BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

IN THE MATTER OF THE PETITION OF SPRINT COMMUNICATIONS COMPANY L.P. FOR ARBITRATION OF INTERCONNECTION RATES, TERMS, CONDITIONS AND RELATED ARRANGEMENTS WITH U S WEST COMMUNICATIONS, INC.	))))))))	**DOCKET NO. UT-003006**

DIRECT TESTIMONY OF

JOSEPH CRAIG

ON BEHALF OF U S WEST COMMUNICATIONS, INC.

April 26, 2000

I.INTRODUCTION

Q. PLEASE STATE YOUR NAME, JOB TITLE AND BUSINESS ADDRESS.

A. My name is Joseph Craig. I am employed by U S WEST Communications, Inc. ("U S WEST") as a Network Interconnection Planning Specialist. My business address is 700 W. Mineral, Littleton Colorado, 80120.

Q. PLEASE REVIEW YOUR WORK EXPERIENCE AND PRESENT RESPONSIBILITIES.

A. I have been in the telephone business since 1974. I began as a directory assistance operator for Mountain Bell. After about 2 ½ years in that position, I transferred into Network Operations and since that time have had network-related responsibilities. My introduction to network responsibilities began in the late 1970s when I had responsibility for installing and repairing telephone service. I had responsibility for installations and repairs until 1980 when I became a Central Office Technician assigned to the Denver South Switching and Control Center in Denver, Colorado.

As a Central Office Technician, I was responsible for switch alarm surveillance, switch maintenance and repair, trunk installation, line and routing translations, switch equipment installation and software upgrades. My responsibilities as a Central Office Technician provided me with detailed knowledge of engineering issues relating to trunking, routing and alarm surveillance in the switching network. I also worked closely with vendor equipment installers and acquired substantial knowledge about switching equipment, switch translations and the overall operation of the switching network.

In 1987, I accepted a three-year rotational assignment to Bellcore's training facility in Chicago, Illinois where I was a Switch Lab Manager. In that position, I was responsible for servicing switching equipment and modifying the equipment to update it with the latest features. My experience at the Bellcore training facility gave me the opportunity to work with switching experts from around the country and to learn about new switching technology and advanced switching repair techniques. I developed expertise in switch repair and recovery techniques, and the operations and functions of Signaling System 7 ("SS7"). While at Bellcore, I was selected for an award for exceptional performance called the "Esteemed Member of Bellcore Staff."

In 1990, I returned to U S WEST working in Network Administration where I acquired additional experience in switching capacity and service measurements. After three years, I assumed responsibility for the Switching Control Center, where I managed the technicians who were responsible for monitoring the switching network for all of Colorado. In 1994, I was assigned to the SS7 Control Center, where I had responsibility for provisioning and maintaining the SS7 signaling network for the 14-state U S WEST region.

In 1997, I accepted a position in Network Planning, and became responsible for writing network plans for new switch services in the SS7 network. I also was responsible for monitoring these plans through the implementation phase. In 1998, I was honored as a recipient of Presidents Club for successfully implementing SS7 into the 911 network for the state of Minnesota.

In June 1999, I accepted a promotion to my current position in Network Interconnection Planning. In my current position, I provide litigation support before state commissions on issues relating to switching, SS7, trunking, and routing.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to address several network issues relating to Internet traffic. The issues I address relate to the question of whether U S WEST should be required to pay Sprint reciprocal compensation for traffic that is bound for Internet Service Providers ("ISPs"). First, I compare ISP calls to local and long distance calls and demonstrate that, from a network perspective, ISP calls are similar to long distance calls. This discussion supports testimony from other U S WEST witnesses that the compensation mechanism for ISP traffic should be modeled after the compensation scheme that applies to long distance calls. This discussion also demonstrates that ISP calls are predominately interstate in nature.

