	ATT/WC	Verizon		ATT/WC	Verizon	ATT/WC 2W CSS/2W BUL	Verizon 2W CSS/2W BUL	% Difference Between ratios
2W BUL			2W CSS					
Cell 1	**4.98**	**17.86**	**Cell 1**	**7.00**	**25.85**	***1.41***	***1.45***	***2.9%***
Cell 2	7.37	26.31	Cell 2	9.49	34.50	*1.29*	*1.31*	***1.8%***
Cell 3	11.77	43.45	Cell 3	13.71	50.95	*1.16*	*1.17*	***0.7%***
AVG.:	6.18	22.33	AVG.:	8.20	30.28	*1.33*	*1.36*	***2.2%***

	ATT/WC	Verizon		ATT/WC	Verizon	ATT/WC 2W BRI/2W BUL	Verizon 2W BRI/2W BUL	
2W BUL			2W BRI					
Cell 1	4.98	17.86	Cell 1	5.91	23.14	*1.19*	*1.30*	***8.4%***
Cell 2	7.37	26.31	Cell 2	8.28	31.83	*1.12*	*1.21*	***7.1%***
Cell 3	11.77	43.45	Cell 3	12.65	48.87	*1.07*	*1.12*	***4.4%***
AVG.:	6.18	22.33	AVG.:	7.09	27.66	*1.15*	*1.24*	***7.4%***

	ATT/WC	Verizon		ATT/WC	Verizon	ATT/WC 4W DDS/4W CSS	Verizon 4W DDS/4W CSS	
4W BUL - CSS			4W DDS					
Cell 1	*19.69*	*56.81*	*Cell 1*	*21.77*	*60.29*	*1.106*	*1.061*	***-4.2%***
Cell 2	24.80	74.19	Cell 2	27.52	78.99	*1.110*	*1.065*	***-4.2%***
Cell 3	32.55	106.49	Cell 3	36.14	113.18	*1.110*	*1.063*	***-4.5%***
AVG.:	22.01	65.50	AVG.:	24.37	69.67	*1.107*	*1.064*	***-4.1%***

355. By way of example, if we apply the ratio analysis and use the ratios generated from the Verizon proposed rates, we would calculate the 2-wire CSS loop rate (see first line of the table above, in bold) for zone 1 by multiplying the basic 2-wire loop rate, zone 1, by 1.45. Were we instead to use the ratios generated from the AT&T/WorldCom restatement rates, we would use a ratio of 1.41 instead of 1.45. In this instance, using the ratio based on the Verizon proposed rates instead of the AT&T/WorldCom restatement rates would generate a 2.9 percent higher 2-wire CSS loop rate (for zone 1).

356. To complete this analysis, we must determine whether to use the ratios generated from the Verizon proposed rates or the AT&T/WorldCom proposed restatement rates. Electronics costs comprise a significant proportion of loop costs, and one of the major cost drivers for electronics is the type of DLC systems used. In determining basic 2-wire loop costs, we concluded that fiber-based loop feeder plant should use 100 percent NGDLC systems.[907] Because we adopt AT&T/WorldCom's position on that issue, and because electronics are a significant loop cost driver, we will use the ratios that result from the AT&T/WorldCom restatement rates rather than from the Verizon proposed rates. In reaching this conclusion, we note that the difference between the AT&T/WorldCom and Verizon ratios (the last column in the table, above) is generally small (less than five percent for all three loop types in all density zones, except for the 2-wire ISDN BRI loop type in zones 1 and 2). We further note that,

[907] *See supra* section IV(C)(2)(k).

although the AT&T/WorldCom ratios result in lower 2-wire CSS and 2-wire BRI ISDN loop rates than do the Verizon ratios, the AT&T/WorldCom ratios also result in higher 4-wire DDS loop rates. The effect, therefore, of our decision to use the AT&T/WorldCom ratios instead of the Verizon ratios is minimal.

V. SWITCHING

357. Local circuit switching refers to line-side and trunk-side facilities used to connect separate lines and trunks, including all of the features, functions, and capabilities of the switch. The Commission's TELRIC pricing rules apply to the rates charged when switching is offered as a UNE.[908] The *Local Competition First Report and Order* and the Commission's rules, however, provide only general guidance on the proper rate structure for incumbent LECs to use in recovering switching costs. The rules specify that an incumbent LEC shall recover local switching costs "through a combination of a flat-rated charge for line ports and one or more flat-rated or per minute usage charges for the switching matrix and for trunk ports,"[909] and tandem switching costs "through usage-sensitive charges, or in another manner consistent with the manner that the incumbent LEC incurs those costs."[910]

358. In its universal service orders, the Commission provided additional guidance for determining forward-looking switching costs. It identified the following guidelines for modeling local switching costs: individual switches should be identified as host, remote, or stand-alone; investment costs should be developed separately for each of these switch types; switch capacity constraints should be included; and modern, high-capacity digital switches should be used.[911] The Commission concluded that both models presented at the time -- the Benchmark Cost Proxy Model (BCPM) 3.0, which relied in part on the SCIS model, and HAI 5.0 -- "meet the . . . requirement that a model assume the least-cost, most-efficient and reasonable technology to provide the supported services."[912] It further concluded that the HAI model better satisfied the forward-looking pricing methodology than did the BCPM/SCIS model primarily because: (1) the HAI model is less complex than the BCPM/SCIS model, but "still provid[es] a degree of detail that is sufficient for the accurate computation of costs for federal universal service purposes;" and (2) proprietary SCIS model data were not entered into the record of that proceeding.[913] The Commission then incorporated the HAI switching cost computations into the

[908] 47 C.F.R. § 51.501 (TELRIC pricing rules apply to UNEs).

[909] 47 C.F.R. § 51.509(b); *see also* 47 C.F.R. § 51.507(c).

[910] 47 C.F.R. § 51.509(e); *see also* 47 C.F.R. § 51.507(c).

[911] *Platform Order*, 13 FCC Rcd at 21353, 21355, paras. 72, 76.

[912] *Id.* at 21355, para. 76.

[913] *Id.* at 21354-56, paras. 75, 77-78.

SM.[914] In so doing, however, the Commission expressly stated that switching costs are less significant than loop costs for universal service purposes,[915] and therefore it devoted less analysis to the switching and interoffice platforms and cost inputs than would have been necessary for purposes of determining unbundled switching and transport costs.[916]

A. Cost Model

1. Positions of the Parties

359. Verizon submitted cost studies to determine the costs of, and thereby the rates for, unbundled end-office and tandem switching.[917] The starting point in the Verizon switching cost study is the SCIS model.[918] The SCIS model is a computer system that has two modules, SCIS/Model Office (SCIS/MO) and SCIS/Intelligent Network (SCIS/IN).[919] The SCIS/MO module is used to develop switching investments and processor-related investments associated with features that do not require any specific, unique hardware.[920] The SCIS/IN module is used to develop incremental investments associated with vertical features.[921] Verizon uses the SCIS model to estimate the initial capital outlay for the physical material of the end-office and tandem switching equipment.[922]

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[914] *Id.* at 21354-57, paras. 75-80. HAI 5.0 uses a single cost module to determine both switching and transport costs. *See id.* at 21354, para. 74. In the universal service proceeding, the Commission adopted this module for use in determining switching and common transport costs. *See id.* at 21354-57, paras. 75-80; *see also infra* section VI(A).

[915] *Platform Order*, 13 FCC Rcd at 21355, para. 75 ("In our evaluation of the switching modules in this proceeding, we note that, for universal service purposes, where cost differences caused by differing loop lengths are the most significant cost factor, switching costs are less significant than they would be in, for example, a cost model to determine unbundled network element switching and transport costs.").

[916] *Compare Platform Order*, 13 FCC Rcd at 21353-57, paras. 71-80 (switching and interoffice platform), *with id.* at 21335-53, paras. 26-70 (loop platform); *compare Inputs Order*, 14 FCC Rcd at 20277-99, paras. 286-337 (switching and interoffice cost inputs), *with id.* at 20172-277, paras. 33-285 (loop cost inputs).

[917] Verizon Ex. 100P, Vols. V, VI, IX (confidential version); Verizon Ex. 125P (Matt Supplemental Surrebuttal), Attach. A-G (confidential version); Verizon Ex. 161P (Matt Second Supplemental Surrebuttal), Attach. H-M (confidential version). Verizon submitted the Telcordia Common Channel Signaling Cost Information System (CCSCIS) study to determine signaling costs and rates. *See* Verizon Ex. 100P, Vol. VII, Parts E-1 and E-2 (confidential version).

[918] Verizon Ex. 107P, at 179-211 (confidential version).

[919] *Id.*

[920] *Id.*

[921] *Id.*

[922] *Id.*

360. Although the outputs from the SCIS model are the foundation of Verizon's switching cost study, they are only the starting point in the switching cost calculations. Verizon uses additional data and applies calculations outside of the SCIS model to estimate the initial capital outlays for incumbent LEC and vendor labor; Engineer, Furnish, and Install (EF&I) factors; power; land; and buildings.[923] It applies cost factors and adds loadings to the capitalized investment obtained from the SCIS model to derive annual costs of capital, depreciation, income and other taxes, maintenance, overhead, regulatory assessments, uncollectibles, umbilical and SS7 link equipment, and right-to-use (RTU) licenses.[924] Verizon also makes certain adjustments to account for utilization (*i.e.*, fill) rates, and to convert an overall cost estimate that is developed initially on a busy hour equipment capacity minute-of-use (MOU) basis to separate cost estimates for originating and terminating traffic that are expressed on an all hour of the day billable MOU basis.[925]

361. AT&T/WorldCom do not challenge the ability of the Verizon switching cost study, including the SCIS model, to generate TELRIC-compliant switching rates.[926] Rather, they challenge most of the significant inputs used by Verizon to develop switching costs.[927] For example, AT&T/WorldCom contend that the limited data set used by Verizon to model switch prices is not appropriate for a forward-looking cost model because it primarily reflects additions to existing switches, rather than purchases of new switches that generally have a much higher vendor discount.[928] They also allege that the Verizon study does not use sufficiently forward-looking technology assumptions, particularly with respect to the type of DLC systems.[929] Finally, they contend that other costs estimated by Verizon, such as RTU fees that are paid to switch vendors for software, are excessive.[930]

362. AT&T/WorldCom affirmatively propose using the MSM to generate TELRIC-

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[923] *Id.*

[924] *Id.*

[925] *Id.* Converting capacity MOU to billable MOU and busy hour MOU to all hours MOU are discussed *infra* in the section on the Busy Hour to Annual MOU Ratio. *See infra* section V(C)(8).

[926] *See* Tr. at 5386-87 (Q: (Mr. Kwiatkowski) "Do you have any specific criticism of SCIS itself? That is the mathematical formulas reflected in SCIS?" A: (Ms. Pitts) "Overall, probably not.") Indeed, Ms. Pitts, AT&T/WorldCom's lead witness on switching cost issues, was at one point "responsible for the technical development, production, documentation, and customer care for the SCIS family of models." AT&T/WorldCom Ex. 4 (Pitts Direct), at 1.

