exceeds the capacity of the available switching fabric. Although the TR008 interface would still have many available idle channels, they may not be effective in making or receiving calls.

The GR-303 architecture offers the opportunity to more closely match the traffic capacity of the loop transport system and the line port requirements of the switch to the designed traffic capacity of the switch. GR-303 Interface groups are generally larger than TR008 Interface Groups and, therefore, will be less susceptible to traffic load variations. Each line within the large GR-303 Interface Group will have access to all of the traffic bearing channels within the interface.

Q. VERIZON CLAIMS THAT IDLC IS NOT COST EFFECTIVE, AND THAT UDLC/COPPER LOOPS ARE THE MOST EFFICIENT TECHNOLOGIES FOR UNBUNDLING LOOPS. DO YOU AGREE?

A. No. GR-303 IDLC is substantially less costly than UDLC, deploys fewer facilities (concentration), is more efficient in its use of switch ports, DS1 cards and ISDN provisioning, and is capable of unbundling and grooming circuits <u>via</u> remotely provided OSS instructions. UDLC is 1970's technology, while copper loop alternatives even pre-date UDLC. These technologies hardly qualify as forward-looking for TELRIC purposes.

Q. ON WHAT BASIS DOES VERIZON INCLUDE ONLY MINIMAL AMOUNTS OF GR-303 DLC TECHNOLOGY IN THE FORWARD-LOOKING NETWORK?

A. Verizon's reason for using only small amounts of GR-303 IDLC interfaces is that most of the digital switches currently employed in Verizon's embedded network

are TR-008 compatible and not GR-303 compatible.[14] Verizon claims that it has no plans to change its embedded switch interface compatibility in the foreseeable future, and thus concludes that a GR-303 interface is not appropriate. Verizon's position is a perfect example of developing "forward-looking" costs based on the older technologies and inherent inefficiencies within its embedded network. Verizon disregards the fact that the SCIS model it uses to develop forward-looking switching costs assumes the placement of all new digital switches. The decision of the appropriate interface compatibility for these new switches is therefore not a backward-looking one as Verizon suggests, but rather a forward-looking one. In this case, the least cost, forward-looking decision is to make these new switches GR-303 compatible.

Network-wide GR303 deployment in a forward-looking study is also consistent with Verizon's own deployment guidelines. **[BEGIN VERIZON PROPRIETARY]** *** **[END VERIZON PROPRIETARY]** Nonetheless, instead of following its own growth guidelines, Verizon retreats to a position that would essentially replicate its embedded plant.

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[14] *See* Verizon Cost Panel Testimony at 103, Lines 3-12.

1 **Q. ARE VERIZON'S ASSUMPTIONS REGARDING THE TYPE OF**
2 **DIGITAL LOOP CARRIER INTERFACE THE SAME AS ITS**
3 **ASSUMPTIONS IN THE FIRST UNE PRICING PROCEEDING?[15]**

4 A. No. When the initial cost studies were performed in 1997, all parties, including
5 Verizon (then Bell Atlantic), agreed that IDLC equipment would be the lowest
6 cost, most efficient means to provision service. In 1997, however, the prices for
7 IDLC equipment with a next generation GR-303 interface that was capable of
8 being unbundled for the provisioning of UNE's had not yet been firmly
9 established. Instead, Verizon developed a surrogate price based in part on the
10 older, more expensive, UDLC equipment that Verizon had previously been
11 deploying.

12 **Q. CAN THE "GROOMING" OF NON-SWITCHED/NON-LOCALLY**
13 **SWITCHED SPECIAL SERVICES BE ACCOMPLISHED TODAY IN A**
14 **COST EFFECTIVE MANNER?**

15 A. Yes. With the advent of TSI in the 1990's, grooming of circuits provisioned at a
16 Remote Terminal can be achieved via a software command. New provisioning
17 OSSs can communicate directly with the DLC. The DLC takes these remote
18 provisioning instructions, makes the internal cross connections without human
19 intervention, and assigns a slot (*e.g.*, a distinct path or channel that digital signals
20 follow between DLC devices). Simply put, TSI is a form of computerized cross
21 connections. Thus, contrary to the contention of the Verizon cost panel,[16] UDLC

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[15] *See* Ex. Parte: To Determine Prices Bell Atlantic-Virginia, Inc. is Authorized to Charge Competitive Local Exchange Carriers, PUC970005 (April 15, 1999).

[16] *See* Verizon Cost Panel Testimony at 26, 93.

is no longer needed – or efficient – for the provisioning of non-switched services or data services like ISDN and DDS.

Q. CAN EFFICIENT, IDLC LOOPS BE HANDED OFF TO CLECS?

A. Yes. Such loops are handed off to CLECs via a DS1 interface. The issue is the type of tie cable arrangement that a CLEC makes via collocation in the central office. Efficient connection would be at the DS1 level via a tie cable from the DSX frame to the CLEC Point of Presence, rather that at the DS0 level from the MDF to the CLEC Point of Presence. Presently deployed IDLC systems have a feature known as virtual interface groups. Virtual interface groups were originally designed to more efficiently balance the load on the switch by permitting the rearrangement of circuits from the RT to the Host switch interface. However, the same technology can be used to unbundle loops provisioned to the host switch by simply rearranging the circuit to an interface group of a different host switch. The process control to effect such unbundling ultimately resides in the SWITCH-DLE system with links to SOAC, LFACS, FOMS, TIRKS, FEPS, OSP/INE, NSDB, WFA/C, NMA, MARCH AND PVI.

Indeed, even in its testimony here, the Verizon cost panel concedes that it is "hypothetically possible to support unbundling of individual loops using the GR-303 interface." [17]

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[17] Verizon Cost Panel Testimony at 94.

