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BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

IN THE MATTER OF THE PETITION OF QWEST CORPORATION FOR ARBITRATION OF AN INTERCONNECTION AGREEMENT WITH UNION TELEPHONE COMPANY dba UNION CELLULAR UNDER § 252 OF THE FEDERAL TELECOMMUNICATIONS ACT OF 1996	)	**Docket No. 04-049-145**

POST SURREBUTTAL TESTIMONY

OF

HENRY D JACOBSEN

FOR

UNION TELEPHONE COMPANY

October 26, 2007

Q. Please state your name and business address.

A. My name is Henry D Jacobsen, and my business address is 1496 Mountain View Drive, Lyman, Wyoming 82937.

Q. Are you the same Henry D Jacobsen who previously filed Post-Rebuttal Testimony on March 19, 2007 in this proceeding that the Commission adopted by order dated April 10, 2007?

A. Yes, I am.

Q. What is the purpose of your post surrebuttal testimony?

A. The purpose of my surrebuttal testimony is to respond to the post surrebuttal reply of Qwest witness Peter Copeland, dated September 28, 2007 and the Rebuttal Testimony of Division of Public Utilities (DPU) witness Paul Anderson, dated October 12, 2007. Specifically, I disagree with the representations made by Peter Copeland with respect to my prior testimony, and the assumptions made by Mssrs. Copeland and Anderson in their cost analyses.

Q. What observations can you make about the TELRIC pricing in general?

A. Total Element Long-Run Incremental Cost (TELRIC) was developed as a means – however difficult, controversial or flawed – for the incumbent local exchange carrier (ILEC) to resolve price and cost disputes on access charges with the competitive local exchange carriers (CLECs). At the heart of the TELRIC analysis is the development of "forward looking costs" for an efficiently-configured and operated network by a carrier other than the ILEC. An additional requirement is that the network elements to be included in the "CLEC" cost model must be traffic-sensitive (TS).

Q. What makes TELRIC pricing assumptions difficult for wireless network analysis?

A. TELRIC envisioned an environment in which network access was similar for the two networks in dispute. What makes this particular arbitration difficult is that it is *not* a comparison of similar access technologies. Wireless adds a dimension of *mobility* as a design constraint, and utilizes the scarce resource of *radio spectrum*.

Q. Was this difficulty recognized by Mr. Anderson?

A. I believe so. He states in his testimony that the HAI 5.2a cost model[1] for landline based ILEC companies "… is not adaptable to and will not capture costs associated with a wireless network…It does not model or contain algorithms pertaining to wireless elements."

Q. In light of this, how did he proceed with his analysis?

A. Although Mr. Anderson recognizes this flaw in the historical cost models used by the DPU, he nevertheless proceeds to analyze the cost structure of a wireless network using the identical arguments applied to landline networks. He quotes, as his only justification, an article published in a Korean Technical Journal[2], based on technology and interconnections policy in Korea.

[1] Cost models recommended by the Commission, and historically used by the DPU for landline based ILEC companies.

[2] Moon-Soo Kim, "The Criteria, Procedure and Classification of Traffic-Sensitive and Not-Traffic-Sensitive Components: A Case of CDMA Mobile System". This work was supported by Hankuk University, Yongin, Gyeonggi-do, Korea. Dr. Kim candidly states "Mobile communication network structures and systems are technically different from those of fixed networks. Morover, there have been insufficient studies on TS and NTS facilities in mobile telecommunications systems." In deriving his separation of TS and NTS components of a wireless network, Dr. Kim reverts to definitions of TS and NTS components defined as far back as 1987, in an environment of predominantly landline services. His definitions of transmission, switching, powering and signaling are derived from landline definitions that are technically different in the wireless network. In describing his conclusions further, Dr. Kim further states "…this figure [outlining TS and NTS breakouts for wireless] is a qualitative result of discussions of experts, economists, and managers related to mobile technology and interconnections policy in Korea… The range of TS and NTS for each function can be changed and corrected by the operator, country, or regulator in technology-specific cases."