[927] AT&T/WorldCom Ex. 12P, at 96-124 (confidential version).

[928] AT&T/WorldCom Ex. 12, at 98-104.

[929] *Id.* at 104-107.

[930] *Id.* at 115-118.

compliant end-office and tandem switching rates and signaling rates.[931] The MSM contains a switching and transport module.[932] End-office switching costs in the MSM are based primarily on the regression analysis adopted by the Commission in the universal service proceeding.[933] There, the Commission analyzed the costs for end-office switching equipment using data from switch installations from 1989-1996.[934] It determined that the fixed cost for a host switch and a stand-alone switch was $486,700 and that the fixed cost for a remote switch was $161,800.[935] It further found that the variable cost for host, stand-alone, and remote switches was $87 per line.[936] Given these cost inputs, end-office switching costs in the MSM depend almost entirely on the number of lines per switch and the relative numbers of host, stand-alone, and remote switches in a network. The Switching/Transport module contains capacity checks, based on the number of lines, busy hour call attempts, and busy hour usage,[937] but these checks have minimal effect on the switching cost estimates generated by the MSM. AT&T/WorldCom also rely on the costs and calculations contained in the underlying SM to generate costs and rates for tandem switching.[938]

363. Verizon challenges the use of the MSM Switching/Transport module as fundamentally inappropriate for use in generating UNE rates, and it claims that many of the module's cost inputs are flawed as well. As a threshold matter, Verizon contends that the Switching/Transport module adopted by the Commission to determine switching costs for federal universal service purposes is inappropriate for use in developing absolute unbundled switching rates in Virginia.[939] Verizon asserts that, in the universal service proceeding, the Commission focused not on whether the calculations provided an accurate estimate of TELRIC switching costs, but rather on whether the module functioned sufficiently to calculate federal universal service switching costs.[940] Verizon claims that AT&T/WorldCom have done nothing in

[931] AT&T/WorldCom Ex. 14, Attach. A; AT&T/WorldCom Ex. 23, Attach. A, J.

[932] AT&T/WorldCom Ex. 14, Attach. A; AT&T/WorldCom Ex. 23, HAI Model Release 5.0a at 53-63 (1998) ("Switching/Transport module"); AT&T/WorldCom Initial Cost Brief at 188. Although AT&T/WorldCom filed a revised version of the Switching/Transport module later in the proceeding to update certain common transport costs, *see* Keffer Dec. 12 Letter, Install A, the general model descriptions provided in the initial cost model filing remain accurate.

[933] *Inputs Order*, 14 FCC Rcd at 20279-93, paras. 290-323.

[934] *Id.* at 20281-91, paras. 296-319.

[935] *Id.* at 20281, para. 296.

[936] *Id.*

[937] AT&T/WorldCom Ex. 23, HAI Model Release 5.0a at 56-57.

[938] *See* AT&T/WorldCom Ex. 23, Attach. A, J.

[939] Verizon Ex. 109, at 47-50.

[940] Verizon Switching Cost Brief at 26 (citing *Platform Order*, 13 FCC Rcd at 21354-56, paras. 75, 78).

this proceeding to improve the accuracy of the switching calculations for use in determining TELRIC switching costs, and that the switching cost estimates produced by the MSM, as well as the input values used to derive them, are therefore not representative of, or appropriate to use to determine, Verizon's forward-looking unbundled switching costs.[941]

364. Verizon contends that the MSM relies on outdated switching data, primarily data from a sample of switches that were deployed between 1989 and 1996.[942] According to Verizon, these input data are not only stale, but they reflect switches that are incapable of providing modern services and features.[943] It argues that many new features have been added to switches since 1996, almost all of which require additional investment, yet the Switching/Transport module fails to account for these modern features and functions or their associated costs.[944] Verizon claims, for example, that the module's data inputs do not reflect the additional costs associated with provisioning ISDN lines on a digital switch,[945] the considerable software investment necessary to comply with the mandates of the Communications Assistance for Law Enforcement Act and LNP obligations,[946] or the requisite hardware modifications included in the current Nortel and Lucent switches.[947] Because it fails to account for the complete range of technologies (both hardware- and software-related) currently being deployed, Verizon alleges that the MSM cannot develop switching costs that will compensate Verizon for all of the switching capabilities that it is required to provide.[948]

365. Verizon also claims that the MSM Switching/Transport module ignores proper switch sizing guidelines and engineering standards, thereby ensuring that the network modeled by the MSM would be incapable of providing adequate and reliable service to Verizon's customers.[949] For example, Verizon contends that the MSM incorrectly assumes that switch sizes are infinitely variable (*i.e.*, that a switch can be sized to meet perfectly the line count in a given

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[941] *Id.*

[942] Verizon Ex. 109, at 47 (stating that switching data in the MSM dates back as far as 1983); Verizon Switching Cost Brief at 29-31.

[943] Verizon Ex. 109, at 47.

[944] Tr. at 5329-30.

[945] Verizon Ex. 109, at 47-48.

[946] Tr. at 5330-31.

[947] Verizon Ex. 109, at 47-48.

[948] Verizon also claims that the MSM significantly understates power and MDF investments, as well as central office construction costs. *Id.* at 91-92, Attach. 4; Verizon Initial Cost Brief at 150-51, 162-63. According to Verizon, these understatements, in turn, result in significantly understated switching costs. *See* Verizon Ex. 109P, at 91-93 (confidential version).

[949] Verizon Ex. 109, at 50-52.

wire center).[950] In practice, however, Verizon notes that switches and switch components come in discrete sizes and cannot be customized to match exactly the demand in a particular wire center.[951] Therefore, according to Verizon, just as breakage requires the deployment of some excess capacity in the context of cables,[952] carriers will similarly incur the cost of some amount of excess switching capacity.[953] Verizon argues, however, that the MSM is incapable of accounting for these and other types of engineering realities.[954]

366. Verizon also asserts that the MSM cannot accurately account for peak period usage. In developing the SM, the Commission stated that a cost model must "ensure that adequate capacity exists in that switching facility to process all customers' calls that are expected to be made at peak periods."[955] Verizon argues, however, that the MSM fails to satisfy this basic criterion because it does not account for the fact that each central office and its associated trunking network experience an annual busy season, as well as a daily busy hour, characterized by periods of peak traffic loads.[956] Rather, the Switching/Transport module provides capacity for the same number of busy hour calls each day of the year without accounting for a busy season.[957] The uniform amount of usage that AT&T/WorldCom posit as peak traffic cannot, Verizon claims, account for peak periods resulting from seasonal fluctuations in demand, such as a resort community for which the bulk of the yearly traffic occurs over a few summer months.[958] As a result, Verizon asserts that the MSM models switches that would be incapable of handling traffic during busy season periods and, therefore, a network on which customers would experience frequent denials of service.[959]

2. Discussion

367. We adopt the Verizon switching cost study, including the SCIS model, because it

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[950] *See* Verizon Switching Cost Brief at 29.

[951] Verizon Ex. 109, at 50-52.

[952] *See supra* note 675.

[953] Verizon Ex. 109, at 50-52; *see also* Verizon Switching Cost Brief at 29.

[954] Verizon Ex. 109, at 50-52; *see also* Verizon Switching Cost Brief at 29.

[955] *Inputs Order*, 14 FCC Rcd at 20164-65, para. 12; *see also id.* at 20277-78, para. 286.

[956] *See* Verizon Ex. 109, at 50-52.

[957] *Id.* at 50.

[958] Resort communities typically experience upwards of 60-75 percent of their total annual traffic during a 2 or 3 month vacation period. *Id.* at 51.

[959] *Id.* at 50-52.

better satisfies the key cost model criteria that we identify above.[960] Specifically, we find that the Verizon switching cost study, as compared to the MSM's Switching/Transport module, better complies with the Commission's TELRIC pricing rules and relies on cost inputs and assumptions that are more transparent, adjustable, and verifiable. To the extent that AT&T/WorldCom raise specific cost input issues, we address these issues in the following subsections.

368. Between the two cost models, only the SCIS model can be adjusted to reflect our findings regarding the most fundamental switching cost input issue: the relative percentages of new and growth switch equipment and the vendor discounts associated with each.[961] As we explain below, efficient carriers will grow their switches over time, and vendors offer different discounts to carriers for new switches than for growth switching equipment. The MSM Switching/Transport module uses inputs based on 100 percent new switch prices, and, presumably, those prices reflect the greater discounts associated with such switches.[962] The module documentation, however, does not identify the specific discount reflected in those prices, nor can the module be modified to account for the lower discount on growth switching equipment. The SCIS model, in contrast, may be adjusted by the user to reflect any desired discount, although Verizon proposes the lower discount based primarily on growth and upgrade purchases. Accordingly, because the key vendor discounts are discernable and adjustable only in the SCIS model, we find the Verizon switching cost study more transparent, adjustable, and verifiable than, and therefore preferable to, the MSM.

369. We also find that the Verizon switching cost study better complies with the Commission's TELRIC rules because it relies on more recent data and therefore better reflects forward-looking switching costs. Verizon's study relies on data from approximately 1998-2000,[963] the most recent data available prior to its submission of its cost studies in July 2001. AT&T/WorldCom, on the other hand, rely on data relating to switches installed between 1989 and 1996. Their proposed forward-looking switching costs are based, therefore, on a sample of switches reflecting decade old equipment. Although it is possible to extrapolate future values by applying regression analysis to historical data, as AT&T/WorldCom propose, the risks associated with such an approach increase the further into the future the historical data are projected, particularly where key variables (*e.g.*, equipment, technology, demand, traffic patterns) change considerably between the period represented by the historical data and the later period. For example, according to Verizon, dial equipment minute (DEM) growth per line occurred at an average rate of approximately one percent from 1989 to 1996, while per line DEM growth occurred at a rate of five percent between 1996 and 2000.[964] Over time, switch vendors

[960] *See supra* section III(B)(3).

[961] *See infra* section V(C)(1).

[962] *See Inputs Order*, 14 FCC Rcd at 20289, para. 315.

[963] *See* Verizon Ex. 100P, Vols. V, VI, IX (confidential version); Verizon Ex. 25P, Attach. A-G (confidential version); Verizon Ex. 161P, Attach. H-M (confidential version).

[964] Tr. at 5334-36.

modify switch design and service providers modify switch equipment acquisition decisions to accommodate anticipated growth in subscriber usage levels. Because Verizon proposes using the most recent data available, it is not necessary to use an outdated regression trend analysis in the calculation of unbundled switching costs and rates, and instead we rely on the Verizon switching cost study.

