Exhibit No. _____ (WGR-1T)
Docket No. UT-023003

BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

In the Matter of the Review of Unbundled Loop and Switching Rates; the Deaveraged Zone Rate Structure; and Unbundled Network Elements, Transport, and Termination	)) DOCKET NO. UT-023003)))

REPLY TESTIMONY OF WILLETT G. RICHTER ON BEHALF OF VERIZON NORTHWEST INC.

OUTSIDE PLANT DESIGN

April 20, 2004

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, CURRENT POSITION AND BACKGROUND.

A. My name is Willett G. Richter, Senior Specialist, Engineering Regulatory Support for Verizon. My qualifications are set forth at page 5 of Verizon's Panel Testimony filed on June 26, 2003.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. The purpose of this testimony is to address the basis for the key engineering inputs and assumptions for outside plant design advanced by Mr. Donovan's testimony.[1]

II. OUTSIDE PLANT ENGINEERING PRINCIPLES

Q. MR. DONOVAN STATES (AT PAGE 5) THAT "HM 5.3 MODELS THE NETWORK SIMILAR TO THE WAY AN [ILEC] OUTSIDE PLANT ENGINEER, SUCH AS THOSE AT . . . VERIZON, WOULD DO." DOES MR. DONOVAN'S "SUMMARY OF OUTSIDE PLANT ENGINEERING PRINCIPLES" COMPLETELY OUTLINE THE STEPS THAT A VERIZON ENGINEER WOULD TAKE WHEN DEVELOPING AN OUTSIDE PLANT PLAN?

A. No, it does not. Mr. Donovan begins by describing "the first step" (page 6 of his testimony) as "the gathering of information" about demand, structure sharing opportunities, IOF requirements, wire center locations, and central office boundaries. He then proceeds to describe a process of "clustering" that is presented as being

[1] Staff's testimony does not specify its engineering assumptions, but it relies upon the same model that Mr. Donovan's testimony supports. Spinks Supplemental Direct Testimony at 6.

analogous to the creation of Distribution Areas ("DAs"). These clusters are then connected to a form of a feeder network, again in an attempt to simulate the way a DA would be connected to the feeder routes of a real network. This description omits many of the critical steps that an outside plant engineer would take in developing an outside plant plan. As noted below, these steps are well documented in the engineering guidelines cited by Mr. Donovan himself, as well as in more recent successor guidelines. In omitting these critical steps, and suggesting that this entire process is simply a matter of "clustering" customers into DAs and "input[ting] pockets of customer demand into a computerized feeder model."[2] Mr. Donovan grossly oversimplifies the process of designing outside plant for a real-world local telephone network.

Q. WHAT STEPS HAS MR. DONOVAN OMITTED?

A. Mr. Donovan leaves out the crucial steps that engineers must take, both at the planning stage and the detailed implementation stage of network design, to familiarize themselves both with the limitations presented by the physical environment in which the network must be constructed and operate, and with the best opportunities for obtaining access to the locations necessary for routing the outside plant back to the Central Office. Engineers have to take careful account of, and design around, physical obstructions such as lakes, rivers, and existing structures. They must design outside plant in a way that assures the safety of the people who live near it, and of the technicians who work on it. Engineers also need to assure outside plant is built in places where technicians can access it day and night. (For example, nearby parking is essential, as is around-the-clock physical access to equipment rooms located in

[2] Donovan Direct Testimony at 7.

commercial buildings and other multi-tenant structures.). Finally, in order to design an efficient network at the lowest possible cost, engineers will leverage the significant value associated with existing easements, in order to avoid the need to acquire new easements. In my experience, such acquisitions today would be significantly more difficult (and, where payment is required, would come at significantly higher relative prices) than was the case when more options were available and landowners were more accommodating.

Q. CAN YOU PROVIDE SPECIFIC EXAMPLES OF THESE CONSIDERATIONS?

A. Yes. Outside plant designers must begin by determining the location of service points, or terminals, to provide telecommunications service to structures (buildings, houses, industrial parks, condominium complexes, and retail outlets). Such placement of terminals requires attention to the existing physical constraints and to access and safety issues as described above. In locating aerial terminals, for example, engineers must consider traffic flow and whether (and how) it will be possible to place a service ladder, so that technicians can quickly and safely reach such terminals, as well as run the drop (service) wire. In locating building terminals, engineers must consider grounding and environmental issues (including lighting, dampness, and the availability of physical access to equipment). In a significant portion of Verizon NW's Washington service area, moreover, placement of cable is subject to requirements that it analyze the impact of buried and underground cable placements on soil erosion and drainage.[3] Engineers determining cable routing must also consider zoning restrictions, building and population density, the availability of electric power for circuit equipment, and the ability

[3] See, e.g., Snohomish County Code at 30.61.100(2); 30.63(A)020(3); 30.63A220(1).

to run auxiliary generators when power supplies are interrupted. Engineers must also consider traffic patterns, since heavy traffic congestion makes certain roads less desirable, and potentially more dangerous for placing and maintaining cables, SAIs, remote terminals, and other facilities.

Engineers also often have to locate terminals and other outside plant in a way that takes account of the rights of property owners and developers. Placing poles on property lines is one familiar example. Another is the need to place and design outside plant in such a way that drop wire feeding one structure is not routed over the driveway or property of another, and that otherwise respects the rights of adjacent landowners. In addition, engineers must design within constraints set by builders or developers, particularly when the developer has predetermined where the terminal location will be by virtue of where the inside wiring in a building or development terminates. Because of all of these considerations, networks will usually follow a route different from the hypothetical route they would follow if they simply traced the shortest possible cable distance. And they will not uniformly distribute terminals to a reduced number of theoretical lots along an artificial grid of "backbone and branch cables."[4]

Q. ARE THESE PRINCIPLES REFLECTED IN ANY OF THE DOCUMENTS UPON WHICH MR. DONOVAN RELIES?

A. Yes. The AT&T Outside Plant Handbook on which Mr. Donovan relies emphasizes repeatedly that engineers must take careful account of natural barriers and of the way that a specific environment affects maintenance conditions. It states, for

[4] See Testimony of Robert A. Mercer, Ex. 4 ("HM 5.3 Model Description") at 22 and 37 (describing how HM 5.3 lays out cable in such a grid to customer locations it has "rasterized" within "geographic rectangles").[4]

example, that design of particular distribution systems will "vary due to the characteristics of the geographic area," AT&T OSP Plant Engineering Handbook at 2-4, and that the defined boundaries of a distribution area "usually correspond [ ] with streets, property lines, railroads, rivers and creeks, or fence lines." Id. at 3-9.

The Handbook also confirms that the choice of particular cable types will depend on "Proposed Location (topography, accessibility)", id. at 2-5, and that choices about structure type will depend on such factors as whether the area is heavily wooded (and likely to have fallen trees), vulnerable to squirrels and other rodents, prone to lightning, or located on roadways where accidents can do damage to structure. See id. at 3-4 to 3-5. It notes that in placing cable and structure, engineers must take account of natural obstacles, such as bridges, railways, road crossings, and waterways, as well as right-of-way limitations and anticipated road developments. See id. at 8-1 (underground), 9-1 (buried), 9-11 (cable placement), and 9-17 and 10-39 (aerial). It emphasizes the importance of safety considerations, noting the need to "minimize, as far as practical, electrical hazards to telecommunication system users and protect those who are engaged in construction, operation, and maintenance of the system." Id. at 3-4 to 3-5. The Handbook emphasizes safety as a key consideration in locating and engineering cable, as well as aerial structure, underground structure, and manholes. See id. at 9-15, 8-1, 8-5, and 10-39.

The same is true of the engineering guidelines relied upon by AT&T in designing and placing aerial cable. These guidelines state that placement of aerial cable must be not only "functional" but also "safe" and also lend itself to "future additions and maintenance." They note that "[c]lose attention to future road, rail, right-of-way plans, and traffic flow should be considered during the design stage" and warn that lack of such consideration could lead to "exposure to the hazards of vehicular traffic, vandalism, and acts of nature such as fire, rain, lightning, etc."[5] There is no reason to believe that these guidelines and procedures will differ in the constructing of a forward looking model and as such would be considered best practices that should be adopted.

Q HAS THE SERVING AREA CONCEPT DESCRIBED BY MR. DONOVAN ALTERED THE DESIGN PROCESS YOU HAVE DESCRIBED FOR OUTSIDE PLANT?

A. No. As Mr. Donovan notes, this concept is over 20 years old, and provides that the "distribution cable network is connected to feeder network at a single interconnection point," the SAI.[6] It does not, and cannot, eliminate the constraints of the real world that engineers must deal with in designing outside plant.

Q. DOES "PRESCRIPTION DESIGN," DESCRIBED ON PAGE 7 OF MR. DONOVAN'S TESTIMONY, ELIMINATE THOSE CONSTRAINTS?

A. No. As Mr. Donovan notes, prescription design provided that all copper cables within a DA had uniform cable gauge makeup and transmission characteristics, so-called "length and gauge." Prescription design did permit "large composite cross-sections of facilities [to be] designed with similar transmission characteristics."[7] That

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5 See Exhibit __ (WGR-4) (Response to Qwest Data Request No. 11 AT&T Engineering Guidelines, Section 18.1, at 5.) AT&T's response to this Data Request notes that "[d]ecisions regarding plant placement are made on a case by case basis taking into account the terrain, local regulations, local conditions, and other factors." Such criteria for decision-making should be, but are not, reflected in Mr. Donovan's description of the engineering criteria that AT&T allegedly incorporates into its model.

6 Donovan Testimony at 9.

7 Donovan Testimony at 7 n.33 (quoting Telcordia, *Notes on the Networks*, October 2000, at 12-2).

was important for providing certain special services in the past. It is far less important today as assignment and engineering systems are migrating towards automating the length and gauge process. In any event, however, prescriptive design never eliminated the design constraints imposed on outside plant engineers that I have described. Indeed, in my experience such constraints are far greater today, when as I have explained, obtaining an easement is often significantly more expensive and difficult (and at times, impractical). Engineers would therefore rely increasingly on existing easements to locate SAIs, DLCs, and other outside plant facilities and support structures.

Q. WILL THE ASPECTS OF THE ENGINEERING PROCESS THAT MR. DONOVAN OMITS BE AS IMPORTANT IN A FORWARD-LOOKING NETWORK AS THEY ARE IN EXISTING NETWORKS?

A. Yes. A forward-looking network must also be a safe and reliable one. Physical constraints (such as buildings, streets and waterways) will limit the networks of the future as much as they constrain the network that exists today (if not more so, as potential sites for placing outside plant become increasingly more difficult to acquire). The most efficient and effective way to design and build a forward-looking network would therefore be to leverage what is already known about that network's environment. Thus, in designing a forward-looking network, engineers would not simply disregard the substantial and detailed knowledge of the environment that their predecessors have accumulated and responded to in designing the existing network. Rather, they would take these solutions to past network design challenges as a starting point for addressing current ones.

Q. ARE THE PRINCIPLES YOU HAVE DESCRIBED HERE CONSISTENT WITH ENGINEERING GUIDELINES RELIED UPON BY VERIZON WA?

A. Yes. For example, in its documentation on distribution area planning and design, Verizon directs engineers to choose easements or rights of way that are "not hazardous or objectionable to the public, the property owner, the tenant or any concerned government agency"; to locate the site next to "an intersection or a busy thoroughfare," and out of the way of "future growth or expansion"; to assure that the site offers safety from vandalism and flooding and is "safe and easily accessible to telephone company employees, with parking available nearby"; and to select sites that "[do] not have the potential for environmental contamination."[8] In addition to satisfying the types of environmental regulations I mentioned earlier, Verizon engineers also follow company practices requiring them to examine -- for example -- whether a potential site is near a wetland, marsh, or standing water, or whether there is evidence of chemical spills or leaks.[9]

Q. HAVE YOU EVER HAD ANY EXPERIENCE IN DESIGNING A LOCAL TELEPHONE NETWORK FROM THE GROUND UP?

A. Yes. From 1993 to 1995, I held the position of Technical Transfer Manager in Southeast Asia. In that position, I was part of a two-man team responsible for roughly 30% of the local loop design and construction of a 2.6 million line expansion project in the Bangkok metropolitan area. This project took approximately 2.5 years. It was part of

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[8] *See* Exhibit No. ____(WGR-2a), Excerpts from Verizon Distribution Area and Planning Design Student Documentation at 2-21 to 2-22.