1 **Q. DO YOU AGREE WITH VERIZON THAT ABSENCE OF WORKING**
2 **OSS MAKES IT INAPPROPRIATE TO ASSUME GR-303 UNBUNDLING**
3 **IN A FORWARD-LOOKING NETWORK?**

4 A. No. Although Verizon tries to hide behind its claim that the Operations Support
5 Systems ("OSS") has not yet been developed to effectively permit unbundling of
6 GR-303,[18] that argument confuses issues related to provisioning GR-303 in the
7 existing network with a forward-looking scenario in which OSS will be
8 specifically designed to work efficiently with the GR-303 interface. The absence
9 of appropriate OSS is no different than the problems that existed when the Act
10 was first implemented and it was technically feasible to unbundle a loop or port
11 but the OSS to do so did not yet exist. To date, the LECs have had little incentive
12 to work with vendors to develop the OSS for GR-303 unbundling. But there is no
13 doubt that a carrier designing a forward-looking network would use GR-303 and
14 would work with vendors to put in place the OSS needed to unbundle the GR-303.
15 It would not be technically difficult to develop such OSS if the BOCs desired to
16 do so. For example, at present, the BOCs have not assigned unique three digit
17 codes to different carriers as would be necessary but creating such codes is not
18 difficult. Finally, it is important to note that even if it is not possible to place an
19 electronic flow-through order for unbundling today, there is no technical issue
20 involved with placing such an order manually.

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[18] *See* Verizon Cost Panel Testimony at 93.

3. DLC CONCENTRATION RATIO

Q. WHAT IS A DLC CONCENTRATION?

A. Concentration is a feature available under the GR-303 interface group that allows less than one DS0 on the switch per assigned channel units at the RT. Instead of creating a dedicated DS0 channel to the switch, the time slot interface of the GR-303 interface is used to make a connection to the switch when a customer requires service. When the customer is through and the phone placed back on the hook, the connection is terminated and the circuit becomes available for use by another customer. The Litespan GR-303 system is designed to concentrate a minimum of 2,015 POTS lines onto 28 DS1's or 672 channels at the RT. This would provide a minimum 3:1 concentration level for the system. But the system can also concentrate far more lines, and, in many instances, this would be efficient. Concentration is possible because a large portion of served customers are not actually using their service at any given time. Simply put, concentration permits multiple circuits to share the outside plant facility, resulting in more efficient and less costly outside plant.

Q. WHAT LEVEL OF DLC CONCENTRATION HAS VERIZON USED IN ITS FORWARD-LOOKING COST STUDY?

A. Verizon uses a DLC concentration ratio of 3:1, the minimum amount of concentration possible on the system. This assumption is not explained or supported anywhere in the Verizon Cost Panel Testimony. It simply appears as an input to the Verizon cost study.

Q. WHAT IS THE APPROPRIATE FORWARD-LOOKING DLC CONCENTRATION ASSUMPTION?

A. In evaluating the potential benefits of the use of GR303 in its own network, Verizon assumed a **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]** concentration ratio,[19] and this is a reasonable assumption. We have nevertheless adopted an extremely conservative forward-looking concentration ratio is 4:1 in our restatement of Verizon's cost study.

C. CABLE SIZING AND UNIT COSTS

Q. ARE THERE OTHER PROBLEMS WITH VERIZON'S CALCULATION OF LOOP COSTS?

A. Yes. In response to AT&T/WorldCom data requests, Verizon has provided supporting documentation that indicates that the data and methods used by Verizon grossly overstate forward-looking costs. Specifically, these flaws cover the unit cost of cable obtained from Verizon's VRUC data, metallic cable sizing, telephone plant indices and the correct installed cost per foot for installed conduit. Additionally, Verizon's unit cost for poles is overstated.

Q. HOW DOES VERIZON DEVELOP ITS OUTSIDE PLANT CABLE COSTS?

A. Verizon bases its cable costs on information contained in the VRUC database. According to Verizon, VRUC includes installed investments associated with fiber and copper cable, which include SAI boxes, distribution terminals, drop wires,

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[19] **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]**

NIDs, and installation and engineering costs. The installations included in the VRUC data relied upon by Verizon covered the years 1997, 1998 and 1999.

Based on this description, it was our understanding that the VRUC database contained summaries of installed cable costs from a variety of actual Verizon outside plant capital investment projects. However, after reviewing some of the underlying details produced by Verizon in discovery,[20] we became convinced that the VRUC unit costs are not derived from actual outside plant placement projects, but instead contain what appear to be estimated cable installation costs resembling those typically found in a cost estimating tool. Most troubling, however, is that year-to-year changes in installed cable prices, particularly between 1997 and 1998, far exceed any reasonable measure of inflation over that period. Because Verizon's installed cable costs are based on an average of the VRUC costs over all three years, the excessive and unsupported inflation in the 1998 and 1988 VRUC costs produce overstated average installed costs.

Q. CAN YOU PROVIDE AN EXAMPLE OF THE EXCESSIVE ANNUAL CHANGE?

A. Yes. The following table presents the underground copper cable prices from the VRUC data for 1997 and 1998.

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[20] Verizon supplemental response to Request AT&T/WCOM 1-11 (a), file VA_VRUC9799.mdb.

[BEGIN VERIZON PROPRIETARY]

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[END VERIZON PROPRIETARY]

As the table shows, the price per foot for these allegedly "actual" installations of underground cable in 1998 are consistently **[BEGIN VERIZON PROPRIETARY]** *** **[END VERIZON PROPRIETARY]** greater than the 1997 installed cost.

