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January 7, 1999

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 Twelfth Street, SW, Room TWB-204
Washington, D.C. 20554

RE: Ex Parte Presentation – Proxy Cost Models
CC Docket No. 96-45

Dear Ms. Salas:

On January 7, 1999, AT&T and MCI WorldCom met with Katie King, James Eisner, Jim Zolnierek, Bob Loube, Richard Smith and Abdel Eqab of the Commission staff to present and discuss several empirical analyses that we performed relative to the switching input values that should be used in the Synthesis Model. AT&T and MCI WorldCom were represented by Richard Clarke, Catherine Petzinger and Mike Lieberman of AT&T, and by Mark Bryant and Chris Frentrup of MCI WorldCom.

The attached written materials and diskette display the analyses and results that we conveyed to the staff, and should be made part of the record in this proceeding. Two copies of this Notice are being submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's rules.

Sincerely,

Richard N. Clarke/RW
Richard N. Clarke

Attachments

cc: Bob Loube
James Eisner
Jim Zolnierek
Abdel Eqab
Katie King (w/o diskette)
Richard Smith (w/o diskette)
Sheryl Todd (w/o diskette)

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Switching Inputs

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Switch Prices

RUS Data

It is important that the RUS data be made as consistent as possible with the FCC's Depreciation/CPR data. It was noted at the December 1, 1998 switching workshop that the RUS data probably does not include the costs of central office power or main distributing and protector frames. AT&T and MCI WorldCom propose that the RUS switch prices be increased by the appropriate amounts, as contained in the HAI 5.0a inputs, for power and MDF/Protector. In performing the statistical analyses described below to determine the appropriate Synthesis Model input values for switching, we have adjusted upward the switch costs reported in the RUS data set in the above-described fashion.[1]

Host/Remote Price Anomalies – Regression Functional Form

The primary difference between a host switch and remote switch is in the extent and complexity of the "getting started equipment," associated with each type of switch (*e.g.*, switch central processor functions, SS7 non-scaleable equipment, maintenance and testing, call recording for billing purposes, etc.).[2] Because most of these functions for lines terminating a remote switch are performed at that switch's host, very little of this type of "getting started" equipment is required at the remote. In contrast, the scaleable equipment used to terminate lines and trunks and to perform basic call processing is essentially the same at the host and remote. In fact, the line units used by Lucent 5E® Remote Switching Modules are identical to those used by 5E host or stand-alone switches.[3] Similarly, the line cards used in Nortel DMS® 100 host or stand-alone switches are the same as those used in DMS 100 remotes, or in DMS 10 host or remote switches.[4] These Lucent and Nortel switches likely make up virtually 100% of the depreciation data set used in the regression.[5]

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[1] Per HAI 5.0a default input values, an upwards adjustment of $12 per line was made for MDF/Protector. Power investments based on the switch's line size were added as follows: $5000 for 0-1000 lines, $10,000 for 1000-5000 lines, $20,000 for 5000-25,000 lines, $50,000 for 25,000-50,000 lines, and $250,000 for over 50,000 lines. The resulting data set is attached on diskette.

[2] In the following discussion, the term "host switch" includes both those host switches that have remote switches subtending them, as well as switches that are "stand-alones."

[3] In the Lucent switch, the same Switch Module (SM) that terminates lines or trunks at a host/standalone switch is placed remotely using copper or fiber. All line and trunk terminating equipment components at the host SMs are the same at the remote SMs.

[4] In the Nortel switches, the same Line Concentrating Module (LCM) that terminates lines at the host/standalone is placed at the remote site. The LCMs at the host and remote sites use identical line card components.

[5] Specific manufacturers are not identified in the RUS data set, however a majority of the equipment is likely to be Nortel.

For these reasons, and because there is no reason to expect any consistent differences in customer usage on host versus remote lines, the scalable costs of line termination equipment required at a host or remote should be almost identical. Thus, any statistical model specification for switching costs should require these variable per-line costs to be identical across host and remote switches. To accommodate this, AT&T and MCI WorldCom have reformulated the FCC Proposed functional form as follows to enforce a single per line variable cost, rather than separate host and remote per line variable costs.

$$Cost = \alpha + \beta_1 * Lines + \beta_2 * Host + \beta_3 * Ln(Time) + \beta_4 * Lines * Ln(Time) + \beta_5 * Host * Ln(Time) + \varepsilon$$

Which converts to the following reduced forms for host and remote switches:

$$Host\ Cost = A_1 + B * Lines,$$
$$\text{where: } A_1 = \alpha + \beta_2 + \beta_3 * Ln(Time) + \beta_5 * Host * Ln(Time), \text{ and}$$
$$B = \beta_1 + \beta_4 * Ln(Time)$$

$$Remote\ Cost = A_2 + B * Lines,$$
$$\text{where: } A_2 = \alpha + \beta_3 * Ln(Time), \text{ and}$$
$$B = \beta_1 + \beta_4 * Ln(Time).$$

Estimating the above functional form for 1997 provides the following switching cost coefficients:[6]

Host constant (A_1):	$290,601
Remote constant (A_2):	$146,808
Host/Remote per line variable cost (B):	$83

While the remote constant may a seem a little high, it should be remembered that this constant captures the costs of both small and large remotes – and some large remotes can be very large. For example, there are eleven remotes out of the 720 remotes included in the combined data set that have greater than 10,000 lines. To give an idea of the heterogeneity in remote sizes provided by the dominant vendors, consider the following. Small remotes generally are provided by Nortel and consist of its 192 line RSLM, 640 line RLCM, and 1024 line RSLE. Midsize remotes serving up to approximately 5,000 lines are available from both Nortel and Lucent, and consist of the Nortel RSC-S, and the Lucent RSM and ORM. In the larger size category, Nortel provides dual RSC-S's that can serve 10,000 lines, and the new Lucent EXM-2000 can serve up to approximately 20,000 lines.[7] The depreciation data set includes all but the Lucent EXM-2000 remote, with the largest number of remotes being the ~5,000 line-size from each vendor.[8]

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[6] Summary outputs from this regression are attached.

[7] A copy of the Nortel web pages defining these remote types is attached.

