

**When best effort is not good enough:  
Incomplete contracting, risk allocation, and demand for consumer protection  
in the market for broadband access services**

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The views expressed herein are the authors' alone and should not be interpreted to reflect those of any organizations with which we are affiliated.

## Abstract

Starting from a luxury available to small networks of relatively high-income users, high-speed access to the open Internet has become a necessity for social and economic participation of individuals, competitiveness of business, and economic development. In the transition of broadband from a luxury to a necessity over the past two decades, “best effort” retail contracts (i.e. up to x Mbps, subject to varying network conditions) have provided Internet service providers (ISPs) with significant flexibility in managing scarce capacity in response to growing consumer demand for network resources. Over time however, the emergence of a wide variety of advanced Internet applications that require reliable high-speed connectivity (i.e. minimum effective bandwidth/speed, Quality of Service (QoS) guarantees) has stimulated the development of a wide range of network management technologies that enable the delivery of quality of service guarantees and fine-grained service quality and price differentiation (e.g. across applications, senders, users).

The combination of these factors has led to the development of a multi-tiered Internet in which capacity is bifurcated into a basic best effort access path to the open Internet and a luxury class of prioritized/sponsored services on the same physical infrastructure. From an economic perspective, mitigating negative externalities from growth in the “fast lane” on best effort “slow lanes” in this differentiated broadband ecosystem have emerged as a seemingly intractable challenge in countries that are further behind in the transition from legacy copper to next generation fiber/4G broadband technologies.

Previous research analyzes the emergence of a two-tiered Internet and draws policy inferences primarily in terms of the existence of market power by monopolistic/duopolistic infrastructure providers, inefficient discrimination by this class of gatekeepers to the open Internet, and/or innovation on the edges of the system. There has been little attention paid to the challenges best effort retail contracts that allocate the risk of capacity under-provisioning pose to buyers in a market where more and more applications require minimum service reliability standards. Voices of consumers are therefore almost always suppressed in research and policy debates about the optimal design of institutions for ensuring universal access to the open Internet.

This article tries to fill this gap by documenting barriers to accessing the open Internet faced by consumers. The first part of the paper provides an overview of the literature on the implications of imperfect contracting for the efficient operation of market systems and as a driver for consumer protection regulation. Then we use quantitative content analysis/natural language processing (NLP) techniques to analyze over 20,000 consumer complaints and carrier responses submitted to the U.S. Federal Communications Commission (FCC) between 2015 and 2017 obtained through the Freedom of Information Act (FOIA) requests to map the interplay between buyers and sellers in a market for Internet connectivity. We conclude with an analysis of public and private legal mechanisms that may help counteract negative externalities from the rise of a two-tiered Internet on quality and affordability of access to the open Internet.

## **I. Introduction: Technological innovation versus institutional persistence**

Starting from a luxury available to small networks of relatively high-income users, high-speed access to the open Internet has become a necessity for social and economic participation of individuals, competitiveness of business, and economic development. In the transition of broadband from a luxury to a necessity over the past two decades, “best effort” retail contracts (i.e. “up to” x Mbps in speed, subject to varying network conditions) have provided Internet service providers (ISPs) with significant flexibility in managing capacity in response to growing consumer demand for network resources. From the perspective of consumers, these “best effort” services remain “good enough” when using first generation Internet applications such as email and simple web-browsing. Over time however, a wide variety of advanced Internet applications have emerged that require better than best effort service standards for reliable use (i.e. minimum effective bandwidth/speed, symmetry, Quality of Service (QoS) guarantees). Service Level Agreements (SLAs) that commit the ISPs to delivering some service performance standard may be feasible to obtain by some large organizations and/or in particular local markets, but in the broad residential and small/medium size business retail markets “best effort” contracts that emerged to support first stages of Internet infrastructure development in the 1990s persist as the standard contractual formulation governing the obligations of the buyers and sellers to each other.<sup>1</sup>

The supply and use of multipurpose broadband networks have however evolved significantly over the past two decades. Emergence of a wide variety of new applications that require reliable connectivity has in turn stimulated the development of advanced network management technologies that enable the delivery of quality of service guarantees and fine-grained service quality and price differentiation (e.g. across applications, senders, users).<sup>2</sup> The adoption of these technologies is increasingly fostering the development of a multi-tiered Internet in which scarce physical infrastructure capacity is bifurcated into a basic best effort access path to the open Internet and a luxury class of prioritized/sponsored services on the same physical infrastructure. Growth in prioritized/sponsored traffic in the “fast lane” has the potential to have a negative impact on effective capacity and affordability of basic broadband services network providers continue to offer only on a “best effort”/up to x Mbps basis; without any legally binding performance commitments to their subscribers.

In retrospect, the “loophole” in best effort retail contracting may have represented an efficient approach to the design of these contracts in the early stages of the development of the Internet as it provided incumbent operators of legacy copper networks with significant flexibility to manage scarce capacity and simultaneously expanding access to broadband connections that delivered

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<sup>1</sup> i.e. up to x Mbps versus some form of minimum, average, median, bandwidth/latency performance commitment, with the possibility of monetary and/or non-monetary contractual remedies in case of subpar service performance. In parts of some competitive urban markets where fiber-to-the-premises (FTTP) networks are available, SLA with minimum performance warranties may be available in the retail market (e.g. new business districts, apartment buildings).

<sup>2</sup> See e.g. product offerings from Sandvine. <https://www.sandvine.com/>

substantially higher service quality than low speed and unreliable dial-up access. Nearly two decades later, it is no longer evident that if the old best effort approach remains necessary or economically desirable approach to structuring retail broadband contracts. The same traffic management technologies that enable fine-grained service quality differentiation and the development of the “two-tiered” Internet now enable network providers to offer and deliver enhanced broadband contracts that include some legally binding performance warranty of better than best effort service delivery.<sup>3</sup> Encouraging network providers to utilize the same technologies to offer some minimum standards of service warranties in standard form retail contracts can help close this contractual imperfection, thereby restricting the scope for the variety of opportunistic behavior enabled by the purposeful incompleteness in standard form contracting.<sup>4</sup>

While more flexible for network providers trying to manage and monetize their scarce network capacity, best effort retail contracts allocate the risks of capacity under-provisioning to the subscriber, whereas it is the supplier that ultimately has the legal authority and technical capacity (with the aid of advanced network management technologies) to ensure sufficient capacity has been provisioned to meet that customer’s expectations of service quality and affordability (per the bilateral retail contract specifying scope of obligations between the parties). Beside limiting the scope for ex post remedies that help protect consumers against ISPs that materially exaggerate the quality of their services, from an economic perspective allocating the risks of capacity under-provisioning to users undermines the incentives of service providers to make sufficient investments needed to meet their obligations to their customers.

This hypothesis is particularly relevant to consider given the “dual use” nature of advanced traffic management technologies large network providers are implementing to monetize demand for better than best effort service quality on both sides of the proverbial “two-sided” market. In the presence of capacity constraint, growth in network intensive applications in the prioritized/sponsored “fast lanes” can degrade service quality in best effort “slow lane” to the open Internet. This degradation may not be relevant for users that live in places where ultra high-capacity fiber-to-the-premises (FTTP) or high-throughput 4G+/5G mobile have been deployed, such as in some high-income/revenue and relatively more competitive urban markets. On legacy copper and mobile networks, prioritizing high-value/payoff network intensive applications and services (e.g. HD video, multimedia advertisement) at the expense of basic service capacity has the potential to exacerbate gaps between best effort/up to xMbps rates specified in retail contracts consumers expect to access what they need from third party sources on the open

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<sup>3</sup> The distinction between conceptualizations of broadband access as a basic telecommunications service versus an enhanced information service represents the key point of contention in the manner in which telecom regulatory authorities interpret their governing statutes and classify high-speed access (e.g. Title II v. I problem in the U.S.).

<sup>4</sup> For general discussions of drivers and anticompetitive effects of standard form contracts see: Gilo, D., & Porat, A. (2005). The hidden roles of boilerplate and standard-form contracts: Strategic imposition of transaction costs, segmentation of consumers, and anticompetitive effects. *Mich. L. Rev.*, 104, 983. Patterson, M. R. (2010). Standardization of standard-form contracts: competition and contract implications. *Wm. & Mary L. Rev.*, 52, 327. Tirole, J. (2009). Cognition and incomplete contracts. *American Economic Review*, 99(1), 265-94.

Internet (e.g. “off net” servers on the edge of the “cloud” in a nearby city) and actual service quality levels their service providers manage to deliver to them in high traffic periods of the day. In addition to motivating the adoption of legal restrictions on potentially anticompetitive differential service quality delivery and pricing (i.e. zero rating) around the world, adoption of binding minimum service quality standards has been proposed as a feasible solution for mitigating against negative externalities of growth in traffic in prioritized/sponsored access paths on service quality and affordability in the best effort access paths to the open Internet.<sup>5</sup>

A growing body of research analyzes the emergence of a “two-tiered” Internet and draws policy inferences primarily in terms of the existence of market power by monopolistic/duopolistic broadband infrastructure providers, inefficient discrimination by this class of gatekeepers, and/or innovation on the edges of the system.<sup>6</sup> Others have explored challenges in delivering SLAs and the problem of monitoring incomplete relational contracts shaping the network provisioning incentives at the wholesale/macro-network levels.<sup>7</sup> Less attention has been paid to the consumer implications of “best effort” standard form retail contracts lacking specific and enforceable performance commitments.<sup>8</sup> Voices of consumers are almost always suppressed in research and policy debates about the optimal design of institutions for ensuring universal access to the open Internet.

This article tries to fill this gap by analyzing a unique body of textual evidence consisting of over 20,000 Internet access related consumer complaints to the U.S. Federal Communications Commission (FCC), as well as some FCC ombudsperson communications and responses by carriers to their unsatisfied customer. This body of evidence has been made public pursuant to a series of requests under the Freedom of Information Act (FOIA) by the National Hispanic Media Coalition (NHMC) and offers a rich window into common problems facing American consumers trying to access information and applications they need from the open Internet, as well as how

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<sup>5</sup> Brennan, T. J. (2011). Net Neutrality or Minimum Quality Standards: Network Effects vs. Market Power Justifications. In *Network Neutrality and Open Access* (pp. 61-80). Nomos Verlagsgesellschaft mbH & Co. K G. <https://papers.ssrn.com/abstract=1622226> ; Brennan, T. (2017). The post-internet order broadband sector: Lessons from the pre-open internet order experience. *Review of Industrial Organization*, 50(4), 469-486.

