BEFORE 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 DECLARATION OF DR. TIMOTHY J. TARDIFF FILED ON BEHALF OF VERIZON NORTHWEST INC.

HM 5.3 CRITIQUE

APRIL 26, 2004

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I. INTRODUCTION

Q. PLEASE STATE YOUR FULL NAME, EMPLOYER AND BUSINESS ADDRESS.

A. My name is Timothy J. Tardiff. I am a Vice President at National Economic Research Associates ("NERA"), 1 Main Street, Cambridge, MA 02142.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND AND WORK EXPERIENCE.

A. I received a B.S. degree from the California Institute of Technology in mathematics (with honors) in 1971 and a Ph.D. in Social Science from the University of California, Irvine in 1974. From 1974 to 1979, I was a member of the faculty at the University of California, Davis. I have specialized in telecommunications policy issues for over 20 years. My research has included studies of the demand for telephone services, such as local measured service and toll, analysis of the market potential for new telecommunications products and services, assessment of the growing competition for telecommunications services, and evaluation of regulatory frameworks consistent with growing competitive trends.

I have extensive experience as a consultant and expert witness in regulatory proceedings. My recent experience includes in-depth evaluations of the HAI Model (Releases 5.2a and 5.3) and the Federal Communications Commission's ("FCC's") universal service cost proxy model, the "Synthesis Model." I have also testified in state proceedings and arbitrations (pursuant to the Telecommunications Act of 1996) on local network unbundling, universal service funding, and most recently implementing the FCC's Triennial Review Order ("TRO"), in Alabama, Alaska, Arkansas, California, the

District of Columbia, Indiana, Kansas, Kentucky, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Texas, Vermont, and Virginia. A copy of my curriculum vitae is attached hereto as Exhibit TJT-1.

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. AT&T Communications of the Pacific Northwest, Inc. ("AT&T") and WorldCom, Inc. (d/b/a "MCI") (collectively "AT&T/MCI") have submitted the HAI Model, Release 5.3 ("HM 5.3" or "Model") for the purpose of calculating Verizon Northwest Inc.'s ("Verizon NW") forward-looking costs of providing unbundled network elements ("UNEs") in Washington. I have reviewed the supporting testimonies of Dr. Mercer, Mr. Donovan, and Dr. Bryant filed on behalf of AT&T/MCI,[1] and have analyzed HM 5.3's calculations and outputs. Based on this evaluation, as well as the Reply Declarations of Messrs. Dippon, Murphy, and Richter, I conclude that HM 5.3 produces UNE cost estimates that are significantly lower than the economic costs Verizon NW incurs when it provides UNEs to competitive local exchange carriers ("CLECs").

For a cost model to produce accurate estimates of the economic costs a carrier incurs in offering UNEs, it must accurately represent both the *quantities* and *types* of network facilities (e.g., the number of poles, the length of 25-pair buried cables, etc.) and the *prices* a carrier pays for these facilities. In addition to the investments associated with network facilities, a cost model must also incorporate accurate estimates of the costs necessary to operate the network on a going-forward basis. Modeling reasonable quantities of network facilities requires a realistic depiction of the efficiencies available to a carrier in designing a network and purchasing facilities to be used therein. For example, the cost model must produce feeder and distribution routes of sufficient lengths, must have adequate and realistic amounts of cable and support facilities, must model enough capacity to enable efficient operation, and must depict prices for assets (such as switches) that the carrier would expect to pay. A careful evaluation of HM 5.3 shows that it does not provide reasonable estimates of these prices and quantities. In particular:

- As described by Mr. Dippon, HM 5.3's cluster input data, which are intended to approximate the incumbent local exchange carrier's ("ILEC") distribution areas, do not adequately represent the routes necessary to connect customer locations to the proper types and amounts of loop facilities along those routes. In addition, as Mr. Murphy describes, the engineering criteria used to produce HM 5.3's clusters do not comport with how an engineer would design outside plant.[2]

- HM 5.3 does not provide the requisite amounts of capacity necessary to operate a network efficiently.

- To a large extent -- and particularly for the amount of labor required to engineer and install telephone plant -- the prices recommended by Mr. Donovan for purchasing and installing network facilities are based on the unsubstantiated, subjective judgment of AT&T/MCI's consultants and/or dated and unverifiable sources that are not Washington-specific. As Mr. Murphy describes in detail,[3] these recommended prices fail to

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[1] Mr. Donovan's testimony was also filed on behalf of XO Washington, Inc.

[2] In particular, the Reply Declarations of Messrs. Dippon and Murphy take issue with the statement: "Thus, the clusters developed pursuant to this process are likely to be the most closely representative of actual telephone distribution areas as determined by outside plant engineers." Before the Washington Utilities and Transportation Commission, Docket UT-023003, *Supplemental Direct Testimony of Dr. Robert A. Mercer on behalf of AT&T Communications of the Pacific Northwest, Inc.* (Jan. 23, 2003) at Exhibit RAM-4 (HAI Model Release 5.3 Model Description ("Model Description")) at p. 35 ("Mercer Supplemental Direct Testimony"). Unless otherwise specified, my analyses are based on the new version of HM 5.3 filed by AT&T Communications of the Pacific Northwest, Inc. ("AT&T") on April 9, 2004.

[3] Murphy Reply Testimony at Section II.

comport with what Verizon NW expects to pay on a going-forward basis for network facilities and, in some cases, differ in implausible ways from what Mr. Donovan recommended in previous proceedings involving prior versions of the HAI Model.[4]

- HM 5.3 does not properly represent the economic conditions a carrier providing UNEs would encounter. In addition to providing insufficient levels of capacity, the cost of capital and depreciation inputs used by Dr. Mercer are not consistent with the risks that a competitive provider of UNEs would face, especially one that was subject to regulatory-determined reductions in UNE prices several times over the economic lives of network assets.[5] In addition, HM 5.3's switch cost algorithm assumes, unrealistically, that an efficient carrier would instantaneously purchase all new switches at deep discounts. In the real world, however, carriers purchase large portions of their switching equipment at higher prices as they equip different locations at different points in time.

Q. HAVE AT&T/MCI ENDEAVORED TO TEST OR VALIDATE THE COST ESTIMATES PRODUCED BY HM 5.3?

A. No. AT&T/MCI have not tested, let alone verified, whether HM 5.3 produces valid and accurate estimates of network investments, operating costs, and UNE costs.[6] Because telecommunications networks and the cost models that depict them are incredibly complex, quantitative tests of model outcomes are essential to determine whether the cost model is functioning properly and producing costs that an actual carrier offering UNEs in the real world can reasonably expect to achieve. Such quantitative tests should

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[4] For example, the prices for installed copper and fiber cable are considerably lower than the prices used in previous versions of the HAI Model, primarily due to HM 5.3's unreasonable reductions for engineering and installation labor costs.

[5] Before the Federal Communications Commission, CC Docket Nos. 01-338, 96-98, 98-147, *Report and Order on Remand and Further Notice of Proposed Rulemaking* (rel. Aug. 21, 2003) at ¶¶ 680 and 689 ("TRO"); Before the Federal Communications Commission, CC Docket No. 03-173, *Notice of Proposed Rulemaking* (rel. Sept. 15, 2003) at ¶¶ 83-84 ("TELRIC NPRM").

[6] *See, e.g.,* Before the Washington Utilities and Transportation Commission, Docket No. UT-023003, *Joint Responses of AT&T & MCI to Verizon's First Set of Data Requests* (July 24, 2003) at Response Nos. 1-7 and 1-20; Before the Washington Utilities and Transportation Commission, Docket No. UT-023003, *Joint Responses of AT&T & MCI to Verizon's Sixth Set of Data Requests* (Aug. 5, 2003) at Response Nos. 6-5 and 6-33.

determine, for example, whether the investment levels (e.g., on a per-line basis) produced by the Model approximate the investment levels that carriers actually have achieved.

An additional validation test is whether successive releases of the HAI Model (typically sponsored by AT&T/MCI's witnesses in this proceeding) are consistent with reasonable trends in the industry. For example, in arguments before the United States Supreme Court and, most recently, in the FCC's ongoing total element long run incremental cost ("TELRIC") investigation, CLECs argued that the FCC's TELRIC rule could produce loop costs that are *higher* than historical levels because only the computer-based network components (e.g., switching) were subject to large productivity gains.[7] Despite these prior unqualified observations that loop costs should not be expected to decline, HM 5.3 produces the opposite outcome -- AT&T/MCI's proposed loops costs are substantially lower than those produced by previous versions of the HAI Model.

In fact, HM 5.3 falls short on both validation tests:

- HM 5.3 produces investment levels that are *less than 30 percent* of the cost of reproducing Verizon NW's network.[8] While some

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[7] "Although the computer-based elements of the network (such as the switches) may be characterized by declining costs, *other elements (such as the loop plant) are not declining; for many elements costs are rising*." *WorldCom, Inc. v. Verizon Communications, Inc.*, Reply Brief for Petitioners WorldCom, Inc., the Association for Local Telecommunications Services, and Competitive Telecommunications Association, No. 00-555 (July 23, 2001) at p. 6 (emphasis added). Indeed, during the October 10, 2001 argument before the U.S. Supreme Court, Donald Verrilli, counsel for MCI, correctly explained that loop costs have not come down over time. *Verizon Communications, Inc. v. Federal Communications Commission,* No. 00-511, et al., Oral Argument before the Supreme Court (Oct. 10, 2001) at pp. 74-75 ("Supreme Court Argument"). In fact, the U.S. Supreme Court's decision upholding TELRIC made the same observation with respect to loop costs. *See Verizon Communications Inc. v. Federal Communications Commission*, 122 S. Ct. 1646 (May 13, 2002). AT&T/MCI have repeated these arguments in the ongoing TELRIC NPRM. *See, e.g.*, Before the Federal Communications Commission, CC Docket Nos. 01-338, 96-98, 98-147, *Comments of AT&T Corp.* (Dec. 16, 2003) at pp. 99-100.

[8] While a reproduction cost is not exactly the same as a forward-looking economic cost, particularly when technologies are changing rapidly, it provides a reasonable benchmark, especially when: (1) the actual and (continued...)

reduction might be expected for some facilities, such as switching, HM 5.3 makes large across-the-board reductions. In fact, the reduction for cable and wire facilities (copper cable, fiber cable, and their support structures) is even more drastic. Similar reductions occur for expenses. For example, HM 5.3 assumes, unrealistically, that an "efficient carrier" serving Verizon NW's customers could maintain the same number of switch locations, serving the same customer volumes, and using the same switch technology (i.e., digital), for *only 56 percent* of the costs incurred by Verizon NW in 2002.

- Contrary to MCI's statements to the United States Supreme Court,[9] loop costs have declined substantially over successive versions of the HAI Model presented to the Washington Utilities and Transportation Commission ("Commission"). In 1997, Version 3.1 produced a loop cost of $14.58;[10] and in this Commission's 1998 universal service proceeding, HM 5.0a produced a loop cost of $12.62.[11] This year, AT&T/MCI advocate a loop cost of $7.64, which is less than 40 percent of this Commission's current rate of $20.[12]

Such drastic across-the-board reductions are unwarranted and cast serious doubt on the reliability of the UNE cost estimates produced by HM 5.3.

II. ECONOMIC ISSUES

Q. DO YOU AGREE WITH DR. MERCER'S CLAIM THAT HM 5.3 IS THE MOST APPROPRIATE MODEL FOR ESTIMATING VERIZON NW'S FORWARD-LOOKING COSTS OF PROVIDING UNES?

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forward-looking facilities are the same (e.g., digital switching); and (2) the components of the network are not subject to rapid technological advance.

[9] *See* note 7 *supra*.

[10] Before the Washington Utilities and Transportation Commission, Docket Nos. 960369, -370, -371, *Supplemental Direct Testimony of John C. Klick* (February 21, 1997) (sponsoring Hatfield Model Release 3.1).

[11] Before the Washington Utilities and Transportation Commission, Docket No. 980311(a), *Direct Testimony of Robert Mercer on behalf of AT&T & MCI* (June 15, 1998) (sponsoring HAI Model, Release 5.0a).

[12] Before the Washington Utilities and Transportation Commission, Docket Nos. 960369-, -370, -371, *Eighth Supplemental Order Interim Order Establishing Costs for Determining Prices in Phase II; and Notice of Prehearing Conference* (April 16, 1998) at ¶ 270 ("1998 Eighth Supp. Order"). In fact, the line-weighted average

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A. No. Dr. Mercer claims, incorrectly, that HM 5.3 is the most appropriate model for determining Verizon NW's forward-looking costs (and alleges this is consistent with FCC's TELRIC rules).[13] In order to assess this claim, it is essential to understand the FCC's *intent* in establishing TELRIC. The FCC's TELRIC methodology is intended to identify an incumbent carrier's actual forward-looking costs,[14] and thus replicate, "to the extent possible, the conditions of a competitive market."[15] Indeed, in its last brief to the United States Supreme Court (in the case that upheld its TELRIC rules), the FCC explained that the costs of the ILEC itself were the focus of the TELRIC rules:

> The costs measured by TELRIC are nonetheless those of the incumbent itself. Those costs are based, moreover, on actual prices of equipment that is commercially available today -- equipment that carriers are already using to upgrade and expand their networks.[16]

HM 5.3 does not adhere to this TELRIC standard because it does not accurately estimate the total costs that Verizon NW, or any efficient carrier, can "actually expect to incur,"[17] even under forward-looking conditions.

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of the current deaveraged loop rates is over $24.00, implying that AT&T/MCI's proposed loop rate is less than one-third of the existing rate.

[13] Mercer Supplemental Direct Testimony at pp. 5, 9-10. In addition, Dr. Bryant made similar claims for the version of HM 5.3 that AT&T/MCI submitted last year. Before the Washington Utilities and Transportation Commission, Docket No. UT-023003, *Direct Testimony of Dr. Mark T. Bryant on behalf of AT&T Communications of the Pacific Northwest, Inc. and WorldCom, Inc.* (June 26, 2003) at pp. 1-2 ("Bryant Direct").

[14] The FCC's TELRIC methodology is intended to produce "costs that incumbents actually expect to incur in making elements available to new entrants." In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98, *First Report and Order*, FCC 96-325 (rel. Aug. 8, 1996) ("First Report and Order") at ¶ 685.

[15] First Report and Order at ¶ 679.

[16] *Verizon Communications, Inc. v. Federal Communications Commission*, No. 00-511, et al., Reply Brief for Petitioners Federal Communications Commission and the United States (July 2001) at p. 6 (*See, e.g., AT&T v. FCC*, 220 F.3d 607, 617 (D.C. Cir. 2000) (state commission, in setting TELRIC price for switching element, looked to prices of switches recently purchased by incumbent)).

[17] First Report and Order at ¶ 685.

The test of whether any particular model is consistent with TELRIC principles centers on whether the cost model produces the quantities and types of equipment that would be observed in a competitive market and whether (as the FCC explained) the prices for the equipment approximate what carriers pay today. As explained by Mr. Murphy,[18] many of the cost inputs recommended by AT&T/MCI, especially for installation labor, are based solely on the judgments of Mr. Donovan and his engineering team, the majority of which were formed many years ago and are unsupported by any empirical evidence.

AT&T/MCI interpret TELRIC to require ubiquitous replacement; their theoretical construct assumes that a new entrant would deploy facilities to "efficiently" accommodate a known and fixed level of demand, more or less precisely located. Although, as Mr. Dippon demonstrates, their Model fails to locate customers with any precision.[19] In building a network under such favorable circumstances, AT&T/MCI assume that the hypothetical new entrant will enjoy the following advantages: (1) facilities are directly routed to customer locations, even though a carrier that builds sequentially as demand materializes or changes over time might have less direct routes; (2) lower levels of capacity are needed because demand is known with a high degree of certainty; (3) more opportunities exist to share structures (e.g., utility poles and buried cable) with other carriers; (4) there are economies of scale related to mass deployment of facilities, such as telephone poles, because work crews can be deployed more efficiently than those of

[18] Murphy Reply Testimony at Section VI.

[19] Dippon Reply Testimony at Section V.

actual telephone companies;[20] (5) much greater initial discounts are available because all equipment is purchased at the same time to serve the entirety of demand; and (6) the latest vintages of technology can be deployed ubiquitously throughout the network, even in cases where compatibility among various network components would make such deployment uneconomic for any real firm. As discussed more fully below, such an aggressive interpretation of TELRIC is extremely unrealistic and inconsistent with the FCC's pronouncements on the matter.

Q. PLEASE EXPLAIN HOW AT&T/MCI'S INTERPRETATION OF TELRIC IS INCONSISTENT WITH THE FCC'S PRONOUNCEMENTS ON THE MATTER.

A. The FCC does not require such an aggressive interpretation of TELRIC;[21] indeed, such an interpretation could never produce accurate UNE cost estimates. Assuming a level of "efficiency" that no real carrier can achieve does not approximate competitive conditions, but rather only serves to produce uneconomically low cost estimates. In particular, the hypothetical routes modeled and facilities deployed by HM 5.3 do not take into account real-world obstacles such as rivers and roads -- an erroneous modeling technique that unjustifiably decreases costs.

Moreover, HM 5.3's modeling of lower amounts of capacity (or higher fill factors) than Verizon NW maintains in its network is similarly flawed. The FCC has rejected claims that lower amounts of capacity are necessarily consistent with TELRIC

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[20] Before the Federal Communications Commission, WC Docket No. 03-173, *Declaration of Michael D. Pelcovits on behalf of MCI* (Dec. 16, 2003) at p. 29.

[21] Most recently, the FCC tentatively concluded that TELRIC rules should more closely account for real-world attributes of an incumbent's network. TELRIC NPRM at ¶ 52. Interestingly, the FCC's Wireline Competition Bureau's opinion in the Virginia arbitration found Verizon's models, which are informed by characteristics of the existing network, to be consistent with forward-looking cost principles. *See e.g.,* Before the Federal

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principles,[22] perhaps in recognition of the fact that, because Verizon NW's interstate services have been subject to price-cap regulation for well over 10 years and the bulk of its intrastate services are subject to price regulations throughout its multi-state territory, it has strong incentives to employ economically efficient amounts of capacity.[23] Accordingly, current levels of capacity are assumed to be reasonable, as evidenced by the fact that these levels have remained stable over time.

Q. DOES HM 5.3'S NETWORK DESIGN INCLUDE ALL RELEVANT ECONOMIC COSTS?

A. No. HM 5.3 specifically excludes, *by design*, the costs incurred in operating a dynamic network (i.e., one with sufficient capacity) on a going-forward basis. A network with insufficient capacity to accommodate churn, irregularly distributed demand, fluctuations in demand over time, and overall growth in demand, cannot serve a carrier's customers without an unacceptable risk of service disruption or a high probability that customer demand for service would go unsatisfied. A network cannot be said to "serve" existing demand if it is not flexible enough to accommodate changes and rearrangements in that demand. As Mr. Murphy explains, engineering guidelines for local exchange networks are designed to cope with three undeniable facts: (1) demand changes over time; (2) demand is uncertain, both as to place and time (i.e., it cannot be determined in advance *which* customers will move, when they will move, or how many lines they will want); and

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Communications Commission, CC Docket Nos. 00-218, -249, 251, *Memorandum Opinion and Order* (rel. Aug. 29, 2003) at ¶ 49 ("Virginia Arbitration Order").

[22] Joint Application by BellSouth Corporation, BellSouth Telecommunications, Inc., and BellSouth Long Distance, Inc. for Provision of In-Region, InterLATA Services In Georgia and Louisiana, CC Docket No. 02-35, *Memorandum Opinion and Order* (May 15, 2002) at ¶ 70 ("BellSouth Order").

(3) technological change and changing market conditions require periodic upgrades to software and hardware.[24] In this environment, it is not efficient for a telecommunications carrier to install only the equipment it will need at a single point in time. Rather, an efficient carrier will install plant that includes enough capacity so that the utilization of that capacity (e.g., "fill factors") are adequate to: (1) accommodate movement of existing customers and their services, (2) meet short-run demand growth (e.g., two to three years for new switches), and (3) implement growth jobs and upgrades over the life of the plant. Therefore, to minimize costs, efficient firms continually adjust their factors of production to augment and replace facilities. The long-run costs of all real-world networks reflect this fundamentally dynamic optimization process.