Q. HOW DO THE INFLATION PATTERNS REFLECTED IN VRUC COMPARE TO THE TELEPHONE PLANT INFLATION INDICES?

A. Not well. The following table presents the change from 1997 to 1998 in price-per-foot across cable sizes from Verizon's VRUC database, Verizon's corresponding TPIs, and the C.A. Turner TPIs that we discuss in more detail below.

[BEGIN VERIZON PROPRIETARY]

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[END VERIZON PROPRIETARY]

As the table demonstrates, the inflation assumptions in VRUC are far out of line with inflation experienced by the telephone industry over the same time period.

Q. ARE THERE OTHER CLUES IN THE UNDERLYING VRUC DATA WHICH HELP CONFIRM THAT THE VRUC UNIT COSTS ARE NOT BASED ON ACTUAL INSTALLATIONS?

A. Yes. For each of the three distinct types of outside plant cable contained in the VRUC database – aerial, buried and underground – the incremental increase in the

installed cost per foot is the same. While this would not necessarily be a problem if the VRUC data measured only the cable material price, it is a big problem here. The VRUC costs are installed costs, which means they include both material and installation labor. It is reasonable to expect that the ratio of installation labor to cable material would be different among the three types of cable, particularly in light of the fact that the installation cost of buried cable includes the cost of digging a trench. However, Verizon's uniform change in installed costs implicitly assumes that the installation labor to material ratio is the same for aerial, buried and underground cable. If the VRUC data were truly derived from actual installations, the difference in the installation labor to material would be captured.

Q. CAN YOU PROVIDE AN EXAMPLE?

A. Yes. The following table sets forth the difference in the 1997 installed cost per foot between 300-pair and 600-pair cable and the difference between 600-pair and 900-pair cable for aerial, buried and underground plant from VRUC.

[BEGIN VERIZON PROPRIETARY]

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[END VERIZON PROPRIETARY]

Q. HOW IS THIS A PROBLEM?

A. Verizon uses a regression analysis of the VRUC data to develop the fixed and variable components of installed cable prices for use in the outside plant characteristics module. The assumption of constant incremental costs across cable types renders Verizon's regression analyses and results suspect. For example, the cost of the trench for buried cable does not increase linearly with the

size of the cable being installed because the size of the trench itself does not vary considerably based on cable size. Yet, Verizon's VRUC implicitly assumes it does and thereby most likely overstates the trench costs.

Q. HOW DID YOU REMEDY THE PROBLEMS YOU IDENTIFIED IN VRUC?

A. While it would be my preference to eliminate Verizon's use of the VRUC data completely from its cost study, the mechanics of the way Verizon's model works renders than an impractical solution. In my restatement of Verizon's costs, we continue to use the VRUC data, but we only use the cost information from 1997 indexed forward to 2001 levels based on the appropriate telephone plant index. In this matter, we avoided the overstatement of costs produced by the excessive and unsupported inflation in the VRUC installed costs beyond 1997. However, there is no way to adjust for the seemingly erroneous nature of Verizon's data showing that changes in cost as cable size increases are identical for different types of cable.

Q. ARE VERIZON'S UNIT COSTS FROM VRUC AND OTHER INTERNAL SOURCES CORRECTLY ADJUSTED FOR INFLATION?

A. No. Verizon uses inflation rates that are too high. Verizon's unit costs are based on the cost of equipment at the time it was installed in its network adjusted for inflation to determine the ostensible cost in 2001. In this proceeding, Verizon uses a combination of actual and forecasted telephone plant indices (TPIs) to inflate costs in its historical database to 2001 levels. The TPI's used in its cost study were developed by Verizon near the end of 1999 and purport to be Verizon-

1 specific indices based on the inflation Verizon experienced through 1998. To
2 account for inflation beyond 1998, Verizon used an outdated forecast.
3 AT&T and WorldCom have asked Verizon in discovery to provide
4 documentation supporting these Verizon specific indices. To date, we have
5 received only limited supporting documentation. Nonetheless, both the Verizon
6 historical and forecast inflation indices used by Verizon appear high.
7 Verizon has not provided any explanation of why indices developed based
8 on Verizon's own experience in installing facilities within its embedded network
9 are correct to use in a forward-looking cost study. Although Verizon may hazard
10 its own justification, a more reasonable and less prone to bias source for telephone
11 plant inflation is the C. A. Turner telephone plant indices. These are publicly
12 available and are based on the experience of the industry as a whole, not just
13 Verizon's experience. In addition, the Turner indices are more recent than the
14 vintage 1999 figures used by Verizon and thus do not need to rely extensively on
15 forecasted inflation rates. These indices confirm that the inflation levels claimed
16 by Verizon in its TPIs are above those experienced industry-wide. The table
17 below compares the inflation rate for underground copper cable from 1999 to
18 2000 and 2000 to 2001 from the Verizon and C.A. Turner indices.
19 **[BEGIN VERIZON PROPRIETARY]**
20 ***
21 **[END VERIZON PROPRIETARY]**
22 The table shows the Verizon indices are far above those published by
23 Turner. Similar patterns exist for other plant accounts. In our restatement of

Verizon's cost study, we substituted the more current Turner Telephone Plant Index values for the unsupported, forecast indices used by Verizon. We applied the Turner Telephone Plant Indexes to Verizon's VRUC cable costs and to Verizon's historical conduit investment costs.