Second, I discuss the effects that Internet traffic is having on U S WEST's networks in Washington and other states. Specifically, the dramatic increase in use of the Internet in the last few years has required U S WEST to increase substantially the capacity of its networks by adding, for example, many new trunks and increased switching capacity. These additions to the network, which will continue into the foreseeable future, have required U S WEST to invest millions of dollars annually in Washington and in the 13 other states in the company's region. My discussion of these issues supports the testimony of U S WEST witnesses, Larry Brotherson and Dr. William Taylor, concerning whether ISP traffic should be subject to reciprocal compensation.

Third, I describe part of the process U S WEST relies upon to measure Internet traffic and to distinguish it from voice traffic. In particular, I describe the CroSS7 system designed by Agilent, formerly known as Hewlett Packard, that is designed to capture and track all call set-up and traffic flow information for calls using Signaling System Seven~~7~~ (“SS7”). CroSS7 creates and stores call detail records that provide U S WEST with hold times for calls. U S WEST uses these data from CroSS7 relating to hold times as the starting point of a three-step analysis designed to identify Internet calls.

Fourth, I address some fundamental differences between the networks of competitive local exchange carriers ("CLECs") that handle primarily ISP-bound traffic and the networks of incumbent local exchange carriers ("ILECs") like U S WEST that must handle all types of traffic. CLECs that focus on ISP-bound traffic can design their networks to handle this traffic in a more efficient, less costly manner than ILECs that must design their networks to handle a wide variety of traffic.

II.FROM A NETWORK PERSPECTIVE, ISP-BOUND CALLS ARE SIMILAR TO LONG DISTANCE CALLS

Q. WHY IS IT APPROPRIATE TO COMPARE ISP CALLS TO LONG DISTANCE AND LOCAL CALLS?

A. Sprint's request that U S WEST pay reciprocal compensation for ISP-bound calls requires an analysis of whether these calls resemble local calls or whether they resemble long distance calls. In support of their requests for reciprocal compensation for ISP calls, CLECs have contended that these calls are local in nature. This contention is incorrect. ISP calls closely resemble long distance calls. In the discussion that follows, I describe local, long distance, and ISP calls and point out the similarities between long distance and ISP calls.

Q. WHAT IS A LOCAL CALL?

A. A local call is one that originates and terminates within a Local Calling Area. Local calls often tend to be short in duration as compared to other types of calls.

Q. PLEASE DESCRIBE THE NETWORK FUNCTIONS FOR A LOCAL CALL.

A. Calls that originate and terminate within a single local calling area typically involve a one-switch, two-switch or three-switch connection. For the purpose of my testimony, I will discuss the network functions for a local call using a two-switch connection – that is, an originating switch and a terminating switch.

Each customer is electrically connected to a switch for the purpose of sending and receiving calls. When a customer originates a local call, the originating switch interprets the dialed digits, and connects the call to the terminating switch over a dedicated route or trunk. This dedicated trunk starts at the originating switch and ends at the terminating switch. If the originating customer and the person the customer is calling are both U S WEST end-users, U S WEST will perform the originating and terminating switch functions. In this situation, U S WEST also will provide transport between the two switches.

Q. HOW DO THE NETWORK FUNCTIONS DIFFER FOR A LOCAL CALL WHEN THE ORIGINATING CALLER IS A U S WEST CUSTOMER AND THE PERSON RECEIVING THE CALL IS A CUSTOMER OF ANOTHER CARRIER?

A. When another carrier is involved, U S WEST performs the originating switch function and provides transport of the call over a Local Interconnect Service ("LIS") to the point of interconnection. The CLEC then transports the call from the point of interconnection to its end office switch where it performs the terminating switch function and delivers the call to its end-user. This process works in reverse when a local call originates from a CLEC end-user that is calling a U S WEST end-user.

Therefore, in the case of a local call, both the originating and terminating switch know where the call is going and where the call came from, and the call stays on the local network in the local calling area.