Economists recognize that the textbook long-run case -- i.e., a period long enough to allow a firm to reach its optimum scale of operation -- is a hypothetically limiting one, and does not reflect the conditions pursuant to which real-world telecommunications firms operate. Even new entrants are constrained by current conditions, including the inherent uncertainty in the location and amount of customer demand over time. No firm has sufficient knowledge about current and future technologies to determine, in advance of making any investment decisions and with perfect certainty, what its global cost-minimizing scale of operations might be. Further, technologies are *not* perfectly foreseeable. Therefore, a real-world firm necessarily makes investment decisions without perfect knowledge of the future of technology or demand, but with the

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[23] The FCC's TELRIC NPRM explored this proposition. *See* TELRIC NPRM at ¶ 58.

[24] Murphy Reply Testimony at Section V.

expectation that demand will grow and shift over time and that facilities will be relieved and replaced. The uncertainties of demand in the real world cannot be eliminated, no matter how "forward-looking" or "long-run" the approach.[25] HM 5.3, with its static view of the network, and its idealized notion of what is required to provide service -- particularly as reflected in its utilization and certain equipment price inputs -- assumes an unrealistic level of efficiency that is in no way required by TELRIC.

Q. PLEASE DESCRIBE SOME OF THE PROBLEMS ASSOCIATED WITH HM 5.3'S APPROACH TO MODELING A FORWARD-LOOKING NETWORK.

A. One of the problems with HM 5.3's modeling approach is its removal of a substantial amount of the current, and very real, costs needed to accommodate growth and respond to changes in demand. HM 5.3 implicitly assumes that an ILEC would instantly size its entire outside plant network based on the amount and location of current demand, and thereby realize unrealistic economies that can only be obtained when total demand is served by ideally-sized facilities purchased at maximum volume discounts. This assumption is counterfactual: real-world firms must grow to meet demand as it materializes over time (growth), and must be structured to respond to shifts in demand at particular locations (churn). Firms -- including efficient ILECs, as well as new entrants --

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[25] This issue is addressed by the application of "real options" theory to telecommunications costing. Professor William Baumol, a prominent economist and frequent consultant to AT&T, described this theory as follows:

> [O]ne can characterize the pertinent part of the new analysis as follows. It tells us that investment decisions typically have a cost component that has usually been overlooked, so that the total costs of such decisions (and, hence, their appropriate price) is normally underestimated. The overlooked cost component is the narrowing of future choices that a current investment commitment entails. By making such a commitment, the decision makers forego some of their future options. The decisions preclude choices the decision makers *may* prefer to change as the passage of time increases the information available to them. But such changes are no longer open to them because of their investment commitment.

William J. Baumol, "Option Value Analysis and Telephone Access Charges," in James Alleman and Eli Noam, eds., *The New Investment Theory of Real Options and its Implications for Telecommunications Economics,* Boston: Kluwer (1999).

add capacity over time, taking into account the trade-off between the lower per unit costs of bigger modules (e.g., larger switches and larger cable sizes), the costs incurred to add capacity (a particularly significant factor for outside plant facilities), and the costs of carrying unused capacity. The markets for critical inputs (e.g., switches, outside plant facilities, and the labor to install them) reflect these fundamental facts. Indeed, carried to its logical conclusion, insistence on the proposition that TELRIC costs should assume that the network could be built instantaneously would require much higher prices for such inputs to reflect the supply constraints that such a scenario would necessarily impose.

With regard to switch prices, approximating what a carrier pays today must account for factors such as: (1) economic choices among multiple vendors, and (2) the relative mix of new and add-on equipment that the carrier expects to incur. HM 5.3's assumption that Verizon NW's switches will be purchased at deeply discounted new switch prices fails to reflect Verizon NW's forward-looking costs. In the competitive market that TELRIC is designed to emulate, new entrants (or incumbents for that matter) would not purchase only new switches to serve their entire volume of lines and usage at a single point in time.[26] Rather, competitive carriers would purchase a mix of new and add-on modules.[27]

[26] Even if there were a firm that would purchase only new switches (which is unlikely), it would be highly improbable for vendors to offer the same new switch discounts, because there would not be an opportunity to charge higher prices on a sufficiently large volume of add-on lines to make up for the low new equipment prices. For example, if the add-on price were twice the new line price, and a mix of 50 percent new lines and 50 percent add-ons permitted a vendor to recover its cost, a 90/10 mix would not allow the vendor to recover its costs.

[27] More generally, Verizon NW's equipment prices reflect the specific terms offered by equipment vendors, *including the expectations by both parties about the relative mix of new and add-on equipment*. It is thus incorrect to mix and match Professor Baumol's long run (where contacts and commitments have expired) with the extreme short run of a particular contract (*see* First Report and Order at n.1682). It is also interesting to observe that the FCC's First Report and Order does not even remotely mention price concerns when explaining why a long-run study is desirable. *See* First Report and Order, *passim*. The FCC noted, "The 'long run' approach ensures that rates recover not only the operating costs in the very short run, but also fixed investment
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Q. ARE HM 5.3'S COST OF CAPITAL AND DEPRECIATION ASSUMPTIONS TELRIC-COMPLIANT?

A. No. Economic depreciation and cost of capital rates are intended to approximate how a firm would recover its investments given the competitive conditions anticipated (or assumed) by a given cost model. AT&T/MCI's aggressive interpretation of TELRIC implicitly assumes extremely competitive conditions that are fundamentally at odds with how AT&T/MCI assume Verizon NW would recover and earn a return on its investment over time. In particular, they assume, unrealistically, the existence of a competitive environment wherein: (1) a large proportion of a firm's costs are for assets with long lives; (2) some of these assets are subject to technological advancement (and hence declining prices over time); (3) the competitive environment provides no guarantee that the expected demand will be sustained over the anticipated economic life of the assets; and (4) UNE prices will be provided at regulated prices indefinitely.[28] In stark contrast, the Model then treats recovery of investment essentially the same as a *guaranteed* loan for the duration of the economic life -- i.e., HM 5.3 determines the constant payment Verizon NW would need to collect each and every period in order to depreciate its assets

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costs that, while not variable in the short term, are necessary inputs directly attributable to providing the element." First Report and Order at ¶ 692.

[28] AT&T/MCI have essentially ignored the FCC's directive to assume the existence of facilities-based competition in estimating depreciation and cost of capital rates. Instead, they continue to insist that there will be little to no competition for network elements, and, at the same time, justify the use of the hyper-competitive assumptions regarding network equipment discussed above on the basis of a "perfect contestability" assumption. *See e.g.*, Before the Federal Communications Commission, CC Docket No. 03-173, *Declaration of Robert D. Willig* (Dec. 16, 2003) at pp. 52-59. The fundamental flaw with this line of reasoning is that the assumptions underlying "perfect contestability" (i.e., that entry and exit are costless) are at odds with the characteristics of telecommunications networks, (i.e., a cost structure with a high representation of long-lived capital assets, many of which are subject to change), as well as the inherent uncertainty of maintaining adequate demand levels over the lives of network assets.

and earn an economic return on the assets' remaining value. This misalignment of competitive assumptions with the assumed pattern of cost recovery necessarily means that Verizon NW could *not* recover the costs of its investments in a way analogous to a long-term loan.

Q. WHAT IMPACT WOULD THE EXTREMELY COMPETITIVE CONDITIONS IMPLIED BY AT&T/MCI'S AGGRESSIVE INTERPRETATION OF TELRIC HAVE ON THE SELECTION OF ACCURATE VALUES FOR DEPRECIATION AND COST OF CAPITAL?

A. The Model's over-arching assumption -- that an "efficient firm" is one that instantaneously sizes its network to "optimally" accommodate current demand at current locations -- necessarily implies significantly shorter depreciation lives and a significantly higher cost of capital than are typically experienced in regulated industries. AT&T/MCI are able to achieve unreasonably low UNE cost estimates, in part, by failing to account for the shorter depreciation lives and higher cost of capital necessitated by HM 5.3's assumptions.

In addition, the Model assumes that the optimally-configured and perfectly-sized network that is built today will again be instantaneously replaced every few years when prices are recalculated based upon another all-new network. Again, assumptions such as this require shorter depreciation lives and a higher cost of capital -- in the real-world, carriers investing in assets with long lives are substantially constrained by such investments because long-term investments are likely to become "stranded" if they are assumed to be replaced every few years by an all-new, optimally-configured network using the most recent technologies available. This need for shorter depreciation lives and a higher cost of capital is true not only for assets that experience relatively high rates of technological progress (such as switches),[29] but also for assets such as outside plant facilities, because HM 5.3's assumptions would render the ILEC's formerly "optimal" configuration inefficient.[30]

III. OVERVIEW OF HM 5.3

Q. PLEASE DESCRIBE HM 5.3'S APPROACH TO DETERMINING THE GEOGRAPHIC AREAS THAT FORM THE FOUNDATION FOR ITS TELECOMMUNICATIONS NETWORK DESIGN.

A. The various releases of the HAI Model share a number of similarities with respect to network design. Each of the releases presented in Washington UNE cost proceedings to estimate Verizon NW's costs start with geographic areas (and associated information such as the number of lines, households, businesses, and the like) that were intended -- though failed -- to represent the distribution areas that accepted telecommunications engineering practices would produce. In all releases, these areas were developed *prior to* their inclusion in the HAI Model.[31] In Verizon NW's previous UNE proceeding before this Commission, the census block groups ("CBGs") used by HM 3.1 were allegedly representative of distribution areas (i.e., they were considered to be representative of

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[29] *See*, *e.g.*, Alfred E. Kahn, *Letting Go: Deregulating the Process of Deregulation*, East Lansing: Michigan State University (1998) at pp. 91-92 and Jerry A. Hausman, "*Valuing the Effect of Regulation on New Services in Telecommunications*," Brookings (1997). Professor Hausman estimates that annual charge factors, based on traditional regulatory depreciation and cost-of-capital, can be too low by a factor of 2 to 3.

[30] For example, suppose the luxury of starting from scratch allowed a hypothetical entrant to serve current lines with 20 percent fewer telephone poles than an ILEC. If this were a realistic possibility (which it is not), then the ILEC's stock of poles, in effect, would have lost 20 percent of its economic value. The depreciation rates used in HM 5.3 completely disregard this fact.

certain aspects of engineering practice, particularly the number of households served in a single distribution area). In later releases, beginning with HM 5.0 and including HM 5.3, an outside firm (TNS Telecoms or "TNS") developed "clusters;" and again, although certain engineering criteria apparently changed between the various releases of the HAI Model, they were determined by the HAI Model sponsors to be consistent with proper engineering practice. That is, the geographical areas (CBGs in earlier iterations and clusters in the later releases) were intended to represent the areas to which a telephone engineer would design and build outside plant.

These geographical areas are developed outside of the Model, and the documentation purportedly describing their development fails to provide the information necessary to verify whether the geographic areas in fact reasonably represent what would result from sound engineering practice or, for that matter, whether they accurately represent the locations to which a carrier would build telecommunications facilities (e.g., whether the facilities' routes are the proper length). Subsequent to AT&T/MCI's January 2004 re-filing, Verizon NW gained access to certain aspects of the incredibly complex and time-consuming data and processes used by TNS to transform the data provided by Verizon NW (and other data maintained by TNS) into the geographic inputs used in HM 5.3. Mr. Dippon's Reply Declaration describes the evaluation of those data and processes, and concludes that, because the clusters produced by HM 5.3 are so far removed from any reasonable depiction of Verizon NW's distribution areas, they could

(...continued)

[31] *See* Mercer Supplemental Direct at p. 9. As discussed in more detail below, some of the most fundamental network design assumptions are hard-wired into the database that represents distribution areas, and thus cannot be modified within HM 5.3.

not possibly produce accurate estimates of Verizon NW's forward-looking costs of providing UNEs.[32]

Q. PLEASE DESCRIBE THE SIGNIFICANCE OF THESE CLUSTERS TO HM 5.3'S OVERALL NETWORK DESIGN.

A. These clusters form the basis upon which HM 5.3's UNE cost estimates are calculated -- i.e., the lengths of facilities' routes (e.g., how much feeder plant is needed between a wire center and the center of a distribution area) and the types and amounts of plant (e.g., how much copper cable of particular size, and what type of associated support structure are needed by a firm with the luxury of building facilities on a "blank slate" to serve Verizon NW's current volumes of demand at their actual locations. Once those quantities are determined, various inputs (e.g., the cost of an installed telephone pole) are used to determine the total investment putatively required to efficiently provide telephone service.

HM 5.3 then makes other calculations, including determining the annual capital charges associated with the investment, annual maintenance expenses, and various "overhead" expenses not directly tied to the network investment. Even if the cluster input data were accurate, the validity of the investment and associated costs produced by HM 5.3 depends on whether the quantities produced by the Model, and the price inputs used to produce the investments, comport with what Verizon NW (or any other real-world carrier) could reasonably expect to achieve. To the extent the "blank slate" (1) fails to represent proper engineering design and decisions, (2) ignores real-world constraints

[32] Dippon Reply Testimony at Section V.

that an actual carrier would face (e.g., routes cannot be direct because rights-or-way are not ubiquitous, carriers need adequate capacity to avoid service disruptions, etc.), (3) inaccurately represents the necessary facilities (e.g., cable sizes and support structures), and/or (4) overlooks the fact that carriers cannot always purchase and install equipment under the favorable terms that HM 5.3 assumes a fictitious "blank slate" carrier would enjoy, the UNE cost estimates produced by HM 5.3 will not represent those that would prevail under competitive conditions. To the contrary, the cost estimates produced will be, at best, imprecise and unrealistically low.

Q. HOW IS THE REST OF YOUR TESTIMONY ORGANIZED?

A. The rest of my Reply Testimony is organized as follows. In the next section, I discuss how information about locations of facilities should be translated into a network design. I then provide several tests, which demonstrate that HM 5.3 produces unreasonably low UNE cost estimates. Next, I identify a number of major changes in outside plant inputs that produce unrealistically low costs and, as Mr. Murphy explains, do not match the costs that a real-world carrier would incur. I then discuss specific modeling issues, including certain features that appear to be inconsequential in Washington, and particular aspects of the Model that produce inaccurate and/or insufficient investment estimates. I then explain why the expense factors proposed by AT&T/MCI produce levels of operating and related expenses that are implausibly low relative to Verizon NW's current levels. Next, I discuss the results of the regulatory scrutiny that AT&T/MCI offer in support of HM 5.3 and demonstrate that they have failed to address the specific concerns raised by this Commission, as well as other state regulatory commissions, with respect to previous versions of the HAI Model. I then identify and criticize a number of HM 5.3's critical inputs and their sources. The final section summarizes my conclusions.

IV. TRANSLATING CUSTOMER LOCATION INFORMATION INTO A VIABLE NETWORK DESIGN

Q. IS HM 5.3'S APPROACH TO LOCATING CUSTOMERS AND DESIGNING A NETWORK REALISTIC?

A. No. Implicit in Dr. Mercer's claim that HM 5.3 is the best model for estimating Verizon NW's forward-looking costs is the proposition that any model that *claims* to construct routes between customers and end-offices (loop plant), and end-offices to each other (interoffice facilities), is inherently superior to a model that starts by measuring some features of the current network and makes appropriate forward-looking adjustments. Such a claim does not withstand careful scrutiny, and has been rejected by a number of state regulatory commissions.

Based on the alleged superiority of a completely hypothetical and highly abstract network, AT&T/MCI embark on what has proven to be an almost impossible task: designing the network of a hypothetically "efficient firm" and dictating what that firm would pay for that network, telephone pole by telephone pole, wire by wire, switch by switch, and so forth. This undertaking is tantamount to a competitive bid for a contract to build Verizon NW's entire Washington network overnight without any financial commitment to do so, and without engaging in any type of sanity check (e.g., are the routes long enough; are there sufficient amounts of network components; does the network design account for *all* the costs a firm would incur in providing UNEs?). AT&T/MCI merely assert that the "least cost" algorithms that draw loop routes (i.e., TNS's development of clusters as a preprocessing step to HM 5.3, as well as the development of interoffice rings by another computer program) are TELRIC-compliant, and contend that the judgment of their engineering team is sufficient to determine not only how a firm will build and operate its network on a going-forward basis, but also what that firm can expect to pay for all of its network components.

Q. HOW WOULD ONE GO ABOUT TESTING THE REASONABLENESS OF HM 5.3'S NETWORK DESIGN?

A. To assess the reasonableness of HM 5.3's network design, it is useful to consider what a "plan" for a new network would entail. It is necessary that: (1) customers are connected to end-offices; and (2) the distribution terminal, which is the end of the loop plant closest to the customers (e.g., on a telephone pole), is close to where actual customers are located. These propositions are unaffected by whether the routes of the current network are more or less efficient than a completely redesigned network, as there is no reason to believe that distribution terminal locations could be more efficiently placed.

Accordingly, a first step in evaluating the results of a cost model would be to assess how distribution terminals are located. HM 5.3 does not explicitly locate these terminals. Instead, it employs the following process that can, at best, provide a rough approximation of where these terminals are located: (1) start with a rectangular representation of the distribution areas that TNS has provided;[33] (2) divide these rectangles into "lots;" and (3) place distribution terminals at lot boundaries, e.g., at the

[33] Mr. Dippon's Reply Testimony shows that, while HM 5.3 treats distribution areas as rectangles, the customer locations in these areas can actually be contained in highly irregular shapes. Dippon Reply Testimony at Section V.

hypothetical locations of telephone poles.[34] In contrast, Verizon NW's cost model starts with the actual locations of most of the distribution terminals used to serve the customers both models are designed to include. The distribution terminals whose locations could not be identified are assigned a location that corresponds to an actual point in the network serving them. Thus, from the outset, Verizon NW's cost model starts with superior information concerning the portion of the network located nearest to the end-users to be served.[35]

Once distribution terminals have been located, a cost model should group these terminals into distinct distribution areas, presumably based on current network design principles. Again, the contrast between HM 5.3 and Verizon NW's cost model is striking -- the proponents of HM 5.3 assert that the generalized engineering rules supplied by Mr. Donovan,[36] and allegedly understood and correctly implemented by TNS, produce more efficient distribution areas than Verizon NW's current areas. The sponsors of HM 5.3 in effect argue that: (1) Verizon NW, with the luxury of starting over today, would group distribution terminals into distribution areas that are different than those existing in the real network; (2) Mr. Donovan's unsubstantiated opinions completely and correctly represent the process by which terminal locations would be grouped; (3) TNS has correctly represented Mr. Donovan's assumptions; and (4) distribution facilities would

[34] In fact, HM 5.3 only partially carries out this process. For example, the costs for distribution terminals are developed on a per-line basis for the entire cluster, with none of the customer location information (apart from lines) being used to estimate distribution terminal costs.

[35] The HM 5.3 model developers claim that they have accurately identified actual customer locations. Whether or not this claim is justified is a moot point since, as is explained below, HM 5.3 does not model a network that connects actual customer locations. Instead, the Model rearranges the locations into a rectangular grill.

[36] Messrs. Murphy and Richter describe how these abstract rules depart from standard network engineering practice and, as a result, produce distribution areas that bear little resemblance to those of an efficient real-world local exchange carrier.

consist of simple rectangular “grills” containing branch and backbone cables of generally uniform size throughout the cluster (e.g., all branch cables are 50-pair), without regard to the actual customer locations or the locations of existing rights-of-way. What the supporters of HM 5.3 ignore, however, is that real-world network designers face constraints that are not represented in Mr. Donovan’s assumptions or TNS’s algorithms. These constraints include, but are not limited to, the locations of roads and rights-of-way, natural and man-made barriers, and unevenly distributed lots within distributions areas. In contrast to HM 5.3, Verizon NW’s cost model starts with the distribution areas in its existing network, thereby recognizing the right-of-way constraints of the real world, as well as the uneven distribution of customer locations.

