Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of:	)	
	)	
Preserving the Open Internet	)	GN Docket No. 09-191
	)	
Broadband Industry Practices	)	WC Docket No. 07-52

REPLY COMMENTS OF INFORMATION TECHNOLOGY AND INNOVATION FOUNDATION

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[1] ITIF is a nonprofit, non-partisan public policy think tank committed to articulating and advancing a pro-productivity, pro-innovation and pro-technology public policy agenda internationally, in Washington and in the states. Through its research, policy proposals, and commentary, ITIF is working to advance and support public policies that boost innovation, e-transformation and productivity.

The Information Technology and Innovation Foundation (ITIF) is pleased to offer the following brief reply comments on the FCC's Notice of Proposed Rulemaking, "In the Matter of Preserving the Open Internet", GN Docket No. 09-191, and "Broadband Industry Practices", WC Docket No. 07-52. ITIF has long advocated protecting and preserving the aspects of the Internet that enable it to serve as an engine of innovation and vehicle for advancing the public interest. We have previously filed comments in the Commission's related proceedings on the Internet and its constituent networks, participated in the Commission's workshops on the National Broadband Plan, and written reports on the Internet architecture[2] and network management practices,[3] as well as on challenges and opportunities facing the Internet and its constituent networks. In the interest of furthering the dialog, we offer the recommendations and refer the Commission to our recent report on the mobile Internet, "Going Mobile: Technology and Policy Issues in the Mobile Internet."[4] The report can be obtained from the ITIF web site, http://itif.org/publications/going-mobile-technology-and-policy-issues-mobile-internet. The summary and recommendations from the report follow.

Summary and Recommendations

Ten years ago, the typical network experience was limited to dialing-up a walled garden to see if we had mail and then poking around a few familiar parts of the Internet. The advent of broadband networking changed this dramatically: it sped up the Web and brought about a host of innovative new applications and services. While the Internet was permeating modern life, a parallel development was taking place that would have even greater significance for billions of people around the world: the development of the cell phone. Inevitably, these two transformative technologies began to merge, enabling the rise of the Mobile Internet.

Convergence is now beginning to rebuild the Web into a personalized, real-time system that responds to the locations, tastes, and whims of billions of people as they live their lives at their desks, in their living rooms, or moving through the world with the flow of experience. Over the next decade, many more people will use the Mobile Internet, and it will produce an enormous array of innovations and quality of life benefits.

Even with all the network magic we enjoy today, we're still at a very early stage in the development of the Mobile Internet; with any luck, we'll look back in another ten years and wonder how we could ever have been so naïve as to tolerate the limitations of the network experience we enjoy today. The flowering of the Mobile Internet will only come

[2] Richard Bennett, *Designed for Change: End-to-End Arguments, Internet Innovation, and the Net Neutrality Debate* (Washington, DC: Information Technology and Innovation Foundation, September 2009), http://www.itif.org/index.php?id=294.
[3] George Ou, *Managing Broadband Networks: A Policymaker's Guide* (Washington, DC: Information Technology and Innovation Foundation, December 2008), http://www.itif.org/files/Network_Management.pdf.
[4] Richard Bennett, *Going Mobile: Technology and Policy Issues in the Mobile Internet* (Washington, DC: Information Technology and Innovation Foundation, March 2010), http://www.itif.org/publications/going-mobile-technology-and-policy-issues-mobile-internet.

to pass, however, when engineering and policy collaborate to successfully overcome the challenges to the development of a Mobile Internet that lives up to its full potential. For this to happen, policymakers must do two key things: First, they need to refrain from strangling the Mobile Internet with excessive regulation, realizing that the well of innovation that brought us where we are has not run dry. Second, policy makers need to ensure that the mobile Internet can develop the infrastructure it needs, the most important part of which is spectrum. Policymakers need to make tough choices, transferring spectrum from less compelling historical uses to the emerging Mobile Internet.

