Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of:	
Framework for Broadband Internet Service	GN Docket No. 10-127

COMMENTS OF THE ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS ("ATIS")

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I. INTRODUCTION AND SUMMARY

The Alliance for Telecommunications Industry Solutions ("ATIS") is a global standards development and technical planning organization that leads, develops and promotes worldwide technical and operations standards for information, entertainment and communications technologies. ATIS' membership is diverse and includes all stakeholders from the information and communications technologies industry – wireline and wireless service providers, equipment manufacturers, competitive local exchange carriers, providers of commercial mobile radio services, broadband providers, software developers, consumer electronics companies, digital rights management companies, and internet service providers.[1]

The ATIS Board of Directors, comprised of chief technology officers and senior-most executives from ICT service providers and their suppliers, directs and implements strategic initiatives impacting ATIS, its membership and the entire ICT industry. Through its Technology and Operations (TOPS) Council, the Board also identifies the industry's most pressing business priorities, from which implementable, end-to-end technical and operational solutions are developed, including the standardization needed to support such solutions.

Nearly 600 industry subject matter experts work collaboratively in ATIS' 18 open industry committees, which develop standards, specifications, best practices, guidelines and other approaches as deemed essential to the operation of communications networks by ATIS members. ATIS' committees focus on a broad range of priorities, including network architectures and platforms, E-911, the

[1] A full list of ATIS member companies can be found at Attachment 1.

seamless delivery of converged wireline and wireless services such as IPTV over multimedia platforms, the ordering and billing of services, and the interoperability of current and next generation technologies.

ATIS takes no position on any of the policy questions raised by the Commission's Notice of Inquiry, and offers no opinion on any of the issues of legal authority identified in the NOI. Instead, ATIS submits these comments solely as technically-based factual foundations for the technical issues and questions that the NOI addresses. Specifically, ATIS wishes to provide technical information concerning (a) the proposed definition of Internet connectivity in the NOI; (b) the processing functions integrated into Internet connectivity; and, (c) where in the Open Systems Interconnection ("OSI") layers the types of conduct giving rise to Commission concern can arise.

II. THE NOI RELIES ON SEVERAL KEY TERMS THAT MUST BE ACCURATELY DEFINED FROM A TECHNICAL STANDPOINT

In the NOI, the Commission never precisely defines what it means for the average user to connect to the Internet. The terms "broadband Internet service," "Internet access service," and "Internet connectivity service,"[2] are not industry-standard terms and do not carry with them any particular technical meaning. Accordingly, the NOI runs the risk of creating confusion about the manner in which users connect to the Internet. ATIS submits the following description of the technical processes involved in accessing the Internet in order to address any potential confusion of this kind.

[2] In the Matter of Framework for Broadband Internet Service, GN Docket No. 10-127, Notice of Inquiry, n.1 (rel. Jun. 17, 2010) ("NOI").

A. The Internet Is A Network of Networks

In the NOI, the FCC refers to users "connecting to the Internet."[3] While this phrase is often used in popular discourse, it is important to remember that the Internet "is not a monolithic, uniform network"[4] or an identifiable destination or location that users "connect[] to" in the same way that, in decades past, users might have "connect[ed] to" a computer bulletin board. As its name implies, what people generally refer to as "the Internet" is in actuality a large-scale interconnection of 60,000 major computer networks.[5] The Internet does not exist separate and apart from the connections to it or the networks and users that comprise it; indeed, it is the very act of establishing the interconnections between computer networks and the individual computers that are, in turn, connected to those networks that bring the Internet into being. As a result, every network and subnetwork that is connected to the Internet is an inherent and integral part of "the Internet." Any discussion of what services are required to connect to the Internet must start from this basic premise.

As the text in NOI footnote 1 goes on to suggest, a connection to the Internet necessarily consists of the ability "to communicate with others who have Internet connections;"[6] this is the essence of what it means to connect to an interconnected

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[3] *Id*.

[4] *See* The Digital Handshake—Connecting Internet Backbones, OPP Working Paper No. 32 at 2 (September 2000), *available at* http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp32.pdf.

[5] *See* Network Management—Network and Technology, Presentation of Verizon at 7 (Dec. 8, 2009), *available at* http://www.openinternet.gov/workshops/technical-advisory-process-workshop-on-broadband-network-management.html ("Verizon Network Management Presentation").