Q. ARE THERE SIMILAR PROBLEMS ASSOCIATED WITH HM 5.3’S MODELING OF FEEDER PLANT?

A. Yes. A cost model should design feeder routes that run between the end-offices and the serving area interfaces (“SAIs” or cross boxes) located within each distribution area. Again, HM 5.3’s claim to greater efficiency rests on the unsubstantiated assertion that: (1) TNS’s and HM 5.3’s algorithms for locating SAIs provide a more efficient design than Verizon NW’s current network; and (2) HM 5.3’s “right angle” feeder routing algorithms produce routes that are more efficient than what Verizon NW’s engineers have designed. Neither assumption is correct. HM 5.3’s unrealistic network design principles ignore real-world constraints and have never been validated against actual measurements based upon actual operating conditions. In particular, as Mr. Dippon explains in detail, not only does HM 5.3 model significantly fewer distribution areas and place substantially fewer SAIs than Verizon NW has in its Washington network, but the hypothetical locations of the SAIs are often not closely aligned with the customer locations they purportedly serve.[37] Similarly, the "right angle" routing of feeder routes ignores any and all obstacles that may be present along the two, hypothetical, straight-line segments connecting the wire centers to SAIs.[38]

Q. IS A COMPARISON OF RELATIVE LOOP DISTANCES SUFFICIENT TO UNDERSTAND THE AMOUNT OF NETWORK EQUIPMENT REPRESENTED BY THE TWO COST MODELS?

A. No. Dr. Mercer attempted such a comparison during a recent workshop in California.[39] However, while distances such as feeder route lengths are important in determining the amounts of equipment to deploy (e.g., the number of telephone poles and the copper cable lengths), the mix of these components is also important in determining total investment and the resulting monthly costs. For example, the amounts of network components for a one-mile stretch of a loop route can vary in their support structure (e.g., poles versus buried), the size of the cables along the route, and so forth. These differences, in turn, can produce important differences in costs. As I explain in detail below, there are large variations in the cost per foot of cable and associated support structure. Therefore, if HM 5.3 selects an unrepresentative mix, the cost estimates produced by the Model would be inaccurate. For example, if the Model placed too much

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[37] Dippon Reply Testimony at Section V.

[38] HM 5.3 assumes that feeder routes consist of a main feeder segment that may connect several clusters and subfeeder routes perpendicular to the main feeder routes. Direct routing (i.e., no accommodation for obstacles) is assumed for both main and subfeeder routes. And the feeder and subfeeder segments tend to be long -- averaging on the order of 1.7 miles of putatively unobstructed distance.

[39] Before the California Public Utilities Commission, Docket R. 93-004-03/I. 93-004-02, *Workshop Transcript* (Jan. 15, 2004) at pp. 3537-40.

outside plant in low density clusters, but offset this error with too little outside plant in high density areas, the average distances could be fairly close to realistic values, but the distribution of costs among the density zones would be skewed.

Q. HOW DOES HM 5.3 DETERMINE ROUTE LENGTHS AND THE NETWORK COMPONENTS FOR THESE ROUTES?

A. It is a two-step process. First, as Mr. Dippon describes in detail, the preprocessing performed by TNS establishes the broad outlines of the HM 5.3 network -- i.e., the number and sizes of distribution areas, their density classification (to establish the costs of certain inputs), the total route distance (i.e., the strand distance) within each distribution area, the number and types of lines, and so forth.[40] The equipment deployed along these routes is then determined within HM 5.3 itself.

Q. DOES HM 5.3 "BUILD" TO THE ROUTES THAT TNS HAS DETERMINED?

A. No. Although in determining the strand distances,[41] TNS in principle has traced routes from the putative SAI for a distribution area to the locations of every customer, HM 5.3 does not use any of this information. Rather, the Model builds a rather simple "grill" within a rectangular area. The grill contains a certain amount of "backbone" cable of unknown sizes,[42] and another amount of "branch" cables, all having the same number of pairs. When the default strand distance constraint is employed, the Model then scales

[40] Dippon Reply Testimony Section IV.

[41] The strand distance is generally the minimum length required to connect customer locations to the SAI location. According to HM 5.3's documentation, right-angle routing is used in determining these lengths.

[42] The Model selects a particular back-bone cable size (e.g., 900-pair) at the SAI, which is assumed to taper in some unspecified manner so that the total cable investment is generally 65 percent of the amount without tapering.

the sum of the "backbone" and "branch" route distances (and, if applicable, connecting routes) to equal the strand distance determined by TNS.

Q. HAVE YOU EXAMINED SOME OF THE RESULTS OF THIS PROCESS?

A. Yes. Perhaps the most significant feature of the clusters produced by TNS is their large size, which as Mr. Dippon emphasizes cannot be changed in any fundamental way by modifying HM 5.3.[43] Moreover, in building to such large areas, HM 5.3 tends to select equipment sizes that are also too large. For example, while HM 5.3 produces about 1,100 SAIs[44] averaging 2,300 lines, VzLoop produces 3,300 SAIs averaging 1,400 lines.[45] Similarly, while HM 5.3 places about 1,100 remote terminals ("RTs") averaging about 1,100 lines each, VzLoop places about 2,760 RTs averaging about 370 lines.

Q. HAVE YOU EXAMINED CABLE SIZES?

A. Yes. In general, HM 5.3's simplistic use of a "grill" to design distribution plant results in relatively few cable sizes (e.g., 25-pair, 50-pair, etc.) being deployed within distribution areas. And like SAIs and RTs, these cables tend to be larger than those represented by VzLoop. Figure 1 shows how the ratio of the average distribution cable size produced by VzLoop and HM 5.3 varies with the number of lines in a wire center.

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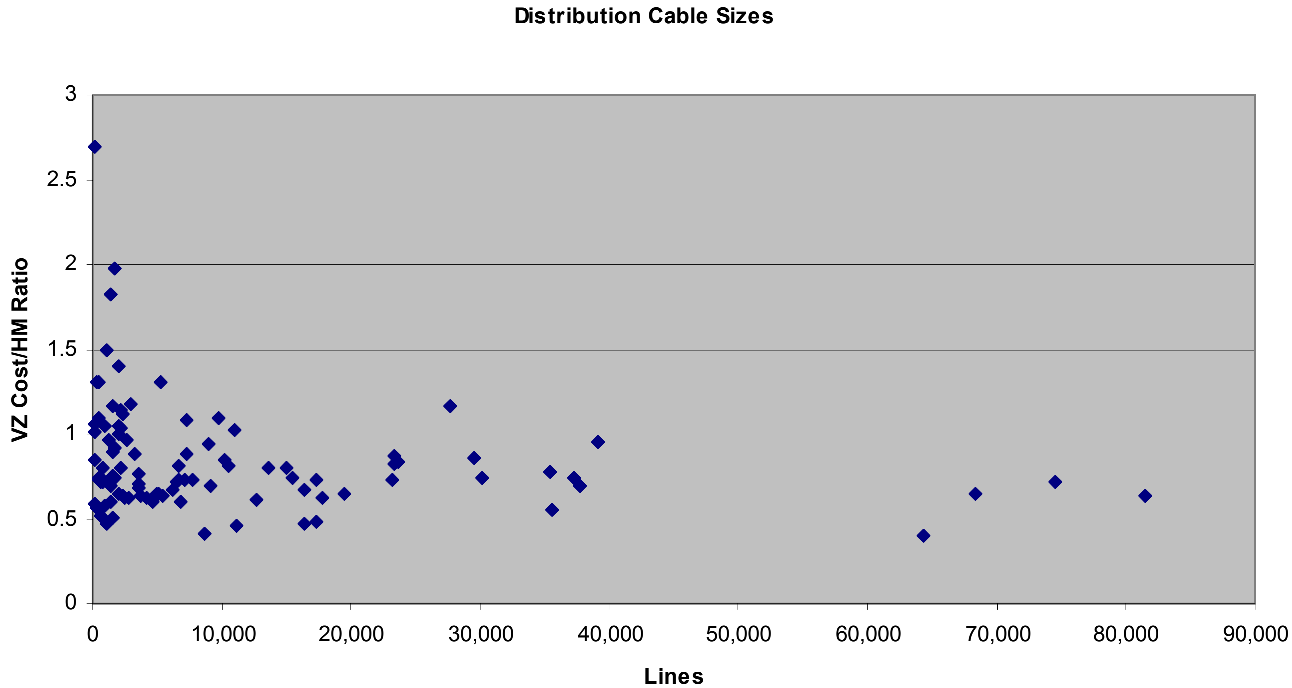
[43] Dippon Reply Testimony at Section V. In particular, by allowing the clustering process to proceed to the point where the number of lines within, and the spatial dimensions of, clusters can be large, TNS's distribution areas differ from what engineers typically design in the real world, as Mr. Murphy explains in detail.

[44] This number is somewhat larger than the number of clusters produced by TNS because, in some cases, HM 5.3 places multiple SAIs within a cluster.

[45] In contrast to VzLoop, which produces a file with an inventory of the specific pieces of equipment placed within each wire center, HM 5.3 does not report such components. I derived the quantities reported here by performing additional calculation on an intermediate file that can be produced by interrupting a HM 5.3 run. To put the large SAI size into perspective, in the large Bothell wire center, 19 of the 38 SAIs placed by HM 5.3 are of the largest (7,200-line) size and account for 68 percent of the total SAI capacity. In contrast, only 22 of the 135 SAIs placed by VzLoop are of the largest (5,400-line) size and account for only 35 percent of the total SAI capacity. Indeed, the *average* SAI capacity placed by HM 5.3 for this wire center is 5,300, or almost the *maximum* capacity ever utilized in VzLoop.

Figure 1



The fact that the majority of these ratios are less than 1.0 demonstrates that HM 5.3 produces larger cables,[46] which as I explain below, are less costly on a per loop basis. Smaller wire centers (which tend to be in lower density areas) are an exception to the general pattern -- in such areas, HM 5.3's average distribution cable sizes tend to be smaller, thereby producing relatively higher costs for smaller wire centers.[47]

[46] Indeed, HM 5.3 produces larger cables, despite the fact that its default inputs provide *less* spare capacity (implying smaller cable sizes than if more spare capacity was specified).

[47] The average cable sizes of each of the respective models in each of the Commission's five current UNE rate zones also demonstrate that generally larger cables are deployed by HM 5.3. The following table shows these results:

(continued...)

Q. WHAT EFFECT DO HM 5.3'S LARGE DISTRIBUTION AREAS HAVE ON THE COST ESTIMATES PRODUCED BY THE MODEL?

A. From a costing standpoint,[48] Mr. Donovan has generally selected inputs that assume economies of scale for larger items (e.g., the cost per pair tends to decrease as cable sizes increases).[49] Consequently, the fact that HM 5.3 tends to produce large distribution areas results in unrealistic scale economies, and consequently low investments and understated UNE cost estimates. That is, because the cost per unit of larger equipment (e.g., the cost per pair foot for a large cable) is lower in many cases than the costs for smaller equipment, the resulting costs (e.g., the costs for the number of pair feet needed to serve an area) would be too low. For example, the larger copper distribution cable sizes produced by HM 5.3 result in an average investment per pair foot that is *twenty percent lower* than the corresponding average that VzLoop's cable size mix would produce when Mr. Donovan's cable investment inputs are used.

(...continued)

UNE Zone	Lines	Average HM Distribution Cable (pairs)	Average VZ Distribution Cable (pairs)
1	286,386	453	292
2	268,451	338	279
3	102,441	255	195
4	197,450	213	157
5	209,488	100	94

Only in Zone 5, the highest cost/least dense zone, are the average cable sizes even remotely comparable.

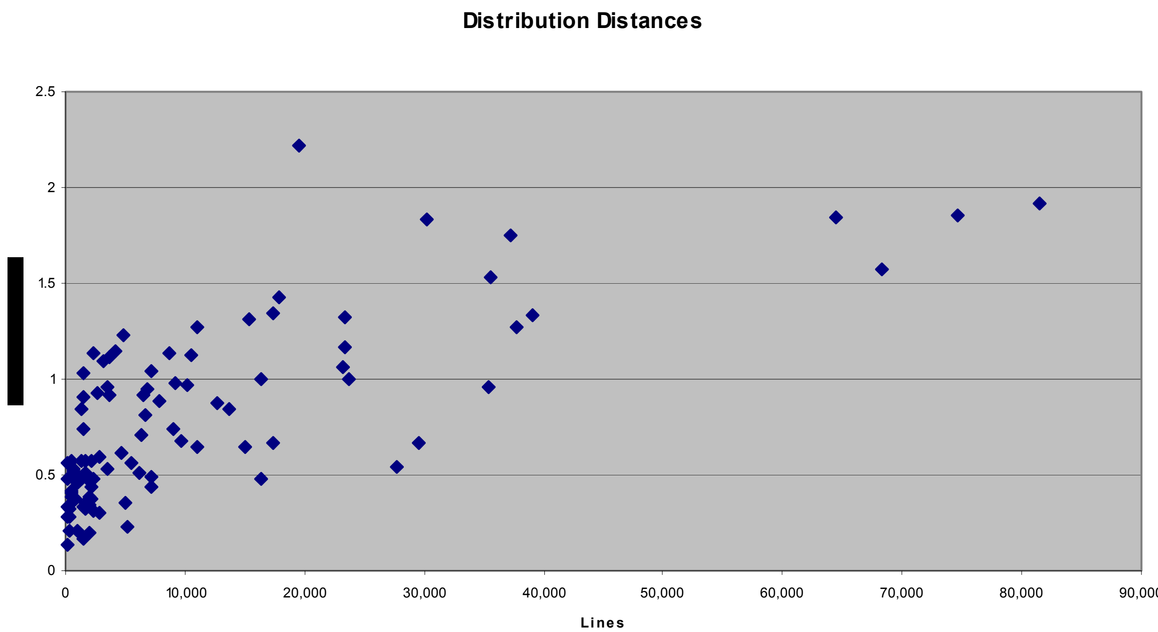
[48] Messrs. Murphy and Richter discuss, from an engineering perspective, the problems associated with modeling large distribution areas.

[49] For example, the cost per pair for a 50-pair cable assumed by HM 5.3 is about twice that of a 200-pair cable and about three times that of a 400-pair cable.

Q. DO YOU HAVE OTHER OBSERVATIONS REGARDING HOW HM 5.3 AND VzLOOP DEPLOY DISTRIBUTION CABLE?

A. Yes. The total cable lengths produced by the two models can differ substantially from wire center to wire center, as shown in Figure 2.

Figure 2



This figure displays the ratio of the total copper distribution sheath distance produced by VzLoop to the corresponding HM 5.3 distance. The general pattern is that, while HM 5.3 tends to produce greater distances for smaller wire centers (indicated by ratios of less than 1.0), the opposite tendency applies to larger wire centers. Similar to the pattern for cable sizes, the cost implication of this outcome is that, relative to VzLoop, HM 5.3 overstates costs in low-density areas, but understates costs in higher-density areas. Not surprisingly, it is the high-density areas where AT&T/MCI are likely to purchase the majority of their UNEs.[50]

[50] The total distribution distances (sheath feet) of each of the respective models in the Commission's current five UNE rate zones also demonstrate HM 5.3's general tendency for underestimating facilities in high-density areas. The following table shows these results.

UNE Zone	**Lines**	**HM Sheath Feet**	**VZ Sheath Feet**

(continued...)

Q. WHY ARE HM 5.3'S DISTRIBUTION AREAS SO LARGE?

A. In response to criticisms levied during the interim phase of the SBC California UNE proceeding regarding the underground placement of RTs, Mr. Donovan changed both the design of HM 5.3's distribution areas, as well as the available sizes of RTs, to allow for the underground installation of RTs, but only in distribution areas with a sufficient number of lines. However, rather than base the decision to place RTs underground on local conditions (e.g., city ordinances), the sole determinant of underground placement is the size of the cluster -- an RT is only placed underground in a controlled environmental vault ("CEV") when a cluster requires more than 2,100 lines of capacity. The design of the clusters was also changed from earlier versions of the HAI Model (e.g., HM 5.0a) to allow for larger clusters that are able to accommodate larger RTs. Specifically, because HM 5.3 places RTs in underground facilities only when demand exceeds Mr. Donovan's 2,100-line threshold, the high costs of acquiring and installing underground structures are spread over a large number of lines, thereby artificially, and unrealistically, reducing the cost per line of the equipment. This stands in sharp contrast to the real world, where the placement of such structures are dictated by factors such as zoning regulations, which are unrelated to the number of lines. Contrary to the assumption made in HM 5.3, in the real network there is no guarantee that the high fixed costs of underground structures can be averaged over a large number of lines.

(...continued)

1	286,386	4,359,728	6,774,346
2	268,451	5,878,559	7,613,789
3	102,441	4,889,445	4,654,231
4	197,450	14,496,606	13,065,616
5	209,488	47,058,919	24,978,666

The drastic impact of Mr. Donovan's use of CEVs to justify such large distribution areas can be seen in the wide differences in RT sizes used by HM 5.3 (which are based on Mr. Donovan's novel design recommendation)[51] and the RT sizes used by VzLoop (which are consistent with Verizon NW's well-established engineering practices), as Table 1 demonstrates. VzLoop has over twice the number of RTs (which is consistent with the design of a network with smaller distribution areas). As a result, the average size of an RT in VzLoop is only about one-third of that produced by HM 5.3. Indeed, over 60 percent of the RT capacity in HM 5.3 is accounted for by CEVs -- alternatives that were not even considered in earlier versions of the HAI Model. These contrasts illustrate a critical issue in assessing the validity of HM 5.3 versus VzLoop: HM 5.3 relies upon a novel and untested "theory" that "bigger is better," whereas VzLoop utilizes a design that reflects proven practices actually employed in designing a real-world network.

[51] *See* Mr. Murphy's Reply Testimony for a discussion of the departure of Mr. Donovan's RT and DA sizing recommendations from industry-accepted standard sizing guidelines.

TABLE 1

	VzLoop				**HM 5.3**			
Size	Number	Capacity	% of units	% of cap	Number	Capacity	% of units	% of cap
24	740	17,760	26.8%	1.8%	194	4,656	17.2%	0.4%
48	271	13,008	9.8%	1.3%				
96	320	30,720	11.6%	3.0%				
120					254	30,480	22.6%	2.5%
192	386	74,112	14.0%	7.3%				
224	77	17,248	2.8%	1.7%				
240					127	30,480	11.3%	2.5%
448	333	149,184	12.1%	14.8%				
672	230	154,560	8.3%	15.3%	218	146,496	19.4%	12.0%
896	137	122,752	5.0%	12.2%				
1120	81	90,720	2.9%	9.0%				
1344	42	56,448	1.5%	5.6%	145	194,880	12.9%	16.0%
1568	24	37,632	0.9%	3.7%				
2016	122	245,952	4.4%	24.3%	23	46,368	2.0%	3.8%
2688					29	77,952	2.6%	6.4%
3360					17	57,120	1.5%	4.7%
4032					6	24,192	0.5%	2.0%
4704					72	338,688	6.4%	27.8%
5376					8	43,008	0.7%	3.5%
6048					0	0	0.0%	0.0%
6720					31	208,320	2.8%	17.1%
7392					2	14,784	0.2%	1.2%
8064					0	0	0.0%	0.0%
	2763	1,010,096			1126	1,217,424		
Average		366				1,081		

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS WITH RESPECT TO HM 5.3'S MODELING APPROACH.

A. In sum, HM 5.3's claims of greater efficiency rest on: (1) the untested and debatable proposition that competition would produce more efficient network designs than exist today; (2) an assumption that the unverified and highly suspect data HM 5.3 employs is accurate enough to locate key facilities, such as distribution terminals, in a network; and (3) a belief that the abstract rules and erroneous algorithms that HM 5.3 employs could produce a realistic representation of a functioning network. With respect to each and every point, AT&T/MCI are mistaken. Ironically, despite the fact that HM 5.3's proponents tout the Model as being more efficient because it is intended to, though in reality does not, produce a more efficient network design, they often defend the Model on the basis that it produces *more* facilities than other models produce and/or are present in the real network (e.g., longer loop lengths).[52] That is, the existing network, which they routinely condemn as inefficient (and out of compliance with TELRIC rules), is used to justify the alleged realism of HM 5.3's hypothetical network. Having failed to establish that HM 5.3 produces a more efficient design, the choice among models would seem to shift to whether a completely hypothetical approach can be more accurate and reliable than one which is grounded in measurements of a functioning network. The answer to that question is plainly, no.

Q. IS VERIZON NW'S APPROACH TO COST MODELING CONSISTENT WITH THE MODELING APPROACHES APPROVED BY THE FCC AND/OR STATE REGULATORY COMMISSIONS?

