BEFORE THE
FLORIDA PUBLIC SERVICE COMMISSION

In the Matter of : DOCKET NO. 980696-TP

Determination of the cost of basic local telecommunications service, pursuant to Section Section 364.025, Florida Statutes.

VOLUME 11

Pages 1178 through 1284

PROCEEDINGS: HEARING

BEFORE: CHAIRMAN JULIA L. JOHNSON
COMMISSIONER J. TERRY DEASON
COMMISSIONER SUSAN F. CLARK
COMMISSIONER JOE GARCIA
COMMISSIONER E. LEON JACOBS, JR.

DATE: Tuesday, October 13, 1998

TIME: Commenced at 9:00 a.m.

PLACE: Betty Easley Conference Center
Room 148
4075 Esplanade Way
Tallahassee, Florida

REPORTED BY: MARY ALLEN NEEL, RPR

APPEARANCES: (As heretofore noted.)

I N D E X

WITNESSES - VOLUME 11

NAME	PAGE
PETER F. MARTIN	
Cont'd Cross Examination by Mr. Henry	1180
Cross Examination by Ms. Bedell	1189
ROBERT M. BOWMAN	
Direct Examination by Ms. Keyer	1186
Prefiled Direct Testimony Inserted	1190
Prefiled Rebuttal Testimony Inserted	1203
Cross Examination by Mr. Ruscus	1222

EXHIBITS - VOLUME 11

NUMBER		I.D.	EVD.
50	PFM-1		1184
51	(Late-filed) Percentage of Customers that Subscribe to Only Basic Residential Dial Tone Service	1185	
52	RMB-1 through RMB-4 (Direct)	1189	
53	RMB-1 through RMB-3 (Rebuttal)	1189	

P R O C E E D I N G S

(Transcript follows in sequence from Volume 10.)

COMMISSIONER DEASON: Excuse me just a second, Mr. Martin, but didn't you also say that you couldn't do that on your own, that it had to be done by this Commission? Is that your understanding?

THE WITNESS: I mean, that's a good point. Whenever this fund is set up, the Commission will need to ultimately decide which rates are reduced, because, again, there will be offsetting rate reductions, but those would be approved by the Commission.

COMMISSIONER DEASON: And to the extent there -- if there is to be any rate rebalancing and the basic rate goes up, that would diminish the need for the fund; is that correct?

THE WITNESS: Absolutely.

MR. HENRY: I don't have any more questions. Thanks.

CHAIRMAN JOHNSON: Staff?

CROSS EXAMINATION

BY MS. BEDELL:

Q Mr. Martin, my name is Cathy Bedell. I'm representing the Public Service Commission Staff today.

My first question relates to the definition of costs that is used in the legislation that we're discussing. In your opinion, would the costs, or should the costs be based on the total cost for a particular geographic area, the average per line cost for an area, or something else entirely different?

A I think the cost should be calculated on a per line base, and it should be de-averaged, at least by wire center.

Q And why is that?

A Because the statute says to do it on a wire center basis, or no larger than a wire center basis.

Q And you said it should be done on an average per line basis?

A Yes. I think, you know, if you wanted to multiply that times the number of lines, you could look at the total costs associated with universal service. But I think that's really what you need to get to, is the per line cost, because ultimately that's what the Legislature is going to need as it works through universal service.

Q And would you agree that using the cluster level that is in the HAI, that that is smaller than a wire center?

A I believe clusters are smaller than wire

centers, yes.
Q And would you also agree that the grid level used in the BCPM is smaller than the wire --
A Yes.
Q If both the cluster level and the grid level are small than a wire center, should the costs be aggregated up or disaggregated?
A That's a good question. Basically you're right. You're putting the pieces together for a wire center, so I guess you could call it aggregating up.
Q And can you explain why that should be?
A Well, I think initially it makes sense to do this at the wire center level. I did in one of my data request responses talk about possibly going to census block groups.
The problem initially is that we just don't know which customers are in which census block groups in terms of, you know, going to the fund administrator and saying these customers are in this census block group. It could be done. It would take some time.
But initially we think it would be best to go ahead and do it at the wire center level.
Q And aggregate up?
A Yes. You're taking the costs for these little pieces and just putting them together or

averaging them out across the wire center, and so that would be the way to do this to meet the statutory mandate.

MS. BEDELL: Thank you. Staff doesn't have any further questions.

CHAIRMAN JOHNSON: Commissioners?

COMMISSIONER JACOBS: It's a matter of contention, Mr. Martin, but if you would accept for the moment that there perhaps a decline in cost curve that would apply here. How would we deal with the fund compensation in the event that the costs would actually prove to decline? You know, do we actually make sure that the fund tracks that?

THE WITNESS: That's an excellent question. In terms of what do you do going forward, there are several possible ways to go. And one way would be to, you know, maybe set a time frame two or three years down the road where you try to transition to some kind of an auction mechanism, for example. GTE has put that on the table.

And I don't know if that's the right answer, but the bottom line is, you could go to something down the road where companies would bid for support, and so to the extent that costs are going down, then that could be reflected that way. That's one way to do it. I'm sure there's other ways.

But, you know, again, I will note that I'm not sure that costs are declining in total, because we do have a lot of copper-served customer, and I think in general copper is going up. But one way to deal with your concern would be to, you know, a few years down the road redo the support, or auction it, something like that.

Did that make sense?

COMMISSIONER JACOBS: Yes, I understand. Thank you.

CHAIRMAN JOHNSON: I think we're ready for redirect.

MS. KEYER: We have no redirect.

I would move PFM-1 be inserted into the record.

CHAIRMAN JOHNSON: So Exhibit 50 is admitted without objection.

Thank you, sir.

(Exhibit 50 received in evidence.)

MS. KEYER: Madam Chairman, was that Exhibit 50 or 49?

CHAIRMAN JOHNSON: Fifty.

MS. KEYER: Okay. Thank you.

CHAIRMAN JOHNSON: Forty-nine will be the late-filed.

MS. KEYER: Thank you.

MR. COKER: Madam Chairman, could I get an exhibit number for the late-filed exhibit that we requested from the witness?

CHAIRMAN JOHNSON: It was 49.

MR. COKER: That was 49?

CHAIRMAN: Uh-huh. The MST analysis?

MR. HATCH: Madam Chairman, no, ma'am. It's a different exhibit. The MST analysis was for Dr. Duffy-Deno. The late-filed that we requested of Mr. Martin is a new -- is different from that one, so it would be the next number in the sequence.

CHAIRMAN JOHNSON: I'm sorry. What is the exhibit you all requested, Tracy?

MR. COKER: We requested a percentage of basic -- of residential customers that subscribe to only basic residential dial tone service.

CHAIRMAN JOHNSON: That will be identified as 51.

(Late-filed Exhibit 51 identified.)

MR. COKER: Thank you.

CHAIRMAN JOHNSON: Thank you.

MS. KEYER: BellSouth would call its next witness, Dr. Robert Bowman.

- - - - -

ROBERT M. BOWMAN

was called as a witness on behalf of BellSouth Telecommunications, Inc. and, having been duly sworn, testified as follows:

DIRECT EXAMINATION

BY MS. KEYER:

Q Would you please give your name and business address?

A Yes. My name is Robert M. Bowman. My business address is 10655 West Rowland Avenue in Littleton, Colorado.

Q By whom are you employed, Dr. Bowman, and in what capacity?

A I am an independent consultant working through INDETEC International and representing BellSouth in this proceeding.

Q Have you testified before this Commission before today?

A No, I have not.

Q Would you please give the Commissioners some of your background and just tell them a little bit about yourself?

A Yes, I'll be glad to. I have a bachelor's and a master's and a doctorate in electrical engineering. I have 28 years of telecommunications experience with Bell Telephone Laboratories and with U.S. West Communications, who is a local exchange carrier. Most of this, in fact, almost all of it, has been in the area of telecommunications cost studies and cost model development and includes expert testimony before state commissions on costs and cost models.

I've performed cost studies and developed loop, transport, and switch cost models for U.S. West. I participated in the development of U.S. West's Benchmark Cost Model, or BCPM, which was one of the predecessors of the BCPM which is being represented here today.

Q Dr. Bowman, have you caused to be filed in this case 13 pages of direct testimony dated August 3, 1998, with four exhibits attached, and 15 pages of rebuttal testimony dated September 2, 1998, with three exhibits attached?

A Yes, I have.

Q Was this testimony prepared by you or at your direction?

A Yes, it was.

Q Do you have any changes to either your direct or rebuttal testimony?

A Yes, I have two changes. The first one is in Exhibit RMB-3 of my direct testimony, page 7 of 25, in the footnote. And there are no line numbers there, but in the fifth line from the bottom, the sentence begins, "In four of the five states analyzed," and you should delete "four of the five." That should read, "In all states analyzed." And then added to the list which follows -- there are four states listed there. The State of Missouri should be added to that list.

And then in the following line, delete the sentence that says, "In the fifth state, Missouri, the results were identical."

Q You said you had two changes. Were those the two changes?

A Yes, one other, and that would be in my rebuttal testimony at page 12, line 5. The word "million" should be deleted, and then the word "BellSouth" changed to "total," so that that line reads as it begins, "This is from a base of 9,842,000 total lines," and continues on.

Q Dr. Bowman, with those changes incorporated, if I were to ask you the same questions today as were asked in your direct and rebuttal testimony, would your answers be the same?

A Yes, they would.

MS. KEYER: Madam Chair, I would like to move Dr. Bowman's direct and rebuttal testimony be inserted into the record as if read and have --

CHAIRMAN JOHNSON: It will be so inserted.

MS. KEYER: Thank you. And have the exhibits attached to his direct and rebuttal identified, marked for identification.

CHAIRMAN JOHNSON: Okay. Exhibits RMB-1 through 4 for the direct?

MS. KEYER: Four, that's right, for the direct.

CHAIRMAN JOHNSON: Will be identified as 52. And for the rebuttal, we have --

MS. KEYER: I believe there were three.

CHAIRMAN JOHNSON: Rebuttal Exhibits RMB-1 through 3, and that will be 53.

(Exhibits 52 and 53 marked for identification.)

DIRECT TESTIMONY OF DR. ROBERT M. BOWMAN

ON BEHALF OF BELLSOUTH TELECOMMUNICATIONS, INC.

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 980696-TP

AUGUST 3, 1998

INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Robert M. Bowman. My address is 10655 West Rowland Avenue, Littleton, Colorado, 80127. I am an independent telecommunications consultant.

Q. PLEASE DESCRIBE YOUR WORK EXPERIENCE AND EDUCATIONAL BACKGROUND.

A. My work experience includes testifying in many proceedings involving incremental costs over the past eighteen years, primarily as an employee of U S WEST Communications. Exhibit RMB-1 describes my background and experience in detail.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. I am testifying on behalf of BellSouth Telecommunications, Inc. (hereinafter "BellSouth"). The purpose of my testimony is to respond to the second issue specified by the Florida Public Service Commission regarding "the appropriate cost proxy model to determine the total forward-looking cost of providing local telecommunications service pursuant to Section 364.025(4)(b). I explain, from an engineering perspective, why the Benchmark Cost Proxy Model, Version 3.1 ("BCPM 3.1"), is the appropriate model for the Florida Public Service Commission to rely upon in estimating the costs of universal service for BellSouth's territory in Florida. I discuss how BCPM 3.1 is a superior cost proxy model because it designs a forward-looking network that efficiently provides universal service. This includes designing a network that has the ability to provide customers in rural and other high cost areas the capability to access advanced services comparable to that provided in urban areas as required by the Telecommunications Act of 1996 ("the Act"). I also explain how BCPM 3.1 integrates its customer location methodology with its network design to ensure that engineering design and constraints reflect the underlying customer location data.

1191

Dr. Kevin Duffy-Deno's direct testimony, on behalf of BellSouth, focuses on BCPM 3.1's customer location methodology and explains why BCPM 3.1 locates customers as precisely as possible, given data that is currently, publicly available.

II. BCPM 3.1 MODELS AN EFFICIENT, FORWARD-LOOKING NETWORK, BASED ON SOUND ENGINEERING PRINCIPLES

Q. ARE THERE ANY PROVISIONS IN THE ACT THAT HAVE IMPORTANT IMPLICATIONS FOR A COST PROXY MODEL'S NETWORK DESIGN?

A. Yes. Principles (2) and (3) in Section 254 of the Act have significant implications for the technical requirements with which the network complies. Principle (2) states: "Access to advanced telecommunications and information services should be provided in all regions of the Nation." Principle (3) states: "Consumers in all regions of the Nation, including low-income consumers and those in rural, insular, and high cost areas, should have access to telecommunications and information service, including interexchange services, that are reasonably comparable to those services provided in urban areas and that are available at rates that are reasonably comparable to rates for similar services in urban areas."

Q. DOES BCPM 3.1 SATISFY PRINCIPLES (2) AND (3) OF THE ACT?

A. Yes. BCPM 3.1 designs a network that has the capability to provide customers in rural and other high cost areas access to advanced services comparable to those provided in urban areas. Engineering design rules and engineering constraints in BCPM 3.1, such as the maximum grid size, restrictions on cable size, and limitations on line cards, play a critical role in assuring access for all customers, at an acceptable level of service quality. I expand upon this later in my testimony.

Q. PLEASE EXPLAIN HOW BCPM 3.1 INTEGRATES ITS CUSTOMER LOCATION METHODOLOGY WITH ITS NETWORK DESIGN.

A. The customer location algorithm essentially uses road network data to place customers more precisely within Census Blocks. This is achieved by a three-step process. First, the Census Blocks that reside within a particular wire center's boundaries, as specified by the Business Location Research (BLR) Data, are identified. Second, micrograids, that are 1,500 feet by 1,700 feet in size, are overlaid on these Census Blocks. Third, for those Census Blocks that span multiple microgrids, Census road network data is used to apportion Census Block customer data within the Census Block based on the proportion of the road network within a Census Block that traverses a microgrid. Dr. Duffy-Deno describes this process in greater detail in his direct testimony.

It is at this point in the modeling process that engineering design plays a role. The microgrids and their underlying customer data are aggregated into larger grids, referred to as "ultimate grids," based on engineering constraints. These engineering constraints conform to the specifications of a forward-looking, efficient network design. That efficient network is based on the designation of a Carrier Serving Area. A Carrier Serving Area is a standard telephone design concept that consists of a geographic area that can be served by a single digital loop carrier (DLC) site. Each ultimate grid corresponds to a Carrier Serving Area. The physical size of the Carrier Serving Area varies, depending on the underlying microgrids' customer location data. Thus, the wire center is composed of these ultimate grids that vary in size based on the engineering constraints of the Carrier Serving Area.

Q. WHAT SIZE GRIDS DOES THE BCPM 3.1 USE?

A. BCPM 3.1 constrains the size of the ultimate grids to be no larger than approximately 12,000 feet by 14,000 feet. The rationale for this constraint on the ultimate grid size is to limit copper loop lengths from the DLC to the farthest customer to approximately 12,000 feet.

Q. IS THIS A LEAST COST NETWORK?

A. This network design is consistent with BellSouth's engineering practices in

1193

Florida. Furthermore, this is a least-cost network design, as opposed to a model that designs grids 18,000 feet by 18,000 feet in size. This is supported by two sets of model runs provided to the FCC by the BCPM model sponsors on December 11, 1997 for the five states specified by the FCC (Florida, Maryland, Georgia, Missouri, and Montana). The first run models 12,000-foot grids, and the second run models 18,000-foot grids. The results for the five states indicate that the 12,000-foot grids result in a lower per-line loop cost than the 18,000-foot grids.

Modeling considerably larger 18,000-foot grids requires the inclusion of an extended range line card that increases the costs considerably. It also requires a larger cable size, i.e., 24 gauge, rather than 26 gauge which also costs more. The extended range line card and the large cable size are necessary to provide basic telephony service, as well as to ensure comparable access to advanced services in rural and urban areas, as specified in principles (2) and (3) of the Act, when using 18,000-foot grids.

BCPM 3.1 uses 24 gauge cable only when the copper loop from the DLC to the furthest customer exceeds 11,100 feet. This distance is based on complying with engineering standards for the maximum dB loss permissible to maintain adequate service quality. An extended range line card is included for loops that extend beyond 13,600 feet from the DLC to the customer. This also is an engineering standard, but is a user adjustable input in the model.

Q. PLEASE ELABORATE ON THE IMPORTANT CHARACTERISTICS OF CARRIER SERVING AREAS.

A. Telephone plant engineers do not typically build plant on a customer-by-customer basis. Rather, they plan and build plant based on Carrier Serving Areas and Distribution Areas. A Carrier Serving Area typically contains no more than 1,000 living units, while a Distribution Area typically contains 200 to 600 living units. A Carrier Serving Area is composed of one or more Distribution Areas. In addition, the Carrier Serving Area is constrained in both the number of lines it can serve, and the length of copper loops from the DLC site. Thus, engineers recognize customer locations and natural clusters of customers when implementing standard engineering practices that try to maximize the efficient use of plant and ensure adequate service quality.