[6] NOI n.1.

network of networks. However, the Commission's NOI also proposes creating a distinction between "Internet connectivity service" and "Internet access service." The NOI defines "Internet connectivity service" as "the service that may constitute a telecommunications service" and that, *inter alia*, "allows users to communicate with others who have Internet connections."[7] By way of apparent contrast, the Commission identifies "Internet access service" as a phrase it has "used in prior orders" to mean "the bundle of services that facilities-based providers sell to end users in the retail market;" the Commission refers to such services now as "broadband Internet service."[8] The Commission's attempt to create a distinction between "Internet access service" and "Internet connectivity service" could inject confusion into this discussion, because it suggests that "Internet connectivity" can occur without "Internet access." In fact, because to connect to the Internet is to access the Internet, the two terms are logically synonymous.

This type of confusion is evident in the NOI's subsequent discussion of past precedent. The NOI notes that the Commission has previously identified "a portion of the cable modem service [as] 'Internet connectivity,'"[9] which the NOI characterizes as:

> establishing a physical connection to the Internet and interconnecting with the Internet backbone, and sometimes including protocol conversion, IP address number assignment, domain name resolution through a domain name system (DNS), network security, caching, network monitoring, capacity engineering and management, fault management, and troubleshooting.[10]

[7] *Id.*

[8] *Id.*

[9] *Id.* ¶ 16, *quoting Cable Modem Declaratory Ruling*, 17 FCC Rcd 4798, 4809-11 (2002).

[10] *Id.*

However, in the very next sentence, the NOI goes on to say that some of the functions that it has just characterized as "Internet connectivity," including "network monitoring, capacity engineering and management, fault management, and troubleshooting" are in fact "Internet *access service* functions that are generally performed at an ISP or cable operator's Network Operations Center (NOC) or back office and serve to provide a steady and accurate flow of information between the cable system to which the subscriber is connected and the Internet,"[11] *i.e.*, to provide the cable modem user the ability to communicate with others who have Internet connections. Whatever policy choices the Commission chooses to make with respect to accessing the Internet, the agency should take great care to ensure that it does not create unnecessary ambiguity by attempting to distinguish between two terms that, factually, mean the same thing.

B. Communicating With Other Users on the Internet Requires Information Processing

Whether one describes the act as "accessing" or "connecting to" the Internet, for a user to "communicate with others who have Internet connections,"[12] the various networks that (when interconnected) comprise the Internet must perform a number of processing functions on the user's communications. A physical connection is not sufficient to ensure that a user will be able to communicate with other users; indeed, a physical connection, standing alone, cannot provide a communications path to other Internet users.

Setting out the Open Systems Interconnection ("OSI") layer concept helps illustrate this point. The OSI model for interconnection was developed by the International Standards Organization ("ISO") in the late 1970s as a tool to aid the further

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[11] *Id.*, *quoting Cable Modem Declaratory Ruling*, 17 FCC Rcd at 4822 (emphasis added).

[12] *Id.* n.1.

development of computer network interoperability and interconnection by creating a means for physically dissimilar computers running different operating systems on different networks to communicate with one another. The OSI model divides the constituent components of computer networking into seven distinct layers.[13] At the bottom, in OSI Layers 1 and 2, are the physical interconnections and data links, respectively. Layer 3 is the network layer, where various different routing functions are carried out by the network. Layer 3 functions include sending data from one point to another on the network based on logical addressing; routers thus typically operate at Layer 3. Layer 4, in turn, provides reliable data transfer by setting the rules for exchanging information, and "manages end-to-end data delivery of information within and between networks, including error recovery and flow control."[14] Layers 5-7 can be generally grouped together as the application layers.

In the simplest terms, as an outgoing data package passes through each layer of the OSI implementation on a user's computer, each layer adds certain information to the data package in the form of headers. On the receiving end (or at steps in between), each layer of the OSI implementation of the destination or intermediate device works with the data in the header created by the corresponding layer in the originating device. A Layer 3 device will thus look at the Layer 3 header information and process that information without regard to the Layer 1 and 2 protocols of the data package. Similarly, the Layer 3 device will process the data package without having to unpack or interpret the application layer information. This hierarchical model allows, for example, diverse networks that

[13] ATIS Telecom Glossary 2007 (ATIS-0100523.2007). *See also* Newton's Telecom Dictionary, 20th Edition at 603.

