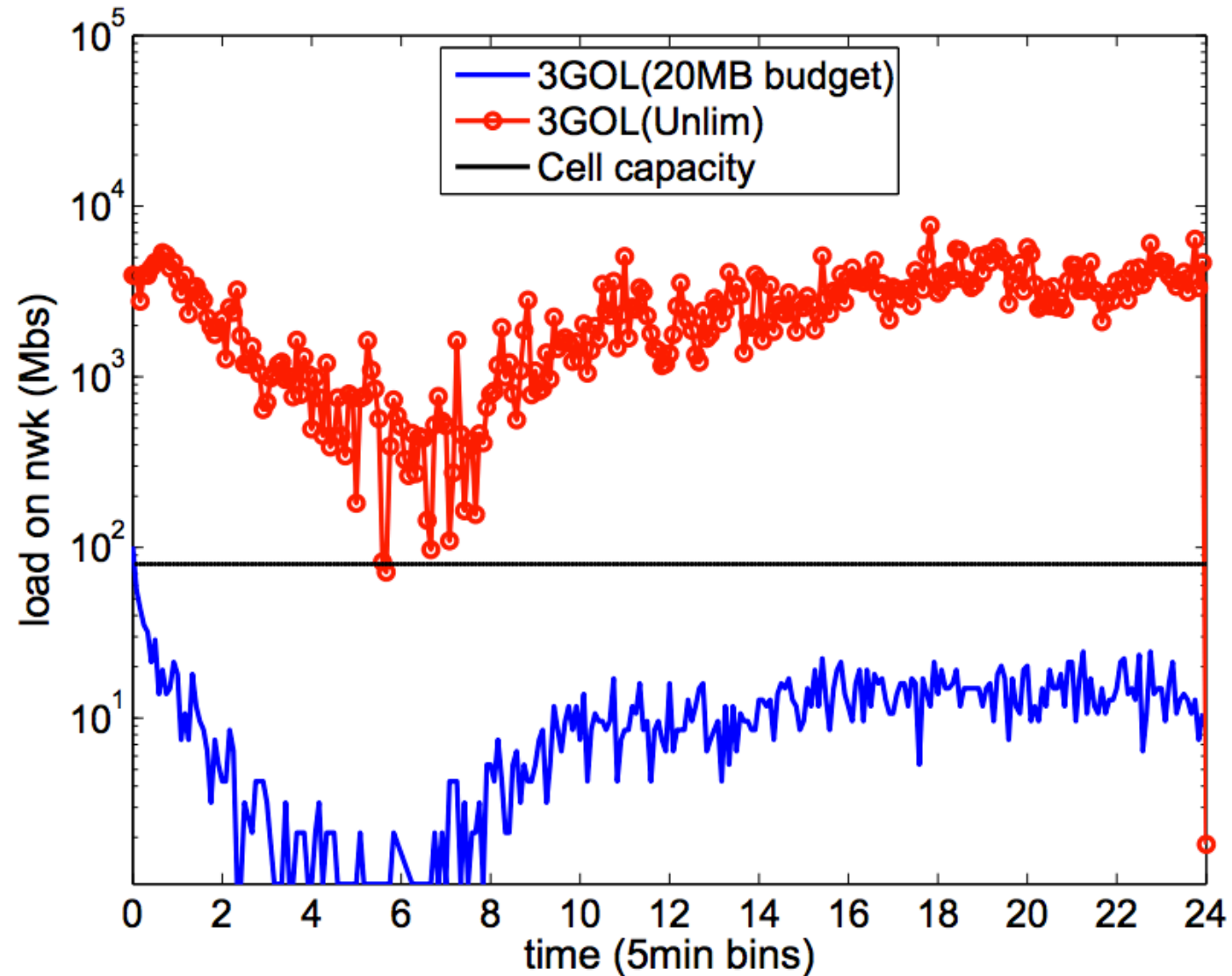
- 40 % of the mobile users use less than 10% of their cap