[8] Because of the heterogeneity in the capacities of different remote switching modules and knowledge of vendor pricing practices, AT&T and MCI WorldCom believe that getting started cost for remotes should vary by classes of line size, e.g., 1-1500 lines, 1500-5000 lines, and over 5000 lines. Unfortunately, the

AT&T and MCI Worldcom have not been able to determine precisely which switches from the depreciation and RUS data sets were included in the FCC's regression analysis, but we have been able to approximate closely the FCC's switch selection. Should more detailed information about the FCC's switch selection process be made available, our selected data set could be fine tuned. Please note that AT&T and MCI Worldcom do not necessarily endorse the prices derived from the above-reported regression studies as correct for forward-looking TELRIC studies. The FCC/RUS data set still appears to contain some irregular observations. For example, the switch indicated as serving nine customers is likely a data error, or the switch may be serving multiple functionalities (*i.e.*, wireless, frame relay or combination local/tandem.) that may elevate implied switch costs. AT&T and MCI believe that other available data suggest that forward looking switch prices are lower than those suggested by these historical depreciation data and small-company RUS data.[9] In all events, AT&T and MCI WorldCom recommend that the cost of switching (fixed plus variable) should not be permitted by the Synthesis Model to exceed $500 per line.[10]

Other Inputs Impacted by Switch Price Curve

The depreciation studies (and the adjusted RUS data) for switching include all investments necessary to make the switch operational. These costs include telephone company engineering and installation, the main distributing frame (MDF), protector frame (often included in the MDF), and power. To take advantage of the information about these ancillary costs implicit in these data, AT&T and MCI WorldCom propose that the costs of MDF, power and telephone company engineering and installation remain as part of the total switch price for cost modeling purposes. To accommodate this augmentation implicit in the input data, the HAI 5.0a input values for these switching cost components must be set as follows to avoid double counting these investments.

HAI 5.0a Input Name	HAI Input #	Value
MDF/Protector Inv. per Line	B79	$0.00
Switch Installation Multiplier	B81	1.0
Power (all 5 inputs)	B88	$0.00

Turner Plant Index/ Telephone Plant Indices

data set available here appears to be insufficient to permit statistical identification of these finer cost distinctions.

[9] See charts labeled Public Data Switch Price Points Per Line

[10] If the Synthesis Model uses any linear equation for switching costs, extremely high switching costs will be generated for "wire centers" with small numbers of lines. Because switching costs in excess of $500 per line are likely not representative of efficient forward looking engineering practice, AT&T and MCI WorldCom recommend that the Synthesis Model permit no wire center to exceed $500 per line in total switching cost.

Staff has asked for comments regarding the appropriateness of the Turner Plant Index. AT&T and MCI WorldCom do not support the use of data adjustments based on the Turner Price Index, or other similar telephone plant indices. This is because these indices are only accounting mechanisms, and do not adequately capture the change in telephone switch prices over time for forward-looking economic cost purposes. This is evident from BellSouth's discussion of the TPI: "It should be noted that TPI forecasts are forecasts of installed equipment price changes. They are not intended to be forecasts of technology changes or productivity improvements."[11] Simply restating the historical costs of embedded technology will not capture the huge capacity increases and equipment component price decreases that have occurred in the electronics industry and the switch industry in particular.

One example of such an uncaptured technology change can be found in trunk terminating equipment. Recent trunk terminating equipment can terminate twice as many trunks, with no corresponding doubling in the price of this equipment relative to older equipment. Thus, the cost per trunk has declined significantly. In addition to technological improvements, the switch manufacturers have been adding functionality that make new switch installations more efficient, thereby increasing productivity. Because the TPI is defined to ignore technological improvements and productivity gains, the TPI will misestimate price trends of switching equipment.

The FCC's statistical approach of restating all switch investments to 1997 dollars is appropriate, especially when the adjustments are made to the regression forms proposed above. It is reasonable, however, that price declines not be trended significantly beyond the data period because other data suggest that the historically large percent price declines seen in recent years may not continue.[12]

DLC Credit

Terminating GR303 IDLC lines is significantly less expensive than analog lines.[13] This is due primarily to [1] the elimination of a MDF and protector frame termination, and [2] the economic efficiencies of terminating multiple lines on a DS-1 trunk termination instead of individual analog line terminations.

But even in the recent RUS and depreciation data on switch installations, the percent of DLC lines deployed is much less than is engineered by any of the TELRIC cost models. Thus, the switch cost information provided in the RUS and depreciation data do not reflect adequately the cost savings that would be realized if 60+% of lines are terminated on DLC – as occurs in the TELRIC models. Hence, the forward-looking switch investments for these models need to be adjusted downward from what is implied by the RUS and depreciation data to reflect the larger fraction of DLC lines that they engineer.

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[11] BellSouth USF Responses to FCC Staff Questions of June 25, 1998 filed 8/7/98. Question 2, page 1 of 2.

[12] The NBI report shows this trend attenuating as well.

[13] Petzinger Supplemental Direct Testimony in Rhode Island UNE proceeding, Docket 2681, November 10, 1998, indicated that port costs decreased by as much as 67%.

Because the gross switch cost "credit" for terminations on DLC should be approximately $20.00 per line,[14] but the average fraction of DLC in the historical data is roughly 15% (or one quarter of the 60+% DLC usage engineered in the HCPM),[15] AT&T and MCI WorldCom recommend that the "net" DLC credit be $15 per line.[16]

Switch Capacity Constraints

AT&T and MCI WorldCom recommend increasing the switch line and traffic capacity constraints to conform with more recent switch vendor-publicized capacities.[17] AT&T and MCI WorldCom's original values for call attempts, CCS and line capacities are now dated, and too conservative relative to current technology. Thus, we recommend that these capacities be increased according to the vendor publicized capabilities, as shown in the attached table.