Exhibit RMB- 2 provides an illustration of a Carrier Serving Area as modeled by BCPM 3.1 in a rural area and an urban area. Note how the ultimate grid diminishes in size in more densely populated areas.

Q. WHAT CHALLENGES DO COST PROXY MODEL DEVELOPERS FACE WHEN DESIGNING ENGINEERING AREAS?

A. One of the major challenges of building a proxy model for universal service funding is reflecting customer locations in a way that integrates engineering practices based on this Carrier Serving Area and Distribution Area approach. BCPM 3.1 effectively integrates its customer location algorithm and engineering design by: 1) adhering to the Carrier Serving Area specifications described previously and 2) designing a network to serve customers based on the most precise depiction of customer locations. BCPM 3.1 designs a network the way actual telephone companies design networks.

Q. FOR PURPOSES OF ESTIMATING UNIVERSAL SERVICE COSTS, WHICH GEOGRAPHIC AREAS ARE PARTICULARLY IMPORTANT?

A. For purposes of estimating universal service costs, it is particularly important for a cost proxy model to provide reasonable and accurate cost estimates in the less densely populated areas, i.e. rural areas, that may need universal service support. Costs of serving customers increase significantly with the distance the customer is from the wire center and the lower density of rural customers.

Q. HOW DOES BCPM 3.1 REFLECT ENGINEERING DESIGN RULES IN ITS CALCULATIONS?

A. BCPM 3.1 reflects standard engineering guidelines as presented in AT&T's Outside Plant Engineering Handbook (August 1994). These or similar guidelines are used by every major telephone company. BCPM 3.1 designs loops to reflect standard transmission guidelines. Ultimate grids are designed such that copper distances beyond the DLC site are generally less than 12,000 feet. The copper/fiber breakpoint in feeder design is user-defined.

Also, BCPM 3.1 includes all components of the loop that are necessary for the safety of subscribers and their property. The engineering design standards embodied in BCPM 3.1 ensure that the subscribers' premises will not be damaged or destroyed because of insufficient electrical protection or missing anchors and guys.

Q. DO YOU HAVE AN ATTACHMENT TO YOUR TESTIMONY THAT

DISCUSSES EFFICIENT NETWORK DESIGN AND ENGINEERING STANDARDS?

A. Yes. Exhibit RMB-3, attached to my direct testimony, contains a section of the December 11, 1997, filing by the Joint Sponsors of the BCPM before the FCC. This section of the filing is entitled, "BCPM3 Designs the Most Efficient Proxy Network." This filing details how BCPM utilizes efficient design and engineering standards.

II. MAJOR COMPONENTS OF THE LOOP NETWORK

Q. WHAT IS THE MOST SIGNIFICANT COMPONENT OF THE COST OF UNIVERSAL SERVICE?

A. The great majority of the costs of universal service are the costs of constructing the loop network. The loop network consists of the facilities from the central office switching center to the customer's premises.

Q. WHAT ARE THE MAJOR COMPONENTS OF THE LOOP NETWORK?

A. The loop includes feeder cable, distribution cable, Feeder Distribution Interfaces ("FDIs"), distribution terminals, drop wire and a Network Interface Device ("NID") at the customer's premises.

Q. WHAT IS THE NETWORK INTERFACE DEVICE?

A. In the residential environment, the loop network typically includes the facilities on the outside wall of the home known as the NID. For an apartment or a business location, the network interface is known as a protected terminal. In either case, the inside wire or cables are typically connected to the protected terminal or NID.

Q. WHAT IS THE DISTINCTION BETWEEN THE FEEDER AND DISTRIBUTION COMPONENTS OF THE LOOP NETWORK?

A. The facilities between the switching center and the terminal at the customer's premises are typically divided into feeder and distribution cable plant. Feeder facilities are the facilities between the switching center and the FDI. An FDI is generally the demarcation point between feeder and distribution facilities.

Distribution facilities begin at the FDI and end at the NID or at a building terminal. A distribution terminal or drop terminal is used to terminate drop wire and connect the drop wire to the distribution cable. Drop wire connects the distribution cable to the NID located at the customer's premises. Exhibit RMB-4 depicts the loop network currently used in the industry and its components.

Q. HOW DOES BCPM 3.1 DESIGN FEEDER ROUTES?

A. Each feeder route is designed from the serving wire center out to the most distant ultimate grid. A feeder route may include only copper cables, only fiber cables, or both copper and fiber cables depending upon the demand within each ultimate grid and the total loop distance to service it. The feeder cable ends in a feeder distribution interface where the feeder cable cross-connects the distribution cable.

Beyond 10,000 feet, each main feeder path is redirected towards the population centroid of BCPM 3.1, or is split into two paths, each directed toward the relevant population centroid. The resulting feeder distance is then compared to the feeder distance that would occur with a system of a main feeder that continues in a straight line with subfeeder running at right angles. The feeder approach that yields the shortest feeder design, and hence, lowest cost design, is used by the Model. This more readily reflects the feeder design that is actually used in real networks. This technique is superior to the assumption of a single straight feeder with subfeeder emanating at right angles.

Q. HOW ARE CARRIER SERVING AREAS REPRESENTED IN BCPM 3.1?

A. Each ultimate grid is designed to serve as a Carrier Serving Area. Within that Carrier Serving Area, a digital loop carrier is established at the road centroid , i.e. weighted average of the road coordinates, of the ultimate grid. Consequently, the ultimate grid not only reflects customer location, it reflects a natural network design area.

Q. HOW DOES BCPM 3.1 MODEL DISTRIBUTION FACILITIES?

A. With the exception of the most densely populated ultimate grid, four Distribution Quadrants are established within each ultimate grid from the road centroid of that grid (which corresponds to the DLC site). For each Distribution Quadrant, the area within 500 feet of the roads in the Distribution Quadrant is calculated. A Distribution Area is configured as a square whose area is equal to the area calculated as described above. The Distribution Area is centered about the road centroid of the Distribution Quadrant. A feeder distribution interface is placed at the center of the Distribution Area for those Distribution Quadrants with sufficient line demand. From the road centroid of the Distribution Quadrant (the FDI location), copper cables emanate in a tree and branch architecture running from the FDI to a terminal. In the case of service provided to a single family home, the terminal connects to the customer premises via drop wire, where it terminates at a network interface device. In the case of a multi-tenant building larger than a threeplex, a building terminal is used. Thus, BCPM 3.1 designs a network to reach all housing units and business from each serving wire center. BCPM 3.1 incorporates opportunities to share structure by multiple subfeeder routes. It also permits sharing of the FDI by Distribution Quadrants, and co-location of the FDI with the DLC, depending on line demand. These features reflect an efficient network design.

As a reasonableness check on cable requirements, the Model constrains the total cable length in the Distribution Quadrant area (including backbone, branch, vertical and horizontal connecting cables) to not exceed the length of the road network in that Distribution Quadrant.

Q. WHAT IS THE RESULT OF INCORPORATING THESE COMPONENTS OF THE LOOP NETWORK IN A COST MODEL?

A. The result is a model that includes all the loop cost elements necessarily incurred in providing subscribers with the capability of placing and receiving telephone calls.

III. SWITCHING, TRANSPORT AND SIGNALING COSTS IN BCPM 3.1

Q. HOW DO YOU DEFINE THE TERMS SWITCHING, TRANSPORT AND

SIGNALING?

A. Switching is the process of opening and closing lines or circuits to connect end points carrying telephony transmission. This function is typically done by a device in a telephone company central office. Transport is the media over which transmission is carried. Signaling monitors the status of a line or circuit, alerts the arrival of a message, or transmits routing and designation signals over the network to set up calls between central offices.

Q. HOW DOES BCPM 3.1 TREAT THE DESIGN AND COSTING OF SWITCHING, TRANSPORT AND SIGNALING?

A. BCPM 3.1 designs a modern network of digital host, remote and stand-alone switches based on the actual in-place network. DMS-100 and 5ESS switches are used in the design process with the user having the option to specify a switch vendor. BCPM 3.1 also includes a new switching cost option for small switches. The interoffice network uses commercially available SONET ring sizes and develops costs for a Signaling System 7 (SS7) network that meets the actual traffic demands of the in-place network. These rings are self-healing and provide the network redundancy requirement by the FCC's September 3, 1997, guidelines on Switching, Interoffice Trunking, Signaling, and Local Tandem Investment.

After designing the network, the Model determines the portion that is applicable to the provisioning of basic service and computes the per line cost of that portion. As an example, after designing the switch network, the Model uses engineering determined partitioning algorithms derived from the Audited LEC Switching Models (ALSMs) to determine the realistic portion of each switch attributable to

1201

universal service.

More detailed information can be found in the BCPM 3.1 Model Methodology document, Chapters Seven (Switching), Eight (Transport) and Nine (Signaling), attached to Ms. Daonne Caldwell's testimony.

IV. SUMMARY

Q. PLEASE SUMMARIZE YOUR TESTIMONY

A. BCPM 3.1 is a superior cost proxy model because it integrates a forward-looking network design that efficiently provides universal service to areas that reflect actual customer locations as precisely as possible. Moreover, BCPM 3.1 efficiently designs a network with the capability to provide those customers in rural and other high cost areas of Florida access to advanced services comparable to that provided in urban areas. For these reasons, I highly recommend that the Florida Public Service Commission adopt BCPM 3.1 as the cost proxy model for determining universal service support for BellSouth in Florida.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes it does.

REBUTTAL TESTIMONY OF DR. ROBERT M. BOWMAN

ON BEHALF OF BELLSOUTH TELECOMMUNICATIONS, INC.

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 980696-TP

SEPTEMBER 2, 1998

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, OCCUPATION, AND ADDRESS.

A. My name is Robert M. Bowman. I am an independent telecommunications consultant. My address is 10655 West Rowland Avenue, Littleton, Colorado, 80127.

1203

Q. ARE YOU THE SAME DR. ROBERT M. BOWMAN WHO FILED DIRECT TESTIMONY ON AUGUST 3, 1998?

A. Yes. Attachment RMB-1 to my direct testimony, filed on August 3, 1998, provides a description of my experience and training relevant to this proceeding.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. I am testifying on behalf of BellSouth Telecommunications, Inc. (hereinafter "BellSouth"). My rebuttal testimony focuses on HAI 5.0a outside plant design from an engineering perspective.

Q. PLEASE SUMMARIZE YOUR REBUTTAL TESTIMONY.

I address two significant issues. First, many of the important assumptions within HAI 5.0a are not included in the user-adjustable inputs. Second, HAI 5.0a continues to violate engineering design rules for outside plant. This results in a network design that uses outdated technology and provides poor service quality. Consequently, HAI 5.01 fails to satisfy fundamental requirements of the Telecommunications Act of 1996 regarding access to advanced services and providing services to rural areas comparable to those provided in urban areas.

The local loop is a necessary component of local exchange service, and the costs of local loop plant are the largest part of the overall cost of supplying local exchange service. However, the HAI 5.0a provides a substandard telephone network and poor telephone service. The HAI 5.0a is clearly not a workable choice for Florida .

1204

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. My testimony addresses two significant flaws in the HAI 5.0a's cost estimation processes:

- The HAI 5.0a user interface makes it difficult for the user to correct the unrealistic and outdated local loop engineering design.
- The HAI 5.0a uses certain outdated engineering parameters and assumptions to design the local loop.

II. HAI 5.0a ASSUMPTIONS THAT ARE NOT EASILY CHANGED

Q. MR. WOOD IMPLIES, E.G., AT PAGE 10 OF HIS DIRECT TESTIMONY, THAT HAI 5.0a IS EASY TO USE AND THAT THE MODEL INPUTS CAN BE READILY ALTERED. WOULD YOU PLEASE COMMENT?

A. Yes. Some of the important assumptions in HAI 5.0a are not user-adjustable. For example, HAI 5.0a does not place telephone poles as part of the aerial structure in the two highest density zones; in essence, it assumes that telephone poles are not required in this density zone. Furthermore, there is no user-adjustable input that allows the user to provide for the placement of poles as part of the aerial structure in the two highest density zones. The user would have to delve into the code to modify the Excel formulas to incorporate a more realistic assumption.

Q. IS THE EXCLUSION OF POLES IN THE HIGH DENSITY ZONES AN IMPORTANT OMISSION?

A. Yes. HAI 5.0a assumes as much as 60% to 85% of loop plant is aerial in its two highest density zones. However, the HAI 5.0a's documentation admits that the model never puts poles under its aerial cable for the two highest density areas. See the HM 5.0a, *Inputs Portfolio* (Revised: January 27, 1998), page 34. A note included there states that "HM 5.0a assumes Aerial Cable in the two most dense zones are Block and Building Cable, not support on poles."

The exclusion of poles in dense areas contradicts the direct testimony of one of HAI's leading proponents, Mr. Dean R. Fassett, provided on January 23, 1998 to the Wyoming Commission. Mr. Fassett has argued many times that it would not be reasonable to ignore the existence of poles in heavily concentrated areas, such as downtown areas, yet ignoring existing pole structures is precisely what the HAI 5.0a does. With no poles, there is no aerial structure cost per se, just the material cost of the cables. Eliminating pole costs results in an understatement of structure cost in the high-density zones, especially since HAI 5.0a assumes such a high percentage of aerial plant. Block cable is aerial cable attached to the sides of buildings. It is decades-old technology, the technology of a bygone era, and inappropriate to use in a modern telephone network. Owners typically do not permit unsightly attachments to the sides of their buildings, and like other forms of aerial structure, block cable is exposed to the weather, electric power and lightning.

Q. CAN YOU PROVIDE ANOTHER EXAMPLE OF AN HAI 5.0a ASSUMPTION THAT IS DIFFICULT FOR THE USER TO CHANGE?

A. Yes. HAI 5.0a does not include manholes, handholes, and pullboxes in the distribution plant. The Model does not have user-adjustable input tables that permit a user to easily add such items of structure to the distribution plant. For this reason, unless a user is capable of altering the Model's computer programming, the Model "automatically" substantially understates underground conduit costs in distribution plant.

HAI 5.0a assumes that distribution manholes, handholes, and pullboxes are not required. Thus, HAI 5.0a imposes this unrealistic assumption. In fact, the larger cable sizes needed in dense urban areas are often too big to sweep up from beneath the ground and attach to pedestals or poles on the surface. Manholes, handholes, and pullboxes are frequently required to build distribution plant in urban areas. Omitting them entirely from HAI 5.0a fails to recognize requisite costs incurred to serve urban subscribers.

Q. WHAT IS THE EFFECT OF HAI 5.0a NOT INCLUDING MANHOLES AND HANDHOLES IN DISTRIBUTION PLANT?

A. Omission of this distribution plant understates the costs actually incurred in providing basic local exchange service. Assuming handholes or pullboxes are spaced 600 feet apart, the HAI 5.0a understates the underground construction cost of distribution plant considerably. Furthermore, the HAI 5.0a does not have an input form allowing the user to incorporate manholes, handholes and pullboxes into the distribution design An explicit inclusion of these costs would require modifications to the model logic.

III. ENGINEERING DESIGN RULES

1207

Q. DOES MR. WELLS DISCUSS STANDARD DESIGN PRACTICES IN HIS DIRECT TESTIMONY?

A. Yes. At pages 4 and 5, Mr. Wells suggests that HAI 5.0a relies on design assumptions that are similar to standard design practices. However, it appears that the HAI "Engineering Team" that Mr. Wells discusses in his direct testimony, has adopted guidelines that are inconsistent with industry standards.

Q. DOES HAI 5.0a ADEQUATELY REFLECT ENGINEERING DESIGN RULES WITH RESPECT TO ITS MODELING OF THE LOOP NETWORK?

A. No, it does not. HAI 5.0a does not adequately reflect engineering guidelines and practices published by Bellcore and AT&T, such as AT&T's "Outside Plant Engineering Handbook, August 1994," reprinted under the Lucent label in 1996. This reference is attached to my rebuttal testimony as RMB-1. Similar criteria are contained in the "Loop Technology Planning Guidelines" from Bellcore (BR 916-100-017).

HAI 5.0a violates these limits by extending copper loops beyond the digital loop carrier (DLC) remote terminal (RT) up to 18,000 feet without additional provisions, such as extended range channel units. Therefore, the local loop design in HAI 5.0a is not capable of providing adequate quality telephone service.

Q. WILL YOU ELABORATE ON WHY THE LOCAL LOOP DESIGN IN HAI 5.0a IS NOT CAPABLE OF PROVIDING ADEQUATE QUALITY TELEPHONE SERVICE?