Q. Why is this relevant to the testimonies previously filed in this case?

A. I believe the approach taken by both Anderson and Copeland attempt to force-fit a wireless network into a like-for-like comparison of a landline network. They do this by stripping away any cost component they feel does not correspond to landline service. As will be explained in greater detail in this testimony, issues of mobility, coverage, modernization, and the design constraints for maintaining remote facilities, are fundamentally different for wireless services than for landline services. Both Peter Copeland and Paul Anderson hold fast to a strict and narrow interpretation of TELRIC in the context of landline services, and casually push aside these significant and higher costs for a wireless network.

Q. Are there specific study deficiencies identified by Mr. Anderson that are technology based?

A. In addition to specific issues he recognizes in the Union cost model, Mr. Anderson makes the following significant network and technology conclusions, shapely largely by the work published in Korea:

a. Placement of future cell tower locations based on future demand is speculative and should not be included in a TELRIC cost model. Cell tower sites are built to capture new subscribers.

b. The use of a “fill factor” (as included in the HAI model) to account for short-term growth and operating efficiency.

c. Failure to use a “sharing model” in Union’s cost model.

d. Coverage (specifically, the extension of coverage) does not meet a “traffic sensitive” standard, thus future cell sites are to be excluded from the study.

e. "Minimum" facilities for a wireless installation are not driven by call volume, and are thus not traffic sensitive. Antennas and cables are not traffic sensitive.

f. "Growth jobs" in the wireless network occur on the same interval as central office growth jobs.

g. Modernization is not considered to be traffic sensitive.

Q. Which of these do you feel to be most fundamental error in Mssrs. Anderson's and Copeland's conclusions?

A. I believe there are two fundamental errors in their testimonies. Both Anderson and Copeland take liberties with the concept of traffic sensitivity (TS) as defined by the FCC[3], which simply states that traffic sensitive facilities vary in proportion to the number of terminating calls. In telephone networks, the inclination or desire to make calls is measured in call attempts, and the amount of calling is measured in MOUs[4]. Traffic facilities are always associated with a grade of service (GOS), that allows usage to translate into the number of required facilities. GOS is typically in percent call loss. Wireless channels are shared by all customers wanting service, and must be increased as more calls are made, so they logically qualify as TS facilities under the FCC definition.

Q. If it is so obvious, why does Qwest argue that wireless access facilities are NTS?

A. Since Union Wireless could not provide actual traffic data to verify the obvious, Qwest contended that Union could not meet its burden-or-proof requirement of TS. When Union *was* able to produce such data, Mr. Copeland responded in two ways: first, that Union

[3] FCC 96-394. In the Matter of Implementation of the Local Competition, CC Docket No. 96-98, and Interconnection between Local Exchange Carriers and Commercial Mobile Radio Service Providers, CC Docket No. 95-185, September 27, 1996.

[4] MOU: Minutes of usage

withheld traffic data when such data was available; and second, that the information provided to Qwest was incomplete.

Mr. Copeland represents that Union purposely withheld critical traffic data from Qwest until March 15, 2007. In its original data request, Qwest specifically requested Union to provide voice *capacity* and capacity *utilization* for each cell site. Mr. Copeland confuses the issues of *usage* with that *capacity* and *utilization*. As mentioned earlier, TS elements in a network are designed around a busy hour grade of service. Prior to March 2007, Union only collected total daily/total weekly usage values, data that is meaningless for identifying capacity and utilization[5]. Without knowing the hourly distribution of traffic (on which objective grade of service is maintained), it was not possible for Union to respond to Qwest's 2006 request for identifying voice *capacity* and capacity *utilization* for a cell site until a more sophisticated measuring system was put into service. Had Qwest been more specific in its 2006 request and asked for *usage*, Union could have complied.

Union put into service a new traffic monitoring and usage collection system in the first quarter of 2007. Upon test and acceptance of this system, Union complied with the original data request promptly and completely, under my rebuttal testimony. Mr. Copeland misrepresents the network usage report provided in my testimony as being limited to the single network component of "radio channels." In fact, the network report included all components of the wireless infrastructure, including radio channels,

[5] For example, 1200 minutes of daily *usage* could be evenly divided throughout the day (50 minutes/hour), or the entire 1200 minutes could occur within one hour.

aggregated BSC-BTS transport, as well as all telephone trunking components of the switch-to-switch network supporting wireless traffic.