This report examines changes that must be made to the Internet and to the mobile network to make the Mobile Internet a pervasive and universal reality in the United States and the rest of the world. Some of these changes are purely technical, but their scope affects Internet engineering as well as mobile network, device, and application engineering. The rest of the changes will take place in the policy sphere, affecting notions of network neutrality and spectrum policy. The examination of technology is quite extensive, and is illustrated with specific examples of emerging devices and applications.

In order to make effective policy for the mobile Internet it's necessary to understand the development of the Internet, the dynamics of the mobile network, and how the converged Mobile internet differs from both of these ancestors. While the traditional Internet and the Mobile Internet share some common features, they operate very differently. The traditional Internet was designed for a small group of low duty cycle, occasional use applications for locked-down computers shared by a modest number of highly-skilled, trustworthy users in a non-commercial setting; but mobile telephony's heritage is one of real-time communication-oriented applications, a diverse group of mobile users, and personal devices competing for market share. It's not surprising that there's friction between Internet culture and mobile culture.

The mobile network was originally designed to serve as an extension of the telephone network that added mobility at the network edge without altering the telephone network's fundamentals. Initially, it used analog technology, and converted to digital in the 1990s. Data services were a special feature added on to the mobile network roughly during the period of its transition from analog to digital. As presently operated, the mobile network is still more efficient at providing telephone service than data service.

Mobile data rates have doubled roughly every 30 months, as predicted by Cooper's Law. By way of contrast, Butter's Law predicts that the data rate of optical fiber doubles every nine months. Because of this, some have said that wireless is a generation behind wired systems and always will be.

This is important because the rate of progress for Internet applications is largely driven by price/capacity improvements in physical networking since the Internet protocols have been stagnant since 1993. As Internet use shifts to wireless networks with slower intrinsic rates of advance, we might expect a slower overall rate of innovation. We might also expect increased fracture between mobile applications and stationary ones, in part because the bandwidth gap between the two can only grow larger. Nevertheless, the

benefits of mobility are so great that the rate of Mobile Internet innovation is bound to increase beyond anything we've seen so far, bandwidth constraints notwithstanding.

Mobile networks require more extensive management and tuning than wired networks, as their capacity is relatively more constrained and demand for this limited capacity is more variable because of roaming. Mobile networks differentiate packets by application, providing very different routing and processing to voice packets than to data packets. This differentiated treatment is a reflection of application requirements; the need for it will persist after mobile networks are fully integrated with the Internet.

While the design and engineering challenges to the full integration of the Internet with the mobile network are serious, considerable progress has been made and the path to success is reasonably clear. The Mobile Internet is already emerging, and with it an exciting new category of applications known as Mobile Augmented Reality.

Operational challenges to the adoption of the Mobile Internet are also well understood, but less easily solved. Networks operators need to build more base stations, add more radio sectors to existing base stations, and increase backhaul bandwidth. While these challenges are relatively simple in the suburbs and exurbs – all it takes is money and accommodating local governments – they're much more difficult in central cities and in rural areas. Next generation systems such as LTE consume more bandwidth than traditional cellular, which requires a beefed up middle mile. Increased use of fiber to connect cell towers with operator facilities and on to Internet exchanges may have positive spillover effects for residential broadband as more dark fiber is deployed.

There are two key policy issues for the Mobile Internet: net neutrality and spectrum. The net neutrality proceeding currently before the FCC – the Open Internet Notice of Proposed Rulemaking – proposes to envelope the Mobile Internet within the same, highly stringent, regulatory umbrella as the wired Internet. Harmonized regulation is philosophically appealing, but has a number of practical drawbacks. If the framework itself were clear and fundamentally sound, a common regime would make sense: after all, the Internet is not as much as wired network as a virtual network and its structure is meant to be technology neutral. However, if the approach is based on preserving wired network operational norms, as it currently is, then the common umbrella becomes a common straightjacket, undesirable for both wired and mobile networks.