A. Yes. The FCC has explicitly approved methodologies like Verizon NW's approach to cost modeling, which is based on the existing network with appropriate forward-looking adjustments, and looks to current costs that Verizon NW actually pays for network components such as switches. The FCC made clear when accepting BellSouth's approach to modeling loop costs:

> While BellSouth's loop model was based on a sample of existing loops, the record demonstrates that loops were redesigned to reflect forward-looking criteria rather than reproducing the existing network.

[52] *See e.g.*, Before the California Public Utilities Commission, Application Nos. 01-02-024, et al., *Declaration of Brian F. Pitkin in support of Joint Applicants' Rebuttal Comments* (March 12, 2003) at p. 49.

> Also, the sample assumed that cable routes would follow existing rights-of-way and roads that BellSouth would use today if it were to place that cable.[53]

Recent decisions by state regulators have also approved forward-looking cost studies that start with measurements of an ILEC's existing network and, in doing so, have rejected previous versions of the HAI Model. Thus, as I describe later, not only has the regulatory scrutiny Dr. Mercer mentioned[54] failed to produce widespread acceptance of the HAI Model, regulators at the same time have rejected AT&T/MCI's inaccurate interpretation of TELRIC as well. For example, in accepting Verizon's cost study and rejecting HM 5.2a, the Massachusetts Department of Telecommunications and Energy found:

> Therefore, because Verizon's reliance on existing network architecture as the starting point can lead to reasonable cost results provided that appropriate modifications are made to render the network "more forward-looking," we find that the LCAM is a reasonable tool for modeling UNE loop costs.…
>
> We find that Verizon has provided sufficient validation of the data it uses to construct its LCAM model and that, with the appropriate modifications to the assumptions about inputs, the existing network configuration can be used to compute reasonable estimates of forward-looking costs.[55]

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[53] BellSouth Order at ¶ 36 (footnotes omitted). In this paragraph, the FCC approved the determination of the Georgia Commission stating: "The Georgia Commission was not hesitant to apply adjustments to BellSouth's cost model to ensure cost-based rates consistent with TELRIC and a forward-looking approach. The evidence shows that the Georgia Commission deliberated over the loop sample methodology and corrected the omission of shorter multi-line business loops. The state commission, however, did not accept AT&T's criticism that BellSouth's loop sample 'improperly adjusted the loop characteristics to be forward-looking.'" In a footnote, the FCC noted that the adjustments included the forward-looking placement of DLC and fiber facilities, and changes in cable gauges -- adjustments that parallel those used in Verizon NW's cost study. The FCC released the BellSouth Order just two days after the Supreme Court upheld the TELRIC rules. *See* BellSouth Order at p. ¶ 22. Thus, there can be no doubt that an approach that accounts for the fundamental characteristics of existing networks fully complies with TELRIC.

[54] Mercer Supplemental Direct Testimony at pp. 6-7.

[55] Before the Massachusetts Department of Telecommunications and Energy, Docket No. D.T.E. 01-20, *Order* (July 11, 2002) at pp. 50-51.

Similarly, the New Jersey Board of Public Utilities ("New Jersey Board") concluded:

> We find that the Verizon NJ models are based upon sound engineering principles and sound modeling concepts. While AT&T has demonstrated that similar results may be obtained by varying the inputs and assumptions contained in its model, we find that it is more appropriate to modify the Verizon NJ models to produce forward-looking, TELRIC-compliant results because its basic construction more accurately replicates [Verizon NJ's] network, whereas the HAI Model employs a methodology designed to create a least-cost, most efficient network without regard to realistic design considerations…
>
> Although in order to determine loop length and structure mix, Verizon NJ takes into consideration characteristics of its outside plant in each UAA, it does not develop its cost estimates based upon embedded costs. In connection with making a decision regarding cost model assumptions for reconstructing the local network, the consideration of the layout and characteristics of the existing network is a reasonable starting point. This is particularly true in light of the fact that customer locations, street locations, central office locations, natural barriers and right-of-way locations will not change significantly.[56]

Likewise, regulators in states such as New York,[57] Pennsylvania,[58] and Maryland[59] have accepted cost studies offered by Verizon, which are similar to the ones that were approved in Massachusetts and New Jersey.

Therefore, the first fundamental issue in this case is which approach is more reliable: the Verizon NW approach, which starts with information concerning Verizon NW's current network architecture and makes realistic and appropriate forward-looking adjustments, or the HM 5.3 approach, which attempts to design a brand-new network

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[56] Before the New Jersey Board of Public Utilities, Docket No. TO00060356, *Decision and Order* (Mar. 6, 2002) at pp. 27, 30 ("New Jersey Order").

[57] Before the New York Public Service Commission, Case 98-C-1357, *Order on Unbundled Network Element Rates* (Jan. 28, 2002).

[58] Before the Pennsylvania Public Utility Commission, Docket No. R-00016683, *Tentative Order* (Oct. 24, 2002).

[59] Before the Maryland Public Service Commission, Case No. 8879, *Order No. 78552* (June 30, 2003) at p. 17.

from the ground up without any regard to real-world operating constraints or accepted engineering criteria. Without having verified that their cost study produces accurate results, AT&T/MCI essentially ask the Commission to: (1) trust TNS' inadequately documented and, in some cases, undisclosed algorithms and processes for producing clusters; (2) endorse the inaccurate methods of drawing "least cost" routes; (3) rely on untested formulas to determine the equipment that is needed to provide service on these routes; and (4) believe that unverified judgments are appropriate support for the price of that equipment and the labor to install it. In contrast, Verizon NW's modeling approach starts with information about a network that is the result of years of growing competition and incentive regulation of some services, and that has provided telecommunications services to real customers at locations where they are in fact found. Verizon NW's cost model measures the key characteristics of that real-world network and captures all the costs necessary to build it and maintain it, many of which are easy to overlook and/or very difficult (if not impossible) to measure accurately (e.g., complying with zoning regulations) in a study such as HM 5.3. Unlike HM 5.3, Verizon NW's modeling approach is grounded not in the speculation inherent in an "optimization" algorithm or unverified input recommendations, but in the reality of experience tested and refined over the years to accommodate the dynamic nature of the telecommunications industry.

V. VALIDATION TESTS

A. INVESTMENT LEVELS, PRICES, AND QUANTITY COMPARISONS

Q. WHAT CONCLUSIONS CAN BE DRAWN FROM YOUR ATTEMPTS TO VALIDATE HM 5.3?

A. HM 5.3 significantly underestimates the investments and expenses necessary to provide UNEs in Washington. Tables 2A and 2B compare the investments and expenses produced by HM 5.3 with the investments and expenses Verizon NW currently incurs to provide telephone service in Washington.[60] The "2003 ARMIS" data in Tables 2A and 2B are from the outputs used in HM 5.3's calculations and, according to AT&T/MCI, were taken from Verizon NW's ARMIS reports. Current investments are calculated by multiplying the ARMIS investment by the current cost-to-book cost ratio that the FCC used to develop the expense factors, which are incorporated into HM 5.3.[61] The result is an estimate of what it would cost to rebuild Verizon NW's current plant, assuming current prices (based on applying current cost-to-book cost ratios) were paid for assets that were

[60] The documentation for HM 5.3 states that the density-zone Expense Modules "include a USOA Detail worksheet that breaks out investment and expense results by Part 32 Account for comparison with embedded ARMIS data." Mercer Supplemental Direct Testimony at RAM-4 (Model Description), p. 64. However, this worksheet (which has appeared in the various versions of the HAI Model from 1998 (5.0a) through 2003 (HM 5.3 in the SBC California proceeding)) is not included in the Model's output file. Thus, the Model documentation itself offers a relevant "sanity check" comparison, despite the fact that AT&T/MCI and their witnesses have tried to distance themselves from this Model output in the past (by insisting that all comparisons to actual network costs are irrelevant), and evidently have done away with it altogether in this proceeding. I have included the "USOA Detail" worksheet here, which accompanied the SBC California version of HM 5.3, and have updated it to include the investments associated with DS-1 and DS-3 UNEs. I have also reduced the general support investments and expenses in the ARMIS and current investment columns to match the proportions assigned to the UNEs modeled by HM 5.3 in this proceeding.

purchased in the past. As described in more detail below, the investments produced by HM 5.3 are generally less than 30 percent of Verizon NW's current levels and the expenses are on the order of one-half (or less) of current levels.

(...continued)

[61] Tenth Report and Order at Appendix D.

Table 2A

Comparison of HM 5.3 Investments to Verizon NW's Actual Investments

USOA	Expense Description	HM 5.3 Investment ($000)	2003 Actual ($000)	Current ($000)	HM 5.3/2003	HM 5.3/Current
	Telecommunications Plant in Service					
2111	Land	$2,925	$8,507	$8,507	34.38%	34.38%
2112	Motor Vehicles	$2,504	$5,777	$6,149	43.34%	40.72%
2113-6	Special Vehicles/Work Equipment	$4,398	$26,876	$28,605	16.37%	15.38%
2121	Buildings	$50,162	$114,864	$175,289	43.67%	28.62%
2122	Furniture	$1,355	$3,126	$4,770	43.34%	28.40%
2123	Office Equipment	$2,450	$5,654	$8,628	43.34%	28.40%
2124	General Purpose Computers	$5,433	$12,538	$19,133	43.34%	28.40%
2110	Total Land & Support Assets	$69,227	$177,341	$251,080	39.04%	27.57%
2212	Digital Electronic Switching	$117,087	$501,324	$447,525	23.36%	26.16%
2232	Circuit Equipment	$291,516	$531,826	$521,283	54.81%	55.92%
	Other	$14,514	$22,855	$22,694	63.51%	63.96%
2411	Poles	$26,769	$45,944	$67,899	58.26%	39.42%
2421	Aerial Cable	$75,280	$223,853	$340,686	33.63%	22.10%
2422	Underground Cable	$46,797	$303,497	$453,656	15.42%	10.32%
2423	Buried Cable	$146,957	$430,955	$578,479	34.10%	25.40%
2441	Conduit Systems	$50,311	$151,646	$279,209	33.18%	18.02%
2410	Total Cable & Wire Facilities	$346,114	$1,155,895	$1,719,929	29.94%	20.12%
240	Total TPIS (before amortizable assets)	$838,459	$2,389,241	$2,939,817	35.09%	28.30%

Table 2B

Comparison of HM 5.3 Expenses to Verizon NW's Actual Expenses

USOA	Expense Description	HM 5.3 Expenses ($000)	2002 Actual ($000)	HM 5.3/Actual
	Plant Specific Expenses			
6112	Motor Vehicles	$441	$384	114.76%
6113-6	Special Vehicles/Equipment	$157	$362	43.34%
6121	Buildings	$1,838	$8,489	21.65%
6122	Furniture	$71	$136	52.56%
6123	Office Equipment	$290	$551	52.56%
6124	General Purpose Computers	$4,968	$9,453	52.56%
6110	Total Land & Support Assets	$7,764	$19,375	40.08%
6212	Digital Electronic Switching	$6,533	$11,570	56.47%
6232	Circuit Equipment	$5,830	$7,590	76.81%
6411	Poles	$593	$2,175	27.27%
6421	Aerial Cable	$3,761	$6,425	58.54%
6422	Underground Cable	$826	$1,553	53.16%
6423	Buried Cable	$4,935	$11,757	41.97%
6441	Conduit Systems	$134	$251	53.27%
6410	Total Cable & Wire Facilities	$10,248	$22,161	46.24%
	Total Plant Specific Expenses	$30,376	$60,696	50.05%
6561	Depreciation TPIS	$51,453	$173,195	29.71%
	Total Non-Plant (Network Operations, Customer Services, and Corporate Operations)	$33,178	$119,891	27.67%
	Total Operating Expenses (Less Depreciation)	$63,553	$180,587	35.19%

Q. PLEASE DESCRIBE THE RATIONALE FOR YOUR VARIOUS VALIDATION TESTS.

A. A proper benchmark for any cost model that purports to measure a carrier's forward-looking costs is whether the model depicts enough equipment and includes accurate prices for that equipment. Similarly, there must be a sufficient amount of ongoing expenses to pay for the labor force needed to run a complex network and cover the ongoing charges for materials that a carrier routinely incurs. Because a cost model should realistically depict existing (or planned) locations of switches and outside plant facilities and, consistent with the FCC's TELRIC principles, the prices ILECs actually pay for their inputs, unusually large deviations between the cost model and reality almost certainly imply inaccuracies in the former, not inefficiencies in the latter. At a minimum, it would seem imperative that a cost model's sponsors justify with specificity why substantially fewer resources are needed and/or why facilities can be acquired, or services can be delivered, at prices far below what a real-world carrier currently pays.[62]

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[62] As discussed in greater detail below, the New Jersey Board rejected HM 5.2a. Its primary concern was the Model's large understatement of investment and expenses:

> Chief among our concerns is a fact pointed out by Verizon NJ that revealed that the HAI model assumes that Verizon's entire network could be constructed for less than one-third of Verizon NJ's existing investment and that it could be operated for approximately one-fifth of Verizon NJ's current operating expenses. Although we recognize that forward-looking investment and operating costs are likely to be less than embedded or current costs, the substantial nature of the difference between the HAI cost estimates and Verizon NJ's actual experience is indeed dramatic and suggests to the Board that the HAI Model may potentially understate forward-looking costs.

New Jersey Order at pp. 25-26 (internal citations omitted).

A useful analogy is the following: suppose a customer came to Verizon NW with a request for a 75 percent discount on a large number of loops. Assume also that this customer knew of a firm that had claimed to have a considerably more efficient way to design loops (as HM 5.3 claims) and could get the necessary materials very cheaply (e.g., at the unrealistically low prices advocated by AT&T/MCI). A real-world carrier like Verizon NW would only accept such a discount if the firm that advertised the more efficient way to design loops agreed to pay any cost difference should the design understate the amount of material required or otherwise be unable to offer the favorable advertised prices.

HM 5.3 would fail this simple sanity check. In general, the Model produces investment levels that are less than 30 percent of Verizon NW's total current investment (and about 35 percent of Verizon NW's ARMIS investments), and expenses for operating the network that are about one-third of Verizon NW's current levels. For example, despite the fact that HM 5.3 assumes a relatively greater proportion of aerial cable investment than appears in Verizon NW's network,[63] the Model provides only about 40 percent of the pole investment that it would take to replace Verizon NW's current poles at current prices. This can only mean that HM 5.3 provides substantially fewer poles and/or it assumes a pole cost that is much lower than what is attainable in

[63] According to Table 2A, 28 percent of HM 5.3's total cable investment is aerial versus 25 percent in Verizon NW's current network.

the real world -- either way, the Model's results are highly suspect.[64] It is inconceivable that Verizon NW's actual forward-looking costs could be up to 70 percent lower than its current costs.

Q. PLEASE DESCRIBE THE RESULTS ILLUSTRATED BY TABLES 2A AND 2B.

A. Table 2A compares Verizon NW's actual capital investment to HM 5.3's estimated capital investment. Table 2A shows that HM 5.3 produces *less than 30 percent* of Verizon NW's current investment in network components. In fact, after applying the current cost-to-book cost ratios to estimate reproduction costs, HM 5.3 produces relatively more investment in electronic switching (26 percent) than cable and wire facilities (20 percent). Similarly, HM 5.3 produces a mere 28 percent of Verizon NW's current support investment (for vehicles, office equipment, and the like).[65]

The investment comparison also shows a noticeable shift away from underground cable, which is generally the most expensive type of cable to place and support. Despite the fact that Mr. Donovan started with ARMIS data on Verizon NW's actual deployment of the various types of cable,[66] HM 5.3's investment in underground cable accounts for only 17 percent of the total cable

[64] For example, the Model assumes that Verizon NW pays only about one-third of the cost of a telephone pole, while electric utilities and other carriers paying for the rest. In fact, as Mr. Murphy describes, the Commission-mandated attachment fees are much lower than the level of cost sharing assumed by HM 5.3's sharing inputs. Murphy Reply Testimony at Section IV.

[65] As explained herein, total current support investments and expenses have been reduced by the same percentage that HM 5.3 uses to assign such costs to UNEs (as opposed to retail operations).

[66] Before the Washington Utilities and Transportation Commission, Docket No. UT-023003, *Direct Testimony of John C. Donovan on behalf of AT&T Communications of the Pacific Northwest, Inc. and WorldCom, Inc. and XO Washington, Inc.* (June 26, 2003) at p.13 .

investment, compared to about 33 percent of Verizon NW's current investment in cable.[67]

Turning to the comparison of Verizon NW's actual expenses to HM 5.3's estimated expenses in Table 2B,[68] the Model produces only about 50 percent of Verizon NW's current plant-specific expenses (i.e., the annual outlays required to maintain and repair the network). The comparison is particularly revealing for digital switching expenses, where the Model estimates that Verizon NW can maintain its switches for only 56 percent of the cost it currently incurs -- that is, AT&T/MCI assume that Verizon NW can maintain its current digital switching technology serving the same number of lines with only about three-fifths of the workforce it now employs. Such an assumption is simply implausible.

The expenses associated with circuit equipment are also unrealistically low. Despite an approximate doubling in the proportion of lines that are assumed to be served by fiber feeder, the Model produces only about 77 percent of the expenses that Verizon NW currently incurs.[69]

Q. HOW DO HM 5.3'S INVESTMENTS COMPARE TO PREVIOUS VERSIONS OF THE HAI MODEL?

[67] Mr. Murphy identifies at least three major causes for this phenomenon: the misclassification of certain portions of the modeled feeder plant as though it were distribution plant, the failure of HM 5.3 to meaningfully identify indoor SAIs resulting from the "all feeder" design, and the oversized "clusters."

[68] Because Verizon NW has only minimal investments and expenses associated with operator services and public telephone, these categories are not included in Table 2B. In addition, including them results in extremely unrealistically expense estimates. For example, HM 5.3 estimates that the expenses associated with operator and public telephone services are over 2.5 times as high as the expenses for cable and wire facilities; when in reality they constitute only three percent of Verizon NW's cable and wire expenses.

[69] ARMIS reports that about 33 percent of Verizon NW's working channels had a fiber digital loop carrier in 2002. ARMIS Report 43-07. In contrast, the proportion of fiber-fed loops in HM 5.3 is 74 percent.

A. A comparison of Verizon NW's investment from 1997 to 2003 -- the time that has elapsed since AT&T/MCI sponsored HAI Model, Release 3.1 in the previous UNE proceeding -- illustrates the unrealistic investment and expense levels assumed by HM 5.3. Over those six years, Verizon NW spent about $976 million on *additions* to its total plant-in-service. HM 5.3, on the other hand, calculates somewhat less than that amount of investment -- $838 million[70] -- to construct *from scratch* Verizon NW's entire Washington network. Similarly, for digital switching, while ARMIS data suggest that investment in additions to digital switches totaled about $165 million between 1997 and 2003, HM 5.3 produces only $117 million to provide entirely new digital switches for all of Verizon NW's lines.[71]

Q. WHY DOES HM 5.3 PRODUCE SUCH LOW INVESTMENT LEVELS?

A. There are at least two explanations for the low investment levels produced by HM 5.3: (1) HM 5.3 models insufficient quantities and/or the wrong type of material (e.g., cable and telephone poles) to provide service; and (2) HM 5.3's

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[70] *See* Table 2A.

[71] ARMIS Report 43-02 shows a total investment of about $280 million for Verizon NW, which is about 59 percent of its lines in Washington. It is highly unlikely that digital switch manufacturers could survive given these dismal investment expectations. And, as FCC Chairman Michael Powell has noted, the health of these vendors is crucial to the economic fortunes of the telecommunications industry:

> Economic recovery in the telecommunications space, as it is for the economy as a whole, rests on spurring capital expenditures. We need service providers buying switches and other equipment from the Nortels, Lucents and Ciscos, who are ever more distressed than the service industry. Such companies are innovators, the R&D arms that have kept the network at the cutting edge of the world. They must survive for our future.

Remarks of Michael K. Powell, Chairman, Federal Communications Commission, Goldman Sachs Communicopia XI Conference (Oct. 2, 2002).

prices for materials are unrealistically low. For example, suppose the cost of a telephone pole was actually $600 and Verizon NW needed 500,000 poles to serve its customers. The required investment would be $0.3 billion ($600 x 500,000). In contrast, if the Model provided only 200,000 poles at a cost of $400, the associated Model investment would be only $0.08 billion -- about 25 percent of the required investment.