Q. Has the delivery of traffic data changed Qwest's approach to this proceeding?

A. I believe that Mr. Copeland has conceded the point that the access portion of Union's wireless network is traffic sensitive (TS) based on the FCC definition. He therefore shifts his argument to a TELRIC concept, that of cost sensitivity (CS), as if to argue that they are two very different concepts. In changing tactics, he dismisses the FCC definition of TS, as provided in my testimony and used throughout the industry, by arguing that such an "ipso facto" definition of *TS* does not constitute *CS*.

Q Why is this significant?

A. Typically, if traffic increases, and more facilities are required to serve that traffic, network costs also go up. This makes TS and CS equivalent, unless the requisite "more facilities" are free. Both Copeland and Anderson contend that since some of Union Wireless's sites are under-utilized, they actually do have "free capacity", and therefore, cannot be considered CS. Copeland takes the analysis further by conveniently defining, independent of busy season traffic, growth rates, etc., those sites that *he* believes have such spare capacity, and amends Union's cost study accordingly. Paul Anderson adopts a similar strategy, which he adopted from the Korean study.

Q. How do you account for the idle capacity in Union Wireless's network?

A. TELRIC analysis is based on forward-looking costs for an efficiently configured and *operated* network. Wireless facilities are not easily accessible, as most cell sites are on remote and/or high ground and experience extremes in weather. Access to these sites,

particularly in the winter, can takes hours[6]. In order to meet *uptime* requirements in the network, an efficiently *operated* network – totally envisioned in TELRIC rules – requires electronic redundancy in the radio systems. This operating requirement places a minimal cell site design with two radios (16 channels) per sector. Both Paul Anderson and Peter Copeland fail to consider efficient operations as a TELRIC consideration, and would be content to penalize Union simply for serving a rural market with reliable services. Union's network design is illustrated in Exhibit 19.

Q. Is there anything else about "traffic sensitivity" that is different for a wireless network?

A. Yes. The FCC definition of TS is very broad, and speaks only in terms of facilities that vary with the number of calls. In a landline network, traffic sensitivity is one-dimensional, that is, it only depends on the availability of an unused or idle circuit. In a wireless network, traffic sensitivity is two-dimensional, that is, it depends on the availability of an idle radio channel, as well as the presence (and strength) of that radio channel. In the latter case, existing customers lose service when they pass out of cell coverage or when they enter facilities that block the radio channel (i.e., a *Walmart* phenomenon). The rate or percentage of these *dropped* calls is routinely measured in a wireless network, and is remedied only by the construction of an *additional* cell site(s) that either extends coverage or generates a stronger local signal. Unlike construction in landline networks – that primarily serve new customers – these network additions in a *wireless* network are in response to additional usage requested by *existing* customers.

[6] Since radio signals travel line-of-sight, wireless sites are deployed on "high ground", typically mountain and hill tops. Winter access to these sites is often difficult, e.g., once an alarm is received, technicians must frequently deploy snow-cats to reach the site. In some instances, technicians must snow-shoe into the cell site to perform repairs. This is markedly different from landline facilities that are located in local, secure, easily-accessed wire center buildings.

With each improvement in coverage, more call attempts of existing customers are served, and the FCC definition of TS is satisfied. The essence of this discussion is that the inherent difference between landline and wireless networks is the element of mobility. Mr. Copeland and Mr. Anderson infer that because there is no concept of mobility in a landline network, such costs must be excluded in the TELRIC process. My response is that it is this essential difference between the networks that argues for an asymmetric cost structure in interconnection compensation. Mobile access in the public telephone network is a reality, with more wireless lines in service in the United States than landlines. It is unreasonable to turn a blind eye to this reality by saying, "mobility doesn't exist in a landline network, so it must be excluded from a TELRIC cost study of a wireless network."

Q. Why effect does this have on the testimonies of Anderson and Copeland?

A. Both Anderson (who quotes the Korean paper as a "cited authority") and Copeland argued that new cell sites served only to expand coverage to "new" – not "existing" – customers, and therefore excluded the costs of new sites from their analyses. I believe this invalidates the conclusions reported in their testimony.