[14] *Id*.

may be running incompatible, proprietary Layer 1 and 2 implementations to nevertheless communicate with one another using Layer 3.

While the Internet does not rigidly adhere to the OSI model, for conceptual purposes, the functions of the Internet can be roughly divided amongst the various OSI layers. Layers 1 and 2 correspond to the physical data links that run between computers that, together, comprise the Internet. For a small network, the Layer 1 and 2 hardware addresses of each device's network adapter are sufficient to ensure that the data reaches its destination; each device on the network simply listens to every piece of traffic and processes those that are addressed to it. But as the size of the network increases, and especially as the network is interconnected with other networks, the physical data link protocols and hardware addresses are not sufficient to ensure that data can be transmitted from one user to another. The volume of traffic becomes too large for each individual device to listen to all of the traffic for its defined hardware address. Thus, to move the data from one user's machine to another, interconnected networks must also employ Layer 3 routing, which uses logical addressing and routing schemes that are more abstract and flexible than those permitted by static hardware addresses and Layer 1 and 2 protocols. This is where Internet Protocol ("IP") addresses and routing take place; at its most basic level, data bound for a user connected to the Internet is routed to the proper destination in Layer 3 using the DNS process and IP addresses described in more detail in Section III.A.

The Internet also employs Transport Control Protocol ("TCP"), which corresponds to the Transport layer, Layer 4. TCP and similar protocols in Layer 4 perform flow and congestion control on network traffic. As a practical matter, TCP and

IP are closely linked in the realm of Internet access, so much so that the Internet's protocol scheme for these Layers is most often referred to as TCP/IP. In the Internet access context, it would make little sense to offer Level 3 routing services without also offering Level 4 congestion control and transport functions, and few, if any, providers do so.

In sum, communication between and among users of the Internet is not possible without the processing that takes place in Layers 3 and 4 of the OSI model. Without these routing and transport functions, data simply could not be transmitted from one location to another regardless of the number or type of physical links established.

C. The Services Identified in the NECA Tariff Do Not Provide Anything Beyond Layers 1 and 2

The NOI asks whether the Commission can "draw guidance from other attempts to define the functionality of an Internet connectivity service, such as the definition in the NECA's DSL Access Service Tariff."[15] The NOI goes on to explain that the NECA tariff offers "a DSL *data telecommunications service*" that "enables data traffic generated by a customer-provided modem to be transported to *a DSL Access Service Connection Point* using the Telephone Company's local exchange service facilities."[16] Because the NECA tariff is not actually defining or offering either Internet connectivity or access, as a technical matter, the Commission can draw very little guidance from this tariffed offering.

The NECA tariff specifically states that it is offering nothing more than a telecommunications service for the transmission of data from the user's modem to a DSL

[15] NOI ¶ 65.

[16] *Id.* ¶ 65 n.179 (emphasis added).

Access Service Connection Point. Critically, the offering in the NECA tariff does not include routing or transport capabilities that would enable the user's data to be carried past the DSL Access Service Connection Point, out onto the Internet, and to other users' computers. The NECA tariff is thus restricted to a Layer 1 and 2 service for linking a user's modem with an Internet access provider, who would presumably separately offer the Layer 3 and 4 routing and transport services necessary to "communicate with others who have Internet connections."[17] Without such functions, even under the FCC's proposed definition, the service offered in the NECA tariff does not qualify as "Internet connectivity;" indeed, contrary to the language in the NOI, the limited service contemplated by the NECA tariff makes no "attempt[] to define the functionality of Internet connectivity service,"[18] because the NECA tariff is referring to a service very different from the one that the Commission appears to have in mind.

For the same reasons, the NOI's later reference to the NECA tariff as "offer[ing] . . . Internet transmission services as telecommunications services"[19] seems to be technically inaccurate. The Commission does not provide a definition for what it means by "Internet transmission service," nor does it explain how this term is intended to be different (if at all) from the logically similar terms "Internet connectivity service" and "Internet access service." Nevertheless, it is fair to say that the NECA offering cannot properly be described as an "Internet transmission service," because as the Commission appears to be using it the term "Internet transmission service" necessarily implies an

[17] *Id.* n.1.