[9] *See Id.* at 2-24.

an initiative of the Thai government to expand the existing land line base in Thailand. The company I worked for, a partner of Verizon (then NYNEX), was awarded the project and asked to plan, design and build to a known waiting list of customers. The network was an entirely new build out of facilities running parallel to the existing telecommunications network. Many of the obstacles we encountered there would be similar to those I would expect to encounter in building a network from the ground up in Washington -- including the challenge of acquiring property, easements (both public and private), and construction permits, and sustaining the burden of restoration costs.

Q. HOW DID THE PRINCIPLES DESCRIBED IN MR. DONOVAN'S TESTIMONY APPLY IN THAT CONTEXT?

A. There is little connection between the methods outlined in Mr. Donovan's testimony and the problems we actually faced. For example, the notion of establishing Distribution Areas in a "cluster" arrangement, and then manipulating them into a theoretical array of lots, was very much at odds with the reality of building a network from the ground up. Simply trying to keep within the confines of the original Distribution Area boundaries, as defined in the planning phase of the project, was difficult and almost always required redesign and innovative solutions to get from "point A" to "point B" with the cable. Our work was constrained in important ways by the need to acquire construction permits and to address issues such as traffic control, water, soil conditions, excavation equipment access, road reconstruction costs and timing, and service dates. These constraints required the creation of special groups of employees dedicated solely to the acquisition of permission to place plant along or across public and private property. They required us to establish night shifts for construction of plant in high traffic areas. Unexpected groundwater often required re-routing of conduit systems and cable, which in turn, required the permission process to begin all over again. When permission to cross a road was denied, special expensive excavating techniques like pipe jacking or directional boring had to be employed. When we were able to cut the road, we had a limited amount of time to restore the crossing to its original state.

Another example involved the sizing of the distribution cable. Despite my best efforts as a technical advisor to stress the importance of building adequate distribution cable, there was a reluctance to do so. There was a requirement to build the new network to accommodate only the number of lines indicated by an official waiting list for telecommunications services. When I returned to Thailand on a three-month assignment (unrelated to my 1993-95 work), I saw the effects of this requirement. Because demand had exceeded the number of lines on the waiting list, technicians were forced to install numerous, excessively long drops in order to utilize spare pairs located away from the customer towards the switch. The attached photo showing a typical terminal in this network in 2000, illustrates this result.[10] This experience underscores the difficulty with sizing guidelines such as those endorsed by Mr. Donovan, which implicitly assume that engineers can identify existing demand, precisely predict short-term demand growth, and then build relatively little cable beyond that dictated by such a prediction. This approach will likely leave engineers scrambling to build additional plant to meet random and unpredictable spikes in demand.

[10] Exhibit No. _____ (WGR-3) (Photo of Thailand Distribution Terminal).

III. CLUSTER SIZE

Q. WHAT IS YOUR UNDERSTANDING OF HOW HM 5.3 GROUPS CUSTOMERS INTO DISTRIBUTION AREAS?

A. Based on my understanding of Mr. Murphy's testimony, HM 5.3 groups customers into "clusters," which are intended to represent distribution areas in the modeled network. Mr. Murphy notes that this version of the HAI model groups clusters into substantially larger sizes than those used in previous versions, exceeding, in 219 clusters, the 1800 lines per cluster that I understand was the maximum allowed by HM 5.2.

Q. IS IT EFFICIENT AND PRACTICAL TO DESIGN A NETWORK WITH SUCH LARGE DISTRIBUTION AREAS?

A. Not when the larger cluster results in a larger DA in terms of land area. Such a design would lead to a smaller number of larger clusters, served by larger backbone cables, SAIs and DLC systems. This would have the effect of shifting the mix of feeder and distribution cable in the modeled network towards the relatively more expensive distribution plant, since reducing the number of DAs means that, on average, customers will be farther away from an SAI.

Designing a network with longer distribution cables and shorter feeder cables is inefficient for at least two reasons. First, as Mr. Donovan recognizes,[11] feeder cable is larger and can be operated at a higher utilization than distribution cable, making feeder cable less expensive on a per-working-pair basis.

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11 *See* Donovan Testimony at 59 (endorsing sizing factors "that produce at least a 50% initial achieved distribution fill and a 75% initial achieved feeder fill for copper cables").

Second, the physical characteristics of distribution cable generally make it more susceptible to service problems, and thus considerably more costly to maintain than feeder cable, which tends to be more stable. Distribution cable typically is placed on poles and always has more splice points and is therefore more vulnerable to environmental conditions such as wind, rain, ice, ultraviolet light, and animals. In addition, activities such as assignments, reassignments, and rearrangements require technicians to work on distribution cable far more frequently than on feeder cable. The nature of distribution cable, its physical environment, and the frequency of work activity all make such cable less stable and more susceptible to damage, and in turn in need of more frequent maintenance.

Of course, using more efficient feeder cable could be expected, in the long run, to lower per unit costs of outside plant. But I understand from Mr. Murphy's testimony that HM 5.3 does not take account of these greater costs of distribution cable. It also uses significantly higher sharing and less expensive structure type assumptions, for distribution cable (as compared to feeder cable), which as noted below are wholly unsupported. Such an approach would fundamentally distort the cost-benefit analysis traditionally conducted by outside plant engineers.

Q. ARE THERE OTHER PRACTICAL LIMITATIONS ON THE USE OF SUCH LARGE DAs?

A. Yes. Even if it were desirable to maximize the size of distribution areas (and thus the size of SAIs), practical considerations often make it impossible or very costly to do so. In more dense areas, such as urban or suburban areas, it is very difficult if not impossible to install larger SAIs, where open space is often unavailable and easement permits are difficult to obtain. For example, a 5400 pair SAI is roughly six feet tall, six feet wide, and two feet thick. Larger SAIs must be mounted on concrete pads with sufficient space for the SAI (with its doors fully opened), the technician, and any test gear that is required. The SAI must provide sufficient ingress and egress for technicians, and may include landscaping as well as traffic barriers (concrete filled pipes placed around the perimeter to stop a wayward vehicle). Certain SAIs can be mounted at the base of a pole (maximum 2700 pair - 1,800 of which would be distribution pairs),[12] but they too have limitations. They are also large (roughly six feet tall, six feet wide, and one foot thick) and are considered by many to be an eyesore. In addition, low mounted cabinets on poles must meet the requirements of the governmental access laws for pedestrians and those with disabilities relative to sidewalks and walkways.

Q. ARE THERE OTHER FACTORS THAT MUST BE TAKEN INTO ACCOUNT WHEN DETERMINING THE SIZE AND LOCATION OF DISTRIBUTION AREAS?

A. Yes. As I have already explained, when planning distribution areas, outside plant planners must take careful account of existing natural and man-made barriers (and their impact on safety and access) and of the environmental impacts of a particular network design. As they do when planning cable routing, they must also attend to (and leverage the use of) the paths of existing easements and rights of way, and take note of how the network will be affected by traffic patterns. They must also consider expected future land development when selecting SAI and distribution area locations so that new developments can be connected to the network in a cost-effective manner.

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[12] Typically, two-thirds of the capacity of an SAI is used for distribution pairs, and the remaining one-third is used for feeder or sub-feeder pairs.

As noted below, planners also typically design new plant so that the length of the copper portion of the loop does not exceed 12,000 feet, in order to accommodate advanced services. In less densely populated areas, this limitation in turn constrains the size of the SAI in terms of pair size and thus typically produces distribution areas with a smaller number of customers than would be the case in more densely populated areas, where larger SAIs can be installed provided there is an available easement.

IV. MAXIMUM COPPER LOOP LENGTH

Q. WHAT IS THE MAXIMUM COPPER LOOP LENGTH ASSUMED BY HM 5.3?

A. Mr. Murphy notes that HM 5.3 claims to use a maximum copper cable length of 18,000 feet.[13]

Q. IS THIS 18,000 FOOT ASSUMPTION CONSISTENT WITH INDUSTRY STANDARDS?

A. No. The CSA design standards cited by Mr. Donovan limit the copper cable length to 12,000 feet.[14] This standard is also reflected in Alcatel practices.[15] Indeed, Mr. Donovan has endorsed this figure in his prior testimony before this Commission.[16] Since most if not all equipment vendors default to the 12,000-foot standard, any deployment of copper beyond this length would encounter significant compatibility

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13 Mr. Murphy also notes that HM 5.3 frequently violates this constraint by modeling loops that have more than 18,000 feet of copper cable. *See* Testimony of Robert A. Mercer, Ex. 5 ("HM 5.3 Inputs Portfolio"), Section 3.7.6, at 40.

14 *See Telcordia Notes on the Networks*, SR-2275, Issue 4 (Oct. 2000), at 12-4.

15 ALCATEL Practice, Litespan Access Platform, Table F, "CSA Cable Guidelines (Nonloaded Cable Only)," November 2001.

16 Reply Testimony of John C. Donovan on Behalf of Covad Communications Company, January 11, 2002, Docket No. UT-003013 (Part D), at 8.

problems. In my experience in Thailand, the copper loops were kept between 2 to 3 kilometers (6,500 to 9,800 feet).

Q. IS THIS ASSUMPTION CONSISTENT WITH THE REQUIREMENTS OF A FORWARD-LOOKING NETWORK?

A. No. Copper loop lengths in excess of 12,000 feet are not capable of maintaining acceptable service levels for services such as high-rate ADSL service, HDSL service (without doublers), and some 2-wire, locally switched voice-grade special services. Thus, HM 5.3's assumption creates a network incapable of efficiently provisioning all UNEs required of Verizon NW, including those necessary for the advanced services that are increasingly being demanded by subscribers. It is my understanding that HM 5.3 incorporates the use of a "doubler" in its network construct for those HDSL loops that exceed standard design constraints. Doublers introduce an unnecessary network component into the High-capacity loop. Thoughtful planning can eliminate the need for this equipment up front and reduce the long term issues (and costs) associated with the assignment and maintenance of such equipment.

Q. DIDN'T THE FCC ADOPT A MAXIMUM COPPER LOOP LENGTH OF 18,000 FEET IN ITS UNIVERSAL SERVICE MODEL?

A. Yes. But as the Wireline Competition Bureau acknowledged in the Virginia cost arbitration, that determination is not relevant here. It was made in the context of modeling a network for universal service purposes, capable of providing only a basic level of voice service. For those purposes, the Commission determined that it was not in the public interest to burden the support mechanism with costs necessary to support a network capable of delivering very advanced services. The Bureau concluded that, for UNE loop purposes, 12,000 feet is the appropriate standard by which to model costs.[17]

V. STRUCTURE MIX

Q. WHAT STRUCTURE MIX DOES MR. DONOVAN RECOMMEND AMONG AERIAL, BURIED, AND UNDERGROUND?

A. Mr. Donovan recognizes that structure mix is quite different for feeder and distribution cable. As noted above, this is a significant distinction, because Mr. Donovan's endorsement of unusually large DAs minimizes the use of feeder (even while he ignores the costs and impracticalities associated with doing so). For distribution cable, Mr. Donovan assumes that in most density zones, the mix will be 43% aerial and 57% buried, with no underground cable at all except in his three highest density zones with at least 2,550 lines per square mile. In these three highest zones, he assumes 5%, 15%, and 35% underground, respectively, and generally reduces the share of buried cable in doing so.