Q. What is the next significant error in Mr. Anderson's technical conclusions?

A. Complicating the issue of network growth and cost sensitivity, is the issue of *limited spectrum*. Union Wireless, like all other wireless carriers in the United States, purchases radio spectrum through FCC auctions. Union Wireless cannot add more channels than allowed in those licenses. Cell sites operate in a similar manner to commercial radio stations, in that adjacent cell sites must operate on different frequencies to avoid

interference. The available spectrum licensed to Union is therefore subdivided into transmit and frequency pairs, which in turn support individual channels.

Q. Does this have an effect on the traffic sensitivity of a cell site?

A. Yes. When additional cell sites are added to existing cell sites, the existing cell sites must frequently surrender some of their assigned frequencies to the new cell site(s) to avoid interference as illustrated in Exhibit 20. So, unlike the landline network which almost always has economy to scale, wireless networks can actually have a declining economy to scale, that is, an increasing cost to traffic growth. This misunderstanding of wireless network design is a major flaw in the cost analysis of both Qwest and Paul Anderson.

Q. How does Copeland handle the issue of new cell sites and cell site capacity?

A. Copeland demonstrates a severe lack of understanding when it comes to wireless network design. He proceeds to critique, then redesign, Union's wireless network based on a sales brochure for Nortel base stations. I believe this is disingenuous, given that he has no stated experience for doing so. He bases his redesign on the assumption that each S8000 cabinet can support eight radios, with two expansion cabinets that can also hold eight radios. Thus, Union Wireless can expand its network indefinitely with little cost. Thus a site has access to "free capacity" and is therefore not traffic sensitive. Whereas it is true that a Nortel S8000 cabinet *could* be equipped with expansion cabinets to provide up to eight radios per sector, this is virtually never done in practice. Multiple-cabinet solutions incur complex issues of expense, space, power, frequency utilization, antenna and cable management, signal loss in duplexing, etc. Suffice it to say, the strategy advocated by Mr. Copeland would violate every principle of "forward-looking and cost-efficient design"

required in TELRIC. Much of Mr. Copeland's subsequent cost analysis is based on this flawed understanding of network design, and is therefore quite useless.

Q. Mr. Anderson expressed concern about the excess capacity in Union Wireless capacity. He suggested an appropriate timeframe for growth projects "to help determine the degree of traffic sensitivity." Would you comment on this concept?

A. I believe Mr. Anderson's argument is that excess capacity is okay, provided it is within a justifiable timeframe for growth projects. Based only on his landline *central office* experience, Mr. Anderson considers a two-year interval to be *reasonable* for wireless facility growth jobs. Any capacity beyond the two-year window would constitute inefficient design, and therefore in violation of TELRIC guidelines. I have already commented on the operational requirements for radio diversity in a rural setting. I would add further that Union has well over two hundred operating cell sites, with the majority of cell sites serving three sectors. This is over six hundred radio sectors that require constant monitoring, administration, engineering and support. By Mr. Anderson's logic, Union would be required to engineer and implement an upgrade to a sector every working day to be TELRIC compliant. This would be an unsupportable level of engineering and construction. As with the Copeland testimony, a lack of wireless experience is reflected in the testimony of Mr. Anderson.

Q. Both Paul Anderson and Qwest argue that "minimum" facilities for a wireless installation are not driven by call volume, and are thus not traffic sensitive. Would you agree with their position?

A. Certainly not. Union serves a rural market that has existing customers that utilize "coverage" as it is made available. The traffic demand – existing customers requesting

service in that area – is traffic engineered within the context of minimum radio provisioning (one radio, eight channels per sector) with electronic diversity (second radio, eight additional channels per sector). These are appropriate operating efficiencies allowed under TELRIC guidelines.

Q. Mr. Anderson discusses the need to incorporate facility sharing in its cost structure. How would respond to this?

A. With respect to facility sharing, Mr. Anderson is not correct in his assumption that Union "may own most of its cell sites." Union leases property in the majority of cell sites it operates. In general, the small amount of sharing revenues serve to offset the operating expense of land leases and the payment of right-of-way fees, rather than as an offset to capital investment.