Exhibit A, attached to my testimony, illustrates the way a local call is made between two switch providers from a technical perspective. The diagram shows the progress of a local call. The local call begins with the originating end-user and travels over a dedicated path to the originating switch. The call then travels from the originating switch over a dedicated trunk to a terminating switch. Finally, the local call travels from the terminating switch to a dedicated path that runs to the end-user that is the recipient of the call. In the aggregate, each of these steps gives rise to a dedicated path running from the originating caller to the recipient of the call.

Q. HOW LONG DOES THIS DEDICATED PATH REMAIN IN PLACE?

A. The dedicated voice path between the originating caller and the recipient of the call remains in place for the entire duration of the call. When either the originating or terminating user hangs up, the voice path is released. Call duration is referred to as hold time and is recorded as usage.

Q. PLEASE DESCRIBE A LONG DISTANCE CALL.

A. In contrast to a local call, a long distance or toll call originates in one local calling area and terminates in a different local calling area. These calls are usually longer in duration than local calls.

Q. IS THERE MORE THAN ONE TYPE OF LONG DISTANCE CALL?

A. Yes. There are four types of long distance calls: (1) Intrastate intraLATA calls, which are calls that originate and terminate within a Local Access and Transport Area ("LATA") within a state; (2) Intrastate interLATA calls, which originate and terminate in different LATAs within one state; (3) Interstate long distance calls, which are calls that originate and terminate in different states; and (4) International calls, which originate in one country and terminate in another country.

Q. PLEASE DESCRIBE THE NETWORK FUNCTIONS FOR A LONG DISTANCE CALL.

A. Long distance calls typically involve more than one carrier’s network. They are billed by minutes of use, whereas local calls are generally billed through a monthly rate that is not affected by the length of calls. Long distance calls are transient in nature, meaning that after they pass through the originating switch, they pass through at least one other switch or switching network before reaching their final destination. In addition, there usually is more distance between the point of origin and the point of destination for a long distance call when compared to a local call.

Long distance calls can be direct connected from the originating switch to the long distance provider, or routed from the originating switch through an access tandem for connecting to the long distance provider. For simplicity, I will use the direct connection architecture in my testimony.

Although the same switch can be used to originate both a local call and a long distance call, the switch in a long distance call does not directly connect the long distance call to its final destination. By contrast, as I discussed earlier, with a local call, the originating switch knows the destination of the call and a dedicated path running directly to the recipient of the call is established. With a long distance call, the originating switch directly connects to an Inter Exchange Carrier ("IXC") to complete the call; it cannot directly connect to the final destination because it does not know that destination. In other words, a long distance call is handed off to another carrier – the IXC – for delivery to its final destination. It is the IXC's switch that knows where the call originated from and where it is going to terminate. The terminating switch network receives the call from the IXC and completes the call. Unlike the terminating switch in a local call, the terminating switch in a long distance call does not know where the call originated.

Q. HOW IS A LONG DISTANCE CALL CONNECTED?

A. The originating local exchange provider switches the call and delivers it over a dedicated trunk to the IXC's point of interconnection. The IXC then transports the call to its switch for routing instructions based on the digits that the originating customer dialed. The IXC then transports the call over its network to the point of interconnection with the terminating provider. The IXC hands off the call to the terminating customer's service provider at the point of interconnection. The terminating provider transports the call to its switch, where the call is then switched and routed to the receiving customer. This process is illustrated in Exhibit B, attached to my testimony, which shows a side-by-side comparison of a long distance call and an ISP call.

Q. PLEASE DESCRIBE THE NATURE OF A CALL PLACED TO AN INTERNET SERVICE PROVIDER USING A DIAL-UP METHOD.

A. An ISP call typically is a call that is delivered to the ISP server by a local exchange provider. The ISP takes the call and delivers it over the Internet backbone to a remote hub specified by the Universal Resource Locator ("URL") address that the originating end-user designates.