SS7-Related Investments

AT&T and MCI WorldCom's initial values for the STP and SCP investments were obtained from a 1994 AT&T capacity study. Although it is certain that these signaling investment costs have come down substantially in recent years – due to increasing competition among SS7 equipment manufacturers, improvements in technology, and scale economies engendered by the huge increases in demand for SS7 equipment resulting from CLASS and 800 number portability and the current SS7 deployments for local number portability, AT&T and MCI WorldCom had no alternative information on prices. BellSouth has provided price information that is substantially lower than AT&T and MCI WorldCom's now dated estimates.[18] We propose that BellSouth's prices be adopted. These are included in the attached table of recommended changes to the inputs.

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[14] Of this $20.00 savings, $12.00 arises because MDF/Protectors are not needed in the switch for incoming lines terminated on DLC because these "lines" are terminated on switch trunk equipment and not line equipment. In addition, multiple line cards are not needed at the switch because these are already provisioned with the DLC equipment. The remaining $8.00 results from further per-line efficiencies realized from terminating at the digital trunk level rather than at the analog line level (e.g., greater usage concentration, eliminated line cards and line units, and the relatively lower cost to terminate trunks carrying DLC lines compared to analog lines, etc.).

[15] 15%/60% = 25%.

[16] 25%*$20.00 = $15.00

[17] See Nortel and Lucent websites for line and call capacities (copies attached). The CCS capacity was increased proportionately to allow the larger number of lines and call attempts.

[18] BellSouth 8/7/98 Ex Parte re CC Docket Nos. 96-45 and 97-160, Attachment to Question 1.

Table

The following table identifies switch-related inputs that AT&T and MCI WorldCom propose be modified from the HAI original value.

HAI Input Name	HAI Input Number	HAI Original Value		Recommended Value	
Switch Real-time Limit, Busy Hour Call Attempts	B63	1-1000 lines 1,000-10,000 lines 10,000-40,000 lines 40,000+ lines	10,000 50,000 200,000 600,000	1-1,000 lines 1,000-10,000 lines 10,000-40,000 lines 40,000+ lines	200,000 200,000 1,000,000 1,000,000
Switch traffic limit, BHCCS	B64	1-1000 lines 1,000-10,000 lines 10,000-40,000 lines 40,000+ lines	30,000 150,000 600,000 1,800,000	1-1,000 lines 1,000-10,000 lines 10,000-40,000 lines 40,000+ lines	800,000 800,000 5,000,000 5,000,000
Switch maximum equipped line size	B65		80,000		100,000
MDF/Prot Inv. per Line	B68		$12.00	$0.00 (included in switch price)	
Analog Line Circuit Offset for DLC lines, per line	B69		$5.00		$15.00
Switch installation multiplier	B70		1.10	1.0 (included in switch price)	
End Office Switch Inv. Constant	B71	BOC and large ICO Small ICO	$242.73 $416.11	Replaced by Host and Remote fixed and variable coefficients	
EO Switch Inv. Slope Term	B72		-14.922	Replaced by Host and Remote fixed and variable coefficients	
Power Investments	B77		$5,000-$250,000	$0.0 (included in switch price)	
Min. STP Inv., per pair	B153		$1,000,000		$224,000
Line Term, Both Ends	B154		$900		$725
SCP Inv./Transaction/Second	B163		$20,000		$2,444
Host Fixed (Constant)			Multiple values*		$290,487
Host Variable per Line			Multiple values*		$83
Remote Fixed (Constant)			Multiple values*		$147,078
Remote Variable per Line			Multiple values*		$83

*The former values are not shown as they are not defined the same for the new values. In addition to the definition of the various line sizes being changed, the proposed recommended values include telephone company engineering, installation, MDF, Protector and Power. In addition, the new values incorporate the data used in the Proposed FCC switch price estimates from both large and small companies, making separate small and large company coefficients unnecessary.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	89.4%
R Square	80.0%
Adjusted R Square	79.9%
Standard Error	1,748,736
Observations	1,288

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	1.56371E+16	3.13E+15	1,023	0
Residual	1,282	3.92045E+15	3.06E+12		
Total	1,287	1.95576E+16			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	547,317	496,595	1.10	0.27	(426,911)	1,521,546	(426,911)	1,521,546
lines	505	34	14.97	0.00	438	571	438	571
host/sa	3,611,444	1,043,123	3.46	0.00	1,565,028	5,657,861	1,565,028	5,657,861
LN(time)	(156,147)	246,192	(0.63)	0.53	(639,130)	326,836	(639,130)	326,836
Lines * LN(Time)	(164)	16	(10.17)	0.00	(196)	(133)	(196)	(133)
Host * LN(Time)	(1,351,938)	521,680	(2.59)	0.01	(2,375,378)	(328,497)	(2,375,378)	(328,497)

Alpha	547,317
Beta 1	505
Beta 2	3,611,444
Beta 3	(156,147)
Beta 4	(164)
Beta 5	(1,351,938)

	Calculated for *1997*
Host Constant (*A1*)	290,601
Remote Constant (*A2*)	146,808
Host/Remote per line variable cost (*B*)	83

who, what, where

product overview

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Systems for Network Operators

Switching and Access Solutions

Switching Systems
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5ESS® AnyMedia™ Switch
is a multi-service, software-based digital switching system designed to evolve with the changing needs of communication service providers, and features the following:

- **High Reliability:** The 5ESS AnyMedia Switch has the least amount of downtime of any switch in its class according to analysis of the latest U.S. FCC reports. The reports reveal that among four major switch vendors, the 5ESS Switch was the most reliable in four standard performance categories and set new benchmarks in two key areas.
- **Modular Design:** The switch's design sets it apart from all others with its intelligence being spread out into modules. This unique architecture allows growth in increments simply by adding modules. Separate modules, rather than entire switches, can be dedicated to specific services, such as long distance. Therefore, adding new services when and where the provider needs to, becomes quick and easy. Also, remote switch modules can be located up to 600 miles from the host switch, making it easy to enter new territories. Basically, the switch supports any network strategy without locking the service provider into a specific future and without interrupting current services.
- **Market Leadership:** With an embedded base of more than 104 million lines and 48 million trunks served by four thousand host switches in more than 50 countries worldwide, the 5ESS Switch is a market leader. A full-sized 5ESS serves up to 200,000 subscriber lines and over 100,000 trunk lines, with flexibility to meet the most diverse business needs.

