Open Internet: Network Management Disclosures

Author: Juan M. Roldan

Engineering and Public Policy

Carnegie Mellon University[1]

February 2015

Abstract

Fixed and mobile broadband access providers (BAPs) are required to disclose their network management practices, performance characteristics and terms and conditions in compliance with the Federal Communications Commission Open Internet ruling. This paper examines different Open Internet disclosures from a total of forty BAPs divided in three groups: four major mobile BAPs, eleven fixed BAPs from the Measuring Broadband America Report, and twenty-five BAPs from a random sample. Results show that BAPs do not comply completely with the Open Internet transparency rule, *e.g.*, 49% from the random sample of forty-nine BAPs do not disclose network management practices and the impact of specialized services in their network. In addition, from the remaining 51%, not all the required information is disclosed. Regarding fixed and mobile BAPs, disclosures lack completeness and specificity, and are difficult to access by the end user, therefore, end users might not be able to include such information in their decision-making process when purchasing broadband services.

[1] The opinions, findings, and conclusions expressed in this paper are those of the author and do not necessary reflect the views of Carnegie Mellon University. The author is grateful to Professor Marvin Sirbu from the Engineering and Public Policy Department at Carnegie Mellon University for his helpful feedback.

Content

Introduction

Fixed and mobile broadband access providers (BAPs) are required to disclose their network management practices, performance characteristics, and terms and conditions in compliance with the Federal Communications Commission (FCC) Open Internet ruling. This paper examines different Open Internet disclosures from a total of sixty-four BAPs divided in three groups: four major mobile BAPs (AT&T, Sprint, T-Mobile, and Verizon), eleven fixed BAPs from the Measuring Broadband America Report, and a random sample of forty-nine BAPs from the FCC's Form 477.[2] Whereas all of the large fixed line and wireless BAPs provide disclosures, results show that 49% from the random sample of BAPs do not comply completely with the Open Internet transparency rule, *e.g.*, do not disclose any network management practices or the impact of specialized services in their network. In addition, from the remaining 51%, not all the required information is disclosed. Regarding fixed and mobile BAPs, disclosures lack completeness and specificity, and are difficult to access by the end user, therefore, end users might not be able to include such information in their decision-making process when purchasing broadband services.

Of the 40 BAPs who do provide some form of disclosure (eleven major fixed line BAPs, four major wireless BAPs, and twenty-five from the random sample of Form 477), I examine in detail the contents and accessibility of their disclosures.

This paper is divided in five sections. The first section describes the current FCC's Open Internet transparency rule. The second section presents a summary of related work in transparency policy in other markets. The third section describes the methodology used in this paper. The fourth section presents the analysis of the current disclosures by the three groups of BAPs, and finally the fifth section summarizes several conclusions.

1. Background

One of the conditions for a perfect market to exist, which according to economic theory leads to an optimal allocation of resources and social welfare maximization, is perfect information, *i.e.*, a situation in which each of the producers and consumers have all the relevant information to perform transactions. Clearly, perfect markets rarely exist, if at all. In fact, imperfect or asymmetric information is present in higher or lower levels in most markets, modifying decisions and behavior of producers and consumers in some cases significantly, and therefore deviating from an optimal allocation of resources.

In the last decades, policymakers have tackled asymmetric information issues through targeted transparency policies in which market agents are required to disclose relevant

[2] The FCC requires that "[a]n entity that is a *facilities-based provider* of *broadband connections* to *end users* must complete and file the applicable portions of this form if it has one or more *broadband connection in service* to an *end user*…" See: http://transition.fcc.gov/form477/WhoMustFileForm477.pdf. The FCC Form 477 used for this study presents a list of all BAPs in the US as of June 30, 2013.

information that otherwise they would be unwilling to disclose, mainly due to negative conclusions or reactions that such disclosure may generate in the market.

The broadband access market has been no exception. The Federal Communications Commission (FCC) included a transparency rule in its 2010 Open Internet Order[3] requiring both, fixed and mobile broadband access providers (BAP), to disclose their "*(…) network management practices, performance characteristics, and terms and conditions of their broadband services*"[4] offered to the mass market, *i.e.*, "*(…) residential customers, small business, and other end-user customer such as schools and libraries.*"[5]

The intention of such disclosures, according to the FCC, is to promote competition "*in at least five ways*:"[6]

i. By ensuring that end users, *i.e.*, "*any individual or entity that uses a broadband Internet access service*,"[7] can make informed choices regarding the purchase and use of broadband services;
ii. By increasing the adoption of broadband services due to the increase in confidence of the end users in the BAP's practices;
iii. By ensuring that startups and other edge providers, *i.e.*, "*content, application, service, and device providers*,"[8] have the technical information necessary to create and maintain online content, applications, services, and devices, and to assess the risk and benefits of embarking in new projects;
iv. By increasing the likelihood that BAPs will abide by Open Internet principles and that the Internet community will identify problematic conduct and suggest fixes; and,
v. By enabling the FCC to collect information necessary to assess, report on, and enforce the other Open Internet rules, *i.e.*, non-blocking and non-discrimination.[9]

[3] Federal Communications Commission. (2010). *Preserving the Open Internet, Broadband Industry Practices, Report and Order.* Washington, D.C. This Order, in addition to the transparency rule, includes also the non-blocking and non-discrimination rules. However, in January 2014, the United States Court of Appeals of the D.C. Circuit, in its decision in *Verizon v. FCC* upheld the transparency rule, but vacated the no-blocking and no-unreasonable-discrimination rules as impermissible common carrier regulation of an information service. Thus, currently the only rule of the Open Internet Order still in effect is the transparency rule.

[4] *Id.* Par. 1.

[5] The term mass-market does not include enterprise service offerings because such customers "*tend to be sophisticated and knowledgeable (often with the assistance of consultants), … contracts are typically the result of RFPs* [Request for Proposal] *and are individually-negotiated (and frequently subject to non-disclosure clauses), … contracts are generally for customized service packages, and that contracts usually remain in effect for a number of years.)*". *Id.* Par. 45, note 47.

[6] *Id.* Par. 53.

[7] *Id.* Par. 4, note 2.

[8] *Id.*

[9] See footnote 3.

In order for BAPs to implement the transparency rule, the FCC's Open Internet ruling suggested "effective disclosure models," allowing complete flexibility so that BAPs could implement the model that they considered appropriate for both end users and edge providers.[10]

Due to this flexibility, no specific format was required to standardized disclosures across different BAPs, instead, the FCC required that "*disclosures be sufficiently clear and accessible to meet the requirements of the rule*."[11] The FCC emphasized that the "effective disclosure model" presented in Table 1, was "*(…) not necessarily exhaustive, nor is it a safe harbor –there may be additional information, not included* [in Table 1]*, that should be disclosed for a particular broadband service to comply with the rule in light of relevant circumstances.*"[12]

Table 1. FCC's effective disclosure model

<table>
<tr><th>Network Management Practices</th><th>Performance Characteristics</th><th>Commercial Terms and Conditions</th></tr>
<tr><td>1. Congestion Management Practices (CMP)
- Description of CMP;
- Types of traffic subject to practices;
- Purposes served by practices;
- Practices' effects on end users' experience;
- Criteria used in practices (indicators of congestion that trigger a practice, frequency of congestion);
- Usage limits and the consequences of exceeding them;
- Reference to engineering standards.</td><td rowspan="4">1. Service Description
General description of the service, including:
- Service technology;
- Expected and actual access speed and latency;
- Suitability of the service for real-time applications.

2. Impact of Specialized Services
- What specialized services, if any, are offered to end users;
- Whether and how any specialized services may affect last-mile capacity available for, and the performance of, broadband Internet access service.</td><td>1. Pricing
Monthly prices, usage-based fees, and fees for early termination or additional network services;</td></tr>
<tr><td>2. Application-Specific Behavior
Whether and why the BAP:
- Blocks or rate-controls specific protocols or protocol ports;
- Modifies protocol fields in ways not prescribed by the protocol standard;
- Inhibits or favors certain applications or classes of applications.</td><td>2. Privacy Policies
- Whether the network management practices entail inspection of network traffic;
- Whether traffic information is:
o Stored;
o Provided to third parties; or,
o Used by the carrier for non-network management purposes.</td></tr>
<tr><td>3. Device Attachment Rules(1)
- Any restrictions on the types of devices to connect to the network;
- Approval procedures for devices to connect to the network</td><td>3. Redress Options
Practices for resolving end-user and edge provider complaints and questions.</td></tr>
<tr><td>4. Security
- Practices used to ensure end-user security;
- Practices used to ensure security of the network. (excluding information that could reasonably be used to circumvent network security)</td><td></td></tr>
</table>

Source: FCC. (2010). *Preserving the Open Internet, Broadband Industry Practices, Report and Order*. Washington, D.C. Par. 56.

(1) Mobile providers, are not required to allow third-party devices or all third-party applications on their networks, however, disclosures regarding third-party device and application certification procedures are required, if any.

[10] *Id.* Par. 58.

[11] *Id*.

[12] *Id*. Par. 56.

In 2011 the FCC released guidance for compliance with the Open Internet transparency rule in order to provide clarification about disclosure practices that will satisfy the rule in five specific areas: (i) Point-of-sale disclosures, (ii) Service description, (iii) Extent of required disclosures, (iv) Content, application, service and device providers, and (v) Security measures.[13]

The guidance confirmed that "*(…) broadband providers must, at a minimum, prominently display or provide links to disclosures on a publicly available, easily accessible website that is available to current and prospective end users and edge providers.*"[14] The guidelines also confirmed that it is not necessary to distribute "*(…) disclosures in hard copy or to train sales employees to provide the disclosures themselves*,"[15] thus, including the disclosures in a website will suffice for compliance with the transparency rule, physical point-of-sale disclosures were not needed.

In addition, to avoid ambiguity regarding the "*(…) not necessarily exhaustive (…)*" "effective disclosure model", the FCC decided to allow compliance with the transparency rule if such a model was used.[16] Thus, the extent of required disclosures was complete if BAPs disclosed the "effective disclosure model" in Table 1.