Q. PLEASE DESCRIBE THE NETWORK FUNCTIONS FOR AN ISP CALL.

A. A customer of an ISP, an end-user making an Internet call, is seeking to connect with the ISP that is providing the end-user with access to the Internet. Assuming the use of a dial-up connection, the end-user connects to its ISP using the public switched telephone network. Dial-up ISP calls use the same switching and transport network as voice calls. The same switch is used to originate ISP calls as is used to originate local and long distance calls. The originating end-user's local exchange provider takes the call to the originating serving central office, switches the call and delivers it to the ISP. The ISP then takes the call and routes it to the appropriate Internet hub using the URL designated by the originating user.

Although only one URL can be specified at a time by the end-user, the URL can be changed as often as the end-user desires on any one call to an ISP. For example, after the end-user connects to the ISP, the first URL may be the web site of a vacation resort. After accessing the resort to determine the availability of a room, the end-user can make a reservation on the web page. After obtaining a hotel reservation, the end-user may then change the URL to an airline in order to obtain a flight reservation. There is no limit to the number of web sites the end-user can access on a single call to an ISP, and this unlimited access can contribute to the length of ISP calls.

National ISPs, sometimes called backbone providers, use dedicated lines to connect directly to the Internet backbone at one or more Network Access Points or Metropolitan Area Exchanges. Smaller regional networks and local ISPs, by contrast, obtain trunks from local telephone companies to connect to national ISPs.

Q. HOW DOES THIS PROCESS WORK WHEN THE ISP IS NOT ON THE NETWORK OF THE LOCAL EXCHANGE PROVIDER THAT PROVIDES DIAL TONE TO THE ORIGINATING END-USER?

A. In this situation, after the originating end-user places a call to its ISP, the local exchange provider that provides the end-user with dial tone switches the call and delivers it over a LIS trunk to the provider on whose network the ISP resides. That provider, whom I will call the ISP serving provider, delivers the call over trunks that the ISP has purchased from the serving provider. Upon receiving the call from the serving provider, the ISP connects the call to its server using a modem pool. The server then transmits the call over the Internet backbone to the web site that corresponds with the URL address the originating end-user specified.

Q. IN YOUR OPINION, IS AN ISP CALL THAT ORIGINATES ON U S WEST'S NETWORK AND IS DELIVERED TO A CLEC FOR DELIVERY TO AN ISP MORE ANALOGOUS TO A LOCAL CALL OR

AN INTERSTATE LONG DISTANCE CALL?

A. From a technical perspective, an ISP call is more analogous to a long distance call than it is to a local call. With both long distance calls and ISP calls, the switch of the originating carrier does not know the ultimate destination of the call, and the originating carrier does not deliver the call to its ultimate destination. Instead, for both types of calls, the originating provider delivers the call to another carrier – an IXC or a CLEC serving an ISP – and that carrier must identify the network for which the call is destined and deliver the call to that network. The originating provider does not have a direct path to the final destination of the call and does not know which network the call ultimately reaches.

In contrast to long distance and ISP calls, with a local call, the switch of the originating carrier knows the destination of the call, and the originating carrier has a direct path to the final destination. The carrier that originates a local call identifies the destination of the call and delivers the call to that destination. Unlike long distance and ISP calls, the originating carrier does not hand off a local call for delivery to the final destination.

Q. HAVE YOU PROVIDED A DIAGRAM THAT DEMONSTRATES THE SIMILARITIES BETWEEN ISP AND LONG DISTANCE CALLS?

A. Yes. Exhibit B to my testimony is a side-by-side depiction of the routing of a long distance call and an Internet call. The diagram shows that for both types of calls, the originating provider delivers the call to an IXC or a CLEC serving an ISP, and the IXC or CLEC delivers the call to the network where the call is ultimately terminated.

Q. DOES THE ROUTING PROCESS FOR ISP CALLS REQUIRE THE CALLS TO CROSS STATE BOUNDARIES?

A.Yes. As I discussed earlier in my description of Internet calls, upon receiving a call, an ISP must deliver it over the Internet backbone to a remote hub specified by the URL address that the originating end-user designates. The Internet backbone is used to access computer servers that manage the resources on a network and that provides a centralized storage area for software programs and data, more commonly known as web sites. The remote hubs to which ISP calls are delivered often are located outside the state of the originating user.