<sup>6</sup> For a review of this literature see Greenstein, S., Peitz, M., & Valletti, T. (2016). Net neutrality: A fast lane to understanding the trade-offs. *Journal of Economic Perspectives*, 30(2), 127-50. <https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.30.2.127> ; Bauer, J. M., & Knieps, G. (2018). Complementary innovation and network neutrality. *Telecommunications Policy*, 42(2), 172-183.

<sup>7</sup> Park, L. T., Baek, J. W., & Hong, J. W. K. (2001). Management of service level agreements for multimedia Internet service using a utility model. *IEEE Communications Magazine*, 39(5), 100-106. Laskowski, P., & Chuang, J. (2006, September). Network monitors and contracting systems: competition and innovation. In *ACM SIGCOMM Computer Communication Review* (Vol. 36, No. 4, pp. 183-194). ACM.

<sup>8</sup> For some exceptions discussing on static/consumer welfare and dynamic/productivity efficiency implications of asymmetric information in market provision of Internet connectivity see Sluijs, J. P., Schuett, F., & Henze, B. (2011). Transparency regulation in broadband markets: Lessons from experimental research. *Telecommunications Policy*, 35(7), 592-602. Rajabiun, R. & Middleton, C. (2015). Lemons on the Edge of the Internet: The Importance of Transparency for Broadband Network Quality. *Communications & Strategies*, 1(98), 119-136. <https://ideas.repec.org/a/idt/journal/cs9805.html>

private suppliers of access to public broadband networks conceptualize their technical, economic, and legal obligations to their subscribers.<sup>9</sup> Researchers and policymakers can readily replicate the approach adopted here to better understand frictions around private contractual arrangements in other industries and enable development of targeted public policy and/or private law approaches to addressing them.

In this article we develop a systematic picture of consumer complaints and other documents generated from the FCC's informal complaint process between 2015-2017 using quantitative content analysis/Natural Language Processing (NLP) techniques. Our approach allows us to automate content extraction and analysis by identifying concepts and themes (i.e. clusters of concepts) as they naturally emerge based on their statistical significance and co-occurrence frequencies in the corpus.<sup>10</sup> While we filter some noisy concepts with little natural meaning, our relatively unsupervised quantitative semantic mapping methodology helps minimize the need to make potentially erroneous assumptions about what is important to complaining consumers or what other parties are trying to convey to each other along the FCC informal consumer complaint process. We further utilize "deep/nested learning" algorithms to map variations in conceptual emphasis between consumers, carriers, and the FCC ombudsperson responsible for advocating with service providers on behalf of aggrieved consumers. Text mining/NLP tools are increasingly deployed by large organizations to monitor communications between their employees and customers to enhance organizational performance. A growing body of research is also beginning to apply NLP technologies to analyze large bodies of information and communications in the analysis of law and policy,<sup>11</sup> including telecom regulatory policy development.<sup>12</sup> We are unaware of any previous studies that utilize quantitative textual analysis to assess consumer concerns with incomplete contracting and what the suppliers think of problems facing their paying customers.

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<sup>9</sup> For details of the process and original data files see: <http://www.nhmc.org/foia-release/>

<sup>10</sup> Smith, A. E., & Humphreys, M. S. (2006). Evaluation of unsupervised semantic mapping of natural language with Leximancer concept mapping. *Behavior research methods*, 38(2), 262-279.

<sup>11</sup> For overviews see: Ngai, E. W. T. and Lee, P.T.Y.(2016) A review of the literature on applications of text mining in policymaking. Proceedings of the Pacific Asia Conference on Information Systems (PACIS). <https://pdfs.semanticscholar.org/348b/ef632226e9a7c0217182d6b720b4c761cf82b.pdf> ; Wilkerson, J., & Casas, A. (2017). Large-Scale Computerized Text Analysis in Political Science: Opportunities and Challenges. *Annual Review of Political Science*, 20, 529-544. Charalabidis, Y., Maragoudakis, M., & Loukis, E. (2015, August). Opinion mining and sentiment analysis in policy formulation initiatives: The EU-community approach. In *International Conference on Electronic Participation* (pp. 147-160). Springer.

<sup>12</sup> See e.g. Epstein, D., Roth, M. C., & Baumer, E. P. (2014). It's the definition, stupid! Framing of online privacy in the internet governance forum debates. *Journal of Information Policy*, 4, 144-172. <http://www.jstor.org/stable/10.5325/jinfopoli.4.2014.0144> ; Rajabiun, R. (2015). Beyond Transparency: The Semantics of Rulemaking for an Open Internet. *Indiana Law Journal, Supp.*, 91, 33. <http://ilj.law.indiana.edu/beyond-transparency-semantics-of-rulemaking-for-an-open-internet/> Rajabiun, R. and Middleton, C. (2015). Public Interest in the Regulation of Competition: Evidence from Wholesale Internet Access Consultations in Canada. *Journal of Information Policy* 5 (2015): 32-66. <http://www.jstor.org/stable/pdf/10.5325/jinfopoli.5.2015.0032.pdf>

Section II provides an overview the FCC informal consumer complaint process that produces the communications and quantitative content analysis techniques we employ to explore what the parties tried to emphasize in their communications with each other. Section III characterizes the evidence using both quantitative indicators of semantic relevance in the content of open Internet complaint documents and visual depictions that offers an intuitive picture of statistically significant linkages among emergent concepts in this body of evidence. Section IV presents broadband speed measurements that help explain and understand the scope of broadband service problems emphasized by consumers in their complaints to their providers and the public agency. Section V concludes by drawing inferences from the evidence with an analysis of public and private legal mechanisms that may help counteract negative externalities associated the emergence of a “two-tiered” Internet on quality adjusted prices in the basic service access paths that enable consumers to procure information and communications services that meet their heterogeneous needs from competing vendors available on the open Internet.

## **II. Context: Data production, limitations, and methodology**

To explore private contractual frictions in the broadband access markets, it is first relevant to briefly explain the public process that generated the body of communications between the parties. In sharp contrast to its formal complaint process, the informal FCC consumer complaint process does not require or specifically authorize the agency to assess particular complaints for their merit. Instead, the FCC’s role is generally limited to transmitting the consumer complaint to the carrier and requesting the service provider to contact the customer and try to solve the problem. According to material in the frequently asked questions on the FCC informal Internet complaint website, consumers that make the effort to make a complaint should not expect the FCC to contact them or follow up with their case:

### ***“Does the FCC contact me directly about my complaint?”***

*No, the FCC serves your complaint on your provider(s) and the provider is obligated to respond to your complaint within 30 days and provide the FCC with a copy of that response. It is likely that your provider(s) will contact you to attempt to resolve your complaint.”*<sup>13</sup>

This statement illustrates that FCC’s informal complaint mechanism that generates our data was not designed to function as a traditional legal dispute processing vehicle (e.g. such as small business courts or administrative tribunals) with the task of assessing the facts in each case, directing the parties to a bargain, impose a solution, and potentially punish the wrongdoer. The informal process essentially functions as a tool for facilitating communications by encouraging service providers to respond and correct harms experienced by their aggrieved consumer. The FCC further suggests the informal consumer complaint process enables collection of data about

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<sup>13</sup> See: <https://consumercomplaints.fcc.gov/hc/en-us/articles/205082880-Filing-a-Complaint-Questions-and-Answersunication>

the consumer experience that may ultimately inform policymaking and deter undesirable behavior of regulated entities that negatively impact American consumers:

*“We do not resolve individual complaints on these issues. However, the collective data we receive helps us keep a pulse on what consumers are experiencing, may lead to investigations and serves as a deterrent to the companies we regulate. Thank you for your help in informing our efforts”*.<sup>14</sup>

Given that the FCC generally only forwards the complaint, rather than investigate and verify information it receives from aggrieved consumers regarding their particular problems, it has issued the following disclaimer in prefacing the documents it released per NHMC’s FOIA requests:

*“Please be advised the FCC receives many complaints and comments that do not involve violations of the Communications Act or any FCC rule or order. Thus, the existence of a complaint or comment filed against a particular carrier or business entity does not necessarily indicate any wrongdoing by any individuals or business entities named in the complaint or comment. These documents represent information provided by the public that has not been verified by the FCC.”*<sup>15</sup>

There is little information on the methodology the FCC used to search its own records for documents sufficiently responsive to the specifications of FOIA requests from NHMC. It appears that agency staff used simple keyword searches to identify and segment complaints documents they considered to fall within the scope of the NHMC FOIA request (e.g. general concepts such as the “Internet”, “open Internet”, “neutrality”, as well as more specific concepts such as “blocking”, “throttling”, “data caps”, “privacy”, etc.). The FCC has produced a number of spreadsheet files with some metadata on each complaint per categories it utilized to compile the data; including information on the date, city/state of the complainant, and the name of the company they were complaining about. Notably, the data column for case “resolution” in these spreadsheet files is empty. This further captures the fact that FCC’s informal complaint process is designed to facilitate communication and negotiation by requesting carriers to respond to aggrieved consumers. It is important to note that even though the FCC may not investigate each individual informal complaint, in the aggregate, these complaints can play a critical role by informing enforcement actions.<sup>16</sup>

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<sup>14</sup> See: <https://consumercomplaints.fcc.gov/hc/en-us/articles/202752940-Your-Role-in-the-FCC-Consumer-Complaint-Process?from=button>

<sup>15</sup> FCC Response to NHMC FOIA request. Available at: <https://www.fcc.gov/response-nhmc-foia-request>

<sup>16</sup> See, e.g. In the Matter of T-Mobile USA, Inc. 31 FCC Rcd 11410 (FCC 2016). During the investigation that led to the \$48 million Consent Decree, the FCC received hundreds of complaints from T-Mobile and MetroPCS subscribers who were unhappy with the de-prioritization policy. Consumers complained that they “were not receiving ‘unlimited’ data as had been sold to them, that their data throughput speeds after de-prioritization caused their data service to be ‘unusable’ for many hours each day...[and] they felt misled by T-Mobile.” *Id.*

“Knowledge” contained in FCC informal consumer complaint documents can be viewed as direct evidence of actual events and problems that restricted the ability of consumers to access information services they perceived they need on multipurpose broadband access network to which they subscribe. It is important to note here that consumer complaints about actual barriers to their access and use are fundamentally of a different nature than opinions of the parties provided as part of public consultation processes to agencies as “comments,” as well as survey data that trying to capture how satisfied the average consumer might be with their Internet service providers. In contrast to potentially erroneous “opinions,” documents we analyze here represent evidence of hard barriers facing American consumers that cannot be easily resolved through mutual engagement and negotiations between buyers and sellers in the market for broadband access services. Since most users initially try to address such problems with the customer service departments of their service provider, the FCC complaint data represents a narrow window into harder problems that cannot be easily resolved through private negotiations around contractual obligations and expectations of the parties to the private contract. As such, these communications provide a unique view into the interplay between private and public law/ market and state institutions.