The FCC clarified in the guidelines that they expected BAPs to "*(…) include* [in the disclosures] *sufficiently detailed information regarding network management practices to enable a technologically sophisticated Internet user to understand how such network management practices work (…),*"[17] with the idea that such detailed information will also be sufficient for an edge provider, and therefore only one disclosure for both, end users and edge providers, will be enough. Currently, Open Internet disclosures are required for fixed and mobile BAPs in the terms described in this section.

2. Related Work

Transparency policies exist today across a wide range of markets, *e.g.*, nutrition labels in the food market, fuel economy and environment labels, and car safety ratings in the vehicle market, hygiene grade cards in the restaurant market, financial disclosures in the banking market, and privacy disclosures across several markets that require personal information, etc. The main objective of all these transparency policies is *"… to change the behavior of individuals and organizations in ways policymakers believe will advance the public interest*."[18]

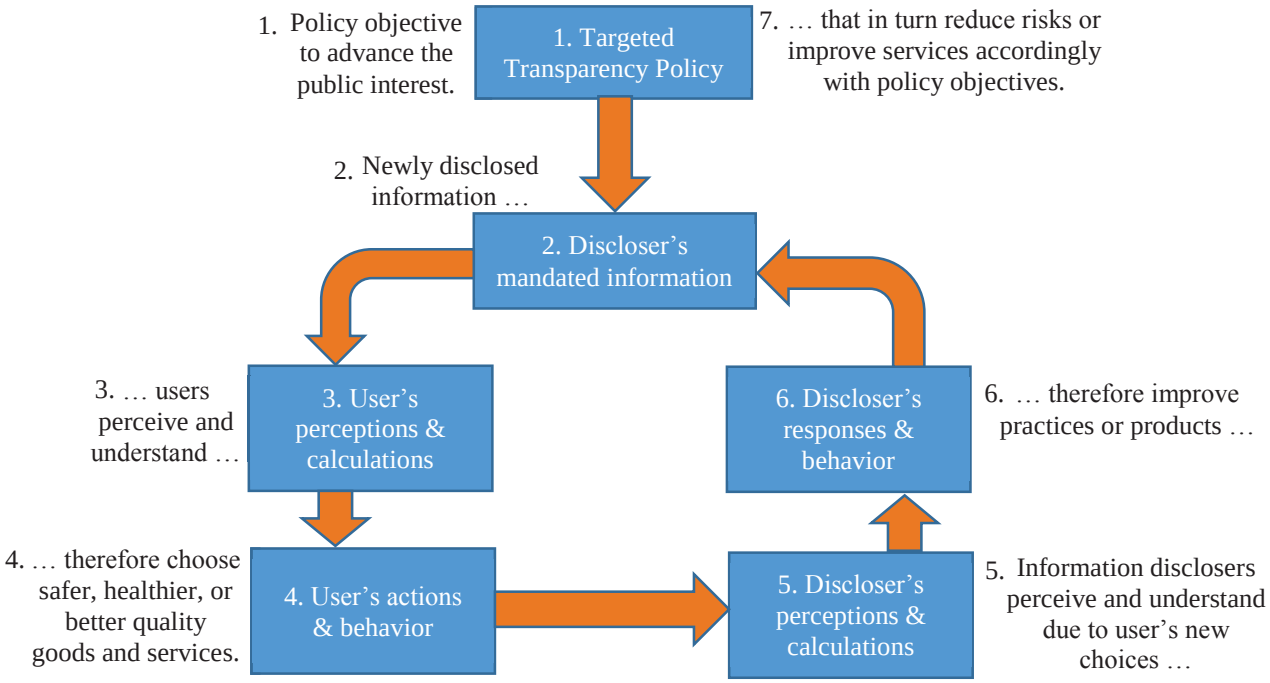
---

[13] Federal Communications Commission. (2011). *Guidance for Compliance with Open Internet Transparency Rule.* Washington, D.C.

[14] *Id.* Page 3.
[15] *Id.*
[16] *Id.* Page 6.
[17] *Id.* Page 7.
[18] Fung, A., Graham, M., & Weil, D. (2007). *Full Disclosure: The Perils and Promise of Transparency.* Cambridge. Page 51, Ch. 4.

Fong *et al.* propose an *Action Cycle* to describe the interaction between *users* who make informed decisions through transparency policies, *i.e.*, individuals, and *disclosers* to whom the transparency policies apply, *i.e.*, organizations.

Figure 1. Action Cycle



Source: Fung *et al.* (2007). *Full Disclosure: The Perils and Promise of Transparency*. Cambridge. Ch. 4.

The Action Cycle has two additional dimensions to describe the transparency policy: effect and effectiveness. If the information disclosed is perceived and understood by the users (step 3), and therefore users change their actions and behavior (step 4), then the transparency policy has an effect on the user's decision-making process. In addition, the system, *i.e.*, disclosures, users and disclosers, is effective "…*only when discloser responses significantly advance policy aims* [steps 5-7]."[19]

The Action Cycle has three possible outcomes: (i) No effect and no effectiveness: information disclosed has no effect on the user's perception and decision-making process, therefore disclosers do not perceive any change in user's behavior and will not respond to advance policy objectives; (ii) Effect but no effectiveness: information disclosed has an effect on user's perception and therefore changes their behavior, however, such change is not consistent with policy objectives and therefore disclosers do not respond to advance those policy objectives; and (iii) Effect and effectiveness: both users and disclosers change their behavior in ways that significantly advance policy objectives.[20]

[19] *Id.* Page 54.
[20] *Id.* Page 51.

The authors analyze eight transparency policies[21] through the above framework and an extensive set of publications studying the effect and effectiveness of such transparency policies. According to the authors, three of the transparency policies[22] are highly effective, *i.e.*, users make informed decisions by including the disclosed information in their decision-making process, and disclosers perceive the change in user behavior, therefore improve their practices or products according to the initial policymaker objectives. In addition, it is likely that there is a causality relationship that links the effect to the effectiveness of the transparency disclosures. Three other transparency policies[23] are moderately effective, and the last two[24] are ineffective, *i.e.*, users do not include the disclosed information in their decision-making process, and therefore disclosers do not perceive any changes that consequently alter their behavior and transparency policy objectives are not achieved.

Regarding the Open Internet disclosures, the FCC's policy objective is to promote competition in at least five ways mentioned previously in section 1, *i.e.*, ensuring that end users make informed decisions, increasing the adoption of broadband service, ensuring edge providers have technical information, increasing the likelihood that a BAP will abide by Open Internet principles, and by enabling the FCC to collect information and enforce Open Internet rules.

To comply with this objective, the FCC defined the "effective disclosure model" presented in Table 1. To our knowledge there has been no study that describes if the current disclosures from BAPs comply with the FCC's transparency rule, or the effect and effectiveness of such rules according to the Action Cycle described above.

However, some authors and regulators have posited principles that must be met by network neutrality disclosures to be successful. According to Faulhaber, disclosures in general should satisfy four principles: (i) Disclose all information (and only such information) that a user needs to make an informed purchase decision, (ii) Disclosures should be easy to access, *i.e.*, information must be available at the point of purchase or use, (iii) Disclosed information must be clear and simple to understand, and (iv) Disclosures should be verifiable.[25] The FCC's "effective disclosure model," (Table 1 above) can be viewed as defining what a disclosure should include to satisfy principle (i), in addition the FCC also states disclosures should be sufficiently clear and accessible which is in line with principles (ii) and (iii).

The regulator in the United Kingdom, the Office of Communications, Ofcom, redefined in 2011 each of Faulhaber's principles as appropriate, accessible, understandable and verifiable respectively, and adds two more principles: (i) Comparable: Consumers should be able to compare information provided by different providers, and (ii) Current: The information available

[21] These transparency policies are related to: 1. Corporate financial reporting, 2. Restaurant hygiene disclosure, 3. Mortgage lending disclosure, 4. Nutritional labeling, 5. Toxic pollution reporting, 6. Workplace hazardous chemicals disclosure, 7. Patient safety reporting, and 8. Plant closing reporting.

[22] Corporate financial reporting, restaurant hygiene disclosure, and mortgage lending disclosure.

[23] Nutrition labeling, toxic releases disclosure, and workplace hazards disclosure.

[24] Patient safety disclosure and plant closing reporting.

[25] Faulhaber, G. (2010). Transparency and Broadband Internet Service Providers. *International Journal of Communications*, 738-757.

to consumers should be up-to-date.[26] Similarly, the regulator in France, *L'Autorité de Régulation des Communications Électroniques et des Postes,* Arcep, required disclosures to be presented in a clear, comparable and detailed fashion, and made readily accessible.[27]

The Universal Service Directive for the European Union states that relevant information regarding publicly available electronic communication services, *e.g.*, broadband access services, should be included in the contracts in a clear, comprehensible and easily accessible form.[28] Moreover, the Body of European Regulators for Electronic Communications (BEREC), included similar principles to the ones mentioned above –accessibility, understandability, meaningfulness, comparability, and accuracy- for fully effective transparency policies to be implemented, and in addition, concluded that disclosures should "*be considered with regards to the concrete situation of the user: a. Before a contract is signed (…), b. At the point of sale (…),* [and] *c. After the contract* [is signed] *(…).*"[29]

There is general consensus on the principles that Open Internet transparency policies should follow in order to have an effect on the consumers' decision-making process. However, based on a study by Kantar Media prepared for Ofcom, the effect may not be as expected.[30] According to this study, only 1% of end users claim to have used traffic management disclosures in their fixed and/or mobile broadband access purchasing decision. Moreover, only 10% of Internet consumers were aware of the term and meaning of traffic management, and only 35% felt it is important to know about traffic management. Finally, the study highlights approaches to realizing "clear", "understandable" or "comprehensible" disclosures as identified by consumers:

- Avoiding text dense formats and using friendly, lay tones to explain traffic management practices
- Using consumer friendly terminology and avoiding use of technical measures (*e.g.* megabytes) without putting in the context of usage (*e.g.* hours of streaming)
- Keeping key fact indicators simple and avoiding using ambiguous symbols to make information easier to process

And highlight to achieve "comparability":

- Third party independent sources providing online formats (*e.g.* comparison sites) would be preferred

This paper describes and compares a set of Open Internet disclosures from different BAPs in the United States. According to the Action Cycle, this paper tackles step 2, *i.e.*, what BAPs are disclosing to comply with the Open Internet rules, and how are such disclosures presented to the public. Future research could tackle the following steps of the Action Cycle, *i.e.*, whether such disclosures have an effect on the users and if the overall system is effective.