370. Technological improvements in switches, moreover, increase the importance of using recent data to determine switching costs. A new switch purchased today can provide more optional or "vertical" features than can the switches reflected in the MSM's sample data. According to Verizon, in the mid-1990s switches included only four vertical features: call waiting, call forwarding, three-way calling, and speed dialing.[965] The Verizon study, in contrast, includes costs for switches that are capable of providing scores of vertical features.[966] There are costs associated with the switch hardware and software required to provide vertical features that should be included in the cost study.[967] The regression equation on which the MSM switch cost inputs are based does not explicitly include a variable for vertical feature costs. Although the regression analysis includes time trend variables intended to capture the effect of time on switch costs,[968] the record does not support a finding that a cost estimate reflecting prices for switches installed between 1989 and 1996, which included relatively few vertical features (and for which there were likely few subscribers), would adequately reflect forward-looking switch costs. Such costs include a considerably larger number of vertical features (and for which there are likely a relatively larger number of subscribers).[969]

371. Similarly, the Verizon switching cost study explicitly includes costs associated

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[965] *Id.* at 5334, 5341-42.

[966] The same vertical feature, however, is included more than once in Verizon's tally of vertical features because some may be offered in connection with more than one service. Verizon Ex. 100P, Vol. VI, section 15, subsection 5.8, Features List at 2 (confidential version); Verizon Ex. 125P, Attach. B-1 (confidential version). The number of distinct vertical features that Verizon offered at the time of the hearing, nevertheless, is substantially greater than the number offered in the mid-1990s.

[967] We expect that these costs will increase as the number of vertical feature subscribers increases. Verizon presumably would need to design its switches to reflect anticipated demand for vertical features.

[968] *Inputs Order*, 14 FCC Rcd at 20287-89, paras. 311-14.

[969] Of the 946 switches in the sample on which the MSM Switching/Transport module is based, only 4 are host or stand alone switches that were installed in 1996, and only 22 are host or stand alone switches that were installed in 1995. *See id.* at 20279, para. 290. (We determined the number and timing of the observations comprising the SM's switch sample through review of these data, which are in the custody of the Bureau's Industry Analysis and Technology Division.) Costs for at least some vertical features are not reflected in the data for remote switches because a remote switch relies on a host switch to provide some vertical feature capability. Thus, the quantity and the quality of the information regarding vertical features switch costs reflected in the more recent 1995-96 observations are limited. In other words, whatever information on vertical feature costs that is reflected in the sample derives primarily from the 1989-1994 data. This compounds our concern that the regression equation does not account for today's vertical feature costs.

with switched digital lines, including ISDN. A switch purchased today serves a much larger percentage of digital lines compared to analog lines than did switches installed during 1989-1996.[970] The MSM produces a blended switch cost reflecting the costs for switches in the sample. That composite cost, based on the ARMIS data, reflects a relatively small percentage of high capacity digital lines and a relatively large percentage of low capacity (4 KHz or equivalent) analog lines. ARMIS data show that high capacity (64 kbps or equivalent) digital lines (*e.g.*, ISDN) did not reach one percent of lines until 1993, more than halfway through the sample period, and that they comprised only 4.28 percent of Verizon's switched access lines in 1996, the last year of the period.[971] In contrast, Verizon's study includes data from the year 2000, when ARMIS data indicate that approximately ten percent of the switched access lines served by Verizon's switches in Virginia were high capacity digital lines.[972] We find that a study based on data that explicitly account for the costs associated with digital lines is superior to a regression analysis based on sample data that may not fully account for the considerable increase in the percentage of digital lines occurring subsequent to the sample period.[973]

372. Further, we note that the Commission's adoption of the SM switching and transport module in the universal service proceeding does not compel the same result here. In the *Platform Order*, the Commission expressed a preference for a simpler switching cost study because switching costs are not as critical as loop costs for universal service purposes.[974] Having

[970] It is uncontroverted that the Verizon study includes switching costs associated with providing ISDN services. *See* Verizon Ex. 125P, Attachs. A, B2, B3, B4, D (confidential version); *see also* Tr. at 5196-200. The MSM Switching/Transport module, in contrast, relies on the regression trend analysis applied to data from 1989 to 1996. Indeed, AT&T/WorldCom concede that the SM, and therefore the MSM, does not produce cost estimates for ISDN. Tr. at 5197, 5199; *see also* AT&T/WorldCom Ex. 16 (Pitts Surrebuttal), at 4. The study that served as the basis for the MSM switching cost regression equation also indicates that ISDN switching costs are not fully reflected in the SM. *See* Gabel Study, *supra* note 765, at 114 ("During the years covered by this data set the overwhelming majority of the lines were for voice service. Therefore, to a large extent, the per line investment estimates do not reflect the additional costs associated with providing ISDN lines on a digital switching machine.").

[971] ARMIS Report 43-08, Table III (Access Lines in Service of Customer).

[972] *Id.* In addition, the MSM's regression trend analysis relies on data from 1989-1996, years in which, according to Verizon, DEMs grew by approximately one percent, and extrapolates such data to 1996-2000, years in which DEMs grew by approximately five percent. Tr. at 5334-36. We question the accuracy of using trend terms from a slow DEM growth period to estimate costs for a subsequent relatively fast growth period.

[973] Because, for the above stated reasons, we find the Verizon switching cost study preferable to the MSM Switching/Transport module, we need not address Verizon's other criticisms (*e.g.*, MDF and power costs, central office construction costs, peak period investment) of the MSM.

We note that neither side offered any significant testimony in support of its signaling cost studies. Because we adopt the Verizon switching cost study and because signaling is usually only provided in conjunction with switching, we adopt the CCSCIS to generate signaling rates. For the reasons we explain *infra* in section IX, we require Verizon to rerun its signaling cost study incorporating our findings regarding cost of capital, depreciation, and ACFs.

[974] *See Platform Order*, 13 FCC Rcd at 21354-55, paras. 75, 77.

concluded that the Verizon cost study is superior to the MSM for calculating unbundled switching costs, we place less weight on the relative simplicity of the MSM's Switching/Transport module. Similarly, concerns expressed in the universal service proceeding regarding the SCIS model's use of proprietary data do not arise here.[975] In this proceeding, AT&T/WorldCom and Bureau staff have had access to the Verizon study and its underlying data. Indeed, AT&T/WorldCom were able to re-run the Verizon switching cost study using different input data and thereby to propose restated switching rates.[976]

373. Finally, we have considered the effects of adopting the MSM for loop rates and the Verizon cost study for switching rates and believe that doing so is reasonable in the circumstances before us. In contrast to the relative cost analysis performed in the universal service proceeding, here the TELRIC rules require that we establish rates for each UNE, including switching, based on the costs attributable to that UNE.[977] Rates for a particular UNE are based on the total costs of the element divided by the total demand for the element.[978] Consistency between assumptions and data for the costs and the demand of a particular element is, therefore, crucial to determining the per unit costs of that element. Identity of model assumptions and data between different elements is not essential so long as they otherwise meet our key model criteria. Neither side, however, submitted cost studies that contain identical or consistent inputs and assumptions across all elements. For example, Verizon did not optimize inputs and outputs between its switching and loop cost studies,[979] and AT&T/WorldCom propose using the MSM for some UNEs and Verizon's cost studies for others.[980]

B. Shared Cost Allocation Between End-Office and Tandem Switching Functions

374. In the Verizon switching cost study, nine of the switches are combined end-office and tandem switches.[981] All other switches are either exclusively end-office switches or exclusively tandem switches.[982] In order to calculate end-office and tandem switching costs, we must determine the appropriate allocation of costs that are shared between end-office switching

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975 *See id.* at 21355-56, paras. 77-78.

976 AT&T/WorldCom Ex. 12, at 97; AT&T/WorldCom Ex. 24 (Pitts Supplemental Surrebuttal), at 18-19.

977 *See* 47 C.F.R. § 51.505(a)-(c).

978 *See* 47 C.F.R. § 51.505(b).

979 Tr. at 4141-42.

980 *See infra* sections VI(A), IX.

981 Verizon Ex. 125 (Matt Supplemental Surrebuttal), Attach. H. Each combined switch in the Verizon study is a Lucent 5ESS switch. *Id.*

982 *See id.*

and tandem switching functions.

1. Positions of the Parties

375. Verizon proposes allocating shared costs as follows: It first uses the SCIS/MO to estimate the pure end-office switch costs.[983] Verizon then re-runs the SCIS/MO to estimate the combined pure end-office switch and combined end-office/tandem switch costs.[984] It determines the amount by which costs obtained in the second model run exceed those obtained in the first model run to arrive at the incremental investment associated with adding tandem trunks to end offices.[985] Verizon proposes to allocate only this incremental tandem investment to tandem switching.[986]

376. AT&T/WorldCom oppose Verizon's approach to allocating shared end-office and tandem switching costs. They contend that end-office switching costs should reflect efficiencies associated with combined end-office/tandem switch equipment.[987] Specifically, they assert that, for combined switches, the "getting started,"[988] equivalent POTS half call (EPHC), and SS7 link investment costs are common to both end-office and tandem switching functions.[989] They propose allocating "getting started" and EPHC investments to end-office switching and to tandem switching based on the relative number of local line and trunk ports and tandem ports.[990] They further propose developing allocation factors by converting line ports to equivalent trunk ports, because line ports use fewer switch resources than do trunk ports and because lines are concentrated whereas trunks have dedicated paths through the switch.[991] AT&T/WorldCom propose using a 4:1 line concentration ratio[992] to determine the number of trunk ports (*i.e.*, divide

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[983] We use the term "pure end-office switch" to refer to a switch that provides line-to-line and line-to-trunk, but not trunk-to-trunk, switching.

[984] We use the term "combined end-office/tandem switch" to refer to a switch that provides line-to-line, line-to-trunk, and trunk-to-trunk switching.

[985] Verizon Ex. 161 (Matt Second Supplemental Surrebuttal), at 5-6.

[986] *Id.*

[987] AT&T/WorldCom Ex. 24, at 10-13

[988] The "getting started" cost of the switch, also known as the "first cost," represents the costs of the central processor, memory, maintenance, administrative, test, and spare equipment, and other common equipment. Similarly, "getting started" investment refers to investment for such equipment, and "getting started" equipment refers to this equipment.

[989] AT&T/WorldCom Ex. 24, at 12.