5ESS Switch Compact Digital Exchange (CDX)
A smaller sized configuration serving up to 37,000 lines, ideal for rural areas or campus locations offering voice, video, or data services.

5ESS Switch Very Compact Digital Exchange (VCDX)
The smallest configuration serving up to 20,000 lines with the same services, quality and reliability as the full sized 5ESS Switch.

PacketStar Gateway Solution
provides a single virtual transport system to interconnect voice and data applications, and thus allows signaling information to be carried from the voice network through the packet data network. This system increases the

amount of traffic that can be carried over data networks and greatly simplifies operations by managing broadband pipes rather than individual trunk groups. Service providers use Packet Star Gateway Solutions to simplify long distance/toll voice and data network operations. This gains them cost savings and generates new revenue.

AnyMedia MultiService Module (MSM)
Integrated in the 5ESS Switch, the MSM is the bridge from the public switched telephone network to various data networks such as the Internet or ATM networks. Service providers with a 5ESS Switch now can quickly and easily offer Internet access, Internet telephony services, or other popular data services, while simplifying network operations and protecting current investments.

AnyMedia Express Access Interface Unit (AIU)
A virtually non-blocking line unit, the AIU relieves line-side congestion problems caused by long hold-time calls such as those to the Internet or data networks. When long hold-time callers are moved to the AIU, they get a direct one-to-one connection, rather than tying up circuits traditionally shared with other callers.

AnyMedia Switching Software
Lucent delivers software releases for the 5ESS Switch on an ongoing basis to help service providers speed deployment of new services such as long distance, Centrex, number portability, and ISDN PRI enhancements and other residential and business services.

Access Systems
For more information go to
www.lucent.com/netsys/supercomm/access8.html

AnyMedia Access System
is Lucent's third generation digital loop carrier that contains the application packs and software to deliver voice and data services. Versatile because of its small size, an AnyMedia Access System can be deployed in a central office, remote terminal or even outside plant environments. As a global open platform, the AnyMedia Access System supports standard network interfaces, including TR303/08 and V5, so it can connect to any switch. The AnyMedia Access System also uses Lucent's AnyMedia "plug and play" application packs-cards that let service providers "plug-in" applications as the market demands them, adding broadband services like ADSL incrementally.

SLC®-2000 Access System
is a multi-service digital loop carrier platform which has an integrated SONET OC-1, 3 and 12 multiplexer backplane that allows the service provider to integrate analog modem traffic, Integrated Services Digital Network (ISDN) and Digital Subscriber Line (xDSL) technology over a single access architecture.

SLC® ConnectReach™ Access System
is a multiservice access solution providing 24 FX voice lines, PBX routing capabilities and 10baseT LAN interfaces. It resides on the customer's premises and integrates voice and data traffic of a small to mid-sized business onto a single T1 line that connects directly to a SLC-2000 Access

System.

SLC® Series 5 Carrier System
is a full service digital loop carrier designed to support residential and business markets. Each Series 5 system dual channel bank (DCB) provides 192 channels of service. Currently, this carrier system offers over 130 DSO services deployable on T1, DSX-1 or fiber via outboard facilities, everything from POTS to ISDN and xDSL.

SLC® LineReach™ Access System
is a small line size digital loop carrier system that interfaces directly with a switch and provides a variety of standard and special voice services to small residential and business serving areas requiring 48 lines or less.

Multi-Service Distant Terminal (MSDT)
is a Fiber-in-the-Loop (FITL) extension of the SLC-2000 Access System or SLC Series 5 Carrier System targeted to residential and small business applications that provides rich narrowband services at a low cost and in a compact, modular design.

DDM-2000 FiberReach Narrowband Shelf
is an extension of the SLC-2000 Access System targeted to residential and small business applications that provides rich narrowband services at a low cost and in a compact, modular design.

ADSL Portfolio
For more information go to www.lucent.com/gsp/www/w5h.html

The portfolio includes a common integrated platform for new builds, lines served off of embedded base Central Office (CO) and Digital Loop Carrier (DLC) equipment, solutions for data network overlays and a standalone Digital Subscriber Line Access Multiplexer (DSLAM). The portfolio also features a common element management system.

- **ADSL for the AnyMedia Access System** Using ADSL application packs that fit in the AnyMedia Access System in both CO and Outside Plant environments, this solution supports both Full-rate and Lite versions of ADSL using ATM over DMT.

- **ADSL for the 5ESS AnyMedia System** Using ADSL application packs that fit in the 5ESS Switch-Integrated AnyMedia Express module, this solution supports both Full-rate and Lite versions of ADSL using ATM over DMT.

- **5ESS® LinkReach™ Access System** Using a switch-integrated Westell SuperVision™ shelf, this ATM over DMT solution supports both Full-rate and Lite versions of ADSL.

- **SLC LinkReach™ Access System** Plug-in channel units for Lucent's SLC-2000 and SLC Series 5 Access Systems that support Full-rate and Lite version of ADSL using ATM over DMT.

- **DSLAM LinkReach™ Access System** A standalone, CO-based DSLAM that supports Full-rate and Lite versions of ADSL using

ATM over DMT.

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Public Carrier Networks

DMS Core Central Processor

DMS-Core is the central processing unit (CPU) and memory of the system, handling high-level call processing for circuit-switched voice and data calls. To allow network providers to capitalize on their most powerful resource - the central office switch - the DMS SuperNode architecture is designed around a distributed processing strategy, allowing many processing tasks to be shared among various application and peripheral processors. System peripheral modules, for instance, relieve the DMS-Core computing module from the overhead of many routine call processing and supervisory tasks.

At the center of DMS-Core design strategy is the use of commercially available microprocessors, allowing it to evolve and incorporate the latest advances in processing technology as they are introduced. In addition, because the DMS-Core accommodates a range of Motorola microprocessors, the DMS SuperNode system is available with increasing levels of DMS-Core processing power, enabling network providers to select the specific processor for their application.

As increased service demands and capacity requirements warrant, the DMS-Core can be easily upgraded from the entry level processor (Series 10) to increasingly more powerful processors (Series 20-60).