The remote hubs – also referred to as Network Access Points and Metropolitan Area Exchange locations – in the continental United States are located in Chicago, New York, Washington D.C., Houston, Dallas, Los Angeles, San Jose and San Francisco. For ISPs in Washington, the closest remote hub is located in San Francisco or San Jose. Accordingly, many Internet calls placed by end-users in Washington cross state lines.

III.INTERNET TRAFFIC REQUIRES U S WEST TO SUBSTANTIALLY INCREASE THE CAPACITY OF ITS NETWORK

Q. HAS THE INCREASE IN USE OF THE INTERNET IN RECENT YEARS HAD AN EFFECT ON U S WEST'S NETWORK?

A.Yes. The emergence of the Internet as a primary mode of communication in recent years has presented many engineering challenges for facilities-based providers throughout the country. The use of the Internet has dramatically increased traffic volumes and, as a result, has required providers to substantially increase the capacity in their networks. The additions that U S WEST has made to

its network in Washington and in other states in response to Internet traffic have required millions of dollars in capital expenditures and will continue to require substantial, additional expenditures into the foreseeable future. For example, in Washington alone, U S WEST's capital expenditures for interoffice facilities, which consist primarily of trunking facilities, increased by nearly 100 percent from 1998 to 1999. In the same period, investment in U S WEST's Washington network for switching increased by more than 35 percent. U S WEST does not specifically track the amount of its capital expenditures that are related to increases in Internet traffic, and the increases in capital expenditures from 1998 to 1999 are not all related to growth of this type of traffic. Nevertheless, the demands placed on the network from Internet traffic were a significant cause of these increases in capital expenditures.

As set forth in the testimony of other U S WEST witnesses, U S WEST believes that the Commission should consider these capital outlays as part of the overall picture that must be evaluated to develop a fair and appropriate compensation scheme for ISP-bound traffic.

Q. HOW HAS INTERNET TRAFFIC LED TO THE NEED FOR U S WEST TO AUGMENT ITS WASHINGTON NETWORK?

A.Internet traffic has caused substantial increases in network usage, and this increased usage has led to the need for U S WEST to increase the capacity of the Washington network. "Usage" has a specific meaning in the context of telecommunications networks. It refers to the length of time a call is in place over a

period of time. Telephone engineers rely on usage statistics and data to plan and design the network. The amount of anticipated usage indicates the amount of trunking and switching capacity an engineer will include in a network design or plan and, in turn, the amount of capital a company will invest to add to the network.

Q.IS THERE A RELATIONSHIP BETWEEN CALLS THAT HAVE LONGER HOLD TIMES AND INCREASED USAGE IN THE NETWORK?

[PROPRIETARY DATA BEGINS]

A.

[PROPRIETARY DATA ENDS]

Q. PLEASE EXPLAIN HOW INTERNET CALLS AFFECT USAGE.

A. Because of the longer hold times of Internet calls, this type of traffic has significantly increased network usage. It is common for many Internet users to stay on the Internet for hours at a time. Telephone companies are now experiencing levels of network usage that are unprecedented because of the dramatic increase in Internet calls and the long hold times that characterize these calls that are placed over the same switching and transport network as voice calls.

Q. HOW DOES THE INCREASED USAGE RESULTING FROM INTERNET CALLS AFFECT THE U S WEST NETWORK?

A. The increased usage caused by Internet traffic has required U S WEST to increase by a large amount the volume of trunks in its network, including in its Washington network. These trunk additions must be supported by additional switch equipment, switch capacity to switch the load, and additional facility routes. Switch capacity additions are needed because as long as a dedicated path is held up, the switch is performing functions to make sure the call stays up until the customer requests a disconnect, more commonly referred to as call supervision.

As long as dial-up ISP calls continue to rely on the same switching and transport network that is used for voice calls, increases in Internet traffic will require U S WEST to increase the capacity in its networks.