In fact, both effects are present, with the price effect being generally larger: HM 5.3 typically produces smaller quantities than what Verizon NW's current investment levels imply, and the materials price inputs used in HM 5.3 are considerably lower than what can be inferred from actual investment levels and available ARMIS plant statistics. The following table shows the investment necessary to replace Verizon NW's outside plant facilities at current prices as a multiple of HM 5.3's investment levels, as well as the corresponding price and quantity multipliers.[72] In terms of the telephone pole example in the previous paragraph, the investment multiplier would be 3.75 (0.3/0.08), the price multiplier 1.5 (600/400), and the quantity multiplier 2.5 (500,000/200,000).[73]

[72] The estimation of pole prices is straightforward. ARMIS Report 43-08 identifies the equivalent number of poles. Therefore, the investment per pole implied by 2003 ARMIS investment and the current cost-to-book cost ratio is simply the pole investment in Table 2A divided by the number of poles -- a figure that can be compared directly to HM 5.3's pole investment input. For cable, I divided investment by sheath distance, which is reported directly in ARMIS, but which has to be calculated by interrupting HM 5.3 at an intermediate point.

[73] Note that the investment multiplier equals the price multiplier times the quantity multiplier.

TABLE 3

Verizon NW's Actual Outside
Plant Investments, Prices, and Quantities as Multiples of HM 5.3 Estimates

	Investment	Price	Quantity
Poles	2.5	1.8	1.4
Cable	5.1	4.0	1.3

As the table shows, the investment required to reconstruct Verizon NW's outside plant facilities is several times higher than what HM 5.3 produces. For telephone poles, at current prices, Verizon NW would have to expend 2.5 times the investment levels assumed by HM 5.3, as shown by the ratio of the $68 million current Verizon NW pole investment to the $27 million produced by HM 5.3. The discrepancy in investments is further explained by the fact that the current replacement cost per pole implied by the FCC's current cost-to-book cost ratio is almost twice that of HM 5.3, and that, despite the fact that HM 5.3 places relatively more aerial cable than Verizon NW has in its network, there are 40 percent more poles in reality than what HM 5.3 produces.[74] Perhaps most informative is the comparison of cable investments: HM 5.3 implies that the same customers could be connected to the same wire centers at a cost of only 20 percent (1/5.1) of what it would cost to replicate Verizon NW's existing plant. Table 3 shows that the estimated quantities in Verizon NW's actual

[74] Indeed, simple arithmetic shows that the investment multiple (2.5) equals the product of the price (1.8) and quantity (1.4) multiples.

network are about 30-40 percent larger than what HM 5.3 produces, and the materials prices are 2 to 4 times higher than HM 5.3's inputs.

Q. BESIDES SERVING AS A BENCHMARK, WHAT ADDITIONAL LIGHT DO THE INVESTMENT COMPARISONS YOU HAVE JUST SHOWN SHED ON THE APPROPRIATENESS OF USING HM 5.3 TO ESTIMATE VERIZON NW'S FORWARD-LOOKING COSTS OF PROVIDING UNES?

A. As I explain in detail below, because HM 5.3 provides, for example, 40 percent of Verizon NW's current pole investment, the Model automatically reduces the expenses allegedly necessary to maintain them by a corresponding 40 percent. Such an assumption is flawed. Just because AT&T/MCI believe (based on a flawed survey of vendors operating outside Washington) that poles may be cheaper does not mean that Verizon NW's expenses to maintain them will be similarly reduced. There is no plausible explanation for HM 5.3's implication that just because a carrier might get a good deal on poles, those poles would be cheaper to maintain than poles purchased at less favorable prices. Both the notion that fewer poles are required (despite the greater prominence of aerial cable in HM 5.3), and the assumption that maintenance expenses would be automatically reduced by corresponding amounts, have no merit.

Q. TABLE 3 INDICATES THAT THE TOTAL CABLE QUANTITIES PRODUCED BY HM 5.3 ARE SOMEWHAT LARGER THAN WHAT ARMIS IMPLIES. IS THE SAME TRUE FOR THE DIFFERENT TYPES OF CABLE?

A. Yes, but the deviations from current prices differ considerably for the different cable types, as shown in Table 4.

TABLE 4

Verizon NW's Actual Cable Plant Investments, Prices, and Quantities as Multiples of HM 5.3 Estimates

	Investment	Price	Quantity
Aerial	4.5	3.9	1.2
Buried	4.0	3.2	1.2
Underground	9.7	5.4	1.8

Of particular note here is the fact that HM 5.3 prices underground cable considerably lower than what Verizon NW's current investments imply. A likely explanation is that, in HM 5.3, about half of the total underground route distance is accounted for by the two lowest density zones (i.e., areas with line densities less than 100 lines per square mile). In contrast, real-world underground facilities tend to be concentrated in high-density areas. Again, relative to both reality and VzLoop, HM 5.3 appears to shift costs away from large, high-density wire centers and towards smaller areas.

Q. HOW DO HM 5.3'S COST ESTIMATES COMPARE TO THE COSTS REPORTED BY VERIZON NW IN THE FCC'S ARMIS DATA, AND TO THE COSTS ESTIMATES PRODUCED BY VzCOST?

A. A comparison of HM 5.3's monthly loop costs to Verizon NW's 2003 actual loop costs (as described in Mr. Dye's testimony),[75] and to VzCost's monthly loop costs, as shown in Table 5 below.

[75] Before the Washington Utilities and Transportation Commission, Docket No. UT-023003, *Reply Testimony of Terry R. Dye on behalf of Verizon Northwest Inc.* (April 20, 2004).

TABLE 5

	Investment	Monthly Capital Costs	Monthly Network Expenses	Other Expenses	Network + Other Expenses	Total Monthly Cost
HM 5.3	$404.44	$4.43	$.98	$2.23	$3.21	$7.64
VzCost	$1,114.84	$21.78	$6.30	$5.59	$11.89	$33.66
2003 Actual	$1,148.71	$12.38			$15.06	$27.44

Table 5 reports total loop investments, and breaks down the respective monthly costs into capital costs (i.e., depreciation, return, and taxes), network expenses (i.e., plant-specific expenses other than general support), and all other expenses.[76] While HM 5.3 produces investments and expenses that are only about one-third of Verizon NW's actual expenses, VzCost shows investments and expenses that, while somewhat different than actual values, are much closer. That is, VzCost results are clearly in line with the previously stated expectations of MCI's counsel, the United States Supreme Court, and the CLECs themselves that loop facilities do not exhibit the potential for rapid cost reduction like other network components, such as switching, and, in fact, may actually increase on a going-forward basis.

Q. PLEASE DESCRIBE SOME OF THE OTHER VALIDATION TESTS YOU HAVE CONDUCTED.

A. Another benchmark is the employment implications of the expenses estimated by HM 5.3. Table 2B shows that HM 5.3 produces total operating expenses, less depreciation, of about $64 million ($30 million for plant-specific and $33

[76] Because Mr. Dye's calculations (which are based on ARMIS data) do not conveniently identify network expenses, only the capital costs and total expenses are shown.

million for network operations, customer services, and corporate operations). These expenses would consist of compensation for the employees operating the network modeled by HM 5.3 and payments for "out-of-pocket" materials. In HM 5.3, these expenses apply to wholesale operations captured in recurring charges only (i.e., they must be attributable to UNEs). In particular, HM 5.3's assumptions imply that 48 percent of total expenses are considered wholesale.

To estimate the number of employees needed to operate HM 5.3's network, 2003 ARMIS data for Verizon NW show that: (1) compensation accounted for about 26 percent of operating expenses, less depreciation; and (2) the average compensation per employee was about $71,000 per year. Therefore, the estimated cost of labor compensation implied by HM 5.3 is ($63 million x 0.26 =) $16.8 million, and the implied number of employees would be ($16.8 million labor compensation/$71,000 per employee =) 240 employees.

In contrast, because Table 2B shows Verizon NW incurred almost three times the out-of-pocket expenses as HM 5.3 produces, Verizon NW had a labor force providing wholesale functions that was about two times that implied by HM 5.3, or about 675 employees in 2003 in Washington.[77] That is, HM 5.3's results are equivalent to a claim that an "efficient carrier" could run its wholesale operations (i.e., produce the same volumes of network elements that Verizon

[77] ARMIS Report 43-02 stated that there were about 2,500 employees for Verizon NW in 2003 (including its operations outside of Washington). Some of the efforts of these employees are for non-regulated, retailing, and non-recurring activities, the associated expenses for which I have estimated and removed from Verizon NW's actual figures.

NW provides to itself and to CLECs today) with only about one-third of Verizon NW's current labor force.

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS WITH RESPECT TO THE AFOREMENTIONED VALIDATION TESTS.

A. As shown in the summary table below, acceptance of the investment and expense levels produced by HM 5.3 requires a belief that Verizon NW: (1) could produce the same volumes of UNEs (e.g., loops and switching) with total network investment ($838 million) that is less than the amount Verizon NW spent in six years (from 1997 to 2003) just for capital *additions* to its current network ($976 million); and (2) would incur only about 35 percent of the total wholesale operating expenses and employ only about 35 percent of the employees that Verizon NW needed to operate its real-world network in 2002. This stark difference between the hypothetical blank-slate theory of HM 5.3 and the reality of Verizon NW's operations demonstrates that HM 5.3 models an entirely unrealistic network and produces substantially understated cost estimates; it in no way implies that the latter is an inefficient carrier.

TABLE 6

	HM 5.3	Verizon NW Actual
Investment	$838 million	$976 million additions (1998-2003)
Expenses Less Depreciation	$63 million	$181 million
"Wholesale" Employees	240	675

B. CONSISTENCY WITH EXPECTATIONS AND PRIOR HYPOTHESES

Q. HOW DO THE COST ESTIMATES PRODUCED BY HM 5.3 COMPARE TO THE RESULTS OF PREVIOUS RELEASES OF THE HAI MODEL?

A. Testing HM 5.3's results against general expectations and/or hypotheses implicit in previous releases of the HAI Model provides yet another validation test, which further demonstrates the absurdity of the cost estimates advocated by AT&T/MCI. As noted earlier, MCI previously noted before the United States Supreme Court that the costs of network elements not involving computer components, such as the loop, are not decreasing (and may even be increasing).[78] In direct contrast, the per-line loop costs advocated by AT&T/MCI in several Washington UNE proceedings have dramatically dropped, as shown in the following table.

TABLE 7

	Investment	Monthly Capital	Network Expenses	Other Expenses	Total
HM 3.1	$705.09	$8.87	$1.28	$4.44	$14.58
HM 5.0a	$614.93	$7.74	$1.13	$3.75	$12.62

[78] Supreme Court Argument at pp. 74-75.

HM 5.3	$404.44	$4.43	$0.98	$2.23	$7.64

Table 7 lists loop investment, annual capital costs, network expenses (plant-specific expenses other than general support), and other expenses (general support, network operations, and corporate overheads). The table shows a reduction of about 48 percent (over seven years) in the cost per loop relative to HM 3.1. AT&T/MCI's changing loop price recommendations translate into annual rates of decline of about 8.8 percent, which, as I described earlier and as MCI's counsel explained to the United States Supreme Court, simply cannot be explained by any technological developments in loop technology.

Q. WHY HAS THERE BEEN SUCH A DRASTIC REDUCTION IN LOOP COSTS BETWEEN HM 5.3 AND PREVIOUS VERSIONS OF THE HAI MODEL?

A. The overall reductions in loop costs (shown in Table 7) reflect changes to both the inputs and the Model itself. In fact, when I used inputs from the previous versions of the HAI Model in the SBC California version of HM 5.3 (a daunting task that was probably only an approximation because of the differences in the number, definitions, and formats of the inputs),[79] HM 5.3 produced somewhat higher investments than the earlier versions, suggesting that, while HM 5.3 may produce more outside plant facilities, any cost increase associated therewith has been more than offset by equipment price reductions, such as Mr. Donovan's very understated cable price recommendations. Indeed, when HM

[79] Before the California Public Utilities Commission, Application Nos. 01-02-024 et al., *Reply Declaration of Timothy J. Tardiff filed on behalf of SBC California* (Feb. 7, 2003) at pp. 34-35.

3.1's cable costs are used in HM 5.3, the investment per line increases to $634 (compared to the $404 and $705 for HM 5.3 and HM 3.1 shown above), and when HM 5.0a's cable costs are used with HM 5.3, the investment per line increases to $572 (compared to the $404 and $615 for HM 5.3 and HM 5.0a shown above). That is, a large portion of the change in costs between successive versions of the HAI Model appear to be the result of Mr. Donovan's changing engineering and installation labor estimates.

Q. IN PARTICULAR, WHY DO HM 5.3'S REDUCTIONS IN LOOP COSTS DEFY COMMON SENSE?

A. As AT&T/MCI have recognized in other contexts, labor accounts for substantial amounts of the investment in loop facilities; and labor costs are not decreasing.[80] Another major component of loop plant -- copper cable -- has experienced recent price increases as well. The average monthly price of copper increased from $0.76 to $1.34 between March 2003 and March 2004.[81] Indeed, when the FCC developed the expense factors used by HM 5.3, it *increased* book investments for loop investment categories when it estimated the cost of current loop plant, as my results in Table 2A illustrate. If loops cost

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[80] . . . [t]here is no reason why economic depreciation need conform to a pattern by which loss in plant value is most severe early and trails off late. While certain pieces of electronic telecommunications equipment (e.g., digital circuit equipment) may display such a characteristic, other pieces (e.g., copper or fiber cable, conduit systems) may not. Because of increases in engineering costs over time, such equipment may enjoy economic appreciation effects that attenuate any loss in value due to physical wear and tear.

Before the Federal Communications Commission, WC Docket No. 03-173, *Declaration of John C. Klick* (Dec. 16, 2003) at ¶ 107 ("FCC Klick Decl.").

[81] In 1997 (when AT&T/MCI offered HM 3.1 to this Commission), the copper price was about $1.07. The ups and downs in copper prices since then indicate that there is no reason to expect this component of loop costs will decline..

were decreasing, one would expect to see the current cost lower than the book cost, as illustrated by digital switching.

Q. IS THERE ANY HISTORICAL PRECEDENT FOR THE HUGE COST REDUCTIONS HM 5.3 IMPLIES?

A. No. In an attempt to demonstrate that such huge differences between the cost estimates produced by HM 5.3 and Verizon's actual costs are reasonable, AT&T/MCI have cited to the railroad industry and interstate long-distances prices to support their contention that HM 5.3's implied reductions to ILEC costs are not unreasonable.[82] However, rather than support the putative cost reductions that HM 5.3 claims are feasible, the railroad experience undermines such a claim. Indeed, those statistics show that railroads reduced their *real* (inflation adjusted) costs (as measured by total expenses per output) over a *twenty-year period* by less than what AT&T/MCI claim could happen *overnight* for Verizon NW. In addition, Mr. Klick's comparison with the railroad industry is not germane for two additional reasons. First, it is likely that much of the improved performance for railroads was the result of their shedding much of their (presumably unprofitable) network, a luxury not available to ILECs such as Verizon NW. Second, while the railroad gains reflect the full effect of deregulation, the potential for comparable gains in telecommunications is much less because of the long history of price cap regulation, and the fact that ILECs have been subject to increasing amounts of competition over the years. Both effects indicate that Verizon NW is already operating at reasonably efficient levels; and thus, immediate 70-percent cost reductions are totally unrealistic. Similarly, Mr. Klick reports that real long-distance prices decreased by 23 to 41 percent after deregulation. However, a substantial proportion of this reduction is attributable to the FCC's contemporaneous reduction in access charges. When this effect is removed, the resulting reduction in real long-distance prices (net of access changes) was actually smaller than the real reduction in local telephone prices (net of subscriber line charges).[83]

C. THE FCC'S SYNTHESIS MODEL DOES NOT VALIDATE HM 5.3

Q. HOW DO THE RESULTS OF THE FCC'S SYNTHESIS MODEL COMPARE TO THOSE OF HM 5.3?

A. Dr. Bryant describes some purported similarities between the FCC's Synthesis Model and HM 5.3 in an apparent attempt to lend credibility to the latter.[84] In actuality, however, the Synthesis Model produces substantially higher loop costs (close to $19 per month and $876 investment per loop) when it is applied in a manner similar to that developed by the FCC for use in Section 271 proceedings.[85]

(...continued)

[82] *See, e.g.,* FCC Klick Decl. at ¶¶ 111-15.

[83] Before the Federal Communications Commission, WC Docket 03-137, *Declaration of Howard Shelanski and Timothy Tardiff on the review of rules for pricing unbundled network elements, prepared for filing with the Federal Communications Commission on behalf of Verizon*, (Jan. 30, 2004) at ¶ 14.

[84] Bryant Direct Testimony at pp. 16-17.

[85] In particular, I used the FCC's default inputs for pct_1 sa and pct_DS-1 that assume two copper pairs per DS-1 service to make a comparable adjustment to the number of business and special access lines.

Equally important, as MCI's counsel explained to the United States Supreme Court:

> The investment [from the Synthesis Model] is too low. And the FCC specifically said it was too low…because it's designed to calculate universal service subsidies at the very most basic low level.[86]

Consequently, any "fixes" developed for the FCC Synthesis Model's low investment problem would only widen the gap between the UNE cost estimates produced thereby and those calculated by HM 5.3. Contrary to Dr. Bryant's assertions, rather than validate HM 5.3, the FCC Synthesis Model confirms how incredibly understated the former's cost estimates truly are.

VI. MAJOR CHANGES IN OUTSIDE PLANT LABOR REQUIREMENTS

Q. WHAT CHANGES, IF ANY, HAVE BEEN MADE TO HM 5.3'S MATERIAL PRICE INPUTS?

A. The bulk of the material price inputs are presented in Mr. Donovan's testimony. While Mr. Murphy evaluates them from an engineering perspective, I focus on the labor requirement implications of the changes to these inputs. Apart from the inputs for cable investment, digital loop carrier ("DLC") line cards, and CEVs, Mr. Donovan presents the many materials prices that have not changed among the various releases of the HAI Model. Since one would expect that general inflation in labor and materials would increase outside plant materials prices, by maintaining the same prices AT&T/MCI are able to produce significantly understated cost estimates. Indeed, for the investments in loop

[86] Supreme Court Argument at p. 74.

plant produced by HM 5.3, cable accounts for about 27 percent, DLC equipment for about 29 percent, and the materials for which Mr. Donovan maintained previous inputs (support structures, terminals, drops, NIDs, and SAIs) for 44 percent of the total loop investment.

Q. PLEASE DESCRIBE THE CHANGES MADE BY MR. DONOVAN TO HM 5.3'S CABLE INVESTMENT INPUTS.

A. With regard to Mr. Donovan's new inputs for cable, he has replaced input prices that combined materials, engineering, and labor with separate materials prices (which he describes as coming from a Florida decision) and separate estimates of the labor necessary to engineer and install cable. As shown in Table 8 below, Mr. Donovan has assigned substantially less cost to labor in HM 5.3 than he recommended in previous versions of the HAI Model. For cable sizes larger than 200 pairs, there is an even larger reduction relative to the cable labor assumed in HM 3.1. The following table presents the comparison for copper cable.[87]

[87] The HM 5.3 installed cable prices can be produced by interrupting an HM 5.3 run at the point the distribution module is fully populated. The labor component is the difference between these total prices and the materials prices presented in Mr. Donovan's testimony. The labor components differ by type of placement. In order to facilitate a comparison with the HM 5.0a and HM 3.1 inputs (which do not differ by type of placement), I weighted them by the proportion of cable investment produced by HM 5.3 for each type: 41 percent aerial, 51 percent buried, and 8 percent underground. For HM 5.0a's inputs (which are the same as cable costs in the later HM 5.2a), AT&T/MCI provided materials prices in response to Data Request 13-25 in the recent California UNE proceeding. Before the California Public Utilities Commission, Docket R. 93-004-03/I. 93-004-02, *Joint Commentors' Responses to Verizon's Thirteenth Set of Data Requests* (Nov. 7, 2002) at Response No. 13-25. These were subtracted from the HM 5.0a default cable prices. For the HM 3.1 cable inputs, labor costs were assumed to be 60 percent of the total installed cost.