- **DMS SuperNode Series 10** - Supports 200,000 Busy Hour Call Attempts (BHCAs) for plain old telephone service (POTS).
- **DMS SuperNode Series 20** - This baseline processor for the DMS and S/DMS Super-Node program supports 440,000 BHCAs. It achieves 2.0 to 2.2 times the capacity of the original NT40 based DMS-100 processor.
- **DMS SuperNode Series 30** - Supports 660,000 BHCAs, over three times the performance of the Series 10 processor.
- **DMS SuperNode Series 40** - Supports 800,000 BHCAs, repre-senting a four times performance improvement over the Series 10 processor.
- **DMS SuperNode Series 50** - The Series 50 BNR Reduced Instruction Set Computing (BRISC) processor, based on Reduced Instruction Set Computing (RISC), will support 1,200,000 BHCAs.
- **DMS SuperNode Series 60** - The Series 60 employs the BRISC pro-cessor and enhanced memory that uses "burst-mode" protocol to sup-port 1,400,000 BHCAs.

Reliability - DMS-Core is fully-duplicated - both planes of DMS-Core are simultaneously processing each call, allowing the "standby" plane to immediately takeover the call processing - with no loss of service - if the primary plane should fail.

The DMS-Core comprises two System Load Modules (SLMs) and two Computing Modules (CMs).

Computing Module (CM) - The Computing Module provides call-handling and processing power for the DMS SuperNode system. Within the CM are the CPU with system memory and a Message Controller (MC) that provides the communications link to DMS-Bus.

System Load Module (SLM) - The SLM stores office images and is used to load new software loads or stored images into DMS-Core. There are usually two SLMs in the bottom shelf of the DMS SuperNode cabinet, duplicated for reliability. As a direct pipeline to the switch, the SLM is an extremely high-speed tool for loading the switch and peripherals with new software, backing up the system memory, dumping images of system operating data, and emergency loading of the DMS-Core in case of on-line problems. Each SLM consists of one tape cartridge drive, a high-capacity disk drive, and a controller card. The SLMs are connected to the Computing Module of the DMS-Core with a Small Computer System Interface (SCSI) connector.

More specialized modules such as the Link Peripheral Processor (LPP) allow network providers to incrementally add processing elements to their system.

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Remote Access

While new businesses, shopping centers, and residential developments fuel the demand for new revenue-generating services, the pressure of rapid growth requires flexible solutions to extend these high-demand services to remotely located areas - and into new markets - simply and quickly.

Nortel's remote access vehicles offer cost-effective solutions for this ever-changing environment, delivering DMS host services to remotely located subscribers. These solutions offer pair gain and feeder relief by minimizing the number of links back to the central office through concentration and intraswitching at the remote terminals. And, by extending the reach of DMS technology, these remote switching solutions provide a powerful platform for digital integration, network simplification, exchange area consolidation, and penetration into new markets or territories.

Nortel's portfolio of remote access products includes two distinct types of network elements:

Switch Remotes

Switch remotes extend DMS-SuperNode or DMS-10 host switch services while offering intra-switching and emergency stand-alone operation - and in some cases, offer the option to grow into a full DMS switch. For the DMS SuperNode and DMS-10 systems, Nortel offers the following switch remotes:

- **Remote Switching Center-S (RSC-S) for the DMS SuperNode and the DMS-10**, supporting up to 6,400 lines or 480 trunks to serve locations up to 650 miles from the switch (4480 lines, 100 miles with DMS-10). Available in a single-cabinet start-up version that supports up to 640 lines, the RSC-S can grow into a dual RSC-S, or even to a full-sized DMS-100 office.
- **Dual RSC-S for the DMS SuperNode**, supporting more than 10,000 lines or 960 trunks to locations up to 650 miles from the switch. Both the Dual RSC-S and the RSC-S can serve as hosts for RLCMs and OPMs in "remote-off-remote" configuration and for TR-08 digital loop carriers.
- **Remote Line Concentrating Module (RLCM) for the DMS SuperNode**, extending DMS services up to 100 miles from the host switch to up to 640 subscriber lines. This remote is architecturally equivalent to the DMS-100 Line Concentrating Module (LCM) peripheral, which reduces inventory requirements.
- **Outside Plant Access Cabinet (OPAC) for the DMS SuperNode**, essentially an RLCM that can be placed outdoors. The OPAC eliminates most construction costs associated with conventional remote sites, and opens up many unconventional and inexpensive deployment opportunities, such as rooftops, parking garages, and inside office buildings.

Public Carrier Networks
Product Portfolio
Public Carrier Solutions
Hot Topics
Customer & User Groups
Technical Education

- **Remote Subscriber Line Equipment (RSLE)** for the DMS-10, the largest member of the DMS-10 family of remotes, supporting up to 1,024 lines up to 100 miles from the central office
- **Remote Subscriber Line Module (RSLM) for the DMS-10**, supporting up to 192 subscriber lines, up to 100 miles from the DMS-10 host.
- **Outside Plant Subscriber Module (OPSM) for the DMS-10**, an RSLM in an self-contained, environmentally protected stainless steel cabinet for outdoor locations.

Remote Access Vehicles

Remote access vehicles include digital loop carriers, "next generation digital loop carriers," and sophisticated servers for ISDN and wideband business services:

- **AccessNode** systems, simultaneously supporting narrowband, wideband, and broadband services - from DS-0 to OC-3 subscriber interfaces - with fiber or copper links to digital or analog switches. With unique service-adaptive line card technology (which allows provisioning to be performed from a remote position through software) AccessNode addresses a major concern of network providers - the high cost of service calls to provision and maintain subscriber services.
- **AccessNode Full Services Terminal (FST)**, offering a cost-effective means of extending up to 48 or 96 lines of AccessNode capabilities to remote locations. In wall-mounted or cabinetized packages, the FST is an ideal low-risk vehicle for entering new markets, especially where growth projections are conservative.
- **AccessNode Fiber Distribution System-One (FDS-1)**, using low-cost optical network units to deliver "fiber to the curb" to locations up to 75 miles from the AccessNode network element or host switch. Using a counter-rotating fiber ring architecture, this system provides route diversity for protection against cable cuts or other network faults.
- **DMS-1 Urban**, the industry's premier digital loop carrier, supporting up to 544 lines in a universal configuration and up to 528 lines in an integrated configuration (directly interfaced to the digital switch through a subscriber carrier module in the host office)

BEFORE THE RHODE ISLAND PUBLIC UTILITIES COMMISSION

DOCKET NO. 2681

SUPPLEMENTAL DIRECT TESTIMONY OF

CATHERINE PETZINGER

ON BEHALF OF

AT&T COMMUNICATIONS OF NEW ENGLAND, INC.