A. Certainly. The line loss standard for good quality telephone service should not exceed 8.5 decibels (dB) of loss for the entire line, as specified in "Bellcore Notes on the Network", Issue 3, December 1997. HAI 5.0a places standard channel unit cards (plug-ins) in its Digital Loop Carrier (DLC). Each standard channel unit card inherently has 2 dB of loss. This permits a maximum of 6.5 dB of loss for the loop. Decibel loss, per 1,000 feet, for underground or buried cable at standard temperatures (i.e., 68 degrees) is 0.54 dB for 26 gauge cable and 0.44 dB for 24-gauge cable. Even with the conservative assumption that all cable is 24 gauge buried cable (aerial cable in the mix increases the loss), the dB loss for just the metallic loop on an 18,000 foot copper cable is approximately 8 dB. An additional 2 dB of loss inherent in the standard channel unit card brings the total dB loss to approximately 10 dB. Still further dB losses will occur if the line is aerial rather than buried or underground. Consider this additional loss to equal 0.5 dB, bringing the total loss to 10.5 dB. These calculations are shown in my attachment RMB-2.

Therefore, the HAI 5.0a 18,000 foot copper loop has approximately 2 dB more loss than the maximum loss allowed for good quality telephone service. Because dB is measured on a logarithmic scale, this additional loss is significant. Good quality telephone service as provided by the BCPM 3.1 network provides approximately 60% more power over the line that the HAI 5.0a 18,000 foot line provides. Customers would have to yell into the telephone of the HAI 5.0a network in order to be heard.

Q. WHAT ARE THE MAXIMUM LOOP LENGTHS THAT ALLOW GOOD QUALITY TELEPHONE SERVICE?

A. My attachment RMB-2 also shows the calculations of the maximum loop lengths of 11,100 feet (for 26 gauge cable) and 13,600 feet (for 24 gauge cable) that allow good quality telephone service. BCPM 3.1, in contrast to HAI 5.0a, reflects engineering standards by using larger 24 gauge cable beyond 11,100 feet and replacing standard channel unit cards with extended range line cards beyond 13,600 feet as described in the BCPM 3.1 Model Methodology.

Q. IS THERE A PROBLEM WITH HAI 5.0a'S USE OF THE STANDARD CHANNEL UNIT CARDS ON COPPER LOOPS THAT EXTEND TO 18,000 FEET BEYOND THE DLC?

A. Yes, there is a significant problem. The standard channel unit cards used by HAI 5.0a cannot reach copper loops that extend 18,000 feet from the DLC to the customer. In other words, HAI 5.0a models copper distances not supported by the technology assumed. HAI 5.0a and BCPM 3.1 both assume the use of the Litespan 2000 DLC technology (manufactured by DSC). DSC's documentation, however, states that the practical limit of the system is 1,000 ohms, and another vendor

(American Fiber Corporation, AFC) suggests that at maximum DC supervision, range transmission loss due to cable length may be greater than 8 dB. In another section of DSC's vendor documentation, it clearly states that the loop design for the standard channel unit card is based on Carrier Serving Areas rules, which, as pointed out above, limit loops to much shorter than 18,000 feet. Exhibit RMB-3 contains excerpts from the "DSC Practice Litespan Engineering and Planning" guidelines that describe limitations on loop lengths and the need for extended range line cards for loops beyond 12,000 feet. (See the "DSC Practice Litespan Engineering and Planning," OSP 363-205-010, Issue 6, July 1997, System Level Planning, Section 5.3 – CSA Transport Planning.)

Q. WHAT ENGINEERING PARAMETERS AND ASSUMPTIONS AFFECT HAI 5.0a'S LOCAL LOOP DESIGN?

A. The HAI 5.0a model connects the outlier clusters to the main cluster using outdated T1 copper. T1 carriers are digital technology permitting 24 channels over two copper pairs. Typically, engineering practice includes protection or redundancy for these systems by adding a second live copper pair available to continue a call should the first pair fail. The HAI 5.0a model includes no such protection, which violates good engineering practice.

Since HAI 5.0a only models one T1 carrier per outlier cluster, the Model does not have any additional capacity available for requirements such as ISDN, video, or graphics. For advanced services, the HAI 5.0a network would have to be overlaid with additional copper cable and repeaters, as well as DLC electronics. This would require digging trenches again, possibly in existing neighborhoods, which is not only expensive, but also very disruptive to existing homes and landscaping. The BCPM 3.1's choice of fiber DLC technology requires only that additional electronics be added at the DLC site.

Q. DOES HAI 5.0a MEET THE CRITERIA ESTABLISHED BY CONGRESS AND THE FCC REGARDING THE PROVISION OF ADVANCED SERVICES?

A. No, it does not. HAI 5.0a does not even meet the criteria for the provision of plain old telephone service (POTS) and modem/fax connections, as discussed above, much less criteria for other advanced services. In addition, HAI 5.0a attempts to identify the cheapest technology to use without any regard for the types of services offered now or in the future. HAI 5.0a purports to evaluate the costs of choosing fiber versus copper as a transport medium. If copper is the cheapest, HAI 5.0a selects it as the medium of choice.

Choosing copper over fiber generally hinders the provisioning of some business voice grade services such as PBX, WATS, etc., and further restricts modem/fax connectivity. Also, as I indicated earlier, customers may have to shout over the phone to be heard. PBX, and WATS may not work at all, depending on the loop length. Using HAI 5.0a for

1212

unbundled network elements exacerbates the problem because the LECs do not necessarily know how competitors will use the LECs' facilities. Additional costs would be incurred to provision copper cable for many of these services.

Two of the principles for universal service established in the Telecommunications Act of 1996 are relevant here. First, that: "access to advanced telecommunications and information services should be provided in all regions of the Nation." And second, that services in rural areas be comparable to those in urban areas. In addition, the FCC stated in their November 13, 1997, Public Notice (DA 97-2372) that the definition of supported services should "advance with technology."

HAI 5.0a does not satisfy the universal principles established by Congress and rather than advancing with technology, HAI 5.0a incorporates unrealistically long copper loops and 1960s technology with its choice of copper over fiber.

Q. HOW DOES BCPM INCORPORATE PROPER NETWORK DESIGN FOR GOOD QUALITY TELEPHONE SERVICE?

A. To overcome the difficulties of long loops, the BCPM standard design is to not exceed 12,000 feet of copper cable on any customers loop connected to a DLC unit. This is in contrast to the HAI 5.0a model, which designs customer loops connected to DLC units to 18,000 feet,

1213

and possibly beyond. The difficulties of long loops have been discussed above in this testimony.

In Florida, BCPM models only 4,169 lines over 12,000 feet from the DLC site. This is from a base of 9,842,000 million BellSouth lines, and represents only about 4/100 of one percent of the lines. In contrast, we estimate that the HAI5.0a models over 47,000 lines in excess of 12,000 feet in length from the DLC sites, more than 11 times as many long loops as BCPM models. This is a significant number of lines, indicating that such long loops are standard design for HAI5.0a. Service to these 47,000+ customers would be inferior in quality.

SUMMARY

Q. WHAT IS THE OVERALL EFFECT ON THE LOCAL LOOP COSTS OF THE HAI 5.0a?

A. The HAI 5.0a model installs the cheapest technology possible, regardless of the quality of service needed by subscribers now or for the next century. By engineering an outdated, inferior local loop network, the HAI 5.0a model unrealistically lowers the local loop costs for the lowest density areas and for the longest loops

The HAI 5.0a does not build adequate plant. It does not even provide adequate plant for plain old telephone service ("POTS"). By building to a total loop length of 18,000 feet, the transmission loss exceeds the maximum loop loss of 8.5 dB for quality voice transmission. Beyond a DLC, the same degradation of all services results. In addition, WATS, PBX, and CENTREX services will not always work in HAI 5.0a's network, whether served from a wire center or a DLC.

The HAI 5.0a's developers have made it difficult for individual users to correct its flawed and erroneous cost parameters and assumptions.

Corrections to the many loop design deficiencies in the HAI 5.0a are difficult for the user to ferret out. Then, to correct the many understated costs such as the 18,000 feet loop and the missing poles or manholes, the user has to locate the complex computer code in the undocumented or missing user-input values in EXCEL. Important parameters and assumptions are not available to the user through the user-input forms that the HAI 5.0a provides. This makes it difficult to modify the HAI 5.0a to put in acceptable values or engineering design.

Q. WHAT ARE THE IMPLICATIONS OF HAI 5.0a'S ENGINEERING DESIGN FOR THE TELEPHONE NETWORK?

A. The HAI 5.0a's preferences for the cheapest technology suggest old-style, old-fashioned technology. The HAI 5.0a chooses copper of inappropriate length, rather than fiber, as the preferred transport medium, and it chooses aerial construction predominantly, rather than the preferred buried or underground construction. By modeling the network as copper cable at inappropriate distances with aerial construction, the HAI 5.0a selects technology of the 1950's and 1960's, not modern technology that supports modem and fax connections. The HAI 5.0a even neglects to add the equipment necessary for its long copper loops to provide ordinary voice-grade telephone service, much less for more sophisticated services.

Q. WHAT DO YOU CONCLUDE ABOUT THE HAI 5.0a?

A. The HAI 5.0a model significantly and systematically understates local loop plant costs. Furthermore, the HAI 5.0a's flaws and errors are deeply embedded in the computer code of the HAI 5.0a model and undocumented; therefore, corrections cannot be made easily.

HAI 5.0a's chains connecting outlier clusters to main clusters are constructed of outdated T1 copper cable. If all plant were being built today, T1 would not be the economic choice. Having only one T1 serve each 24 channels of voice in the HAI 5.0a chain provides no protection to insure that the system will continue to operate in case of a system failure. Industry standards necessitate an additional T1 carrier for protection.

In general, the industry considers advanced services as any use of the basic network for service other than voice communications, particularly analog modems for computer internet connections and FAX machines, as well as ISDN (Integrated Services Digital Network), ADSL

(Asynchronous Digital Subscriber Line), HDSL (Hybrid Digital Subscriber Line), and possibly others. The HAI 5.0a T1 copper technology has no capacity available for additional requirements for advanced services. With its fiber configuration, BCPM can support such services.

The HAI 5.0a network would have to be overlaid with additional copper and repeaters, as well as DLC electronics, to meet additional requirements. This is expensive and disruptive to existing customers.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?
A. Yes, it does.

1217

Q (By Ms. Keyer) Dr. Bowman, have you prepared a summary of your testimony?

A Yes, I have.

Q Would you please give that summary to the Commissioners?

A I would be delighted.

We are here to answer the question of what is the best method to develop the cost for universal service. There are two models presented, the BCPM 3.1 and the Hatfield model, or HAI, Version 5.0.

The two basic issues are, number one, where are the customers located, and number two, is the telephone network modeled a quality network. You've just heard Dr. Duffy-Deno address the issues of accurately locating customers. I will address the engineering of the network.

BCPM 3.1 is the best method to cost universal service for three reasons: Number one, it follows industry standard design rules for a high quality network. Number two, it designs a least-cost, forward-looking, efficient network. And three, the BCPM network provides the capability for advanced services when additional equipment is added. Let me take these points one at a time, if I may.

Regarding the use of industry standard

design rules, the BCPM follows standards contained in the Outside Plant Handbook, the 1994 edition, which was developed and published by AT&T and which has been addressed earlier in these proceedings. The most recent edition is 1996. Similar guidelines are found in documents from BellCore, the loop technology planning guidelines, and even by DSC Communications, who is vendor of some of the digital loop carrier equipment used for cost proxies in these models. These are the current standards for outside plant design and development. This is how all telephone companies in the United States build networks.

In addition to first cost, engineers must also consider other factors, such as the need to eventuallly reinforce networks, what it costs to maintain the network, consider service disruptions, and even governmental policies regarding how facilities should be placed.

Use of these industry standard design rules limits the size of carrier serving areas such that copper loops don't exceed approximately 12,000 feet in length. This length is based on the line power loss of copper cables and standard remote terminal equipment.

In spite of Mr. Wells' assertion that the

Hatfield model conforms to local loop standards and design practices, it does not. The HAI model allows copper loops in extended carrier service areas up to 18,000 feet in length as standard design in Florida. The result of such a network would be that some customers would have to yell over the phones in order to be heard.

The BCPM designs loops in carrier serving areas not to exceed 12,000 feet as standard design. As a result, the BCPM network delivers 60% more talking power than the Hatfield model, ensuring that customers can actually talk over the telephones.

And even with these excessively long loops, the Hatfield model is more costly, not less costly than the BCPM network. This is shown in a study of five states provided in response to a request from the FCC, one of which was Florida.

The Florida results showed an investment per line of $1,263 for the 18,000-foot HAI network versus $1,248 for the 12,000-foot BCPM network. The apparent savings from having larger extended carrier serving areas in the Hatfield network is more than offset by the extra cost of needing extended range line cards and larger size and length cable.

Regarding the least-cost, forward-looking, efficient network, this is an FCC guideline. But least-cost does not mean cheap. It does not imply that one should minimize the network at the expense of quality telephone service which the customers of Florida deserve.

The Hatfield model takes a minimalist approach by using these excessively large extended carrier serving areas and by assuming transmission characteristics for copper cable which are unattainable in the real world. These transmission characteristics were taken from an illustrative set of information provided by DSC Communications, who is a remote terminal equipment manufacturer, not a cable manufacturer. Such a network would violate sound engineering design rules, underestimate the cost of the telephone network, and would provide inadequate service to customers.

The BCPM transmission characteristics are the ones used by BellSouth and other local exchange telephone companies when they build actual networks.

My third point regarding advanced services, many customers want to do more than just talk over the telephone. Many also want to use the basic network for, for example, Internet access and even fax modems. The Telecommunications Act specifies that rural customers should have access to services comparable to those of urban customers. The Hatfield model's network's minimalist design will not allow even modems to work for many customers.

The BCPM network meets design standards which will allow quality modem connections over the network for most customers.

So in conclusion, the BCPM is the best model for universal service costing because it follows industry accepted design standards used by all telephone companies when they built actual networks, it allows for advanced services when additional equipment is added to the network, and it builds a high quality network over which the people of Florida can actually talk.

Thank you.

MS. KEYER: Dr. Bowman is available for cross.

CHAIRMAN JOHNSON: AT&T?

CROSS EXAMINATION

BY MR. RUSCUS:

Q Dr. Bowman, Stephen Ruscus representing AT&T.

A Good afternoon, Mr. Ruscus.

Q Good afternoon.

Dr. Bowman, I believe you stated prior to your summary that your educational background was in electrical engineering; is that correct?

A That's correct.

Q But isn't it the case that you've had no training and have never worked as a telecommunications engineer designing telephone networks?

A No. I've spent, as I said, the better portion of my career in developing engineering cost models for telecommunications networks, which involves a lot of training in how those networks are built and engineered.

Q In response to my question, didn't you just indicate that you had spent a large part of your career developing cost models?

A Yes.

Q And I asked you whether you had in the course of your career designed telecommunications networks.

A I've designed telecommunications networks for use in cost models, but not for outside plant design.

Q And what we're trying to do here in the models, would you agree, is to emulate the experiences of the engineers who actually design the networks that are deployed in the field?

A In a broad sense, yes. But we're really engineering a network for the future, in a sense, that has probably never been engineered or built before.

Q And you have not had experience in designing those telephone networks; correct?

A Well, the ones I mentioned we're talking about, which is a least-cost, most efficient, forward-looking network built from scratch, has never been designed and built by anyone.

Q Let me be clear. Have you ever designed any telephone network deployed in the field anywhere?

A I think I said I hadn't. I've worked in developing engineering networks for cost models.

Q Would you agree that how a cost model engineers a network will drive the costs calculated by that model?

A Yes.

Q And we previously agreed that the engineers design the models, not the cost models themselves. Excuse me. The engineers design the actual networks and not the cost models; correct? Strike that.

We previously agreed that engineers design networks in the real world, and cost models do not dictate networks in the real world; is that correct?

A No. The networks would -- the network engineering parameters would dictate the network assumptions needed to build the cost models. And as I said, the type of network we're talking about here today in its entirety has never been built anywhere.

Q Would you agree that to capture the costs in a verifiable way of producing a network that would or could be produced in the real world, that a cost model would need to reflect the decisions an engineer would make?

A Yes, engineering -- decisions that engineers made would be part of the inputs to the model, yes.

Q On page 2 of your testimony, you state that from an engineering perspective, you believe that the BCPM is an appropriate model. Do you see that at the first two lines of page 2?

A Of my direct testimony? Actually, I don't.

Q Correct. Beginning on page 1 -- this is your August 3rd direct testimony, the last four words, "I explain from an," page 2, "engineering perspective why the Benchmark Cost Proxy Model, Version 3.1, is the appropriate model." Do you see that?

A Yes, I see that.

Q And in line 5, you indicate that the BCPM designs a forward-looking network that efficiently provides universal service. Do you see that?

A Yes, I do.

Q Is it your understanding that from an engineering perspective, that the appropriate cost model will design a forward-looking network and one that efficiently provides service?

A By appropriate cost model, you mean the one --

Q For this proceeding.

A Okay. Give me that again.