Q. ARE THE DEMANDS ON U S WEST'S NETWORK RESULTING FROM INTERNET TRAFFIC INCREASED BY COMPETITIVE CARRIERS THAT MAINTAIN DATA NETWORKS SEPARATE FROM VOICE NETWORKS?

A. Yes. My understanding is that Sprint has a data network that is separate from its voice network and is dedicated exclusively to carrying data traffic. The use of a separate data network that utilizes data switches indicates that Sprint is anticipating very high volumes of data traffic. These volumes will require U S WEST to install in its network large numbers of one-way, dedicated trunks and switch ports at very substantial cost. In addition to these trunks and ports for Sprint's data network, dedicated trunks and switch ports for Sprint's voice network also will be needed. These additions to the network to support Sprint's data services, as well as the services provided on its voice network, will require significant expenditures.

Q. WHAT WOULD OCCUR IF U S WEST DID NOT ADD FACILITIES TO ITS NETWORK

TO ACCOMMODATE INTERNET TRAFFIC?

A. As I explained earlier, regular voice calls and dial-up ISP calls share the same switching and transport network. If U S WEST did not add to its network to account for the increased usage caused by Internet calls, there eventually would not be enough trunks to connect calls. Once a trunk group reaches the maximum amount of usage, measured in centum call seconds ("CCS"), no other calls can be carried on that trunk group. If no trunks are available, call blocking will occur. Since trunk groups are engineered to meet usage requirements, without the capital outlays that U S WEST has made in response to the increased usage from Internet traffic, call blocking levels would be substantially higher.

IV.U S WEST IS ABLE TO MEASURE INTERNET TRAFFIC AND TO DISTINGUISH IT FROM VOICE TRAFFIC.

Q. DOES U S WEST HAVE THE ABILITY TO MEASURE INTERNET TRAFFIC AND TO DISTINGUISH IT FROM VOICE TRAFFIC?

A.Yes. As explained in the testimony of Larry Brotherson, U S WEST has developed a procedure for identifying Internet traffic and measuring it separately from voice traffic. The procedure consists of three steps. First, U S WEST has implemented the CroSS7 system designed by Agilent, formerly known as Hewlett Packard, which is designed to capture and track call set-up and traffic flow information for calls using SS7. Using CroSS7, on a state-specific basis, U S WEST captures data relating to calls originated by U S WEST customers and delivered to CLEC customers. The data U S WEST captures using CroSS7 includes the number of calls and the minutes of use per call. Second, to identify modem traffic,

U S WEST applies an algorithm to the call detail records stored by CroSS7. As Mr. Brotherson explains in his testimony, the algorithm identifies modem traffic based on call characteristics that are common to Internet calls. Third, after applying the algorithm and identifying the calls that meet the characteristics of modem traffic, U S WEST utilizes a modem identifier to determine whether calls initially identified as modem traffic through application of the algorithm are, in fact, Internet traffic. Mr. Brotherson also explains this third step in his testimony.

Q. PLEASE DESCRIBE THE CROSS7 SYSTEM THAT U S WEST USES TO COLLECT THE CALL DATA THAT ARE USED IN THIS PROCESS.

A.CroSS7, or "Call Records Over SS7," is a billing application of acceSS7 that is used primarily to measure call characteristics for billing purposes. CroSS7 collects and formats call data from the U S WEST Signaling System Seven ("SS7") Network that can be used for billing on a usage-sensitive basis and to monitor call activity. The data that CroSS7 compiles, known as call detail records, include the start and end times for calls, which equates to call hold times.

The SS7 Network from which CroSS7 creates call detail records is used in connection with setting up, supervising, and releasing calls. SS7 is an out-of-band network, meaning that it is separate from the network that carries voice calls. The SS7 network links end office switches to Signal Transfer Points ("STPs") for the purpose of transmitting and receiving call-related messages. Through a series of messages generated from switching equipment, SS7 sets up, supervises, and releases the talk paths or trunks that are used for calls. The first SS7 message, known as the Initial Address Message, occurs when the originator of a call picks up a telephone and dials the digits of a phone number. After the call is connected for conversation, and one of the parties to the call hangs up the telephone, SS7 generates a release message that releases the dedicated talk path or trunk that was used for the call. The call detail record that CroSS7 creates for each call includes the amount of time from the initial address message to the release message, which is an accurate measure of the length of each call, or the call hold time.