The manner in which data files of the complaint documents were produced, as well as missing carrier responses and related documents, do not allow us to develop a systematic picture of how the complaints were resolved, or not. The content of the communications from consumers, responses by service providers, and FCC ombudsperson emails are provided in sets of separate pdf documents. Table 1 provides an overview of the types and number of informal complaints as segmented by the FCC in its FOIA response.

<b>Table 1: FCC Informal Consumer Complaints</b>	
<b>Blocking</b>	619
<b>Data Caps</b>	25,875
<b>Inaccurate Disclosures</b>	334
<b>Inconsistent Speed</b>	1,149
<b>Interference</b>	6,314
<b>Jamming and Blocking</b>	872
<b>Less Than Advertised Speed</b>	2,451
<b>Privacy</b>	8,801
<b>Throttling</b>	1,361
<b>Other</b>	6,197
<b>Total</b>	<b>53, 973</b>
<b>Source: <a href="https://www.fcc.gov/response-nhmc-foia-request">https://www.fcc.gov/response-nhmc-foia-request</a></b>	

We focus on a subset of these documents that are more directly related to Internet access. For distinct reasons, we exclude the content of two of the largest complaint document files associated with “data cap” and “privacy.” In the case of complaints designated as relating to data caps by the FCC, this is because the large volume of these complaints may be the product of previous consumer advocacy campaigns that enabled consumers to express their concerns about capacity constraints they face. Since such complaints may be a reflection of general concerns by people about capacity constraints, they do not necessarily arise out of specific contractual conflicts between users and providers. We also exclude complaints about “privacy” from the analysis based on the assumption that these concerns tend to refer to breaches and actions by third parties of sensitive personal information, not necessarily the network provider. This assumption may be incorrect as network providers have near exclusive access to a wide range consumer generated data that raises privacy/security concerns. Security vulnerabilities of network providers may in fact be an enabler of third party breaches in some instances, making it potentially worthwhile for future research to explore. Narrowing the scope of this analysis by excluding these two large classes of complaints enhances the robustness of the results by reducing potential “noise” and enables us to extract informative “signals” that emerge from the content of the informal Internet access related complaint documents.

With the exclusions noted above, we are left with a sample around 20,000 informal complaints the content of which reflects information from adverse experiences by consumers trying to access the open Internet via high-speed broadband networks to which they subscribe. We also have 823 pages of carrier responses (out of at least 18,000) to these complaints and around 1,500 FCC ombudsperson emails in corpuses analyzed in the subsequent section. Unfortunately, due to the manner in which the FCC has produced the documents we cannot associated complaints, ombudsperson communications, and carrier responses on a case-by-case basis. We therefore explore three aggregated corpuses consisting of communications from the contracting parties and the public agency consumer advocate. As documented below, our empirical methodology is such that it enables extracting informative signals about barriers facing subscriber who are paying for Internet access, but apparently something has gone seriously wrong with their private arrangement with their network provider.

To develop a systematic overview of the content of these documents, we utilize quantitative Natural Language Processing (NLP) methods to analyze what consumers were trying to convey to the agency in their informal complaints and related documents noted above. There is a wide variety of approaches and software tools available for particular NLP technologies in personal and business applications, including special purpose tools for monitoring textual and verbal communications between employees and customers. In the analysis that follows, we utilize a general-purpose NLP/text analytics tool that is designed to extract concepts and themes as they “naturally” emerge from communications by calculating quantitative measures of their co-

occurrence relative to each other.<sup>17</sup> In broad terms, we utilize a two-stage process to analyze the content of consumer complaint documents:

- **Quantitative analysis:** First we extract the text of the document and generate quantitative indicators of frequencies by which the words in the corpus co-occur. The resulting co-occurrence frequency matrix is then used to identify “concepts” as words that tend to appear relatively more frequently in the context of other words in blocks of sentences that make up the corpus.
- **Relational analysis:** In the second stage we explore underlying relationships among concepts discovered based on quantitative indicators of their relevance in the first stage, using iterative clustering algorithms designed for identifying groupings of concepts (i.e. “themes”) based on their co-occurrence frequencies and mapping connections among them.

It is nevertheless important to note that some measure of expert human supervision remains for analyzing unstructured bodies such as the FCC consumer complaint documents. For example, our software has algorithms that help merge word variants. However, these “stemming” algorithms do not always work perfectly and multiple variations on the same essential concepts can emerge from the purely quantitative analysis. Other statistically relevant concepts may not be informative, for example words that connect other words or formulaic components that appear repeatedly in the text (e.g. “please,” web site addresses, etc.). Including these noisy elements in the analysis can make it hard to identify informative concepts that naturally emerge in human communications. Some measure of noise filtering through manual merger of word variants into a single concept and suppression of uninformative elements of the text is therefore necessary. We generally filter/suppress statistically significant “name-like” concepts we discover, such as the “FCC” or the names of large service providers that commonly appear in the consumer complaints. This allows us to focus “word-like” concepts that reflect ideas expressed in the communications among the parties rather than their specific identities and proclivities. The clustering algorithms used to map discovered concepts are stochastic, which means they do not necessarily always converge to the same place (i.e. state of the semantic network). We have tried to check the robustness of the results that are presented here using different clustering models and assumptions to ensure they converge to broadly similar stable states.

In the analysis that follows in the next section, “concepts” are defined quantitatively as the most frequent word in collections of words that travel together in blocks of text (i.e. in the context in which they appear; not simple keywords in the usual sense/as represented in traditional word clouds; each “context block” is defined as two sentences for the purposes of this analysis to capture interconnectedness among the words as they travel together). “Themes” are defined as

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<sup>17</sup> See Smith, A. E., & Humphreys, M. S. (2006). Evaluation of unsupervised semantic mapping of natural language with Leximancer concept mapping. *Behavior research methods*, 38(2), 262-279.  
<https://link.springer.com/content/pdf/10.3758/BF03192778.pdf>; <https://info.leximancer.com/>

higher level groupings of concepts that tend to travel/cluster together, which are purely statistical constructs named as the most frequent concept in that particular concept cluster. The results are presented in two formats:

- **Statistical relevance:** Basic quantitative indicators of the content of the documents are co-occurrence frequency matrices of the concepts extracted from the corpuses. Based on this data we construct and present a normalized “relevance” metric that helps capture the interconnectedness of particular concepts to the rest of words and ideas in the corpus. This metric particularly informative as it is normalized to 1, with the most important emerging concept defined to be associated with 100 percent of context blocks (which we define as two sentences in this analysis).
- **Content maps:** In the next section we primarily rely on two-dimensional visual depictions of the content of the three classes of documents to characterize statistically relevant concepts and themes as they naturally emerge from the corpuses. These visualizations are “heat mapped,” with the most relevant concept and clusters appearing in red, then orange, yellow, blue, green, and so on. The proximity and links among individual concepts in the figure are determined using stochastic clustering models for exploring interconnectedness of semantic elements in the text that tend to co-occur. The visual depictions of the quantitative content analysis are relevant as they should be relatively easy to interpret by most readers without specialized knowledge of content analysis or telecom policy.<sup>18</sup>

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<sup>18</sup> Some readers may be able to visualize the two-dimensional content maps presented here in a three-dimensional space, where hotter/brighter concepts and themes represent peaks of mountains and hills of emergent/statistically relevant meaning from flat valleys below.

### III. Imperfect Contracting and the Semantics of Market Failures

We evaluate the content of the informal complaint documents as follows. First, we document quantitative indicators of concepts emphasized by consumers in their informal complaints to the FCC. Then we provide visual depictions of statistically relevant concepts in terms of their interconnectedness to other words and aggregated them into a small set of higher level “themes” (i.e. concept clusters). We subsequently analyze samples of FCC ombudsperson emails and carrier responses to the consumer complaints that have so far been released per NHMC FOIA requests using a broadly similar methodology and summarize the results with visual depictions that should be readily interpretable by most readers. We conclude the section by using special “nested learning” algorithms to compare the emphasis placed by particular groups on key themes/concept clusters.

**A. Consumer complaints:** For reasons outlined earlier, we exclude complaints relating to “privacy” and “data caps” from the sample analyzed in this report. This leaves us with a sample of approximately 20,000. Some of these complaints are relatively short and include little information, while in others aggrieved consumers provide significant context and technical details about the problem they cannot resolve with their service providers.<sup>19</sup> Table 1 identifies nearly 100 of the most important concepts as measured by their “relevance” in the context of all other word-like concepts discovered from the corpus of complaints. The relevance indicator represents the percentage of text blocks in the entire corpus associated with a particular concept and is normalized (with the most important concept defined to be interconnected to 100% text blocks).

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<sup>19</sup> Given the relative ease by which consumers can submit their informal complaints to the FCC, some comments are not necessarily related to the ability of that customer to access the Internet. Quantitative methodology to the analysis of the content of the complaint documents used here is particularly useful for abstracting away from the “noise” created by the unrelated and conceptually random complaints that exist within the larger corpus of relevant consumer complaints.