(NON-PROPRIETARY VERSION)

NOVEMBER 10, 1998

III. OTHER SCIS INPUT PROBLEMS THAT CAUSE INCORRECT RESULTS

Q. WHAT INPUTS SHOULD BE CHANGED TO REFLECT FORWARD-LOOKING TECHNOLOGY?

A. The Bell Atlantic digital loop carrier inputs to SCIS reflect old technology. As specified throughout Bell Atlantic's contracts, TR303-compliant digital loop carrier (i.e., Next Generation Digital Loop Carrier – NGDLC) has been available for years. NGDLC is universally accepted in the industry to be the forward-looking technology. Despite Bell Atlantic's claims that GR303 (also known as TR303) NGDLC has not been approved and is not currently being deployed, Bell Atlantic does recognize it as a forward-looking technology. This is evident in NYNEX's Request for Proposal to Nortel for switching that states: [start proprietary].[end proprietary][10] All of the old-technology digital loop carrier line inputs should be changed to be GR303 NGDLC lines as inputs to SCIS.

Q. WHAT WOULD BE THE IMPACTS OF USING NGDLC COSTS IN PLACE OF OLD-TECHNOLOGY DLC?

A. Using Bell Atlantic's SCIS program for the Riverside office, I replaced the old-technology digital loop carrier inputs with NGDLC inputs.[11] The results are as follows:

[start proprietary] [end proprietary]

Based on this analysis, we would expect the digital port costs to decrease by 67%.

Q. WHAT OTHER INPUTS SHOULD BE CHANGED TO REFLECT FORWARD-LOOKING TECHNOLOGY?

A. Bell Atlantic has assumed all copper-based remote switch modules for the 5ESS switch. Eighty-nine percent (89%) of all remotes in Rhode Island are 5E remotes. These remotes

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[10] NYNEX RFP 92-0711JJB to Nortel, page 55 of 106 provided in Bell Atlantic's second supplemental response to AT&T7-12 provided on October 8, 1998.

[11] See Exhibit CEP5 for the SCIS inputs and outputs of the original Bell Atlantic Riverside office and the results for the Riverside office with NGDLC (TR303) line inputs.

Public Data Switch Price Points Per Line

$/Line	Source	Comments	Cite
$85/$115/$140	Southwestern Bell	Prices based on line sizes >40K, 15-40K, and 1-15K, respectively	Hugh W. Raley Direct Testimony in TX PUC Docket 16189, 16196, 16226, 16285, 16290
~$50	Nortel/US West	Contract in excess of $100 million for 2.2 million lines announced on Nortel Website (at $50 per line, would equal $110 million)	Nortel News Release 6/16/97, on www.nortel.com/home/press
$120	Sprint	$150K fixed + $110 per line for $120 per line for 15K line switch	Sprint's Hanna ex parte letter 3/24/97 in CC Docket No. 96-45
$70	Pacific Bell		Prof. Jerry Hausman Testimony for Pacific Bell, 4/8/98, Pg. 8 in CA PUC, later removed from transcript as not pertaining to issues under review

Additional General Switch Information

Pricing Data	Source	Comments	Cite
Digital Switch Prices Continue to Decline even after analog switch replacements	Bell Atlantic	Declining switch prices are not due solely to analog switch replacement contracts, but reflect overall trend in industry	Opposition of BA to Petitions to Suspect and Investigate in 1998 annual Access Tariff Filings, 6/26/98
Digital Switch Prices Declining nearly 8% per year	Pacific Bell	Compare to conservative 3% decline cited by NBI study.	Prof. Jerry Hausman Testimony for Pacific Bell, 4/8/98, in CA PUC, later removed from transcript as not pertaining to issues under review

Additional General Switch Information (Cont'd)

Pricing Data	Source	Comments	Cite
HM Switch Curve Results High, but Acceptable	Minnesota PUC	Staff's consultant was "knowledgeable of actual switching costs through his familiarity with Ameritech's switch contracts, his knowledge of the switch contracts of other RBOCs, and because he reviewed US WEST switch contracts in connection with his work for the Department" and recommended HM switch curve even though it was "conservative"	Report of the ALJ on Selection of Cost Study for MN PUC In the Matter of the State of Minnesota's Possible Election to Conduct its own forward-looking economic cost study to determine the appropriate Level of Universal Service Support., 4/2/98.
New Switch Prices, and not growth prices, are Appropriate for TELRIC	Sprint/Carolina Telephone/Central	New switches prices (often lower than prices for growth equipment) is the correct price to use for TELRIC	Bill Bollinger Supplemental Direct Testimony before NC PUC 2/16/98.

	Telephone		

TX 09-09-02AR

DOCKET NOS. 16189, 16196, 16226, 16285, 16290

SOUTHWESTERN BELL TELEPHONE COMPANY

DIRECT TESTIMONY

OF

HUGH W. RALEY

PUC Issues

VII.(j)(2) Central Office Plant Inputs to the Hatfield Model

September 6, 1996

Q. **WHAT OTHER PROBLEMS HAVE YOU IDENTIFIED?**

A. The biggest problem with the Hatfield Model, in my opinion, is the basic assumption that the entire network would be put out for bid at one time. This is totally impractical and results in an unrealistically low price for major network elements such as switches. However, even if you accept that unrealistic premise, the model inputs for switching are perilously understated.

For example, the Hatfield Model shows a price of $59 per line for a large switch. In several recent bids for switches in this size range, the "Engineered, Furnished and Installed" (EF&I) price was $85/line. In addition, if you add telephone company cost plus tax, you arrive at a total of $109/line. If you then add frame, power and test sets, you have a total cost of $183/line. This is using the Hatfield Model assumption of simultaneous replacement. SWBT's average growth cost per line on a digital switch is $248/line. It appears that the Hatfield Model may be only considering bid prices (and even then the costs shown are unrealistically low), ignoring the associated costs for the installation and testing of the switch.