Q. Mr. Anderson concluded that antennas and coaxial cable are independent of the radios and are therefore not traffic sensitive. Do you agree?

A. No. Antennas and coaxial cable are closely coupled with the number of radios serving a sector. The FCC licenses for microwave require an antenna specification. Any microwave upgrade, due to traffic increases, will involve an antenna change-out as well. On the BTS side, radio projects that change coverage or capacity will generally require a different antenna strategy[7].

Q. Mr. Anderson argues that transport costs are only partially traffic sensitive. Do you wish to comment on this?

[7] These changes could include a change in operating frequency, radiating pattern, down-tilt capability, duplexing ports, etc. Since coaxial cable is typically cut to length at the time of install, antenna replacement may include a replacement of coaxial cable as well.

A. The wireless network requires a great deal of expensive backhaul from the cell sites to the base station controllers (BSCs) in Mountain View and Casper. In many cases, these radio costs are nearly equivalent to the capital cost as base station radios themselves. These microwave radios serve as access (to the switch), not transport (between switches). Anderson bases his testimony on his landline experience. However, there is no corresponding lengthy access in the landline network, where it is assumed that foreign exchange services (where the customer is outside the serving *wire* center of the switch) are insignificant. Since wireless access is not terminating into a switch port, per se (these sit behind the BSC), it is a different architecture than the landline network, where transport is entirely on the trunking[8] side of the switch. Anderson specifically mentions the HAI model's focus on the trunking side of the network, which is of little relevance to the high cost of traffic termination in a wireless network. This is one of the critical differences in access costs between wireless and landline networks that are at the heart of this docket.

Q. Paul Anderson considered "modernization" of a network to be non-traffic sensitive. This is a major component of network costs to exclude from the TELRIC cost model. Do you agree with his opinion?

A. Actually, it was Dr. Moon-Soo Kim who considered "modernization" of a network to be non-traffic sensitive. Mr. Anderson simply quoted the Korean position. Notwithstanding the frequency resources and spectrum policies of Korea, each technology shift within the domestic wireless industry (i.e., analog to TDMA to GSM to UMTS to LTE) has

[8] In telephone convention, the access side of the network is from a customer device, e.g., telephone set, to the telephone switch. The trunking side of the network is the interconnection between switches. Each call is comprised of two portions of access, and any inter-switch trunking required to connect the end devices together.

provided a marked improvement in spectrum utilization for voice calls. In Union's markets, the need to conserve and reuse its fixed spectrum resources – by adopting new technology – is essential to its ability to serve areas of increasing traffic. Union relies on network modernization to meet TELRIC's "forward looking and efficient" requirement of serving increasing traffic. It is the only means of truly expanding capacity, within a spectrum constraint, to meet an increase in traffic.

Q. What impact does this have on the alternative cost models developed by Copeland and Anderson?

A. The obvious impact is that the elimination of modernization costs significantly reduces network costs. But modernization also impacts the depreciation rate of wireless facilities. Wireless technology is experiencing a service life of about seven years. This is far shorter than the 14.5 year depreciation assumed by Mr. Anderson.

Q. Mr. Copeland also states that Union has objected to "reasonable requests for factual data concerning usage and capacity of network components that Union claims are traffic sensitive." How do you respond to this allegation?

A. It is interesting that in his objections, Mr. Copeland states that Union must base its study on *quantitative* evidence, while at the same time imposing data requests that required conjecture on the part of Union. The "reasonable requests for factual data" – which Union contended to be irrelevant or unreasonably burdensome and refused to answer – invariably began with a statement such as "suppose there were a …." In addition to being pure conjecture, Union accurately contended that such analyses were over-burdensome to the proceeding. However, by refusing to provide such *subjective* data, Mr. Copeland argues that Union has failed to meet its burden of proof in this docket. I find this logic to

be faulty. Qwest could impose any number of irrelevant or impossible analyses on Union, then argue that failure to provide constitutes a failure to meet a burden of proof.