Spectrum policy has historically featured conflict between licensing regimes and unlicensed "Open Spectrum" models such as the White Spaces system. With the parties to this controversy in détente, the focus shifts to the struggle among various license holders. The United States unfortunately adopted an obsolete standard for Digital TV ten years ago, and has failed to reap as large a digital dividend as Europe and Asia will gain as they transition away from analog television. Extracting poorly utilized DTV spectrum from broadcasters is a daunting challenge that must be solved by federal regulators with all the creativity they can muster. It's unfortunate that TV broadcasting casts such a long shadow on mobile networking at a time when 85% of Americans watch TV over a cable or satellite system and few of the over-the-air subscribers watch on HD screens. The

broadcast filibuster can be mitigated by offering incentives for broadcasters to share spectrum with each other and give back the excess for auction, and by modernizing government's spectrum use.

The general approach we recommend is for the government to facilitate the Mobile Internet by removing impediments to further build-out and adoption. Speculative fears have played too large a role in the Internet regulation debates of the last decade, and it's more productive to shift the emphasis toward the government's role in facilitating progress.

First, it would be a mistake to impose the "net neutrality heavy" guidelines on either wired ISP networks or mobile networks. Rather than enacting overly prescriptive regulations banning experiments with new transport services and business models, the FCC should rely primarily on transparency and disclosure to protect consumers from speculative harms, maintain active oversight of provider practices, and reserve direct intervention for instances of clearly harmful conduct. Second, policymakers should embark on a program of spectrum modernization and expansion to ensure that mobile services can continue to grow. A special focus should be placed on the transfer of licenses from inefficient DTV use to the general pool of spectrum available for auction.

Spectrum modernization should also be employed to replace inefficient federal, state and local government uses and release unneeded spectrum to an auction pool. Finally, regulations should encourage technical solutions to be developed and deployed that enable consumers to obtain the best possible service for the best prices. Doctrinaire net neutrality heavy formulas simply don't accomplish these ends for mobile networks.

1. Stick with Light-touch Regulation

If heavy-handed net neutrality regulation is ultimately bad for investment, deployment, and adoption of wireline networks, as it is, it is potentially a fatal disaster for mobile networks. A key way to ensure that networks serve the public interest is through market mechanisms based on meaningful competition. The United States enjoys among the most competitive intermodal wireline broadband and even stronger wireless competition, with four national wireless networks, as well as a number of regional networks and Mobile Virtual Network Operators (MVNOs) such as Virgin Mobile. Fixed wireless networks such as Clearwire and the emerging LTE system are both reasonable substitutes for wired broadband, and the two satellite networks are in the process of upgrading capacity significantly. Competition can be made more effective by ensuring there are minimal delays in switching between mobile providers.

2. Enact a Sensible Transparency Rule

Just as a well-functioning democracy requires an informed citizenry, a well-functioning network ecosystem requires its well-informed and honest critics. While the new European Internet transparency rule is too new to be judged a complete success, it represents a promising direction for which there is broad consensus. There is still disagreement regarding the specific nature of required disclosure, which is

understandable given the complexity of network systems and the gap between consumer awareness and technology. The challenge for a transparency rule is to disclose the things that must be disclosed in order for users to gauge the experience they'll have on any given part of the Internet ecosystem in terms the average person can understand, while making additional information available to the audience of technologists and policy analysts. Certain details of practice represent trade secrets and need not be disclosed; the means by which a particular user-visible effect is produced are less important than the effect itself. One approach that recommends itself is the co-regulatory approach championed by Marsden, in which stakeholders convene with the regulator to draft specific guidelines.[5] Toward that end, we encourage stakeholders to form a working group to advise the FCC on the particulars of disclosure.