[18] *Id.* ¶ 65.

[19] *Id.* ¶ 72 and n.190.

ability to "communicate with others who have Internet connections."[20] At most, the NECA tariff offering is a "data telecommunications service" (as the tariff itself states) that along with routing and transport would make up one component of a true "Internet transmission service," but because the NECA offering provides neither Layer 3 routing nor Layer 4 transport it simply is not sufficient to constitute a means by which users can exchange data with other users who are connected to the Internet.

D. Wireless Networks Present Unique Technical Challenges

While the NOI addresses wireless separately, it asks "which of the three legal frameworks specifically discussed in this Notice, or what alternate framework, would best support the Commission's policy goals for wireless broadband."[21] ATIS takes no position with respect to any of the Commission's policy goals, but notes that wireless networks face unique technical challenges.[22]

For wireless networks to work properly and successfully manage the limited spectrum resources available to them, these networks require a tight coupling of the transport and physical layers. For example, for handoffs to occur smoothly as a mobile device moves from being served by one base station to another, OSI Layers 1 through 4 must interact closely with one another. This same level of integration between OSI Layers 1-4 is also required for functionality such as RF power management and for packet prioritization, which wireless networks must use for services such as VoIP and

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[20] *Id.* n.1.

[21] *Id.* ¶ 102.

[22] Moreover, as a technical matter the service identified in the NECA tariff has no applicability in the wireless context. Quite apart from the complete lack of tariffed offerings, wireless networks have no DSL Access Service Connection Point or similar network architecture. There is thus no analog in the wireless world to the service that NECA offers in its tariff.

high data rate video that are affected by latency issues. The tight integration amongst the first four OSI Layers is only growing more necessary with the introduction of next generation wireless air interfaces, such as LTE, that are completely packet-based, but still require backwards compatibility with existing circuit-based wireless systems.

While ATIS hopes that these general comments on wireless networks will be of assistance to the Commission, the tight integration of the four network layers in wireless networks means that there may be technical nuances among the various different implementation schemes that could be important to the Commission's overall inquiry. As a result, to fully address the question posed by the NOI regarding wireless networks, the Commission would need to seek and receive specific comments on the network infrastructure used by the various wireless providers (which varies from provider to provider) and determine how broadband data flows through the network.

III. CERTAIN PROCESSING SERVICES ARE INTEGRAL TO THE PROVISION OF INTERNET ACCESS

In addition to the general points above regarding the nature of Internet access, the Commission should bear in mind that certain specific information processing functions are integral to the ability to connect to the Internet. Because these functions are so closely integrated with providing users the ability to communicate with other users on the Internet, they are either technically inseparable from Internet service or as a practical matter are offered as part of each and every Internet service offering.

A. DNS Lookup Is An Integral Part of Internet Access

The Domain Name Service ("DNS") is the most common means by which information is located on the Internet. As any user of the Internet will instantly recognize, DNS is a hierarchical naming system that provides top level domains (such as the com in .com, the mil in .mil or the org in .org), along with subdomains such as "atis" in "atis.org." While such domain names are easy for users to remember, they do not provide sufficient information for computers on the network to locate and access stored information. To accomplish Layer 3 routing, computers that are linked to the Internet are each assigned a unique IP address that allows other computers on the network to locate the information stored on that computer and send a request for that information at the user's behest. The IP addresses employed by computers on the Internet are long numeric strings that are difficult for users to remember (such as 40.120.134.126). To associate domain names with an IP address, computers that are connected to the Internet must consult a DNS lookup server, which contains a list of domain names and the associated IP addresses of the computers that are linked to those domain names. These lists are generally updated dynamically, continually, and automatically, although the actual process involved is beyond the scope of these comments. Without DNS lookup functionality, a user would be required to keep track of and manually resolve the various IP addresses associated with specific domain names. Given the breadth and number of domain names and IP addresses available, this would be an impossible task. As a result, to ATIS's knowledge, no provider offers a service described as connecting to the Internet without also making DNS lookup available as part of that service.