**Table 2. Major Concepts Emphasized by Consumers in Informal Complaints to the FCC**

<b>% of context blocks relating to particular concepts</b>					
<b>Primary concepts</b>		<b>Secondary concepts</b>		<b>Tertiary concepts</b>	
<b>service</b>	100	<b>Plan</b>	16	<b>due</b>	9
<b>internet</b>	93	<b>Consumers</b>	15	<b>house</b>	9
<b>speed</b>	59	<b>Video</b>	15	<b>believe</b>	8
<b>data</b>	56	<b>Line</b>	15	<b>monopoly</b>	8
<b>caps</b>	47	<b>Down</b>	15	<b>website</b>	8
<b>use</b>	44	<b>Throttling</b>	14	<b>request</b>	8
<b>time</b>	42	<b>Business</b>	13	<b>online</b>	8
<b>issues</b>	39	<b>Download</b>	13	<b>neutrality</b>	8
<b>pay</b>	38	<b>Account</b>	13	<b>past</b>	8
<b>month</b>	35	<b>Tech</b>	13	<b>someone</b>	8
<b>provider</b>	35	<b>Modem</b>	13	<b>competition</b>	7
<b>customer</b>	31	<b>Computer</b>	13	<b>signal</b>	7
<b>calls</b>	27	<b>Live</b>	12	<b>different</b>	7
<b>phone</b>	27	<b>Information</b>	12	<b>router</b>	7
<b>work</b>	25	<b>Blocking</b>	12	<b>content</b>	7
<b>problem</b>	25	<b>Slow</b>	11	<b>broadband</b>	7
<b>connection</b>	23	<b>Network</b>	11	<b>doing</b>	7
<b>day</b>	22	<b>Hours</b>	11	<b>system</b>	7
<b>told</b>	22	<b>Able</b>	11	<b>addresses</b>	6
<b>access</b>	22	<b>Year</b>	11	<b>sent</b>	6
<b>company</b>	22	<b>Money</b>	11	<b>free</b>	6
<b>area</b>	21	<b>Open</b>	11	<b>during</b>	6
<b>complaint</b>	19	<b>Continue</b>	11	<b>previous</b>	6
<b>cable</b>	19	<b>Number</b>	10	<b>local</b>	5
<b>received</b>	19	<b>Unlimited</b>	10	<b>rules</b>	5
<b>usage</b>	18	<b>Devices</b>	10	<b>page</b>	5
<b>need</b>	18	<b>Several</b>	10	<b>long</b>	5
<b>home</b>	18	<b>Net</b>	10	<b>family</b>	4
<b>streaming</b>	17	<b>Stop</b>	9	<b>via</b>	4
<b>limit</b>	17	<b>Users</b>	9	<b>others</b>	3
<b>trying</b>	17	<b>Support</b>	9	<b>public</b>	3
<b>people</b>	17	<b>Personal</b>	9	<b>security</b>	3

These quantitative indicators offer a systematic and concrete view of how consumers conceptualize their access to the Internet. “Service” and “Internet” emerge as the most relevant

concepts from the corpus, relating to almost all context blocks in the corpus. This not surprising since we are looking at consumer complaints to the FCC about Internet access. After the core concepts relating to the subject matter of Internet service, “speed” of “data” “connections” and “caps” on capacity that restrict the ability of consumers to “use” the Internet emerge as primary “issues” they are trying to convey to the FCC.

Below the key economic elements of the complaints regarding service delivery quality/speed and affordability of access to broadband data services, concepts relating to attempts by complaining consumers to resolve their “problem” with the “provider” and being “told” something about it. Subsequently, a number of more specific secondary concepts emerge relating to why slower than expected speeds and data caps restricting use of the Internet impact them as “people” “trying” to “access” “information” services they “need” at “home” and in “business.” A glance through the list of concepts ranked in descending order of relevance readily captures how problems with data delivery speeds are particularly pronounced in particular “times” of the “day” and with respect to particular applications (e.g. “streaming” “video”). Practices the consumers have been “told” or perceive might be the cause of “slow” “download” “connection” “speeds” appear in substantive proportions of the corpus of consumer complaints (e.g. “modem” problems, “throttling”, “blocking”).<sup>20</sup>

In order to document the relationship between concepts that naturally emerge from the corpus, we utilize stochastic clustering algorithms to identify linkages among them based on their co-occurrence frequencies. Statistical clustering allows us to explore how particular concepts tend to move together in the text with minimal human supervision. Figure 1 offers a visual depiction of emergent concepts from the corpus of complaints and clusters them into four higher-level “themes.” These themes are statistical constructs and are named after the most relevant concept in that cluster/theme. Lines connecting the concepts into a “spanning tree” represent main linkages between the concepts as measured by their co-occurrence frequencies relative to other concepts in the corpus.

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<sup>20</sup> i.e. in the second column of the Table in 10-20% of context blocks each. Discussions of the implications of the higher levels problems with less than expected connection speeds and capacity for the “family” of the consumer, the “public”, and in terms of “security” are present in about 5% of the blocks of text. Although these issues may not appear important from a quantitative semantic perspective, they are likely to be critical for understanding why people might care about speeds/quality of service their operators actually deliver and usage limits that restrict their access to the open Internet.



network management practices they consider reasonable, but lack credible commitments to deliver data transfer speeds/service quality their consumers might expect per their agreement. Imperfect contracting in the retail broadband market can create perverse incentives on the part of some service providers to substantially overestimate speeds/service quality they signal/advertise to users relative to the capacity that they have actually provisioned.<sup>22</sup>

Moving counter clockwise from the red to the dark green cluster on the right-hand side of the Figure, the evidence captures efforts in terms of “time” consumers have spent contacting “tech” “support” and being “told” that the problem is with the “modem” or “routers” at their “house.” As documented later with the analysis of carrier responses to the complaints, this represents a common theme in responding to consumers complaining about service quality levels their operators are delivering. The cluster/theme on top of the Figure in blue captures what consumers “believe” might be barriers restricting “access” of their “family” to the “content” they need. The left-hand side cluster in light green includes problems relating to “data” “caps” that “limit” the ability of “users” to access content and application services they demand from an “open” Internet.<sup>23</sup> On the edge of this and the red cluster on the bottom, consumers appear to be

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commitments by sellers and quality of service variability have negative implications for the ability of users that require applications that need better than best effort service reliability standards. Information asymmetries between sellers and buyers about expected service quality levels create the potential for both distributional and productive inefficiencies by: a) Enabling low-performing providers to extract excessive consumer surplus by over-promising speeds relative to what they can actually deliver given their provisioning policies, b) Furthermore, untruthful signals by low-performing incumbent operators can reduce the incentives of higher-performing incumbents or potential entrants to invest in network capacity and new technologies as it obfuscates price/quality signals and degrades the ability of consumers to identify low from high quality offers in the market. See Sluijs, J. P., Schuett, F., & Henze, B. (2011). Transparency regulation in broadband markets: Lessons from experimental research. *Telecommunications Policy*, 35(7), 592-602. <http://www.sciencedirect.com/science/article/pii/S0308596111001029>  
Rajabiun, R., & Middleton, C. (2015). Lemons on the Edge of the Internet: The Importance of Transparency for Broadband Network Quality. *Communications & Strategies/DigiWorld Economic Journal*, 1(98), 119-136. [https://works.bepress.com/reza\\_rajabiun/15/](https://works.bepress.com/reza_rajabiun/15/)

<sup>22</sup> In addition to access technology and provisioning practices of operators, speed measurements reflect the demand/willingness of customers to pay for service packages advertising particular speeds at various price points. Even when higher speeds are advertised and consumers are willing to pay a premium to move up to a higher speed tier, these advertised speeds are not necessarily delivered. For example, evidence compiled by the State of New York in a lawsuit against one of the biggest cable broadband providers in the U.S. suggests actual speeds of premium plans (with 100-300 Mbps in advertised speeds) were up to 70% slower than those it had promised customers. See Supreme Court of the State of New York, case no. 450318/2017; available at: [https://ag.ny.gov/sites/default/files/summons\\_and\\_complaint.pdf](https://ag.ny.gov/sites/default/files/summons_and_complaint.pdf)

<sup>23</sup> It is relevant to note that this is the case despite the fact that as noted we have excluded the large body of complaints defined in the FCC FOIA release as specifically relating to the topic of data caps from the sample of complaints analyzed here. The emphasis on data caps therefore emerges here naturally from individual complaints, not some sort of nefarious consumer advocacy campaign as AT&T has alleged in its ex parte disclosure opposing the NHMC Joint Motion to incorporate these consumer complaint documents as evidence in the FCC Restoring Internet Freedom proceeding. Although “unlimited” service packages are becoming common in the U.S. mobile market (with some form of speed limits above some threshold level of usage or on particularly network intensive applications such as high-definition video), some fixed networks providers continue to rely extensively on two-part tariffs involving restrictive data caps. In addition to helping maximize consumer surplus an operator can hope to extract from its scarce network capacity, such caps can be utilized strategically to limit the scope for technological “convergence” through “cord cutting” and procuring over-the-top (OTT) “information services” (i.e. telephone, TV)

attributing barriers that limit their access to the open Internet to a lack of “competition” for “broadband” services in their “area”. This area of the content map also captures consumers’ concerns about what they have “received” from the “cable” “company” compared to what they were expecting in terms of speeds in return for what they “pay” per “month.” At the intersection of concept clusters/themes at the center, the Figure captures the importance of access to the physical “network” “people” “need” to “use.”