---

[26] Office of Communications. (2011). *Ofcom's Approach to Net Neutrality.* Page 13 and 14.
[27] Autorité de Régulation des Communications Électroniques et des Postes. (2011). *Annual Report.* Page 129.
[28] European Parliament. (2009). Directive 2009/136/EC. *Official Journal of the European Union*. Art. 21.
[29] Body of European Regulators for Electronic Communications (BEREC). (2011). *Guidelines on Transparency in the scope of Net Neutrality: Best practices and recommended approaches.* Page 14.
[30] Kantar Media. (2013). *Transparency in Internet Traffic Management.*

3. Methodology

This paper follows a positive research approach, *i.e.*, I examine and describe a set of current Open Internet disclosures regarding congestion management practices (CMP), application-specific behavior, device attachment rules, security, and specialized services, from different BAPs. In addition I also include an analysis of the accessibility of Open Internet disclosures to the consumer through the BAPs' websites.

To compare and analyze Open Internet disclosures from the three groups of BAPs I design a group of questions presented in Table 2. These questions are intended to obtain both quantitative and qualitative data regarding each of the Open Internet disclosers to be examined.

Table 2. Questions to compare and analyze BAP's Open Internet disclosures

Accessibility
1. Number of links needed to access Open Internet disclosures.
2. Additional links included in the Open Internet disclosures to gather information.
3. Are links for Open Internet disclosures located where the broadband plan offers are?
Congestion Management Practices (CMP)
4. Does the BAP implement CMP?
5. If yes, what type of practice is used? ▪ Best effort ▪ Prioritization ▪ Throttling ▪ Other ▪ No information
6. If yes, what type of traffic is managed? ▪ Traffic agnostic ▪ Real time traffic or browsing, email, instant messaging, gaming and VoIP traffic ▪ No information
7. If yes, are practices used only during congestion periods?
8. If yes, are congestion thresholds that trigger management practices disclosed?
9. If yes, what are these thresholds?
10. If yes, do practices apply to: ▪ All users ▪ High traffic users ▪ No information
11. If practices apply to high traffic users, are thresholds to identify these users disclosed?
12. If yes, does the BAP disclose the effects on the end user experience due to CMP? ▪ Traffic delays ▪ Lower throughput ▪ No information
13. Are congestion periods specifically disclosed?
14. Does the BAP impose usage limits/caps?
15. If yes, what is the usage limit/cap?
16. Once the limit/cap is reached what actions are imposed by the BAP? ▪ Additional fee for additional capacity (*e.g.*, $10 per additional 50 GB)

▪ Reduce broadband speed ▪ No information 17. Are engineering standards referenced? 18. If yes, which standards and for what reason?
Application-specific behavior
19. Does the BAP, based on application, source, destination, protocol, or port, do any of the following : ▪ Block traffic ▪ Prioritize traffic ▪ Degrade traffic 20. If yes, what is the reason? 21. If no, are there exceptions?
Device attachment rules
22. Does the ISP restrict the types of devices that can be connected to the network? 23. If yes, which types of devices are restricted? 24. If no, what additional conditions may be in place? 25. Are there any procedures in place for devices to connect to the network?
Security
26. Does the ISP implement security measures such as blocking spam, malicious content, viruses, DoS, DoSS, phishing, among others? 21. If yes, what kind of traffic/ports are blocked for security reasons?
Specialized services
22. Does the ISP offer specialized services? 23. If yes, does the ISP prioritize its specialized services?

Three groups of BAPs are included in this analysis. The first group includes eleven fixed BAPs from the Measuring Broadband America Report: AT&T, Cablevision, Century Link, Charter, Comcast, Cox, Frontier, and Windstream, which serve over 80% of all fixed broadband access subscribers in the US. The second group includes four major mobile BAPs, AT&T, T-Mobile, Sprint-Nextel, and Verizon. The third group includes twenty-five BAPs that actually had a disclosure from an original random sample from the FCC's Form 477 of forty-nine BAPs.[31] Note that the FCC's transparency rule does not include any exceptions for mass-market retail BAPs from the requirement to disclose Open Internet practices, on the contrary, it requires that both fixed and mobile providers using any technology platform -i.e., wired or wireless, including satellite and terrestrial wireless- to make such disclosures. Nevertheless only 51% of our original random sample of BAPs complied with this obligation.

4. Open Internet disclosures

In this section I analyze the Open Internet disclosures publicly available from each BAP in each of the three groups of BAPs described above. To guide the analysis and compare such disclosures across different BAPs, I use the set of questions presented in section 3. This section is divided in six subsections, each addressing one of the following topics: accessibility,

[31] Annex 1 presents a list of all BAPs included in this paper and the process used to randomly select the sample of BAPs.

congestion management practices, application-specific behavior, device attachment rules, specialized services, and security.

4.1. Accessibility

The FCC's guidance for the Open Internet rules clearly state that for BAPs to comply with the transparency rule, disclosures should be publicly available and easily accessible through a website.[32] However, no standard on how and where those disclosures should be "publicly available" is defined for BAPs to follow. Total flexibility is given by the FCC on how to disclose network management practices and performance characteristics and terms and conditions of broadband offers, except that such disclosures should be accessible through a website.[33]

Thus, even though all four mobile BAPs and eleven fixed BAPs included in the MBA Report comply with the transparency rule requirement by including specific links in their websites that lead to Open Internet disclosures, basically each BAP has its own way of making accessible such disclosures to end users and edge providers.

For instance, the name of the first link in the BAP's home website to access Open Internet disclosures is different across BAPs, *e.g.*, "Legal," "Legal Home," "Corporate, Legal and Regulatory," "Disclosure," etc. In addition, seven fixed BAPs include a second link consumers must follow to finally access such disclosures, *e.g.*, "Policies," and then "Internet Service Disclosures" links. Although the second link uses a name allusive to the Open Internet disclosures, it is interesting to observe the number of different names that are used by different BAPs, *e.g.*, "Open Internet Order," "Network Management Disclosure," "Open Internet Statement and Policy," and "Broadband Internet Service Network Management Policy," to name a few.[34]

In general, except for CenturyLink and Cablevision, BAPs do not make a link to Open Internet disclosures clearly available in their website broadband plan offer, which could be considered a virtual point-of-purchase. Links are mainly at the bottom of the website where other links such as "Privacy Policy," "Site Map," and "Website Terms of Use," are located in small font. Thus, end users that are not aware of the existence of Open Internet disclosures and consequently will not search for them will not be informed of such disclosures.

In Comcast's case, the "Customer Agreement Policy" link that leads to Open Internet disclosures, is below the "My Account" title at the bottom of the home website, which could mislead prospective customers that currently do not have an account with Comcast (see Figure 2). Regarding Verizon Wireless, it is necessary to follow four links before accessing the disclosures: "Support," "Service and Applications," "Mobile Broadband," and finally "Important Information

[32] See footnote 14.
[33] See footnote 3. Par. 59
[34] Annex 2 presents the links leading to the Open Internet disclosures for each BAP.

About Verizon Wireless Broadband Internet Access Services."[35] Although Verizon describes network management practices for its wireless/mobile service, it does not mention that such a description is required to comply with the FCC's Open Internet transparency rule.

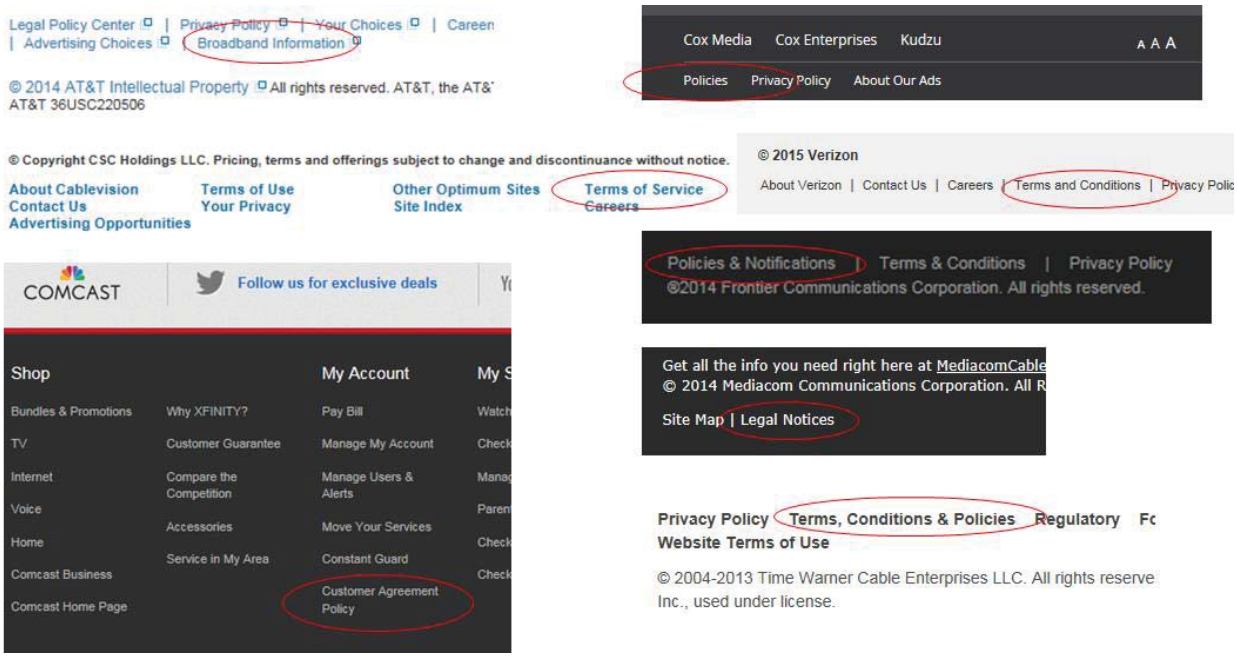


Figure 2. First link to Open Internet disclosures from different BAPs. Clockwise from top left AT&T, Cox, Verizon, Frontier, Mediacom, Time Warner Cable, Comcast, and Cablevision
Source: Websites from BAPs, retrieved between December 2014 and January 2015.