Q Is it your understanding that for the purposes of this proceeding and from an engineering perspective, the appropriate cost model would design a forward-looking network and one that efficiently provides universal service?

A Yes. I think that's what my testimony we just covered says.

Q In your summary you indicated that there were two important characteristics of a cost model. One was the location of the customers. Do you recall that?

A Yes.

Q And the second was that the network was a quality network. Do you recall that?

A Yes.

Q Would you agree that there's a third element missing from your summary, which is that it be an efficient network, meaning that the network that's modeled not deploy in excess of the amount of plant necessary to create a quality network?

A Well, efficiency is certainly part of it. That's covered in my description of a quality network, where I said, as you just referenced in my testimony, it needs to be least-cost, most efficient, and forward-looking.

Q Your Exhibit RMB-4 is a schematic of portions of a network; is that correct? And could you turn to that exhibit?

A I have that in front of me. And, yes, it is a schematic of a network.

Q In particular, it's a schematic of the switch and loop portions of that network; is that correct?

A It doesn't reference the switch per se. The switch would be located at the wire center. It really represents the loop network. That's the title of it.

Q For the purposes of this line of questioning, would you agree that the wire center is the location at which the switch is located for purposes of these models and in real life?

A Yes.

Q Now, you indicated the necessity to have forward-looking technology in a network. From the standpoint of the switch, in your mind, would that include digital switches?

A Yes, digital switches generally represent the forward-looking technology used in both cost models.

Q And so those switches are used in the BCPM; correct?

A BCPM and Hatfield, yes.

Q And in addition, I see for the longer loops, you've indicated that the use of fiber feeder is presumably what's used in the BCPM cost model; is that correct?

A Yes. For longer loops, generally for feeder in the BCPM model, fiber is used, yes.

Q And that's because for longer loops, the fiber is the forward-looking technology?

A Yes, it's forward-looking technology. It's least-cost, particularly in a need to provide a network that will provide adequate quality for use by the customers.

Q And in the context of the use of fiber in the feeder portion of the plant, would you agree that forward-looking technology involves the use of digital loop carrier systems which translate analog voice signals into digital for transmission to the switch?

A Excuse me. Yes, particularly for longer loops.

Q In conjunction with the deployment of fiber?

A Yes.

Q And because I know this term comes up in your testimony a great deal and will come up today, isn't it the case that the geographic area that is served by the digital loop carrier terminal is what's described as the carrier serving area?

A Yes, that's correct.

Q And that carrier serving area would include, from your schematic, the RT, which is the remote digital loop carrier terminal; correct?

A That is part of the equipment that's placed in a carrier serving area, yes.

Q So it would include that. And also all the equipment to the right of the RT, including the feeder distribution interface; correct?

A Correct.

Q And the copper distribution; correct?
A Correct. It would also include the drop and the NID, and maybe other connecting cables listed in the diagram.
Q Thank you. Is it your understanding that the forward-looking form of digital loop carrier systems currently is the next generation integrated digital loop carrier systems?
A Yes, I've heard that term used to describe digital loop carrier systems. The terms have been around for a number of years.
Q And does the BCPM model those systems as forward-looking technologies?
A Yes. Digital loop carrier systems, yes, I think I said it does.
Q Well, in addition to digital loop carrier systems, next generation integrated digital loop carrier systems?
A As I understand the term, yes.
Q Tell me, in a digital switch, what equipment is necessary -- if you're going to model in the loop the next generation integrated digital loop carrier systems, what equipment is needed in the switch to marry up with or otherwise connect with that system?

A Well, next generation digital loop carrier systems, we're really integrating a digital loop carrier system in at the wire center into the switch. And what is generally referred to as an integrated digital loop carrier requires that the equipment at the switch end match up to the switch at the DS1 level or T1 electrical level to connect into the switch.

Q Is there a particular type of port, or is the term "port" relevant in this context?

A Well, I'm not sure. Do you have a question on that?

Q Is the term "switch port" -- does the digital carrier system terminate in a switch port in the context of integrated digital loop carrier?

A Yes. Generically, any line connection into the switch terminates in a switch port of some designation. Switch port is more of a generic term.

Q And these --

A Even an analog line connects into a switch port of a type. It's a different type of switch port.

Q Thank you. And this will conclude my line of questioning on this subject. In particular, when the loop that's next generation integrated digital loop carrier meets the digital switch, is the port in that context different from the port you would find in an analog or non-next-generation integrated digital loop carrier context?

A Yes. I believe that's what I just answered to the previous question. The answer is yes.

Q Excuse me. Now, would you agree that the bulk of the cost of the entire network is contained within the cost of the switch and the loop together?

A Yes.

Q And a considerable amount of that cost is tied up in the components that we described as being within the carrier serving area, namely, the digital loop carrier remote terminal and the FDIs and the feeder associated with serving those DLC terminals?

A Well, certainly a considerable portion. That's not to say that the rest of the loop plant, which is the feeder connection, and the switch is not important. They're all important.

Q So when an engineer designs a carrier serving area in real life with digital loop carrier technologies, that engineer gives careful consideration to the location of the digital loop carrier system and the carrier serving area? Would you agree with that?

A Yes. That's one of the things he must consider in the process.

Q And this is in order to situate the DLC and all the other equipment so as to efficiently serve the customers where he finds them; is that correct?

A Yes.

Q And it doesn't do any good to put a carrier serving area where there are no customers, would you agree?

A I would say in general that's a bad engineering decision, yes.

Q And likewise, there's no need to put five digital loop carrier systems where only one would suffice, would you agree with that?

A Yes. Of course, there's judgment as to whether you would need one or five systems. You want to follow the right criteria for designing the network, yes.

Q Now, when the BCPM designs carrier serving areas for the rural areas, which are the focus of this proceeding, isn't it true that there is no engineering decision that forms the basis for the location of the carrier serving areas?

A No, I disagree with that statement.

Q Well, isn't it true for any carrier serving area which has less than 999 household units, that what has been termed earlier as the macrogrid doubles as the carrier serving area?

A Yes. The macrogrid becomes the carrier serving area in that case.

Q And those macrogrids are overlaid on Florida beginning with a latitude and longitude coordinate; correct?

A Yes. I think Dr. Duffy-Deno addressed all of that. Yes.

Q And they occur, the latitude and longitude lines, every 100 -- excuse me, 1/25th of a degree of latitude and longitude beginning with an origin; correct?

A Yes, that's correct. They are also further divided into microgrids, as was discussed extensively earlier today.

Q But for the carrier serving areas in rural areas, the CSA is not the microgrid. It's the macrogrid; correct?

A Yes, in most cases, for rural areas.

Q And the origin point we're talking about is in the lower left-hand corner of the wire center; correct?

A Well, it's a grid system. I don't think it necessarily represents the wire center. It represents the entire United States the way it's set up.

Q My point is, these grids or the grid system is not overlaid on Florida with an eye towards where the customers actually are located; is that correct?

A No. The grid system is not, that's correct.

Q And for the -- in rural areas, the CSAs equal the grid system, in that the CSAs are the same as the macrogrid; correct?

A Yes, that's correct.

Q So if I were an engineer and I were working -- and I were a real world engineer, but I was required to work within the BCPM rules, and I saw a group of customer that I would contain in one carrier serving area, but within the BCPM this group of customers was broken up by one of these latitude and longitude lines, isn't it true that I would be forced to supply two digital loop carriers, one to each of the carrier serving areas, and two sets of feeders to those, and two sets of FDIs in order to serve those customers?

A I'm sorry. I lost you in the middle of that question.

Q If I were an engineer and I had to play by the BCPM rules, and I saw a group of customers that I would serve with one carrier serving area -- that means one DLC unit, one set of FDIs, et cetera -- and one of these latitude and longitude lines bisected my group of people, then under the BCPM rules, I would actually have to serve those customers in two carrier serving areas, and I couldn't do it in one; correct?

A Well, under your hypothetical. But the question makes no sense, because the gridding process would be the one by which the carrier serving areas are set up within the model.

You're now presuming that there are some other set of carrier serving areas out there, and now this grid process comes along and overlays and breaks up some existing carrier serving areas. That's not the case. The whole concept of the model is to lay out the grid system and develop contiguous carrier serving areas to serve all customers.

Q Well, I guess my question goes to the validity of the whole concept of the model. If I as an actual engineer would serve a group of customers as one CSA, and the model's concept, because it has arbitrary latitude line, would force me to serve it with two, isn't that a problem in terms of efficiency?

A Well, it's a hypothetical on what the engineer would do. And I would say the same would be true if the engineer looked at that and decided that the ultimate grid represented a good carrier serving area because it met engineering guidelines and made that one carrier serving area, then there would be no problem with efficiency. So as a hypothetical, yes.

Your question was a hypothetical, and I said it cannot occur in the real world. But as a hypothetical, I'll agree with you.

Q You don't believe that a group of customers exists in the real world that a real world engineer might like to serve with one carrier serving area which could be bisected into two or more by your model?

A It could be, but the whole purpose of the model is to set up carrier serving areas so that they are contiguous, you know, they do not overlap, and that all customers can be served.

Now, the gridding process is not -- in and of itself not the process for determining carrier serving areas. It's a beginning point for that, for locating customers. And you have mentioned the rural example, in which the entire macrogrid becomes the carrier serving area.

The real issue -- and let me say there, the reason that that becomes the limit is the geographic size of that ultimate grid, which is approximately

12,000 by 14,000 feet. That's the limit in size that limits the design of our loops to exceed no more than 12,000 feet in general. That's why the size of that was chosen.

Now, in most cases, that gridding process is used to determine pockets of customers that need to be served by carrier serving areas that are smaller than this ultimate grid, and that's the aggregation process that you referenced to that's discussed in my testimony, and it's also listed as Attachment B in the BCPM documentation.

So I don't want to leave the impression that all carrier serving areas are the size of these ultimate grids or the macrogrids.

Q Just the ones in rural areas; correct?

A Yes.

Q And while the size of the macrogrids may be determined by an engineer's criterion, the location of the macrogrids is not; correct?

A Correct.

Q Now, I would like to talk with you about what happens when a macrogrid has over 999 households. My understanding, as we've just discussed, and correct me if I'm wrong, is that if it has under 999 households, or under 1,000, actually, the model outputs that carrier serving area as a CSA; correct?

A That's -- you're referencing households. It's really housing units.

Q Excuse me. Housing units.

A If it's less than 999 housing units, it will output that as one carrier serving area, yes.

Q Now, if I add two more housing units to the same geographic area, to the same macrogrid, the model will no longer serve those as a single carrier serving area; is that correct?

A That's correct, and for good reason.

Q And in fact, the model documentation says that the carrier serving area will be divided into four equal quadrants. Is that your understanding?

A No. You're now confusing the process of determining carrier serving areas with the process of establishing distribution areas within carrier serving areas. If this ultimate grid exceeds the limit of 999 housing units, the rest of the algorithm kicks in to look to determine whether that ultimate grid should be further broken down into other carrier serving areas. And in some cases it will, and in some cases it will not.

Now, the reason for the 1,000 housing unit or 999 housing unit criteria is an engineering criteria. That's why I said it's for a good reason that that happens.

Q And --

A Let me finish if I may. That's the number of housing units, around 1,000. There is also a need to consider additional lines and business lines in the process. And the factor used for development in the BCPM is a ratio of about 1.2. So that says there are approximately 1,200 lines for every 1,000 housing units.

Now, if you look at the maximum size of the digital loop carrier equipment which can serve a carrier serving area, that's 1,344 lines. And if one allows for a fill factor of 90% on that equipment, which is the one used in BCPM and a standard one for design of digital loop carrier systems, that brings the 1,344-line capacity down to approximately 1,200. So it was that process from the engineering capacity of the equipment that came down to the decision of 999 or about 1,000 lines, or 1,000 housing units as the maximum to be considered in carrier serving area.

Q Okay. I'm going to leave my point and take your point, since you raised a different issue, and that is why you have a 999 limit.

When was the BCPM first -- the first

iteration of the BCPM promulgated?

A I don't know if I could tell you exactly. Some years ago. There have been a number of versions of the model.

Q At that time, is it your contention that the large size high density DLC unit was 1,344 lines in capacity?

A Yes.

Q Now, since that time, isn't it true that at least two of the major producers of digital loop carrier equipment have come out with higher capacity digital loop carrier systems presently deployed by the ILECs?

A There are cabinets which can house larger size equipment than 1,344 lines in the system, which is what you're talking about.

The issue from the ILECs' standpoint is, is this deployed as standard design and equipment in the network. And from the sponsors of BCPM and BellSouth, the answer to that question is no. It is not used as standard design. And they chose in building and engineering the BCPM to look at equipment they deploy as standard design.

Q Well, we're talking about a somewhat extraordinary situation anyway in which you have more than 1,344 lines within a serveable area; is that correct? We're not talking about the use of the largest piece of equipment for any set of circumstances. Isn't it true that the model contemplates deploying digital loop carrier systems depending on how many people need to be served within a given area?

A Yes. It's going to deploy the equipment efficiently, depending on how many people are served in the area, yes.

Q So in these cases where you do have these maximum amounts, isn't it true that, for instance, BellSouth currently deploys both the Mesa 6 by DISC*S, which has a capacity of 2,016 lines, and the Litespan 2030, which has a capacity of 2,016 lines, to serve large numbers of customers?

A Okay. I do not believe that the Litespan system has a capacity of 2,016 lines. I know that RELTEC makes a cabinet that will house this, and BellSouth does not deploy that on a regular basis. It certainly does not contemplate deploying that for use in areas equivalent for the BCPM model. It has a larger capacity.

And Ms. Caldwell might want to address this further, but generally they only employ that in very unusual circumstances. And it costs more to put it in, and they don't contemplate it as standard design.

Q Do you know what percentage of the total number of high density DLCs BellSouth deploys actually are the Mesa 6 cabinet?

A No, I do not.

Q And are you aware that Litespan doesn't make just one model, it makes three, the 2010, the 2020, and the 2030?

A I know that it makes more systems than that. Yes, I know it makes those systems.

Q But you're not aware that the 2030 has a capacity of 2,016? Is that your testimony?

A I don't know what the capacity of the 2030 is.

Q So you just don't know? I mean, you don't know?

A I just said I don't know what the capacity of that is.

Q And do you know what percentage of the total number of high density digital loop carrier systems BellSouth deploys are in fact the Litespan 2030 model?

A No, I do not.

Q Now, back to my original question, which was, what happens when you have a carrier serving area that could be served with one digital loop carrier system, but you go from 999 housing units to 1,001, two more, that is, in the same geographical area.

And you told me, I believe, that I confused the distribution quadrant algorithms with the carrier serving area algorithms. Was that your answer, basically, when we brought this up before?

A I believe so.

Q Okay. Now let's turn to page 33 of the model documentation which was published April 28, 1998, developed by BellSouth, INDETEC International, Sprint, and U.S. West. Page 33 talks about the development of CSAs and not the distribution quadrants, and it indicates about the middle or the second third of the final paragraph -- that would be one, two, three, four, five, six lines down. "The macrogrid is partitioned into smaller grids, if warranted, based on household and business line data associated with the underlying microgrids and CSA guidelines. The iterative process partitions the macrogrid into four equally sized subgrids."

A Excuse me. Before you go on, you have a different version of that documentation than I do.

Q I'm sorry. What --

A I think it will save time if we get the same set and go from it.

Q Sure. What's the date of yours?

A The BCPM? April 30, 1998. This is the version that was filed with Ms. Caldwell's testimony. It's probably printed out in a different format with different page numbers.

Where are we? Can I find out where we are?

Q (Indicating.)

A Okay.

Q Mr. Bowman, did the portion of the BCPM model methodology I read to you refresh your recollection as to whether when 999 or 1,000 -- 999 lines is exceeded, the model in an iterative process partitions the macrogrid into four equally sized subgrids?

A May I have a moment to read this?

Q Yes, sir.

A Okay. And your question again?

Q Does this refresh your recollection that the process of dividing into quadrants is used not only when you're doing distribution quadrants, but also when you exceed a certain number of lines in the determination of carrier serving areas?

A This process, which is the process by which the carrier serving area is chosen by looking at the distribution of households within the ultimate grid, is the one that I referenced. I was correct in what I said. You're correct in what you say, in that this process is used to determine what ultimate grids are.

Q Just to clarify --

A The way you had said it, it sounds like you were describing distribution areas and not a refinement process from the ultimate grid.

Q My apologies.

A If I said something to assume that, I apologize.

Q And I apologize likewise. Just to clarify for the Commission, because we have heard a lot of talk about model details, if you have a carrier serving area of 999 units and it's just the macrogrid and you're serving it with one DLC, when the time comes to deploy the distribution, you may well divide that into four distribution quadrants, depending on where the roads are; correct?

A Yes. That's what I said earlier. Carrier serving areas are then eventually divided into distribution areas. What you read here is a part of the process for determining what the carrier serving areas are.

