Before the
Federal Communications Commission
Washington, DC 20554

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

To: The Commission

COMMENTS OF MOBILE FUTURE

To assist the Commission in considering the under-developed issues highlighted in the *Public Notice*,[1] Mobile Future submits the attached report by Rysavy Research, "Innovation Enabled by Mobile Wireless Network Management."[2] Mobile Future is a broad-based coalition of businesses, non-profit organizations, and individuals interested in and dedicated to advocating for an environment in which innovation in wireless technology and services is enabled and rewarded.

The attached Report discusses the critical role played by network management in facilitating the paradigm-shifting innovation that continues to transform mobile wireless networks. It details how traffic management and quality-of-service (QoS) control are essential tools for network engineers to ensure the success of wireless networks and applications. Specifically, the Report chronicles how QoS control can be used in applications for public safety,

[1] *See Further Inquiry Into Two Under-Developed Issues in the Open Internet Proceeding*, GN Docket No. 09-191, WC Docket No. 07-52, Public Notice, DA 10-1667 (rel. Sept. 1, 2010) ("*Public Notice*").

[2] Attached as Exhibit (the "Report").

health care, smart grid, education, voice, video and many more areas. It also describes the benefits of network and traffic management that secures the network, and enables next generation services and innovative pricing arrangements. "With the ability to dynamically manage spectrum-based networks in real-time, as network operators have done for more than twenty years, not only will wireless networks perform reliably despite more traffic, they will also support a greater range of new consumer and enterprise applications."[3] Finally, the Report discusses how QoS and policy management mechanisms will allow operators and other providers to make possible a number of alternatives in how they bundle and price their services, "which could further unleash a wave of innovation in the industry."[4]

The insights of this Report are offered against the backdrop of the significant and ever-growing importance of mobile Internet access in American life. Mobile Future has filed extensive information on the explosion of wireless Internet usage, and what it means for the country.[5] Given the profound role of wireless in the broadband revolution that is re-shaping the economy and our lives, and the unique technical and operational characteristics of wireless broadband networks and the devices that attach to them, the Commission must ensure that any regulations adopted in this proceeding do not unintentionally constrain the capabilities of 3G and 4G wireless broadband technologies to deliver the kind of ubiquitous, affordable wireless broadband services that serve as a platform for innovation. Innovation in the mobile wireless

[3] Report at 7.

[4] *Id*. at 8.

[5] *See, e.g.,* Comments of Mobile Future, GN Docket No. 09-51 (filed July 21, 2009); Comments of Mobile Future, GN Docket No. 09-191, WC Docket No. 07-52 (filed Jan.14, 2010); Reply Comments of Mobile Future, GN Docket No. 09-191, WC Docket No. 07-52 (filed Apr. 26, 2010); Letter from Allison Remsen, Executive Director, Mobile Future, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 09-191, WC Docket No. 07-52 (May 12, 2010).

ecosystem is fueled by network management, and the Commission should consider this symbiotic relationship in assessing its wireless policy direction.

Respectfully submitted,

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RYSAVY RESEARCH

Innovation Enabled by Mobile Wireless Network Management

October 12, 2010

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Introduction

Today's mobile wireless networks are unleashing a massive wave of innovation that spans multiple industries, including telecommunications, computing hardware, computer software, and data networking. Key to this successful innovation is providing users – residential as well as enterprise – with a wide range of applications and dependable service. For the pace and scope of wireless technology innovation to continue or even accelerate, mobile broadband networks must operate in ways that enable an ever-wider range of applications that work reliably even as network traffic increases exponentially and possibilities of network congestion increase accordingly. Given the spectrum-based capacity constraints of wireless networks, reliable, high-quality wireless connections to the Internet can only be accomplished when spectrum-based network operators dynamically and effectively manage their networks, as they have been for the last twenty years.

Managing spectrum-based networks allow providers to offer the best user experience possible to the largest number of users, to minimize instances of abusive user actions that degrade overall network performance and the experience of other non-abusive networks users, and to enable providers to offer more personalized, innovative and flexible service plans to consumers. These benefits, along with continued device and network evolution, will propel the mobile-broadband industry along the innovation trajectory it is already on and will deliver even more positive effects on the entire economy, creating jobs and helping the United States maintain its global leadership position in mobile broadband.

Restrictive interpretations of network-neutrality regulatory proposals, however, would limit the network and traffic management approaches currently available to network operators, as well as undermine the efficacy of even more efficient management tools being designed for 4G technologies, seriously compromising the technical and consumer innovation that these management approaches enable.