For feeder cable, he acknowledges that there will be higher percentages of underground structure (above 50%) in the three highest density zones, but assumes that feeder cable in any density zones lower than 850 lines per square mile will consist primarily of aerial and buried cable. Mr. Donovan also assumes that underground structure in these zones will encompass no more than 20 or 30% of the total feeder cable, and no more than 5% in density zones with 200 lines or less).

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[17] Memorandum Opinion and Order, *In the Matter of Petition of WorldCom, Pursuant to Section 252(e)(2) of the Communications Act for Preemption of the Jurisdiction of Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc.and for Expedited Arbitration*, DA 03-2738, CC Docket Nos. 00-218 and 00-251, at ¶¶ 303-318 (Aug. 29, 2003) ("Virginia Arbitration Order") ¶¶ 241-42.

Q. WHAT BASIS DOES MR. DONOVAN HAVE FOR USING THE ABOVE STRUCTURE MIX?

A. He purports to derive it from Verizon NW's existing network in Washington. For some of his assumptions, he relies on statewide ARMIS data containing the sheath km for each structure type. For others, such as the critical questions of how the structure mix varies by density zone, how it varies between feeder and distribution cable, and what the mix would be for IOF plant, he simply relies on undocumented and wholly unexplained "experience."

Q. WHY ARE THESE ASSUMPTIONS UNRELIABLE?

A. ARMIS data may provide very useful information for some purposes, but not for the purposes for which Mr. Donovan relies upon it here. The ARMIS data is simply an aggregation of all the cable in the existing network by construction type -- aerial, underground, buried and intrabuilding. It does not differentiate between feeder and distribution cable; nor does it separately identify IOF facilities. Nor does it provide any basis for determining how the makeup of plant mix might vary in the specific "density zones" created by Mr. Donovan, because there is no geographic reference in the ARMIS data that points to where the existing structure might be located.

Q. IS THERE A MORE RELIABLE SOURCE OF INFORMATION ABOUT THE STRUCTURE TYPE USED IN SPECIFIC DENSITY ZONES, OR FOR FEEDER AS OPPOSED TO DISTRIBUTION CABLE?

A. Yes. As noted in section 5.1 of the VzLoop Cost Manual, VzLoop relies on existing plant records to determine the most prevalent structure type for each relevant cable segment. VzLoop's use of this data eliminates the need to make assumptions about how structure mix varies by density zone and does not rely on a model's ability to determine the actual density below the wire center level. This methodology provides a far more reliable basis for modeling structure type than guessing at the kind of granular distinctions or allocations of ARMIS sheath feet.

Q. HOW DO THESE NUMBERS COMPARE WITH MR. DONOVAN'S ASSUMPTIONS?

A. An examination of this granular, segment-specific real world data about Verizon NW's Washington network shows that the percentage of cable in underground structure for distribution cable is higher than Mr. Donovan assumes. Thus, in many wire centers where AT&T conclude (on the basis of Mr. Donovan's structure mix assumptions) that Verizon's capital costs for underground distribution would be *zero*, Verizon NW's own records indicate that underground constitutes 15 to 30% of existing structure.[18]

The structure mix Mr. Donovan assumes for use of underground feeder cable is likewise questionable. As he acknowledges, the "structure mix for *feeder* cable will reflect a significantly different breakdown," and "much more underground structure will prevail for feeder cable."[19] As noted above, however, by emphasizing novel clustering techniques from a computer model to substantially reduce the use of feeder cable, HM

[18] For example, AT&T assumes zero capital costs of underground distribution in Clearview Exchange (where Verizon's data indicate 28% of structure is underground), in the Laconner Exchange (16% underground) and West Richland (18% underground). *See* Verizon Supplementary Panel Testimony Filing, January 26, 2004, CD No. 2/4.VzCost Document Sets/Document Set 2 of 2 (Loops Only), WA Whsl. Loop Rev. 01082004.pdf at Subsection 3.3 CopperMix.rpt.

[19] Direct Testimony of John C. Donovan at 13 (emphasis in original).

5.3 achieves wholly illusory cost reductions by eliminating the need for underground feeder.[20]

Telcordia's Notes on the Networks, on which Mr. Donovan relies, is not specific to Washington. However, it indicates that the use of underground structure is far more prevalent for feeder in routes to business locations even outside of dense urban areas. It reports on a 1983 survey showing that "more than 85 percent of cable structure is underground close to the Central Office," *Telcordia Notes on the Networks* at 12-12. It also states that "[a] large majority of the loops to large business customers" -- about 84% of them – "are in underground conduit, with limited "spare duct capacity." Id. at 12-19.

Q. GIVEN ITS HIGHER COSTS, WHAT EXPLAINS WHY UNDERGROUND STRUCTURE IS PREVALENT?

A. Underground structure has significant long run operational advantages that often make it crucial (or far superior to the alternatives) even though it is initially more costly to put in place. Underground cable not only provides for "out-of-sight" plant, but also ensures better protection from the elements than cable that is strung on poles (as discussed above). Underground cable is also far easier to augment, replace or repair than direct buried cable, because there is no need to re-excavate the site. Underground cable can thus be repaired with much less disruption to the community than buried

[20] Dr. Tardiff shows, via ARMIS investment data and analysis of HM 5.3, that in spite of the trend I have discussed here, the investments produced by HM 5.3 lead to a noticeable shift away from underground cable. And Mr. Murphy has identified the reasons why HM 5.3 leads to this erroneous result.

cable would require. The municipal policy of "minimiz[ing] street cuts," upon which Mr. Donovan relies,[21] is thus far better served by undergrounding.[22]

Q. ARE MR. DONOVAN'S ASSUMPTIONS CONCERNING THE PREVALENCE OF UNDERGROUND STRUCTURE ANY MORE APPROPRIATE FOR A FORWARD-LOOKING NETWORK?

A. No. Indeed, because of its practical advantages, the percent of structure that is underground is likely to increase. As Mr. Donovan notes at page 22 of his testimony, there is increasing public pressure for "out-of-sight" plant. While Mr. Donovan asserts without support that this means that this trend will lead to more *buried* structure, this is likely to be true only in the distribution plant for residential subdivisions. Even there, however, Verizon's experience is that some form of conduit is used to ensure future serviceability. Where it is important to assure ease of maintenance and protection from the elements, subterranean plant is likely to be underground rather than buried.

ARMIS data for aggregate sheath feet of each structure type also confirm this trend. They show that the percent of underground structure in Verizon NW's Washington service area has been steadily increasing. In the eleven-year period from 1991 to 2002, the percent of underground outside plant relative to total plant has increased by 28.3% (9.75% to 12.51%), while aerial *and* buried plant have decreased by 3.9% (39.14% to 37.63%) and 2.5% (51.12% to 49.85%), respectively.[23]

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21 Donovan Testimony at 23 (quoting Nevada decision).

22 As noted below, such municipal ordinances do not mandate sharing, which has long been recognized to be an ideal that is generally impracticable in the real world (and even more unrealistic in the context of designing a network from scratch with existing utilities already in place).

23 *See* Donovan Testimony at 18 (reproducing ARMIS data).

VI. STRUCTURE SHARING

Q. WHAT ASSUMPTION DOES MR. DONOVAN MAKE ABOUT THE SHARING OF AERIAL STRUCTURE?

A. He hypothesizes that Verizon NW will always be able to share away 50% of the cost of its poles, and that in areas above 5 lines per square mile it will always be able to share away at least 66% of these costs, presumably sharing at least equally with both electric companies and cable operators. And he assumes that in all areas above 100 lines per square mile, Verizon NW will always be able to share away 75% of its pole costs, presumably with the electric company, the cable operator, and one other user such as a CLEC.[24]

Q. IS MR. DONOVAN'S ASSUMPTION ABOUT SHARING OF AERIAL STRUCTURE A REASONABLE ONE?

A. Not in my experience or that of Verizon NW. First, Mr. Donovan appears to assume that cable operators provide service to all households and businesses in all areas of Verizon NW's service area down to 5 lines per square mile, and that everywhere a cable operator is franchised to offer residential service, it will want to share investment in 100% of poles Verizon NW has running cable to both business and residential users in that area. That undocumented assumption is wholly unwarranted. Cable operators focus on residential areas, not in commercial areas.[25] But in any event,

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[24] *See id.* at 23-24; HAI Inputs Portfolio, Appendix B, at 173-74.

[25] Mr. Donovan himself acknowledges that, unlike power companies and Verizon NW, cable operators will often avoid providing service in his lower density zones. *See* Donovan Testimony at 24 ("[I]n the lower density zones, there is less possibility of cable . . . being available").

as AT&T itself have conceded,[26] cable operators almost never pay the costs and fees associated with pole ownership.[27] In Washington, they pay Verizon NW only attachment fees, which at $3.60 per attachment per year are only a small offset to the cost of the pole. Thus, Mr. Donovan's assumption of three-way sharing of ownership everywhere above 5 lines per square mile, and his use of the Nevada Commission's reliance on rights to non-discriminatory access under the pole attachment provisions of federal law,[28] substantially understate Verizon's pole costs.

Second, AT&T also provides no empirical support that Verizon NW's pole costs will be reduced to 25% "as new service providers enter the telecommunications market,"[29] creating what he seems to posit as at least an equal four-way ownership arrangement. As with cable operators, there have been no attempts by CLECs to subject themselves to the costs and liabilities of owning poles in Verizon NW's territory in Washington. They neither serve less profitable residential areas, nor provide service to all customers in the areas they do serve. Given the relatively low cost of pole attachments, and the widespread distribution of their customers, they have no incentive to do so.

Third, Mr. Donovan asserts that power companies may, in some states, own a larger portion of pole space or pay more of the costs than "low voltage users" like

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[26] HAI Inputs Order, Appendix B.3, at 174.

[27] Indeed, AT&T noted in response to a Qwest Data Request that Mr. Donovan does not assume "that CATV or other low voltage providers have paid for the embedded investments in existing pole structures" but rather that "his cost allocation" allegedly reflects "the allocation of space consumed on the pole." See Exhibit No. ____ (WGR-10) (AT&T response to Qwest Data Request No. 83).

[28] *See* Donovan Testimony at 23.

[29] HAI Inputs Portfolio, Appendix B3, at 176.

telephone companies.[30] It is true that joint use agreements may require power companies to pay more of the costs of a pole, where they do share with Verizon NW, because for safety reasons they must place high-voltage lines high on a pole. For poles jointly-owned by power companies and Verizon NW in Washington, these arrangements generally involve a 55/45 split in ownership. They do not require the power company to pay twice as much as Verizon NW, as suggested by AT&T.[31]

Q. HOW MUCH OF VERIZON'S BURIED STRUCTURE DOES MR. DONOVAN ASSUME WILL BE SHARED WITH OTHER COMPANIES?

A. He assumes that Verizon NW will only sustain 33% of the cost of its buried distribution plant and 40% of the cost of its buried feeder cable.[32]

Q. ARE THESE ASSUMPTIONS REASONABLE?

A. Not in my experience or that of Verizon NW. Mr. Donovan presents no empirical data to support these numbers and does not even purport to base them upon his own experience. He states only that companies will have incentives to engage in such coordination to reduce costs or to prevent "disruption of facilities and thoroughfares," but does not explain how such an assessment (even if it were accurate) would justify the significant percentages of sharing that he assumes. In fact, if multiple utilities were to share in buried structure, each utility would be more vulnerable to disruption resulting from repair work by any single utility[33] and consequent failure of utilities. Such

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30 Donovan Testimony at 23-24.