Q. YOU PREVIOUSLY MENTIONED THAT VERIZON ALSO HAS A PROBLEM WITH METALLIC CABLE SIZING. COULD YOU DESCRIBE THE PROBLEM?

A. Verizon sizes metallic cable in the Plant Characteristics Module based on the average number of working lines within each wire center. The cost of the cable sized to accommodate the number of working lines is derived from the VRUC regressions. Verizon converts these cable costs to an investment cost per working circuit. The costs are then increased through the application of a distribution utilization factor for distribution cable and a separate feeder utilization factor for feeder cable. By developing the investment cost per cable based on the number of working lines and then adjusting the cost upward by a utilization factor, Verizon's methodology fails to reflect that the average cost per pair of metallic cable declines as cable sizes increase.

Q. CAN YOU PROVIDE A SIMPLIFIED EXAMPLE?

A. Yes. Assume there are 300 working lines within a Verizon wire center. Further assume that a 300-pair cable costs $12.00 per foot, 600-pair cable costs $20.00 per foot, and the cable utilization factor is 50 percent. Based on the assumption of 300 working lines and a 50-percent utilization factor, a 600-pair cable is needed to serve this hypothetical demand. Rather than use the cost per pair-foot for a 600 pair cable of $0.033 ($20.00/600), Verizon begins by assuming a 300-pair cable is

needed to serve the 300 working lines. Verizon thus uses the cost per pair-foot for 300- pair cable OF $0.040 ($12.00/300). To get to the 600-pair size that will actually be placed in the model, Verizon divides by the 50-percent utilization, thereby maintaining an effective cost per pair foot of $0.04. Simply put, Verizon's method uses the unit cost for 300-pair cable when the model calculates that 600-pair cable is needed. In this simplified example, cable costs are overstated by more than 21%.[21]

Q. HOW DID YOU CORRECT THIS SIZING ERROR IN YOUR RESTATEMENT OF VERIZON'S COSTS?

A. Verizon runs a regression on its installed metallic cable costs for aerial, buried, and underground feeder and distribution cable to isolate that portion of the costs that vary with the size of the cable (i.e., the copper pair and splicing costs) and those that do not vary materially with size (i.e., the cable sheath). The fixed and variable components are input to the Plant Characteristics Module and are used to compute cable investment by wire center. As cable sizes increase, the constant or "fixed" portion of the cable costs are spread over more cable pairs, producing a decrease in the average cost per pair. To correct Verizon's sizing flaw, we multiplied the constant portion of the cable regression output by the feeder fill factor for feeder cable and by the distribution fill factor for distribution cable. In this way, when the costs per pair are divided by the utilization factor in the loop module, the resulting cost is consistent with the intended size of the cable.

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[21] ($0.04 / $0.033) – 1 = 0.212 or 21.2%.

Q. DOES VERIZON USE THE CORRECT FORWARD-LOOKING COST PER FOOT OF INSTALLED CONDUIT?

A. No. Verizon develops its installed cost of conduit based on the average cost per duct foot of its historic duct installations in Virginia between 1996 and 2000. In relying on this historical average, Verizon ignores the clear pattern in the historical conduit costs that installed costs per foot decline as the amount of conduit installed increases. Table 2 displays the Verizon installed cable cost per foot sorted by the total miles of conduit installed in each year.

[BEGIN VERIZON PROPRIETARY]

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[END VERIZON PROPRIETARY]

Under the TELRIC assumption of scorched-node, the new entrant hypothesized for this costing exercise would be required to install conduit sufficient to serve total demand. Because of the demonstrated economies of scale associated with installing conduit, a conservative starting point for developing the conduit installation cost is not the average of the historical experience used by Verizon, but rather the cost associated with the largest number of miles installed in an individual year, which is far less than the number of miles that would be installed in a reconstructed network. We have used Verizon's installed cost per conduit foot of **[BEGIN VERIZON PROPRIETARY]** *** **[END VERIZON PROPRIETARY]** as the starting point for the forward-looking conduit investment costs.

Q. DOES VERIZON USE THE APPROPRIATE FORWARD-LOOKING POLE COST?

A. No. Similar to the way it develops conduit costs, Verizon relies on its historical experience installing poles in Virginia as the source for its forward-looking pole investment. Because Verizon Virginia's pole placements over the past five years are not comparable in scope to the pole installations contemplated under the scorch-node TELRIC assumptions, they do not reflect the economies of scale the forward-looking entrant can achieve in installing poles sufficient to meet total Virginia demand. Similar to the discussion of conduit above, pole installations in the forward-looking network will benefit from the economies of sequential installation, minimizing the amount of mobilization and demobilization attributable to the limited pole installations reflected in Verizon's historical data. A more appropriate forward-looking pole investment is the $417 per installed pole used by the FCC in its Synthesis Model. We have used this investment cost per pole in my restatement of Verizon's costs.

D. UTILIZATION FACTORS

Q. DID VERIZON USE THE CORRECT FORWARD-LOOKING UTILIZATION FACTORS IN ITS DEVELOPMENT OF CLAIMED UNE COSTS?

A. No. As Terry Murray has explained in her separate testimony for AT&T and WorldCom, the fundamental error in Verizon's approach is its assumption that the amount of unused capacity properly charged to current ratepayers is equivalent to the amount of spare capacity that an engineer would include in the design of a plant. This assumption is incorrect: the costing exercise here is conceptually distinct from the task of an outside plant engineer. From a costing perspective,