Q Right. Separate and apart from the distribution quadrants, if you have over an excess number of lines, then you divide the initial macrogrid into quadrants for purposes of testing again for defining the carrier serving areas themselves; correct?

A Correct.

Q Okay. Now, my question is, if one digital loop carrier system were sufficient to serve 999 people in a macrogrid, what engineering guideline or tradition suggests that you supply four digital loop carrier systems if you put two more people in the same or two more households in the same area, as envisioned by the quadrant system here?

A Well, as I said earlier, it may break it down into just two, or three, or four. It's not always the case that it goes to four.

What you described here is the process of determining what the ultimate grid would be. It does not always go from one carrier serving area to four carrier serving areas.

Q Isn't it true that the ultimate grid is in fact defined as the carrier serving area?

A Oh, yes. The ultimate grid and the carrier serving area are essentially the same thing.

Q And isn't it true that this indicates that if you've got too many people in the macrogrid, you divide it into four quadrants?

A Yes. But it does more than just divide them into four quadrants.

Q It then tests to see if under the model's criteria, those are acceptable carrier serving areas; correct?

A Right. And in some cases, it leaves some of these four quadrants together. You may find that one of those four quadrants has enough customers located in it to merit its own carrier serving area system. It may make that a carrier serving area, because this 999 criteria that we discussed, if it exceeded the 999 criteria, you would need more than one digital loop carrier system in that macrogrid.

So by dividing it down into quadrants, it may find that one of those quadrants is heavily enough populated and decide to put a digital loop carrier system in that. It would then put one within that quadrant, and in many cases, leave the other three quadrants together as another carrier serving area.

So it's inappropriate to say that it goes from one to four digital loop carrier systems. In some cases it goes from one to two, in some from one to three, and in some from one to four, depending upon the distribution of customers in that area.

Q Thank you for your clarification.

In the instances where it goes from one to four and you start with an area that can be served by one digital loop carrier terminal, and you add two households to the same geographic area, leaving aside what the model does, because that's a computer, what engineering precept requires that you go from one DLC to four separate DLCs, four separate sets of FDIs, and the related subfeeder?

A It's trying to find generally efficient size areas to be served. And if you're saying -- your premise is what? That if it's 1,000 and these are four times 250 that might be served there, that 250 is too small to be served by a digital loop carrier system?

I would say that's engineering judgment. It's not necessarily the case that one has to put in. The size of the area itself would merit the fact that if you put in larger digital loop carrier systems, you're going to have to run longer loops if you leave these other three areas to be served by one digital loop carrier system.

Q I guess I asked you for the engineering precept which required four instead of one. And did you tell me it was engineering judgment?

A Yes.

Q When does an engineer know that instead of going to two digital loop carrier systems, you need to go to four?

A Well, he would look at -- he would look at a number of items. I don't know. He's got to look at potential growth in the area, possibly. He may look at where roads are, terrain, and other items.

Q And when the BCPM goes from one to four, you're claiming that the BCPM in the definition of carrier serving areas looks at road, terrain, growth, and other demographic data?

A No, I didn't say that. You asked what engineering judgment would go into the decision.

Q Right. I'm sorry. But I want to know which engineering judgment informs the decisions or is behind the decisions in the BCPM to go from one to four instead of one to two, if that's even necessary.

A Well, I think as I said earlier, all it's trying to do is define hot spots and an efficient area that can be served by digital loop carrier systems. And serving them to areas with 250 households is not necessarily inefficient.

Q I've got one more area to discuss with you in this line of questioning, and I would like to approach the board, if that's okay.

CHAIRMAN JOHNSON: You'll need to use that microphone.

MR. RUSCUS: I might need some technical assistance.

Q (By Mr. Ruscus) Okay. Dr. Bowman, I've approached the board here. I need to draw a schematic, and I would like to discuss it with you.

Earlier this morning we had a discussion about allocation of people to micrograds. That was in the customer location portion of the presentation, and I wanted to discuss with you the way the BCPM engineers to customer locations in a particular context.

The large square I'm drawing is a macrogrid. And we're talking about a rural area, so there are not too many people in this. There are not 999. There may be zero, one, two, three, four, five, or some small number. And I'm going to draw in the micrograds just to give a sense of -- to help tie this into the morning's presentation.

While I'm doing that, Dr. Bowman, can you tell me approximately what the dimensions in miles of a macrogrid is?

A I can tell you in feet. It's approximately 15,000 by 17,000. I'm sorry, approximately 12,000 by 14,000 feet.

Q So this is --

A I know that a microgrid is 58 acres.

Q Me too now.

Okay. So this is -- let's say the short dimension is 12,000 feet, and the long dimension is 14,000 feet. Those are approximate dimensions of all macrogrids in our portion of the hemisphere; correct?

A Approximately, yes.

Q And would it be a fair estimate in terms of miles if I said that 12,000 feet is a little over two miles?

A A little over two miles.

Q Maybe two and a quarter. I'm not sure precisely what it is.

A Right.

Q And 14,000 feet is a little over two and a half miles, maybe 2.6 miles?

A Sounds about right to me.

Q Now, if I know that there are three people in this macrogrid, and I have a road that runs through it, and these three people, maybe parents and one of their kids who stayed behind and a neighbor, are clustered up in one end like this, I would like to ask you how the BCPM serves these customers and whether the way it serves the customers is a product of the customer location algorithm or some engineering judgment that you would have participated in.

My understanding is that these three people are going to be, in practical effect, allocated evenly along the road area. Is that your understanding?

A Not within the macrogrid, no. Well, this is really a question that should have been addressed to Dr. Duffy-Deno, but they would be distributed along the road within the microgrid.

Q But the only way that you know if it's in a microgrid is because you spread all customers over all road, all microgrids that have roads in them; correct?

A Well, you know, this should have been to Dr. Duffy-Deno, but you left out a key part of this process, and that is overlaying the grid onto the census blocks for determination of that.

Q Excuse me. Let's assume --

A None of that is shown here, and that's part of the process.

Q Let's assume -- I agree, and I had written the assumption in my notes -- that this whole macrogrid, which is about six square miles, is within one census block. Okay? We have census blocks, I believe either you or Dr. Duffy-Deno testified earlier, that can be up to 30 square miles, is that correct, in rural areas?

A I don't recall what he said.

Q Would you agree they can about be over six square miles?

A You know, I really don't know.

Q Okay. Then let's -- I need to get through this to ask you how you design the plant, so let's assume for my argument that they're within one census block. Isn't it true that the people in the census block are distributed in microgrids depending on the road area in the microgrid?

A That's my understanding of how the preprocessing of this data works, yes. Again, it's Dr. Duffy-Deno's area.

Q Okay. So those people, in effect, may be distributed in this manner. I believe he testified this morning that, in effect, they were equally dispersed upon all roads. My question is, how --

A I don't think that's correct. I thought it was all roads within the microgrid.

Q I'll have to leave this as a hypothetical reflective of his earlier testimony, because I can't testify for him either at this point.

How would -- if this were a CSA defined as a macrogrid, because we're in a rural area now, and there than only three customers in it, how would the BCPM serve these three customers, given its customer location algorithm? Where, for instance, does the BCPM place the digital loop carrier system?

A Okay. Let me make sure I understand your example. The entire ultimate grid -- there are only three customers in there, so that's going to be --

Q Correct.

A -- one ultimate grid.

Again, I'll have to give my best shot of the customer location portion, because it's not my area of expertise, but --

Q And remembering that my ultimate question is where you put the DLC as an engineering -- as a model engineering thing.

A I'll give it my best shot. It's not my area of expertise.

First of all, it only looks in micrograids in which the customers are actually located, and if that's the two in the upper right -- okay. I guess in your hypothetical, if you've taken -- the census block is bigger than this --

Q Correct. We're in a rural area, and my understanding is they can --

A Well, I don't know that all of them are like that. I said I don't know the size of --

Q It's a hypo --

A I don't know the size, you know, what other ultimate grids are overlaid on the census block, so --

Q Excuse me. For the hypothetical, it's within the census block. It simply simplifies the equation.

Let me see if I can help you a little bit. It's my understanding --

COMMISSIONER GARCIA: What's your answer? Because I've lost the hypothetical. What's your answer to his question, basically? Would they be located along the line, the roadway? If that's the hypothetical, you've got a census block that is -- what do you call the bigger grid? The --

MR. RUSCUS: This is the macrogrid.

COMMISSIONER GARCIA: The macrogrid. Would they be located evenly or distributed along that line?

THE WITNESS: I said I'm not the expert in this. After thinking about it now, I believe maybe they would. I'll accept your hypothetical --

COMMISSIONER GARCIA: All right. Let me ask you a question now.

MS. KEYER: Commissioner, excuse me. I believe that -- I believe he did state that that was Dr. Duffy-Deno's testimony.

COMMISSIONER GARCIA: I understand. I understand.

MS. KEYER: That's really outside his scope.

COMMISSIONER GARCIA: Let me ask you, using that -- do you understand how the Hatfield model works? I mean, you've been able to give us an answer on this, more or less, what you think it works, right, more or less? Or you just don't feel comfortable even with that answer you just gave us?

THE WITNESS: Well, I'm not comfortable answering this. It's Dr. Duffy-Deno's area.

COMMISSIONER GARCIA: Okay.

BY MR. RUSCUS:

Q My question to you is -- and I think you have to be able to answer this, because you're the only engineer here. How does the model engineer the digital loop carrier systems, the fiber, and the FDIs to this example? That's an engineer question.

A Give me your example. The three --

Q My example is, you've got a macrogrid within a census block. The actual locations of the customers are here, because it's an enclave. There are not many people in the census block. But the road runs through the census block, as is common across many -- I mean through the macrogrid, as is common across many stretches of countryside. That's my hypothetical.

Where, given that hypothetical, do you engineer the DLC and the FDIs and the feeder?

A You would have to go further in the process of where the customers are located. Your hypothetical is that they're located at the Xs on that?

Q My understanding is -- and I understand that it might take two witnesses for this, but to get to the part that you know about, my understanding is, and let's assume it's a hypothetical, that the BCPM would assume they were deployed evenly along the road area.

A In this example, it would put the DLC site in the geographic center of the ultimate grid.

Q Because that's the -- not only is it the geographic center, but it's also the road centroid, because I've got equal pieces of road here; correct?

A It's because it's the road reduced

centroid, yes.

Q Now, where would it place the FDIs? There's road area down here, and there's road area up here.

A Well, there would be only one FDI. The next thing it's going to do is determine the road reduced area for determining the distribution area size, which is this 500-foot buffer on either side of the road.

Q So there's 500 feet down here?

A So it's going to be 1,000 feet times the length of that road to determine the road reduced area to be served.

Q And --

A It would then assume that that's a square area and put those three customers in a square area of that size, and divide the total area by three to determine the lot size.

Q So your contention is that the only distribution quadrant would be the upper right-hand quadrant; is that true? Or where would the distribution quadrant be?

A There would be only one distribution quadrant centered over the digital loop carrier site.

Q So you would think the distribution

quadrant would be centered around the digital loop carrier site?

A Yes.

Q Okay. My question is, we talked earlier this morning about moving people within a tenth of an acre. If you're deploying the plant in the configuration that you've discussed with the DLC site here --

A I think you mean a tenth of a square mile.

Q A tenth of a square mile, excuse me, 58 acres.

If you're deploying the DLC site here, isn't its distance from what I have posited are the actual home sites measured in miles and not in smaller increments?

A I don't understand your question. Isn't it measured in miles?

Q We talked this morning about people being within a microgrid and how that was only within 50 acres of each other. But isn't it true that in a macrogrid in a rural area with this configuration, that the DLC site, not to mention the FDIs, which we're not discussing, is approximately -- can be as much as two miles from the points indicated here?

A Well, under your hypothetical that that's

[illegible]

[illegible]

[illegible]

[illegible]

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[illegible]

* [illegible]

[illegible]

[illegible]

[illegible] some years ago. And I've talked on those lines, and I know people who have them, and they don't call it quality telephone service. They have a lot of bad words for it.

Q (By Mr. Ruscus) And I have not talked on it, so you probably know better. How far can acceptable voice-grade service be transmitted on a loaded copper loop?

A I don't know. Some in excess of -- I don't know specifically. [illegible] tens and [illegible] of thousands of feet, but I don't know the exact parameters on that.

Q About --

COMMISSIONER CLARK: Excuse me, Mr. Ruscus.

Loaded copper loop?

MR. RUSCUS: Loaded, l-o-a-d. It means the provision of special electronics back then to I think boost the signal.

COMMISSIONER CLARK: Do you agree with that?

THE WITNESS: Yes, that's the characterization of loaded.

When the network was used just for telephony, just to talk on years ago, the engineers found out that they could put what are called load coils on long copper loops and add transmission characteristics to the loop so that people could talk on longer copper loops.

This goes back into the pre-electronics days when the only mechanism you had was to string out long copper loops to people to try and make them work. So the only mechanism was to use thick copper wire, because thicker copper wire has less attenuation, and string them out from those central offices and put load coils on them and do the best you could. So that's essentially what people did. If you wanted to get from --

COMMISSIONER CLARK: Is that the same thing as --

THE WITNESS: -- A to B, you strung it out there, and you put load coils on it, and you tried to talk over it.

COMMISSIONER CLARK: Is that the same thing as conditioning the line?

THE WITNESS: Yes. Putting load coils on it is one method of conditioning the line, yes.

Q (By Mr. Ruscus) So you would agree that the loaded copper loops were able certainly to extend into the 20,000 foot range with acceptable voice service?

A I would say not with acceptable. The issue is, is that a quality network.

Q Well, my question is, could you hear them with less than the 8-1/2 decibel loss you cite in your testimony as being a threshold?

A I don't know the specifications on that, because it's not an issue in either of these models.

Q Okay. The FCC determined that for I think reasons related to advanced services, it did not wish to see loaded loops in its models; correct?

A Yes. And it's my belief -- that's a good starting point for this. The FCC said exactly that for advanced services. It did not want to see loaded networks. And it's generally agreed among engineers and I think among both parties in this case that loading is required on loops beyond about 18,000 feet. And I don't know, Hatfield would have to speak for it, but I believe that's why they those 18,000 feet as the absolute limit on which they could talk.

The BCPM looked at other criteria required for a good quality network and decided that designing loops on something less than 18,000 feet, and more specifically, on designing to loops in general no more than about 12,000 feet, was the appropriate design criteria.

Q So we agree that for purposes of this proceeding, we're not talking about attempting to provide services that -- loops over 18,000 feet as a model characteristic?

A Yes. I think both parties agree that you should not in general provide service on loops longer than 18,000 feet.

Q And I think you have testified that you believe quality service can be provided over loops that are less than 12,000 feet; correct?

A Well, certainly loops that are less than 12,000 feet, if engineered properly, can provide quality service. What I said was, we chose 12,000 feet as the design limit standard in the Benchmark

Cost Proxy Model to prevent problems that come in with longer loops that degrade the service quality.

Q And you agree that within both models, loops that are 12,000 feet or under can provide quality voice-grade service; is that correct?

A I would say that's generally true, yes, again, if the proper design criteria -- you know, you use sufficient gauge wire, et cetera.

Q So your statement in your summary that the Hatfield model had 60% less talking power or that the BCPM had 60% more talking power was not correct as to 12,000-foot loops in both models; is that true?

A It was a comparison of an 18,000-foot loop to a 12,000-foot loop, and specifically the way each of those would be -- the 18,000-foot loop as designed by the HAI model and the 12,000-foot loop as designed by the BCPM model.

Q Okay. But between 12,000-foot loops, there is no 60% difference in talking power; correct?

A No. If the same gauge wire and engineering criteria are used, then those at 12,000 feet would act the same.

Q And customers in both of those -- in both models under those circumstances having loops less than 12,000 feet wouldn't have trouble hearing, would they?

A No, not in general. They should not.

Q Your testimony indicates that the Hatfield model has 99-1/2% of its loops less than -- roughly less than 12,000 feet as an estimate; is that correct?

A I don't recall that's what I said. I think I said the Hatfield model has in excess of 47,000 lines greater than 12,000 feet in length. That computation could probably be made.

But the BCPM model has, by virtue of its design, only about 4,000 lines that are in excess of 12,000 feet. And the issue is, for these 47,000 customers compared to the -- in the HAI model and the 4,000 in BCPM, in general, which customers are getting better service.

Q Would you accept my characterization that approximately 99-1/2% -- extrapolating from your testimony, that approximately 99-1/2% of all the loops in the Hatfield model are under 12,000 feet?

A I think I've done that calculation in my head, yes. And the 47,000 people who can't talk over it don't really care about that number.

Q So as to 99-1/2% of the people in the Hatfield loop, you would agree that because they're under 12,000 feet, there are no problems hearing, and there's no 60% loss of talking power; is that correct?

A Yes.