31 See HAI Inputs Portfolio, Appendix B3, at 176.

32 Donovan Testimony at 22.

33 Id. at 22 (noting that coordination is necessary to "prevent the disruption of facilities").

arrangements might also leave phone company lines were vulnerable to possible damage from water or power lines).

In any event, despite the incentives (and the responsibility of engineers at Verizon NW to pursue them), in practice such coordination is and will continue to be extraordinarily difficult, and often impossible. Different utilities cannot share the costs of trenching (and avoid redigging) unless they bury their cables at the same time, and in the same trench. But other companies, with different needs and budget cycles, will rarely need to place cable or lines for their services at the same time that Verizon NW is placing cable for phone services. Thus, while Verizon's engineers are constantly in contact with other utilities, they have rarely been able to identify opportunities for sharing of buried trenches. The only exception to this are the joint buried residential subdivisions. Both Verizon NW and the electric company are compelled to serve customers within the subdivision at the same time and the control over the trench lies with the developer. Such developments do not reflect sharing opportunities elsewhere in the network, where coordination between different utility companies is significantly more difficult and often impossible.

As with pole sharing, Mr. Donovan also adopts the unrealistic assumption that in his middle and higher density zones, cable operators will place cable *everywhere* that Verizon NW has buried cable. Again, this assumption does not reflect reality: even if utility companies could overcome the significant practical barriers that make buried sharing so rare, cable operators would have little need or incentive to place cable (and share trenches) in all of the residential or business areas within such a middle or high density zone.

Q. HOW DID THE FLORIDA COMMISSION DEAL WITH MR. DONOVAN'S ARGUMENT ON SHARING BURIED CABLE?

A. In a decision relied upon by Mr. Donovan for other purposes, the Florida Commission noted his argument that "housing development contractors provide free trenches for Bell South" and that Bell South's 6% sharing input "is an extremely low number . . . [b]ased on my experience." The Florida Commission rejected this argument as lacking "any documentation in the record," and agreed that BellSouth's experience showed that "sharing the costs of buried structures is rare because of timing problems and because CATV and power lines are already in place." Citing to its prior determinations on this point, the Florida Commission concluded that placing BellSouth's lines near high voltage lines could cause interference, and that insistence on joint trenching could prompt poor economic decisions. Perhaps most important, it recognized that sharing assumptions are even less realistic in a forward-looking model, because they sweep other utilities into that model: "assuming sharing percentages which require . . . power and cable TV companies to rebuild their networks so that more of the cost of a telephone network can be shifted to other industries, *means a network severed from reality*."[34]

Q. DON'T LOCAL ORDINANCES THAT LIMIT OR DISCOURAGE STREET CUTS FORCE UTILITIES TO SHARE BURIED STRUCTURE IN SPITE OF THESE OBSTACLES?

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[34] Final Order, Investigation into Pricing of Unbundled Network Elements, Docket No. 990649A-TP, Order No. PSC-02-1311-FOF-TP, (Fla. P.S.C. 2002), at 39 (emphasis added) ("Florida 2002 Decision").

A. No. Such ordinances are typically designed to limit repair projects to certain times of the day or certain seasons, e.g. during the night or during the off-season in resort areas. In some cases ordinances can have the effect of discouraging discretionary work by requiring utilities to repair entire street sections (curb to curb) versus simply the area they disrupt. While some municipalities do have ordinances designed to provide coordination in new construction, these recognize the practical limitations I have described and thus typically are limited to notification or reasonable efforts requirements.[35] Moreover, sharing buried structure would not lead to significant reduction in repair projects even if such sharing were practicable, because utility failures (and the associated repairs) rarely occur at the same time. Similarly, augmentation projects typically do not occur in the same physical area at the same point in time.

Moreover, as I have explained earlier, in my experience, decreasing the need for repeated digging will best be accomplished not by mandating coordination with other companies, but rather by placing more underground conduit or underground utility corridors, allowing additional facilities to be placed in the future without additional excavation. Although Mr. Donovan relies on the Nevada Commission as finding that increased sharing is "a reasonable assumption of how a business would respond to" local ordinances seeking to minimize street cuts,[36] he does not provide any evidence showing that telephone companies have been able to overcome the practical obstacles

35 See, for example, Washington ordinances described in attachments to AT&T's TELRIC NPRM comments, which only direct "utilities to look for opportunities to combine projects and share trenches" (Lacey County, WA) or state that it is "the goal of the County to encourage shared occupancy of underground conduit." (Washington, Pierce County). Decl. of Joseph P. Riolo on Behalf of AT&T, Review of the Commission's Rules Regarding the Pricing of Unbundled Network Elements and the Resale of Service by Incumbent Local Exchange Carriers, FCC WC Docket No, 03-173, Attach. B (Dec. 16, 2003).

36 Donovan Testimony at 22-23.

to do so that I have described (and that the Florida Commission identified). Nor did the Nevada Commission. I am not aware of, and Mr. Donovan has not pointed to any, specific ordinance in Verizon NW's territory that requires sharing of buried structure as a means of reducing street cuts.

Q. HOW MUCH OF VERIZON'S UNDERGROUND COST DOES MR. DONOVAN ASSUME WILL BE SHARED WITH OTHER COMPANIES?

A. For feeder routes, Mr. Donovan assumes that Verizon will never sustain more than 50% of the cost of underground structure. In all his zones with over 200 lines per square mile, he assumes Verizon will share away all but 33% of this cost. For distribution plant, he assumes that Verizon will be responsible for 100% of this cost only in areas of less than 5 lines per square mile, and 33% in his highest density zones.[37]

Q. ARE THESE ASSUMPTIONS ABOUT SHARING OF UNDERGROUND STRUCTURE REASONABLE?

A. Not in my experience or that of Verizon NW. Mr. Donovan explains that the rationale for such assumptions is that "[i]n large cities, it is well known that there are many occupants with facilities located in ILEC-owned conduit networks."[38] He does not say anything about density zones outside of large cities. Nor does he identify any large cities in the Verizon NW area where this holds true.

Again, Verizon NW's engineers responsible for exploring potential joint use arrangements are regularly in contact with their counterparts in other utilities about such possibilities. However, Verizon has found that in Washington it has few opportunities

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[37] Donovan Testimony at 23.

[38] Id.

for sharing of its underground conduit, for the reasons noted below. The Florida Commission rejected Mr. Donovan's unsupported sharing assumptions, in favor of an underground sharing value of just 0.07% for BellSouth. That Commission relied on the same work coordination, safety, and available space considerations I have described here.[39]

Q. WHY IS SHARING OF UNDERGROUND PLANT SO RARE?

A. There are a number of serious problems that usually preclude sharing other utilities' underground structure. Sharing of underground space with power or gas companies raises serious safety concerns: phone company technicians could not operate in such an area without extensive training on safety issues. Most existing underground structure has also not been built in a way that allows sharing. Power companies and other utilities do not build conduits with extra duct space to accommodate sharing with other utilities. When they have spare conduit, they generally prefer to reserve it for their own use. Underground structure at or near customer locations is also often inappropriate for sharing because in many cases cables used by power companies, phone companies, and other utilities enter the building at different points. Thus, they cannot follow the same route. To create such different entry paths from shared underground structure in the street would often require phone companies or other utilities sharing that structure to dig up new conduit paths leading to a particular property or structure, requiring a disruption of the kind that most communities and property owners seek to avoid.

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[39] Florida 2002 Order, at 22-23.

Q. WILL SUCH PRACTICAL DIFFICULTIES DISAPPEAR IN A FORWARD-LOOKING NETWORK?

A. No. As noted above, Mr. Donovan's figures depend upon the unrealistic assumption that all utilities will reconstruct their networks from the ground up with the aim of creating more opportunities for sharing, and taking into account the specific needs of telephone carriers. The sorts of barriers to sharing discussed above will not disappear unless power companies, for example, rebuild their conduit banks from scratch in a way which addresses the above-mentioned safety concerns and makes it more feasible for phone companies to serve their customers' needs with minimal disruption.

Q. WHERE SHARING DOES OCCUR, HOW MANY ENTITIES WILL LIKELY BE INVOLVED?

A. As is true for aerial and buried structure, AT&T wrongly assume that CLECs and other companies needing underground cable will provide service to *100% of* customers in the density zones where they exist, when in fact, they are likely to provide service only to a limited number of (their) customers.

Q. ARE THERE ADDITIONAL COSTS ASSOCIATED WITH SHARING OF UNDERGROUND OR BURIED STRUCTURE?

A. Yes. It requires sustained costly negotiations with other utility companies to coordinate any form of joint use. Moreover, in order to allow sharing, trenches must be wider or deeper than they otherwise would be (with the additional installation costs).[40] Likewise, sharing of underground structure with power or gas companies would require

[40] *See* Verizon Direct Panel Testimony at 51-52.

that Verizon NW undertake significant costs of training its technicians in safety-related procedures (as would the power company technicians have to be trained in low voltage plant) and negotiating with other utilities about how to reconcile needs specific to different types of services (e.g., different routing requirements for phone service and electricity).

Joint use agreements themselves are burdensome for parties to enter into and maintain. In parity arrangements, each company is required to place, or dig, equal amounts of plant over a given period. If parity is not kept by one party or the other, there are penalties paid from the deficient company. There is consequently a significant amount of administrative work associated with monitoring these agreements. The complexity of these contracts grows significantly as more parties are added.

Q. WHAT ASSUMPTIONS DOES MR. DONOVAN MAKE ABOUT THE SHARING OF FEEDER AND DISTRIBUTION STRUCTURE?

A. Mr. Donovan asserts that a high percentage of feeder cable "can ride on structure already built to carry distribution cable" and that 55% of feeder routes also include distribution cable.[41]

Q. IS THIS ASSUMPTION ABOUT SHARING OF DISTRIBUTION AND FEEDER STRUCTURE A REASONABLE ONE?

A. No. As Mr. Donovan acknowledges,[42] the type of structure that predominantly carries distribution cable is aerial or buried, while the type of structure that is predominant for feeder cable is underground. Thus, use of common structure would

[41] *See* Donovan Testimony at 24.

[42] *See id.* at 12.

usually be quite difficult. Nor is Mr. Donovan's undocumented assumption consistent with Verizon NW's actual experience. In September 2003, Verizon NW took a Washington-specific sample of the type of cable on 251 cable sections involving 28 different wire centers in a wide variety of density zones. Only 21 (or 8.37%) consisted of both feeder and distribution cable. And of 147 sections with feeder cable, only 14.29% included distribution cable as well.[43] This extensive random sample is far more probative evidence on the prospect of structure sharing in Verizon NW's Washington service area than that relied upon in the Kansas Decision cited by Mr. Donovan,[44] which has not been introduced here and for which AT&T has been unable to provide any evidentiary support.[45] I do not expect this to materially change in the forward-looking network.

VII. POLE SPACING

Q. WHAT POLE SPACING ASSUMPTIONS DOES MR. DONOVAN MAKE?

A. He assumes that the spacing of poles will range from 150 feet in his three densest zones, to 200 feet in his intermediate zones, to 250 feet in his two least-dense zones.[46] The impact of Mr. Donovan's pole spacing assumptions in his four least-dense zones is significant: the poles in the two least-dense zones account for 60% of all pole investment modeled by HM 5.3, and the poles in his two next-least-dense zones (which

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43 *See* Exhibit No. ____(WGR-5).

44 Donovan Testimony at 24-25.

45 AT&T noted in response to Qwest Data Request No. 85, Exhibit No. _____ (WGR-10) that "Mr. Donovan is not the author of that study, nor does he have a copy of that study or Dr. Johnson's workpapers."