BAPs include on average four additional links from their Open Internet disclosure web page in order to add more information regarding disclosure specific issues such as devices approved to connect to the network, security tools, and port blocking; thus, not all the information is included on a single web page, requiring end users to browse additional web pages.[36]

According to the FCC, effective disclosures should be timely disclosed, revised periodically, and updated accordingly. Five BAPs updated the Open Internet disclosures between June and December 2014, and seven do not include the date of the last update, thus it is not possible to know if such disclosures have been recently modified. Only one BAP, AT&T, has not updated its disclosures since March 2012. In addition, Comcast's PDF file explaining in detail their congestion management practice seems to be from 2008.

Similar complexity is found on the websites of the twenty-five BAPs from the random sample. For 15 (60%) of these BAPs, a sequence of two links is necessary to access Open Internet disclosures. In addition, 17 (68%) BAPs from the sample do not include a link that

[35] For Verizon Wireless, it was necessary to use a search engine to find the Open Internet disclosures. Once disclosures were found using the search engine, I found the link sequence to access the disclosures through Verizon's official website. Fixed and wireless disclosures are different and are located in different Verizon websites.

[36] Annex 2 presents the number of additional links for each BAP.

leads to Open Internet disclosures near the Internet offer on the BAP's website. Thus, it is likely that a consumer seeking broadband service, and not aware of the existence of such disclosures, will not be informed at the website's "point-of-sale."

Once the consumer finds the website or PDF document describing the Open Internet rules, 8 (32%) BAPs in the sample include additional links to other websites with additional information, thus making it more tedious to find all the information the customer needs to know in one single place.

Finally, 14 (56%) of the BAPs in the sample do not indicate the last time the disclosures were updated or revised, and 9 (36%) date their disclosures from 2013 or earlier, even going back to 2010. Only 2 (8%) BAPs from the sample indicate their disclosures were updated during 2014.

In conclusion, there is no prominent and standardized name or logo that consumers can easily identify used as a website link to access Open Internet disclosures. On the contrary, such links are relegated in most cases to the bottom of the home web page and in small font, making it hard for consumers to find. Once the link is found, it is very likely that more links will be necessary to access the disclosures and to gather additional information. In addition, in most cases it is not clear if such disclosures are updated.

4.2. Congestion management practices

BAPs from the Measuring Broadband America (MBA) report

Not all of the BAPs that are included in the MBA report –specifically, Mediacom, Time Warner Cable, and Verizon– use network management practices to solve issues related to congestion. Similarly, several other BAPs like AT&T, CenturyLink, and Cox, which disclose their congestion management practices (CMP), relate such practices to increasing capacity of the network, data plans with caps, or implementing spam detection techniques. These actions, although helpful to mitigate traffic congestion in their networks, are not CMP that deal with congestion issues at the time that such issues take place, *e.g.*, during peak hours. These actions are more related to network improvements that take time to implement, from days to weeks, once congestion patterns are detected, or to security practices that are in place all the time and not solely during congestion periods.

Traffic management practices during congestion periods, *i.e.*, CMPs should refer to actions that BAPs implement to manage traffic more efficiently during the specific time intervals in which congestion occurs, *e.g.*, prioritizing services and applications that are sensitive to delays, throttling certain bandwidth intensive applications or high traffic users, or even not managing traffic at all, *i.e.*, a "best effort" approach. Comcast for example, specifically mentions that data caps "*do not address the issue of network congestion, which results from traffic levels that vary*

from minute to minute."[37] On the contrary, AT&T includes data plans as a mean to address potential network congestion.

Other BAPs, mainly cable providers, use Cisco's Subscriber Management Traffic (SMT) technique to change traffic priority whenever the subscriber exceeds the maximum bandwidth,[38] and also include a fixed maximum amount of bandwidth for peer-to-peer uploading of files during peak hours, although such bandwidth is not specified.

Only four providers disclosed traffic management techniques that are specifically used during congestion periods. The remaining providers either present practices that are used at any time, such as filtering spam or do not specifically tie their CMP to congestion periods.

Most of the BAPs either do not disclose any information regarding the effects on end users' experience due to CMP, or only state that *most* subscribers will not experience any effects or change in their Internet experience. Only Comcast adds some information, limiting the effects of their CMP to high traffic users.

Comcast is the only BAP to clearly describe the threshold to identify high traffic users, *i.e.*, users that use 70% or more of their up/downstream provisioned capacity during a fifteen minute interval. Comcast is also the only provider from the MBA report group to describe the thresholds that trigger CMP, *i.e.*, 70% for upstream and 80% of downstream port utilization during a fifteen minute interval.

Finally, all BAPs in this group who report the use of CMP disclose that they implement usage caps, however, only three include what the specific cap is. The following table summarizes the findings from the subset of BAPs included in the MBA report that disclose CMP.

Table 3. Description of Congestion Management Practices (CMP) from the subset of BAPs included in the MBA report that disclose CMP

	AT&T	Cablevision	CenturyLink	Charter	Comcast	Cox	Frontier	Windstream
CMP used by BAP:								
Best effort							X	
Prioritize traffic		X(1)		X(1)	X			

[37] Comcast Corporation. (2008). *Description of Planned Network Management Practices to be Deployed Following the Termination of Current Practices.* Retrieved December 2014, from http://downloads.comcast.net/docs/Attachment_B_Future_Practices.pdf. Page 2.

[38] According to Cisco, SMT allows BAPs *"to identify and control subscribers who exceed the maximum bandwidth allowed under their registered quality-of-service (QoS) profiles. (…) Subscribers who exceed the maximum bandwidth that is specified by their enforce-rule can be automatically switched to a separate enforced QoS profile that limits their network use for a customizable penalty period. The enforced QoS profile can change the guaranteed bandwidth, priority, or any other aspect of the traffic that the service provider considers an acceptable response to subscribers who violate their service agreements.*" Source: http://www.cisco.com/c/en/us/td/docs/cable/cmts/feature/ubsubmon.html#wp1046952, retrieved December 2014.

	AT&T	Cablevision	CenturyLink	Charter	Comcast	Cox	Frontier	Windstream
Other	X[2]	X[3]	X[2]	X[3]		X[2]		
No information								X
Type of traffic managed by BAP:								
Real time traffic								
Agnostic					X		X	
No information	X	X	X	X		X		X
CMP used only during congestion only	N.I.	Yes	Yes	Yes	Yes	N.I.	N.I.	N.I.
CMP effects on end users' experience:								
Delays					X			
Lower throughput								
Other		X		X				
No information	X		X			X	X	X
Congestion periods disclosed	No	No	Yes[4]	No	No	No[5]	No	No
Thresholds that trigger CMP disclosed	No	No	No	No	Yes[6]	No	No	No
Do CMP apply to:								
All subscribers							X	
High traffic users		X	X		X			
No information	X			X		X		X
Threshold to identify high traffic users	No	No	No	No	Yes[7]	No	No	No
Are engineering standards referenced	No	Yes[8]	No	Yes[8]	No	No	No	No
Usage caps:								
Does BAP use caps?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap specified	No	No	Yes[9]	No	Yes[10]	No	Yes[11]	No
Exceed usage limit consequences	N.I.	Yes[12]	Yes[13]	N.I.	N.I.	N.I.	Yes[14]	N.I.

[1] STM and fixed maximum bandwidth for peer-to-peer upload. See footnote 38 for STM description.
[2] Add capacity to the network, plans with data caps, and/or spam detection techniques.
[3] Automated processes to more evenly distribute the available bandwidth.
[4] Weekdays 7 to 11 p.m.
[5] Does mention that it is more likely to occur during peak hours in the evening.
[6] Upstream ≥ 70% port utilization, downstream ≥ 80% port utilization during a 15 minute interval.
[7] Exceed 70% of subscriber's provisioned upstream or downstream bandwidth during 15 minutes interval.
[8] STM
[9] Download usage limits 150 GB and 250 GB
[10] 250 GB
[11] 100 GB and 250 GB per month
[12] Limit bandwidth
[13] Subscriber upgrade to higher speed plan
[14] Advised subscriber of limit usage and/or upgrade to a higher speed plan
N.I.: No information.
Source: Disclosures from BAPs.

Major mobile BAPs

Three of the four major mobile BAPs –AT&T, T-Mobile, and Sprint- clearly disclose that they do implement CMP, either prioritizing or throttling traffic during congestion periods. Verizon does not specifically use the term CMP, although it does disclose management practices it follows when a cell site is "experiencing high demand".

For all the major mobile BAPs, CMP apply to high traffic users that exceed certain data caps, *e.g.*, 3 or 5 GB in a billing cycle, or customers within the top 3 or 5% of data usage,

therefore CMP apply during the following billing period once the caps are exceeded. If the customer continues to exceed the cap, it will continue to be subject to CMP in subsequent monthly billing periods, and will also be advised to change to a higher tier plan.

Mobile BAPs also disclosed the end user's experience due to CMP, mainly lower throughput or speed compared to non-congested sites. Sprint prioritizes depending on the plan or device acquired by the customer, *e.g.*, customers with higher priority plans or devices are given additional network resources at the expense of lower priority customers who experience throughput limitations, only during congestion periods.

Mobile BAPs include additional management practices for delay sensitive applications, *e.g.*, video, gaming, web browsing, voice, etc. Technologies used include Video Delivery Synchronization to deliver video just in time to the mobile device, Quality Aware Transconding, which optimizes according to the bandwidth available to the user, Video Transconding, optimizing video according to the mobile device used, and Intelligent Caching to reduce delays.