In at least one place, the NOI correctly notes that DNS lookup is an integral part of accessing the Internet, and that the provision of a DNS lookup service must be part of what the Commission describes as "Internet connectivity service."[23] However, elsewhere the Commission refers to "Internet connectivity service" as potentially constituting a

[23] *See, e.g.*, NOI ¶ 16, *citing Cable Modem Declaratory Ruling*, 17 FCC Rcd at 4809-11.

"telecommunications service,"[24] and being similar in some way to the data transmission service offered via the NECA tariff.[25] As explained above, the NECA tariff does not offer any Layer 3 functionality and DNS lookup does not appear to be part of that service. Although ATIS offers no opinion on either the descriptive or normative legal classification of any particular service, the Commission's reference to "Internet connectivity service" as being potentially a telecommunications service and similar to the NECA tariffed service appears to be at variance with the technical reality that no service can fairly be described as "connecting" to the Internet unless it allows users to resolve DNS addresses.

B. <u>Quality of Service Mechanisms are Integral to Internet Access</u>

Internet access could also not be accomplished without Quality of Service ("QoS") mechanisms, which work to ensure that data is properly transmitted from one Internet user to another. Mechanisms such as Layer 3 error control, which verifies the integrity of data routed between addresses, and Layer 4 congestion control, which manages traffic flow over the network, have been an integral part of Internet standards for decades. While the growth in Internet traffic and the rise in popularity of applications that are more sensitive to issues such as latency[26] has highlighted and enhanced the need for QoS mechanisms, the Commission should not ignore the fact that QoS has long been an integral part of all Internet service. Indeed, the Commission has

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[24] NOI n.1.

[25] *Id.* ¶¶ 65, 72.

[26] *See, e.g.,* Verizon Network Management Presentation at 8.

previously recognized the role that Layer 4 TCP plays in QoS in a number of different contexts.[27]

Moreover, while QoS is critical in the wireline broadband context, it is even more so when it comes to wireless broadband. Wireless providers have inherent capacity constraints stemming from limited spectrum availability that are significantly more restrictive than those faced by wireline providers. As a result, wireless carriers must manage their networks to ensure that broadband data is appropriately transported, and due to latency requirements for certain IP-based communications, certain broadband data (VOIP, video streaming) must have better prioritization to ensure seamless transmission.[28] In short, effective wireless broadband networks must have QoS as a key consideration as part of the network architecture

C. Integral Network Security Is an Increasingly Important Part of Internet Access

As use of the Internet has exploded, the corresponding threats posed by malware, bot nets, Distributed Denial of Service attacks and other malicious activities have increased exponentially. Internet users both on the enterprise and consumer side generally implement their own security solutions to defend against many of these threats,

[27] *See, e.g.*, *In the Matter of IP-Enabled Services*, 19 FCC Rcd 4863, 4867 n.12 (noting that "[a]pplications requiring segmented data to arrive in sequence and without error generally rely on a higher-level end-to-end protocol such as the Transmission Control Protocol (TCP)"); *In the Matters of Formal Complaint of Free Press and Public Knowledge Against Comcast Corporation for Secretly Degrading Peer-to-Peer Applications*, 23 FCC Rcd 13028, 13030 (2008), *vacated by Comcast v. FCC*, 600 F.3d 642 (2010) ("*Comcast Order*") (noting that "[f]or certain applications to work properly, [the TCP] connection must be continuous and reliable. Computers linked via a TCP connection monitor that connection to ensure that packets of data sent from one user to the other over the connection arrive in sequence and without error, at least from the perspective of the receiving computer.") (quotation omitted).

[28] Verizon Network Management Presentation at 9-10.

but Internet access providers have increasingly been making certain baseline network security functions an integral part of Internet access.

For example, some carriers have implemented a series of security protocols on all Internet traffic that crosses its backbone.[29] These protocols utilize algorithms that are designed to detect and thwart abusive practices such as bot net attacks. By analyzing the type of traffic that it generates, algorithms of this type can detect the "signature" of a computer that has been seized by a bot net with a high degree of confidence. Once detected, the carrier can send the user an alert notifying the user of the bot net threat.