1 the relevant question is not how much spare capacity should be *built* today, but
2 how much should be *charged* to today's ratepayers in current rates. As Ms.
3 Murray explains, the conceptual answer to the latter (*i.e.*, economic) question
4 requires one to estimate the present value of the future costs of building and
5 operating the capacity over its expected life, and to calculate unit costs based on
6 the net over the same expected life. The resulting cost-based prices will not
7 require current ratepayers to subsidize the future customers on whose behalf the
8 spare capacity is being built. Because an efficient firm would not build spare
9 capacity for future growth unless the present value of the future revenue from the
10 growth capacity exceeded the present value of its cost, the conservative
11 simplifying assumption is to assume away both the existence of future growth in
12 demand *and* the existence of the capacity to meet that growth. Hence, the cost of
13 plant capacity is properly attributed to current ratepayers (including CLECs, with
14 respect to local loops) *without considering any capacity needed for future growth.*
15 Moreover, even if the engineering analysis used to size plant were the
16 correct approach for attributing costs between current and future ratepayers – and
17 it is not – the engineering fill factor or capacity utilization assumptions employed
18 by Verizon in its UNE cost models are derived directly from the utilization of the
19 embedded network. TELRIC hypothesizes an efficient provider of telephone
20 services. Because the new provider is not encumbered by Verizon's embedded
21 plant configuration, it can develop an efficient design that will be able to achieve
22 higher utilization levels than Verizon's embedded plant. In addition, Verizon's
23 analysis of utilization is calculated by dividing only the *working* units or pairs by

1 the total available units or pairs. This assumption is incorrect under standard
2 engineering practice and is even inconsistent with the manner in which Verizon's
3 own engineers define utilization in actual practice. For these reasons, we would
4 recommend the following utilization rates if the Commission were (improperly, in
5 our opinion) to rely on engineering rather than economic analysis to determine the
6 efficient forward-looking amount of spare capacity: a copper feeder utilization
7 rate of 80%; a copper distribution fill factor of 60%; a plug-in equipment
8 utilization of 90%; a fiber feeder utilization of 100%; and a conduit utilization of
9 100%.

10 **1. UTILIZATION OF DISTRIBUTION**

11 **Q. WHAT UTILIZATION FACTOR DID VERIZON USE FOR**
12 **DISTRIBUTION CABLE?**

13 A. Verizon used a **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON**
14 **PROPRIETARY]** distribution cable fill factor that was based directly upon the
15 distribution fill levels currently experienced in the embedded network.[22] This
16 distribution fill is equivalent to well below the two lines per living unit
17 recommended by the SCC in the prior UNE proceeding and results in unnecessary
18 excess spare capacity in the forward-looking distribution network. Indeed, as
19 applied in the cost study, Verizon's **[BEGIN VERIZON PROPRIETARY] ***
20 **[END VERIZON PROPRIETARY]** spare distribution pairs for each working

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22 Verizon Cost Panel Testimony at 112.

distribution pair.[23] In other words, Verizon's distribution fill assumption places approximately **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]** distribution pairs for each household with a single residential telephone line, **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]** distribution pairs for each household with two telephone lines and **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]** distribution pairs for households with three telephone lines. Verizon's approach thus requires CLECs to pay for layer upon layer of spare capacity.

Q. BASED ON A FORWARD-LOOKING METHOD FOR DESIGNING OUTSIDE PLANT, WHAT IS THE APPROPRIATE DISTRIBUTION UTILIZATION FACTOR?

A. A highly conservative copper distribution fill for use in a forward-looking study is 60% or even higher.

Q. WHY SHOULD A 60% COPPER DISTRIBUTION FILL BE CONSIDERED CONSERVATIVE?

A. In determining the economically appropriate amount of capacity to be attributed to the user of a cable pair, one must consistently treat the costs and potential revenues of spare capacity reserved for future growth. The fill factor resulting from a pure economic analysis, without taking growth into consideration, should be the range of 90% or so. As we discuss below, we have taken a modest amount

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[23] **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]**

of growth into account. Even with those growth assumptions, a fill of 60% is still highly conservative.

Q. WHAT ROLE DO ENGINEERING GUIDELINES FOR GROWTH CAPACITY PLAY IN DETERMINING APPROPRIATE FILL FACTORS?

A. None directly. As Ms. Murray explains, the question facing the Commission here is different from the one posed by engineering guidelines. Engineers ask how much spare capacity should be built. The Commission's task here is to decide a different question: how much spare capacity should be built *and charged to current ratepayers*. As Terry Murray has explained elsewhere, proper consideration of the present value of both the cost and the future revenue – generating demand associated with growth capacity can only decrease, not increase, the unit costs properly attributed to current rate payers. In any event, as we discuss in what follows, application of engineering standards here would also demonstrate that Verizon's proposed utilization rates are substantially too low.

Q. ASSUME FOR THE SAKE OF ARGUMENT THAT THE COMMISSION WERE TO USE ENGINEERING STANDARDS, RATHER THAN ECONOMIC ANALYSIS, TO DETERMINE THE APPROPRIATE AMOUNT OF SPARE CAPACITY. HOW WOULD YOUR PROPOSED FILL FACTOR OF 60% FARE AGAINST SUCH A STANDARD?

A. The 60% standard would readily pass muster even if the Commission used as its benchmark the generally accepted engineering standards as the basis for its decision. A forward-looking engineering analysis is not constrained by the engineering rule of thumb that provides for two lines per living unit across the entire service area footprint. Unlike the situation in residential developments in the design phase or under construction, much of the demand in Virginia has been

stable for a long time. Thus, a new entrant could construct its network with far fewer than two lines per household and still have significant excess capacity for customers who order second lines. Under scorched-node, for those areas where demand for additional lines has remained stable and is likely to remain so going forward, fewer spare facilities can be provisioned, resulting in more efficient use and higher utilization levels. By tailoring distribution design to meet only the anticipated needs of today's demand, as TELRIC requires, distribution utilization can be improved to levels well above those experienced by Verizon in its embedded network.