Table 4. Description of Congestion Management Practices (CMP) of the four major mobile BAPs

	AT&T	Sprint	T-Mobile	Verizon
CMP used by BAP:				
Prioritize / Throttling traffic	X	X	X	
No information				X[(1)]
Type of traffic managed by BAP: Real time traffic				
Agnostic	X		X	X
No information		X		
CMP used only during congestion only	Yes	Yes	Yes	Yes
CMP effects on end users' experience: Delays				
Lower throughput	X	X	X	X
Other				
No information				
Congestion periods disclosed	No	No	No	No
Thresholds that trigger CMP	No	No	No	No
Do CMP apply to: All subscribers				
High traffic users	X	X	X	X
No information				
Threshold to identify high traffic users	Yes[(2)]	Yes[(3)]	Yes[(4)]	Yes[(5)]
Are engineering standards referenced	No [(6)]	Yes[(7)]	No	No [(8)]
Usage caps: Does BAP use caps?	Yes	N.I.	Yes	N.I.
Cap specified	Yes[(9)]		Yes[(10)]	
Exceed usage limit consequences	N.I.		N.I.	

[(1)] Verizon does not use the term CMP, however, it does mention the effects on the user's experience due to management practices when a "(…) cell site experiencing high demand."
[(2)] 3GB data cap for 3G or 4G smartphones, and 5 GB data cap for 4G LTE smartphones during a billing period for unlimited plans.
[(3)] Top 5% of data users are prioritize below other users on a monthly basis.
[(4)] Top 3% of data users are prioritize below other users on a monthly basis.
[(5)] For 3G devices on an unlimited plan, users within the 5% of data users will have lower data throughputs during the following billing cycle.
[(6)] No engineering standards are referenced for CMP during congestion periods, however video optimization techniques such as Buffer Tuning are implemented during and peak and non-peak hours.
[(7)] Optimization techniques are used during peak and non-peak hours for video and web browsing, *e.g.*, Video Delivery Synchronization, Quality Aware Transcoding, Video Transcoding, Intelligent Caching, Cashing, Text/Binary Compression, and Image Compression. During congestion periods, the proportional fairness scheduler algorithm is used to allocate network resources.

[8] No engineering standards are referenced for CMP, however video optimization techniques such as Buffer Tuning are implemented during and peak and non-peak hours.
[9] Varies depending on the speed plan
[10] Varies depending on the speed plan.
N.I.: No information.
Source: Disclosures from BAPs.

Given that radio channel throughput in a mobile cell varies dynamically due to signal fading and the location of end users within the cell, a maximum throughput at any instant is difficult to define. Not surprisingly, mobile BAPs do not disclose percent utilization thresholds that trigger CMP.

Random sample of BAPs from the FCC's Form 477

From the BAPs that published Open Internet disclosures, 18 (72%) clearly state they have CMP, while the remaining 7 (28%) indicate they do not manage traffic during congestion periods. However, 4 BAPs -22% of the 18 BAPs that use CMP-, claim to use "best effort" during congestion periods, which is equivalent to not managing traffic. Other BAPs use more than one type of network management practice, *e.g*, in addition to prioritization or throttling traffic, they include under CMP management practices security issues (such as identifying spam, viruses, and malicious traffic), or normal expansion of the network, (adding capacity to the network when needed). Figure 2 shows the percentage of BAPs that mention use of each technique. Practices related to the prevention of spam, viruses and malicious traffic are not included because all BAPs implement such measures, whether or not they use CMPs.

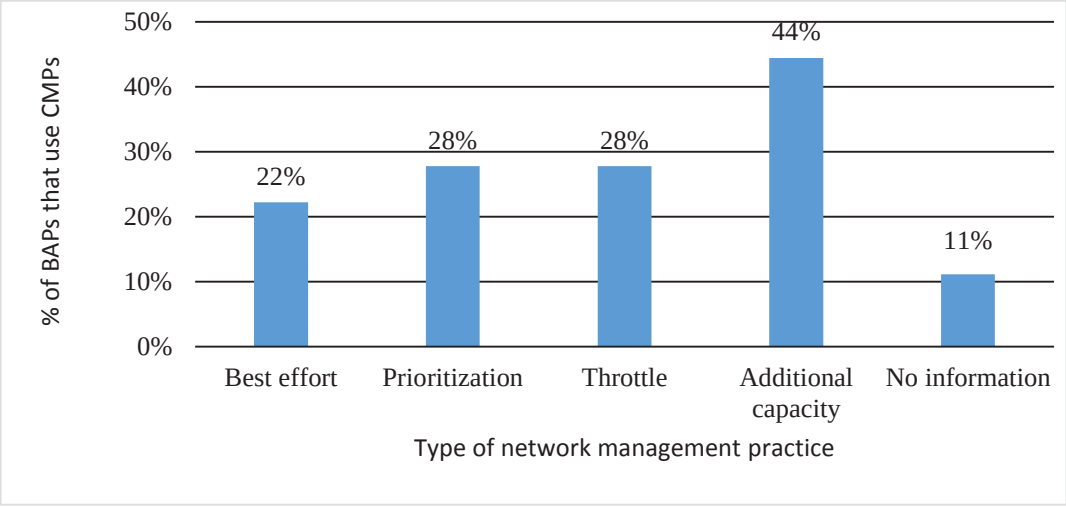


Figure 3. Percentage of BAPs that use each type of network management practice. BAPs may use more than one
Source: Disclosures from BAPs included in the random sample.

Although 72% of BAPs use CMPs, 11% did not mentioned any additional information regarding which type of technique they used. In addition, 67% specify that their CMPs are

content and application agnostic, while, 17% give priority to time sensitive applications such as browsing, streaming, instant messaging, VoIP, video, and gaming, among others.

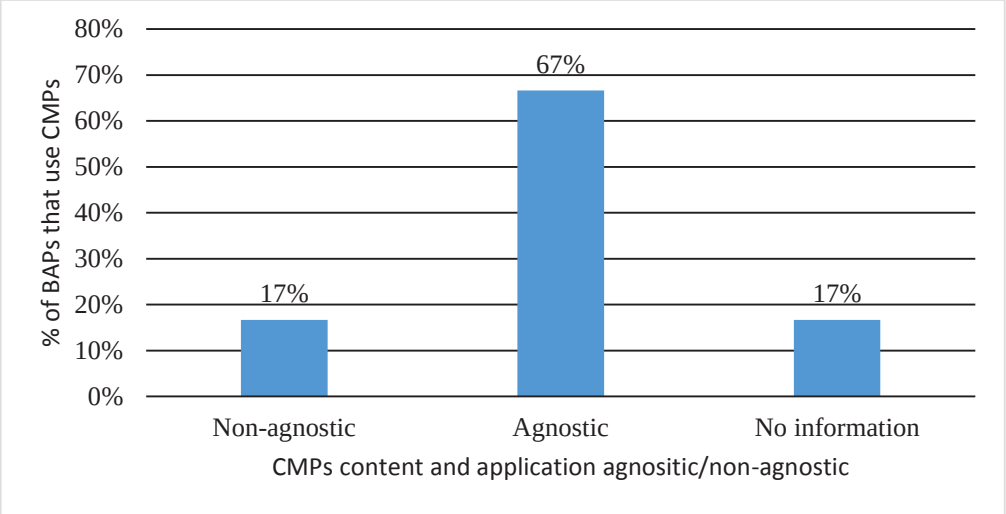


Figure 4. Percentage of BAPs that implement content and application agnostic CMPs
Source: Disclosures from BAPs included in the random sample.

Half of the 18 BAPs from the random sample that implement CMP, apply these practices only to high traffic users. Fifteen wired BAPs only state that high traffic users will be subject to CMP but do not disclose what the threshold to classify high traffic users are. The sample includes three wireless providers: one each of a fixed wireless provider, a mobile provider and a satellite provider. All of these report thresholds at which they implement CMP.

Table 5. Thresholds for wireless BAPs for different technologies and plans, and consequences of exceeding such thresholds

Wireless technology	Plan offer	Thresholds	Consequences of exceeding thresholds
Fixed terrestrial wireless	Plan 1	Up to 500 MB per day	Normal speed: 15 Mbps
		Above 500 MB per day	Reduced speed: 7 Mbps
		Above 6 GB per day	Reduced speed: 4 Mbps
Mobile access	Plan 1 Plan 2	Above 10 GB per month Above 15 GB per month	Throttling Throttling
Satellite	Plan 1 Plan 2 Plan 3	Above 30 MB in 30 min Above 45 MB in 30 min Above 67.5 MB in 30 min	Reduced priority

Source: Disclosures from BAPs included in the random sample.

Half of the 18 BAPs disclose the CMP's effects on end users' experience, mainly lower throughput and delays to access content and applications. The three wireless providers with thresholds indicate they provide notifications to the end user once their data consumption is over or near the threshold.

Congestion management practices are only used during congestion periods by 14 (78%) of the 18 BAPs that do implement such practices. Three (17%) do not inform if CMPs are present all the time or only during congestion periods, and one mobile BAP (6%) implements CMPs in both, peak and off-peak hours.[39]

Four (29%) of the 14 BAPs that indicate they engage in CMP during periods of congestion, identify particular periods of the day as "congested" based on historical experience, and indicate they apply CMP throughout the period, independent of actual minute-to-minute traffic.

Table 6. Congestion periods disclosed

Hours	Days
7:00 – 11:00 p.m.	Every day, but especially on Friday and Saturday nights, and holidays
4:00 – 11:00 p.m. 10:00 a.m. – 11:00 p.m.	Weekdays Weekends
6:00 p.m. – 1:00 a.m.	No information
5:00 – 10:30 p.m.	No information

Source: Disclosures from BAPs included in the random sample.