Integrated network security of this type, which is distinct from the optional security packages that consumer or enterprise users can purchase, such as virus software or firewall services, can be thought of as "network hygiene," as it is run in the background at no cost to the end user. Moreover, because it can be run on all traffic crossing particular backbones, it can cover large percentages of the total traffic on the Internet to the benefit of all of the users of the Internet. An Internet "connectivity" service that did not offer access to integrated network security of this type is difficult to conceptualize, as it would require that certain traffic (regardless of the provider from whom the traffic originated) be specifically exempted from general network hygiene practices. Not only would this be difficult to achieve, it would be affirmatively undesirable both from a network operator and customer standpoint—exempting certain traffic from integrated security would be an invitation for hackers and other attackers to connect to the Internet using such paths, to the detriment of all users.

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[29] *See, e.g.*, Comments of AT&T, PS Docket No. 10-93, at 8-9 (Jul. 12, 2010); Comments of the National Cable and Telecommunications Ass'n on NBP Public Notice #8, GN Docket No. 09-47, at 4 (Nov. 12, 2009).

IV. THE CAPABILITY TO ENGAGE IN THE PRACTICES CAUSING THE CONCERNS THAT GAVE RISE TO THE NOI TYPICALLY OCCUR AT OSI LAYER 3 OR ABOVE

As the preceding discussion explains, for Internet users to connect with other Internet users and exchange data among networks, Layer 3 routing and Layer 4 traffic control are absolutely essential. The kind of interconnections between networks necessary to form "the Internet" would not be possible without Layer 3 and Layer 4 functions. It is thus perhaps not surprising that the two cases cited in the NOI as cause for concern took place not at the hardware or physical link layer (i.e., Layers 1 and 2), but rather at the transport and network layers, respectively (i.e., Layers 3 and 4).[30]

In its *Comcast Order*, the Commission described the activity that raised the agency's concerns. Comcast, the Commission explained, had been interfering with the use of "BitTorrent and similar technologies" by sending TCP reset packets when a user attempted to establish a peer-to-peer connection using one of the applications in question.[31] Because BitTorrent and similar peer-to-peer services require a continuous connection, sending TCP reset packets effectively terminated the connection.[32] ATIS takes no position on the practices that led to the *Comcast Order* or any of the legal issues that arose in that proceeding. However, it is important to emphasize that, as a technical matter, the TCP reset packets that were the subject of that dispute were not operating at Layer 1 or 2; instead, as explained above, these are Layer 4 transport issues.

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[30] There have been no documented cases of any such activity being undertaken by any wireless carriers.

[31] *Comcast Order*, 23 FCC Rcd at 13030.

[32] *Id.* at 13031.

Similarly, in 2005 the FCC's Enforcement Bureau resolved by Consent Decree, an investigation that it had initiated against Madison River Communication arising out of allegations that Madison River had been blocking its customers from making VoIP calls over its network using one or more of its non-facilities based competitors.[33] The *Madison River Consent Decree* does not go into great detail about the underlying facts at issue in that case, but does note the Enforcement Bureau was responding to "allegations that Madison River was blocking ports used for VoIP applications, thereby affecting customers' ability to use VoIP through one or more VoIP service providers."[34] As part of the consent decree, Madison River agreed that it would "not block ports used for VoIP applications or otherwise prevent customers from using VoIP applications."[35] Even from this relatively terse discussion, it is clear that the port blocking alleged to have occurred in the Madison River case must have been occurring at Layer 3 (or higher); logical port blocking of the kind described by the *Madison River Consent Decree* is a function of the Layer 3 network/IP layer. Again, ATIS takes no position on any of the legal or policy issues presented by the Madison River case; the purpose of this discussion is only to emphasize that these blocking activities were not taking place at the Layer 1 or Layer 2 level.

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[33] *In the Matter of Madison River Communications, LLC and affiliated companies*, 20 FCC Rcd 4295 (2005) ("*Madison River Consent Decree*").

[34] *Id*. at 4297.

[35] *Id.*

V. <u>CONCLUSION</u>

As it moves forward with this proceeding, the Commission should take into account the technical complexities involved in providing Internet connectivity, and should develop its definitions so that they carefully and accurately reflect technical realities.

Respectfully submitted,

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By:

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ATTACHMENT 1

ATIS Members

ACM, Inc.
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Underwriters Laboratories
Union Telephone Company
Verimatrix, Inc.
Verint Systems
VeriSign, Inc.
Verivue, Inc.
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