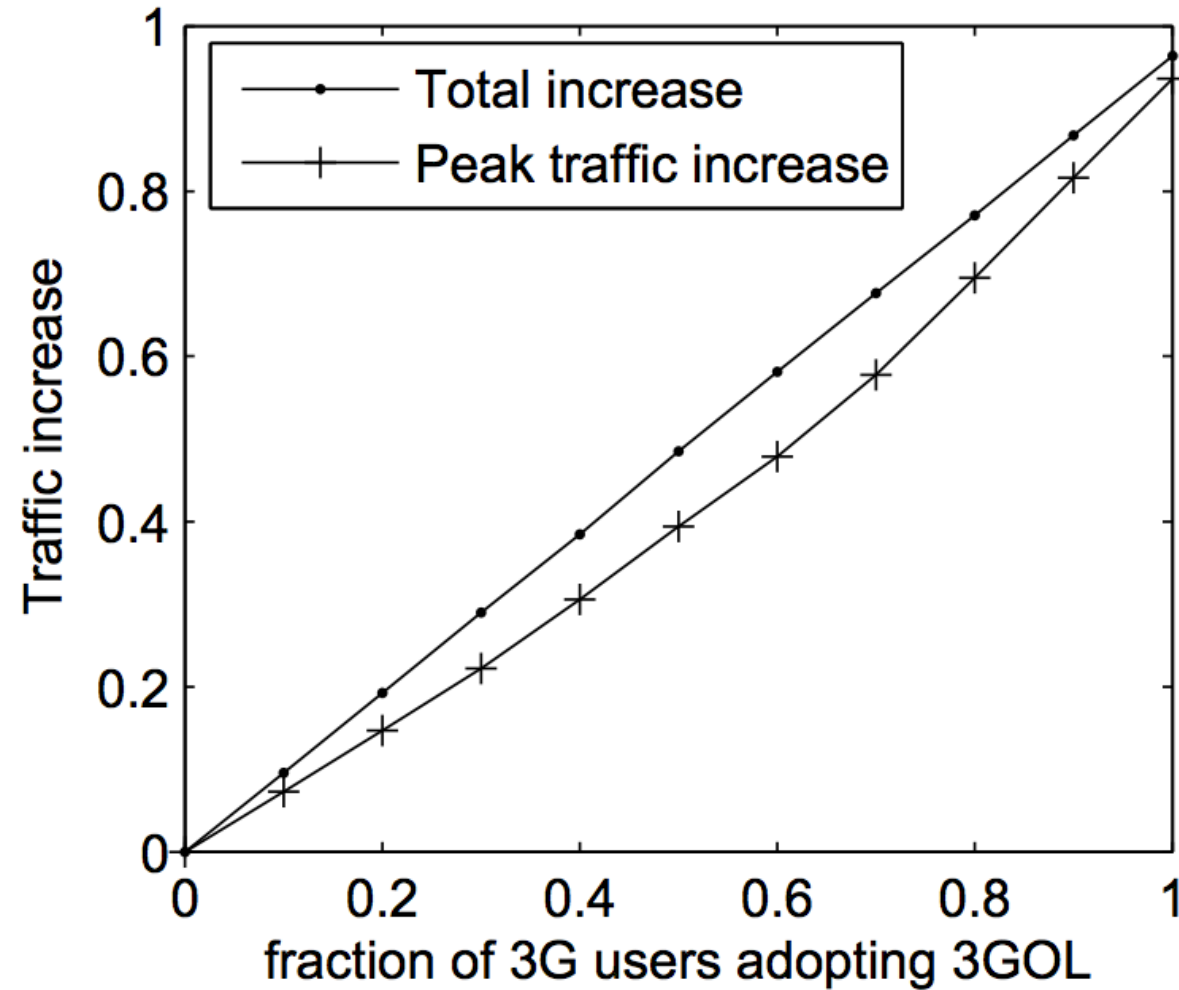
Volume Allocation Math

- *insert Math they came up with in this slide*
- Numbers they used allowed 65% of available capacity to go to 3GOL
 - Expected overrun time of under 1 day per month
- Math can be modified to handle data caps

Load on the Cellular Network (it's not so bad)



Cool! oh.. wait.



Summary

- 3GOL does have benefits
- Enhances the performance of *certain* applications
- There are challenges:
 - When to use 3GOL
 - What applications to use it with
 - How much data to onload
- What do you do if you have different connections?