[990] *Id.*

[991] *Id.* at 12 n.18.

the number of lines by four) in this allocation.[993] They also contend that SS7 link investments are limited to trunks and therefore should be allocated based on the relative number of end-office trunk ports and tandem trunk ports.[994]

2. Discussion

377. We adopt Verizon's approach to allocating costs that are shared between end-office and tandem switching functions. As a preliminary matter, we note that the effect of using AT&T/WorldCom's proposed allocation factors instead of Verizon's would be fairly minimal. AT&T/WorldCom estimate that use of their allocation factors would reduce Verizon's end-office switch costs by only four percent.[995]

378. Verizon's approach is preferable for several reasons. First, as we explain *infra* in the end-office switching rate structure section, we require Verizon to recover end-office switching costs, including "getting started," EPHC, and SS7 link costs, on a flat, per line basis, and not on a per MOU basis.[996] Any "getting started," EPHC, and SS7 link costs shared between tandem and end-office switch functions that are allocated to tandem switching would, however, under the parties' proposed tandem rate structures, be recovered on a per MOU basis. Second, recovery of these shared costs through either element will permit total element cost recovery and should not affect the total payments made by competitive LECs. Because the shared costs that AT&T/WorldCom propose allocating to tandem switching would equal precisely the shared costs that would be allocated away from end-office switching, and because we expect that competitive LECs that purchase unbundled end-office switching are also likely to purchase unbundled tandem switching, competitive LEC payments for these two switching elements

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[992] Line concentration enables a LEC to reduce the number of DS-1 feeder facilities necessary by assigning a feeder transmission path as a telephone call is made instead of dedicating a specific channel in the feeder plant to a particular line at all times. *See* Verizon Ex. 122, at 183-85; Verizon Switching Cost Brief at 14. Concentration is possible because not all callers use the telephone at the same time.

[993] AT&T/WorldCom Ex. 24, at 12 n.18. In their restatement of the Verizon studies, AT&T/WorldCom allocate "getting started" and EPHC investments to end-office switching and tandem switching, respectively, based on the following formulas: ((lines/4) + local trunks)/((lines/4) + local trunks + tandem trunks) and tandem trunks/((lines/4) + local trunks + tandem trunks). They apply these allocation factors to 5ESS end-office switch and combined end-office/tandem switch investment. They do not apply these factors to Nortel or Siemens switch investment because none of the Nortel or Siemens switches is a combined end-office/tandem switch. *Id.*; *see also infra* section V(C)(3).

[994] AT&T/WorldCom Ex. 24, at 12 n.18. In their restatement of the Verizon studies, AT&T/WorldCom allocate SS7 link investments to end-office switching and tandem switching, respectively, based on the following formulas: local trunks/(local trunks + tandem trunks) and tandem trunks/(local trunks + tandem trunks). They apply these allocation factors to 5ESS end-office switch and combined end-office/tandem switch investment. They do not apply these factors to Nortel or Siemens switch investment because none of the Nortel or Siemens switches is a combined end-office/tandem switch. *Id.*

[995] *See id.* at 12.

[996] *See infra* section V(D).

would not vary significantly regardless of the allocation of shared costs.[997] AT&T/WorldCom fail to provide an economic rationale to support their proposed allocation factors, and, indeed, there is no absolute economically "correct" method of allocating shared costs. Accordingly, we find it preferable to allocate the shared switching costs to end-office switching because, as we explain *infra*, end-office switching costs will be recovered on a flat, per line basis.[998]

379. In addition, we note that AT&T/WorldCom do not justify their proposal to use a 4:1 line concentration ratio to convert line ports to equivalent trunk ports. This concentration ratio would be used to convert all of Verizon's lines to equivalent trunk ports and therefore should be based on the average of the efficient ratios for all lines. Although AT&T/WorldCom acknowledge that line concentration ratios vary widely, they propose the same 4:1 line concentration ratio they recommend for use with GR-303 NGDLC systems.[999] They fail to offer evidence, however, that the concentration ratio that they recommend for GR-303-based lines represents an average of the efficient ratios for all of Verizon's lines, including both analog lines and GR-303-based lines.

C. Cost Inputs

380. Having chosen a switching cost model and determined the allocation of shared end-office/tandem switching costs, we now resolve the cost input issues raised by the parties.

1. Switch Discount

a. Positions of the Parties

381. There is no dispute that large carriers such as Verizon routinely receive substantial discounts off the manufacturer's list price when purchasing switches.[1000] In the SCIS model, the amount of this discount represents a significant variable in calculating switch prices. The amount of the discount may vary considerably depending on whether the discount is for new switches or for additional equipment to accommodate additional users.[1001]

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[997] Verizon argues that AT&T/WorldCom's proposed allocation methodology would reallocate combined end-office and tandem switch costs between end-office and tandem switching elements, but would not change the total amount of these costs. Verizon Reply Cost Brief at 113-14. We agree with Verizon based on our review of AT&T/WorldCom's restatement of Verizon's end-office and tandem switching cost studies.

[998] *See infra* section V(D).

[999] Analog line concentration is engineered within the switch, whereas GR-303-based line concentration is engineered outside the switch in the DLC system. As we explain *infra*, we adopt for GR-303 lines Verizon's proposed 3:1 concentration ratio rather than AT&T/WorldCom's proposed 4:1 ratio. *See infra* section V(C)(3).

[1000] *See, e.g.,* AT&T/WorldCom Switching Cost Brief at 5; Verizon Switching Cost Brief at 1-2.

[1001] *See, e.g.,* AT&T WorldCom Switching Cost Brief at 5; Verizon Switching Cost Brief at 1-2, 3-4.

382. Verizon states that its proposed switching costs properly reflect the best available estimate of the discounts that Verizon would receive as it incrementally upgrades and expands its network and that they are therefore appropriate for use in determining its forward-looking switching costs.[1002] Verizon bases the discount it uses in the SCIS model for the Lucent 5ESS switch and the Siemens EWSD switch on the discount it received on year 2000 purchases.[1003] It bases the discount for the Nortel DMS-100 and DMS-200 switches on the discount reflected in its current contract with Nortel and the purchases Verizon expects to make under this contract.[1004] Verizon's proposed discounts reflect almost entirely the discounts it receives on additions to existing switches (the "growth discount," as opposed to the "new switch discount"), because the purchases on which the proposed discounts are based are almost entirely for switch growth and upgrade equipment.[1005] Verizon argues that AT&T/WorldCom's proposed all-new switch discount is unrealistic and has been previously rejected by this Commission, the D.C. Circuit, and state commissions as inconsistent with TELRIC principles.[1006]

383. AT&T/WorldCom argue that the Commission's TELRIC pricing rules require the use of the most efficient technology and thus assume the deployment of new switching equipment.[1007] Therefore, they argue that the new switch discount is the appropriate discount for calculating the cost of this equipment.[1008] Furthermore, although the discounts that vendors give for purchasing a new switch historically have been greater than the discounts for add-on equipment or growth to an existing switch, AT&T/WorldCom assert that, more recently, Verizon has filed testimony in a variety of proceedings stating that the discounts it now receives for growth equipment have deepened and are roughly the same as the discounts for a new switch.[1009] Thus, AT&T/WorldCom argue that it is reasonable to rely entirely on new switch discounts when developing switch costs in this proceeding.

384. In contrast to the extensive record developed concerning end-office switching, the

[1002] Tr. at 5230, 5235; Verizon Switching Cost Brief at 4. Verizon's proposed discounts and supporting data for the Lucent 5ESS switch and Nortel DMS-100 and DMS-200 switches are set out in its cost studies. *See* Verizon Ex. 100P, Vol. IX, Tab VA Switch Discount Support, Exhibit Part C-P1 and Part C-P2 (confidential version). Its proposed discount and supporting data for the Siemens EWSD switch are set out in Verizon Ex. 122P (Recurring Cost Panel Surrebuttal), Attach. O (confidential version).

[1003] Verizon Ex. 122, at 166-67.

[1004] *Id.* at 167.

[1005] *See id.*; Verizon Ex. 125P, Attach. D (confidential version); Verizon Ex. 212P (Verizon response to record request no. 28 (requested Nov. 28, 2001)) (confidential version).

[1006] Verizon Switching Cost Brief at 6-7, 9-10 (citing *AT&T Corp. v. FCC*, 220 F.3d at 618).

[1007] AT&T/WorldCom Switching Cost Brief at 5-7; AT&T/WorldCom Reply Cost Brief at 82.

[1008] AT&T/WorldCom Switching Cost Brief at 6-7; AT&T/WorldCom Reply Cost Brief at 82.

[1009] AT&T/WorldCom Reply Cost Brief at 82.

parties devote little attention to tandem switching issues in their oral and written testimonies. Although the issues associated with tandem switching are similar to those associated with end-office switching, distinctions do exist and we address these distinctions as necessary.

b. Discussion

385. Switch vendors typically have provided relatively large discounts on the carrier's initial switch investment and smaller discounts on growth jobs based on their expectation that the carrier would grow the switch over time.[1010] A LEC that seeks to minimize switching costs over time may: (1) install a relatively large switch (on which there typically is a relatively large vendor discount) built to satisfy current demand and any demand growth expected over the life of the switch; or (2) install a relatively smaller switch built to satisfy current demand, and then "grow" the switch by adding components (on which there is a relatively small vendor discount) over time as demand increases. An efficient carrier would be expected to choose the option that has the least cost on an expected present value basis,[1011] *i.e.*, the expected value of the initial and the future cash outlays associated with each option discounted to present worth at the company's cost of capital.

386. Switching has a high degree of modularity, making it relatively cost effective to grow a switch over time by adding components to it.[1012] Moreover, as Verizon argues, efficient carriers do add to or grow their switches over time,[1013] presumably because they expect this approach to minimize costs. By growing the switch over time, rather than installing a large switch, the carrier reduces the risk and cost of installing too much capacity, given that demand growth is always uncertain. Furthermore, by growing the switch over time, the carrier reduces the risk and cost of installing unused capacity that becomes obsolete and is replaced, given that technological change is also uncertain. The carrier also reduces the costs of financing and maintaining the switch over its life by growing it over time.[1014]

[1010] *See, e.g., Georgia/Louisiana 271 Order*, 17 FCC Rcd at 9059, para. 81 (generally, vendors have provided a greater discount for new switches and smaller discounts for growth or expansion of existing switches).

[1011] Present value refers to the worth today of a payment, or a series of payments, to be made in the future. The concept of present value is illustrated by asking the following question: how much money today is equivalent to $100.00 one year from today, if this sum can be invested and earn a 10 percent annual rate of return? The answer is $90.91 because $90.91 invested at ten percent would grow to 100.00 ($100.00/1.10). In this example, $90.91 is the present value of $100.00 payable one year from today.

[1012] Verizon Ex. 123 (Garfield Surrebuttal), at 10-11; AT&T/WorldCom Ex. 12, at 113-14; Tr. at 5440-42, 5445-47.

[1013] Verizon Ex. 122, at 166-67.

[1014] If carriers did not typically grow their switches over time, it is unlikely that switch vendors would provide relatively large discounts on the initial switch investment. *Id.* at 178-179; Verizon Switching Cost Brief at 9-10; Verizon Reply Cost Brief at 101-102; *see also Joint Application by BellSouth Corporation, BellSouth Telecommunications, Inc. and BellSouth Long Distance, Inc. for Provision of In-Region, InterLATA Services in* (continued....)