Quality-of-Service and Policy Concepts

Today's spectrum-based networks already employ a number of essential network-management functions. Without these, networks would suffer under the weight of increasing mobile-data usage and consequent instances of network congestion. For example, in 3G networks, the networks must prioritize voice communications so that users can make voice calls, keep them up for the duration of the call, and maintain them if users move from the coverage area of one cell to another. Voice calls are unaffected by the amount of data traffic. If the digital bits used for voice had to traverse the network using the same priority as bits used for data applications such as e-mail, Web browsing or video streaming, operators would simply not be able to offer dependable voice service.

Moving forward, network engineers have designed additional capabilities for managing traffic into next-generation networks that will both enable a much wider range of applications and allow existing ones to provide a much more consistent user experience, particularly under heavy-load conditions.

The need for traffic management arises because different applications have fundamentally different requirements when it comes to communications attributes such as rates of packet loss, data throughput, and packet delay. For example, a non-interactive video stream demands a relatively constant level of throughput, but it is largely insensitive to delay. A user is not usually concerned that a video clip is a few seconds delayed relative to when it was transmitted. This couple of seconds delay, however, would be disastrous for voice communications. Similarly, users are unlikely to notice slight delays in the loading of a Web page. Meanwhile, a file transfer in the background to update the operating system on a phone is even more impervious to delays or variations in throughput. By contrast, control messages for a voice-over-IP (VoIP) telephone call require the highest priority.

One of the leading 4G technologies that is starting to be deployed by operators worldwide is Long Term Evolution (LTE). Along with faster speeds and higher spectral efficiency, LTE implements a comprehensive QOS framework. LTE has nine different classes of data traffic defined, with each level having an associated Quality Class Indicator (QCI). Some levels provide guaranteed bit rates, whereas others do not. There are also different packet delays and packet loss rates associated with each QCI value. As an example, QCI 5 has the highest priority since it is used for control messages that set up multimedia (including VoIP) calls. Table 1 provides examples of LTE quality classes.

Table 1: Example of LTE Quality Classes

Quality Class Indicator	Priority (1 is highest)	Guaranteed Bit Rate?	Packet Delay (milliseconds) Allowed	Packet Loss Allowed	Application Examples
1	**2**	Yes	100	Some	Conversational voice
2	**4**	Yes	150	Slightly more	Conversational video
3	**5**	Yes	300	Minimal	Buffered streaming video
5	**1**	No	100	Minimal	Network control messages
9	**9**	No	300	Minimal	File transfer, e-mail.

The exact details of how the framework operates are beyond the scope of this paper; instead, this paper focuses on the innovations enabled by these next generation frameworks. For additional background, however, it is important to understand the concept of policy management, which goes hand-in-hand with QoS in next-generation networks.

Policy management is quite simply a set of rules that determine what type of parameters the network needs to assign to users' data sessions based on their subscription profiles (e.g., type of service plans) and the types of applications they are using. In LTE, this function is called Policy Charging and Control (PCC). PCC can be either relatively static, using predefined rules that do not change very often, or dynamic, using rules that can be easily or even automatically changed based on varying circumstances. For example, different pricing for different throughput rates, as is common with cable modem or DSL service, can be implemented through policy control.

Both QoS and policy management are vital for the realization of next-generation wireless network functionality, as well as for the management of congestion, as discussed next.

Innovations Enabled by Quality-of-Service Control

QoS concepts have existed for many years and are implemented in a variety of ways in different networks. The Internet, however, largely operates without QoS control. In other words, if a user is to stream a movie, there is no assurance that the entire movie will get through without pauses or changes to video resolution in the middle of the movie. Yet users are increasingly using such services. So it is fair to ask why QoS is needed for spectrum-based networks. The answer is simple: bandwidth in the "wired" Internet is over-provisioned – there is more capacity than most people need for what they are doing. Bandwidth in spectrum-based networks, however, is extremely limited and, as explained in the Rysavy Research report "Mobile Broadband Capacity Constraints and the Need for Optimization[1]," just a small number of wireless data users can consume the entire capacity of a single cell sector. Yet wireless users would like to do everything they do on wireline connections. And demand for mobile broadband is on the rise. The FCC's recent report on Internet access found a 40% increase in wireless broadband connections to the Internet between December 2008 and June 2009 in contrast to just a 23% increase for wired connections in the same period.[2] Simultaneously, mobile application developers want to create new types of applications to expand their business frontiers. In many cases, mobile-application

[1] Rysavy Research, February 24, 2010,
http://www.rysavy.com/Articles/2010_02_Rysavy_Mobile_Broadband_Capacity_Constraints.pdf

[2] FCC, "Internet Access Services: Status as of June 30, 2009," September 2, 2010,
http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0902/DOC-301294A1.pdf

developers do not make network efficiency a high priority in their designs, which can further strain networks.