46 Donovan Testimony at 28-29.

are spaced 200 feet apart), account for another 20% (meaning that 80% of all pole investment fall into four density zones with spans of 200 ft. or greater).[47]

Q. ARE THESE POLE SPACING ASSUMPTIONS REASONABLE FOR A FORWARD-LOOKING NETWORK?

A. Not in my experience or that of Verizon NW in Washington. Mr. Donovan made a similar proposal in Florida, but it was rejected in the 2002 Florida Decision he cites in his testimony, which adopted a distance of 150 feet for all density zones,[48] as does the VzCost model here.

Indeed, because of the larger clusters Mr. Donovan now endorses, he appears to assume the use of backbone distribution cables that are substantially larger than the maximum cable size for his suggested spacing. As AT&T acknowledges, pole spacing must not create sag below the NESC's mid-span clearance guidelines.[49] All of the areas served by Verizon NW in Washington state are classified as "Medium Storm Loading," for which the NESC calls for a road clearance of 15.5 feet for "wires, conductors, or cables [that] run along and within the limits of highways or other road rights of way but do not overhang the roadway."[50] The cable sag associated with a 250 foot span in Washington's storm loading zone would limit the size of the backbone cable significantly (100 pair 26 gauge for the 250 foot span and 400 pair 26 gauge for a 200

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[47] *See* Exhibit No. _____ (WGR-6).

[48] Florida 2002 Decision at 18.

[49] HAI Inputs Portfolio, Section 3.6.2, at 37.

[50] NESC 2002 Section 232B1.

foot span). It is questionable as to whether these backbone distribution cable sizes could support the large DA areas Mr. Donovan proposes.[51]

VIII. MANHOLE SPACING

Q. WHAT ASSUMPTIONS DOES MR. DONOVAN MAKE ABOUT MANHOLE SPACING?

A. He assumes that there will typically be:

- 800 feet between manholes in density zones of less than 650 lines per square mile
- 600 feet between manholes in density zones between 650 and 5,000 lines per square mile

and

- 400 feet between manholes in density zones of over 5,000 lines per square mile.

Q. ARE THESE ASSUMPTIONS CONSISTENT WITH DATA ABOUT MANHOLE SPACING IN EXISTING NETWORKS?

A. No. Manholes are no more than 550 feet apart on average, even in the most sparsely populated zones. They are spaced at 525 feet apart in density zones of 200-850 lines per square mile, 460 feet apart in zones of 850-10,000 lines per square mile, and 250 feet apart in zones 10,000 lines per square mile.

Q. WOULD ONE EXPECT THIS SPACING TO CHANGE IN A FORWARD-LOOKING NETWORK?

A. No. The factors that make it difficult to increase manhole spacing now are likely to continue to exist in a forward-looking network. The distance between manholes is

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[51] *See* Exhibit No. _____ (WGR-6).

determined by several major factors (in addition to the length of cable that can be put on a reel): the street layout, the location of building service entry points (and subsequent need to drop facilities off), the location of other utilities in the ground, and the number of, and angle of, bends between any given two points (this is particularly true of large diameter cables, which are very rigid). The average city block is between 250 and 350 feet. Generally there is more than one building on a street, and invariably there are other utilities obstructing the engineer's ability to place conduit in a straight line from point A to Point B. It is not reasonable to assume that the shortest distance between manholes will be on average 400 feet in such an environment.

Q. WILL THE GROWING ROLE OF FIBER IN THE NETWORK ELIMINATE THE NEED TO HAVE MANHOLES SPACED SO CLOSELY TOGETHER?

A. No. Fiber and copper cable are frequently placed in the same underground structure. Thus, even if technicians do not need access to fiber every 550 feet, they will still need to access the copper cable in the same conduit. Indeed, in Washington, virtually all of the fiber that Verizon NW places underground shares structure with copper cable close to the Central Office. And even where copper cable does not currently share underground structure with fiber cable, phone companies must preserve the possibility that it will be feasible to put it there. Having only pullboxes in such areas would make it impossible to install and maintain copper cable.

IX. PLACEMENT, LABOR AND ENGINEERING PRODUCTIVITY

Q. HOW LARGE A CREW DOES MR. DONOVAN ASSUME WILL BE SUFFICIENT TO PLACE COPPER AND FIBER CABLE?

A. He assumes (without support) that a two-person crew will be sufficient, regardless of whether they are placing aerial, buried, or underground cable.[52]

Q. IS A TWO-PERSON CREW TYPICALLY SUFFICIENT FOR PLACING UNDERGROUND CABLE?

A. No. Using a two-person crew in these situations would require significant sacrifices in safety (both to our employees and to the public) and efficiency. Except in the unusual case where crews are pulling cable on private property, or into a building, the placement of underground cable generally requires a minimum of four technicians (two crews of two technicians each), with one crew at the pull hole and one at the feedhole. Whenever a manhole is opened, two technicians are required at the manhole site for safety reasons (related to gas monitoring, air ventilation, and work area safety). Should one person be injured, the other can stop the work process to avoid further injury or damage to property. In fact, the set-up for placing underground cable is itself a laborious process and cannot be performed in a timely way without at least four technicians -- for such tasks as spotting the cable reels, loading reels in the construction yard, and establishing access to the duct to insert the cable at the feed hole and assembling the equipment at the pull hole.[53]

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52 Donovan Testimony at 47, 50. In a discovery response addressing the support for this assumption, Mr. Fassett now appears to have qualified Mr. Donovan's assumption: He states that placing crews are "generally" made of two technicians and suggests that this assumption is more likely to hold true for "aerial placing" than for other types of placement. *See* Exhibit No. _____ (WGR-11).

53 Certain discrete tasks among those necessary to place underground cable may sometimes require fewer than four technicians. But it would be very inefficient for technicians to try to hire a two- or three-person team to perform just these tasks, and then bring a fourth person to a site solely for those tasks requiring additional help. Even if it were possible to divide up the placement process in this way, doing so would dramatically slow the process of placing cable. It is therefore established engineering practice to have all of the technicians needed for a placement job working on a site for the duration of the job. This is true not only of underground, but of aerial and buried placement as well.

There is also another reason that such work requires at least four workers: there is often a requirement for traffic control in the form of flagmen (usually two, each with associated hourly costs). This is because underground cable is typically placed in densely populated areas with high traffic volumes and limited access. Indeed, AT&T's own engineering guidelines for cable placement stress the need to address traffic and recommend that engineers "[c]onsider using flag personnel when work that blocks one lane of a two-lane roadway is required or where fast moving traffic will be encountered."[54] Four technicians are also needed for fiber placement, set up, and disassembly which involve procedures very similar to those for copper cable and are equally laborious.[55] When conditions permit, Verizon blows the fiber cable through an inner duct with a compressor. As with the other copper and fiber cable placement techniques, four technicians are required for this task when there are two manholes involved. One two-person crew manages the fiber as it comes off the cable wheel, with one person needed to grease and lube the cable as it is blown into the duct, and another to monitor the paying out of the cable. Another two-person crew manages the cable at the receiving end.

Q. IS A TWO-PERSON CREW SUFFICIENT FOR PLACING AERIAL PLANT?

A. Generally not. In placing poles, three technicians are frequently needed to assure that the placement is done in a way that is efficient and safe for the technicians.

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54 *See* Exhibit No. _____ (WGR-4) (AT&T engineering guidelines at 18.1.5.1).

55 For example, AT&T's guidelines for placing aerial fiber cable note that "[h]andling and transporting large cable reels poses a potential danger to both construction personnel and to the public sector," that "[a] full reel of maximum size fiber cable can weigh as much as one ton," and that "[e]xtreme care must be exercised in loading, securing, transporting, and unloading at the approved job site." *See* Exhibit No. _____ (WGR-4). (AT&T engineering guidelines at 18.1.5.1).

The placement of non self-supporting aerial cable is a complicated process that involves (1) first placing stainless steel "messengers" on the spans between poles onto which cable will be placed or lashed, (2) positioning down guys to counter the tension that results from the placing of messenger strands and/or other pole-to-pole guys or down guys, (3) positioning the cable by placing rollers at the top of each pole and pulling the cable (with a pull rope) between the two poles, and (4) securing the cable to the steel messengers with a process called "lashing," during which a thin stainless steel wire is wrapped around the cable and the messenger with a lashing machine. In the course of this process, technicians must make several trips up and down each pole. In my experience, it is typical for two technicians to climb every other pole while another handles tasks on the ground. Moreover, as AT&T's engineering guidelines on aerial cable placement state, "[a]erial construction often involves the setting of new poles and anchors or removing of old poles," and this process often entails numerous precautions and use of a pole trailer.[56]

Stringing cable on poles also requires special safety measures, since many poles are jointly-used with power companies and technicians placing cable therefore work near high-voltage wires. Typically a pole must be placed while live power is still on the existing pole. An insulating blanket is placed at the top of the new pole to prevent the pole from acting as a conductor between the high voltage lines on the old pole and the new pole. Like the aerial placement tasks described earlier, these require at least two technicians and more often than not a traffic detail.

Q. HOW LARGE A CREW IS NEEDED FOR PLACING BURIED CABLE?

[56] *See* Exhibit No. _____ (WGR-4). (AT&T engineering guidelines at 18.1.3.1, 18.1.3.16-17).

A. The number of technicians needed to install buried cable is not fixed, but depends on the environment where the trenching takes place, the size of the cables to be installed, the amount of the trench that is open, how much of the installation has conduit, and the time frame for closing the trench. In most circumstances, buried placement cannot take place without a crew of at least three technicians. When buried cable is placed outside of subdivisions, for example, the process generally occurs on a roadway, and therefore it requires at least one flagman for traffic control. As a result, crews placing buried cable therefore typically consist of at least three people (two technicians and a flag man).

When buried cable is installed in residential subdivisions or in condominium complexes, it is preferable to install it within a 4-inch PVC conduit to allow for better protection and ease of maintenance or repair. In such a scenario a crew of four would be needed to install the cables. Indeed, because of the protection it offers, today an increasing amount of buried cable is placed in such conduit (and not, as Mr. Donovan claims, "placed in dirt trenches without any additional structure)."[57]

Q. ARE MR. DONOVAN'S ASSUMPTIONS ABOUT THE SIZES OF SPLICING CREW SIZES REASONABLE?

A. No, they are not. He assumes that a crew of only one technician is sufficient for aerial splicing and that a crew of two technicians is sufficient for underground splicing. Both aerial and underground splicing often occur along streets and roadways, and flag men are therefore required in addition to the crew sizes Mr. Donovan assumes.

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[57] See Donovan Testimony at 12.

Q. ARE MR. DONOVAN'S ASSUMPTIONS ABOUT SPLICING LOCATIONS REASONABLE?

A. No. Mr. Donovan's approximation of 1000 feet between splices would be justifiable only in the most remote parts of the network, where the roads are long, demand is limited, and the need to taper is minimal. In urban and suburban areas, splices must occur where demand forces the pairs to be allocated down side streets and into buildings, industrial parks, subdivisions and condominium complexes. The occurrence of any one of these will drive the placement of not only a pole, SAI or a manhole, but also in all probability a splice.