Moreover, Verizon includes defective pairs as unused pairs in determining its utilization factor. As explained below, there are a significant number of defective pairs in Verizon's network. But in a reconstructed plant with all new plant there would be very few defective pairs. In Mr. Riolo's experience, when new plant is installed, there should be fewer than 1% defective pairs. Thus, these pairs must be removed from the denominator of Verizon's calculation.

Q. ASSUME FOR THE SAKE OF ARGUMENT THAT THE COMMISSION WERE TO USE THE TRADITIONAL ENGINEERING STANDARD OF TWO DISTRIBUTION PAIRS PER HOUSEHOLD, RATHER THAN ECONOMIC ANALYSIS OR FORWARD-LOOKING ENGINEERING STANDARDS, TO DETERMINE THE APPROPRIATE AMOUNT OF SPARE CAPACITY. HOW WOULD YOUR PROPOSED FILL FACTOR OF 60% FARE AGAINST SUCH A STANDARD?

A. The 60% standard would readily pass muster even if the Commission used Verizon's proposed engineering standards as the basis for its decision. The generally accepted engineering standard for building distribution plant of two

1 lines per household. According to Verizon, residential subscribers in Virginia
2 subscribe on average to 1.18 lines per subscriber location. An 18-percent second
3 line penetration produces a distribution fill of 59 percent.[24]
4 But the 59% rate is based on Verizon's entirely improper definition of
5 utilization. Verizon defines the utilization factor for copper distribution cable as
6 "the actual utilization of terminated distribution pairs experienced in the Verizon-
7 Va. network with an adjustment for breakage."[25] For this rate case, however,
8 Verizon's definition of utilization for copper distribution omits idle dedicated
9 pairs, defective pairs, and connect-through pairs. This definition is at odds with
10 generally accepted industry guidelines, **[BEGIN VERIZON PROPRIETARY]**
11 ***** [END VERIZON PROPRIETARY]**
12 In accordance with the Serving Area Concept (SAC), distribution pairs are
13 permanently committed from the interface to each ultimate living unit. The first
14 pair is designated as the primary pair, the second pair is designated as the
15 permanent secondary pair, while all other pairs are designated as re-assignable
16 secondary pairs. Each primary and permanent secondary pair is dedicated and
17 permanently entered into the assignment record. However, engineers include idle-
18 assigned pairs and defective pairs in the numerator of the generally accepted

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[24] Two lines per living unit produces a distribution fill of 50%. 50% multiplied 1.18 subscriber lines per location increases distribution fill to 59% (0.50 x 1.18 = 0.59).

[25] Verizon Cost Panel Testimony at 113.

1 engineering definition of fill factors.[26] Similarly, Verizon's own engineering
2 guidelines state that **[BEGIN VERIZON PROPRIETARY] *** [END**
3 **VERIZON PROPRIETARY]**
4 Therefore, when utilization rates are compared with traditionally accepted
5 engineering standards, consistency dictates that the primary and secondary
6 permanent cable pairs should be counted in the numerator of the ratio.
7 Accordingly, two pairs per household -- as opposed to 1.18 lines per subscriber --
8 should be included in the numerator of the fill ratio. Defective pairs should also
9 be included. This is so for a second reason as well. As set forth below in the
10 discussion of fiber feeder, a reconstructed network would have no defective pairs.
11 If these are included, the utilization rate is substantially above the 60% we have
12 conservatively assumed.

13 **Q. VERIZON STATES THAT THE EFFECT OF CHURN WILL REDUCE**
14 **THE COPPER DISTRIBUTION UTILIZATION RATE. DO YOU**
15 **AGREE?**

16 **A.** No. Subscriber churn, as defined by Verizon, would only change the cable pair
17 status from working to idle assigned, with the net result that the utilization fill
18 remains the same. For these reasons, coupled with the fact that any defective
19 cable pairs would also increase the utilization factor, Verizon's Copper
20 Distribution Cable Utilization can conservatively operate with a 60% fill.

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[26] Two lines per living unit produces a distribution fill of 50%. 50% multiplied 1.18 subscriber lines per location increases distribution fill to 59% (0.50 x 1.18 = 0.59).

Q. VERIZON CLAIMS THAT ITS LOW DISTRIBUTION FILL LEVELS ARE NECESSARY TO AVOID COSTLY AND DISRUPTIVE REINFORCEMENT OF ITS OUTSIDE DISTRIBUTION PLANT. DO YOU AGREE?

A. No. The Verizon Panel defends its low distribution fill factor in part by suggesting that a higher fill will require costly and disruptive relief of the outside distribution plant. That argument is simply a variant of the erroneous claim that current ratepayers should pay for capacity stockpiled to meet future growth. Furthermore, AT&T/WorldCom have asked Verizon Virginia to provide information relating to its distribution relief jobs in its Virginia service territory over the last three years. Although Verizon objected to this request,[27] I believe that most of the distribution relief jobs undertaken by Verizon in Virginia were not because of exhausted outside plant facilities, but instead were for replacement of facilities that had deteriorated over time and thus were generating a high number of service trouble reports. This would suggest that Verizon's existing distribution fill levels are so low that it is virtually guaranteed that distribution cable will not exhaust before reaching the end of its useful life. While this may be Verizon's goal in designing its outside plant, it does not reflect the practice of a least-cost, efficient provider.

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[27] Response to AT&T/WorldCom #1-47.