387. Accordingly, as a threshold matter, we conclude that TELRIC-based switch costs should reflect switch manufacturer prices for both new equipment and growth equipment; therefore, we reject both Verizon's proposed discount (based largely on growth additions) and AT&T/WorldCom's proposed discount (based entirely on new switch purchases). This limited departure from baseball arbitration is consistent with Commission precedent regarding switch discounts in the context of section 271 applications. Upon consideration of arguments similar to those presented here, the Commission found that an assumption of 100 percent growth additions is inconsistent with TELRIC principles, but it also rejected arguments that the TELRIC rules require an assumption of 100 percent new switches.[1015]

388. In order to implement this conclusion, we require Verizon to use in the SCIS model three separate vendor discounts to model costs attributable to end-office switching, as set forth in sections V(C)(1)(b)(i)(a), V(C)(1)(b)(ii)(a), and V(C)(1)(b)(iii), below. First, we will use the discounts that Verizon currently receives on new switches in order to calculate "getting started" investment.[1016] Second, we will use a weighted average discount reflecting Verizon's current discount on new switches and growth equipment in order to estimate switch investment other than "getting started," trunk port, and SS7 link investment. Third, we will use a separate discount for end-office switching investment attributable to trunk ports and SS7 links.

389. We must also develop vendor discounts for new switches and growth equipment for use in the SCIS model to develop tandem switching costs. Based on the record before us, we conclude that the appropriate discounts for tandem switching costs are similar to the discounts for end-office switching.[1017] For tandem switching, however, we conclude that we need only two discounts. We will use the discounts that Verizon currently receives on new switches for tandem switching "getting started" investment. We will use a weighted average discount reflecting Verizon's current discounts on new switches and growth equipment for estimating tandem switch investment, other than "getting started" investment.

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Alabama, Kentucky, Mississippi, North Carolina, and South Carolina, WC Docket No. 02-150, Memorandum Opinion and Order, 17 FCC Rcd 17595, 17635, para. 83 (2002) (*BellSouth Multistate 271 Order*) (levels of new and growth switch discounts reflect vendors' judgments about anticipated purchases); *Georgia/Louisiana 271 Order*, 17 FCC Rcd at 9059, para. 81 (vendor discounts are valid only when an overall purchase of both new and growth equipment is made).

[1015] *See, e.g., Rhode Island 271 Order*, 17 FCC Rcd at 3318, para 34 (The Commission "strongly question[ed]" an assumption of 100 percent growth additions. "Although an efficient competitor might anticipate some growth additions over the long run, rates based on an assumption of all growth additions and no new switches do not comply with TELRIC principles."); *Georgia/Louisiana 271 Order*, 17 FCC Rcd at 9059-60, para. 82 (rejecting AT&T's claim that the use of a mix of new and growth switch purchases in a cost model may never be used to determine forward-looking costs, because it may not be cost-effective to acquire all of the projected need at the outset).

[1016] As we explain *supra* note 988, the "getting started" equipment is the central processor, memory, maintenance, administrative, test, and spare equipment, and other common equipment.

[1017] *See, e.g.,* Verizon Ex. 107, at 194.

(i) "Getting Started" Switch Investment Discount

(a) End-Office Switch "Getting Started" Investment

390. As we discuss more fully below, we conclude that end-office "getting started" investment is best estimated using the discounts that Verizon currently receives on new switches. Thus Verizon should estimate end-office "getting started" investment using the discounts it received on new switch purchases in 2000.[1018]

391. We agree with AT&T/WorldCom that, for purposes of selecting the appropriate switch discount, the "getting started" costs are fixed costs.[1019] That is, they are costs that do not vary with the number of lines, trunks, or usage on the switch. Verizon agreed with AT&T/WorldCom that switch manufacturers today design switches that are limited only in the number of lines that they can serve.[1020] As Verizon noted at the hearings, advances in digital switching have increased the capacity of the switch to as many as 250,000 lines.[1021] Each of Verizon's wire centers in Virginia serves far fewer than 250,000 switched access lines.[1022] Verizon acknowledges, moreover, that the central processor of the Lucent 5ESS switch, which accounts for a large majority of Verizon's switch costs and lines,[1023] will not exhaust.[1024] Verizon also states that it has not had to install as many new switches in recent years as it would have had the processor limit been exceeded.[1025] The SCIS model is consistent with these real-world experiences. The office-by-office results in Verizon's SCIS study show extremely low levels of processor utilization, indicating that the amount of traffic on switches could increase tremendously without the need to add processor capacity.[1026] Verizon's study also shows that the central processor of each of its switch technologies is expected to have so much capacity that it

[1018] In response to a staff record request, Verizon identified the discounts it actually received in 2000 on new Lucent 5ESS, Nortel DMS-100, and Siemens EWSD switches. *See* Verizon Ex. 216P (Verizon response to record request no. 32 (requested Nov. 28, 2001)) (confidential version). We direct Verizon to use these actual new switch discounts to estimate end-office "getting started" investment for the Lucent 5ESS, Nortel DMS-100, and Siemens EWSD switches in its compliance filing. *See id.*

[1019] *See* AT&T/WorldCom Ex. 4, at 7-8; AT&T/WorldCom Ex. 12, at 11-12.

[1020] Tr. at 3448-49.

[1021] *Id.* at 5381-82, 5449-50.

[1022] Verizon Ex. 226P (Verizon response to record request no. 42 (requested Nov. 29, 2001)) (confidential version).

[1023] *See* Verizon Ex. 123, at 10; *see also* Verizon Ex. 125P, Attach. D (confidential version).

[1024] Tr. at 5457 (Gansert: "[O]ur assumption at the current time would be that for most of our switches the central processor is not going to exhaust.").

[1025] *Id.* at 5449 (Gansert: "[I]t's true that if you exceeded the [processor's] limit, you would have to put in more switches, and over recent years we haven't been doing that.").

[1026] AT&T/WorldCom Ex. 12, at 111-12.

need not be replaced over the life of the switch.[1027] Finally, the SCIS model user guide indicates that the "getting started" costs for the switch technology in the Verizon study that accounts for most of the investment and most of the lines are independent of both usage and the number of lines.[1028]

392. Verizon does provide examples of components of the "getting started" equipment that it has replaced or augmented over the life of the switch.[1029] Verizon fails, however, to provide empirical evidence to quantify the extent to which it has grown or replaced the "getting started" components of the switch. It does not, for example, provide any evidence to support an estimate of the percentage of overall investment in the "getting started" components of a modern switch that would be installed initially and the percentage that would be installed subsequent to the initial installation date. These examples therefore do not undermine the other record evidence that supports the conclusion that the new switch discount is appropriate for estimating the "getting started" investment.

393. Moreover, whatever the extent to which "getting started" equipment is replaced or augmented, Verizon acknowledges that a primary reason for doing so is to upgrade the switch, not to accommodate growth, especially for the Lucent 5ESS switch, which comprises the majority of Verizon's switch investment.[1030] To the extent that "getting started" equipment is augmented or replaced for reasons other than growth, use of a discount other than the new switch discount to develop "getting started" investment would result in rates that recover from current subscribers costs for future upgrades from which they receive no benefit today.

394. Finally, Verizon's experience with regard to replacing or augmenting "getting started" equipment derives in part from switches that were installed many years ago and that have had lives exceeding those that may be expected for a modern digital switch installed today, the starting point for developing forward-looking costs. That is, a switch installed today may never reach the age of a number of Verizon's existing switches. We recognize that a modern digital switch installed today may have a relatively shorter life by prescribing a 12-year switch life as the basis for calculating depreciation expense.[1031] This 12-year life is at the low end of the Commission's safe-harbor range and likely is shorter than one that we would have prescribed for developing unbundled switching prices several years ago. Given that a digital switch installed today would have a shorter life than one installed years ago, we also would expect that

[1027] *Id.*

[1028] AT&T/WorldCom Ex. 24P (Pitts Supplemental Surrebuttal), at 16-17 (confidential version); *see also* Verizon Ex. 123, at 6 (stating that SCIS models "the investment for processor-related equipment and other equipment independent of switch size (*i.e.*, lines and trunks) and traffic").

[1029] Verizon Ex. 122, at 175.

[1030] *Id.* at 178; Tr. at 5434-38, 5440-41 (for example, carriers might add processing capacity over time to run application software that supports advanced features or to accommodate new regulatory mandates, such as LNP).

[1031] *See supra* section III(D)(3).

commensurately less of the "getting started" equipment would be replaced or augmented over the life of a switch installed today than would be the case with respect to a switch installed years ago. Thus, based on the record before us, we find it inappropriate to use a discount other than the new switch discount to estimate "getting started" investment.

395. We base the new switch discounts for use in estimating the "getting started" investment on the discounts Verizon actually received on new switch purchases it made in 2000.[1032] These discounts are appropriate for calculating forward-looking costs, because they are discounts actually received through a competitive bidding process on recent (as of the time the record closed) new switch purchases.

396. Verizon argues that use of the switch discounts it received on new switch purchases to calculate the weighted average discount would understate its costs because digital circuit switching is at the end of its life-cycle.[1033] It argues that vendors offer higher discounts at the end of a life-cycle because research and development costs for these switches are lower than at the beginning of the cycle.[1034] We disagree. Record evidence indicates that an efficient carrier would receive this discount on the purchase of a new switch today, and that is the appropriate basis for determining the level of the vendor discount under the Commission's TELRIC rules. There is no record evidence that Verizon is replacing digital circuit switches with a newer technology, *e.g.*, packet switches. Moreover, as noted above, the relatively short 12-year depreciation life we adopt for switching adequately captures the effect of nearing the end of the digital switching life-cycle on an efficient carrier's switching costs.[1035]

397. AT&T/WorldCom restate Verizon's switch cost study by basing investment for each component of the switch on the new switch discount.[1036] In this re-statement, they use new switch discounts reflected in Verizon's contracts with Lucent, Nortel, and Siemens that were obtained through discovery in a UNE pricing proceeding before the New Jersey Commission.[1037] AT&T/WorldCom argue that, for one of these switch technologies, use of the discount obtained during the New Jersey proceeding in their restatement of Verizon's cost study results in an overstatement of Verizon's costs because Verizon acknowledges receiving a much higher

[1032] As we explain below, these discounts also will be used in calculating the weighted average discount used to estimate investment other than "getting started" investment.

[1033] Verizon Ex. 213P (Verizon response to record request no. 29 (requested Nov. 28, 2001)) (confidential version); Verizon Switching Cost Brief at 5-6.

[1034] Verizon Ex. 213P (confidential version); Verizon Switching Cost Brief at 5-6.

[1035] *See supra* section III(D).

[1036] AT&T/WorldCom Ex. 12, at 104.

[1037] *Id.* at 104, Attach. 3.

discount on more recent new switch purchases of this technology.[1038]

398. We reject the new switch discounts proposed by AT&T/WorldCom for use in Verizon's switching cost study because they are based on older contracts that may not reflect the discount Verizon would receive for new switches obtained though a competitive bidding process.[1039] We have been unable to determine the dates of some of the contracts on which AT&T/WorldCom rely,[1040] but the contract with Lucent for 5ESS switches, which account for a large majority of Verizon's switch costs and lines in its study,[1041] is a 1997 contract that was not subject to a competitive bidding process.[1042] The parties agreed, however, that new switch prices reflected in prior vendor contracts typically represent the highest prices that Verizon would pay, given that it might obtain a lower price from competitive bids.[1043] Use of prior contract prices for new switches may therefore overstate the price that an efficient carrier would pay today for a new switch. Thus we conclude that Verizon's year 2000 new switch purchases, which it made pursuant to a competitive bid process, are the best record evidence of the new switch discounts an efficient carrier would receive. Finally, we note that, in any event, the discounts reflected in the contracts proffered by AT&T/WorldCom are comparable to those Verizon received for its 2000 new switch purchases, particularly for Lucent 5ESS switches.