Q. WHAT ASSUMPTIONS DOES MR. DONOVAN MAKE ABOUT THE PRODUCTIVITY OF PLACEMENT CREWS?

A. With only a very general reference to his personal experience,[58] Mr. Donovan, assumes a crew can place:

- 3,600 ft per day of underground cable
- 8,000 ft per day of buried cable or
- 5,000 ft per day of aerial cable

Q. ARE THESE ASSUMPTIONS REASONABLE?

A. Not in my experience or that of Verizon NW. There are significant natural and artificial barriers that crews must frequently avoid or remove when placing cable. Aerial

[58] Donovan Testimony at 47-48, 52-53. Mr. Donovan also relies on an interview in which he was allegedly told by two contractors for Cablevision that they placed from 8,000 to 10,000 feet a day. *Id.* at 52-53. Mr. Donovan does not explain how he chose the two contractors (as opposed to others) or what questions he asked to elicit the information or under what conditions such an amount could be achieved (e.g., whether they were placing fiber cable or much heavier copper cable). Mr. Fassett, who has adopted Mr. Donovan's testimony, has stated that he will not rely on this interview. (See Exhibit No. ___-(WGR-11).

placing crews often must grapple with tree limbs and existing service wires from other utilities.[59] Buried and underground placement is often slowed by the existence of street crossings, other utilities' cables, or other subterranean obstacles.[60] Plowing equipment is generally large and difficult to maneuver, and therefore used infrequently.[61] Nor is it appropriate to assume that crews can dig continuous trenches and use uniform cable sizes. Even in a residential development, it is rare that a developer has the capacity to have 8,000 feet of trench opened at one time. It is far more likely that a crew will have to cut and coil cable frequently, and it is highly unlikely that the cable being placed would be 8,000 feet of uniform size. Thus, a placement crew will typically have to make at least one additional trip back to the garage for a different cable reel. Crews installing underground cable have to take numerous precautions to assure the crew's own safety and those of drivers and pedestrians in the vicinity. As I have noted, such measures include working with flagmen, closing streets or parts thereof, and setting up deceleration zones. It may also be necessary to have manhole sediments tested for hazardous materials (and subject to a clean up process where such hazardous materials exist).

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59 AT&T's own engineering guidelines note that aerial construction may well involve placing poles "on joint use power lines and across public streets, bridges, creeks, rivers, highways, and railways" and lists numerous other tasks that will make the aerial placement rates assumed by Mr. Donovan impossible to achieve. Exhibit No. _____ (WGR-4) (AT&T engineering guidelines at 18.1, pages 4-22).

60 Like the Florida Commission, as described above, I am assuming that in a TELRIC model it is unrealistic to assume that other utilities would be swept into the model's forward-looking assumptions. Thus, in a forward-looking environment, Verizon NW would be required to deal with the existing facilities of other utilities.

61 See photos of plowing equipment, included as Exhibit No. _____ (WGR-3).

Q. WHAT PLACEMENT RATES ARE REASONABLE WHEN ONE TAKES SUCH BARRIERS INTO ACCOUNT?

A. Current productivity assumptions in Verizon's ECRIS system (Engineering and Construction Resource Information System), conservatively projects placing rates of approximately 1000, 1200 and 1300 feet per day per crew for underground, buried and aerial respectively. Again, the actual rates will vary significantly and almost always towards a number (feet per day) lower than I have identified. They are extremely unlikely to reach Mr. Donovan's proposed rates, which appear not to take account of any of the difficulties I have described above.

Q. WHAT ASSUMPTIONS DOES MR. DONOVAN MAKE ABOUT ENGINEERING PRODUCTIVITY?

A. He assumes that an outside plant engineer can engineer at the following productivity rates: 10,000 feet of copper or fiber cable/day, 30-minutes/splice location, and 1200 pairs/hour.[62]

Q. ARE THESE ASSUMPTIONS REASONABLE?

A. No. They are entirely unrealistic, and substantially oversimplify what is required by the engineering process. I have already described the numerous tasks that engineers must undertake in planning the network, and there are likewise numerous tasks an engineer must take after planning is completed. At a minimum, engineers must identify the terminal locations, establish cable IDs and counts, and determine preferred counts (to ensure effective assignments of cable pairs). They must acquire easements and locate SAIs and terminals; coordinate with other developers, internal

[62] Donovan Testimony at 46.

units, other utilities, and customers; take erosion control measures; communicate and sometimes train other staff; enter and maintain records; engage in quality control; prepare project sites, order NGDLC/NGADMs, SAIs, cables, and other equipment, and arrange for AC power supply to the site. These many tasks cannot be handled efficiently and properly within Mr. Donovan's proposed time frame.

Moreover, AT&T's testimony disregards the labor costs of the many other workers upon whom the OSP engineer relies, such as right of way agents and other engineering personnel, who play a crucial role in the planning and designing of the network.

Q. IS ENGINEERING FIBER CABLE EASIER THAN COPPER CABLE AS MR. DONOVAN STATES?

A. No. In fact, an engineer working with fiber must consider many more variables. Copper cable design is essentially linear, originating from the central office as large cable and tapering down into smaller cables as it extends away from the wire center. The demand is confined to those services that can be provisioned on a copper medium, like POTS, ISDN, and xDSL, and is then aggregated as it goes back to the central office building.

Fiber, by contrast, is capable of supporting not only those services provisioned on copper but also many others. It is also the only material used for IOF transport. When an engineer contemplates the allocation of fiber strands, he or she must therefore consider whether or not there is a likelihood that there will be a demand for a "ring" architecture (IOF or customer or both). Such variables make the allocation of fibers and the subsequent engineering of the fiber ribbons far more complex than the engineering of copper cable, contrary to Mr. Donovan's assertions.

X. DLC DESIGN AND INSTALLATION

A. MIX OF IDLC AND UDLC

Q. WHAT TYPE OF DIGITAL LOOP CARRIER ("DLC") TECHNOLOGY DOES MR. DONOVAN ASSUME WILL BE USED FOR FIBER-FED LOOPS?

A. He assumes the use of 100% GR-303 integrated DLC ("IDLC") for fiber-fed loops.[63]

Q. WHAT IS GR-303 IDLC?

A. GR-303 IDLC refers to a format for connecting DLC-fed loops to a switch. The term "integrated" refers to the fact that the individual loops in an IDLC system are integrated, or multiplexed, into larger circuits (typically DS-1 circuits) and connected to the switch in that multiplexed format. "GR-303" refers to a particular protocol for the interface between a DLC system and the switch. The other commonly deployed IDLC interface is the TR-008 interface. Most DLC equipment available today can be deployed using either the GR-303 interface or the TR-008 interface.

Q. IS IT APPROPRIATE TO ASSUME THAT IT WOULD BE POSSIBLE TO PROVISION STANDALONE UNE LOOPS IN A NETWORK WITH 100% GR-303 IDLC?

A. No. Though Mr. Donovan is correct in that UNE-P arrangements (or DS-1 service) can be provided using GR-303 IDLC, currently available products and technology do not support unbundling standalone loops (*i.e.,* loops that are handed off

[63] *See generally* Donovan Testimony at 85-88.

on a physical medium, discretely at both the customer and central office ends of the loop) through the GR-303 IDLC interface. Thus, it would not be technically feasible to provide standalone UNE loops to customers served by DLC systems under Mr. Donovan's 100% IDLC assumption.

Q. HOW DO YOU RESPOND TO MR. DONOVAN'S CONTRARY CONTENTION?

A. Mr. Donovan fails to take into account limitations of currently available DLC equipment. He correctly recognizes that, when using the GR-303 IDLC interface, loops are delivered to the switch in groups of multiplexed DS-1s called an "interface group."[64] It also is true that the multi-hosting capabilities of GR-303 allow interface groups from one DLC system to connect to more than one switch, but only if those switches belong to the same carrier. However, Mr. Donovan wrongly theorizes that the multi-hosting capabilities of GR-303 would allow a carrier such as Verizon simply to cross-connect one or more DS-1 circuits from Verizon's central office terminal to a CLEC collocation cage for delivery to a *CLEC switch*.[65] By connecting a switch to a DLC system through a GR-303 interface group, the switch gains full access to the operations functionality (e.g., provisioning, alarm reporting, test access, etc.) of the DLC system. This includes full access to all of the individual lines served on the same DLC system. Allowing multiple switches from different carriers to connect to the same DLC system through a GR-303 interface group creates significant risks of conflict between instructions sent by the different carriers' switches to the DLC system and of compromising the security or functioning of any of these carriers' telecommunications services.

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64 *See* Donovan Testimony at 87.

65 *See id.* at 87-88.

The numerous security, error-protection, and operational issues presented by such an arrangement have yet to be resolved by DLC suppliers and, until they are, it is not practicable to connect different carriers' switches to the same DLC system through the GR-303 IDLC interface, as Mr. Donovan proposes. Indeed, the very document from Telcordia attached to Mr. Donovan's testimony acknowledges this problem: "Since the GR-303 Interface Group supports operations functionality, *there are a variety of issues* (provisioning, alarm reporting, sharing of test resources, etc.) that are currently being addressed by the industry."[66] As indicated more recently on Telcordia's web site, these issues have not been resolved.[67]

Q. DOES MR. DONOVAN IDENTIFY ANY PARTICULAR DLC VENDORS OR MODELS THAT SUPPORT UNBUNDLING STANDALONE LOOPS THROUGH THE GR-303 INTERFACE?

A. No. This omission is particularly telling because, if there truly did exist a GR-303 DLC system capable of supporting multi-hosting with multiple carriers (and thus the provisioning of loops through the GR-303 interface), one would expect that to be indicated in the manufacturer's specifications for that product. However, Mr. Donovan has not provided any manufacturer's specifications showing that a particular model of DLC equipment is capable of unbundling loops in the manner that he describes. Nor has he even identified any particular models that he alleges are capable of doing so.

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66 *Telcordia, Notes on the Networks* 12-55 (Issue 4, Oct. 2000) (submitted as Attachment JCD-6 to Donovan Direct Testimony) (emphasis added).

67 See Exhibit No. _____ (WGR-7a). *See also* Exhibit No. _____ (WGR-7b).

Q. IF IT IS NOT POSSIBLE USING CURRENTLY AVAILABLE PRODUCTS TO UNBUNDLE DS-0 UNE LOOPS THROUGH THE GR-303 IDLC INTERFACE, WHAT IS THE MOST EFFICIENT WAY TO UNBUNDLE STANDALONE LOOPS SERVED ON DLC SYSTEMS?

A. The most cost-effective way is through the use of a universal DLC ("UDLC") system. UDLC line cards demultiplex individual loops from the DS-1 format to individual analog DS-0s at the central office. Once demultiplexed, these loops can be connected to the main distribution frame ("MDF") at the central office and then physically cross-connected from the MDF to a CLEC's collocation cage, just as if they were all-copper loops. Verizon typically deploys DLC systems with a combination of IDLC and universal DLC ("UDLC") line cards at the central office, allowing Verizon to take advantage of the efficiencies of IDLC while at the same time having UDLC available to provide standalone UNE loops or other non-switched services that require loops to be demultiplexed before they reach the Verizon switch.[68]

Q. DOES VERIZON NW'S ASSUMPTION ABOUT THE FORWARD-LOOKING PERCENTAGE OF UDLC TAKE INTO ACCOUNT THE ABILITY TO PROVIDE UNE-P USING IDLC?

A. Yes. Verizon NW assumes that 90.2% of all fiber-fed DLC loops would be served using GR-303 IDLC. These loops would be used to serve Verizon NW's POTS service, as well as customers served with UNE-P. The remaining fiber-fed DLC loops

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68 Another alternative would be to switch a customer served by a DLC system over to an all-copper loop, if one is available. However, if a network modeled by HM 5.3 does not include redundant copper feeder facilities (as I understand to be the case with HM 5.3), this option would not be available.

would be served by UDLC to accommodate standalone UNE loops and non-switched narrowband services that require UDLC.

Q. IS YOUR CONCLUSION ABOUT THE NEED FOR UDLC FOR STAND-ALONE LOOPS SUPPORTED BY THE FCC'S TRIENNIAL REVIEW ORDER?

A. Yes. In paragraph 297 of that order, the FCC noted that the IDLC system "is integrated directly into the switches of incumbent LECs," and thus "a one-for-one transmission path between an incumbent's central office and the customer premises may not exist at all times."[69] In requiring incumbent LECs to provide access to a transmission path over hybrid loops served by IDLC systems, the FCC recognize[d] that "in most cases this will be either through a spare copper facility or through the availability of Universal DLC systems." (Emphasis added). The D.C. Circuit's recent order upheld this determination against AT&T's protests about reliance on UDLC for these purposes. *USTA v. FCC*, No. 00-1012 (D.C. Cir. Mar. 2004), 359 F.3d 554, 582-3.