TABLE 8

HM Copper Cable Labor Costs Inputs ($ per foot)

Size	HM 5.0a	HM 3.1	HM 5.3	% reduction between 5.0a and 5.3	% reduction between 3.1 and 5.3
4200	$8.12	$44.55	$1.28	84.2%	97.1%
3600	$8.06	$38.25	$1.15	85.7%	97.0%
3000	$8.00	$31.95	$1.01	87.3%	96.8%
2400	$7.94	$25.65	$0.88	88.9%	96.6%
1800	$6.88	$19.35	$0.75	89.2%	96.1%
1200	$5.82	$13.05	$0.61	89.5%	95.3%
900	$5.29	$9.90	$0.54	89.7%	94.5%
600	$4.51	$6.75	$0.48	89.4%	92.9%
400	$3.74	$4.65	$0.43	88.4%	90.7%
200	$2.55	$2.55	$0.39	84.8%	84.8%
100	$1.50	$1.50	$0.37	75.6%	75.6%
50	$0.98	$0.98	$0.35	63.8%	63.7%
25	$0.71	$0.71	$0.35	50.9%	51.2%
12	$0.58	$0.58	$0.35	40.4%	40.4%
6	$0.51	$0.51	$0.34	32.5%	32.5%

Such large decreases in labor costs are simply implausible.

Q. HAVE YOU ATTEMPTED TO VALIDATE MR. DONOVAN'S PROPOSED CABLE LABOR INPUTS IN ANY OTHER WAY?

A. Yes. Another benchmark for Mr. Donovan's proposed cable labor inputs is to determine their labor force implications. To do this, I compared the cable investment produced by HM 5.3 to an alternate run in which the cable labor rates were changed from the default rate of $60 to zero. The $31 million difference in cable investment between the runs is the total labor payments for engineering and installing all distribution and feeder cables (including DS-1 and DS-3). At a rate of $60, this means about 260 employees would be able to engineer, splice and place on poles and in buried or underground facilities all the cable necessary to serve Verizon NW's customers throughout the state of Washington in one year -- a plainly unrealistic proposition. In other words, within one year, these hypothetical employees could purportedly design and place every piece of cable in every neighborhood in every city where Verizon NW's 1.1 million loops are located.

Although not as convenient, it is also possible to estimate the labor expenditures for installing other outside plant facilities (e.g., NIDs, drop wire and terminals, support structures, and DLC equipment).[88] The result was a total of about $68 million, which is equivalent to less than 570 person years. That is, within one year, fewer than 600 employees supposedly would be able to place every NID, drop wire and terminal, erect all poles, dig every trench, and place all DLC equipment in every neighborhood in every city where Verizon NW's 1.1 million loops are located. Again, such assumptions are simply implausible.

Q. HOW DO THE FCC'S SYNTHESIS MODEL'S CABLE PRICES COMPARE TO THE CABLE PRICES MODELED BY HM 5.3?

A. The cable prices estimated by the FCC's Synthesis Model are approximately double the cable prices modeled by HM 5.3. In fact, since cable investment accounts for a substantial proportion of total loop investment, the FCC's inputs would obviously produce much higher loop costs regardless of the model in

[88] For underground and buried trenching, and SAIs, I used the labor content percentages provided in the HAI Inputs Portfolio ("HIP") (*see* Mercer Supplemental Direct Testimony at Attachment RAM-5, p. 162) to separate labor costs from materials. The manhole labor content was based on the HIP at pages 90 and 93. The labor content for DLC common equipment was based on Mr. Donovan's estimates in the SBC California proceeding. Before the California Public Utilities Commission,
(continued...)

which they are used. Indeed, using the FCC's copper and fiber cable investment inputs (with no other input changes) in place of HM 5.3's inputs increases the investment per loop from $404 to $502 -- a result that increases the monthly cost by 25 percent from $7.64 to $9.54. In a recent UNE proceeding in Pennsylvania, the prices used in the Synthesis Model were endorsed by Mr. Riolo,[89] one of the original (and current) members of the HAI Model's engineering team.[90] It is inconceivable that any recent real-world changes can explain the large reduction in cable prices that AT&T/MCI assert are TELRIC-compliant in the instant proceeding.[91]

VII. SPECIFIC MODELING ISSUES

A. HM 5.3 IS NOT "INTEGRATED" AS AT&T/MCI ALLEGE

Q. DO YOU AGREE WITH DR. MERCER'S ASSERTION THAT HM 5.3 BENEFITS FROM THE INTEGRATION OF ITS VARIOUS COMPONENTS?

A. No. In listing the purported advantages of HM 5.3, Dr. Mercer claims that the various components of the Model -- i.e., ordinary POTS loops, high-capacity loops, feeder facilities, end-office switches and interoffice facilities -- are

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(...continued)

Application Nos. 01-02-024 et al., *Declaration of John C. Donovan in support of Joint Applicants' Rebuttal Comments* (Mar. 12, 2003) at p. 20.

[89] Before the Pennsylvania Public Utility Commission, *Direct Testimony of Joseph P. Riolo On Behalf of AT&T Communications of Pennsylvania, Inc. and MCI WorldCom Network Services, Inc.* (Dec. 7, 2001) at p.13. Mr. Riolo lowered the fiber cable investment inputs, but only for interoffice facilities.

[90] Mr. Donovan reported that he had consulted with Mr. Riolo in preparation for the filing of HM 5.3 in this proceeding. Before the Washington Utilities and Transportation Commission, Docket No. UT-023003, *Joint Responses of AT&T and MCI to Verizon's Second Set of Data Requests* (Aug. 4, 2003).

integrated within HM 5.3.[92] As a threshold matter, any benefits from allegedly integrating various components are far outweighed by the highly abstract and inaccurate nature of the Model. The mere existence of "bells and whistles" that ostensibly make the Model more sophisticated are of minimal value when the overall Model is unreliable.

In fact, Dr. Mercer's assertion is overstated and the supposed benefits of integrating components such as loop facilities, end-office switches, and interoffice facilities are illusory. HM 5.3's lack of integration is demonstrated most notably by: (1) TNS's creation of clusters completely separate from, and entirely outside of, HM 5.3; and (2) the lack of integration between feeder, distribution, and interoffice support structure, as discussed below. Indeed, it seems impossible to "optimize" feeder plant and interoffice facilities -- both of which are assumed to share 75 percent of their common support structure -- when the former is determined by the TNS preprocessing, and the latter are subsequently produced by an undocumented Visual Basic program.

Yet another example of the un-integrated nature of the Model is provided by HM 5.3's modeling of interoffice transmission facilities. HM 5.3 assumes that such facilities are 29 percent aerial, 27 percent buried, and 44 percent underground *in every zone* -- there is absolutely no variation between zones. Accordingly, even in the two highest density zones where facilities would

(...continued)

[91] In fact Mr. Murphy reports that no "…significant changes in methods, procedures or technologies…" related to cable placement have occurred in about 25 years. Murphy Reply at p. 112.

[92] Mercer Supplemental Direct Testimony at p. 12.

normally be in underground conduit, HM 5.3 assumes that 56 percent of interoffice facility structure is on poles or simply buried in trenches (and the price per foot is the same as what the Model assumes for the lowest density for distribution and feeder structure).

In addition, like the overall Model itself, Dr. Mercer's alleged "integration" is represented in a highly abstract manner -- e.g., by simply assuming certain percentages of feeder structure can be shared with distribution. The Model does not attempt to identify common routes where structure might be shared.[93] For example, in larger distribution areas, there would likely be many streets with distribution cables that do not overlap with the single sub-feeder route depicted by HM 5.3; therefore, the route sharing opportunities are proportionately smaller than for areas with fewer distribution routes.

Q. HOW MUCH IMPACT DOES HM 5.3'S ATTEMPT AT INTEGRATION HAVE ON THE COSTS AT&T/MCI HAVE PROPOSED IN THIS PROCEEDING?

A. Very little. Dr. Mercer's emphasis on integration stems from his apparent belief that there are large savings to be had when different components of the network (e.g., feeder and distribution) share structure (e.g., telephone poles and buried trenches). To test whether this was the case in HM 5.3, I ran two scenarios that removed all of the sharing assumptions from HM 5.3. Specifically, I changed the inputs that assume sharing between distribution and feeder, and between feeder and interoffice routes, from their defaults of 55

[93] Before the California Public Service Commission, Docket R. 93-004-03/I. 93-004-02, *Workshop Transcript* (Jan. 15, 2004) at p. 3563.

percent and 75 percent sharing, respectively, to zero. As a result, the loop cost increased only slightly from $7.64 to $7.77, and the total cost of network elements (which would reflect the cost of both input changes) increased a comparably minimal amount, from $14.58 to $14.84.[94] To test the impact of structure sharing between POTS and high-capacity facilities, I changed the HM 5.3 database so that all high-capacity lines had zero demand. Removing this facilities' sharing -- in other words, effectively assigning all structure costs to ordinary loops -- again increased the loop cost a minimal amount (from $7.64 to $7.69).[95] The practical consequence of the minimal impact of these highly-touted features is that their presence plainly demonstrates the unreliable, and fundamentally flawed, nature of HM 5.3.[96]

Q. ARE THERE OTHER FEATURES THAT DR. MERCER DEEMED "HIGHLY SOPHISTICATED" THAT HAVE A EQUALLY MINIMAL IMPACT ON COSTS?

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94 The minimal impact could be due, in part, to the fact that the Model produces the illogical result that when the amount of sharing of interoffice structure with other utilities is reduced (i.e., Verizon NW purportedly incurs more of these costs), both the investment and monthly cost of an ordinary loop *decrease*. For example, when the proportion of sharing with other utilities decreases from the default assumption of 67 percent to no sharing, loop investment per line decreases from $404 to $398; and the corresponding monthly cost is reduced from $7.64 to $7.54.

95 As Staff witness Spinks observes, the explicit treatment of high-capacity loops in HM 5.3 distinguishes the Model from previous versions, e.g., such as HM 5.2a. The representation of high-capacity loops as multiple ordinary loops in the earlier versions of the substantially reduced ordinary loops costs, perhaps leading its proponents to the conclusion that HAI Model there should be large savings from sharing structures.

96 An exhaustive explanation of why the inclusion of high-capacity loops has such a modest impact on ordinary loop costs would have to consider, among other things, the interactions among: (1) the impact of the flawed representation of how high-capacity loops are assumed to share outside plant and DLC facilities with ordinary loops (as described by Mr. Murphy), (2) the assumed levels of structure sharing with other utilities, and (3) the inputs used for structure and cable, particularly Mr. Donovan's estimates of engineering and installation labor.

A. Yes. Part of the basis for Dr. Mercer's assertion that HM 5.3 is "highly sophisticated"[97] appears to be the Model's dubious "optimization" feature, as well as other, similarly flawed, modeling techniques. However, as with the sharing assumptions discussed above, these features have minimal to no effect on cost. For example:

- The feature that is designed to optimize between aerial and buried placement[98] only reduces loop costs by a miniscule amount (0.08 percent).
- Ignoring terrain effects,[99] by setting them to the most favorable conditions everywhere, causes only a 0.52 percent decline in loop costs, resulting in little more than a four-cent change in unit costs.

In summary, some of the specific features that HM 5.3's sponsors have touted as extremely beneficial appear to be of minimal importance. In particular, HM 5.3's lack of sensitivity to how much sharing might take place between various parts of the network clearly implies that AT&T/MCI's attempts to use such features to demonstrate the superiority of HM 5.3 over VzCost are essentially meaningless.

[97] Mercer Supplemental Direct Testimony at pp. 5, 30-31.

[98] Mercer Supplemental Direct Testimony at RAM-4 (HIP) at pp. 34-36.

[99] Mercer Supplemental Direct Testimony at RAM-4 (HIP) at pp. 40-42.

B. SPECIFIC EXAMPLES WHERE THE HM 5.3 CALCULATIONS PRODUCE INSUFFICIENT AND/OR INACCURATE INVESTMENT

1. SAI SIZE LIMIT OPTION

Q. PLEASE DESCRIBE HM 5.3'S NEW OPTION TO LIMIT THE MAXIMUM SIZE OF AN SAI.

A. Although AT&T/MCI recommend the use of large SAIs and large RTs or CEVs, HM 5.3 provides an option to limit the size of SAIs.[100] In contrast to the typical placement of the SAI at the center of a distribution area, HM 5.3 purportedly can now place multiple, smaller SAIs within a given cluster.[101] Curiously, Mr. Donovan has reported that this option would either modestly increase cost,[102] or have a slight impact in either direction.[103]

Q. DOES LIMITING THE MAXIMUM SIZE OF THE SAI HAVE THE EFFECT MR. DONOVAN EXPECTED?

A. No. Invoking the SAI size limit option produces a loop cost of $7.26, noticeably lower than HM 5.3's default result of $7.64. Similarly, the average investment per loop decreases from $404 to $386, with the change due to puzzling

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[100] Model Description at p. 40. It should be noted, however, that a meaningful limit on RT capacity within distribution areas cannot be implemented within HM 5.3, but can only be imposed by re-running the TNS clustering process.

[101] Mr. Murphy explains in detail why this option does not work and the counterintuitive results produced when the option is invoked. *See also* Murphy Reply Testimony for an explanation of why smaller clusters should produce increased feeder lengths but no change in distribution length.

[102] Before the California Public Utilities Commission, Application Nos. 01-02-024 et al., *Workshop Transcripts* (June 25, 2003) at p. 655.

[103] Before the California Public Utilities Commission, Docket R.93-04-003/I.93-04-002, *Workshop Transcripts* (Jan. 15, 2004) at p. 3639.

reductions in distribution cable and RT investments. This outcome strongly suggests that the option has not been properly implemented, and may be the product of input and/or algorithm errors.

2. SAI CAPACITY

Q. DOES HM 5.3 MODEL SUFFICIENT SAI CAPACITY?

A. No. Mr. Donovan's definition of distribution fill is the ratio of customer lines in a cluster to the number of pairs in the backbone cables that terminate at the SAI. Presumably, in order for those pairs to be available as spare capacity, there needs to be room at the SAI to connect them. For example, if a distribution area were served with two 600-pair backbone cables and the (sub) feeder cable was 900-pair, the SAI would need a capacity of at least 2,100 pairs (2 x 600 + 900). However, the formulas used in HM 5.3 do not insure that the required SAI capacity is provided.

For example, consider Cluster 2 in the ACME wire center. The relevant characteristics are as follows:

Total lines: 397

Total Households: 265

Total non-residential lines:[104] 61

Calculated distribution fill: 49.6%

Feeder sizing factor: 80%

[104] In sizing the SAI, HM 5.3 counts each business, voice-grade dedicated circuit, ISDN, and dedicated ASDL line as one line, and each DS-1 as two non-residential lines.

HM 5.3 produces the required SAI line capacity by multiplying the number of households by 3.5 and the number of non-residential lines by 2 (i.e., 3.5 x 265 + 2 x 61 = 989). HM 5.3 then utilizes the next largest SAI size of 1,200.

The calculated distribution fill implies that 800 lines terminate at the SAI on the distribution side (397/0.496). Applying the 80 percent feeder-sizing factor produces a required capacity of 497 lines, which requires a 600-pair feeder cable. Thus, there would be an SAI capacity shortfall of 200 lines in this example (800 + 600 – 1,200).

The situation illustrated by this example is very common: 551 of the 829 main clusters produced by the Model have SAIs that are too small to handle the distribution and feeder cables that are supposed to meet at the SAI. Importantly, these clusters account for over 1.02 million of the approximately 1.06 million lines modeled by HM 5.3.

Q. IS THERE ANOTHER WAY TO ILLUSTRATE THE INADEQUATE SAI CAPACITY?

A. Yes. HM 5.3's achieved fills are approximately 50 percent for distribution and 80 percent for feeder. Putting aside the insufficiency of such fills, the fact is, the capacity implied by these figures is only available if all of the pairs can terminate at the SAI. In particular, the SAI must have space for about 2 connections at the distribution side (1/0.5) and 1.25 at the feeder side (1/0.8), or about 3.25 overall. Therefore, the total SAI capacity required to accommodate Verizon NW's 1.06 million lines is about 3.5 million connections. HM 5.3, in contrast, provides only 2.6 million connections.

Q. CAN A USER CHANGE AN INPUT TO PROVIDE MORE SAI CAPACITY?[105]

A. No. There are no inputs that allow the user to adjust SAI capacities. Accordingly, the under-sizing of SAIs cannot be fixed short of changing specific formulas in HM 5.3. Consequently, the reported achieved distribution and feeder fills, which are themselves unrealistically high, cannot be realized because all pairs cannot be connected at the SAI.

Q. ARE THERE PARTICULARLY EXTREME EXAMPLES OF INADEQUATE SAI CAPACITY?

A. Yes. HM 5.3 assumes that 8 clusters are "high-rise" buildings, which range in size from a "building" of 62 floors in the Everett (XC) wire center[106] to a "high rise" of a single story.[107] For these clusters, HM 5.3 assumes that there is an indoor SAI in the basement of a building and riser cables within the building. As Mr. Murphy explains in detail, HM 5.3 therefore places only 8 indoor SAIs throughout Verizon NW's entire territory, and, in the process, reduces costs by substituting low-cost aerial distribution structures for costly underground feeder facilities in high density areas.

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[105] In the SBC California UNE proceeding, ALJ Duda requested a table that contained, among other items, the achieved SAI fill. This request required special calculations with HM 5.3's intermediate output, similar to my analysis here. For that exercise, AT&T/MCI defined the SAI fill as the ratio of twice the number of lines to total SAI capacity. This definition would produce an astounding 83 percent fill for Verizon NW.

[106] Notably, the New Jersey Board cited the HAI Model's anomalous treatment of high-rise buildings (i.e., its erroneous representation of extremely tall buildings) as one of its main reasons for rejecting the model. New Jersey Order at p. 25.

[107] HM 5.3 estimates the size of a high-rise building by first assuming its footprint is 8,000 square feet. It next estimates the required floor space by assuming that each household requires 1,500 square feet and each employee requires 200 square feet. The required floor space is then divided by the building's footprint to estimate the number of stories. Model Description at p. 34.

Further, in all such buildings, the indoor SAIs are too small to accommodate the feeder and riser cable that need to be joined. The most extreme example is the "high-rise" building in Everett (XC) of one story. It is equipped with a 50-line SAI (typically sufficient for under 20 working lines), yet contains 551 lines.

3. STRAND-DISTANCE CONSTRAINT

Q. WHAT PROBLEMS, IF ANY, HAVE YOU AND VERIZON NW'S OTHER WITNESSES ENCOUNTERED WITH HM 5.3'S STRAND DISTANCE CONSTRAINT?

A. As Mr. Dippon describes, in low-density areas, a fundamental problem arises when irregularly shaped clusters formed in TNS's preprocessing stage are converted into rectangles of the same area for use in HM 5.3's distribution module. The FCC recognized this, finding that:

> HAI's approach of designing plant to simplified customer locations within rectangularized serving areas, instead of to actual customer locations, could result in a systematic underestimation of outside plant costs … The HAI Model also sacrifices accuracy by assuming that customers are dispersed uniformly within its distribution areas … We agree that inaccuracies may be introduced by modifying the geographical boundaries of distribution areas and the location of customers within those areas for purposes of constructing outside plant.[108]

The Florida Commission reached an almost identical conclusion:

> ….HAI has certain defects and we cannot recommend reliance on its cost estimates. While the HAI Model starts

[108] Fifth Report and Order, *In re Federal-State Joint Board on Universal Service, In re Forward-Looking Cost Mechanism for High Cost Support for Non-Rural LECs*, 13 FCC Rcd 21323, ¶¶ 57-58 (1998) ("Fifth Report and Order").

> out with data on actual customer locations, *it disregards much meaningful information and chooses not to build plant to any of these known sites*. Instead, for modeling convenience, what began as irregular polygons reflecting natural customer groupings were transformed into regular rectangles. Unfortunately, this step appears to have introduced a downward bias into the model.[109]

Despite the fact that the Model's proponents seem to have been ambivalent on the use of the strand distance,[110] to address this problem, the Model now includes an option that adjusts the distribution distance to the strand distance (a form of "minimum spanning tree" ("MST") distance).[111] In addition, although the option was introduced to address regulators' concerns about *insufficient* facilities in low-density areas (thus producing costs that are too low), using the option has typically *reduced the estimated costs* in higher density areas. Indeed, for Verizon NW, the constraint decreases both total route distance (from 83.8 million to 80.6 million feet) and the resulting estimated loop cost (from $8.18 to $7.64). More importantly, if anything, HM 5.3's use of the

[109] Before the Florida Public Service Commission, Docket No. 960949B-TP, *Final Order on Rates for Unbundled Network Elements Provided by Verizon Florida* (Nov. 15, 2002)at pp. 11-12 (emphasis added).