This is where QoS control can provide huge benefits. QoS control can be applied in multiple ways for many innovative types of applications. Table 2 provides a listing of examples that will benefit from QoS and explains how QoS can be applied.

Table 2: Examples of QoS Applied for Application Innovation

Application Innovation	How QoS Can Be Used
Public Safety	QoS can allocate the highest priority to public-safety communications, meaning that even in disaster situations with massive demand on the network, public-safety users can still have reliable access to the network.
Health Care	Telemedicine can benefit through reliable video that will enable doctors to remotely diagnose conditions. Emergency messages can travel with higher priority in crisis situations.
Smart Grid	Smart grid applications do not necessarily need much bandwidth, but control messages need to travel with absolute minimum delay in critical situations in which energy-consuming systems have to be instantly turned off.
Education	Distance learning can benefit from interactive classrooms with reliable voice and video. Professionals can view educational Webcasts in which the voice stream can be slightly delayed but must stream reliably.
Child Safety	Parents can elect to have certain applications or types of content blocked from their children's telephones.
Home Security	Alarm messages do not require bandwidth guarantees but do need low levels of packet loss.
VoIP within Applications	Increasingly voice will be embedded as a component in many types of applications, such as voice support for people with questions in the midst of a Web-based shopping transaction.
Video	Video is representing an increasing percentage of network traffic and like voice will be part of many applications. Interactive video requires control of bandwidth and delay, but can withstand some packet loss. Streaming video is less delay sensitive. Both benefit strongly from QoS control.
Social Networking	Social networking sites, whether consumer, professional, or special-interest related increasingly will take advantage of voice/video communications.
Field Service	Field service technicians can benefit from video-oriented depictions of service procedures that use streaming video.
Video Entertainment	There is a rapid shift from DVDs to streaming video, and users want to watch some or all of this content on their mobile devices. Some users may wish to pay more for high definition.
Finance	Banking operations may not need much bandwidth, but reliability is paramount.
Priority Traffic	Users can elect for momentary acceleration of traffic if pressed for time.

Application Innovation	How QoS Can Be Used
Gaming	Interactive Internet games require bandwidth control for video-oriented content, as well as minimum delay for user actions to be effective.
Future Applications	As the mobile-broadband industry grows, innovators will find countless new opportunities to leverage QoS mechanisms.

All of these applications can function without implementation of QoS in unloaded networks, but once networks are loaded, they can become unreliable or unusable unless QoS is implemented.

Innovation Due to Greater General Dependability

With the ability to dynamically manage spectrum-based networks in real-time, as network operators have done for more than twenty years, not only will wireless networks perform reliably despite more traffic, they will also support a greater range of new consumer and enterprise applications. This will foster an environment that encourages users to access more applications and encourage developers to build more applications. The result is a virtuous cycle of innovation. In contrast, without the ability to appropriately use traffic management tools, spectrum-based network operators will not be able to support a new wave of applications that require greater and greater network reliability and dynamism. This means the applications will fail in unpredictable ways, consumers will lose confidence in them, developers will become more cautious, and the market for wireless broadband services could stall.

Traffic management on wireless networks is not only beneficial for greater dependability of mobile applications, but also is important for protecting the networks. For example, imagine a virus that has spread across many thousands of devices and that at a certain point in time triggers continuous data use. Unchecked, this condition would cause a massive denial of service that could affect millions of users. However, with a dynamic policy control system in combination with QoS control, a wireless network operator could detect this condition and either block or limit the throughput of each affected system, thereby leaving the network operational for other users.