This purely quantitative perspective suggests consumers tend to perceive their access to the Internet primarily in terms of the speed/quality and the quantity of data services that enable them to utilize content and application services that meet their heterogeneous needs. This is consistent with the conceptualization of Internet connectivity as a basic stand-alone telecommunications service distinct from the variety of information services consumers can procure on top of multipurpose broadband telecommunications networks (i.e. Title II versus I classification under the U.S. statutory framework). The quantitative textual perspective on how consumers perceive broadband connectivity is consistent with the common law conceptualization of the nature of broadband Internet access as a standalone “offer,” as outlined succinctly by Justice Scalia more than a decade ago in the seminal dissent in *Brand X* regarding the public regulatory agency’s earlier attempts to justify why high-speed access should be defined as an enhanced “information” service versus a basic “telecommunications” (Title I versus II of the statutory framework for the operation of the sector specific regulator, the FCC):<sup>24</sup>

*“..... it would be odd to say that a car dealer is in the business of selling steel or carpets because the cars he sells include both steel frames and carpeting. Nor does the water company sell hydrogen, nor the pet store water (though dogs and cats are largely water at the molecular level). But what is sometimes true is not, as the Court seems to assume, always true. There are instances in which it is ridiculous to deny that one part of a joint offering is being offered merely because it is not offered on a ‘stand-alone’ basis... If, for example, I call up a pizzeria and ask whether they offer delivery, both common sense and common ‘usage’...would prevent them from answering: ‘No, we do not offer delivery-but if you order a pizza from us, we’ll bake it for you and then bring it to your house.’ The logical response to this would be something on the order of, ‘so, you do offer delivery.’ But our pizza-man may continue to deny the obvious and explain, paraphrasing the FCC and the Court: ‘No, even though we bring the pizza to your house, we are not actually “offering” you delivery, because the delivery that we provide to our end users is “part and parcel” of our pizzeria-pizza-at-home service and is “integral to its other*

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from competing vendors on the Internet. The relatively higher degree of retail competition in the mobile compared to fixed broadband markets may explain growing differences in the design of capacity pricing strategies at the retail level across the two sub-markets. This can change in the future as public policy and market competition co-evolve (e.g. reclassification of broadband, mergers and acquisitions activity).

<sup>24</sup> The inconsistency between the economic reality of broadband as a basic standalone “telecommunications service” and the impetus by the FCC to define it “information service” motivated the dissent in *Brand X* and can explain this insightful statement by Justice Scalia in that case: “This is not only bizarre. It is probably unconstitutional.” At 14. Scalia J. (joined by Souter, Ginsburg) dissenting, *National Cable & Telecommunications Association v. Brand X Internet Services*, 545 U.S. 967 (2005).

*capabilities”’. .... Any reasonable customer would conclude at that point that his interlocutor was either crazy or following some too-clever-by-half legal advice.”<sup>25</sup>*

The consistency of the perspective offered by the quantitative analysis of the complaints with common understanding of broadband Internet access as a standalone telecommunications service with minimal “enhancements” is not surprising. What is more surprising is the recent decision by the FCC to reclassify broadband access as an “information” service, purportedly because in addition to pure data transmission network providers also provide Domain Name System (DNS) and data cache services.<sup>26</sup> This claim is technically valid as network providers in fact do provide these (and other) services in addition to the basic delivery of Internet traffic to their customers. However, it is not clear if this argument has any merit from a common law perspective as pet stores and pizzeria’s also tend to sell other things besides stand-alone pets and pizzas they deliver.<sup>27</sup> Retail Internet access providers might be engaged in other related tasks (e.g. a pet shop needs to groom the pets it is selling and a pizzeria has to prepare the dough and buy cheese too), but it would be both unjust and economically inefficient if these other functions were used to rationalize a degradation in the quality of the basic transmission service they have advertised they can deliver and their customers are expecting. Broadband “offers” bind subscribers to paying their suppliers even if what is delivered falls short of what the seller had notionally promised/the customer was expecting, enhancing the scope for opportunistic behavior and poor service/capacity under-provisioning driving open Internet consumer complaints to public agency.

**B. Ombudsperson emails:** As detailed earlier, FCC’s informal complaint process does not require a substantive assessment of the individual consumer complaint by the agency. Complaining consumers should generally not expect to hear back from the FCC since the agency forwards the informal complaint to the relevant carrier and requests they provide a formal response to the aggrieved consumer in a timely fashion. The FCC has not published any data that captures if and, if so, how particular cases may have been subsequently resolved. Some consumers have appealed their cases to the FCC ombudsperson, a position created under the *2015 Open Internet Order* and abolished in the *2017-18 Restoring Internet Freedom Order*. The responsibility of the ombudsperson was advocating on behalf of aggrieved consumers with unresponsive carriers. The power of the ombudsperson was limited to requesting service providers to respond formally to complaints by consumers that choose to actively pursue their

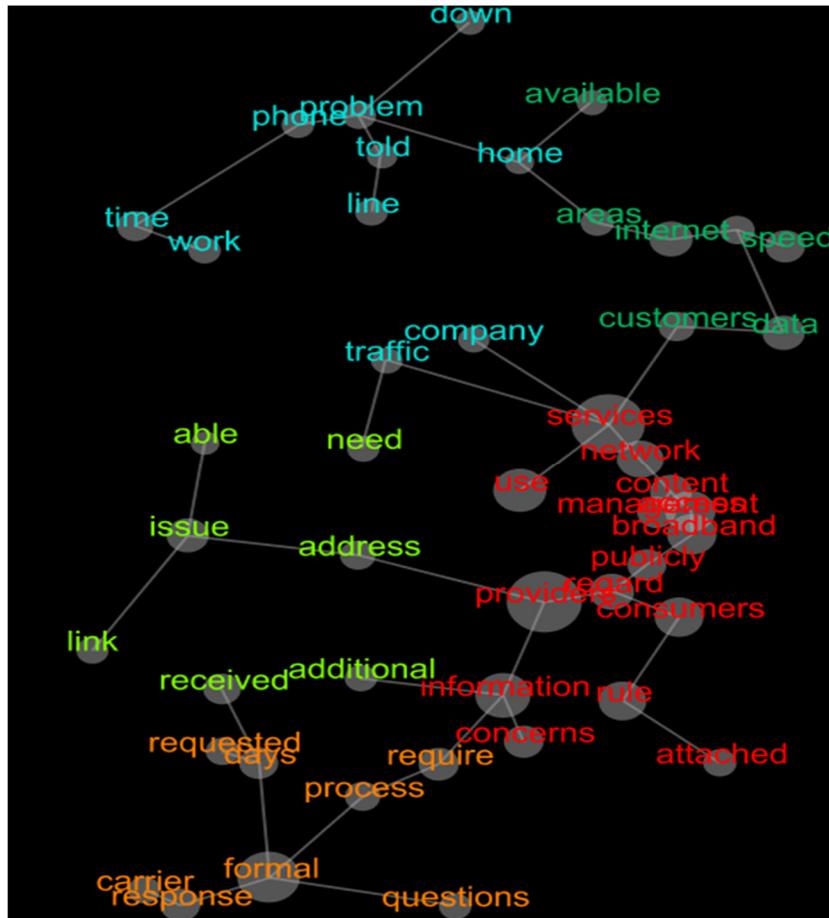
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<sup>25</sup> At pages 3 & 4. Citations omitted. Scalia J. (joined by Souter, Ginsburg) dissenting, *National Cable & Telecommunications Association v. Brand X Internet Services*, 545 U.S. 967 (2005).

<sup>26</sup> See paras. 26 to 38 . Restoring Internet Freedom. A Rule by the Federal Communications Commission on 02/22/2018. The Federal Register: <https://www.federalregister.gov/documents/2018/02/22/2018-03464/restoring-internet-freedom>

<sup>27</sup> The extent to which the U.S. appeals courts will side with the federal bureaucracy versus the common usage/common law conceptualization of the broadband “offer” outlined by Scalia in the Brand X dissent will likely have important implications for the development of institutional environment in the U.S., as well as potentially internationally due to spillovers into industry practice at the global level and regulatory replication/harmonization pressures.

cases as it cannot impose a compensatory remedy, fine or compel carriers to address particular complaints. The FCC FOIA document release contains around 700 pages of ombudsperson emails (around 1,500 emails). Given that there are around 50,000 complaints in the FCC disclosure, the small size of the ombudsperson emails documents the relatively limited authority of this office and resources the FCC allocates to following up on informal complaints consumers forward to the public agency. Figure 2 depicts relevant concepts that emerge from the content of these emails in a manner that helps link the analysis of consumer complaints above with those of carrier responses analyzed below.



**Figure 2. Content Map of FCC Ombudsperson Emails**

Moving down from the top of the Figure, the visualization documents ombudsperson’s appeal on behalf of the consumer, reiterating the “problem” they are having at “home” and what the customer has been “told” by the company on the “phone.” Less than expected “Internet” “service” “speed” that restrict the consumer’s ability to “use” the “network” and access “content” they “need” emerge as key reasons for the complaints ombudsperson is inquiring about (in dark green and red on the right-hand side). “Network” “management” practices of the provider emerge as central issues relating to the ability of “consumers” to “use” their service and access “content” they demand. Ombudsperson communications tend to refer to a “rule” and

request that carriers provide a “formal” “response” to the “questions” raised in the complaint in a number of “days” as “requested” (bottom of the Figure in orange).

The relatively small set of ombudsperson emails released by the FCC likely represents an incomplete picture of relevant communications as specified in NHMC’s FOIA requests. Even with this relatively small sample, the analysis clearly captures the role the FCC and its ombudsperson played in advocating on behalf of consumers with the carriers for a response to why the service provider is not delivering what their customers expected. This informal process represents a relatively flexible approach to encouraging providers to be transparent about why they may not be meeting expectations of their customers, without limiting the carriers’ discretion to implement reasonable network traffic management practices they consider might be necessary when the provider has invested too little in provisioning capacity compared to what it had promised to its customers. As in the case of consumer complaint documents released per NHMC FOIA requests, the sample of ombudsperson emails offers valuable insights about the opportunistic behavior enabled by purposefully incomplete standard form best effort broadband retail contracts that allocate the risk of under-provisioning away from the network provider and to the unsuspecting subscribers that rely on their ISP for what is now an essential input.

**C. Carrier responses:** Figure 3 provides a visual depiction of relevant concepts extracted from this sample of formal responses from the carriers to requests from the FCC staff and/or its ombudsperson to provide the aggrieved customer with an adequate response to the problem.