3. Define Reasonable Network Management

The transparency rule, and its specific implementation, provides insight into the boundaries of reasonable network management practices. While the use of the term "reasonable" without definition is impossibly vague, anchoring management practices to service disclosure resolves a great deal of the mystery. We know that a practice is reasonable if it does what the operator says it does, conforms to standards devised by responsible bodies such as IEEE 802, IETF, and the ITU, and doesn't violate basic user freedoms. We know that it's unreasonable if it fails to accomplish its stated purposes, arbitrarily restricts the use of applications, or restricts basic user rights. Beyond these general guidelines, a Technical Advisory Group must work with the FCC to develop additional clarity regarding management boundaries and help advise on a case-by-case basis when needed.

4. Legitimize Enhanced Transport Services

There is widespread agreement among filers in the FCC's Open Internet NPRM that differentiated services for differentiated fees are legitimate in their own right, and not simply as an adjunct to network management. Similar services have a long history on the Internet, where they are known as Content Delivery Networks, Overlay Networks, and Transit Networks. The logic of "pay more to get more" has long been accepted practice. These practices have proved worthwhile for content resellers and application service providers such as Netflix and Skype, so it stands to reason that they would be beneficial for future competitors in the market for video streaming and telephony. If ISPs who operate the so-called "eyeball networks," including wireless mobile Internet services, serving retail customers are permitted to compete with CDNs and Overlays, new application entrants can expect lower prices and more competition, and end users can expect a wider array of options, especially among mobile applications.

5. Preserve Engineering and Operations Freedom

The primary emphasis of the Open Internet NPRM's framework of rules is on the preservation of users' freedom to experience the Internet as they see fit, without arbitrary

[5] Christopher T. Marsden, *Net Neutrality: Towards a Co-regulatory Solution* (London: Bloomsbury Academic, 2010), http://www.bloomsburyacademic.com/pdf files/NetNeutrality.pdf.

limitations. A key way to preserve this freedom is to address the dynamics of technical freedom that make it possible. Users experience the Internet as they do now because engineers, network operators, and application innovators have been free to improve networks, network technology, and user experience.

Toward that end, the NPRM should make it clear nothing in the FCC's approach denies the freedom to invent, develop, and adopt new networking technologies, business models, and practices that have the potential to enhance the Internet's power, efficiency, vitality, or effectiveness.

To operationalize this, the FCC should consider adding two additional principles to its list: Engineering Freedom and Operations Freedom. The telephones that worked on the PSTN in the first year of the Carterfone regime still work 35 years later. If the cell phones we use today are still usable on the mobile network 35 years from now (or even ten years from now), that should be regarded as a failure of innovation. The Mobile Internet is driven by an ethic of continual improvement and this principle more than any other must remain in the forefront. Thus, we propose two additional rules for the Open Internet NPRM:

- No part of this regulation shall be construed as limiting the freedom of network engineering to devise, develop, and deploy technologies to enhance the Internet or to improve user experience.

- No part of this regulation shall be construed as limiting the freedom of Internet Service Providers, other network operators, or other service providers to devise new financial or business models that better align user incentives with those of network operators or application-based service providers without limiting user choice.

These rules make it clear that innovation is the engine that best ensures the Internet's continued public value.

6. Review Existing Spectrum Licenses

The FCC needs to complete its inventory of the licenses it has issued over the years, and implement a system that eliminates or reduces ambiguity about licenses going forward. If it's true that the FCC has somehow lost track of some licenses, as some have suggested, this error should be corrected. It's simply not acceptable for the national regulator of wireless networks to lose track of issued licenses. Legislation to create a national spectrum map introduced by Sen. Kerry (D-MA) and Sen. Snowe (R-ME), is a step in the right direction.

7. Eliminate Redundant and Archaic Licenses

Once the license inventory is complete, it will be possible to examine licenses to determine which are unused, which are redundant, and which can be combined with others to free up spectrum for auction or other kinds of assignment. Part of this process

will entail reassigning some occasional uses to the control of other agencies, license holders, or custodians of other kinds. Rarely used public safety applications can be combined with consumer services, for example, by allowing public safety uses to take precedence in times of emergency. The general principle that should hold in the process of review is modernization, replacing archaic analog applications with more spectrum-efficient digital ones. No single approach to spectrum management exceeds all others in terms of general utility, but there should be a bias in favor of spectrum custodians in either the public or the private sector with vested interests in efficient use. Sufficient spectrum exists, in principle, to meet projected user requirements for mobile networking. There is not sufficient spectrum that we can afford to waste large swathes on speculative projects of uncertain utility, however. A reasonable approach is embodied in the White Spaces order, where all licenses are experimental ones renewable day-by-day. Proven applications can be rewarded under this system with license of longer duration.