1 **2. UTILIZATION OF FEEDER**

2 **Q. DID VERIZON USE THE CORRECT FORWARD-LOOKING COPPER**
3 **AND FIBER FEEDER FILL FACTORS?**

4 A. No. For copper feeder, Verizon uses a **[BEGIN VERIZON PROPRIETARY]**
5 *** **[END VERIZON PROPRIETARY]** fill factor. For fiber feeder, Verizon
6 uses a **[BEGIN VERIZON PROPRIETARY]** *** **[END VERIZON**
7 **PROPRIETARY]** fill factor.[28] Both of these factors are far too low for a
8 forward-looking cost study. For fiber cable, Verizon's fiber provisioning
9 practices as described in its engineering guidelines support a fill factor for fiber
10 feeder of 100 percent. Because copper feeder cable is engineered to be reinforced
11 on a 3-to-5 year basis, the appropriate forward-looking fill factor for copper feeder
12 is 80 percent.

13 **a) Fiber Feeder Utilization**

14 **Q. VERIZON CLAIMS THAT THE APPROPRIATE FORWARD-LOOKING**
15 **FIBER FEEDER UTILIZATION IS 41.8%. DO YOU AGREE?**

16 A. No. Verizon states that 41.8% represents its current utilization of fiber feeder, and
17 asserts that "[t]here is no basis to believe this utilization rate would increase in the
18 forward-looking network."[29] Verizon claims that this low utilization rate is
19 caused by the 12-fiber ribbon structure which necessitates provisioning of excess

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28 *See* Verizon Cost Panel Direct at 100.

29 *See* Verizon Cost Panel Direct at 112.

1 strands.[30] Verizon is wrong because a forward-looking network would use spare
2 strands for other purposes. Indeed, Verizon's own planned offerings clearly
3 require increased fiber utilization over current levels.

4 **Q. FOR WHAT PURPOSES DOES VERIZON INTEND TO USE "SPARE"**
5 **FIBER?**

6 A. Verizon intends to use additional fiber for its planned DSL service and for its
7 offering of Dark Fiber. Although Verizon currently does not offer any DSL
8 service over fiber, during discovery in this proceeding, Verizon produced the
9 Litespan 2000 Application Guidelines, which state that **[BEGIN VERIZON**
10 **PROPRIETARY] *** [END VERIZON PROPRIETARY]**

11 Not only does Verizon's recommended fiber utilization rate ignore the
12 additional fibers that would be required for its planned DSL service, but it also
13 ignores the additional fibers that would be deployed in the future as a result of
14 Verizon's proposed rates for Dark Fiber. This offering would undoubtedly
15 increase Verizon's current fiber utilization. Verizon simply cannot have it both
16 ways. Verizon cannot legitimately contend that its current fiber utilization rate
17 will remain constant in the forward-looking network, while simultaneously taking
18 steps to offer services that will necessarily increase its current utilization of fiber.

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30 *See* Verizon Cost Panel Direct at 110-12.

Q. ARE THERE ANY OTHER SERVICES THAT WOULD BE DEPLOYED ON SPARE FIBERS IN A FORWARD-LOOKING NETWORK?

A. Yes. Typically, business demands for high speed services are satisfied by extending spare fibers from a Remote Terminal location into the building location. For other high speed business services, multiplexers are installed at the CO and RT location on spare available fibers and a sub-set of the capacity is extended into a business location from the Remote Terminal.

Q. ARE SPARE FIBERS AT A REMOTE TERMINAL EVER USED TO UPGRADE THE SITE?

A. Yes. Frequently, larger installations (*e.g.,* CEVs) that contain older stand-alone multiplexer-driven DLC, are augmented or upgraded to newer Next Generation Digital Loop Carrier (NGDLC). Spare fibers are terminated at the site on the newly installed NGDLC equipment.

Q. ON A FORWARD-LOOKING BASIS, WHAT IS AN APPROPRIATE UTILIZATION FACTOR FOR FIBER CABLE?

A. Because the technology is rapidly evolving, fibers will be completely utilized for a variety of transmission services. The key to these advanced systems lies in using the existing fibers. These transmission systems are emerging in the network today, as Dense Wave Division Multiplexing (DWDM) is deployed. It is therefore appropriate to assume a utilization of 100% for fiber cable on a forward-looking basis.

1 **b) Copper Feeder Utilization**

2 **Q. DID VERIZON USE THE CORRECT FORWARD-LOOKING COPPER**
3 **UTILIZATION RATE IN ITS COST STUDY?**

4 A. No. Verizon's cost study uses a 56.9% copper feeder utilization rate which is far
5 too low. As noted above, Verizon's analysis of copper feeder utilization is
6 fundamentally flawed because it inappropriately relies solely on engineering
7 analyses of how much spare capacity to build, and omits the further (economic)
8 analysis of how the cost of that capacity should be apportioned between current
9 and future ratepayers.

10 Moreover, even if a purely engineering analysis were sufficient for cost
11 attribution, the amount of spare capacity in Verizon's cost studies is inconsistent
12 with standard engineering practices in a forward-looking environment. Verizon's
13 analysis is based on: (1) an erroneous definition of utilization; (2) a flawed
14 analysis of the effects of breakage; (4) an incorrect understanding of the effect of
15 customer churn on the fill factor; and (4) a failure to analyze properly the effect of
16 demand fluctuations and facility relief efforts.

17 **Q. WHAT IS THE PROCESS USED IN THE INDUSTRY FOR**
18 **DETERMINING WHEN FACILITY RELIEF IS APPROPRIATE?**

19 A. Copper feeder cable is generally relieved close to the time that its capacity will be
20 exhausted. The relief effort will then add sufficient cable feeder to account for
21 three to five years of growth. We have calculated that the minimum utilization
22 rate of a route in the network should be 82% for a route growing at the average
23 growth rate in Verizon's network (3%) – immediately after a relief job if five

1 years of spare capacity are provided.[31] The maximum utilization rate is close to
2 100% just before a relief effort occurs. We have therefore conservatively
3 assumed an 80% utilization rate.