(b) Tandem Switch "Getting Started" Investment

399. We adopt discounts for estimating tandem switching "getting started" investment for Lucent 5ESS and DMS-200 switches that are the same as the discounts Verizon actually received on new end-office switch purchases in 2000.[1044] We find that tandem switching "getting started" investment is best estimated using these discounts for three reasons. First, these are discounts actually received on relatively recent new switch purchases. Second, no party argues that there is a difference between the vendor discounts that apply to end-office and tandem switching equipment. Verizon uses the same vendor discount in its tandem switching study as it

[1038] AT&T/WorldCom Switching Cost Brief at 13 n.14. The information on the new switch discount that Verizon received in 2000 from the vendor of this particular technology apparently was not available to AT&T/WorldCom before they submitted their re-statement.

[1039] Verizon Ex. 122, at 173; Verizon Ex. 216P (confidential version); Verizon Ex. 217P (Verizon response to record request no. 33 (requested Nov. 28, 2001)) (confidential version).

[1040] *See* AT&T/WorldCom Ex. 12, Attach. 3; Verizon Ex. 218P (Verizon response to record request no. 34 (requested Nov. 28, 2001)) (confidential version). Neither of these sources provides copies of the contracts relied on by AT&T/WorldCom or clearly indicates the years these in which these contracts were executed.

[1041] *See* Verizon Ex. 123, at 10.

[1042] *See* Verizon Ex. 218P (confidential version).

[1043] AT&T/WorldCom Ex. 12, at 104; Tr. at 5269-71.

[1044] We direct Verizon to use in its compliance filing the new Lucent 5ESS and DMS-100 switch discounts identified in its response to staff record request no. 32. *See* Verizon Ex. 216P (confidential version).

does in its end-office switching study.[1045] AT&T/WorldCom re-state Verizon's end-office and tandem switching study using the same vendor discount.[1046] Third, nine of the 13 switches for which investment is developed in Verizon's tandem switch study provide both tandem and end-office switching functions.[1047]

(ii) Other Switch Investment

400. In order to implement our conclusion that switching costs should reflect a combination of new and growth purchases,[1048] we must develop weights to assign to the new and growth switch discounts. As we explain more fully below, to determine the appropriate weights, we must estimate, for end-office switches, line growth over the life of the switch and, for tandem switching, tandem trunk growth over the life of the switch.

(a) End-Office Switch Investment (Other Than "Getting Started," Trunk Port, and SS7 Link Investment)

401. To estimate end-office switching investment, other than "getting started" investment and trunk port and SS7 link investment (other end-office switch investment), we adopt weighted average discounts for the Lucent 5ESS, Nortel DMS-100, and Siemens EWSD switches.[1049] We require Verizon to modify its end-office switching study by: (1) calculating the weighted average discount for each of these switch technologies using the discounts and the new line and growth line weights discussed below; and (2) estimating other end-office switch investment for each of these switch technologies using each of these weighted average discounts.

402. *Weighting*. We determine the new switch and growth equipment weights for use in calculating the weighted average discount applicable to other end-office switch investment as follows: First, we assume that a new switch sized to serve current demand is placed in service today, and then we calculate the percentages of the present value for the investments required for all lines expected to be installed on the switch over its life representing both lines installed today (new lines) and lines expected to be installed on the switch over its life other than those installed

[1045] Verizon Ex 107, at 194, 207-208.

[1046] AT&T/WorldCom Ex. 12, at 104, Attach. 3.

[1047] The nine switches that provide both end-office and tandem switching functions are Lucent 5ESS switches. Verizon also develops in its study investment for one 5ESS tandem switch and three Nortel DMS-200 switches that provide only tandem switching. Verizon Ex. 161P, at 5, Attach. H.

[1048] *See supra* para. 386.

[1049] The weighted average discounts that we adopt in this order are to be calculated by: (1) multiplying the weight we adopt for the new switch discount by the new switch discount we adopt; (2) multiplying the weight we adopt for the growth switch equipment discount by the growth switch equipment discount we adopt; and (3) summing (1) and (2).

today (growth lines). The first percentage is the weight that applies to the new discount. The second percentage is the weight that applies to the growth discount. Present values are appropriate because they recognize that money has a time value, and the capital outlay for the growth lines is incurred in the future, not today.[1050]

403. We base the present value analysis on the following assumptions: (1) a cost of capital of 12.95 percent as discussed in section III(C)(3) *supra*; (2) a 2.5 percent annual line growth rate, as explained below; (3) growth lines are installed every two years;[1051] and (4) a switch life of 12 years as discussed in section III(D)(3) *supra*. Given these assumptions, the percentage of new lines installed on the switch is 88 percent, and the percentage of growth lines is 12 percent.[1052]

404. The 2.5 percent annual line growth rate is our finding of estimated line growth over the 12-year life of a switch that is placed into service today. This growth rate estimate is consistent with the annual switched line growth rate assumed by Verizon in its switching cost study for the period 2001-2003.[1053] It is lower than the 4.58 percent annual switched line growth rate assumed by AT&T/WorldCom in the MSM for the period 2001-2002.[1054] We find that the AT&T/WorldCom forecasted growth rate is too high for their forecasted periods, and much too high for the 12-year life of a switch placed in service today. ARMIS data show that Verizon VA's switched access lines grew at rates of 5.01, 6.68, 5.62, 5.01, .51, and -5.13 percent for 1996 through 2001, respectively.[1055] The geometric average annual growth rate for the period 1996-2001 is 2.87 percent, and the arithmetic average annual growth rate is 2.95 percent. These numbers capture the growth rate after the passage of the 1996 Act. More recently, growth has slowed. The geometric average annual growth rate for the years 1999-2001 is .05 percent, and the arithmetic average annual growth rate for this period is .13 percent. These numbers capture the more recent downward trend in the rate of growth of switched access lines. In light of these trends, we find that a 2.5 percent growth rate is a reasonable estimate of the growth rate of Verizon VA's switched access lines over the next 12 years.

[1050] One generally prefers having an amount of money today to having the same amount of money at some point in the future. Consider the worth of a dollar received today versus the worth of a dollar received in the future. The dollar that is received today is worth more than one received in the future because a return on today's dollar may be earned immediately by investing it, but none may be earned on a future dollar until it is received.

[1051] The assumption that growth lines are installed every two years is based on the opinions expressed at the hearings by both Verizon and AT&T/WorldCom. Both parties agreed that LECs typically add lines to the switch approximately every two or three years. Tr. at 5265-67. There is no significant difference in the results of the present value analysis if lines are assumed to be added every three years, rather than every two years.

[1052] *See* Appendix C.

[1053] Verizon Ex. 226P (confidential version).

[1054] AT&T/WorldCom Ex. 23, Attach. D.

[1055] ARMIS Report 43-08: Switch Access Lines in Service by Technology.

405. *New and Growth Switch Discounts*. We must select new and growth switch discounts in order to calculate the weighted average discount used to estimate other end-office switching investments. For the reasons set forth above,[1056] we adopt new switch discounts based on the new switches Verizon purchased in 2000.[1057]

406. We adopt growth switch discounts for the Lucent 5ESS and the Siemens EWSD based on the growth and upgrade purchases Verizon made in 2000[1058] because they are discounts actually received on recent growth and upgrade purchases. For Nortel DMS-100 switches, we adopt a growth switch discount that is based on the discount Verizon receives on growth and upgrade purchases under its current contract.[1059]

(b) Tandem Switch Investment Other Than "Getting Started" Investment

407. Based on the weights and discounts discussed below, we adopt weighted average discounts to estimate tandem switching investment, other than "getting started" investment (tandem switching other investment), for the Lucent 5ESS and Nortel DMS-200 switches. We require Verizon to modify its tandem-office switching study by: (1) calculating the weighted average discount for each of these switch technologies using the discounts and the new trunk and growth trunk weights discussed below; and (2) estimating tandem switching other investment for each of these switch technologies using each of these weighted average discounts.

408. *Weighting*. We determine the new tandem switch and growth equipment discount weights for use in calculating the weighted average discount applicable to tandem switching other investment as follows: First, we assume that a new tandem switch sized to serve current demand is placed in service today, and then we calculate the percentages of the present value of

[1056] *See supra* section V(C)(1)(b)(i)(a).

[1057] We direct Verizon to use the new Lucent 5ESS, Nortel DMS-100, and Siemens EWSD switch discounts identified in its response to staff record request no. 32 in its compliance filing. *See* Verizon Ex. 216P (confidential version).

[1058] We direct Verizon to use as the growth discount for the Lucent 5ESS and Siemens EWSD switches in its compliance filing the growth discounts that it identified for each of these switches in response to staff record request no. 29. *See* Verizon Ex. 213P (confidential version). The Lucent 5ESS growth discount identified in Verizon's response to this record request is equal to the Lucent discount in Verizon's cost study. *Compare id., with* Verizon 100P, Vol. IX, VA Switch Discount Support, Exhibit Part C-P1 (confidential version). The Siemens growth discount identified in Verizon's response to this record request is based on the switch equipment expenditure data identified in the cost study accompanying Verizon's surrebuttal panel testimony. *See* Verizon Ex. 125P, Attach. O, (revised) Exhibit C-P3 (confidential version). It is not identical to the discount in Attachment O because the data in that attachment include expenditures on new switch and growth and upgrade equipment. The Siemens discount identified in response to the record request reflects only expenditures on growth and upgrade equipment.

[1059] We direct Verizon to use as the growth discount for the DMS-100 switch in its compliance filing the Nortel discount identified in Verizon's cost study. *See* Verizon Ex. 100P, Vol. IX, VA Switch Discount Support, Exhibit Part C-P2, at 2 (confidential version).

the investments required for trunks expected to be installed on the switch over its life representing: (1) trunks installed today (new trunks); and (2) trunks expected to be installed on the switch over its life other than those installed today (growth trunks). The first percentage is the weight that applies to the new discount. The second percentage is the weight that applies to the growth discount.

409. We base the present value analysis for other tandem investment on the assumptions we use to calculate other end-office investment, except that we assume a three percent annual trunk growth rate. Given these assumptions, the percentage of new trunks installed on the switch is 85 percent, and the percentage of growth trunks is 15 percent.[1060]

410. Trunk growth is a function of busy hour switched access usage growth, which in turn is a function of switched access line growth and busy hour switched access usage per line growth. We estimate that the expected busy hour switched access usage per line growth rate over the 12-year life of a switch is approximately five percent per year, given forecasts of 2.5 percent per year switched access line growth, as explained in para. 404, above, and 2.5 percent per year busy hour switched access usage per line growth, as explained below.