Q. Mr. Copeland states that you have made misleading statements when comparing landline and cellular switches. How do you respond?

A. Mr. Copeland misrepresents my testimony. I have been an engineer in the telephone industry for over 35 years. I have never stated in any testimony that a telephone switch is not a shared resource. Many of the elements of a switch are used in "common" – as shared resources – such as "common battery", "common control", and so forth. I clearly stated that the element of landline switching that is not shared is the access portion of the network. The landline local "loops" are dedicated to a specific customer[9] and are insensitive to the amount of traffic the customer originates. This is in stark contrast to the access portion of a wireless network, in which the access medium (radio channels) are shared by all customers seeking service.

Q. Mr. Copeland states that the Utah Commission has ruled in the case of landline switches, a shared resource can be non-traffic sensitive if that resource is configured to include usage for a reasonable forecast period. Do you believe this is relevant in this docket?

A. Mr. Copeland fails to provide a reference for this purported ruling for *landline* switches, so it is difficult to know the context in which it was made, and for what components of the switch it applied. I look at this statement as a red herring intended to divert attention from the issues in this docket.

[9] In recognizing the loop's insensitivity to traffic the legacy "1FR" or "1FB" designation for single-party, flat rate, residential/business service commercially define a dedicated customer loop that is insensitive to traffic.

Q. Mr. Copeland concedes that a wireless switch is more expensive than a landline switch, due to its extensive electronics and control, but argues that this is irrelevant to the issue of additional cost. How do you respond?

A. I am having some difficulty following Mr. Copeland's logic. First, he argues that a landline switch is a shared (and therefore, usage sensitive component of the network), then, that it might not be if it is sized for future growth. He then argues that it's irrelevant in any case, since the additional costs are for the purpose of providing *mobility*. As stated earlier, I believe this fundamental difference in access is the specific issue of this docket. Wireless customers have a mobile service, and – as Mr. Copeland recognizes – it costs more to terminate a Qwest-originated call to a mobile customer than to a landline customer.

Q. Mr. Copeland argues that the landline digital loop carrier systems have a grade of service and are therefore "traffic sensitive," but are considered NTS in UNE rates. Do you agree?

A. I believe Mr. Copeland is mistaken in his statements. (He makes it clear that he has no direct knowledge of loop carrier, and is merely quoting second-hand information he received from Qwest engineers.) Much of the loop technology deployed today is in association with high-speed data services that are carried over fiber optics and terminate in DSLAMs.[10] These are traffic engineered for the data portion of the traffic they carry. Exclusive of data services, there are two general forms of landline "loops" from the customer premises to the telephone switch. One is dedicated copper-based facilities in

[10] A Digital Subscriber Line Access Multiplexer (DSLAM) allows telephone lines to make faster connections to the Internet. It is a network device, located near the customer's location, that connects multiple customer Digital Subscriber Lines (DSLs) to a high-speed Internet backbone line using multiplexing techniques. By locating DSLAMs at locations remote to the telephone company central office (CO), telephone companies are now providing DSL service to consumers who previously did not live close enough for the technology to work.

which each customer has an unshared facility; and a multiplexed loop carrier system, traditionally referred to as a "pair-gain" system[11] or Universal Digital Loop Carrier (UDLC) system. The latter provides a dedicated channel (vs. a dedicated pair of wires) without concentration and without grade of service engineering; they are correctly categorized as "non-traffic sensitive". In addition, there are intelligent loop systems that move the line port of the switch to the outside plant, e.g., Integrated Digital Loop Carrier [IDLC]. This is not traditional loop technology, as it supplies line concentration normally provided within the switch itself.

Q. Do you agree with Mr. Copeland's argument that since processors, common control, switching matrix and memory are sized for the life of a switch, they are not cost sensitive to increasing call traffic?

A. No. The only issue is that, being large network components, it costs more to expand capacity as traffic increases. Nortel, the vendor of Union's DMS switching platforms, has made available a series of switches of increasing capacity, e.g., the smaller Super Node – Size Enhanced (SNSE) switch, the SuperNode switch, and the XA-Core switch. As traffic increases to the designed limit of a switch, any company is required to add an additional switch, or to change out the processor of the existing switch, to carry more traffic. Union's GSM switch is SNSE-based, and is approaching its design capacity and design life. When these capacity constraints are exceeded, Union will be required to replace the switch with one of greater call carrying capacity.