I have attached an exhibit which shows recent actual bid prices versus recent actual growth prices for common units of central office equipment. Even just looking at the bid price scenario, the Hatfield Model is very unrealistic for most types of equipment. Below I give a comparison of some of these differences:

NETWORK DEPLOYMENT COST ANALYSIS
SOUTHWESTERN BELL TELEPHONE COMPANY

- Average New Digital Switch Cost Per Line

	Digital Lines					
Cost Per Line	0 - 15,000		15 - 40,000		40 - 80,000	
Digital Switch	Capital	Expense	Capital	Expense	Capital	Expense
EF&I	140	14	115	11	85	8
Telco & Tax	39	1	32	1	24	1
TOTAL	179	15	147	12	109	9
New COSMIC Frame	58	0	58	0	58	0
Power & Emgy Engine	26	0	24	0	15	0
Test Sets	5	0	2	0	1	0
TOTAL	268	15	231	12	183	9

Per line cost based on the following switch sizes:

0 - 15,000 ~ 7,703 lines
15 - 40,000 ~ 21,062 lines
40 - 80,000 ~ 53,653 lines

Note: Switch cost exclude transmission equipment (umbilical), Network Operations conversion, OSP Cost splicing and equipment side half tap

- Average Digital Switch Growth Cost (Including EF&I, Telco and Tax)
  - ⇒ $ 248 / Line ($ 225 Capital, $ 23 Expense)
  - ⇒ $ 517 / Trunk ($ 470 Capital, $ 47 Expense)

- Average New Tandem Total (Typical Size ~ 55,000 Trunks)

Description	Capital	Expense
Digital Switch	4.3	0.9
End Office Trunking	4.7	0.8
Power	1.0	0.0
Transmission Eqpt	1.0	0.0
Ntwk Operations	0.0	0.6
TOTAL	11.0	2.3
Cost/trunk	$200	$42

Note: Operations expense includes cost of conversion, translations and training

- Average Tandem Growth Cost
  - ⇒ $ 517 / Trunk (Assume same as trunk growth cost for End Office switch)

- Average STP Pair Total Cost

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1 bid comprise? What were they bidding on?
2 A It was an EF&I – engineering,
3 furnish and install – price for a switch
4 of - in the size range between forty and
5 eithty thousand lines. It was for the
6 switch itself. It did include, you know,
7 the processor and line termination and the
8 trunk terminations. It was the entire
9 switch.
10 Q Okay, did the bid contemplate
11 doing anything with the existing switch?
12 A No.
13 Q Did the bid include the switch
14 port?
15 A The switch port? I'm sorry. I
16 don't know what a switch port is.
17 Q Okay, so you don't know whether
18 it included it or didn't include it
19 presumably?
20 A Well, were you asking on the
21 85-dollar line bid?
22 Q Yes, sir.
23 A That bid included everything that
24 is required to make the switch work. So
25 when you say "switch port," that's a little

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1 generic for me. There are lines, and there
2 are trunks, and they could either one be
3 considered ports. So I didn't know which
4 one you were talking about.
5 Q Did it include a trunk port —
6 A Yes.
7 Q — at $85 a line?
8 A Yes.
9 Q Is there such a thing as a line
10 port?
11 A Well, that's not a
12 nomenclature that I'm used to dealing with,
13 but you could look at it that way, yes.
14 Q Do you-all have a fancy name for
15 what I would call a line port?
16 A Well, actually I would just call
17 it a line.
18 Q A line? Okay.
19 A I call it line and trunk and
20 port. Some people, I guess, use that, but
21 that's not the common nomenclature for us.
22 Q Okay, now, the $85 a line that
23 you reference in your testimony - was that
24 the low bid price?
25 A No, that was the average.

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1 Q What was the low bid price? I'm
2 going to ask you the question without
3 identifying the particular vendor.
4 A I would be very uncomfortable
5 answering that because of confidentiality.
6 Q Well, then let's —
7 MS. HUNT: Let's go off the
8 record a second. I think we have a
9 misunderstanding as to what is being asked.
10 Can we go off for one minute?
11 MR. DAWSON: Let's go off
12 the record. That's fine.
13 (Discussion off the record.
14 Q (By Mr. Dawson) Tell me
15 - explain to me what the $85 a line
16 represents.
17 A The $85 a line – I thought I had
18 done that, but it's the EF&I costs -
19 engineering, furnish and install costs for
20 the switch that includes the lines, the
21 trunks, the fabrics, the processors - the
22 total price from a vendor standpoint
23 divided by the number of lines on the
24 switch.
25 Q And with respect to the bids,

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1 that is the average price over the various
2 bids that Southwestern Bell accepted during
3 the time period that you referenced
4 earlier?
5 A That's correct.
6 Q Do you know whether there were
7 any instances where Southwestern Bell chose
8 not to accept the lowest bid offered to it
9 for any reason?
10 A I do not know. I would be
11 surprised.
12 Q And do you know whether those bid
13 prices included the vendor discount?
14 A Yes, they did.
15 Q You then talk about telephone
16 company cost plus tax?
17 A Yes.
18 Q Where did you get that
19 information?
20 A The information on switch cost,
21 I'd say just in general, came from Gary
22 Shaw, an employee of Southwestern Bell in
23 Dallas, in the network planning
24 organization.
25 Q Back to the bid information,

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1 where did you get that? Is that from Mr.
2 Shaw also?
A That's correct.
Q And Mr. Shaw - you're relying on
5 him for the numbers that were used for the
6 telephone company cost?
7 A That's correct.
8 Q Would that also be true for the
9 frame, power and test sets?
10 A That's correct.
11 Q Do you know, sir, whether there
12 were any documents that would substantiate
13 the numbers that are contained on Page 7 of
14 your testimony?
15 A Yes, I believe so. At the time I
16 did the testimony, I was in telephone
17 contact with Mr. Shaw and actually some
18 others, although Mr. Shaw was the one that
19 put it together for me. After the
20 testimony had been filed, he has sent me
21 some confirming correspondence of where he
22 got some of these numbers from and their
23 basis and all. So I believe that that
24 probably satisfies what you're asking for
25 there.