4 Verizon's copper feeder cable extends from the Central Office Main
5 Distribution Frame (MDF) to the Feeder Distribution Interface (FDI), or the
6 Serving Area Interface (SAI) as it is sometimes called. In general, the cable
7 facilities are larger at the Central Office end and taper to smaller sizes as they
8 traverse the route to destination FDI(s). The cable is typically monitored at the
9 MDF (Main Frame Fill), in the route (cross-section fill), and at the feeder side of
10 the interface. **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON**
11 **PROPRIETARY]**

12 When analyzing the plant in these circumstances, the engineer does not
13 necessarily provide for immediate provisioning of new facilities. The engineer
14 may determine that no relief facilities are required or facilities should be
15 rearranged. In general, the engineer will not provide for provisioning of new
16 facilities until close to the time when facilities will be exhausted. Verizon's
17 engineering guidelines state that "Facility relief must be provided prior to the
18 critical exhaust date which is defined as that point in time when the current

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31 If the growth rate of a particular route were more than 3% a year, than a relief job that provided 5 years of spare capacity would bring utilization below 82%. If the growth rate were less than 3% a year, the relief job would bring utilization down to a level that was higher than 82%.

1 facilities available can no longer support the service demand in a given route."[32]
2 Thus, in the aforementioned example, relief facilities would be provided before
3 the remaining 135 pairs of the non-interfaced cable (900-765) or 90 pairs of the
4 interfaced cable (900-810) are used. If the route is growing at a rate of 3% per
5 year, the critical exhaust date would be approximately 5 years hence for non-
6 interfaced cable or 3+ years for interfaced cable. In either case, the engineer
7 would typically not undertake relief effort but rather continue to monitor the plant
8 until much closer to the critical exhaust date. Typically, the engineer would not
9 begin a relief effort until a year before critical exhaust was likely to occur and the
10 relief effort would be completed less than a year before critical exhaust.
11 When a relief effort was finally undertaken, the engineer would ordinarily
12 provide for three to five years of growth. Standard industry engineering
13 guidelines state that copper feeder cable should be installed to service all known
14 demand as of the service date of the cable, plus three to five years of growth.[33]
15 Thus, generally accepted engineering practice calls for building sufficient spare
16 pairs to allow reinforcement every three to five years. **[BEGIN VERIZON**
17 **PROPRIETARY] *** [END VERIZON PROPRIETARY]**
18 The impact of a relief job on utilization rates can be seen from the
19 following example. Assume a Central Office has a major feeder route serving
20 5,000 lines and that the route is experiencing a growth rate of 3% per year or 150

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32 Outside Plant Engineering Guidelines, 1998-00397-OSP, (July 20, 1998) at 10.

33 Feeder Administration, AT&T 916-100-013.

lines (5,000 x 0.03), which, as we explain below, is the average growth in the number of lines in Virginia over the last three years. In such a case, a relief job would be planned to complete sometime before the last 150 lines were used. For the sake of simplicity, assume that the relief cable would complete one year before critical exhaust, when 150 lines of spare remained or when 4,850 lines were working. (This is a conservative assumption because relief jobs typically will not complete until much closer to critical exhaust.) The fill at the time of relief would be 97% (4,850 divided by 5,000). Since typically 3 to 5 years growth is provided when relieving a route (3x150=450, or 5x150=750),[34] a minimum of 600 cable pairs or a maximum of 900 cable pairs would be provided due to manufactured cable sizes. Thus, the fill in the route would decline, at most, from 97% to 82% (4,850 divided by 5,000+900) – and this would be the lowest level of fill over the 5 year period.[35] It comports with our experience that copper feeder utilization can conservatively operate at 80% fill.

Q. IS VERIZON CORRECT THAT THERE IS A MANDATORY SPARE CAPACITY LEVEL?

A. No. Verizon claims that a minimum 15% margin of spare capacity is needed to allow for efficient copper feeder operation, administration and management.

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[34] If compounding were taken into account, the real numbers would be 464 lines or 788 lines. For simplicity's sake and because of our otherwise extremely conservative approach, we have ignored this small effect of compounding.

[35] If the relief job were completed when utilization was 99%, utilization after relief would decline to 84%. Moreover, if only three years of spare capacity were provided of a route with 99% fill, utilization would decline to 90%.

There is no sound basis for this conclusion. As explained above, both standard industry guidelines and Verizon's own guidelines call for relief jobs that provide three to five years of spare capacity and then call for relief to occur prior to critical exhaust. Despite Verizon's assertion to the contrary in this proceeding, standard industry practice does not call for "administrative spare" beyond that which is required in the guidelines. In fact, there is no reference to any such minimum 15% spare margin in Verizon's Engineering Guidelines and Outside Plant Engineering Reference Manual produced in discovery in this case. Verizon's reliance on a so-called mandatory "administrative spare" capacity is nothing more than a ruse to lower the utilization rate and raise costs. Moreover, Verizon's proposed low copper fill factor – that reflects a spare capacity beyond that which is required under standard engineering guidelines – would simply yield inefficient amounts of spare facilities that risk technical obsolescence if they are not used over the facility's life cycle.

Q. DO YOU AGREE WITH VERIZON'S ANALYSIS REGARDING THE EFFECT OF BREAKAGE ON THE COPPER FEEDER UTILIZATION RATE?

A. No. Verizon claims that "breakage," or an increase in cable size caused by cable manufacturing constraints, automatically lowers the copper feeder utilization rate.[36] Although breakage does occur, it should have less of an effect than Verizon indicates. The "uncommitted pairs" that result from breakage can be left

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[36] Verizon Cost Panel Testimony at 106.