411. The annual 2.5 percent busy hour usage per line growth rate is lower than the annual busy hour usage per line growth rate assumed by Verizon in its switching cost studies for the period 2001-2003.[1061] We find that Verizon's claimed usage per line growth rate is too high for its study period and much too high for a 12-year life of a switch placed in service today. Our 2.5 percent estimate for busy hour usage per line growth is based on ARMIS data showing that Verizon VA's all hour of the day (not busy hour) usage per switched access line grew at rates of 5.76, 3.38, 2.01, 7.72, 4.89, and 4.19 percent for 1996 through 2001, respectively. The geometric average annual growth rate for the period 1996-2001 is 4.64 percent. The arithmetic average annual growth rate for this period is 4.66 percent. In this case, however, past usage per switched access line growth may not be indicative of future growth. A principal reason for usage per switched access line growth since 1996 is dial-up Internet usage growth. Going forward, however, dial-up Internet growth rates and therefore switched access usage growth rates should slow, as Internet usage over DSL and cable modem lines increases.[1062] It seems

[1060] *See* Appendix D.

[1061] Verizon Ex. 226P (confidential version).

[1062] The Bureau estimated that only one percent of occupied housing units in Virginia had a high speed line in service as of December 1999, whereas 15 percent had such a line as of December 2002. *See Federal Communications Commission Looks at Data on Growth of Broadband Subscribership In Rural Areas*, FCC Press Release (Aug. 6, 2003). This growth in high speed lines coincides with the successively slower usage per switched access line growth rates reflected in the ARMIS data for Verizon Virginia subsequent to 1999. The Bureau also estimated that only two percent of occupied housing units nation-wide had a high speed line in service as of December 1999, whereas 16 percent had such a line as of December 2002. *Id.* Thus, the growth in Virginia high-speed lines mirrored nation-wide growth. Nielsen/NetRatings recently reported that time spent online nationally by high-speed Internet subscribers in January 2003 rose 64 percent from the prior January while time spent online by dial-up subscribers decreased three percent. *See Broadband access outpacing dial-up connections* (Mar. 5, 2002) (continued....)

reasonable to expect, therefore, that switched access usage over the next 12 years will be closer to the lowest growth rate during the 1996-2001 period, 2.01 percent in 1998, than the 1996-2001 average growth rate of approximately 4.7 percent. Thus we find that a 2.5 percent switched access usage per line per year growth rate is a reasonable estimate for Verizon VA over the next 12 years.[1063]

412. Verizon forecast both the annual growth rate of busy hour switched access usage[1064] and the annual growth rate of trunks.[1065] Its predicted trunk growth rate is approximately 41 percent lower than its predicted busy hour switched access usage growth rate.[1066] We find that Verizon's busy hour switched access usage growth rate is too high because it is based, in part, on a busy hour usage per line forecast that we determined is too high.[1067] We base the trunk growth rate on the busy hour switched access usage growth rate we adopt above,[1068] five percent per year, reduced by the amount by which Verizon's switched access usage growth rate exceeds its trunk growth rate. This calculation results in a switched access trunk growth rate of approximately three percent (a busy hour switched access usage growth rate of five percent per year less 41 percent).

413. *New and Growth Switch Discounts*. We must select new and growth switch discounts in order to calculate the weighted average discounts used to estimate other tandem switch investments. For the reasons set forth above,[1069] we base the new switch discounts on the

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<http://www.usatoday.com/tech/news/2002/03/05/broadband- report.htm>. We would expect roughly the same usage changes in Verizon Virginia's territory as these nation-wide usage changes.

[1063] We also note that there is no obvious basis in the record for developing a busy hour growth rate forecast that differs from an all hour of the day forecast.

[1064] Verizon's annual growth rate forecast of busy hour switched access usage is equal to its line growth rate forecast plus its busy hour usage per line growth rate forecast. *See* Verizon Ex. 107, at 200-201; Verizon Ex. 226P (confidential version); Verizon Ex. 125P, CD-ROM "VZ-VA FCC ARB (Additional Cost Studies)," Folder "VA EXCEL and WORD STUDIES," Folder "VA SWITCHING SUPPORT FILES," Folder "VA UNBUNDLED REC & SWITCH," Excel File "Backup VA MOUR-10-31 Part C-8," Worksheet "EO MOU," cells C58, D58, D60, Worksheet "Tdm MOU," Cells G12, G14, G21 (confidential version); Verizon Ex 161, at 5, Attach. H.

[1065] Verizon Ex. 125P, CD-ROM "VZ-VA FCC ARB (Additional Cost Studies)," Folder "VA EXCEL and WORD STUDIES," Folder "VA SWITCHING SUPPORT FILES," Folder "VA UNBUNDLED REC & SWITCH," Excel File "Backup VA MOUR-10-31 Part C-8," Worksheet "EO MOU," cell D60, Worksheet "Tdm MOU," Cells G12, G14, G21 (confidential version); Verizon Ex 161, at 5, Attach. H.

[1066] *See supra* notes 1064-65.

[1067] *See supra* para. 411.

[1068] *See supra* section V(C)(1)(b)(i)(b).

[1069] *See supra* section V(C)(1)(b)(i)(a).

discounts Verizon received on new switch purchases in 2000.[1070] We adopt growth switch discounts for the Lucent 5ESS switches based on the growth and upgrade purchases Verizon made in 2000.[1071] For Nortel DMS-200 switches, we adopt a growth discount based on growth and upgrade purchases Verizon expects to make under its contract with Nortel.[1072] These discounts are appropriate for the reasons we give above and because they relate to Verizon's expenditures for both tandem and end-office equipment.[1073]

(iii) End-Office Switch Trunk Port and SS7 Link Investment

414. Based on the weights and discounts discussed below, we adopt for estimating end-office trunk port and SS7 link investment weighted average discounts for the Lucent 5ESS, Nortel DMS-100, and Siemens EWSD switches. We require Verizon to modify its end-office switching study by: (1) calculating the weighted average discount for each of these switch technologies using the discounts and the new trunk and growth trunk weights discussed below; and (2) estimating end-office trunk port and SS7 link investment for each of these switch technologies using each of these weighted average discounts.

415. *Weighting*. We calculate these weighted average vendor discounts using weights reflecting the three percent per year trunk port growth rate that we developed above, resulting in 85 percent new switch trunks and 15 percent growth trunks.[1074] We use the trunk growth rate to estimate the vendor discount for both end-office and tandem trunk ports because there is no reason to expect that they would grow at different annual rates. Verizon uses the same trunk growth rate forecast in its tandem and end-office switching cost studies, as do AT&T/WorldCom in their re-statement of these studies.[1075] We use the trunk growth rate to estimate the vendor

[1070] We direct Verizon to use the new Lucent 5ESS and Nortel DMS-100 switch discounts identified in its response to staff record request no. 32 as the new switch discounts for Lucent 5ESS and Nortel DMS-200 tandem switches in its compliance filing. *See* Verizon Ex. 216P (confidential version); *see also infra* section XIII.

[1071] We direct Verizon to use as the growth discount for Lucent 5ESS tandem switches in its compliance filing the growth discounts that Verizon identified for Lucent 5ESS switches in response to staff record request no. 29. *See* Verizon Ex. 213P (confidential version). The Lucent 5ESS switch growth discount identified in Verizon's response to this record request is the same as the Lucent 5ESS discount identified in Verizon switching cost study. *Compare id., with*, Verizon 100P, Vol. IX, VA Switch Discount Support, Exh. Part C-P1 (confidential version).

[1072] We direct Verizon to use as the growth discount for DMS-200 tandem switches in its compliance filing the Nortel discount identified in Verizon's cost studies. *See* Verizon Ex. 100P, Vol. IX, VA Switch Discount Support, Exh. Part C-P2 at 2 (confidential version).

[1073] Verizon Ex. 107, at 194.

[1074] *See supra* para. 409.

[1075] Verizon Ex. 125P, CD-ROM "VZ-VA FCC ARB (Additional Cost Studies)," Folder "VA EXCEL and WORD STUDIES," Folder "VA SWITCHING SUPPORT FILES," Folder "VA UNBUNDLED REC & SWITCH," Excel File "Backup VA MOUR-10-31 Part C-8," Worksheet "EO MOU," cells D58, D60, Worksheet "Tdm MOU," cells G9, G12, G14, G21 (confidential version); AT&T/WorldCom Ex. 24P, CD-ROM "VZ-VA FCC ARB, Docket (continued....)

discount for end-office SS7 link investments because these investments are needed only for inter-office traffic.

416. *Switch Discounts.* For the reasons set forth above, we require Verizon to calculate these weighted average vendor discounts using the new and growth discounts that we require it to use to estimate other end-office investment.[1076]

2. Switch Demand and Sizing

417. There is a need for consistency between the line and trunk growth assumptions we make to calculate the weighted average discount, the physical size of the switch for which the discount is used to estimate investment, and the number of line ports, trunk ports, and minutes of use over which to spread the investment. If there is an inconsistency, cost per unit may be overstated or understated.

418. Regarding physical size, we therefore require that end-office switch investment be based on a switch sized physically to accommodate the present value of the investments required for the number of lines and trunks it will serve over a 12-year period, assuming a 2.5 percent annual rate of line growth, a three percent annual rate of trunk growth, and that these lines and trunks are installed every two years. We also require that tandem office switch investment be based on a switch sized physically to accommodate the present value of the investments required for the number of trunks it will serve over a 12-year period, assuming a three percent annual rate of trunk growth, and that trunks are installed every two years.

419. Regarding demand, we require that the line port demand over which to spread end-office investment reflect the present value of the investments required for the number of line ports demanded over a 12-year period, assuming a 2.5 percent annual rate of line growth and that line demand grows every year. For developing dedicated tandem trunk port prices, we require that the trunk port demand over which to spread trunk port investment reflect the present value of the investments required for the number of trunk ports demanded over a 12-year period, assuming a three percent annual rate of trunk port growth, and that trunk port demand grows every year. For developing common trunk port prices, we require that the minutes of use over which trunk port investment is spread reflect the present value of the investments required for the number of tandem switch minutes demanded over the a 12-year period, assuming a five percent annual rate of minutes growth, and that tandem trunk demand grows every year.

420. We also require that end-office and tandem office switch investment be based on traffic and subscriber calling characteristics (*e.g.*, busy hour calls per trunk), identical to those in Verizon's proposed cost study, except for busy hour hundred call seconds (CCS) per line and per

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00251, Workpapers Supporting Supplemental Surrebuttal of Catherine E. Pitts," Folder "VA Unbundled REC & SWITCH," Excel File "Switch Backup," Worksheet "EO MOU," cells D58, D60, and Worksheet "Tdm MOU," cells G9, G12, G14, G21 (confidential version).