[110] In earlier versions of the HAI Model, its proponents expressed strong reservations about the usefulness of the strand distance adjustment: "Setting the switch 'off' would be consistent with the HAI Model developers' strong reservations about the usefulness of the MST [minimum spanning tree] as an indicator of what the DRD [distribution route distance] should be." Before the Massachusetts Department of Telecommunications and Energy, D.T.E. 01-20, *Direct Testimony of Robert A. Mercer on behalf of AT&T* (May 8, 2001) at RAM-3 (HAI Model Release 5.2a-MA Inputs Portfolio) at Section 2.13.1, p. 47. This qualification has been removed from the current version of the HM 5.3 Inputs Portfolio.

[111] The MST distance is a construct from graph theory. A spanning tree is a set of line segments that connect every point in a dispersion of points, simply drawing a line from one point to another. Dr. Mercer reports that these lines are based on right-angle routing. The MST for a set of points is the set of connecting line segments whose total length is the shortest possible for the given set of points. The MST distance is a measure of the dispersion of a set of points, and is provided in the cluster database by TNS.

strand distance makes the distribution clusters less representative of the areas in which Verizon NW's actual customers live.

Q. WHAT OTHER PROBLEMS ARE ASSOCIATED WITH THE MODEL'S USE OF THE MST ADJUSTMENT?

A. The Model's MST adjustment only serves to further distort the clusters modeled by HM 5.3. HM 5.3's distribution module calculates the ratio of the unadjusted distribution distance produced by the Model to the MST distance. All distribution distances (e.g., cable lengths and associated support structure distances) are scaled by this ratio. The associated investment and expenses for distribution plant are then based on these scaled distances. As a result, the MST adjustment distorts all of the clusters (and implicitly the customer locations within the clusters) modeled by HM 5.3 -- a fact that only exacerbates the clusters' distortion of actual customer locations identified by Mr. Dippon and recognized by the FCC and the Florida Commission. For example, when the MST adjustment calls for less cable than the Model would have provided absent the adjustment, the rectangular clusters are compressed along both dimensions. In the process, customers are in effect packed into smaller, higher density lots. Conversely, when the strand distance exceeds the calculated route distance, the cluster in effect expands and potentially overlaps with adjoining clusters. Mr. Dippon provides maps that illustrate these phenomena.

Q. IS HM 5.3'S EXPANSION AND COMPRESSION OF DISTRIBUTION FACILITIES THROUGH THE STRAND DISTANCE ADJUSTMENT A

REASONABLE APPROXIMATION OF HOW FACILITIES ARE PLACED WITHIN DISTRIBUTION AREAS?

A. No. Unlike the abstract "grill," which then is scaled up or down to match TNS's strand distance, in the real world, cables are routed, and the specific sizes of the cables linking the distribution terminals to the SAI are chosen to fit the unaltered layout of a distribution area. HM 5.3's modeling techniques thus represent a significant break from reality. As Mr. Dippon describes in detail, while the TNS clustering process results in clusters with irregular areas, HM 5.3: (1) distorts these areas into rectangles; (2) essentially assumes that locations are evenly distributed over the rectangles; (3) builds a specific grid of backbone and branch cables to fill the rectangle;[112] and (4) at the end of the process, attempts to impose a semblance of realism by forcing the total length of the grid to match TNS's strand distance measure. In the process, the Model either shrinks or expands the entire grid (cable sizes and all), with no regard as to how the locations originally included in the cluster could actually be connected.

In contrast, VzLoop produces a much more realistic representation of these routes than does HM 5.3's abstract "grills."[113] Verizon's cost model starts

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[112] At this stage of the process, distribution cables run one lot length or width short of the edges of the rectangle.

[113] HM 5.3's proponents frequently assert that the Model's representation of distribution areas reasonably approximates how the FCC's Synthesis Model treats distribution areas. Bryant Direct Testimony at p. 16. This is false. In fact, VzLoop comes much closer to what the FCC's Synthesis Model intends to accomplish than does HM 5.3. VzLoop and the Synthesis Model both start with measurements of where distribution terminals are located and where those terminals are assigned to specific SAIs. Both models then design plant to these locations without any distortions (e.g.,
(continued...)

with the actual locations of the distribution terminals and the specific SAIs to which those terminals are assigned. It then designs plant to these locations without any distortions (e.g., it does not assume that customers are evenly dispersed over perfect rectangles, as HM 5.3 does). Further, unlike HM 5.3, VzLoop has specific information on the type of structure (e.g., buried or underground) that would be used to connect locations within distributions areas, thereby producing a much more realistic depiction of Verizon NW's forward-looking network.

Q. ARE THERE ANY SPECIFIC PROBLEMS CAUSED BY HM 5.3'S EXPANSION AND COMPRESSION OF DISTRIBUTION FACILITIES THROUGH THE STRAND DISTANCE ADJUSTMENT?

A. Yes. Mr. Murphy identified numerous instances where HM 5.3 produces copper loop distances that exceed the purported maximum threshold. This error arises from the fact that, while HM 5.3 is designed to prevent such occurrences, the requisite safeguards are only invoked *before* distances are scaled by the strand distance. For example, when the dimensions of a rectangular cluster would produce excessively long copper lengths, HM 5.3 divides such clusters into two or four smaller clusters. In effect, clusters that "pass" such tests before the

(...continued)

assuming that customers are evenly dispersed over perfect rectangles, as HM 5.3 does). In fact, viewed in this light, VzCost is an improvement over the FCC's approach in a number of ways: (1) it has better and more up-to-date information on where distribution terminals are located (the Synthesis Model, at best, only approximates such locations through its use of surrogate customer locations that are several years old); (2) the assignment of terminals to SAIs reflects real-world engineering and design considerations, rather than the workings of an abstract clustering algorithm; and (3) VzLoop (continued...)

strand distance adjustment applies now "fail" the tests subsequent to the adjustment. As a result, the network facilities designed by HM 5.3 are faulty from an engineering perspective.[114] By the same token, the compression of other clusters means that some clusters that are deemed to require DLC equipment prior to applying the strand distance adjustment would qualify for all-copper treatment afterwards (e.g., the maximum loop length in the cluster would be less than the threshold). In fact, clusters whose loop lengths are under the relevant thresholds for the provision of DLC (and do not have outliers attached) account for about 12 percent of Verizon NW's lines. In short, the expansion and compression induced by the strand distance adjustment seriously distort not only the outputs of the Model, but also the engineering rules the Model was intended to represent.[115]

(...continued)

has specific information on the type of structure (e.g., buried or underground) that would be used to connect locations within distributions areas.

[114] Although HM 5.3 deploys DLC facilities in instances where copper lengths are excessive, this does not remedy the problem -- copper distribution lengths can still exceed the maximum.

[115] A similar flaw in the workings of the strand distance adjustment is illustrated by changing the distribution module (Column Q) so that the number of locations to which the Model builds loop plant matches the number of locations in the TNS database. As Mr. Dippon explains, HM 5.3 compresses locations determined by TNS into a smaller number of "lots," which would intuitively seem to produce lower costs, because the effect of increasing lots would seem to be an increase in both the lengths of backbone and branch cables (because the decrease in lot size that accompanies the increase in the number of lots brings cables closer to the edge of the rectangular clusters) and a possible increase in the number of branches (smaller lots may mean that more "roads" are needed). In fact, the opposite is true -- increasing the number of lots results in a decrease in loop cost from $7.64 to $7.53. And increasing the number of lots causes a decrease in the number of DLC (fiber-fed) lines, as well as decreases in the distribution and DLC investments per line, which are partially offset by an increase in feeder investment.

These anomalous results are a consequence of the strand distance constraint. When more branches are needed, the proportion of distance accounted for by the typically smaller (in terms of number of pairs) branch cables increases. Therefore, the average cable cost per unit of distance decreases. And, because the strand-distance constraint causes the total distribution distance to be the same in the two scenarios, cable costs are lower when there are more lots.

(continued...)

4. INTEROFFICE FACILITIES

Q. PLEASE DESCRIBE HM 5.3'S APPROACH TO MODELING INTEROFFICE FACILITIES.

A. HM 5.3 produces unit costs for interoffice transport UNEs based on its representation of the network components that link Verizon NW's end-office switches to each other, to tandem switches, and to interexchange carriers' ("IXC") points-of-presence ("POPs"). The Model depicts 13 ring systems, one for each of the tandems (or pseudo tandems) modeled by HM 5.3.[116] Each of these ring systems actually consists of several rings that are linked together, either because the tandem is part of multiple rings or by intrabuilding fiber links that join the remaining rings in the system. These rings can contain up to 16 nodes.[117]

HM 5.3 purportedly designs "optimal" interoffice routes, which are the product of a 35-page, undocumented Visual Basic program that supposedly is

(...continued)

The explanation for the decrease in DLC lines (and the concomitant decrease in DLC investment per line) is somewhat similar. The increase in the number of branches (as well as the increased length of branch and backbone cables before the strand distance constraint is imposed) means that the multiplier that either expands or shrinks the "grill" is smaller when there are more lots. This, in turn, reduces the maximum distance from the SAI. Therefore, there are clusters for which the maximum copper length is exceeded (and therefore fiber feeder is deployed) when the default number of lots is used, but the maximum distance is not exceeded and copper feeder is deployed when there are more lots (because the "grill" is smaller in area). The increase in feeder costs in these cases results from the fact that for a given number of loops, fiber cable is cheaper than copper cable.

[116] The Model considers the following wire centers as the tandem locations for the 13 ring systems: Blaine, Everett, Grayland, Kirkland, Mount Vernon, Naches, Palouse, Rockford, North Richland, Skykomish, Seattle, and Wenatchee.

[117] The Model produces a total of 22 rings for the 99 wire centers modeled by HM 5.3.

able to find the "least cost" configuration of interoffice rings.[118] As Mr. Murphy explains, the demand information used to determine these rings, as well as the engineering assumptions employed therein, are severely flawed.[119]

Q. WHAT FLAWS HAVE YOU IDENTIFIED REGARDING HM 5.3'S APPROACH TO MODELING INTEROFFICE FACILITIES?

A. Even if HM 5.3's approach to modeling interoffice facilities did not suffer from the flaws Mr. Murphy identifies, it is far from clear that the undocumented program is producing meaningful results. The program purportedly decides which wire centers belong on which rings using an overly simplified sequential comparison of the cost of directly connecting an office to a tandem with the cost of adding it to a ring. The costs considered in this comparison depend on the input costs for fiber cable, support structure, and electronics. In fact, HM 5.3's method of determining "optimal" interoffice SONET rings is very insensitive to the both the demand that it considers (i.e., traffic volumes entering or exiting a ring at each wire center) and the costs for fiber cable and electronics -- a result that calls into serious question what exactly is being "optimized."

For example, I tested the impact on interoffice design of removing the effect of high-capacity loops, and concluded that they account for about two-thirds of the demand HM 5.3 assumes in designing and costing interoffice rings. As one would expect, this demand is not uniformly distributed. Rather, some of

[118] Dr. Mercer provides a high-level description of what the program purportedly does. *See* Mercer Supplemental Direct Testimony at RAM-4 (HM 5.3 Model Description) at pp. 66-71.

[119] Murphy Reply Testimony at Section V.

the smaller offices have little to no interoffice demand associated with high-capacity loops (and therefore, their interoffice demand with or without high-capacity loops are similar), while other offices have large numbers of high-capacity loops. Consequently, both HM 5.3's total interoffice demand and the distribution of that demand among individual wire centers are radically different when high-capacity loops are excluded. Despite the fact that such a change would seem to call for a different arrangement of "optimal" SONET rings, *HM 5.3 produces absolutely identical rings, regardless of whether high-capacity loops are present or not*.[120]

Q. WHAT ARE THE COST CONSEQUENCES OF THE MODEL'S INSENSITIVITY TO MANY ASPECTS OF RING DESIGN?

A. The extreme sensitivity of the unit costs of interoffice facilities, which Mr. Murphy has identified, is the result of: (1) the insensitivity of total ring costs to demand; and (2) the concomitant high sensitivity of total demand to the essentially arbitrary input that includes from zero to 100 percent of non-

[120] In contrast to the dubious nature of the interoffice facilities' locations produced by HM 5.3, in a proceeding before the FCC, Stephen Turner, a witness representing AT&T/MCI, agreed that Verizon's model is capable of producing reasonable results:

> Mr. [Francis J.] Murphy, at least in his testimony, goes at length in talking about how difficult it is to model a SONET network, and Mr. Gansert [Verizon's engineering witness] was saying he thought I was initially agreeing with him, and I would say it's a very complex problem to do. That said, though, given that, I think you have to look at what is Verizon's current experience is in terms of trying to evaluate, at least in this area because of the complexity, the number of nodes that they have on their SONET … I mean, what Verizon has actually implemented in their network is rational implementation for SONET traffic given the constraints that they have.

Before the Federal Communications Commission, CC Docket Nos. 00-218, -249, -251, *Hearing Transcript* (Nov. 29, 2001) at pp. 5630-32. Indeed, the FCC's Wireline Competition Bureau adopted Verizon's transport model instead of the model proffered by AT&T/MCI (which is substantially similar to HM 5.3's module). *See* Virginia Arbitration Order at ¶¶ 503-08.

switched demand when determining interoffice investments. The following table illustrates this phenomenon.

TABLE 9

	0%	**50%**	**100%**
Total Investment	$120 Million	$152 Million	$184 Million
# of DS-3s	301	944	1,584
Investment/DS-3	$397 Thousand	$162 Thousand	$116 Thousand

The table shows that changing the user-adjustable input "fraction of high-capacity loops requiring interoffice transport" from 0 percent to 50 percent (default) to 100 percent causes a large difference in demand (measured in DS-3s), but only a modest difference in cost. Indeed, changing this input from the value of 100 percent that was assumed in previous versions of HM 5.3 causes a large increase in unit investment (from $116 thousand to $162 thousand).

Q. DOES HM 5.3'S APPROACH TO MODELING INTEROFFICE FACILITIES PRODUCE MEANINGFUL RESULTS?

A. No. Given that the Model essentially guesses at the volume of demand that interoffice facilities need to accommodate (by invoking the input illustrated in Table 9), and the fact that the resulting investment is extremely insensitive to that arbitrary demand, the Model cannot be expected to produce meaningful results. Indeed, the shaky foundations of HM 5.3's interoffice calculations produce results that defy common sense. In particular, despite the expectation that high-capacity facilities such as DS-3s would be less costly on interoffice facilities than as stand-alone loops to end-user customers, because of the greater economies of scale in the former, HM 5.3 produces higher costs for interoffice DS-3 facilities than it does for stand-alone loops. For the interoffice DS-3 facilities, the total cost is $3,065, with about $2,590 attributable to electronics and about $475 to transmission facilities (i.e., fiber cables and support structures). For DS-3 loops to end-users, the total cost is about $653, with $574 attributable to electronics and about $80 to transmission facilities.[121]

These anomalous results are not surprising, and indeed are consistent with the erroneous results produced by previous versions of the HAI Model. In fact, while some version of the HAI Model's switching and interoffice module has been available since 1998, getting it to produce the proper amounts of interoffice facilities has been a particularly vexing problem. The seriousness of the problem first became apparent in the New York UNE proceeding. Verizon's panel explained that the HAI Model failed to properly include substantial amounts of interoffice equipment, thereby causing AT&T/WorldCom to submit two corrected versions of the switching and interoffice module during the course of the proceeding.[122] After the New York proceeding, the module was modified at least once (e.g., the module included in HM 5.2a and filed in 2001 in a Massachusetts proceeding differed from the version filed in New York). In the

[121]Mr. Murphy has identified some serious design flaws associated with HM 5.3's assumptions regarding the engineering of DS-3 loops, which ultimately result in DS-3 loops that would be nonfunctional in the real world.

[122] The inclusion of improperly excluded equipment would obviously increase total investment. AT&T/WorldCom reduced the impact of the greater amounts of equipment by simultaneously changing the input prices for interoffice electronic components. In ultimately rejecting the Model, the New York Commission appeared to take notice of such corrections: "But when all is said and done, the recurring corrections to the Model seem to confirm its weaknesses more than its suppleness, and the Model continues to suffer from the flaws identified by the Commission in the First Elements Proceeding." Before the New York Public Service Commission, Case 98-C-1357, *Recommended Decision on Module 3 Issues by Administrative Law Judge Joel A. Linsider* (May 16, 2001) at p. 34 ("Linsider Decision").

ongoing SBC California UNE proceeding, I uncovered additional errors in HM 5.3's interoffice calculations, which AT&T/MCI subsequently acknowledged.[123] Correction of these errors increased interoffice electronics investments by at least 50 percent.[124]

5. END-OFFICE SWITCHING

Q. DOES HM 5.3'S SWITCHING COST FUNCTION ESTIMATE THE APPROPRIATE, FORWARD-LOOKING SWITCHING INVESTMENT?

A. No, it does not. HM 5.3's estimate of new switch costs assumes only new switches. Verizon NW's actual forward-looking costs, however, will be for upgrades and growth additions only.

Q. IS THE EXCLUSION OF THE COSTS OF UPGRADES AND GROWTH SWITCH ADDITIONS FROM HM 5.3 SIGNIFICANT?

A. Most definitely. Earlier versions of the HAI Model relied upon a 1995 McGraw-Hill study, which indicated that add-on switch prices were about 50% higher than new switch prices. The study explained that:

> Once a switch supplier sells a new system, it has a nearly captive customer; a telecommunications company can only grow a switch by buying add-on lines from the manufacturer of a switch. Therefore, add-on lines are priced higher than lines on new systems and represent higher marginal sales.[125]

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[123] Before the California Public Utilities Commission, Application Nos. 01-02-024 et al., *Declaration of Robert A. Mercer in support of Joint Applicants' Rebuttal Comments*. (March 12, 2003) at pp. 105-07.

[124] The counterintuitive results described in the last paragraph indicate that merely correcting calculation errors is not sufficient to render HM 5.3's interoffice facilities' calculations reasonable.

[125] Northern Business Information, *US Central Office Equipment Market – 1994*, McGraw-Hill.

The McGraw-Hill Study showed that carriers actually spend about three times more to purchase additions to existing switches than to purchase new switches, and noted that the "gap between additions and new installations will continue to increase as the installed base approaches 100% digitization."[126] As the 1995 study anticipated, Verizon NW's forward-looking switch costs will be only the cost of upgrades and growth switch additions -- Verizon NW has no plans of installing new local switches because it has achieved "100% digitization." Yet, HM 5.3 assumes away all costs of upgrades and growth switch additions.

Q. ARE HM 5.3'S INPUT ASSUMPTIONS CONSISTENT WITH RESPECT TO SWITCHING COSTS?

A. No. If the Commission wants to accept HM 5.3's approach, and assume that there is never any growth switching added or upgrades, it would need to revise a number of HM 5.3's input assumptions in ways that would increase greatly the Model's cost estimates. For example, if Verizon NW actually installed switches with no plans to ever purchase additional lines, which is not realistic, then the switches would need substantial excess capacity -- much higher than assumed by HM 5.3. For example, if lines were growing at 3 percent annually, and 6 percent capacity is needed for administrative fill, installing a switch with enough capacity for the 16-year life assumed by HM 5.3 would require 70 percent initial spare capacity. Because spare capacity would be substantially increased (on

[126] *Id.* at p. 61.

the order of 30 percent over the life of the switch), the initial investment and capital costs would also increase.

Q. ARE THERE ALTERNATIVE MODIFICATIONS THAT COULD ACCOMMODATE HM 5.3'S UNREALISTIC SWITCHING ASSUMPTIONS?

A. Yes. Consistent with HM 5.3's assumption that the network uses only new equipment, each switch would have to be replaced every few years to allow for growth and technological advances in switching (e.g., GR-303 interfaces). Accordingly, the depreciation on switches would have to be much higher because the life of the switch would be substantially shorter than assumed by HM 5.3. This would obviously increase the initial investment and the subsequent capital costs by significant amounts. Replacing a switch every 3 years, rather than every 16 years, implies that depreciation is more than 5 times higher per year. This also increases annual switch costs by substantial amounts -- the annual charge factor for a 3-year life is about 3.3 times the corresponding factor for a 16-year life.