While not a CMP narrowly defined, two BAPs describe the congestion thresholds on a link, which, if exceeded on a regular basis, will lead the operator to invest in additional capacity.[40]

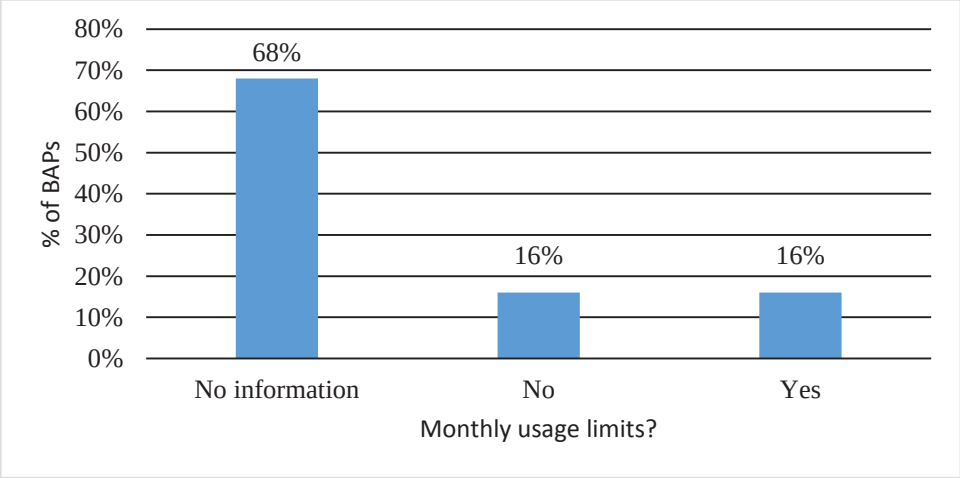


Figure 5. Percentage of BAPs that include monthly usage limits
Source: Disclosures from BAPs included in the random sample.

[39] nTelos, Inc. throttles download speeds after the usage cap is exceeded. At the beginning of each billing cycle, data speeds are reset to the normal levels until caps are exceeded again.

[40] Consistently exceeding 75% of maximum capacity at a node for one BAP, and when peak utilization has reached 65% on a point-to-point link for the other BAP.

Seventeen BAPs from the random sample of 25, (68%), do not include information regarding monthly usage limits. Four (16%) disclose volume caps: three wireless providers and one cable provider, and the remaining four disclose not to implement monthly limits. Table 7 presents the different monthly usage limits for a given access technology for each of the BAPs that disclose volume caps.

Table 7. Monthly usage limits for different technologies and consequences of exceeding such limits

Wireless technology	Monthly usage limit	Consequences of exceeding thresholds
Fixed wired – cable	200 to 500 GB	$10 per additional 50 GB
Fixed wireless	150 to 250 GB	$2 per additional 10 GB
Mobile	10 to 15 GB	Advice to upgrade plan and lower throughput
Satellite	Different for each plan	Speeds and/or access is curtailed

Source: Disclosures from BAPs included in the random sample.

Finally, none of the BAPs included in the random sample referenced engineering standards.

4.3. Application-specific behavior

Almost all 40 BAPs, mobile and fixed, except a few that use wireless technologies, indicate they do not block, prioritize or degrade applications, services or content. However some exceptions are included in all disclosures, *e.g.*, unlawful traffic, traffic harmful to the network, security threats, reasonable network management, and when ordered by law enforcement agencies, BAPs may apply application specific behavior.

There is only one satellite BAP that disclosed prioritizing applications according to their sensitivity to delay, *e.g.*, first priority is given to Internet browsing and video streaming applications, second priority is given to email, FTP, and similar applications, and the lowest priority is given to software updates, large file transfers, and similar applications.

One fixed wireless BAP disclosed it blocks Windows Net Neighborhood SMB ports without any explanation. Regarding prioritization, mobile BAPs do not disclose if they managed traffic based on content. However, some do disclose prioritizing based on access plans and devices.

4.4. Device attachment rules

BAPs from the Measuring Broadband America (MBA) report

All BAPs from the MBA report do not restrict types of devices that can be connected to the network as long as such devices do not harm the network or violate the Acceptable Use Policy, AUP. Cable providers require that the modem should comply with the CableLabs, FCC, and Underwriters Laboratory Certifications, in addition to the provider's testing. A list with approved devices is disclosed by cable providers.

One provider, includes procedures to approve devices to connect to the network. Other providers using DSL and FTTH charge a fee if the customer needs assistance in the installation of third-party devices. Generally, the BAP does not give technical support for non-certified modems.

Major mobile BAPs

Two of the BAPs, Sprint and Verizon, require certified or approved devices by them to connect to the network. T-Mobile allows any GSM, UMTS or LTE device to connect to the network as long as such device is not harmful. Finally AT&T allows only FCC approved devices not harmful to the network, 2G devices are forbidden.

Random sample of BAPs from the FCC's Form 477

Six of these of 25 BAPs disclose no information regarding device attachment. Fourteen (56%) indicate no restrictions on devices that can be connected to the network. Five BAPs clearly state that they do restrict devices that can be connected to the network, such devices, mainly modems, should either be approved by the BAP or provided directly by them. One mobile BAP discloses that only handsets provided or approved by them can be connected to their network.

Different BAPs seem to define "network" differently. For some, the network ends on the subscriber side of a network provided modem or termination unit. For these BAPs "device" means a home router, computer, tablet, mobile device, and game console, among others, that is connected to the BAPs modem on the subscriber side. For others, the network ends on the network side of the modem, and so a "device" might mean a third-party provided modem. For these the end user may connect a third-party modem to their network as long as it is a certified and approved modem by the BAP.

4.5. Specialized Services

BAPs from the Measuring Broadband America (MBA) report

Some BAPs disclose offering "specialized services," *e.g.*, TV or voice services over the same network as the broadband Internet service, even though they state that the FCC has not defined this term. Other BAPs, either do not disclose any information or disclose that they do not offered specialized services.

Providers are inconsistent in their understanding of what is a specialized service. Time Warner acknowledges providing a specialized service for its VoIP offering, while Comcast denies that it is providing any specialized service, despite its provision of IP-based Comcast Digital Phone service, which shares bandwidth at the physical layer with Comcast's Internet service.

Several BAPs do not disclose any information regarding specialized services, although some offer TV and voice services in addition to broadband Internet access. Finally, none of the BAPs

disclose if they prioritize the specialized services offered, though it is well understood that virtually all broadband access technologies provide support for capacity allocation or prioritization at the link level for individual service flows[41].

Table 8. Specialized services offered by BAPs.

	AT&T	Cablevision	CenturyLink	Charter	Comcast	Cox	Frontier	Mediacom	Time Warner Cable	Verizon	Windstream
Specialized services											
BAP offers specialized services	N.I.	Yes(1)	N.I.	N.I.	No(2)	N.I.	No	N.I.	Yes(3)	Yes(4)	Yes(5)
Are specialized services prioritized	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Yes	Yes

(1) Voice services share capacity with broadband Internet access services.
(2) TV and voice services are offered, however, the BAP argues that these services are not specialized services according to the FCC's definition. TV and voice services are designed to not affect the performance of Internet services.
(3) Video and voice services, among other services, that may be defined as specialized services are provided, however, the BAP argues that the provision of such services does not impact negatively the broadband Internet services.
(4) The fiber network, FiOS, also provides TV and voice services. According to Verizon, the capacity available for Internet access may be reduced if multiple TV on-demand videos are watched.
(5) Virtual private networks, VPN, video, or voice services are used, less bandwidth is available for broadband Internet access services.
N.I.: No information.
Source: Disclosures from BAPs.

Major mobile BAPs

Mobile BAPs do not include any information related to specialized services in their Open Internet disclosures. However, Sprint does disclose that its labeled products such as Sprint Football Live or NASCAR Sprint Cup do not have precedence over other applications and are treated like any other data application, including during congestion periods.

Random sample of BAPs from the FCC's Form 477

Most of BAPs from the random sample, 15 (60%), do not disclose any information regarding specialized services. Only 8 (32%) disclosed offering specialized services and 2 (8%) disclosed they do not offer such services.

[41] FCC Technological Advisory Council. (2014). *Supporting the Transition to IP Reference Architecture for Future Broadband Networks.* Retrieved February 2015, from http://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting12414/Transition-to-IP-Addendum-Reference-Architecture-for-Future-Broadband-Network.pptx.

Of the 8 BAPs who disclosed offering specialized services, only 2 (25%) specifically disclosed prioritizing a specialized services such as video, either all the time or during congestion periods.

4.6. Security

BAPs from the Measuring Broadband America (MBA) report

All BAPs disclose implementing security measures to protect their network. All of them use techniques to filter or block spam, viruses, worms, Denial of Service, DoS, or Distributed Denial of Service, DDoS, attacks, malicious traffic, etc. However, there is a wide difference regarding the ports that are blocked, *i.e.*, some BAPs do not specify any ports which may be blocked for security reasons, while others include a complete list of several ports.

Table 9. Security measures implemented by BAPs.

	AT&T	Cablevision	CenturyLink	Charter	Comcast	Cox	Frontier	Mediacom	Time Warner Cable	Verizon	Windstream
Security											
Does the BAP implement security measures	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DoS/DDoS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N.I.	Yes
Virus and spam protection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N.I.	Yes
Block ports	Yes[(1)]	Yes[(2)]	Yes[(3)]	Yes[(4)]	Yes[(5)]	Yes[(6)]	N.I.	N.I.	Yes[(7)]	Yes[(8)]	N.I.
Phishing	N.I.	N.I.	Yes	N.I	Yes	Yes	Yes	N.I.	Yes	N.I.	N.I.

[(1)] Port 25.
[(2)] Does not specify which ports.
[(3)] Port 25.
[(4)] Does not specify which ports.
[(5)] Ports 0, 25, 68, 135, 139, 161, 162, 445, 520, and 1080.
[(6)] Ports 25, 80, 135, 136, 139, 445, 1433, 1434, and 1900.
[(7)] Does not specify which ports.
[(8)] Port 25.
N.I.: No information.
Source: Disclosures from BAPs included in the random sample.

Major mobile BAPs

Similar to fixed BAPs, all mobile BAPs disclose implementing security techniques to block spam, viruses, malicious traffic, etc., including DoS/DDoS. AT&T specifically discloses blocking port 25. T-Mobile discloses that it blocks ports but does not specify which ones. The other two mobile BAPs do not disclose any port blocking.