Q Now, you indicated that what you meant in your summary when you said that the Hatfield network had 60% less talking power than the BCPM network was that if had you a loop in the Hatfield model that was 18,000 feet and a loop in the BCPM model that was 12,000 feet, there would be a power differential; correct?

A Yes.

Q Do you know if there are any loops that are 18,000 feet in the Hatfield model?

A No. It wouldn't surprise me. I know there are a number over 12,000 feet. And because the model allows design up to 18,000 feet as standard design, I don't know why you wouldn't find the distribution between 12 and 18,000 feet in the Hatfield model. As a matter of fact, I would expect to find those in there, because that's the design criteria.

Q Okay. Now, my question was, do you know whether there are any loops that are 18,000 feet in the Hatfield model?

A I think I just answered that question. I said no, and I gave my explanation.

Q No. Okay. And isn't it true that the BCPM model also allows loops up to 18,000 feet?

A Yes, and I characterized that it has only about 4,000 loops in excess of 12,000 feet. I would expect to find very few out to that limit, out to 18,000 feet.

Q If there were a Hatfield loop that was 18 000 feet and there were a BCPM loop that was 18,000 feet, would the talking power between those loops have a differential of 60%?

A All other things being equal, they would not.

Q Okay.

COMMISSIONER DEASON: If the BCPM has a modeling criteria or criterion of 12,000 limitation, how is it that they are 4,000 loops in excess of 12,000 feet? That was a constraint within the model.

THE WITNESS: It's a general design constraint, and we use the 12,000-foot length as nominal. If you recall, these serving areas are approximately 12,000 feet by 14,000 feet at their maximum. So within that, you could find some loops as long as about 13,000 feet under those criteria. Therefore, I would expect most of those loops that are beyond 12,000 feet to be no longer than 13,000 feet.

There are also a couple of instances in

which partial grids are aggregated into other ultimate grids for serving efficiency purposes that in rare cases generate some loops longer than 12,000 feet also.

Q (By Mr. Ruscus) Isn't it true that if the BCPM model determines, based on its road weighting, that the majority of the roads closer to a particular corner of a macrogrid than in the center, in other words, there are lots of roads in one corner and not so many roads everywhere else, that it will locate the digital loop carrier, because the BCPM people think that's efficient, down in the road centroid towards that corner?

A Yes. I think I understand your question. I'm not sure others do. But, yes, I agree with that.

Q And when the digital loop carrier is located in the corner because that's where all the roads are or most of the roads are, because that's in your view the efficient thing to do, that can give rise to long loop distances across the diagonal of the macrogrid to get to any customers at the far sides; isn't that correct?

A Yes. You characterized this as being located in the corner. And more accurately, the location of the digital loop carrier site within this carrier serving area, its location is determined by the weighted road distance. We talked a lot about the roads early this morning in Dr. Duffy-Deno's testimony.

I believe the point you're trying to make is that all the roads are up in one corner of the carrier serving area. In that situation, yes, it's going to put the digital loop carrier site up there. But they go on to say, doesn't that cause some longer loops back the other direction?

And the answer is, I suppose so, but if there are customers located back in the other direction, that's going to affect the weighting also, so that it's -- you're not going to have the case that it's going to be located in an extreme corner of the carrier serving area and all of the loops are run back the other direction. That's not what it does. As a matter of fact, it puts it up in that corner because that's where the majority of the people are.

Q Right. So if the majority of the people are towards one corner and very few are in another corner, that would be one instance, because it's efficient to do so in your view, that you would create potentially a long loop going from the DLC in the populous corner out to the people at the other corner?

A Yes. If I follow what you're saying, you're saying that there could be some in excess of 12,000 feet caused by that too.

Q Correct.

A Yes, that could be the case. It's a fairly rare occurrence, but that could occur.

Q And in every single situation where that occurrence exists, it's standard practice to place the digital loop carrier equipment at the road centroid of the macrogrid; correct?

A That's correct, because that's the most efficient way to serve the network, trying to minimize cost in this network.

Q And the other instance, I believe you stated, where you tend to get long loops is if you pull into your macrogrid small clusters of -- I think it's less than 100 people that otherwise would have to be served by separate DLC equipment; is that correct?

A Yes. There are typically partial grids with fewer than 100 customers on the border of one of the ultimate grids, and they're pulled into that for efficiency of serving purposes, yes.

Q Because it's efficient. I'm sorry. Is that what you said?

A Yes. It's trying to be more efficient and keep the cost down, yes.

Q So your model is not constrained by 12,000 feet, and in fact, where it's efficient to do so in your belief -- and I know we disagree as to when it's efficient, but where it's efficient to do so, within your model, you have loops longer than 12,000 feet; correct?

A Yes.

Q I would like to turn with you to one of your exhibits. It's Exhibit RMB -- Rebuttal RMB-3. This document is a portion of the DSC practice -- DSC is the maker of Litespan products, I think; is that correct?

A Yes. DSC makes Litespan and other equipment, yes.

Q And while this -- I think this document notes the carrier serving area guidelines you're talking about, but it also says in paragraph 5.3.2 on the second line that economy often requires a 33% increase in the length in non-loaded CSA loops. Do you see that?

A Yes. That statement is in there, and it's in the paragraph headed "Extended CSA Design," yes. And that paragraph is a description, I believe, of this extended carrier serving area that the HAI model uses as its standard design, yes.

Q Is it your testimony that if in half a percent of the cases, the Hatfield uses loops longer than 12,000 feet, that that constitutes often within the context of this paragraph?

A I don't know if I want to characterize often. As I said earlier, I think it's important to those 40-some thousand people out there how long their loops are.

Q Now, what does BCPM do for its long loops to ensure -- that is, its loops above 12,000 feet, to ensure quality voice-grade service?

A It depends on the length of the loop from -- if the loop is between 11,100 feet and 13,600 feet, it uses 24-gauge cable. If it's beyond 13,600 feet, in addition to that, it uses extended range line cards, they're called.

And one of the key distinctions is -- in this quality issue is, the Hatfield model does not use extended range line cards on loops beyond 13,600 feet. It says they put them on loops in excess of 17,600 feet for the large DLC systems, not until 17,600 feet. And for the smaller system, they say that they use extended range line cards on all of the lines in the small system. But there is an issue of these loops between 13,600 feet and 17,600 feet served by the large DLC sites, and that's a majority of the systems. It's a majority of the lines on the systems.

Q Would you agree that when in the BCPM model you place extended range cards on a small number of loops over 12,000 feet as necessary, you achieve quality voice-grade service?

A Well, to be more precise, it only puts them on those beyond 13,600 feet. And you're providing as good a quality service as you can under the circumstances. In general, they will work for -- probably work for voice services. It's unclear whether or not they will work well for data services and other advanced services.

Q So your testimony is that they will work within the guidelines you specify at 8-1/2 decibels for voice-grade services with extended range line cards?

A Yes, and using the extended range line cards that we think are appropriate on those, yes.

Q And you're aware, as you indicated, that AT&T through its witness, Mr. Wells, has stated that they provide extended range cards on low density. For this half a percent of the people over 12,000 feet, they've provided extended range cards actually on all of the loops served by low density DLC and the loops over 17,600 feet served by high density DLC?

A Yes. That's my understanding of Mr. Wells' position and the position of the Hatfield model people.

Q Now, you've also indicated you have a concern over the ability of these long loops to provide analog modem services; is that correct?

A Yes.

Q And in your testimony -- in your summary, I think you said, and correct me if I'm wrong, that the Hatfield network didn't even allow modems to work. Is that what you said?

A I don't think I said that. It's an issue of how well modems work on these longer loops.

Q So in your mind, there's no issue of whether they work at all?

A I would think that in most cases modems would work on loops out to 18,000 feet. I would generally expect they would. It's an issue of how well they work and the connect rate.

Q And that would be for the loops out to 18,000 feet in the BCPM and those in the Hatfield model as well; is that correct?

A Yes.

Q I would like you to turn to your exhibit to your direct testimony, RMB-3, page 23 of 25. Have you got that?

A Yes, I have that in front of me.

Q Now, this document, as I understand it, and correct me if I'm wrong, is provided by you to support the proposition that analog modems experience degradation as you get longer copper loops. Is that correct?

A Yes, that's generally what it's used for. There's even a statement on that page --

Q Now, in the top of --

A -- to that effect. Excuse me. Could I just finish? It's even -- it's the first -- actually, the second full sentence on that page reading down under the list of the 15 loops, and it says -- it talks about bridge caps, but it also says it is more dependent -- and it's talking about the connect rate -- on the actual length of the cable. And that's one of the key issues in connect rate, and that's the purpose of providing this document.

Q And as I look at the loops in the table at the top of the page, they range from about 12,000 feet out to 18,000 feet. Would you agree with me on that point?

A Well, the A loops on it. This has both A and B loops in it, and that's one side of this connectivity test.

Q Okay.

A So what they were doing was trying to connect -- they were trying to simulate loop connections and switch connections for purposes of determining modem connect rates, and they chose the short loop under the -- what's called BT in that category as representative of what Internet service providers might have.

Internet service providers try to locate close to switches to limit the lengths of their loops, because they know that long loops degrade modem performance. That's one of the prime reasons they do that.

So that's the purpose. They were trying to do this, and your characterization of this is correct.

Q And with one exception, all of the connect rates in both the A Receive and the B Receive column range from 24.0 kilobits per second to 26.4 on a modem that runs at an optimum speed of 28.8; correct?

A Yes, that's what the table says.

Q Now the FCC and the Telecommunications Act require access to comparable services; is that correct?

A They talk about comparable with -- yes, rural, I think, as compared to urban was the issue on comparable services. Is that what you mean?

Q Yes.

A You mean advanced services?

Q No, comparable -- when they say, yes, access to comparable advanced services in urban and rural areas.

A Yes, rural area.

If I can point out, the other key criteria from this page, as long as we're there, relating to length is the scoring system that I discuss in my testimony. And at the bottom of the page, it shows the scoring system for loops and the number of points against it that degrade performance. Without going through all of this, Mr. Perez has come up with a system to try and evaluate by this point system what your connect rate might be.

Q And that's derived from his test data; correct?

A Yes, all of the test data.

Q So my question --

A And it says that, you know, from zero to nine kilofeet, there are no points to penalize this.

From nine to 12 kilofeet, one point goes in as the loop gets slightly longer. But as it goes from 12 to 18,000 feet, three points come into that process. And if you read through this document, it says that six points or more from everything are going to limit modem speeds from their full capability of 28.8 kilobits per second.

Now, if it's a 28.8 kilobit per second modem, it's kind of the least technical standard to try and make these loops work for advanced services, if you will. And what this demonstrates is, if you get loops longer than 12,000 feet, even the performance of basic modems tends to degrade on longer loops. You know, it says nothing about more advanced services, but the inference from that is, even more advanced services, the performance would degrade even further than this.

Q Now, you appear to lump digital advanced services in with modem advanced services in your answer, but that's not actually correct, is it? The inference you make --

A Well, it is correct that I put both in my answer, yes.

Q And the inference --

A What's your question?

Q -- from the analog modem study does not go to advanced services that are digital; is that correct?

A Well, I would say that it certainly does. The criteria -- it's not those criteria, but longer loops don't -- the longer the loop, the more difficult it is to make it work for a modem, and the more difficult it is to make it work for any advanced service.

Q And this data shows that for the 28.8 modem, you get 24 to 26.4 out to 18,000 feet; correct?

A Now you're back to this table again. Is that what --

Q I'm back to the data you provided.

A Well, I see one on there of 21.6 as a connect rate.

Q Okay. And with that exception, at 18,000 feet, we agree that you don't know -- and I could tell you, but you don't know whether there are any loops at 18,000 feet in the Hatfield model; correct?

A No, I do not know that. I would be surprised if there are not some out there, as I said before, because that's the design criteria.

Q With that one exception, the modems work from 24 to the 26.4; correct? With the one exception of the 18,000-foot loop which has a 21.6 connect rate, the rest of the modems out to 18,000 feet but short of 18,000 feet work from 24 to 26.4 kilobits per second?

A In Mr. Perez's test, yes.

Q Now, the paragraph under "Six General Assumptions," which is on the same page beneath it, says that on average, the last sentence, the majority of the modem users will realize a connect rate of 24.0 to 26.4 kilobits per second. Do you see that?

A That's what I says, yes. I see that.

Q Now, if the majority of modem users have connect rates in that range, and that's precisely the same range that people experience out to but short of 18,000 feet, how is it that you consider those figures not to be comparable within the meaning of the Telecommunications Act?

A I'm not sure what you mean by what figures not comparable.

Q Well, presumably you think that the modem performance on these long loops, which is 24 to 26.4 by your own data, provides service that's not comparable to what everybody else is getting. But this indicates that the majority of people get precisely the same bit rate connection, and I want to know why you think that's not comparable.

A Well, as I said before, in reference to Mr. Perez's conclusion on the impact of the length of the loop, the issue from this is, do longer loops work as well. And the answer he concludes is no, the longer the loop, the more difficulty you have in making even an analog modem work.

(Transcript continues in sequence in Volume 12.)

$

$1,248 1220:20
$1,263 1220:19

1

1 1225:19
1,000 1238:25; 1239:24; 1240:5,9,20,20; 1245:13; 1249:14; 1259:11
1,001 1244:3
1,200 1240:9,17
1,344 1240:13; 1241:6,15; 1242:1
1,344-line 1240:17
1.2 1240:8
1/25th 1234:10
10 1180:3
100 1234:10; 1273:17,20
100,000 1262:16
10655 1186:11
11 1178:14; 1179:3,13
11,100 1275:14
1178 1178:15
1180 1179:6
1184 1179:15
1185 1179:16
1186 1179:9
1189 1179:7,20,21
1190 1179:10
12 1188:16; 1269:17; 1281:1,2; 1284:8
12,000 1219:21; 1220:9; 1238:1,3; 1252:3,9,14; 1266:10,21,23,24; 1267:4,21,25; 1268:5,8,12,19,25; 1269:8,14; 1270:3,14,16,20,24; 1271:3; 1273:3; 1274:2,6; 1275:4,11; 1276:6,24; 1278:23; 1281:12
12,000-foot 1220:20; 1267:12,14,16,18; 1270:18
1203 1179:11
1222 1179:12
1284 1178:15
13 1178:22; 1187:16
13,000 1270:22,24
13,600 1275:14,15,20; 1276:1,9
14,000 1238:1; 1252:4,10,20; 1270:20
146 1178:25
15 1187:17; 1278:16
15,000 1252:3
17,000 1252:3
17,600 1275:22,23; 1276:1; 1277:2
18,000 1220:4; 1266:2,4,8,14,16; 1269:7,12,15,17,21; 1270:1,5,7,7; 1277:19,23; 1278:24; 1281:3; 1282:11,17,20; 1283:2,3,14
18,000-foot 1220:19; 1267:13,15; 1283:1
1994 1219:2
1996 1219:5
1998 1178:22; 1187:17,18; 1244:12; 1245:4

2

2 1187:18; 1225:14,17,21
2,016 1242:14,15,18; 1243:13
2.6 1252:21
20 1261:17
20,000 1265:10
2010 1243:8
2020 1243:9
2030 1242:15; 1243:9,12,14,23
21.6 1282:15; 1283:1
23 1278:2
24 1282:11,25; 1283:3,20
24-gauge 1275:15
24.0 1279:21; 1283:8
25 1188:2; 1278:2
250 1249:15,15; 1250:24
26.4 1279:21; 1282:11,25; 1283:3,9,20
28 1187:1; 1244:11
28.8 1279:22; 1281:6,8; 1282:10

3

3 1187:16; 1189:16
3.1 1218:10,17; 1225:22
30 1245:4; 1264:4
33 1244:10,13
33% 1274:19
364.025 117 1:10
3rd 1225:20

4

4 1189:9
4,000 1268:11,14; 1270:3,15
40-some 1275:8
4075 1178:26
47,000 1268:7,12,21
49 1184:22; 1185:6,7

5

5 1188:16; 1225:25
5.0 1218:10
5.3.2 1274:18
50 1179:15; 1184:17,20,22; 1260:19
500 1259:10
500-foot 1259:8
51 1179:16; 1185:20,21
52 1179:20; 1189:13,17
53 1179:21; 1189:16,17
58 1252:6; 1260:10

6

6 1242:13; 1243:5
60% 1220:10; 1267:10,11,19; 1269:1,5; 1270:9
6:30 1261:25,25

7

7 1188:2

8

8-1/2 1265:15; 1276:16

9

9,842,000 1188:19
90% 1240:14
980696-TP 1178:5
99-1/2% 1268:4,17,18,23
999 1233:24; 1238:22,24; 1239:5,18,25; 1240:19,24; 1244:3; 1245:13,13; 1246:16; 1247:9; 1248:14,15; 1251:20
9:00 1178:23; 1262:1