The most prominent theme in the visualization is the cluster surrounding terms of the contractual agreement relating to “price” and “quality” of the service the carrier delivers (in red). Shortfalls in service “quality” operators deliver relative to the consumers’ expectations are in some way associated with “habits”, presumably of the consumers themselves for using too much data and congesting the carriers’ capacity constrained networks. Even though this may lead to less than expected speeds relative to the best effort/up to xMbps rates in the retail contracts, according to their responses the sellers maintain that the value they deliver reflects the result of a “market” process that “fairly” prices and allocates scarce capacity.<sup>28</sup>

The emphasis on network management practices carriers consider necessary because of congestion on their capacity constrained networks for justifying why they might be failing to meet their customers’ expectations is consistent with the flexible rule-of-reason approach to substantive design adopted by the Commission in the 2015 *Open Internet Order*.<sup>29</sup> In contrast to ex ante per se rules that restrict the boundary of permissible conduct by operators it could have adopted, in the 2015 Order the sector specific regulator provided service providers with significant flexibility and discretion to engage in traffic management practices they consider reasonable given their individual capacity constraints and business strategies.<sup>30</sup>

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<sup>28</sup> The fact that U.S. carriers perceive their pricing reflects “fair” market value for what they are delivering in terms of speeds and capacity is not surprising. According to international comparisons, U.S. carriers are able to charge substantially higher quality adjusted prices than their counterparts in most other advanced economies. See: Bischof, Z. S., Bustamante, F. E., & Stanojevic, R. (2014). Need, Want, Can Afford: Broadband Markets and the Behavior of Users. In Proceedings of the 2014 Conference on Internet Measurement (pp. 73-86). ACM. Figure 10, p. 81. Available at: <http://conferences2.sigcomm.org/imc/2014/papers/p73.pdf>; European Commission (2017). Fixed Broadband Prices in Europe 2016. Available at: <https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2016>; in light of international price comparison and existing affordability concerns in the U.S. market, it is pertinent to highlight that financial analysts confident the Commission will repeal Title II classification of broadband and thereby minimize its own capacity to promote competition and protect consumers already expect significant scope for price increases over the medium to longer term: See e.g. <https://ph.news.yahoo.com/ready-home-internet-prices-double-160153862.html>; <https://potsandpansbyccg.com/2017/10/06/a-doubling-of-broadband-prices/>; <https://www.techdirt.com/articles/20171004/09404038343/wall-street-predicts-apatetic-regulators-limited-competition-will-let-comcast-double-broadband-prices.shtml>

<sup>29</sup> The reasonable network management exception applies to all the rules outlined in the 2015 *Order*, except the prohibition on paid prioritization: “A network management practice is reasonable if it is primarily used for and tailored to achieving a legitimate network management purpose, taking into account the particular network architecture and technology of the broadband Internet access service.” See para. 32. This construction provides significant discretion for operators to engage in discriminatory traffic management practices while justifying their actions as a technical necessity. It also provides the regulatory agency with significant discretion to determine what type of practices are reasonable, which can be a challenging task in complex and rapidly evolving broadband Internet access markets.

<sup>30</sup> For discussions of economic trade-offs in the application of per se versus rule-of-reason in design of prohibitions against anticompetitive and abusive practices see: Christiansen, A., & Kerber, W. (2006). Competition policy with optimally differentiated rules instead of “per se rules vs rule of reason”. *Journal of Competition Law and Economics*, 2(2), 215-244. <https://academic.oup.com/jcle/article-abstract/2/2/215/892423>; Rajabiun, R. (2012). Private Enforcement and Judicial Discretion in the Evolution of Antitrust in the United States. *Journal of Competition Law and Economics*, 8(1), 187-230. <https://academic.oup.com/jcle/article-abstract/8/1/187/818261> For an analysis of the balance between per se v. rule-of-reason approaches to substantive design in the development of the 2015 *Open Internet Order*, see: Rajabiun, R. (2015). Beyond Transparency: The Semantics of Rulemaking for

More fundamentally, the evidence suggests carriers commonly conceptualize their “offer” as a basic data delivery service that connects the subscriber to the open Internet at potentially sufficient speeds. When they fail to meet their consumers’ expectations in terms of effective speeds, the carriers tend to attribute their failures to the necessity of using network management practices to manage congestion.<sup>31</sup> For providers that have failed to make sufficient investments in capacity enhancements in the past to deliver speeds their customers were expecting, utilizing network management practices that restrict their subscribers access to the open Internet may seem reasonable and “fair” for delivering the basic telecommunications service they are offering. At least according to their responses to unsatisfied buyers, sellers also appear to conceptualize their “offer” as a stand-alone basic “telecommunications service” that is only delivered only on a “best effort” basis, without any frills or enhancements on top the basic “high-speed” transmission services users hope they can access for the price they are paying for their monthly subscriptions. The strategic use of the best effort loophole in the retail contract by sellers to avoid responsibility for the quality of Internet access they are delivering is clearly pronounced in the quantitative semantic analysis of service providers’ formal responses to complaining customers and concerned FCC ombudsperson.

**D. Comparative semantics:** To summarize the quantitative explorations above and compare the semantics of the parties, we further utilize special “nested learning” algorithms that enable semantic mapping of different corpuses in relation to each other. Figure 4 provides a visual depiction of emergent concept clusters/themes from the text of the entire corpus that includes communications from consumers, carrier responses, and the ombudsperson emails. Folders containing documents are “tagged” and concepts within them are “profiled” against the quantitative indicators of semantic emphasis. The proximity/distance between the folder tags captures the emphasis textual material it contains place on emergent themes relative to the entire corpus.

Clusters of concepts around “Internet” “service” “speeds” represent the most relevant themes (in red) emphasized by consumers in their complaints about their “connection”. Despite excluding complaints explicitly associated with “data caps” in the FCC FOIA release from the analysis, “caps” that limit “usage” of “content” “people” demand still emerge as a cluster of secondary themes (in purple on the bottom). Compared to other parties, the ombudsperson emails emphasize to the carriers that there are some “rules” in place for protecting and promoting consumer access to the “open” Internet. Carrier responses emphasize they are in contact/going to “contact” the “customer” to “address” “issues” raised in the “complaint”. Consumer complaints tend to conceptualize these problems in terms of barriers to “access” and “use” of the Internet by “people”, whereas the carriers tend to view these “people” as “customers” having “issues” with

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an Open Internet. *Indiana Law Journal, Supp.*, 91, 33. <http://ilj.law.indiana.edu/beyond-transparency-semantics-of-rulemaking-for-an-open-internet/>

<sup>31</sup> In essence, blaming their other customers’ “habits” for the problem facing the complaining customer.



#### IV. Cognitive Dissonance and Demand for Consumer Protection

We discuss some potential public and private law solutions to emergent contractual conflicts between buyers and sellers in the subsequent concluding section. Before looking at possible remedies, it is useful to provide some estimates of the empirical relevance of insights generated by the semantic analysis of FCC consumer complaint documents as a public policy problem. As noted earlier, informal complaint documents consumers filed with the federal agency represent a narrow window into hard barriers facing American consumers trying to access information and application that meet their heterogeneous needs. Only some proportion of customers are likely to be unsatisfied with their services, for example when their ISP is facing more competition in that local market (or trying to foreclose on future competition/entry), and therefore has decided to respond faster to emergent congestion as demand grows than its counterparts that dominate regional and local market in other parts of the country. Then, unsatisfied customers are likely to complain to their service providers first, which may lead to a mutually satisfactory solution. Only a small group of very unsatisfied customers who could not get satisfaction from their private negotiations are likely to know about the existence of FCC's informal consumer complaint process and then take the time/motivation to ask the FCC to ask their network providers to respond to their concern. The FCC consumer complaint documents should therefore be viewed more as the proverbial "canary in the mine" that apparently sends important signals about the state of play in the broadband market, rather than a random sampling from the general population.

Given that there are over 100 million fixed broadband subscribers in the U.S.,<sup>33</sup> issues identified in 20,000 complaints may seem marginal. To explore if this is in fact the case, it is relevant to look at concrete indicators of broadband service quality and compare them with some common benchmarks of what can be considered an acceptable minimum service level. We evaluate this with broadband speed measurements generated from crowdsourced user tests based on the Measurement Lab (M-Lab)/Network Diagnostic Tool (NDT).<sup>34</sup> In contrast to up to x Mbps best effort advertised speeds that might be theoretically "available" or speedtests that measure only the access link speed (from users to within their service providers network),<sup>35</sup> the M-Lab/NDT tests measure actual connection speeds to "off-net" servers (usually in a nearby city on the edge of the "cloud"). It therefore offers a more realistic view of service quality levels users experience when trying to access third party resources from the basic service access paths available to the "open Internet" versus prioritized/cached content in the "fast lane".

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<sup>33</sup> As well as many mobile only users, particularly low income groups for whom paying for both fixed and mobile monthly subscriptions is unaffordable. See USTelecom Industry Trends and Metrics 2018. <https://www.ustelecom.org/broadband-industry/broadband-industry-stats>

<sup>34</sup> <https://www.measurementlab.net/tests/ndt/>

<sup>35</sup> For a discussion of distinct windows different broadband testing methodology offer into the differentiated and fast evolving world of Internet connectivity, see Rajabiun, R., & McKelvey, F. (2018). Complementary Realities: Public Domain Internet Measurements in the Development of Canada's Universal Access Policies. Forthcoming. *Information Society*.

Following the best effort/up to xMbps market convention that evolved in the 1990s for signalling service quality levels to buyers, policymakers in the U.S. continue to measure and map broadband “availability” based on maximum best effort speeds that sellers report they offer in particular areas of the country.<sup>36</sup> The Congress has recently recognized the extent to which this approach overestimates “availability” and asked the National Telecommunications and Information Administration (NTIA) to update the national broadband map with third party data that provide a more accurate picture of service quality/capacity gaps within the U.S.<sup>37</sup> Based on data sellers report to the FCC and 25/3 Mbps universal service targets FCC has suggested should be available to all Americans, NTIA estimates that “approximately 8 percent of Americans lived in places where fixed terrestrial broadband service was unavailable by the end of 2016.”<sup>38</sup> Given that a 25/3 service can be considered good enough for most uses, this view of “availability” may create the impression that sub-par service quality levels are only of marginal relevance as barriers to the ability of Americans to access and use what they need from the Internet.