Q. IS CROSS7 USED BY OTHER COMPANIES IN THE TELECOMMUNICATIONS INDUSTRY?

A. Yes. A review of Hewlett Packard's web site shows that CroSS7 is widely accepted and used in the industry. As shown in the excerpt from the web site, attached as Exhibit C of my testimony, GTE, NYNEX, Bell Atlantic and Ameritech have deployed the Agilent acceSS7 system in their SS7 networks.

V.THE EFFICIENCIES OF NETWORKS DESIGNED TO SERVE PRIMARILY INTERNET TRAFFIC

Q. DOES SPECIALIZING IN INTERNET TRAFFIC PERMIT A CARRIER TO DESIGN A NETWORK TO MAXIMIZE EFFICIENCIES AND ECONOMIES IN HANDLING THAT TYPE OF TRAFFIC?

A. Yes. A carrier that handles large amounts of Internet traffic can design its network to maximize cost efficiencies associated with that traffic.

Q. WHY IS THIS ISSUE RELEVANT TO THE ISSUES THAT ARE BEFORE THIS COMMISSION?

A. This issue is relevant because of Sprint's request that U S WEST pay reciprocal compensation for ISP-bound traffic that U S WEST delivers to Sprint. If Sprint is specializing in handling ISP traffic, the costs it incurs to handle that traffic likely are less than the costs U S WEST incurs, for example, to terminate voice traffic. In addition, the per minute of use cost of ISP traffic usually is lower than the comparable cost associated with voice traffic.

Q. FROM AN ENGINEERING PERSPECTIVE, WHICH TYPE OF NETWORK IS MORE EFFICIENT - A NETWORK THAT SERVES A DIVERSE POPULATION OF RETAIL CUSTOMERS OR A NETWORK THAT SERVES MOSTLY ISPs?

A. A network that serves mostly ISPs is likely to be more efficient because the service provider is able to anticipate the load and does not have to build to accommodate variable peaks that are inherent in a diverse network. A network that serves mostly ISPs is built to the needs of the ISP customer only. Also, the needs of most ISPs are similar, while the needs of a diverse customer base are vastly different, and the local exchange provider serving diverse customers will attempt to meet those different needs. This means that the network of the provider with diverse customer needs will not be built for efficiency only, but instead, must be built to serve other, diverse needs.

For instance, the voice network is engineered by the average amount of time customers want to use it. If the only service provided is voice service, the voice network will be very efficient because the network knows how voice calls work and knows how different voice services, such as voice mail, work. As the demand for voice services increases, the network is built to meet those demands efficiently. With the introduction of ISP calls on the voice network, however, there is no longer an available forecast of growth or anticipated load, usage, or demand for voice calls alone. This means that efficiency of the voice network must give way to meet the demands of both voice customers and ISP customers whose needs differ greatly.

Q. DOES SPRINT'S USE OF A DATA NETWORK SEPARATE FROM ITS VOICE NETWORK INCREASE THE EFFICIENCY WITH WHICH IT CAN HANDLE INTERNET TRAFFIC?

A. Yes. The use of a network designed specifically to handle data traffic allows Sprint to handle this traffic with increased efficiency and with a minimization of costs. Data networks, referred to as packet switch networks, are shared networks that deliver traffic in bursts called packets. The costs of routing traffic over a packet switch network generally are less than the comparable costs in a voice network. As stated in Newton's Telecom Dictionary, "packet switched networks are shared networks, based on the assumption of varying levels of latency and, thereby, yielding a high level of efficiency for digital data networking." Newton's Telecom Dictionary, Volume 15 at 580 (February 1999).