B. DLC Installation

Q ARE THE REQUIREMENTS FOR PLANNING, DESIGN, AND INSTALLATION OF DLC EQUIPMENT DESCRIBED ACCURATELY BY MR. DONOVAN?

A. No. Mr. Donovan both omits important steps in this process, and then oversimplifies the tasks he does describe, in both the design and the physical installation of DLC equipment at the remote terminal.[70] For the reasons noted below, his suggestion that Verizon NW can somehow avoid these tasks simply by having them

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[69] Report and Order and Order on Remand and Further Notice of Proposed Rulemaking, Review of Section 251 Unbundling Obligation of Incumbent Local Exchange Carriers, 18 FCC Rcd 16978 ¶ 297 (2003).

[70] Donovan Testimony at 65.

done "at the factory" is completely unrealistic, as is his estimate of 44 hours allocated for all of these engineering functions.

Q WHAT IS THE FIRST STEP REQUIRED FOR DLC INSTALLATION?

A. The first step, which Mr. Donovan omits, involves the engineer's selection of an appropriate remote terminal site. In addition to all of the site selection criteria for SAIs that I have described above, the engineer confronts special difficulties in the selection of sites for DLC equipment. These include but are not limited to additional space requirements for housings, the need for electric company facilities for AC power, planning for the ability to deliver and then run a generator for extended periods of time during an emergency, special security needs for AC-powered equipment, more sophisticated grounding schemes, additional inspections and permits, and the need to arrange for delivery of a boom or crane to the site for installation. Where an RT is installed in a building, installation of fiber and electronic equipment needs to be coordinated not only with the building owner or developer, but with the other providers of service to that building (to reach agreement on space and footprint arrangements)

Q. DESCRIBE THE PROCESS FOR SITE ACQUISITION.

A. Site acquisition typically begins with a field visit to confirm the suitability of the site. The task of acquiring the site is often handed off to a right of way agent with experience in dealing with the community. This agent must describe to the property owner and relevant municipal planning authorities what the purpose for the easement will be, what the DLC equipment will look like, what Verizon traffic can be expected, and how the site will be landscaped. Once a tentative agreement is established with the property owner, the right of way agent will hire a surveyor to obtain a legal description of the easement for use in the transaction. Next, the agent must research title on the property, obtain the necessary deed information to prepare the easement, and make all necessary filings for permits, variances, special use permits, environmental restrictions, building permits, recordings and approvals from municipal planning and zoning authorities. This includes all professional costs for surveying and/or acquiring department of environment approvals. Such authorities typically convene only once a month and almost always after normal working hours. This process alone will consume dozens of engineering hours.

Q. DESCRIBE THE PROCESS OF SELECTING DLC EQUIPMENT.

A. In Washington, there are currently 74 standard equipment configurations for DLC equipment available from the Verizon Advanced Remote Terminal Assembly Center ("VARTAC"), the centralized equipment assembly source used to select and order such equipment. To these standard configurations must be added custom configurations, since often there are requirements for special assembly (e.g., concentration of high capacity loop equipment, or special limitations for paint, size, or other characteristics dictated by right of way requirements). It will take the engineer several hours to identify, select and then communicate exactly what is required to the assembly plant for a particular application, including what the appropriate backup battery configuration will be. Engineers will also consider the available space at the potential Remote Terminal site and consider whether it requires a technology that is not available at the central office.

Q. WHAT IS INVOLVED IN THE SITE PREPARATION WORK FOR DLC EQUIPMENT?

A. The engineer communicates the requirements of the site to the construction personnel, at times working directly with the property owners, town officials or the contractors that will develop the site (and in a building, with the multiple service providers that provide service to it). The first task is arranging to bring in heavy equipment for grading, landscaping, and trenching. Several hundred feet of trench and conduits can be required, from the DLC equipment housings and SAI, to poles or underground structures for communications and AC power cables. Underground grounding grids are placed, and concrete pads are poured. In some cases liquid propane is used as a fuel supply for auxiliary generator backup, requiring additional work to be done. Typically, security fences and/or traffic barriers are also installed, as are shrubs and greenery to hide the site. The engineer will often coordinate electric power supplies and meters, as well as the installation of grounding grids to conform to the national Electric Safety Code specifications, and work with the inspector to obtain the necessary electrical permits.

Q. IS ALL OF THE INSTALLATION WORK DONE AT THE FACTORY?

A. No. There are many more installation and assembly functions that must occur after factory assembly. The equipment will be delivered to the site by a boom truck or crane. Typically a large flatbed truck with the equipment and a second truck or separate crane (depending on the size of the equipment) will arrive on site, position themselves (which at times requires stopping traffic with the permission of and/or assistance of local authorities) and then lower the equipment from one truck using the boom or crane from the other. Once the equipment has been lowered and power has been turned on, there are many more testing procedures that occur on-site, after factory testing. While turn-up procedures vary by manufacturer, virtually all take many hours and almost always require more than a couple of trips back and forth to the site over the course of several days. Environmental alarms, test controller pairs, terminal blocks, bonding and grounding, battery installation and various other tasks must be completed (both at the remote terminal and in the central office) in order for the system to become functional.

Q. IS THE PROCESS COMPLETE AFTER TURNUP?

A. No. The next critical step is rigorous acceptance and conformance testing. Acceptance testing is the formal procedure that must be undertaken with the maintenance organizations to ensure that all alarms work properly – i.e., that they correctly identify the environmental alarms (open door, heat, humidity, sump pump, and other conditions) and that the alarms are carried appropriately in the overheads back to the central monitoring staff. It is absolutely critical to have the organization that will be monitoring the performance of the system, and serving it when and if it should fail, formally "sign off" at turn up for they will be assuming the responsibility of the system from that day forward. Each line card slot must also be tested with the automated line test equipment. This process alone can take two people an entire day, particularly if they identify defects in the equipment (some of which may be a result of transporting the equipment to the site). Conformance testing, which follows, requires a series of rigorous copper loop tests for every derived pair from the DLC equipment to the SAI. This too will take many hours to complete and will vary by the number of derived pairs created and the number of SAIs served by the RT site. Testing is also performed for all circuits as to the particular service requested.

XI. HIGH CAPACITY LOOP AND MULTIPLEXER ENGINEERING AND INSTALLATION

Q. HOW MUCH TIME DOES MR. DONOVAN ALLOCATE FOR THE ENGINEERING AND INSTALLATION OF DS3 AND MULTIPLEXER?

A. He allows three hours for engineering and installation of these items at the customer premises and 20 hours for engineering and installation of 12 multiplexers in Central Office 12 OC-3 Multiplex Bay.

Q. IS THE 3 HOURS SUFFICIENT FOR ENGINEERING AND INSTALLING THESE ITEMS AT THE CUSTOMER PREMISES?

No. In my experience it is not close to sufficient. Mr. Donovan does not take any account of the initial transaction time necessary to arrange the engineering with the customer. High capacity services at the DS3 level are typically ordered by firms with large IT departments or are outsourced to firms specializing in IT, and the first step of identifying, contacting, and holding preliminary discussions with the person authorized to approve the location of the multiplexer can at times take a significant portion of the time that Mr. Donovan allots. Such discussions must, for example, deal with and generate agreement on the provision of AC power and of 24/7 access at the site. Only after such discussions have occurred can the cable and room layout design at the location begin. In applications where High Capacity Services will be fed to multiple customers, the engineer will need to meet with all customers to design routes to their respective equipment rooms.

Q. WHAT STEPS MUST OCCUR ONCE THE INITIAL DISCUSSIONS AND CABLE ROOM LAY OUT PLANNING ARE COMPLETE?

The engineer must engage in a complex analysis that attends to specific variables such as the size, configuration and ownership of the building (e.g., whether the customer is the landlord or a tenant). He or she must also consider the physical distance limitations of the non-fiber (coaxial) portion of the circuit between the multiplexer and the customer's equipment, since such limitations will require the multiplexer to be relatively close to the customer's equipment. If the engineer is faced with the probability that more than one High Capacity Loops customer will occupy the building or complex, there are additional issues that he or she must address in locating the equipment. For example, even when serving many customers, it is efficient to have one physical location for equipment to service them, largely because this makes it more feasible for the engineer to have 24/7 access to such equipment. To begin addressing each of these issues, the engineer would typically spend multiple hours taking field notes and coordinating his proposed solutions with the customers' needs and preferences.

Once all these steps are complete, the engineer has to go back to the office and begin the process of ordering the equipment (in manner very similar to the DLC equipment ordering process I outlined earlier). He also has draw up detailed engineering plans and schedule the installation of the High Capacity Loop and multiplexer. Three hours is simply not sufficient to conduct such planning and negotiations with the care necessary to perform these tasks effectively.

Q. ARE MR. DONOVAN'S ASSUMPTIONS ABOUT INSTALLATION TIME REASONABLE?

No. Contrary to the impression Mr. Donovan gives that the design is "simple" and the installation of multiplexers is a matter of plugging it into a wall outlet and letting it do a self-test,[71] the process and logistics required to make a system functional in the field are actually quite complex and time-consuming. A fiber multiplexer is usually installed on relay racks or in a secure cabinet. More often than not, there is ancillary equipment required including Optical Termination Cabinets, Cable racks and supports, rectifiers, battery back up, alarm blocks and DSX3 panels.[72] Wall mount multiplexers, like the Adtran Opti-3, that can deliver an OC-3 (3 DS3s) are also available.[73] Installing each of these items takes time. For example, the batteries are shipped separately, because of their hazardous nature, and must be placed and wired carefully so as not to cause damage to life or property. The relay racks must often be secured properly to the floor and ceiling.

Moreover, installation is not the end of the process. After the equipment is installed and secured, the technician must undertake a system turn up and Acceptance Process. These involve multiple steps, as is illlustrated by the attached exhibit showing a portion of Lucent's Turn Up Procedures for one of their multiplexers, the DDM-2000.[74] These outline the steps that must be taken to make the equipment functional and provision a DS3, and these steps can often take technicians at least one or two days: They must perform initial shelf turn up, establish the end to end System (which differs

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[71] Donovan Testimony at 90.

[72] See Exhibit No. _____ (WGR-7).

[73] *Id.*

[74] See Exhibit No. _____ (WGR-8).

according to the specific configuration), perform acceptance procedures and detailed level procedures, and add the new DS3 service. Finally, engineering and provisioning personnel must identify the system in the inventory and provisioning systems, a process which alone sometimes takes 4 hours to complete. Moreover, each battery must be tested prior to being wired to the rectifier.

Q. IS MR. DONOVAN'S ALLOTMENT OF 20 HOURS SUFFICIENT FOR ENGINEERING AND INSTALLING 12 MULTIPLEXERS AT THE CENTRAL OFFICE?

A. No. While AC and DC power is more readily available at the central office, many of the same engineering, installation, and turn-up procedures necessary to perform such an installation at the customer premises -- determining the proper location of the unit, installing ancillary equipment such rectifiers, battery back up, alarm blocks, and acceptance procedures outlined above -- will also have to be performed at the Central Office. These will take longer than the 40 minutes per multiplexer that Mr. Donovan proposes. Moreover, each multiplexer must be engineered separately, and so, contrary to Mr. Donovan's assumption, the quantity of multiplexers will not lead to a reduction in the time required to engineer each one.

In fact, there are a number of difficulties an engineer must address in engineering of multiplexers. For example, a Battery Distribution Fuse Bay (BDFB) can quickly become exhausted when powering this quantity of multiplexers. Additional power engineering would then be required. When installing and cabling this quantity of multiplexers, cable routes to the ancillary equipment (i.e., DSX-1 /DSX-3 / DCS cable routes) become congested and new routes need to be designed and constructed.