Spectrum grants for digital TV greatly exceed consumer demand and should be reduced in the public interest.

In addition, spectrum grants for DTV greatly exceed consumer demand and should be reduced in the public interest with the freed up spectrum auctioned off. Spectrum policy should respect the public's evident wishes and make more spectrum available for Mobile Internet services for which demand is growing.

8. Protect Spectrum Subleasing

Secondary markets for licensed spectrum enabled by resale and subleasing have proved useful in the U. S., where dozens of Mobile Virtual Network Operators (MVNOs) lease capacity from license holders and roaming agreements permit licensees to share capacity. These kinds of secondary markets are also useful in the microwave backhaul and point-to-point space where a given license holder can adjust microwave paths with relays and dogleg arrangements to accommodate most effective use. Therefore it is important for policy to permit the trading and leasing of most licensed spectrum.

9. Cautiously Enable Secondary Uses

One area of controversy concerns such secondary uses as wireless underlay and overlays on licensed spectrum. Advocates insist that such uses are non-interfering with properly restricted, and license holders are skeptical. The reality is that the nature of the interference caused by overlay networks such as Ultra-Wideband depends on the nature of the incumbent service. Ultra-Wideband interferes, in some installations, with highly sensitive applications such as radio astronomy, but this fact is known and the Ultra-Wideband waveform is adjusted accordingly. When the details of the incumbent service are known, in terms of coding, modulation, and framing protocols, overlay and underlay services can be engineered for cooperation without interference. Nevertheless, when details of the primary service change, interference may arise anew. For this reason, all secondary uses should be required to back off and even shut down completely until they can be certified as non-interfering with the primary license holder. The principle use of secondary services should be in areas where the primary user is not active; this is the

logic behind the Dynamic Frequency Selection (DFS) system in IEEE 802.11a Wi-Fi. This system requires Wi-Fi systems to look for the use of radar on certain channels, and to refrain from using channels where radar is found.

In all cases, the burden falls on the secondary user to avoid causing interference with the primary user. Systems of enforcement for this principle need to be incorporated into all secondary use regulations; the White Spaces database has this capability.

10. Allow the Experiment to Continue

The Internet as we know it today is the fruit of a 35-year experiment. In the beginning, it was the prototypical science project, albeit one with government support shepherded by a highly skilled and dedicated band of researchers, champions, and developers out to prove that a new vision of networking was not only practical but superior to the old one.

The mobile data network has a completely different creation story, originating in a commercial context and targeted toward adding an important new feature to the existing network without fundamentally altering its nature.

Each of these networks has a story, a set of champions, and a vision. Each has been transformative in its own way, giving rise to its own industry, and liberating some vital element of human society along the way. It's not surprising that the convergence of these networks should occasion debate and conflict, some of it intense and heated.

The way forward requires some give and take. It's not enough to impose the Internet's operational traditions on the mobile network, because the Internet's operational community has chosen not to adopt the Internet standards most relevant to mobile networking: RSVP, IntServ, and Mobile IP. It's not enough for mobile operators to demand that Internet users abandon open access to the web at reasonable speeds in favor of a constrained system of locked-down portals and proxies. Each culture has things to learn from the other.

The way forward is a careful, diligent, step-by-step process beginning with reviews of historical rules and precedents and ending in the creation of a new framework that will enable the next generation of networking to flourish. The evidence of an emerging consensus among responsible parties in the United States and Europe suggests it's well underway.

Conclusion

Thank you for your kind attention.