[1076] *See supra* paras. 405-06.

trunk assumptions. Busy hour CCS per line and per trunk assumptions must reflect the sizing and demand assumptions set forth in the two previous paragraphs.

3. Digital Loop Carrier

a. Positions of the Parties

421. In its switching cost study, Verizon assumes a mix of 42.4 percent analog ports and 57.6 percent IDLC ports.[1077] Verizon bases these percentages on inputs from its loop cost study. In that study, Verizon assumes that 57.6 percent of loops use IDLC systems and that 42.4 percent of loops either use UDLC systems or are all-copper loops.[1078] Further, as in its loop study, Verizon assumes that ten percent of all loops use GR-303 IDLC switch interface technology and that the remaining IDLC loops use TR-008 switch interface technology.[1079] For the ten percent of lines that are served using GR-303 IDLC systems, Verizon assumes a line concentration ratio of 3:1, based on the experience of its engineers, who, Verizon contends, balance the resource savings associated with higher concentration ratios against the risk of blocked calls if the concentration ratio is too high.[1080]

422. AT&T/WorldCom challenge the mix of analog to digital line ports, and the DLC assumptions on which they are based, in the Verizon cost study. They propose an assumption that all DLC-based lines (82 percent in the Verizon study) use GR-303 NGDLC systems and therefore enter the switch via a digital port.[1081] They therefore propose a digital to analog port ratio of 82:18. AT&T/WorldCom argue that NGDLC technology is currently available and may be used to provide unbundled loops.[1082]

423. Verizon claims, as it does in its loop analysis, that AT&T/WorldCom assume an unjustifiably high percentage of NGDLC loops.[1083] Verizon argues that UDLC loops are necessary to provide stand-alone unbundled loops and that, given that Verizon-East has deployed almost no GR-303 NGDLC systems, it is appropriate to assume the use of TR-008 IDLC systems in a forward-looking cost study.[1084]

[1077] Verizon Ex. 107, at 187; Verizon Switching Cost Brief at 12.

[1078] *See supra* section IV(C)(2)(k)(ii).

[1079] Verizon Ex. 107, at 187; Verizon Switching Cost Brief at 12-13; *see also supra* section IV(C)(2)(k)(ii).

[1080] Verizon Ex. 122, at 183-85; Verizon Switching Cost Brief at 14-15.

[1081] AT&T/WorldCom Ex. 12, at 104-07; AT&T/WorldCom Ex. 24, at 9-10

[1082] *See supra* section IV(C)(2)(k)(ii).

[1083] *See id.*

[1084] *See* Verizon Switching Cost Brief at 12-14.

424. AT&T/WorldCom also contend that Verizon's 3:1 line concentration ratio is too low and that the appropriate ratio is 4:1.[1085] They further assert that even a 4:1 ratio is conservative, as evidenced by the fact that Verizon's 1999 network planning guidelines assumed a higher line concentration ratio in evaluating the potential benefits of DLC systems that use the GR-303 switch interface standard.[1086] Further, AT&T claims that its competitive LEC facilities are engineered using NGDLC systems configured with line concentration ratios of higher than 3:1.[1087] WorldCom, however, notes that, to the extent that it uses NGDLC systems, it configures them with less than a 3:1 concentration ratio.[1088]

b. Discussion

425. As we explain at length in our loop analysis, we adopt AT&T/WorldCom's assumption that all fiber-fed loops use GR-303 NGDLC systems. We found there that: (1) GR-303 NGDLC systems are more advanced and efficient than TR-008 IDLC systems; (2) it is technically feasible to unbundle NGDLC loops; (3) Verizon fails to demonstrate that UDLC systems are necessary to provision special services; and (4) neither Verizon's OSS nor its security concerns undermine these conclusions.[1089] Because NGDLC loops enter the switch through a digital, rather than analog, port, we require Verizon to re-run its switching cost study assuming that all fiber-fed loops use GR-303-capable digital ports.

426. Because of the need for consistent assumptions for loop plant and switching, however, we do not adopt the 82:18 digital to analog port ratio proposed by AT&T/WorldCom. Instead, we require Verizon to re-run its cost model using the percentage of digital ports that the MSM calculates for NGDLC-based loops and the percentage of analog ports that the MSM calculates for all-copper loops. Specifically, Verizon shall use 78.9 percent digital ports and 21.1 percent analog ports in its cost study re-run.[1090] Use of these figures ensures consistent DLC technology assumptions between the loop cost study and the switching cost study.

[1085] AT&T/WorldCom Ex. 12P, at 104-07 (confidential version); AT&T/WorldCom Ex. 24, at 9-10.

[1086] AT&T/WorldCom Ex. 12P, at 31 (confidential version).

[1087] Letter from Mark Keffer, AT&T Chief Regulatory Counsel, Atlantic Region, to Magalie R. Salas, Secretary, Federal Communications Commission, CC Docket Nos. 00-218, 00-251, at response to record request no. 9 (requested Nov. 28, 2001) (filed Dec. 21, 2001) (confidential version) (Keffer Dec. 21 Letter) (The public version of this response was filed on Jan. 4, 2002. *See* Letter from Mark Keffer, AT&T Chief Regulatory Counsel, Atlantic Region, to Magalie R. Salas, Secretary, Federal Communications Commission, CC Docket Nos. 00-218, 00-251 (filed Jan. 4, 2002)).

[1088] WorldCom responses to record requests no. 2-4 (filed Jan. 18, 2002) (confidential version).

[1089] *See supra* section IV(C)(2)(k)(iii).

[1090] Of the 3,724,335 lines modeled by the MSM, 2,937,347, or 78.9 percent, use NGDLC systems. The remainder, or 21.1 percent, are all-copper loops.

427. We also require Verizon to use its proposed 3:1 line concentration ratio for digital ports in its cost study re-run.[1091] Verizon asserts that line concentration is engineered as an inverse function of usage.[1092] Verizon's 3:1 line concentration assumption, which is based on the expertise of its network engineers,[1093] seems reasonable given that usage growth is exceeding line growth[1094] and actual NGDLC system deployment (including line concentration) is only beginning.[1095] Evidence introduced by AT&T/WorldCom shows that, depending on the application, line concentration ratios of both greater than or less than 3:1 may be appropriate,[1096] thus Verizon's proposal may assume either too much or too little concentration. The AT&T/WorldCom evidence, which is based in large part on the experiences of AT&T's and WorldCom's competitive LEC operations, does not undermine the reasonableness of Verizon's proposal for the purpose of setting UNE prices for Verizon's operations as an incumbent LEC in Virginia.

4. Fill Factors

a. Positions of the Parties

428. As we explain *supra* in the loop section of this order, fill factors represent the percentage of total usable capacity of a facility that is expected to be used to meet a measure of demand.[1097] Verizon asserts, without further elaboration, that it bases its analog line port and digital trunk port fill factors on its "current operating objectives."[1098] It proposes a digital line port fill factor that is considerably lower than its analog line port fill factor because it claims that switch capacity is installed before RT capacity.[1099] To arrive at its proposed fill factors, Verizon first inputs an administrative fill factor into the SCIS model.[1100] The SCIS model accounts for

[1091] This concentration ratio is specific to line concentration for the digital ports and is independent of the line concentration ratios that Verizon uses in the switches themselves.

[1092] *See* Verizon Ex. 107, at 183-185.

[1093] *See* Verizon Ex. 122, at 184-85; Verizon Switching Cost Brief at 14.

[1094] *See supra* section V(C)(1)(b)(ii)(b).

[1095] *See* Verizon Switching Cost Brief at 13 n.20.

[1096] *See* Keffer Dec. 21 Letter, at response to record request no. 9 (requested Nov. 28, 2001) (confidential version); WorldCom responses to record requests no. 2-4 (filed Jan. 18, 2002) (confidential version).

[1097] *See supra* section IV(C)(2)(g).

[1098] Verizon Ex. 107, at 195-96.

[1099] *Id.* at 195.

[1100] *Id.* at 196; *see also* Verizon Ex. 168 (Errata on Matt Supplemental Surrebuttal). Verizon uses different inputs for administrative fill for each of the different switching fill factors, *i.e.*, analog line ports, digital line ports, and digital trunk ports. *See* Verizon Ex. 168, at 1-3, 8.

breakage in its estimate of investment.[1101] Verizon then applies a utilization adjustment factor (UAF) to adjust the investment derived from the SCIS model to reflect its proposed fill factors.[1102] It develops the UAF by determining the fill reflected in the SCIS model investment and the percentage by which this investment must be increased to reflect its proposed fill factors.[1103]

429. The UAFs that Verizon applies to the SCIS model investment are weighted averages of separate UAFs developed for different switch technologies (*i.e.*, Lucent 5ESS, Nortel DMS-100 and DMS-200, and Siemens EWSD switches).[1104] Verizon uses weighted average UAFs for trunk ports and line ports by weighting the UAFs for the different technologies by the average number of trunks per node and the average number of lines per node, respectively.[1105] These weighted average UAFs are applied to weighted average investments developed from the SCIS model for the same technologies.[1106] The weighted average end-office line port investment developed using the SCIS model is based on the number of lines on each type of switch.[1107] The weighted average end-office trunk port investment developed using the SCIS model also is based on the number of lines.[1108] The weighted average tandem office trunk port investment developed using the SCIS model is based on the number of tandem trunks.[1109]

430. AT&T/WorldCom restate Verizon's switch cost study using only the fill factor

[1101] *See* Verizon Ex. 107, at 197.

[1102] Verizon Ex. 122, at 186-88; *see also* Verizon Ex. 168.

[1103] *See* Verizon Ex. 122, at 186-88; Verizon Ex. 168.

[1104] *See* Verizon Ex. 168.

[1105] For example, Verizon calculates the weights for use in calculating the weighted average analog line port UAFs by dividing the average number of analog lines on Lucent 5ESS, Nortel DMS-100, and Siemens EWSD switches by the sum the averages. *See* Verizon Ex. 168, at 3.

[1106] More specifically, in the case of POTS and ISDN BRI line ports, the weighted average UAFs for analog line ports, GR-303 line ports, and TR-008 line ports are weighted by the percentage of the total POTS lines that are analog, GR-303, and TR-008 in the Verizon study, then this weighted average of the weighted averages is applied to POTS and ISDN PRI investment derived from the SCIS model. Verizon Ex. 168, at 5. In the case of dedicated IDLC line ports, the weighted average UAFs for GR-303 line ports and TR-008 line ports are weighted by the percentage of the total of these two lines that are GR-303 and TR-008 lines in the Verizon study, then this weighted average of the weighted averages is applied to IDLC investment derived from the SCIS model. *Id.*

[1107] Verizon Ex. 161P, CD-ROM "VZ-VA FCC ARB (Additional Cost Studies)," folder "VA EXCEL & WORD STUDIES," folder "VA SWITCHING SUPPORT FILES," folder "VA Unbundled Ports Support" (confidential version).

[1108] *Id.*

[1109] *Id.*