something

Paper #0, 3 Pages

Abstract

FCC reclassifying broadband and broadband speeds
HD content, video traffic, CDNs
How should ISPs progress?
Want to know the current utilization during peak periods
Better way to offer broadband

1 Introduction

hello [1]

2 Data Source

Our dataset consists of network usage byte counters reported by Comcast gateways every 15 minutes from October 1, 2014 to December 29, 2014. There are two sets of broadband tiers that were used to collect this data: controlset, consisting of homes and businesses with a 105 Mbps access link, and the testset, consisting of homes and businesses that were paying for a 105 Mbps access link, yet were receiving 250 Mbps instead. Users in the test set were selected randomly and were not told that their access bandwidth has been increased. There were more than 15000 gateway devices in the control set, with varying usage over the three months, and about 2200 gateway devices in the test set. TODO: confirm - these were reported by Comcast gateways right?

Both the testand controlsets were collected from users in Salt Lake City, Utah, to avoid any biases in behavior based on location. Although this dataset corresponds to just one ISP, we believe that it is broadly representative of urban users in the US in the same, or higher broadband bandwidth tier (100 Mbps). Thus, we use this data to draw general conclusions about behavioral change with link capacity TODO: (add more here...)

SG: Supplement the data with bismark?

SG: My Speed Test Usage Patterns data - Any chance?

2.1 Data Description

Comcast splits the controlset into 8 separate pools on different date ranges and gateways TODO: confirm if there is repeated device IDs in control1-8. . Each dataset contains the following relevant fields: Device ID, sample period time, service class, service direction, IP address, and the bytes transferred in the 15 minute sample slot, as described in table 1. TODO: find out more about service class name, and IP addresses being the same across all sets

Field	Description
Device_number	Arbitrarily assigned CM device identifier
end_time	Fifteen minute sample period end time
date_service_created	Service start (not used in our analysis)
service_class_name	Used to differentiate data application
cmts_inet	Cmts identifier (derived from ip address)
service_direction	1-downstream, 2-upstream
port_name	Cmts port descriptor
octets_passed	Byte count
device_key	not used in our analysis
service_identifier	Service id (not used in our analysis)

Table 1: *Field Descriptions for Comcast Dataset by Comcast*

2.2 Data Processing

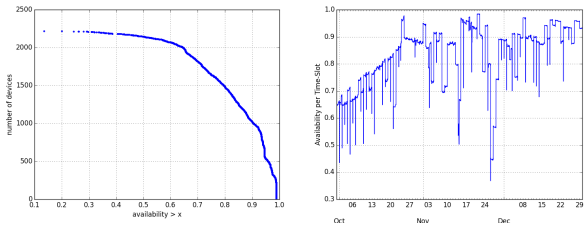
To process the large amount of data (more than 15000 unique devices, 96 time slots per day, 3 months, multiple service classes per time-slot), we first split the data by direction into uplink and downlink. The nature of the questions we ask in section 1 encourages us to concentrate on the downstream data, although we present similar results for upstream data in section 4. We also do not use the service class name identifier in our analysis, which is internal to Comcast. TODO: Our analysis showed that ignoring the service class identifier does not change our conclusions on usage patterns and statistics. Thus we only considered overall usage for each gateway device in each time slot, in uplink and downlink direction.

Note that 15 minute time slots were synchronized to the same time stamp. They were off only by a few seconds (under 30, as claimed by Comcast). As our analysis deals with aggregated patterns on a granularity of 15 minutes, we believe this time synchronization to be irrelevant.

2.3 Data Sanitization

Our initial analysis of data transferred per time slot showed that certain gateway devices were responsive only for brief periods. We also noticed that certain time slots had a very low response rate throughout the dataset. TODO: Why? asked comcast .

We evaluate the fraction of responsiveness of a gateway throughout the dataset, as well as the fraction of responsiveness per time slot, and call this the **availability**. Figure 1 shows how the number of devices decreases for a higher availability requirement. Based on the common trend of this plot throughout the testand controldatasets, we decided to only choose gateway devices with an availability of at least 0.8.



(a) *Availability by device* **(b)** *Availability by date*

Figure 1: *Availability, based on gateway device responsiveness.*

On exploring control4, we noticed that the dataset spanned the October-December period, but for the first week there were 15000 unique devices reporting their usage statistics, while after the first week, the number dropped to 5000. Furthermore, control5 and control6 reported usage for 5000 devices in the month of November, but only a 100 devices in December. We did not want stray devices impacting our measure of availability, therefore we sliced the controldatasets to monthly date ranges with a minimum of 4000, or at least half the total unique devices present.

Finally, we sliced the sanitized testset based on the date range of each individual controlset for comparison. We compared each of these tests individually to ensure that there are no outliers. We refer to the testand controlsets in this case simply as datasets $1-8$. To analyze data by each month, we also sliced and combined the sanitized data to give us controland testdata for October, November, and December, referred to as *oct*, *nov*, *dec*. Finally, we combine all controlsets to form a large concatenated dataset over the same date range as the complete testdataset, and we refer to this simply as $full$. A description of these sanitized sets is provided in table 2

TODO: Figure 1 Make common **EPS** plot of availability – 8 control sets (half filtered) + test sets vs availability.

SG: Figure 1a should show why we chose 0.5 as threshold, Figure 1b should show why we expected 3k-4k sanitized devices per set

TODO: Table 2 recheck all numbers and rewrite para accordingly, it seems control4 did not end at just one month - continued till December

TODO: Table 2 turn it around

3 Methodology

4 Results

Q/A
Plots

5 Discussion

results that are contradictory
results that data suggests that is wrong
- suggest that this may be due to representation
a better way to measure and offer broadband based on utilization?

6 Related Work

fcc reports + sandvine on usage patterns
papers studying broadband vs utilization
Note: this can go in the intro if lack of space

Dataset	set_1	set_2	set_3	set_4	set_5	set_6	set_7	set_8	set_{oct}
Start Time	2014-09-30	2014-10-01	2014-10-01	2014-11-01	2014-11-01	2014-11-01	2014-11-01	2014-12-01	2014-10-01
End Time	2014-10-31	2014-10-31	2014-10-312	2014-12-29	2014-12-29	2014-12-29	2014-12-29	2014-12-29	2014-10-30
Devices$_{control}$	3627	4033	3969	1266	3632	3852	3644	4277	11629
Devices$_{test}$	1481	1481	1481	1481	1481	1481	1481	1481	1481

Table 2: *Sanitized Dataset Description: Most of our analysis will be based on set_{full} unless otherwise stated*

References

[1] Federal Communications Commission. International Broadband Data Report (Fourth), February 2015. (Cited on page 1.)