Random sample of BAPs from the FCC's Form 477

All BAPs from the random sample disclose implementing security measures to block spam, viruses, worms, and malicious traffic. Only two BAPs disclose the specific port numbers they block, and two others discloses blocking harmful or hostile ports without specifying any particular port numbers. Finally, 8 (36%) of BAPs disclose they take measures to respond to DoS/DDoS attacks

5. Conclusions

I have examined websites of all major wired and wireless Internet Service Providers and a random sample of 59 other ISPs for the disclosures required by the FCC's Open Internet order, requirements which remain in force even after the recent appellate court decision vacating parts of the order.

All major providers had some level of disclosure, but 49% of the random sample had none. Of those websites with disclosures none included all of the elements of the FCC's "effective disclosure model." For example, disclosures rarely include information on specific thresholds that triggered congestion management practices, though such thresholds are specifically identified as a component of an effective disclosure.

Disclosures are difficult to access. Most disclosures' links are in small font at the bottom of the BAP's home website, included under vague headings, and typically it is necessary to follow more than one link to reach them. In addition, given the lack of standardization, Open Internet disclosures have many different link names that may confuse the end user.

Practices disclosed by some BAPs may go unmentioned by others, leaving the consumer confused as to whether the lack of mention means the practice is not used by a particular provider, or was merely left out.

BAPs give different meaning to the constructs suggested by the FCC for inclusion in a disclosure. For example, for some BAPs increasing capacity and data caps qualify as congestion management practices (CMP), for others they do not. For some BAPs a modem or termination unit is viewed as part of the "network," so that device attachment rules refer to devices attached on the customer side of the modem. For others, device attachment refers to the use of customer provided modems.

BAPs are inconsistent in their disclosure of specialized services and their impact. TWC describes its VoIP offering as a specialized service, while Comcast, which offers VoIP in a comparable manner, declares it offers no specialized service. Verizon and Windstream acknowledge that video or video on demand is prioritized over Internet service, while AT&T, whose U-verse video shares xDSL link capacity with Internet access, makes no such acknowledgement.

Mobile and wireless BAPs tend to describe in more detail their CMP and the effects on the users' experience, than do fixed BAPs, Fixed BAPs do not clearly disclose the effects on the end

user due to CMP, nor the likelihood that such CMP will affect all or a fraction of consumers. All BAPs disclose the use of volume caps, however only a few specify the actual cap limits.

It is difficult to make comparisons across providers. This arises from the failure of some providers to disclose at all; because BAPs do not disclose the same information or with the same level of specificity; because they do not disclose how a practice will affect the user's experience; and because they apply different interpretations to key terms in their disclosures. The lack of comparability makes it difficult to understand how network management practices should influence the purchase decision.

6. Annex 1: Broadband Access Providers

Section A shows all BAPs from the Measuring Broadband America 2014 Report, except Qwest which was acquired by CenturyLink, and ViaSat/Exede.[42] Section B shows the four major mobile BAPs, and Section C shows the forty-nine BAPs randomly selected from the FCC's Form 477. For each BAP, information regarding technology, states covered, population covered, and source of open Internet disclosures is included. Websites to retrieve Open Internet disclosures were accessed during the months of December 2014 and January 2015.

Section A. Fixed BAPs from the Measuring Broadband America Report

#	Internet Service Provider	Technology*	States Covered*	Population Covered* (millions)	Open Internet Disclosures Source
1	AT&T	DSL; Fiber to the Node	53	312	http://www.att.com/gen/public-affairs?pid=20879
2	CenturyLink, Inc.	DSL	36	50	http://www.centurylink.com/Pages/AboutUs/Legal/InternetServiceManagement/
3	Charter Communications	Cable	29	29	https://www.charter.com/browse/content/network
4	Comcast Corporation	Cable	40	113	http://www.comcast.com/Corporate/Customers/Policies/Policies.aspx
5	Cox Communications, Inc.	Cable	18	22	http://www.cox.com/aboutus/policies/internet-service-disclosure.cox
6	CSC Holdings LLC – Cablevision	Cable	CT, NJ, NY, PA	13	https://www.optimum.net/pages/Terms/Internet/Open-Internet-Disclosure.html
7	Frontier Communications Corporation	DSL; Fiber to the Node	29	18	http://frontier.com/networkmanagement
8	Mediacom Communications Corporation	Cable	21	7	https://mediacomcable.com/site/legal.html
9	Time Warner Corporation, Inc.	Cable	29	67	http://help.twcable.com/description_of_network_management_practices.html
10	Verizon Communications, Inc.	DSL; Fiber	51	310	http://www.verizon.com/about/terms/networkmanagementguide/
11	Windstream Corporation	Cable	23	11	http://www.windstream.com/SiteSelector.aspx (link: Windstream Broadband Network Statement)

* Source: Broadband Map, www.broadbandmap.gov/about-provider.

[42] Source: http://www.fcc.gov/reports/measuring-broadband-america-2014.

Section B. Four major mobile BAPs

#	Internet Service Provider	States Covered	Population Coverage* (millions)	Open Internet Disclosures Source
1	AT&T	53	312	http://www.att.com/gen/public-affairs?pid=20879
2	Sprint Nextel Corporation	51	282	http://www.sprint.com/legal/open_internet_information.html
3	T-Mobile	46	246	http://www.t-mobile.com/Company/CompanyInfo.aspx?tp=Abt_Tab_ConsumerInfo&tsp=Abt_Sub_InternetServices
4	Verizon	51	310	http://www.verizonwireless.com/support/broadband-services/

* Source: Broadband Map, www.broadbandmap.gov/about-provider.

Section C. Random sample of BAPs from the FCC Form 477

From the FCC Form 477 we selected a random sample of 80 BAPs from a list of more than five thousand BAPs by state. After eliminating BAPs already included in the first two groups, *i.e.*, BAPs from the Measuring Broadband America report and the four major mobile BAPs, and eliminating repeated BAPs or BAPs that do not offer mass-market services as defined by the FCC's Open Internet rules, we ended up with 49 BAPs randomly selected BAPs that must comply with the Open Internet rules. These BAPs are listed below.

#	Internet Service Provider	Technology*	States Covered*	Population Coverage* (thousands)	Open Internet Disclosures Source
1	Access One, Inc.	No information	NJ	40	Open Internet disclosures not available
2	Armstrong Telephone Company-North	Cable	6 states	1,006	http://armstrongonewire.com/policies/openinternetpolicy.pdf
3	ATG Communications, LLC	Fixed wireless	GA	306	Open Internet disclosures not available
4	Atlantic Broadband (Delmar), LLC – Cogeco Cable Inc.	Cable; Fiber	6 states	920	http://atlanticbb.com/sites/default/files/tiny_mce/files/Atlantic_Broadband_Network_Management_Disclosure_12-4-2013.pdf
5	Axxis Communications Inc.	DSL**	OR, WA	53	Open Internet disclosures not available
6	Border to Border Communications, Inc.	DSL; Fiber; Fixed wireless**	TX	15	http://www.border2border.com/net-neutrality-statement.htm
7	Bulloch County Rural Telephone Cooperative, Inc.	Fiber**	GA	41	Open Internet disclosures not available
8	C-M-L Telephone Cooperative Association	Fiber**	IA	2	http://www.cmltelephone.com/images/NetworkManagementPolicy.pdf
9	Coaxial Cable TV Corporation	Cable	PA	19	Open Internet disclosures not available

#	Internet Service Provider	Technology*	States Covered*	Population Coverage* (thousands)	Open Internet Disclosures Source
10	Digis LLC – JAB Wireless, Inc.	Fixed wireless	10 states	21,402	http://www.digis.net/legal/open-internet-statement-and-policy/
11	Farmers Mutual Telephone Company of Stanton, Iowa	DSL**	IA	4	http://home.myfmtc.com/images/stories/forms/network_mgmt_policy.pdf
12	Glenwood Telephone Company	DSL**	GA	2	http://www2.gtconline.com/wp-content/uploads/2012/05/Open-Internet-Order-Disclosure.pdf
13	Got Sky Unlimited – Plumas-Sierra Rural Electric Cooperative	Fiber; Satellite; Fixed wireless	CA	9	http://www.plumassierratelecommunications.com/docs/PST_nmp.pdf
14	Gunnison Telephone Company	DSL	UT	6	Open Internet disclosures not available
15	Hiawatha Broadband Communications Inc.	Cable; Fiber to the Home	MN	96	http://www.hbci.com/wp-content/uploads/2013/12/040513broadbandinetservicedisclosureweb.pdf
16	Hill Country Telephone Cooperative, Inc.	DSL; Fiber**	TX	79	http://www.hctc.net/upload/pdfs/Hill%20Country%20Net%20Neutrality%2011%2017%2011.pdf
17	Inventive Wireless of Nebraska, LLC	Fixed wireless**	CO, NE, WY	209	Open Internet disclosures not available
18	Jefferson Communications, LLC – Long Lines	DSL; Cable**	IA, NE, SD	52	http://www.longlines.com/networkmanagement/index.php
19	Logix Communications, LP	Fiber**	OK, TX**	No information	Open Internet disclosures not available
20	Lonsdale Telephone Company	No information	MN	9	Open Internet disclosures not available
21	LTD Broadband LLC	Fixed wireless**	IA, MN	31	Open Internet disclosures not available
22	Mid Century Telephone Cooperative, Inc.	No information	IL	10	http://www.midcentury.com/corporate-legal-regulatory/network-management-acceptable-use-policy/
23	MoKan Dial, Inc.	DSL**	7 states	61	Open Internet disclosures not available
24	Multi-Path Networks Inc.	Fixed wireless**	AL	12	Open Internet disclosures not available
25	Northeast Iowa Telephone Company	DSL; Fiber; Fixed wireless**	IA	45	http://www.neitel.com/legal/netmanage.pdf
26	Northern Telephone Cooperative, Inc.	DSL**	MT	8	http://www.northerntel.net/services/Resources/Northern%20Net%20Mgmt.pdf
27	Northland Cable Ventures LLC – Northland	Cable	8 states	698	http://www.yournorthland.com/legal/Broadband%20Internet%20Services%20Network%20Management%20Policy_022013.pdf