XII. SIZING AND FILL FACTORS

Q. HOW DOES MR. DONOVAN PROPOSE TO SIZE COPPER DISTRIBUTION CABLE?

A. He sizes the cable to meet the current demand and adds a "cushion" for spare capacity. To obtain this cushion, he divides the current demand by a "cable sizing factor" of 75%.[75] In other words, the model assumes that the network will require no more than 33% more cable than is needed for existing demand.

Q. IS THIS CUSHION SUFFICIENT FOR AN EFFICIENTLY-FUNCTIONING NETWORK?

A. No. Distribution cable is significantly more vulnerable to deterioration or maintenance issues and requires significantly more spare to meet unforeseen spikes in demand.

First, because more distribution cable is generally aerial or buried structure, it is more vulnerable to environmental damage. When service problems arise as a result of such damage, Verizon NW has to be able to restore service as quickly as possible. The most efficient way to do so is not to force the customer to wait for on-site repair to the damaged pair, but rather to shift service to a spare pair in the interim. This ability to restore service quickly has become even more important with customers' increased dependence on the network for data centric, mission critical services.

Second, a larger cushion for distribution cable is also needed to meet unforeseen spikes in demand. Unexpected influxes of new residents or businesses may occur anywhere within a distribution area. Residential customers might need a second or

[75] Donovan Testimony at 54-55; HAI Portfolio at 3.6.1.

third line. Businesses will typically have multiple lines (with large variations between different businesses), and they often request increased numbers of lines as their business changes. While it is impossible to predict where such increases will occur, Verizon NW can be certain (from past experience) that they will occur in many distribution areas. And the most efficient and cost-effective way to prepare for them is to build enough distribution cable to absorb such increases in demand.

The alternative course of action -- simply waiting until demand arises before building sufficient cable -- is completely at odds with Verizon NW's service obligations and with sound engineering practice. It is also inconsistent with Washington Utilities and Transportation Commission requirements that services must be restored within a maximum two business days (even when it requires on-site work).[76]

If companies wait for additional line orders to install the cushion of distribution cable they need, they will find themselves unable to meet developing customer needs without going through a costly process of installing additional cable. As noted above, this problem arose in the network I helped to build from the ground-up in Bangkok: against my recommendation that we size cable sufficient to absorb unanticipated increases in demand, officials in charge of the project insisted on providing only enough facilities to the known demand. When I returned four years later, it was evident that the telephone company had been required to run significant numbers of long drop wires back towards the SAI in search of spare pairs. Rather than follow this course of action, it is much more efficient -- and less costly in the long run -- to build enough additional cable so that the carrier can easily adjust to unpredictable increases in demand.

[76] See WAC 480-120-173.

Q. CAN VERIZON NW REDUCE THE AMOUNT OF NEEDED SPARE DISTRIBUTION CABLE BY PREDICTING WHERE SUCH SPIKES IN DEMAND WILL OCCUR?

A. Not unless it is willing to gamble with the service of customers in a particular distribution area by leaving too little spare capacity. In my experience, demand growth within a wire center is difficult to predict with any certainty. Engineers charged with designing the local loop to meet customer demand do not have any formula available to them that calculates how many lines will be needed or where they will materialize. They use their best judgment, based on their knowledge of a multitude of factors about the local region to which new lines must be built – drawing on their experience with the area, looking at the nature of existing businesses and residences, zoning laws, the incentives or plans for new businesses to move in, and projected need for high capacity services. As Verizon guidelines note, for example, it is appropriate to ask, "What kind of business would likely occupy that building at a future date?"[77] Even with the aid of such information, such demand is extremely difficult to predict.

Mr. Donovan's limited distribution capacity sizing is below that currently used in designing local networks, demands estimates far more accurate than any engineer is capable of, and would impose significant costs on both carriers and customers when such estimates are wrong (as many inevitably will be). If, for example, new, unexpected growth occurs at the time that a network's utilization rate is already at 80% or more, carriers will be poorly-equipped to respond efficiently to the needs of new customers,

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[77] *See* Exhibit No. _____ (WGR-2a), Excerpts from Verizon Distribution Area and Planning Design Student Documentation at 40-41.

and will find it harder to address disruptions to existing customers' service, affecting quality standards for both on-time provisioning and mean time to repair. Indeed, the AT&T Outside Plant Handbook, upon which Mr. Donovan relies, notes that it is often more efficient to place larger cable to avoid the burden of placing additional cable in the not-so-distant future.[78] As Mr. Donovan himself has acknowledged, "On an individual case basis, reinforcement always looks worse than having built the extra capacity at the time of the initial installation."[79] AT&T's Outside Plant Handbook itself recommends five pairs per business (for "small business[es]"). [80]

Q. IS MR. DONOVAN CORRECT IN STATING (ON PAGE 58) THAT FILL LEVELS FOR DISTRIBUTION CABLE SHOULD APPROACH 100% AS THE CABLE NEARS THE END OF ITS LIFE?

A. No. Even after distribution cable has been in place for a long time and is nearing the end of its economic life, it will still need to contain sufficient spare for restoring service and for meeting unanticipated spikes in demand. For a number of other reasons, it is extremely unlikely that a cable will ever near the level of 100% fill. As Mr. Donovan concedes, cables tend to come in certain "discrete sizes."[81] For example, if there were a street with six lines of demand, a full 25-pair, non-multiplied binder group and cable would be used to serve the street. The utilization rate would therefore be 24%. Another example might be that of a 600 to 400 pair cable taper. Specifically, let

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[78] See AT&T OSP Handbook at 3-9.

[79] Reply Declaration at ¶ 413, (CA PUC Docket No. A.01-02-024/035 filed Feb. 7, 2003).

[80] See AT&T OSP Handbook at 3-11.

[81] Donovan Direct Testimony at 55.

us assume that a 600 pair distribution cable leaves an SAI and runs for 1000 feet. Then a 400 pair cable is spliced into the 600 and runs an additional 2000 feet. If the aggregate demand from the SAI to that point (the taper point where the 600 is spliced into the 400) is anything less than 200 pair (600-400 pairs), then the remainder will be spare unused capacity. This is not at all uncommon in a real world situation.[82]

Q. HOW MANY LINES THEN MUST A CARRIER BUILD IN THE NETWORK TO ASSURE THAT IT MEETS MAINTENANCE NEEDS OR CUSTOMER REQUESTS FOR ADDITIONAL LINES?

A. Verizon NW follows a long-standing guideline of 2 to 3 lines per customer location. Even for residential lines, Verizon's Distribution Training notes that a minimum of 2 pairs per residential living unit is standard and that there will be some cases when a greater number is advisable. Businesses will need many more than two. Verizon's experience indicates that this ratio has generally provided sufficient excess capacity to meet unexpected variations in demand. Mr. Donovan's suggested ratio of 1.5 to 2 lines per customer is insufficient for this purpose. Indeed, 1.5 is well below the value recommended by AT&T witness Joseph P. Riolo in Florida Docket No. 990649-TP, who testified: "[The two pair per dwelling unit is somewhat of a minimal guideline. The actual design criteria is really left to the engineer, who should be more familiar with the geography to be served. For example, in some very affluent areas where the perception might be, and very well so, that five and six pair would be the proper number

82 It is also more efficient for a carrier to build lines for all living units, occupied and vacant, rather than run the risk of having to augment the network when the vacant units become occupied. Since 5 to 10% of housing units are vacant at any particular time, this figure alone will cause 5 to 10% of network capacity to go unused at any given time.

per household, it certainly does not preclude the engineer from doing that. There has to be some sufficient material that would indicate things of that nature. But I know of locations that were designed on certainly more than two pairs per dwelling unit."[83]

Q. WON'T INCREASED USE OF FIBER CABLE AND WIRELESS REQUIRE SMALLER SIZING FACTORS?

A. No. Mr. Donovan notes that "outside plant network may migrate toward fiber and wireless solutions."[84] However, customers and businesses continue to order additional lines. And for the reasons stated above, Verizon NW cannot predict with any certainty whether trends in technological development will necessarily reduce total demand in any given area in which it is required to provide service (and to do so on a timely basis).

Q. CONCEDING THAT THERE MAY BE INCREASES IN DEMAND FOR NEW POTS SERVICES, CAN'T SUCH INCREASES EASILY BE MET BY INSTALLING NEW ELECTRONIC DLC "LINE CARDS" INSTEAD OF INSTALLING ADDITIONAL CABLE?

A. Line cards only provide new facilities at the DLC site. Cable will still have to be placed from the SAI to wherever the customer is located in the distribution network. In addition, the DLC system would have to have been sized properly in the first place. Retrofitting certain RT sites can be as costly and time consuming as some cable jobs.

Q. WHAT FILL OR "UTILIZATION" FACTOR DOES MR. DONOVAN TREAT AS A TARGET FOR FIBER CABLE?

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[83] Florida Order No. PSC-01-1181-FOF-TP, Docket No. 990649-TP, May 25, 2001, at 165.

[84] Donovan Testimony at 58.

A. He states that Verizon needs no fiber cable above that necessary to serve existing demand. He argues that this assumption of a "100% fill level" is appropriate, since a four-strand fiber cable already has a redundant transmit and receive cable strand built into it, and that the next larger fiber cable size is 6-fiber cable.[85]

Q. IS THIS FILL OR "UTILIZATION" FACTOR REASONABLE FOR A FORWARD-LOOKING NETWORK?

A. No. For one thing, fiber cables are generally manufactured in 12-strand ribbons and like copper cables, there are efficiencies to be gained in using standard size cables. Moreover, as with copper cable, fiber cable must be built in a way that takes account of unpredictable increases in demand. With increasing demand for fiber-cable services,[86] Verizon NW must be prepared for the inevitable requirements of new businesses (and new services for existing businesses) for significant expansion in fiber-based services.

Furthermore, it is erroneous to say that redundant (or protect fibers) are "essentially spare." Protect fibers are there for a reason. They are insurance against unexpected fiber failures and would not be used in the same manner as spare fibers in a forward-looking model. Again, service reliability is a critical feature of a modern data network and the level of risk in utilizing protect fibers in the same manner as spare fibers, would not be adequate to meet those demands.

Q. IS MR. DONOVAN CORRECT IN ASSUMING A DLC FILL LEVEL OF 90%?

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85 *Id.* at 55-56.

86 As Mr. Donovan acknowledges, fiber is becoming a more and more important part of the network. *See* Donovan Testimony at 58 (noting that "outside plant network may migrate toward fiber . . . solutions").

A. Given the realities of standard DLC configurations, unpredictable demand, and the high costs associated with dispatches (in incrementally adding line cards), it is erroneous to assume such high utilization of DLC systems. Like standard cable sizes, there are standard DLC sizes. Typically, the number of line cards supported by a given channel bank is a multiple of 24, corresponding to the number of DS0s per DS1. As a result, fill levels often fall below that proposed by Mr. Donovan. If an engineer had to service a 100-line demand site, he would use a 192-line DLC. Assuming the demand did not change, and the DLC was equipped with enough line cards to service the 100 lines and no more, there would be only 52% (100/192) utilization at the DLC site even if there was 100% utilization on the line cards themselves. In reality, most new line cards have more than one POTS line per card (typically four) so 100% utilization would only occur when the demand is some multiple of four. Moreover, it is not, as Mr. Donovan states, a matter of minutes to add a line card.[87] It often makes economic sense to seed the DLC with additional line cards to avoid costly installation dispatches.[88]

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

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87 *See* Donovan Testimony at 11.

88 See excerpts from Verizon - Draft Engineering and Planning Guidelines – 2003-00235-OSP page 10. (attached hereto as Exhibit No. _____ (WGR-2b)).