The only other alternative, under HM 5.3's assumption that growth switch costs are never incurred, would be to install a new, smaller switch every time Verizon NW experienced enough growth to exhaust existing switch capacity. At a growth rate of about 3 percent per year, a switch initially installed at HM 5.3's assumed utilization would need to be augmented with a new, smaller switch at the same location in about 3 years. Adding new switches every 3 years to serve line growth and maintain an assumed administrative fill of 94 percent would also increase the cost per-line substantially, even using the seriously understated costs for new switches in HM 5.3.

Of course, the need for floor space, the costs for interconnections between the additional switches, as well as the costs of disrupting the central office, should also be included. In addition, HM 5.3's inputs are inappropriate because, if Verizon NW only deployed new switches and never added growth lines, the manufacturers' discounts would be much smaller (and thus prices would be higher) for new lines. If switch manufacturers could not count on the higher margins they currently receive for growth lines, they would be unwilling to accept the low margins currently earned on initial installations.

Q. DOES HM 5.3 INCORPORATE THE FCC'S SWITCH COST COMPUTATION?[127]

A. No. HM 5.3 reduces switching costs when DLC lines are deployed; the FCC's Synthesis Model does not. The result is a reduction in end-office switching investment by about 13 percent.

VIII. EXPENSES

Q. PLEASE DESCRIBE HM 5.3'S EXPENSE MODULE.

A. As previously discussed, the assorted components of HM 5.3 estimate the investment required for various network facilities (e.g., the cable and wire needed for loop facilities, the number and type of switches to be modeled, and

[127] Indeed, the FCC's Wireline Competition Bureau selected Verizon's SCIS model over the switching model used in the HAI Model, citing SCIS's superior treatment of discounts offered by vendors and the fact that the data used to estimate switch investments (which HM 5.3 has adopted in this proceeding) are dated. *See* Virginia Arbitration Order at ¶¶ 367-73.

the amount of electronics needed for fiber optic facilities). And, as described more fully below, the Model also produces estimates of: (1) investments for support assets, such as buildings and motor vehicles, (2) annual capital costs associated with network and support investments, (3) annual operating and maintenance expenses for the network and support facilities, and (4) annual network operations and corporate overhead expenses.

Cost estimates for each of these four categories start with the investments in network facilities produced by HM 5.3 (i.e., they are all multiples of the network investment levels). For example, general support investments apply the ratio of the ARMIS (booked) investment -- a particular general support category (e.g., buildings not used for switches) -- to investment in ARMIS total plant in service ("TPIS"), less general support investment. Thus, if building investment is five percent of TPIS in the ARMIS data, HM 5.3 assumes that building investment would be the same five percent of the investment in network facilities produced by the Model.[128] Because HM 5.3 produces substantially less investment than Verizon NW's book investment, it in effect assumes that an "efficient carrier" could serve the same volumes of traffic Verizon NW serves today with fewer (or smaller) buildings, fewer motor

[128] HM 5.3 assumes that a portion of support assets are assigned to retail services (and therefore are not included in UNE costs). For buildings, furniture, office equipment, and general purpose computers, the Model first assigns corporate operations expenses to wholesale and retail, based on the proportion of total expenses for plant (less general support), network operations, and customer operations (ARMIS Report/Account 6600)that are in the customer operations account. HM 5.3 then calculates an allocator for general support costs that is the ratio of the sum of network operations expenses and the corporate operations expenses assigned to wholesale, to the sum of network operations, customer operations, and corporate operations. That calculation results in an allocation of about 42 percent of these assets to wholesale. A somewhat different calculation results in an allocator of about 41 percent for motor vehicles and work equipment.

vehicles, less investment in computers, and so forth, as shown in Tables 2A and 2B above. AT&T/MCI have produced no support for this arbitrary and questionable outcome.

In addition, the ratio of the book investment of a support asset to the total network investment should not be applied to the lower levels of forward-looking investment produced by HM 5.3, because there is no basis for assuming that the level of support assets varies directly with the level of network investment. For example, the price of central office switches has declined over time (although not as much as the HM 5.3 suggests), but the cost of land and buildings has not. Therefore, any land and building ratio based on book cost would be too low for calculating forward-looking costs if the ratio is applied to discounted, forward-looking switch investments. Such erroneous assumptions underestimate the required investment in land and buildings. In fact, the average ratio of support assets to network assets based on current costs is 25 percent higher than the average ratio based on book costs.[129]

Q. DOES HM 5.3 ACCURATELY ESTIMATE NETWORK OPERATIONS EXPENSES?

A. Absolutely not. HM 5.3's approach to estimating network operations expenses (ARMIS Account 6530) is similarly flawed. HM 5.3 multiplies: (1) the ratio of book expenses in this account to total current investment, by (2) the total investment produced by the Model, to estimate HM 5.3's network operations

[129] This calculation uses the current cost to book cost ratios reported in Appendix D of the FCC's Tenth Report and Order.

expenses. As discussed herein, because HM 5.3's investments are understated, network operations expenses are understated as well. Even if a forward-looking network required less investment, there is no logical reason to assume that a reduction in these investments automatically implies that an efficient firm could proportionately reduce its expenditures for power, network engineering, and the like.

Q. PLEASE DESCRIBE HM 5.3'S USE OF EXPENSE-TO-INVESTMENT RATIOS, AND THE PROBLEMS ASSOCIATED THEREWITH.

A. With the exception of the annual capital costs,[130] the specific factors used to produce HM 5.3's cost estimates are adapted from the FCC Synthesis Model. These factors include expense-to-investment ratios for specific plant categories (e.g., aerial copper cable), and each category of support asset (e.g., buildings). In order to produce reliable estimates of forward-looking expenses, such expense-to-investment factors must be developed such that they represent the proper *relationship* between the forward-looking level of network expense and the forward-looking level of network investment.

As described more fully below, a fundamental problem arises when these expense-to-investment ratios are used to estimate the forward-looking expenses associated with providing UNEs in Washington. Unless there is a close match between the investment levels used to develop the ratios and the

[130] The Direct and Reply Testimonies of Mr. Sovereign and Dr. Vander Weide demonstrate that AT&T/MCI's recommendations for cost of capital and depreciation produce unreasonably low UNE cost estimates.

investment levels to which the ratios are applied in the cost studies, the application of such ratios, without appropriate forward-looking adjustments,[131] will not produce accurate UNE cost estimates.[132]

Q. PLEASE EXPLAIN WHY IT IS IMPORTANT TO ALIGN THE PRICES USED TO CALCULATE FORWARD-LOOKING INVESTMENT AND FORWARD-LOOKING PRICES.

A. Adjustments to expense-to-investment ratios based on booked network investment are necessary to make them appropriate for estimating forward-looking expenses, as the following example illustrates. Suppose a carrier installed ten new poles last year for $500 each and paid $5 per year to maintain each pole. Further, suppose the price of a new pole this year is $600, but still it costs $5 per year to maintain. In this example, then the current cost to book cost ("CC/BC") ratio for poles is $600/$500 or 6/5. Application of the CC/BC ratio to the booked investment in the denominator of the ratio $5/$500 (.01) yields a new factor of .0083. Because HM 5.3 in many cases erroneously assumes that prices are less in the future,[133] applying this factor to the a lower

[131] For example, in the case of switching, there is a clear misalignment in HM 5.3 -- while the FCC's current cost-to-book cost ratio implies that Verizon NW would need to spend 89 percent of its book investment to replace its switches, HM 5.3 says the replacement could be accomplished for only 26 percent.

[132] VzCost applies a Forward-Looking Calibration ("FLC") factor to ensure that the investment levels of the network expense factors are properly aligned with the reduced level of forward-looking investment produced by the other parts of Verizon's cost model. *See* Before the Washington Utilities and Transportation Commission, Docket No. UT-023003, *Panel Testimony of Verizon Northwest Inc. on Recurring Costs* (June 26, 2003) at pp. 150-55.

[133] Pole investment is a prime example of this understatement: When the pole investment in the 2003 ARMIS data is adjusted by the current cost-to-book cost ratio and then divided by the number of poles reported in the ARMIS data, the price is twice HM 5.3's pole price. Therefore, even if HM 5.3 (continued...)

pole price of, for example, $400 produces incorrectly low maintenance expense of $3.33 per pole.

A similar problem arises if HM 5.3 produces an incorrect estimate of the quantity of facilities required by a carrier providing telecommunications services. For example, if Verizon NW's real-world operations require 100 poles, but HM 5.3 produces only 80 poles, the assumption of the $400 pole price would produce a hypothetical investment of $32,000 (80 x $400), and an associated maintenance expense of $267 (0.0083 x $32,000), while the real-world maintenance cost would be $500 (100 poles x $5 per pole as described above). In the case of plant-specific expenses, the costs of maintaining the network are reduced to only 50 percent of what Verizon NW spent to maintain its network in 2003.

Finally, there is the additional problem that the FCC's expense-to-investment ratios are national averages, estimated from historical 1997 and 1998 data.[134] As such, the use of these ratios fails to capture Washington-specific or Verizon NW-specific operating conditions.[135] The FCC used aggregate data for ILECs, but explicitly acknowledged that a national average

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(...continued)

produced the correct number of poles and an accurate network expense factor was used, the associated maintenance expenses would still be understated by one-half.

[134] In contrast to AT&T/MCI's ratios that are based on data that are now five to six years out-of-date, Verizon NW uses data from 2001 and makes them forward-looking through the application of inflation and productivity adjustments.

[135] Virginia Arbitration Order at ¶ 136.

was appropriate for USF purposes only.[136] Similarly, although the FCC used data that was based on the prices ILECs pay for equipment, the FCC used nationwide estimates of input costs to calculate the value of current investment. Thus, the expense factors used by AT&T/MCI for UNE purposes fail to align properly with the equipment price inputs used for their Verizon NW, Washington-specific cost study.

Q. DESCRIBE HM 5.3'S APPROACH TO ESTIMATING CORPORATE OVERHEAD EXPENSES, AND THE PROBLEMS ASSOCIATED THEREWITH.

A. To estimate corporate overhead expenses, HM 5.3 applies an overhead factor of 10.4 percent to all the other costs calculated by the Model. The results of this calculation are that, while Verizon NW incurred corporate expenses (USOA Accounts 6710 and 6720) of about $88 million in 2003,[137] the Model produces less than one quarter of that amount (or $21 million).

The large reduction from Verizon NW's current expenditures results from the fact that HM 5.3 applies a ratio of 10.4 percent for corporate expenses to all of its other substantially understated forward-looking costs.[138] As Table 2B shows, those estimates are well below what Verizon NW needs to run its

[136] The FCC distinguished between the use of its Synthesis Model to support the federal USF and its use for other purposes. In a USF context, the FCC did not attempt to describe any particular company (Tenth Report and Order at ¶ 360), whereas in a UNE context, the objective is to estimate the costs an ILEC actually expects to incur.

[137] This figure is the product of 2003 ARMIS expenses and HM 5.3's estimate of the proportion of corporate expenses that correspond to the "wholesale" activities depicted by the Model.

[138] VzCost applies a 4.8% Marketing factor, a 3.6% Marketing Support factor, and a 6.3% Common factor to recover overhead expenses.

current network. And the resulting overhead cost estimates, likewise, understate forward-looking overhead expenses. This illustrates the general problem with expense factors -- if hypothetically the cost of all network components were reduced by 50 percent, there is no reason to expect, for example, that only half of the current professional workforce would be required to manage that network.

IX. REGULATORY SCRUTINY AND HM 5.3'S TREATMENT OF THE CONCERNS VOICED BY OTHER STATE REGULATORY COMMISSIONS

Q. WHAT WEIGHT SHOULD BE PLACED ON DR. MERCER'S STATEMENT THAT THE HAI MODEL HAS BENEFITED FROM CAREFUL REGULATORY SCRUTINY?[139]

A. None. While it is accurate to state that the HAI Model has been filed in many states and has been extensively reviewed, such reviews have often resulted in the rejection of the model. Even though the HAI Model sponsors replaced the CBGs used in Release 3.1 with the cluster inputs developed by TNS (or its predecessor firm), regulators in North Carolina, New Hampshire, Rhode Island, New York, New Jersey, and Massachusetts have all found that the versions of the HAI Model sponsored by AT&T/MCI are problematic nevertheless, and have adopted the ILECs' cost models instead.[140]

[139] Mercer Supplemental Direct Testimony at pp. 6-7.

[140] I appeared as a witness in each of these proceedings, as well as in several universal service proceedings in 1998. With the exception of Kentucky, which selected HM 5.0a for universal service purposes, the regulators in each of these states rejected the HAI Model and opted instead for the cost models sponsored by the ILECs.

For example, a Recommended Decision released by the New York Public Service Commission selected Verizon's cost model over the HAI Model, Release 5.2 , describing the latter as "a ponderous tool that is too far removed from the reality of Verizon's circumstances to be used when there is an alternative better grounded in real data."[141] Similarly, in adopting Verizon's cost model, the New Jersey Board concurred with Verizon NJ and others that the HAI Model "failed to use TELRIC-compliant inputs."[142] Chief among the New Jersey Board's concerns was "the substantial nature of the difference between the [HAI Model's] cost estimates and Verizon NJ's actual experience," which suggested that the HAI Model "may potentially understate forward-looking costs."[143] Moreover, the New Jersey Board was troubled by AT&T's offsetting adjustments and "alarmed" by the anomalous results produced by the HAI Model's clustering algorithm.[144] In the end, the New Jersey Board declined to adopt the HAI Model, noting that the "Model employs a methodology designed to create a least-cost, most efficient network without regard to realistic design considerations."[145]

[141] Linsider Decision at p. 35. Judge Linsider's decision was subsequently affirmed by the New York Commission, which noted that "none of [the parties, including AT&T] excepts to the Judge's rejection of the HAI Model." Before the New York Public Service Commission, Case 98-C-1357, *Order on Unbundled Network Element Rates* (Jan. 28, 2002) at pp. 14-15, 17.

[142] New Jersey Order at p. 25.

[143] New Jersey Order at pp. 25-26.

[144] New Jersey Order at p. 26.

[145] New Jersey Order at p. 27.

Q. HAVE ALL OF THE PROBLEMS IDENTIFIED BY THE COMMISSION WITH RESPECT TO PREVIOUS VERSIONS OF THE HAI MODEL BEEN REMEDIED?

A. No. While the proposition that HM 5.3 should rise or fall on its own merits is reasonable, it is also the case that a number of the problems that this Commission found with HM 3.1 and HM 5.0a still remain.

Q. PLEASE DESCRIBE THESE PROBLEMS.

A. In particular, HM 5.3 fails to address two major concerns the Commission has raised in earlier decisions: (1) problems with particular inputs, such as placement costs, drop lengths, and switch investments,[146] and (2) the need validate certain model outputs, such as loop lengths.[147] With regard to the former, I note that a large number of outside plant and other inputs are the same as the HM 5.0a values about which the Commission previously expressed concern -- in general, in contrast to the inputs used in VzLoop, HM 5.3's inputs are the result of Mr. Donovan's opinions, and have no basis whatsoever in what a real-world carrier can expect to pay for such inputs in Washington.

With regard to validation, Dr. Mercer has not presented the types of comparisons to actual data (e.g., loop lengths) that the Commission suggested in earlier orders. This omission is not surprising given that, as demonstrated

[146] 1998 Eighth Supp. Order at ¶¶ 93, 134, 285.

[147] Tenth Supplemental Order at ¶ 271.

herein, such comparisons only serve to demonstrate the imprecise nature of HM 5.3.

Q. PLEASE EXPLAIN.

A. A revealing test is to compare the average loop lengths for each wire center produced by the model to corresponding external measures of average loop length. For the latter, I used the average loop lengths that Mr. Spinks used in his modified version of HM 5.3. In particular, I calculated the absolute percentage deviation between the HM 5.3 loop length and Mr. Spinks' loop length for each wire center. For HM 5.3, these percentages *averaged* 57 percent, ranging from 1 percent to 635 percent. In contrast, when I performed the same test on VzLoop loop lengths, the average deviation was only 15 percent, ranging from 0 percent to 108 percent.

Q. IS MR. SPINKS' ADJUSTMENTS TO HM 5.3'S COSTS, WHICH ARE BASED ON "TRUING UP" HM 5.3'S LOOP LENGTHS TO THESE EXTERNAL MEASURES, A RELIABLE WAY TO ESTIMATE UNE COSTS?

A. No. As I described earlier, not only does HM 5.3 produce imprecise loop lengths, it tends to place the wrong types of facilities (e.g., cables of a particular size) in the wrong places. Consequently, a mere "true up" of distances will not guarantee that the cost outputs are reliable.

X. MAJOR COST CATEGORIES IN HM 5.3

Q. PLEASE IDENTIFY THE MAJOR CATEGORIES OF LOOP INVESTMENT.

A. Valid estimates of economic costs require that a cost model's inputs comport with the costs and operating conditions Verizon NW experiences. An informative way to identify the most critical inputs is to determine proportions of total investment (e.g., ordinary loops) accounted for by specific types of facilities. In selecting the inputs that ultimately result in total investment, Mr. Donovan generally has not relied upon data specific to Verizon NW, but rather has used his own unverified judgment to substantiate a substantial number of HM 5.3's inputs and investments (e.g., engineering and placement of cable, support structures, DLC engineering and installation, etc.). In contrast, the corresponding inputs to VzLoop are based on Verizon NW's recent experience providing service in Washington (e.g., vendor contracts and the like). The identification of the critical investment categories below highlights the extent to which HM 5.3's costs depend on Mr. Donovan's unsubstantiated opinions, as opposed to any realistic and accurate measure of the actual costs Verizon NW expects to incur when building and operating its network.

TABLE 10

	HM 5.3		**VzLoop**	
	Investment/Line	**% of total**	**Investment/Line**	**% of total**
Poles	$23.32	5.77%	$46.75	4.21%
Aerial	$43.00	10.63%	$70.65	6.36%
Buried	$84.51	20.89%	$187.81	16.91%
Underground	$12.62	3.12%	$49.03	4.42%
Conduit	$40.15	9.93%	$283.69	25.55%
DLC Equipment	$117.77	29.12%	$301.18	27.12%
SAI	$8.74	2.16%	$17.13	1.54%
Drop Terminal	$43.06	10.65%	$40.27	3.63%
Drop Wire	$13.64	3.37%	$73.14	6.59%
NID	$17.64	4.36%	$40.83	3.68%
Total	$404.44		$1,110.48	

This table shows that, in each model, the costs for cable and structure account for about one-half of the total investment; and DLC equipment accounts for approximately one-quarter of the total investment.[148] Further, HM 5.3's investments are generally about one half VzLoop's investment levels across the board. While a proper cost study requires accurate measurement of *all* cost inputs, it is essential to develop accurate cost estimates for the more critical inputs. HM 5.3 fails miserably in this regard.

XI. CONCLUSIONS

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS.

A. HM 5.3 should not be used to set UNE rates for Verizon NW in Washington. The Model does not comply with proper forward-looking cost methodologies (including those called for by TELRIC), fails the validation tests to which it is subjected, and is based on an incorrect representation of the economics and operations of local exchange networks. Numerous errors are also built into the HM 5.3's estimating methodologies and input assumptions, resulting in incredibly understated forward-looking costs of the network required to provide reliable service in Verizon NW's Washington territory.

In particular, HM 5.3 assumes that service could be provided in Washington for only 30 percent of Verizon NW's current investment levels, and that Verizon NW's network could be operated with only one-half of the out-of-pocket expenses (and one-half the labor force) currently experienced.

[148] Of course, total investment also depends on the quantities of each component. As I discussed earlier, HM 5.3 generally produces insufficient (or imprecise) quantities of loop facilities as well.

Similarly, Mr. Donovan's ill-advised engineering and installation labor estimates have the incredible implication that an entire network serving all of Verizon NW's 1.1 million lines could be completely installed in one year by a labor force of little over 800 workers.

For the foregoing reasons, and others discussed in the testimonies of Messrs. Dippon, Richter, and Murphy, the Commission should not rely upon HM 5.3, to any extent, to establish Verizon NW's UNE rates.

Q. DOES THIS CONCLUDE YOUR REPLY TESTIMONY?

A. Yes.