#	Internet Service Provider	Technology*	States Covered*	Population Coverage* (thousands)	Open Internet Disclosures Source
	Communications Corp.				
28	nTelos Telephone Inc. – nTelos, Inc.	DSL; Mobile	KY, MD, VA, WV	2,690	http://www.ntelos.com/open-internet-transparency-disclosure-information
29	NTInet, inc	Fixed wireless**	SC	84	http://www.ntinet.com/about/legal
30	Orwell Telephone Company – Fairpoint Communications, Inc.	DSL	17 states	3,073	Open Internet disclosures not available
31	Oxford Telephone and Telegraph now Oxford Networks	No information	ME	18	http://oxfordnetworks.com/pdf/NetworkManagementPolicy.pdf
32	Palo Cooperative Telephone Association	DSL**	IA	2	http://www.gopcta.com/images/NetworkManagementPolicies.pdf
33	PUD No 1 of Chelan County	Fiber**	WA	65	Open Internet disclosures not available
34	Sacred Wind Communications Inc.	No information	NM	120	Open Internet disclosures not available
35	Santa Rosa Telephone Cooperative, Inc.	No information	OK, TX	33	Open Internet disclosures not available
36	Shenandoah Cable Television, LLC – Shenandoah Telecommunications Company	Cable; Mobile**	MD, VA, WV	689	https://www.shentel.com/legal/open_internet_disclosure
37	Shrewsbury Community Cablevision	Cable**	MA	37	Open Internet disclosures not available
38	Sierra Communications – Baca Valley Telephone Company, Inc.	DSL**	NM	7	http://www.bacavalley.com/legal/network-policy.htm
39	Smart City Telecommunications LLC – Smart City Finance, LLC	DSL**	FL	19	Open Internet disclosures not available
40	Spanish Fork City	Cable**	UT	39	Open Internet disclosures not available
41	SpeedConnect LLC	Fixed wireless; Mobile	ID, MT, NE, SD	889	Open Internet disclosures not available
42	Tidewater Telecom, Inc. – Lincolnville Telephone Company	DSL**	ME	18	Open Internet disclosures not available
43	Warwick Telephone Company now Alteva, Inc.	No information	NJ, NY	104	http://www.warwick.net/residential-products/internet/open-internet-order

#	Internet Service Provider	Technology*	States Covered*	Population Coverage* (thousands)	Open Internet Disclosures Source
44	WaveDivision Holdings, LLC	Cable	CA, OR, WA	1,043	Open Internet disclosures not available
45	Wavelinx – Terral Telephone Company	No information	OK	37	Open Internet disclosures not available
46	WildBlue Communications, Inc.	No information	No information	No information	http://www.wildblue.com/downloads/master/network-management-policy.pdf
47	WDT World Discount Telecommunications Co., Inc.	DSL	No information	No information	Open Internet disclosures not available
48	XO Communications, LLC – XO Holdings, Inc.	Fiber	12 states	655	http://www.xo.com/legal-and-privacy/public-policy/internet-transparency-disclosures/
49	Zayo Group, LLC	Fiber	16 states	1,912	http://www.zayo.com/images/uploads/resources/Policies/Network_Openness_Policy.pdf

* Source: Broadband Map, www.broadbandmap.gov/about-provider.
** Source: BAPs website.

7. Annex 2: Web page links leading to Open Internet disclosures

This annex shows the different Web page links needed to access the Open Internet disclosures' Web page. In addition, it shows the number of Web links included in the Open Internet disclosures Web page that lead to additional information necessary to fully understand the disclosures. Finally, the last date in which the Open Internet disclosures were updated for each BAP is also included.

Section A. Fixed BAPs from the Measuring Broadband America Report

#	Broadband access provider	First link	Second link	Additional web pages	Last update
1	AT&T	Broadband Information	(not necessary)	4	03/2012
2	Cablevision	Terms of Service	Cablevision's Open Internet Disclosures Statement	5	06/2014
3	CenturyLink	Internet Management Disclosures	(not necessary)(1)	10	No information
4	Charter	Terms of Service/Policies	Network Management Practices	2	No information
5	Comcast	Customer Agreement Policy	(not necessary) (2)	7	09/2014 2008(3)
6	Cox	Policies	Internet Service Disclosures	5	12/2014
7	Frontier	Policies & Notifications	Network Management Policy	0	No information
8	Mediacom	Legal Notices	FCC Disclosures	3	No information

#	Broadband access provider	First link	Second link	Additional web pages	Last update
9	Time Warner Cable	Terms, Conditions & Policies	Network Management Disclosures	2	09/2014
10	Verizon[4]	Terms and Conditions	Network Management Guide for Broadband Internet Access Services	6	No information
11	Windstream	Broadband Network Statement	(not necessary)	1	06/2014

[1] "Internet Management Disclosures" link also available at the high speed Internet website offer.
[2] For additional information on Comcast's network management practices follow the link "Network Management Information Center", and then the link "More questions? View our Network Management FAQs".
[3] Comcast's disclosures include a detail pdf document, "Description of Planned Network Management Practices to be Deployed Following the Termination of Current Practices." This document was released in 2008 according to the section IV. Conclusion on page 15.
[4] The "Network Management Guide for Broadband Internet Access Services" link is also accessible from the home website through the "High-Speed Internet (DSL)" link, and then under the "Reliable Network" title.

Section B. Four major mobile BAPs

#	Broadband access provider	First link	Second link	Additional websites	Last update
1	AT&T	Broadband information	(not necessary)	4	03/2012
2	Sprint Nextel Corporation	Legal	Open Internet Information	2	No information
3	T-Mobile	Open Internet	(not necessary)	2	No information
4	Verizon Wireless[1]	Three initial links: 1. Support 2. Service and Applications 3. Mobile Broadband	Final link: Important Information About Verizon Wireless Broadband Internet Access Services	4	No information

[1] To access Verizon Wireless' network management practices four links must be followed.

Section C. Random BAPs from the FCC Form 477

#	Broadband access provider	First link	Second link	Additional websites	Last update
1	Armstrong Telephone Company-North	Open Internet Policy	(not necessary)	0	07/2014
2	Atlantic Broadband (Delmar), LLC – Cogeco Cable Inc.	Legal	Network Management Disclosure	3	12/2013
3	Border to Border Communications, Inc.	Internet Service – Net Neutrality Statement	(not necessary)	1	No information
4	C-M-L Telephone Cooperative Association	Internet Services	Network Management Policy	0	No information
5	Digis LLC – JAB Wireless, Inc.	Legal	Open Internet Statement and Policy	1	12/2011
6	Farmers Mutual Telephone Company of Stanton, Iowa	Internet – Network Management Policy	(not necessary)	0	No information

#	Broadband access provider	First link	Second link	Additional websites	Last update
7	Glenwood Telephone Company	Disclosure	(not necessary)	0	No information
8	Got Sky Unlimited – Plumas-Sierra Rural Electric Company	Satellite	Network Management Policy	0	01/2013
9	Hiawatha Broadband Communications, Inc.	Net Neutrality	(not necessary) Link on the Internet offer	3	07/2012
10	Hill Country Telephone Cooperative, Inc.	Internet – High Speed Internet	Network Management and Acceptable Use Policy	1	11/2011
11	Jefferson Communications, LLC – Long Lines	Site Map	Network Management		No information
12	Mid Century Telephone Cooperative, Inc.	Corporate, Legal & Regulatory	Policies – Network Management and Acceptable Use Policy	0	12/2014
13	Northeast Iowa Telephone Company	Internet	Network Management Policy	0	No information
14	Northern Telephone Cooperative, Inc.	Services – High Speed Internet	Network Management Policies	0	11/2011
15	Northland Cable Ventures LLC – Northland Communications Corp.	Legal Home	Broadband Internet Services Network Management Policy	2	2/2013
16	nTelos Telephone Inc. – nTelos, Inc.	The Open Internet	(not necessary)	1	No information
17	NTInet, Inc.	Policies	Legal	0	No information
18	Oxford Telephone and Telegraph now Oxford Networks	Internet	Policies - Network Management Policy	0	No information
19	Palo Cooperative Telephone Association	Internet Service	Network Management Policies	0	No information
20	Shenandoah Cable Television, LLC – Shenandoah Telecommunications Company	Broadband Policies	(not necessary)	1	No information
21	Sierra Communications – Baca Valley Telephone Company , Inc.	Legal Information	Open Network Policy	0	No information
22	Warwick Telephone Company now Alteva, Inc.	Internet	Open Internet Order	0	No information
23	WildBlue Communications, Inc.	Legal Documents & Policies	Network Management Policy	0	11/2011
24	XO Communications	Internet Transparency	(not necessary)	2	No information
25	Zayo Group, LLC	Legal	Network Openness Policy	0	01/01/2010

8. Bibliography

Autorité de Régulation des Communications Électroniques et des Postes. (2011). *Annual Report.*

Body of European Regulators for Electronic Communications (BEREC). (2011). *Guidelines on Transparency in the scope of Net Neutrality: Best practices and recommended approaches.*

Comcast Corporation. (2008). *Description of Planned Network Management Practices to be Deployed Following the Termination of Current Practices.* Retrieved December 2014, from http://downloads.comcast.net/docs/Attachment_B_Future_Practices.pdf

European Parliament. (2009). Directive 2009/136/EC. *Official Journal of the European Union*.

Faulhaber, G. (2010). Transparency and Broadband Internet Service Providers. *International Journal of Communications*, 738-757.

FCC Technological Advisory Council. (2014). *Supporting the Transition to IP Reference Architecture for Future Broadband Networks.* Retrieved February 2015, from http://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting12414/Transition-to-IP-Addendum-Reference-Architecture-for-Future-Broadband-Network.pptx

Federal Communications Commission. (2010). *Preserving the Open Internet, Broadband Industry Practices, Report and Order.* Washington, D.C.

Federal Communications Commission. (2011). *Guidance for Compliance with Open Internet Transparency Rule.* Washington, D.C.

Federal Communications Commission. (2013). *Form 477 Filers National Level.* Washigton, D.C.

Fung, A., Graham, M., & Weil, D. (2007). *Full Disclosure: The Perils and Promise of Transparency.* Cambridge.

Kantar Media. (2013). *Transparency in Internet Traffic Management.*

Office of Communications. (2011). *Ofcom's Approach to Net Neutrality.*