Q. PLEASE CONTRAST HOW DATA NETWORKS AND VOICE NETWORKS ROUTE CALLS.

A. In a packet switch network, data is divided into individual packets, and each packet is assigned the address of the recipient of the call, much like a letter that one drops into a mail box. Each packet is sent over the network to the recipient of the call, and the packets that comprise one call can take different routes to the recipient. The individual packets arrive at the destination address and are delivered in the proper sequence to the recipient. Significantly, the packet switch network over which these packets travel is a shared network, meaning that multiple calls traverse the network simultaneously.

In contrast, voice calls are carried over a circuit switch network. This network creates private paths for each call that are dedicated to the user for the entire time of the call. Once a connection is established, the path is used for one purpose and by a single user for the entire length of the call. No other user can use this dedicated path until the first user vacates or disconnects the use of the dedicated path. In other words, unlike the routes in a packet switch network, the routes created in a circuit switch network are dedicated to a user for the length of a call and are not shared. In addition, the circuit network creates direct routes that a call must follow, while the packets in a packet switch network can follow multiple routes.

Q. ARE THERE DIFFERENCES IN COSTS PER CALL BASED ON THE USE OF A PACKET SWITCH NETWORK OR A CIRCUIT SWITCH NETWORK?

A. Yes. The use of a packet switch network results in a lower cost structure than the use of a circuit switch network. As reflected in the definition of a packet switch network that I cite above from Newton's, packet switch networks handle digital data with a very high level of efficiency. This efficiency leads to lower costs.

First, for voice calls, the processor in a circuit switch must set up a dedicated path for each call. The cost that results from the creation of these paths is traffic-sensitive, meaning that it varies based on the number of calls that are made. Packet switch networks, on the other hand, utilize data switches, referred to as ATM switches, that have minimal set-up functions and associated costs. The difference in set-up functions and costs arises from the fact that a packet switch network does not set up dedicated call paths. This difference in set-up functions contributes to the lower cost structure for data traffic carried over a packet switch network.

Second, data networks utilize digital, one-way trunks that run to the ATM switches. In both a data network and a circuit network, the cost of the facilities that are connected to switches are traffic-sensitive in that they vary based on the minutes of use per trunk group. Because the average data call is substantially longer than the average voice call, the trunks in a data network have a higher utilization rate than the trunks in a voice network. Stated another way, there are more minutes of use per trunk group with data trunks than with trunks in a voice network. Trunks on a data network also have higher utilization rates than trunks on a voice network because during off-peak hours, the amount of data traffic tends to be higher than the amount of voice traffic. These higher utilization rates for data trunks contribute to the lower cost structure of data calls.

Q. ARE THERE ANY OTHER FACTORS THAT LEAD TO LOWER COSTS FOR DATA CALLS THAN FOR VOICE CALLS?

A. Yes. There is at least one additional factor that contributes to the lower cost structure of data calls. Data networks employ a process known as statistical multiplexing that reduces the per unit cost of data calls. The use of an ATM switch involves statistical multiplexing of traffic from a number of various sources. Through this process, a data carrier can place 108 data calls on each DS1 facility that is connected to an ATM switch. By contrast, on a voice of network, only 24 calls can be placed on a DS1. This difference in the number of calls that can be placed on a DS1 through statistical multiplexing contributes to the lower cost structure of ISP calls.

Q. DOES THIS COMPLETE YOUR TESTIMONY?

A. Yes it does.

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IN THE MATTER OF THE PETITION OF	**)**	
SPRINT COMMUNICATIONS COMPANY L.P.	**)**	
FOR ARBITRATION OF INTERCONNECTION	**)**	**DOCKET NO. UT-003006**
RATES, TERMS, CONDITIONS AND	**)**	
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WEST COMMUNICATIONS, INC.	**)**	

EXHIBITS OF

JOSEPH CRAIG

U S WEST COMMUNICATIONS, INC.

April 26, 2000