[11] It is referred to as a "pair gain" system because the system appears to gain pairs in an existing cable. For example, two pairs of wire – which would normally support only two customers – can be used to carry 24, 48 or 96 multiplexed channels. The effect is that there is an apparent net increase, or gain, in the number of dedicated channels that can be provided.

Q. Mr. Copeland disagrees with your statement that if all cellular customers doubled their usage, twice as many end-to-end facilities would be required. How do you respond?

A. Mr. Copeland argues that due to idle capacity in the network, additional traffic can be carried without much network augmentation. Therefore, the network must be *cost* insensitive to increasing traffic, i.e., NCS. Mr. Copeland posed an imprecise question, and as a result, is taking my testimony out of context. The question was a hypothetical question whether a doubling of usage would result in a doubling of end-to-end facilities in the network. Within the context of slight efficiency gain due to higher traffic volume (marginal efficiency to scale), twice as much traffic would occupy twice as many radio channels, trunks, etc. I made no statement of whether this doubling of requirements would or would not exceed the installed capacity of the network.

Q. In a subsequent question, Mr. Copeland did ask Union to identify the network components required to accommodate a doubling of Qwest-originating calls? Why did Union decline to respond?

A. Union declined to respond because a response is problematic. To answer the question as posed by Qwest, it would be necessary to obtain, were it possible, every minute of traffic between Qwest and Union, for each cell site sector used by each call, for each hour of the day, week and month, overlay it on all facilities used by each call, perform an incremental peak-hour analysis of its impact on the network, and re-size the facilities accordingly. Such an analysis, if it could be done at all, would be incredibly time consuming. In addition to being irrelevant, Union contended that such an analysis was overly burdensome to the proceeding. As stated earlier, Qwest could impose any number

of impossible analyses such as this on Union, then argue that failure to provide constitutes a failure to meet a burden of proof.

Q. Mssrs. Anderson and Copeland raise the issue of data services, stating that Union heavily markets its data capabilities, and that network upgrades are driven by new and faster data services. Do you agree?

A. No. First, Union does not "heavily market" its data services. While it is true Union advertises the data capabilities of its GSM network, it is not a heavily marketed service and currently accounts for less than one percent of Union's monthly wireless revenue. Further, Mr. Copeland fails to understand the technical reasons for successor networks. Although it is true that next-generation networks have been increasingly data friendly, it is largely a side effect of improved frequency utilization for voice traffic, which heavily dominates wireless networks.

Q. Testimony on Mr. Copeland's revised cost models is addressed in Jason Hendrick's testimony. Do you have any technical concerns about the revisions Mr. Copeland proposes to Union's cost model?

A. Mr. Copeland has made several significant errors in his analysis. From a traffic engineering perspective, all of his utilization calculations are based on the carried load capacity of traffic-sensitive facilities, rather than offered load capacity. Mr. Copeland has based all of his capacity calculations on the basis of a five-day peak hour *average*, even though previous testimony by Union has clearly stated that its grade of service objectives are based on a peak-hour criteria. By failing to use Union's stated grade of service design objective, Mr. Copeland has understated Union's network utilization by at least thirty percent. Mr. Copeland is also utilizing data that is significantly reduced from Union's

busy season, which occurs in the summer months. This can be an additional forty to sixty percent higher than the data provided to Qwest. Together, these effects could be 100 percent error in Copeland's results.

Q. Do you agree with Mr. Copeland's assessment that there is a trend of decreasing traffic MOUs per BTS?

A. Mr. Copeland draws generalized conclusions based on limited data samples. He has taken two data samples reasonably close together in time, and extrapolated a future value. He completely disregards the fundamental principles of week-to-week and month-to-month traffic variations. His conclusions are totally unfounded on year-to-year true busy-season growth. Both within Union and within the wireless industry, MOU/user has been constantly increasing.