A

a.m 1178:23
ability 1277:7
able 1257:12,21; 1262:19; 1265:9
above 1275:11
absolute 1266:5
Absolutely 1180:17; 1262:10
accept 1183:8; 1256:25; 1266:16
acceptable 1248:7; 1263:18; 1265:10,12
accepted 1222:10
access 1221:24; 1222:1; 1279:25; 1280:8
accurately 1218:15; 1271:24
achieve 1276:6
acre 1260:6
acres 1252:6; 1260:11,20
across 1183:1; 1258:5,7; 1271:20
Act 1221:25; 1267:22; 1279:24; 1283:16
actual 1221:20; 1222:11; 1224:21; 1236:19; 1258:2; 1260:14; 1278:19
actually 1183:12,12; 1220:12; 1222:15; 1223:25; 1225:18; 1235:3; 1236:4; 1238:25; 1243:4; 1255:23; 1276:25; 1278:14; 1281:20
add 1239:7; 1249:6; 1264:12
added 1188:7,9; 1218:23; 1222:13; 1263:5
addition 1219:13; 1228:14; 1230:16; 1275:16
additional 1218:23; 1222:12; 1240:6
address 1186:9,11; 1218:14,15; 1242:24
addressed 1219:4; 1234:7; 1253:11
adequate 1228:24
adjourn 1261:25
administrator 1182:18
admitted 1184:18
advanced 1218:22; 1221:21; 1222:12; 1265:20,24; 1276:14; 1280:6,8; 1281:10,14,16,18,19; 1282:2,8
affect 1272:13
afternoon 1222:24,25
again 1180:11; 1184:2; 1226:11; 1245:19; 1247:4; 1254:17; 1255:14; 1262:1; 1267:7; 1282:12
against 1280:16
aggregate 1182:23
aggregated 1182:7; 1271:1
aggregating 1182:10
aggregation 1238:8
agree 1181:22; 1182:2; 1223:24; 1224:15; 1225:6; 1227:2,25; 1229:2; 1232:5,23; 1233:7,12; 1237:7; 1253:24; 1254:7; 1264:5; 1265:8; 1266:12,16; 1267:3; 1268:24; 1271:15; 1276:4; 1278:24; 1282:18
agreed 1224:19,23; 1265:25
ahead 1182:22
algorithm 1239:19; 1253:5; 1255:7
algorithms 1244:6,7
ALLEN 1178:26
allocated 1253:8; 1261:12
allocation 1251:12
allow 1222:3,6; 1277:12
allows 1220:2; 1222:12; 1240:14; 1269:15; 1270:1
almost 1187:4
along 1236:12; 1253:9,12; 1256:17,22; 1258:18
always 1247:17,20
among 1265:25; 12(4:1
amount 1227:5; 1232:9
amounts 1242:12
an, 1225:21
analog 1229:4; 1231:19; 1232:1; 1277:8; 1278:7; 1282:1; 1284:6
analysis 1185:3,10
analyzed 1188:7
analyzed, 1188:5
announcement 1261:24
answer 1183:22; 1218:7; 1232:4; 1241:20; 1244:7; 1256:14,16; 1257:12,15,21; 1272:11; 1281:20,23; 1284:4
answered 1232:3; 1269:23
answering 1257:17
answers 1188:24
anyone 1224:10
anyway 1241:25
anywhere 1224:12; 1226:5
apart 1247:1
apologies 1246:10
apologize 1246:12,13
apparent 1220:21
appear 1281:16
APPEARANCES 1179:1
apply 1183:10
approach 1221:7; 1251:3
approached 1251:9
appropriate 1225:16,23; 1226:5,8,14; 1266:10; 1276:20
approved 1180:12
approximate 1252:10
approximately 1219:21; 1237:25; 1240:9,17; 1251:25; 1252:2,3,12; 1260:23; 1268:17,18; 1270:20
April 1244:11; 1245:4
arbitrary 1236:21
area 1181:5,6; 1187:5; 1229:13,15,17,21; 1232:11,19,22; 1233:6,24; 1234:1,3; 1235:14,25; 1237:2,3,10,22; 1239:1,6,8,10,13; 1240:13,21; 1242:1,7,10; 1244:1,4,7; 1246:1,16; 1247:13,20,23,25; 1248:12,13,22; 1249:2,5,7,20; 1250:9,22; 1251:1,18; 1253:9; 1254:15,16; 1255:4,16,21; 1256:2; 1257:17; 1258:19; 1259:3,3,7,7,12,16,16,17; 1260:21; 1272:1,7,16; 1274:17,25; 1280:10
areas 1219:20; 1220:3,9,22; 1221:8; 1233:16,18,21; 1234:16,17,19; 1235:6,18; 1236:5,8,11,13,16; 1237:14,19; 1238:7,13,15; 1239:16,17,18,21; 1242:22; 1245:24; 1246:8,22,23,25; 1247:5,21; 1248:7; 1249:13,23; 1250:13,24; 1254:5; 1270:19; 1280:9
argument 1254:12
around 1230:11; 1240:5;

1260:1
aside 1249:7
ask 1188:22; 1253:2; 1254:11; 1257:2,10
asked 1188:23; 1223:17; 1249:25; 1250:15
assertion 1219:25
assistance 1251:7
associated 1181:17; 1232:13; 1244:20
assume 1246:11; 1253:21,24; 1254:12; 1258:17,18; 1259:15
assuming 1221:8
assumption 1253:25
assumptions 1225:3
Assumptions, 1283:8
AT&T 1219:3; 1222:10,20; 1261:23; 1276:22
attached 1187:17,19; 1189:8
Attachment 1238:10
attempting 1266:13
attenuation 1263:8; 1264:20
auction 1183:19; 1184:7
August 1187:16; 1225:20
available 1222:17
Avenue 1186:11
average 1181:5,14; 1283:7
averaging 1183:1
aware 1243:7,12; 1276:21

B

bachelor's 1186:24
back 1243:25; 1261:22; 1264:3,15; 1272:10,12,16; 1282:12,14
background 1186:22; 1223:2
bad 1233:8; 1263:14
base 1181:8; 1188:19
based 1181:4; 1219:22; 1244:19; 1271:6
basic 1178:8; 1179:18; 1180:15; 1185:17,18; 1218:11; 1221:23; 1281:13
Basically 1182:8; 1244:8; 1256:16
basis 1181:12,12,14; 1233:20; 1242:20
BCPM 1182:3; 1187:12,13; 1218:9,17,22; 1219:1; 1220:8,10,15,20; 1221:18; 1222:5,8; 1225:16,25; 1228:11,13,16,19; 1230:12; 1233:17; 1235:12,14,24; 1236:3; 1238:11; 1240:8,15,25; 1241:1,19,22; 1242:22; 1245:4,11; 1250:11,12,19; 1251:14; 1253:3; 1255:6,8; 1258:17; 1261:6; 1266:6; 1267:11,17; 1268:10,14; 1269:5,7,25; 1270:7,13; 1271:6,11; 1275:10; 1276:4; 1277:23
becomes 1234:2; 1237:21,24
Bedell 1179:7; 1180:22,23; 1183:4
begin 1261:23; 1262:1
Beginning 1225:19; 1234:5,11; 1237:19
begins 1188:5,19
behalf 1186:3
behind 1250:19; 1253:1
belief 1265:22; 1274:4
believe 1181:25; 1189:14; 1223:1; 1225:15; 1232:3; 1237:8; 1242:17; 1244:5,9; 1254:3,20; 1256:24; 1257:4,4; 1266:4,20; 1272:5; 1273:14; 1274:24
Bell 1187:2
BellCore 1219:6
BellSouth 1185:24; 1186:3,17; 1188:18; 1221:19; 1241:19; 1242:13,20; 1243:4,22; 1244:12
Benchmark 1187:12; 1225:22; 1266:25
beneath 1283:6
best 1182:21; 1218:8,17; 1222:8; 1255:14,20; 1264:21
better 1223:8; 1263:17; 1268:15
Betty 1178:24
beyond 1266:2; 1270:24; 1275:15,20; 1276:9
bid 1183:23
bigger 1256:1,19
bisected 1236:2; 1237:11
bit 1186:23; 1258:12; 1283:24
block 1182:15,17,19; 1254:2,13,14; 1255:25; 1256:8,10,18; 1258:2,4,5
blocks 1253:20; 1254:2
board 1253:3,9
boost 1264:4
border 1273:20
bottom 1183:22; 1188:4; 1280:14
BOWMAN 1179:8; 1185:25; 1186:2,10,13; 1187:15; 1188:21; 1218:1; 1222:17,22; 1223:1; 1245:11; 1251:8,24; 1282:2
Bowman's 1189:2
break 1247:15; 1261:19
breaks 1236:12
bridge 1278:17
brings 1240:16
broad 1224:2
broken 1235:15; 1239:21
brought 1244:8
BT 1279:9
buffer 1258:8
build 1219:12; 1221:20; 1225:3
building 1241:21
builds 1222:13
built 1222:11; 1223:11; 1224:4,9,10; 1225:5
bulk 1232:6
business 1186:9,11; 1240:6; 1244:19

C

cabinet 1242:19; 1243:5
cabinets 1241:14
cable 1220:24; 1221:9,13; 1275:15; 1278:19
cables 1219:23; 1230:3
calculated 1181:7; 1224:16
calculation 1268:20
Caldwell 1242:24
Caldwell's 1245:5
call 1182:10; 1185:24; 1256:19; 1283:13
called 1186:3; 1264:11; 1278:17; 1279:9
can't 1255:1; 1261:2; 1268:21
capability 1218:22; 1281:6
capacity 1186:14; 1240:17,18; 1241:7,11; 1242:14,15,18,23; 1243:13,14,18
caps 1278:17
capture 1225:6
cards 1220:24; 1275:17,20,24; 1276:5,18,20,23,25
care 1268:22
career 1223:9,15,18
careful 1232:20
carrier 1187:4; 1219:8,20; 1220:3,8,21; 1221:8; 1229:4,14,15,17,19,21; 1230:6,8,10,14,16,18,23; 1231:1,3,5,13,14,24; 1232:2,11,12,18,19,22,22; 1233:5,11,17,21,23; 1234:1,2,16; 1235:[illegible],18,25; 1236:4,8,11,13,15; 1237:1,3,10,14,18,22; 1238:7,13; 1239:1,6,9,13,16,17,21; 1240:12,13,16,21; 1241:11,12; 1242:5; 1243:21; 1244:1,2,6; 1245:24; 1246:1,15,21,24; 1247:5,9,12,20,21,23,24; 1248:7,12,13,16,19,22,24; 1249:6,16,21,24; 1250:5,13,23; 1255:8; 1257:23; 1259:24; 1260:2; 1262:7; 1271:11,16,25; 1272:1,7,8,16; 1273:9; 1274:17,25
carriers 1235:17
case 1187:18; 1223:5; 1229:13; 1234:3; 1236:14; 1247:17; 1249:19; 1261:13; 1266:1; 1272:14; 1273:5
cases 1234:19; 1238:5; 1239:22,22; 1242:11; 1248:9,21,25; 1271:3; 1275:3; 1277:18
category 1279:10
Cathy 1180:23
cause 1272:9
caused 1187:15; 1273:3
census 1182:15,17,19; 1253:20; 1254:2,2,12,13; 1255:25; 1256:8,10,18; 1258:2,4,5
Center 1178:24; 1181:9,12,12,24; 1182:8,10,13,22; 1183:1; 1227:21,25; 1231:3; 1234:21,24; 1258:21,23; 1271:8
centered 1259:24; 1260:1
centers 1182:1
central 1264:20
centroid 1258:23; 1259:1; 1271:12; 1273:9
certain 1245:23; 1262:7
certainly 1227:7; 1232:14; 1242:21; 1265:9; 1266:22; 1282:4
cetera 1236:1; 1267:8
Chair 1189:1
CHAIRMAN 1178:17; 1180:20; 1183:6; 1184:12,17,21,23,25; 1185:3,6,8,9,14,19,23; 1189:4,8,12,15; 1222:19; 1251:4; 1261:15,18,22
changed 1188:18
changes 1187:24; 1188:1,13,14,21
characteristic 1266:15
characteristics 1221:9,11,18; 1226:20; 1264:13
characterization 1264:8; 1268:16; 1279:18
characterize 1275:8
characterized 1270:2; 1271:23
cheap 1221:2
chose 1241:21; 1266:24; 1279:8
chosen 1238:4; 1246:1
circumstances 1242:4; 1243:1; 1262:8; 1267:24; 1276:11
cite 1265:15
claiming 1250:12
clarification 1249:3
clarify 1246:6,13
CLARK 1178:19; 1263:25; 1264:5,24; 1265:4
clear 1224:11
close 1279:13
closer 1271:7
cluster 1181:22; 1182:5
clustered 1253:2
clusters 1181:25; 1273:16
coils 1264:12,21; 1265:2,6
COKER 1185:3,7,16,22
Colorado 1186:12
column 1279:20
comes 1229:11; 1236:12; 1246:18
comfortable 1257:14,16
Commenced 1178:23
COMMISSION 1178:2; 1180:7,9,12,24; 1186:18; 1246:14
COMMISSIONER 1178:18,19,20,21; 1180:4,13; 1183:7; 1184:10; 1256:14,21; 1257:1,3,6,10,18; 1262:21; 1263:1,5,25; 1264:5,24; 1265:4; 1270:13
Commissioners 1183:6; 1186:21; 1218:5
commissions 1187:7
common 1258:5,6
Communications 1187:3; 1219:7; 1221:12
companies 1183:23; 1219:12; 1221:20; 1222:11
comparable 1222:1; 1279:25; 1280:2,4,7,8; 1283:15,18,22,25
compared 1268:13; 1280:3
comparison 1267:13
compensation 1183:11
components 1232:10
computation 1268:9
computer 1249:8
concept 1236:14,18,20
concern 1184:6; 1262:5; 1277:7
conclude 1231:21
concludes 1284:4
conclusion 1222:8; 1284:2
conditioning 1265:5,7
Conference 1178:24
configuration 1260:7,21
conforms 1220:1
confused 1244:5
confusing 1239:15
conjunction 1229:8
connect 1230:24; 1231:7; 1277:21; 1278:18,20; 1279:6,8,19; 1280:19; 1282:16; 1283:1,8,12
connecting 1230:3
connection 1231:15; 1232:16; 1283:24

connections 1222:6; 1279:7,7
connectivity 1279:3
connects 1231:19
consider 1219:14,16; 1232:25; 1240:6; 1283:14
considerable 1232:9,14
consideration 1232:21
considered 1240:21
constitutes 1275:4
constrained 1274:2
constraint 1270:16,18
consultant 1186:15
Cont'd 1179:6
contain 1235:13
contained 1219:1; 1232:6
contemplate 1242:21; 1243:2
contemplates 1242:5
contention 1183:6; 1241:5; 1250:19
context 1229:1; 1231:9,14,25; 1232:2; 1251:16; 1275:5
contiguous 1236:15; 1237:15
continues 1186:20; 1284:7
coordinate 1234:6
copper 1184:2; 1219:21,23; 1220:3; 1221:9; 1230:1; 1262:6,11,22; 1263:6,19; 1264:1,12,14,17,18,19; 1265:9; 1278:8
copper-served 1184:4
corner 1234:21; 1271:8,9,13,17,24; 1272:6,15,18,21,22,25,25
correct 1180:16; 1223:3,4; 1224:6,22,25; 1225:19; 1227:13,19; 1228:12,17; 1229:16,19,24,25; 1230:1,2; 1233:3; 1234:6,12,13,18,22; 1235:3,5,8,9; 1236:5; 1238:15,19,20,23; 1239:1,10,11; 1242:2; 1246:3,4,20; 1247:6,7; 1248:6; 1252:11; 1253:16; 1254:5,23; 1255:12; 1256:2; 1256:24; 1262:9,13; 1265:21; 1266:21; 1267:5,11,19; 1268:5; 1269:1,9; 1271:22; 1273:4,10,11,19; 1274:7,13; 1277:8,11,24; 1278:6,9; 1279:18,22; 1280:1,21; 1281:20,22; 1282:3,11,20,25
cost 1178:7; 1181:4,5,7,19; 1183:9; 1187:5,6,7,9,10,12; 1218:8,17; 1219:9,13; 1220:23; 1221:15; 1223:9,15,21; 1224:14,15,20,22,24; 1225:3,8,22; 1226:5,8,14,20; 1228:9,16; 1232:6,7,9; 1267:1; 1273:13; 1274:1
costing 1222:9
costly 1220:14,14
costs 1181:2,3,4,17; 1182:6,24; 1183:11,24; 1184:3; 1187:7; 1219:15; 1224:16; 1225:6; 1243:1
couldn't 1180:6; 1236:5
countryside 1258:7
couple 1270:25
course 1223:18; 1233:13
covered 1226:18; 1227:8
create 1227:6; 1261:8; 1272:23
criteria 1233:15; 1239:25; 1240:1; 1246:7,14,15; 1266:6,11; 1267:7,21; 1269:19; 1270:14,22; 1280:11; 1282:5,5,23
criterion 1238:16; 1270:14
Cross 1179:6,7,12; 1180:21; 1222:18,20
CSA 1234:17; 1236:20; 1239:1; 1244:20; 1255:3; 1274:20,23
CSAs 1235:6,7; 1244:14
current 1219:10
currently 1230:7; 1242:13
curve 1183:9
customer 1184:4; 1236:13; 1251:13,15; 1253:5; 1255:6,15; 1261:1
Customers 1179:17; 1182:17,19; 1185:17; 1218:12,15; 1220:6,12; 1221:4,17,22; 1222:1,2,4,7; 1226:21; 1228:25; 1233:3,6; 1235:3,15,20,24; 1236:4,18,19; 1237:6,16,20; 1238:6; 1242:16; 1248:11; 1249:2; 1253:3,4,15; 1255:5,6,11,23; 1258:3,12; 1259:16; 1262:6; 1267:23; 1268:13,14; 1271:21; 1272:12; 1273:20