This optimistic characterization of the data is technically valid given the construction of the estimate based on data that captures maximum connection speeds suppliers advertise they offer, rather than indicators of network performance they actually deliver to their customers.<sup>39</sup> However, data underlying this claim have little to do with the effective service quality levels most Americans experience under normal use conditions, such as when everybody in the neighbourhood is also trying to access content and application services they need or when the user is trying to access non-prioritized/cached data from the open Internet (i.e. in the best effort “slow lane”). To contextualize the dissonance between the official service provider/federal agency’s relatively optimistic picture of broadband “availability” as advertised best effort speeds versus effective bandwidth American consumers experience, Figure 5 below documents the distribution measured download speeds for a sample of 99,999 unique IP addresses conducted on the M-Lab/NDT’s distributed measurement platform between 2015 and 2016. According to these measurements, only around 40% of connections at the time had sufficient effective capacity available that allowed users to exceed FCC’s 25 Mbps download speed target. Effective bandwidth available to the majority of users (approximately 60%) fell short of FCC’s 25 Mbps aspirational universal service target. Developed based on maximum theoretical up to xMbps

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<sup>36</sup> Collected via the FCC Form 477 process from service providers. <https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477>

<sup>37</sup> Improving the Quality and Accuracy of Broadband Availability Data, [Docket No. 180427421–8421–01] RIN 0660–XC042. <https://www.ntia.doc.gov/federal-register-notice/2018/comments-improving-quality-and-accuracy-broadband-availability-data>

<sup>38</sup> Ibid.

<sup>39</sup> Network providers typically collect this type of information for their internal provisioning and traffic management needs, but consider them confidential and unwilling to share with policymakers or customers. In particular, latency measurements represent a key indicator governing optimization in intelligent traffic control systems. See Sandvine. Network Congestion Management V.2.0: Considerations and Techniques <https://www.sandvine.com/hubfs/downloads/archive/whitepaper-network-congestion-management.pdf>

services sellers claim they can deliver, FCC's 25 Mbps national universal service target appears rather unrealistic when considered against effective speeds users experience.<sup>40</sup> This suggests the asymmetric information problem between network providers on the one hand, and consumers and policymakers on the other, might be more extensive than previously thought.

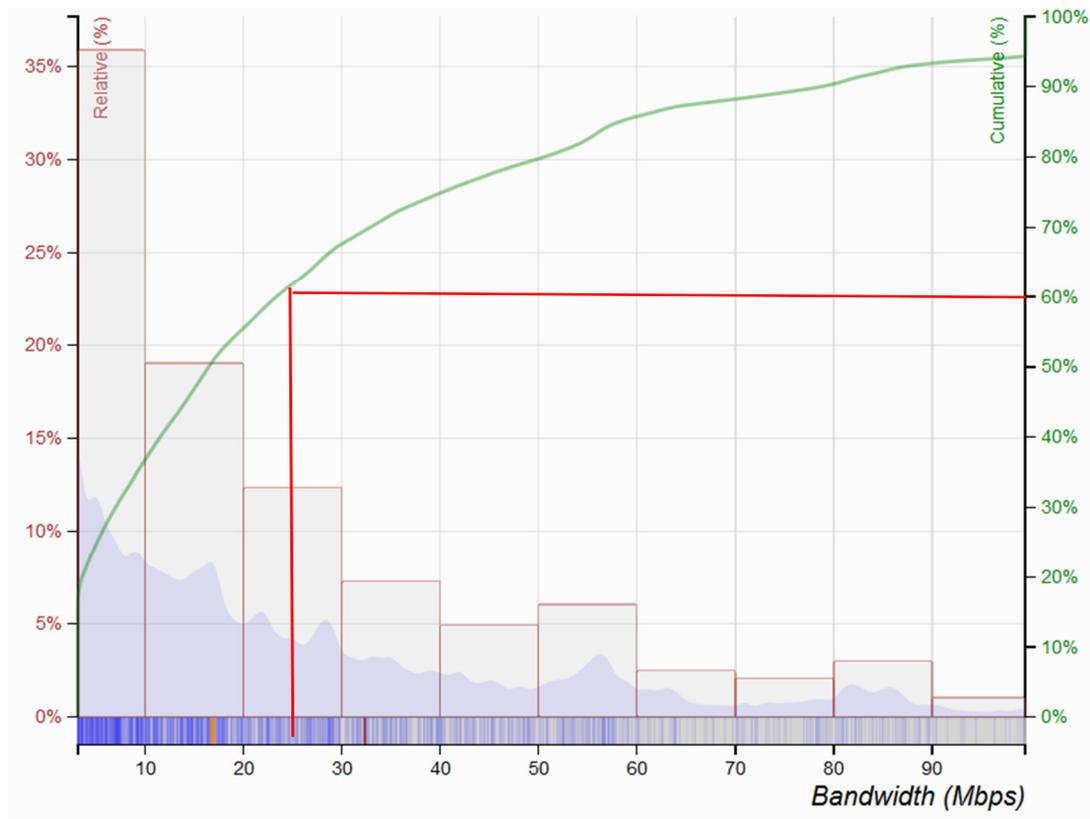
On the right-hand side of the Figure, there are a number of peaks above 50 Mbps, likely capturing well provisioned services fiber-based access. In the context of intractable service quality problems restricting consumers' access at the slower end of the spectrum on the left-hand side of the Figure, around 35% of connections had effective downstream bandwidth below 10 Mbps, while over 25% had speed below 5 Mbps.<sup>41</sup> Connections with speeds below 5 Mbps may be sufficient for first generation Internet applications such as email and simple web browsing, but it becomes increasingly challenging to use more advanced applications (which motivated FCC to increase its aspirational universal service target to 25 Mbps to begin with).<sup>42</sup> Evidence that somewhere around a third of connections had effective bandwidth below the 5-10 Mbps range indicates that the problem of sub-par service quality levels is more pervasive than suggested by rose-colored supplier centric/official approach to measuring broadband "availability" in terms of maximum best effort rates suppliers advertise. The substantive group of American consumers experiencing sub-par services in terms of effective speeds helps explain their demand for some form of public intervention that alleviates existing barriers they face when trying to access what they need from the open Internet and protects their access in the future.

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<sup>40</sup> The shared optimism generated by the type of data emphasized by sellers and the federal bureaucracy tend to emphasize explains growing concerns by elected representatives about the relevance of the national broadband map.

<sup>41</sup> Note that these measures capture bandwidth to third party "off-net" test servers and it might be possible that users with low speeds according to M-Lab/NDT data are able to achieve higher speeds when accessing prioritized/sponsored/cached data in the "fast lane."

<sup>42</sup> Please note that we are only discussing downstream capacity here, whereas upload speeds and low latency connectivity are also relevant in shaping the ability of users to deploy advanced applications that require reliable connectivity to the "cloud."



**Figure 5. Distribution of Download Speed Measurements in the U.S. (2015-2016)**

Source: M-Lab NDT/RIPE NCC, n=99,999

## V. Policy Instruments and Optimization

Traditional legal and economic literature on incomplete standard form contracting tends to explain them in terms of the catch-all phrase of “transaction costs”, which these types of contracts help reduce. These transaction costs include both ex ante costs of negotiating and writing a more complete contract accounting for more contingencies and ex post costs of adjusting terms/compensating the parties when there is an idiosyncratic development/something goes wrong. More recent information theoretical literature on incomplete contracting in a bilateral monopoly setting (which readily applies to standard form retail contracts) considers appeal to transaction cost as unrealistic as it does not consider strategic drivers of purposeful incompleteness.<sup>43</sup> Instead, this approach looks at imperfect contracting in terms of strategic rent seeking behavior and construction of information asymmetries between buyers and sellers at the microeconomic level. While a review of this literature is beyond the scope of this paper, at its most basic level Jean Tirole elegantly captures the problem with incomplete contracts in terms of a “a garbling of the information structure” that enables inefficient opportunistic behavior in

<sup>43</sup> Tirole, J. (1999). Incomplete contracts: Where do we stand?. *Econometrica*, 67(4), 741-781. Tirole, J. (2009). Cognition and incomplete contracts. *American Economic Review*, 99(1), 265-94.

bilateral contractual relations.<sup>44</sup> The dissonance between conceptualizations of broadband service quality as advertised v. delivered outlined in the last section offers a unique example of the broader information garbling phenomenon that helps sustain imperfect contracting in world of rational (but information constrained) economic actors.

The so-called Toulouse School of Economics approach to incomplete contracting and rational economic behavior has a number of implications that are particularly relevant for evaluating the evidence from the U.S. broadband industry analyzed in this article.<sup>45</sup>

- Rent-seeking, rather than just transaction cost avoidance, can drive incomplete contracting.
- Ex ante competition between sellers does not necessarily reduce transaction costs facing buyers and scope for rent seeking.
- Incomplete contracting is endogenous to the structure of the industry, with reverse causality from strategic incomplete contracting to institutional arrangements associated with the need to reduce transaction costs (e.g. standard form, relational contracting, vertical integration).<sup>46</sup>

FCC consumer complaint documents provide a relatively intuitive picture of contractual conflicts between buyers and sellers in the market for “high-speed” connectivity that is consistent with these generalized insights about strategic drivers of incomplete contracting. The standard form best effort contract endogenously and naturally emerged as a way to reduce cost facing incumbent operators of legacy telephone and cable TV networks expanding access to higher speed connections in the late 1990s and early 2000. The best effort loophole in the contract provided the flexibility suppliers required to manage scarce capacity available on their networks, while attracting new customers by advertising ever higher maximum up to x Mbps services. Given the advantages of broadband over dial-up and the fact that best effort services tend to be good enough for first generation Internet applications (e.g. email, simple web browsing), lack of performance warranties from suppliers may not have been a problem from consumers. This convention in the design of standard form retail broadband contracts has however become increasingly problematic as people have become more dependent on reliable Internet access and a wide range of advanced application require better than best effort service quality for reliable use.

The purpose incompleteness that initially emerged to reduce (both ex ante and ex post) transaction cost of contracting for “high-speed” access increasingly provides new opportunities for rent seeking enabled by the best effort “loophole” in the basic service contract. Without some form of minimum service level of commitments by network providers, growth in

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<sup>44</sup> Ibid.

<sup>45</sup> Ibid.