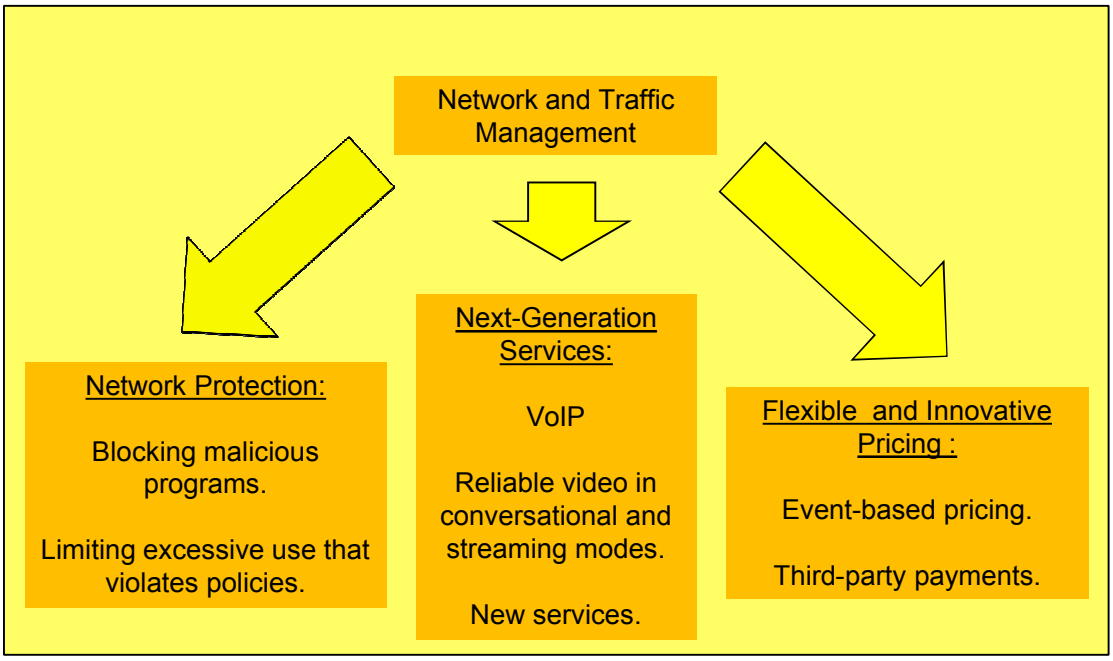
Meanwhile, the cause of network saturation may not even be intentional. For instance, a developer could design a mobile application poorly to check for updates of the software at a specific time. If millions of copies of the application simultaneously started downloading an update, this could also cause widespread congestion. Again, with dynamic policy control, a wireless network operator could instantly use different traffic management tools to mitigate the network-wide impact, thereby protecting the network for continued use by other non-offending users and applications. Such network protection will further increase the confidence of users and developers.

As mobile platforms become more powerful, there will be a greater number of vulnerabilities that can be exploited for malicious purposes. Denial of service through excessive network use will remain a potential problem so long as networks are based on a best-efforts approach where all bits have to flow through the network with equal priority.

Even in the absence of applications behaving poorly, wireless operators could implement clearly-articulated policies that state that certain applications, such as file transfers, will operate at lower priority when the network is busy. This will help protect wireless users from congestion-associated failures.

Thus, as shown in Figure 1, QoS control and policy management enable application innovation and can protect networks against malicious application behavior as well as mitigate congestion effects.

Figure 1: Benefits of Network and Traffic Management



Innovation in Service and Pricing Plans

Once the QoS and policy management mechanisms are in place at the network level, operators and other providers will be in a position to offer a myriad of beneficial alternatives in how they bundle and charge for services, which could further unleash a wave of innovation in the industry. Some of the possibilities include:

- Offering an assortment of pricing plans to reflect the varying bandwidth needs of users.

- Providing premium services to consumers who need QoS applied to specific applications – for example, doctors needing QoS-controlled telemedicine applications.
- Alerting users when they are close to their monthly data quotas and providing them options such as purchasing additional blocks of data.
- Allowing third parties to provide QoS-sensitive offerings. An example is advertisers wishing to deliver QoS-controlled advertising or demonstrations of their services (e.g., games).
- Charging on a per-event basis, such as watching a QoS-controlled movie.
- Combining per-event or third-party-payments with user-location information for enhanced services such as advanced navigation options or highly targeted, location-dependent promotions.
- Countless other innovations as the market takes advantage of the flexibility available in these services.

Conclusion

Faster networks, powerful mobile platforms, and hundreds of thousands of applications are driving the explosive growth of the mobile-broadband industry, creating jobs, fostering competition and empowering consumers. While the future of this industry looks promising, it can only achieve its true potential if operators are able to effectively manage their networks. Through traffic management and policy control systems, operators can make many applications work more dependably and provide a framework for new applications and services that would not otherwise be possible. Prominent examples are in the public safety, education, smart grids, and medical areas. Business and consumer applications will also see advances. A framework that allows operators flexibility in managing their networks will also help to guard against and respond to malicious applications and network congestion, and will enable a variety of service and pricing plans and new business models that further promote innovation and adoption. As a result, it is crucial that regulations not be imposed that hinder the effective deployment of these frameworks. They are critical for the continued success of this industry and for its continued innovation.