Q. **Do you have comments about the inclusion or exclusion of BTS related costs in Mr. Copeland's cost analysis?**

A. Mr. Copeland's response to this question is a study in double-speak. He states in his testimony that BTSs are traffic sensitive, but *not* cost sensitive to increasing call traffic. He then proceeds to incorporate BTS costs into his analysis, on the *possibility* a BTS might be cost sensitive to traffic. As if to concede the weakness of his argument due to the overwhelming body of evidence provided by Union, he states "this is to assure that there is a TELRIC BTS cost on the record, should it *somehow* be decided that some of the BTS costs are traffic sensitive, that is consistent with the *little* information that Union has provided in its reports as opposed to the 100 percent traffic sensitive assumption made in Union's most recent cost study." I object to the offhanded manner in which Mr. Copeland dismisses the extensive traffic data provided by Union on its wireless network, which

demonstrated without any doubt that wireless facilities and infrastructure are traffic engineered and are traffic sensitive to increasing traffic.

Q. Do you agree with Mr. Copeland's arguments that a BTS is not cost sensitive?

A. No. As before, Mr. Copeland moves quickly from NTS to NCS – from non-traffic sensitive to non-cost sensitive, by reverting to the previous discussion on marginal unused capacity in Union's wireless network. As stated earlier, Mr. Copeland's arguments are based on a total misunderstanding of a Nortel S8000 cabinet with respect to the number of radios the cabinet can support, the cost and space requirements for an expansion cabinet, etc. I consider this analysis technically flawed to the extent of being useless.

Q. Is there anything else in his conclusions that is particularly misleading?

A. Yes, there are two things on which I would comment. As stated earlier, Mr. Copeland is unaware of cabinet costs and the cost and impact of adding radios to a wireless sector. Notwithstanding, these are critical elements of his cost analysis. As a matter of proper and cost effective design, it would be inappropriate to add the expansion cabinets at the time of initial site construction, which would triple the cost of BTS deployment and immensely complicate the space and power requirements, implementation and cabling associated with the site. Mr. Copeland has pointed out many times the need for "cost effective" design in the TELRIC study, but would introduce in his cost study a tripling of initial BTS expense to over-accommodate future growth, *so the site would not thereafter be considered cost sensitive to the growth of traffic*. I decline to comment further on this argument.

Q. What was the second misleading conclusion?

A. I was surprised by the conclusions reached by Mr. Copeland in lines 568-579 of his testimony. Mr. Copeland clearly does not understand how to interpret TELRIC study results. He states that the low value of the R-squared regression statistic (0.06) "is yet another instance where Union has failed to provide sufficient detailed data to meet its burden in this case." The R-squared regression statistic is the square of the correlation coefficient, and does *not* represent the relationship between material costs and working voice channels, as stated by Copeland. All it measures is the percentage reduction in the mean-squared-error that the regression model achieves, which may or may not be the appropriate model for the purposes of comparison. There is no absolute standard for what is a "good" value for R-squared. The correlation coefficient (R) – which in this case is the square root R squared – approximately 0.25 – is a meaningful positive correlation. Thus, Mr. Copeland is incorrect in his conclusion that a very poor correlation exists in Union's cost data. He is therefore also wrong in his conclusion that "This is yet another instance where Union has failed to provide sufficient detailed data to meet its burden in this case." *I fail to see how Mr. Copeland's unfamiliarity with statistics constitutes a failure of Union to meet a burden of proof in this case.*

Q. How would you categorize the technical foundation for the alternate cost analysis developed by Mr. Copeland?

A. I would say that the assumptions made about unused capacity in the network serving as a basis of incremental costs is entirely in error. His analysis on Nortel costs, cabinet capacity, and so forth, are made in total ignorance of practical network design, and his use of traffic capacity tables is technically flawed. There are so many flaws in his assumptions, that I believe the entire analysis is invalid.

Q. Does this conclude your testimony on this matter?

A. Yes.

Certificate of Service

I hereby certify that on the 26th day of October, 2007, I caused to be emailed a true and correct copy of the foregoing Post Surrebuttal Testimony of Henry Jacobsen in Docket No. 04-049-145 to the following:

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