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1 Q Well, what I'm trying to
2 understand, sir, is you've got a bunch of
3 numbers in here, and I'm not being
4 critical, but where did they come from?
5 All you've told me so far is Mr. Shaw. Do
6 you happen to know where he got them from?
7 A Oh, yes.
8 Q Where did he get them from?
9 A Mr. Shaw - his job
10 responsibilities include doing fundamental
11 switch planning for the state of Texas.
12 He's the individual that does - he and his
13 people do analysis that justify replacing
14 the switch. They are the ones that arrange
15 to bid it with the vendors. They're the
16 ones that track it on what it actually
17 costs. So he has a - he is a rich source
18 of factual information on the cost of
19 switching.
20 Q And do you expect that Mr. Shaw
21 has available to him documents that would
22 support the $85 a line bid cost that you
reference in your testimony?
24 A I would assume so.
25 Q Would you expect that Mr. Shaw

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1 has available to him documents which would
2 support or substantiate the total company
3 cost that's referenced in your testimony?
4 A Yes, I do.
5 Q And the same for the frame, power
6 and test sets?
7 A Yes.
8 Q And to your knowledge, sir, have
9 any of those documents been either produced
10 in this proceeding or made available to any
11 of the parties?
12 A They have not.
13 Q Then you say later in the
14 paragraph beginning on Line 13 - you say,
15 "Southwestern Bell's average growth cost
16 per line on a digital switch is $248." Do
17 you see that, sir?
18 A Yes, I do.
19 Q First of all, what is an average
20 growth of the cost per line on a digital
21 switch? What are you referring to there?
22 A The reference is basically the
23 same as the $59 or $85 a line cost. If you
24 took the - on a normal growth job on a
25 digital switch -- and we use that to be

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1 forward looking -- this is what the average
2 cost per line is for a total job.
3 Q Let me back up. The bids that
4 you received - were they for analog or
5 digital switches?
6 A Digital.
7 Q Okay, and that gives you a total
8 cost of $183 a line?
9 A For a new switch.
10 Q For a new switch? All right, and
11 is this what you're saying for an existing
12 digital —
13 A Growing an existing digital
14 switch costs 248, and that's - again, that
15 is illustrating what I was discussing
16 earlier of the cheapest you ever get the
17 switch is at the initial point. Growth
18 jobs cost you a bit more.
19 MS. HUNT: And I would
20 caution here to be real careful not to talk
21 over and let him finish the question
22 because the court reporter has a hard time
23 getting both down if you talk over each
24 other.
25 Q (By Mr. Dawson) Okay, what's the

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1 network, you've got - a certain percentage
2 of your switches at any given time are
3 relatively new switches. There's no
economic incentive to replace them. So if
5 you assume that the total demand that
6 you're trying to satisfy is going to be
7 handled by bid switches, dial-to-dial
8 replacements on everything that's out
9 there, no one would even remotely consider
10 doing that.
11 Q Okay, anything else?
12 A That's the primary point there.
13 Q Okay, beginning on Line 8, you
14 say that the Hatfield model shows a price
15 of $59 per line for a large switch. Do you
16 see that?
17 A Yes.
18 Q Did you get that out of the
19 Hatfield model itself?
20 A Out of the input, yes.
21 Q Okay, do you know what that
22 59-dollar charge refers to? In other
23 words, let me put it this way: Do you know
24 whether that includes or does not include
25 the switch port?

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A I did not know with any degree of
2 certainty. When I read it, I assumed that
3 it handled the line termination itself and
4 the basic switching function of the switch
5 involved, but it doesn't explain it one way
6 or the other.
7 Q Okay, now, you then say in
8 several bids EF&I price for switches at
9 Southwestern Bell was $85 a line. Do you
10 see that?
11 A Yes, I do.
12 Q Okay, first of all, what
13 particular bids are you referring to?
14 A Basically it was bids on switches
15 that we were replacing in Texas over the
16 past year and a half, I believe it was, in
17 that size range. We took a specific
18 example there, and the Hatfield model had
19 several sizes, and these were switches in
20 the forty to eighty thousand line size, and
21 this was the average bid in Texas over the
22 last 18 months.
Q What switches were you receiving
bids on?
25 A The name of the specific switch?

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1 Q Yes, sir.
2 A I do not recall.
3 Q You don't know if they were
4 DMS-10s?
5 A Oh, you're talking about vendor?
6 I thought maybe you were talking about
7 location.
8 Q No, I didn't mean location. I
9 meant the type of switch. There's like a
10 DMS-10 and DMS-100 and 5E.
11 MS. HUNT: I'm going to
12 caution here. Again, if we're getting into
13 vendor-specific prices where you can really
14 tell what their individual price is, we
15 need to advise the court reporter and make
16 arrangements.
17 Q (By Mr. Dawson) At this point,
18 I'm not trying to get into prices. I just
19 want to know which particular switches were
20 you receiving bids on.
21 A Okay, I might have to rephrase it
22 just a little bit.
23 Q Well, I don't —
24 A I think what you want to know is
25 which vendors were we —

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1 Q What types of switches?
2 A — were we inviting to bid on
3 these particular projects. Right?
4 Q And the types of switches you
5 were asking them to bid on.
6 A Okay, well, they're not
7 bidding on a type of switch. They are
8 bidding a type of switch. You know, as an
9 example, Lucent bids a 5ESS. Nortel bids a
10 DMS-100 typically on — well, they really
11 have virtually no choice in this size
12 switch. That's the only one they could
13 bid, and those are the two vendors that we
14 have in this model.
15 Q Okay, so when you say - when
16 you're referring to recent bids, are you
17 referring to bids from Lucent and Nortel?
18 A That's correct.
19 Q And no others?
20 A That is correct. Let me clarify
21 that. For the 59-dollar line - not the 59,
22 but the 85-dollar line, that portion of it
23 was just those. Some of the other stuff
24 down here had other bidders involved in it.
25 Q And what was the - what did the