<sup>46</sup> See e.g. Williamson, O. E. (1983). Credible commitments: Using hostages to support exchange. *The American Economic Review*, 73(4), 519-540.

prioritized/sponsored traffic in the “fast lane” is likely to exacerbate existing barriers facing consumers trying to access information and applications they need from competing vendors on the open Internet.

By signalling that it can deliver services with attractive quality adjusted prices, a network provider can expand its market, but only up to a point. After that it starts to become more profitable to start rationing fixed network capacity, by either charging higher prices for basic broadband access to the open Internet and/or charging third party content/service providers on the “second side” of the market for better than best effort connectivity to their customers.<sup>47</sup> Users outside of high-value and relatively more competitive urban markets with access to fiber and upgraded cable networks are likely to be particularly exposed to the negative externalities from growth in premium/sponsored traffic on their basic service quality than those in underserved communities where incentives to invest in new technologies and capacity enhancement is already lagging behind (e.g. rural communities, older/lower income urban/suburban areas). While it is true that Internet speeds/service quality levels can have substantive ebbs and flow, the fact that they “vary” does not imply that it is desirable to retain contractual institutions that allocate the risk of capacity under-provisioning by suppliers (with the power to avoid less than expected speeds by investing more) to paying consumers (who can’t do much about the failure of their suppliers to provision sufficient capacity to deliver on what they expected per their retail contract).

In terms of policy responses, previous literature and many jurisdictions have primarily focused on adoption of formal rules against discriminatory traffic management and pricing practices of service providers, notably as they relate to paid prioritization and/or sponsored data/zero rating. Others have highlighted the non-binding nature of these types of formal rules, suggesting instead utilization of minimum service quality guarantees to mitigate against the negative impact of growth in premium traffic on basic service quality. In Europe for example, the Body of European Regulators for Electronic Communications (BEREC) has adopted a flexible set of guidelines for the implementation of EU network neutrality regulations that encourage national competition authorities to utilize rules against discriminatory practices in conjunction with minimum service quality standards.<sup>48</sup> The European approach is instructive from a policy optimization perspective as it helps account for the significant informational asymmetries between policymakers and carriers that can limit the effectiveness of formal conduct rules as economic constraints on large and resourceful enterprises. In Canada, the telecom regulator has recently justified prohibiting certain differential pricing/zero rating practices in part based on risks their growth can pose on basic service quality<sup>49</sup> and is moving to adopt minimum Quality of Service (QoS) standards for

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<sup>47</sup> See, e.g. Tier Flattening: AT&T and Verizon Home Customers Pay a High Price for Slow Internet, National Digital Inclusion Alliance (July 31, 2018), <https://www.digitalinclusion.org/wp-content/uploads/2018/07/NDIA-Tier-Flattening-July-2018.pdf>

<sup>48</sup> [https://berec.europa.eu/eng/news\\_and\\_publications/whats\\_new/3958-berec-launches-net-neutrality-guidelines](https://berec.europa.eu/eng/news_and_publications/whats_new/3958-berec-launches-net-neutrality-guidelines)

<sup>49</sup> Telecom Regulatory Policy CRTC 2017-104, para 94, noting concerns from consumers with disabilities that “that it is unclear how such differential pricing practices would impact an ISP’s best efforts to preserve or improve the

universal service.<sup>50</sup> These international developments suggest the complementary nature of formal restrictions on the boundary of discriminatory service quality/price differentiation and minimum performance standards in mitigating negative externalities on basic service quality expected from growth in prioritized/sponsored traffic on capacity constrained networks.

These trends are relevant to note in the context of FCC consumer complaint documents analyzed in this article and efforts by the sector specific regulator FCC to relinquish itself from its statutory obligations to monitor and address anticompetitive practices in the provision of basic communication services and to allocate this function to the general purpose antitrust and consumer protection agency the Federal Trade Commission (FTC). Unlike the FCC, FTC is not designed as a rulemaking agency and can only apply general prohibitions against anticompetitive and abusive practices ex post as it does across many other industries as needed. This closes the door for using ex ante prohibitions against discriminatory traffic management/pricing practices that fragment scarce network capacity and can erode basic service quality. In addition to vacating the ex ante rules, the FCC has also abandoned its statutory authority (Title II) that would be needed to impose binding minimum service quality standards. While forbearance from using a sector specific framework for the regulation of basic communications services may enable sellers to get paid more readily for their scarce network capacity, it leaves consumers already experiencing sub-par service quality levels with the risk of negative externalities associated with growth in network intensive prioritized/sponsored traffic on basic service quality. These costs are likely to vary across local markets and communities, depending on local competitive conditions and private sector strategies that shape network provisioning decisions of suppliers in that market.

In the context of these technological and regulatory developments, and evidence presented in this article on emergent contractual conflicts about basic service quality, is relevant to explore other potential public and private strategies for protecting consumers against the risks of incomplete contracting in the market for the provision of broadband access services. Below we provide partial list of potential approaches that could limit the scope for opportunistic behavior enabled by the traditional design of the retail broadband contract driving consumer complaints analyzed in this article aimed at aligning the capacity provisioning incentives of suppliers with expectation of their subscribers trying to access what they need from the open Internet:

**A. Evolution of contracts:** From an economic welfare perspective, “first best” solution to the incomplete contracting problem in the market would be a world with individualized Service Level Agreements (SLA) that allow users to select from a menu of options and commits the seller to delivering the agreed upon performance standard. It is not clear if this solution would be feasible for a long time to come as it would substantially restrict the flexibility of network providers to manage scarce capacity they increasingly need for monetizing prioritized/sponsored

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service quality of fixed and mobile services that are currently available.” <https://crtc.gc.ca/eng/archive/2017/2017-104.htm>

<sup>50</sup> Telecom Regulatory Policy CRTC 2016-496, paras 98-111. <https://crtc.gc.ca/eng/archive/2016/2016-496.htm>

services via the “fast lane”. Nevertheless, in low cost/high revenue/rate of return local markets where private sector providers have strong incentives to deploy ultra high capacity fiber access networks, it is feasible to imagine providers with better networks start to specify some minimum service quality commitments as part of their contractual “offer” in the retail market. Monitoring the extent to which reasonably priced services that include a verifiable minimum performance commitment (as a substitute or complement to the maximum up to x Mbps best effort rate) could shed further light on the empirical interplay between market competition and the evolution of the common law of contracts. Policy strategies that “nudge” private network providers to offer more concrete and verifiable minimum performance guarantees in retail residential and business market may have some long term impact in addressing market failures associated with incomplete contracting driving consumer complaints analyzed in this article. From a dynamic efficiency perspective, a hardening of performance targets is also likely to enhance investment incentives of Internet access providers.

**B. Price/Service Standard Regulation:** In economic terms price and quality are jointly determined and their regulation represents the “second best” response to opportunistic behavior in markets where the scope for competition is limited. Economic history and theory have long recognized that in markets where consumers have heterogeneous tastes suppliers with market power have a tendency to distort quality on the low-end and offer a wider range of products on top of the basic service “offer” in order to maximize consumer surplus they can extract. Service tiering and other “smart pricing” strategies common in the broadband market represent manifestations of these incentives. Price ceilings and minimum service standards represent related instruments for counteracting such distortions. While price ceilings can help increase social welfare in such situations, imposing minimum standards can have some negative implications by increasing prices on the low price/service quality end of the demand curve and therefore increasing affordability concerns for those with lower income/willingness to pay.<sup>51</sup> Prohibitions on state authorities included in FCC’s recent course reversal with respect to Title II/non-discrimination rules can be viewed in the context of the importance of price ceiling/minimum service standard regulation in the private provision of a service that is now an essential utility.

**C. Civil litigation:** In the evolution the U.S. antitrust system, private litigation has served as a high-powered complement to public enforcement in restricting the scope for anticompetitive and abusive practices.<sup>52</sup> The scope for litigation by both public authorities (federal or state attorneys general offices) and private enforcement through class actions for misleading advertising is limited, to a large degree because of the purposeful incompletes of the contracts that specify expected service quality levels in terms of maximum theoretical speeds that might be available to

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<sup>51</sup> Besanko, D., Donnenfeld, S., & White, L. J. (1987). Monopoly and quality distortion: effects and remedies. *The Quarterly Journal of Economics*, 102(4), 743-767.

<sup>52</sup> Particularly during the post World War II period of rapid technological diffusion and economic growth in the 1950s and 1960. See Rajabiun, R. (2012). Private enforcement and judicial discretion in the evolution of antitrust in the United States. *Journal of Competition Law and Economics*, 8(1), 187-230.

the subscriber, without any binding warranties of minimum performance by the seller. Consequently, demonstrating that network providers are delivering service quality levels that are sub-par can require establishing acts of intentional misrepresentation and obfuscation of actual speeds/service quality levels sellers are delivering.<sup>53</sup> “Completing” the retail contract by closing this loophole is likely to be a precondition for enabling effective civil actions by public and/or private litigants against network providers that are more aggressive than others in exploiting over-promising/under-provisioning strategies incomplete best effort contracting enables.

In practice, a combination of these institutional developments will likely to be required for protecting consumers from anticompetitive practices enabled by the incompleteness of broadband contract driving consumer complaints we analyzed in this article. More concrete contractual terms are needed to enable civil litigation and reduce the need to adopt price/service quality regulation. However, precisely because they are perceived to be so beneficial by suppliers, closing this fundamental contractual loophole in the provision of broadband access will likely be thwarted by parties accustomed to super-normal profits available from over-promising/under-provisioning strategies in an increasingly differentiated broadband ecosystem. Until “offers” that include verifiable minimum service guarantees and/or SLAs are widely available to residential and business users, growth in network intensive traffic in prioritized/sponsored “fast lanes” has the potential to further restrict the freedom of consumers to provision information and application services they need from competing vendors available on the open Internet.

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<sup>53</sup> See e.g. evidence compiled by the State of New York in a lawsuit against one of the biggest cable broadband providers in the U.S. suggests actual speeds of premium plans (with 100-300 Mbps in advertised speeds) were up to 70% slower than those it had promised customers. See Supreme Court of the State of New York, case no. 450318/2017; available at: [https://ag.ny.gov/sites/default/files/summons\\_and\\_complaint.pdf](https://ag.ny.gov/sites/default/files/summons_and_complaint.pdf)