D

data 1182:14; 1244:19; 1250:14; 1254:17; 1276:13; 1280:20,22; 1282:10,14; 1283:21
DATE 1178:22; 1245:3
dated 1187:16,18
days 1264:16
de-averaged 1181:6
deal 1183:10; 1184:5; 1229:12
DEASON 1178:18; 1180:4,13; 1270:13
decibel 1265:15
decibels 1276:16
decide 1180:10; 1248:19
decided 1236:25; 1266:7
decision 1233:9,20; 1240:19; 1250:16
decisions 1225:9,11; 1250:18,19
decline 1183:9,12
declining 1184:3
define 1250:22; 1282:14
defined 1247:23; 1255:3
defining 1247:5
definition 1181:1; 1250:12
degradation 1276:8
degrade 1267:2; 1279:14; 1280:16; 1281:13,16
degree 1234:10
delete 1186:8,10
deleted 1186:17
delighted 1218:6
delivers 1220:10
demographic 1250:14
demonstrates 1261:11
density 1241:6; 1243:4,21; 1276:23; 1277:1,2
dependent 1278:16
depending 1242:6,9; 1246:19; 1249:1; 1254:14
depends 1275:13
deploy 1227:5; 1241:22; 1242:6,20; 1246:18
deployed 1224:1,12; 1241:12,18; 1256:16
deploying 1242:5,21; 1260:6,12
deployment 1229:8
deploys 1242:13; 1243:4,22
derived 1280:20
describe 1230:9
described 1229:15; 1232:10; 1247:18
describing 1246:8
description 1227:8; 1274:24
deserve 1221:5
design 1218:19; 1219:1,11,19; 1220:2,4,9; 1221:15; 1222:3,5,10; 1223:22,25; 1224:20,21,23; 1226:6,14; 1238:2; 1240:16; 1241:18,21,23; 1243:2; 1254:11; 1266:10,25; 1267:7; 1268:11; 1269:15,15,19; 1270:17; 1275:1; 1282:23
Design, 1274:23
designation 1231:17
designed 1223:18,20; 1224:10,11; 1267:15,16
designing 1223:7; 1224:6; 1233:15; 1266:7,9
designs 1218:20; 1220:6; 1226:1; 1232:18; 1233:17
details 1246:15
Determination 1178:7; 1245:24; 1253:20
determine 1238:6; 1239:20; 1246:5; 1259:6,12,18
determined 1238:18; 1265:19; 1272:1
determines 1271:6
determining 1237:18; 1239:16; 1246:24; 1247:19; 1259:7; 1279:8
develop 1218:8; 1236:15
developed 1187:9; 1219:3; 1244:12
developing 1223:9,15; 1224:14
development 1187:6,11; 1219:11; 1240:7; 1244:14
diagonal 1271:20
diagram 1230:4
Dial 1179:18; 1185:18
dictate 1224:25; 1225:2
didn't 1180:5; 1223:13; 1250:15; 1277:12
difference 1267:19
different 1181:6; 1185:10,12; 1231:20,25; 1240:23; 1244:24; 1245:6,7
differential 1269:8; 1270:9
difficult 1263:9; 1282:6,8
difficulty 1284:5
digital 1219:8; 1228:7,8; 1229:3,5,14,19; 1230:6,8,10,14,16,17,20,22; 1231:1,2,5,13,14,23,24; 1232:1,11,19,21; 1233:11; 1235:17; 1240:12,16; 1241:10,12; 1242:5; 1243:21; 1244:2; 1247:8,11; 1248:16,19,24; 1249:6,16,21,23; 1250:5,23; 1255:8; 1257:23; 1259:24; 1260:1; 1262:7; 1271:11,16,25; 1272:8; 1273:9; 1281:18; 1282:2
dimension 1252:9,9
dimensions 1251:25; 1252:10
diminish 1180:15
Direct 1179:9,10,20; 1186:6; 1187:16,25; 1188:2,23; 1189:2,6,9,11; 1225:18,20; 1278:2
direction 1187:22; 1272:10,13,17
disaggregated 1182:7
disagree 1233:22; 1274:4
DISC'S 1242:13
discuss 1251:1,10,14; 1280:13
discussed 1234:14; 1238:9,23; 1248:14; 1260:7
discussing 1181:3; 1260:23
discussion 1251:11
dispersed 1254:22
disruptions 1219:16
distance 1260:13; 1272:2
distances 1262:12,14; 1271:20
distinctions 1275:18
distributed 1253:12; 1254:14,20; 1256:22
distribution 1229:24; 1230:1; 1239:17; 1244:6,14; 1245:22; 1246:2,8,18,19,23; 1247:2; 1249:2; 1259:7,20,22,23,25; 1269:16
divide 1246:18; 1247:3; 1248:3,4; 1259:17
divided 1234:14; 1239:13; 1246:22
dividing 1245:21; 1248:17
DLC 1232:13; 1233:1; 1236:1; 1241:6; 1246:17; 1249:9; 1255:18; 1258:10,20; 1260:7,12,22; 1272:24; 1273:18; 1275:22; 1276:2; 1277:1,2
DLCs 1243:4; 1249:10
DOCKET 1178:5
doctorate 1186:25
document 1274:11,16; 1278:5,21; 1281:4
documentation 1238:11; 1239:12; 1244:11,24
documents 1219:6
does 1220:2; 1221:2,2; 1230:12,15; 1231:12; 1242:20,21; 1245:20; 1247:19; 1248:4; 1249:8; 1250:4; 1255:7; 1257:22; 1272:17; 1275:10,19; 1282:1,4
doesn't 1183:4; 1227:20; 1233:5; 1243:7; 1262:22; 1272:9
doing 1245:22; 1251:24; 1279:5
done 1180:6; 1181:13; 1182:20; 1266:20
doubles 1233:25
down 1183:18,23,25; 1184:7; 1239:21; 1240:17,19; 1244:17; 1247:16; 1248:17; 1259:3,10; 1261:9; 1271:12; 1274:1; 1278:15
Dr 1185:11,25; 1186:13; 1187:15; 1188:21; 1189:2; 1218:1,14; 1222:17,22; 1223:1; 1234:7; 1251:8,24; 1253:12,18; 1254:3,18; 1257:5,17; 1262:2; 1272:3
draw 1261:9,21
drawing 1261:17
drive 1224:16
drop 1230:2
DS1 1231:6
DSC 1219:7; 1221:12; 1274:11,11,14
Duffy-Deno 1185:11; 1218:14; 1234:7; 1253:12,18;

1254:3
Duffy-Deno's 1254:18; 1257:5,17; 1272:3
duly 1186:4

E

earlier 1219:4; 1233:25; 1234:15; 1246:21; 1247:15; 1250:21; 1251:11; 1254:4; 1255:1; 1260:4; 1275:7
early 1272:3
Easley 1178:24
economy 1274:19
edition 1219:2,5
educational 1223:2
effect 1253:8; 1254:19,21; 1276:13
efficiency 1227:7; 1236:22; 1237:4; 1271:2; 1273:22
efficient 1218:21; 1221:1; 1224:8; 1227:4,10; 1249:12; 1250:22; 1271:12,19; 1272:23; 1273:12,23,25; 1274:3,5,5
efficiently 1226:1,7,15; 1233:2; 1242:9
either 1187:24; 1254:3; 1255:2; 1259:8; 1265:18
electrical 1186:25; 1223:3; 1231:7
electronics 1264:3
element 1227:3
else 1181:8; 1271:10; 1283:22
employ 1242:25
employed 1186:13
emulate 1223:24
enclave 1258:3
end 1231:6; 1253:2
engineer 1223:7; 1225:9; 1232:18,20; 1235:10,11,23; 1236:19,24,25; 1237:9; 1250:4; 1257:22,22,24; 1258:10
engineer's 1238:18
engineered 1223:12; 1224:4; 1266:23
engineering 1187:1; 1218:16; 1221:15; 1223:3,9; 1224:3,14; 1225:2,11,15,21; 1226:5,13; 1233:9,19; 1237:2; 1239:25; 1240:18; 1241:22; 1247:10; 1249:9,18,25; 1250:2,16,18; 1253:5; 1255:18,19; 1267:21
engineers 1219:13; 1223:25; 1224:16,19,21,23; 1225:12; 1251:15; 1264:10; 1265:25
enough 1248:11,18
ensure 1275:11,12
ensuring 1220:11
entire 1232:6; 1234:25; 1237:21; 1255:10
entirely 1181:8
entirety 1225:5
envisioned 1247:13
equal 1235:7; 1239:14; 1258:24; 1270:10
equally 1244:22; 1245:15; 1254:21
equation 1256:11
equipment 1218:23; 1219:9,24; 1221:13; 1222:13; 1229:20,23; 1230:21,23; 1231:5; 1233:2; 1240:12,14,19; 1241:11,15,18,22; 1242:3,8; 1261:9; 1273:9,16; 1274:15
equivalent 1242:22
Esplanade 1178:26
essentially 1247:25; 1264:22
establishing 1239:17
estimate 1252:13; 1268:5
evaluate 1280:18
EVD 1179:14
evenly 1253:8; 1256:22; 1258:18
event 1183:11
eventuality 1219:15
eventually 1248:22
everybody 1283:22
everything 1281:5
everywhere 1271:10
evidence 1184:20
exact 1263:22
exactly 1241:2; 1265:23
Examination 1179:6,7,9,12; 1180:21; 1186:6; 1222:20
example 1183:19; 1221:24; 1237:21; 1255:10; 1257:24,25; 1258:1,20
exceed 1219:21, 1220:9; 1238:2; 1245:23
exceeded 1245:14; 1248:15
exceeds 1239:18
excellent 1183:14
exception 1279:19; 1282:17,24,25
excess 1227:5; 1247:2; 1263:20; 1268:7,11; 1270:3,15; 1273:2; 1275:21
excessively 1220:13; 1221:7
exchange 1187:3; 1221:19
Excuse 1180:4; 1224:21; 1229:6; 1232:5; 1234:10; 1239:4; 1244:23; 1253:21; 1256:9; 1257:3; 1260:10; 1263:25; 1276:13
Exhibit 1184:17,20,22; 1185:4,4,10,15,21; 1188:2; 1227:12,14; 1274:10; 1278:1
EXHIBITS 1179:13; 1187:17,19; 1189:6,8,15,17; 1274:10
existing 1236:13
exists 1237:9; 1273:8
expect 1269:18; 1270:4,23; 1277:20
expense 1221:3
experience 1187:2; 1224:5; 1278:7; 1283:13
experiences 1223:24
expert 1187:6; 1256:23
expertise 1255:16,21
explain 1182:11; 1225:21
explanation 1269:24
expresses 1262:5
extend 1265:9
extended 1220:3,21,23; 1221:7; 1274:23,25; 1275:18,20,24; 1276:5,17,19,23,25
extending 1262:6
extensively 1234:14
extent 1180:13; 1183:24
extra 1220:23
extraordinary 1241:25
extrapolating 1268:17
extreme 1263:10; 1272:15
eye 1235:2

F

facilities 1219:18
fact 1187:4; 1239:12; 1243:22; 1247:23; 1249:20; 1261:6; 1269:18; 1272:18; 1274:3
factor 1240:7,14
factors 1219:14
fair 1252:13
fairly 1273:5
far 1262:25; 1263:2,17; 1271:21
fax 1221:24
FCC 1220:17; 1221:1; 1266:19,23; 1279:24
FDI 1259:5; 1261:8,9
FDIs 1232:12; 1235:19; 1236:1; 1249:10; 1257:23; 1258:10; 1259:2; 1260:22; 1261:8
feeder 1225:15,19; 1229:2,23; 1232:13,16; 1258:10
feeders 1235:18
feel 1257:14
feet 1219:21; 1220:4,9; 1238:1,3; 1252:2,4,9,10,14,20; 1259:10,11; 1262:16; 1263:22; 1266:2,4,8,10,14,18,21,23,25; 1267:4,22,25; 1268:5,8,12,19,25; 1269:7,8,12,14,15,17,21; 1270:1,3,5,7,8,16,20,20,22,24 1271:2; 1273:3; 1274:3,6; 1275:4,11,14,14,15,21,22,23; 1276:1,1,6,9,24; 1277:2,19,23; 1278:23,24; 1281:3,12; 1282:11,18,20; 1283:2,3,14
few 1184:6; 1270:4; 1272:21
fewer 1273:20
fiber 1228:15,19,21; 1229:1,9; 1257:23
field 1224:1,12; 1262:22
fifth 1188:4,11
Fifty 1184:23
figures 1283:14,17
filed 1187:15; 1245:5
fill 1240:14
final 1244:16
find 1231:25; 1245:8; 1248:10,18; 1249:12; 1269:16,18; 1270:4,21
finds 1233:3
finish 1240:4; 1278:14
first 1181:1; 1188:1; 1219:13; 1226:17; 1240:25,25; 1255:22; 1278:14
five 1188:5,6; 1220:16; 1233:10,14; 1244:17; 1251:20
FLORIDA 1178:2,10,27; 1220:4,17,18; 1221:5; 1222:14; 1234:5; 1235:2
focus 1233:18
follow 1233:15; 1273:1
following 1188:10
follows 1180:2; 1186:5; 1188:8; 1218:19; 1219:1; 1222:9
foot 1265:10
footnote 1188:3
force 1236:21
forced 1235:16
form 1230:6
format 1245:6
forms 1233:20
Forty-nine 1184:25
forward 1183:15
forward-looking 1218:21; 1220:25; 1224:9; 1226:1,6,15; 1227:11; 1228:5,9,21,22; 1229:3; 1230:6,13
found 1219:5; 1264:11
four 1187:17; 1188:5,6,8; 1189:10; 1228:20; 1239:14; 1244:17,22; 1245:15; 1246:19; 1247:11,16,17,20; 1248:3,5,10,11,24; 1249:1,5,10,10,15; 1250:1,6,11,20; 1251:20
frame 1183:17
front 1227:15; 1278:4
full 1278:15; 1281:5
fund 1180:9,16; 1182:18; 1183:11,13
further 1183:5; 1234:13; 1239:21; 1242:25; 1258:11; 1281:17
future 1224:3

G

GARCIA 1178:20; 1256:14,21; 1257:1,6,10,18; 1262:21; 1263:1,5
gauge 1267:8,20
gave 1257:15; 1269:24
gears 1262:3
general 1184:5; 1233:8; 1236:3; 1266:9,17; 1268:2,14; 1270:17; 1276:11; 1283:5
generally 1228:8,18; 1231:4; 1242:25; 1249:12; 1265:25; 1267:6; 1277:20; 1278:10
generate 1271:3
generation 1230:7,17,22; 1231:1,23
generic 1231:17
Generically 1231:15
geographic 1181:5; 1229:13; 1237:24; 1239:8; 1249:7; 1258:21,23
geographical 1244:4
gets 1281:2
getting 1268:14; 1283:22
gives 1232:20
glad 1136:24
going 1181:20; 1182:14,18; 1183:15,24; 1184:5; 1230:21; 1240:22; 1242:8; 1249:22; 1250:5; 1251:21; 1253:8; 1255:11; 1259:6,11; 1261:18,24; 1262:4; 1272:8,13,14,15,24; 1280:16; 1281:5
good 1180:8; 1182:8; 1222:24,25; 1233:5; 1237:1; 1239:11; 1240:1; 1265:22; 1266:7; 1276:10
governmental 1219:17
great 1229:12
greater 1268:8
grid 1182:2,5; 1234:23; 1235:1,4,7; 1236:12,15; 1237:1,25; 1258:8; 1239:18,20; 1246:2,9; 1247:19,22,24; 1253:19; 1255:10,13; 1256:19; 1258:21
gridding 1236:7; 1237:17; 1238:5
grids 1235:1; 1238:14; 1244:18; 1248:5; 1256:8; 1271:1,2; 1273:19,21
group 1182:20; 1235:13,14,24; 1236:3,19;

1237:8
groups 1182:15,17
growth 1250:9,13
GTE 1183:19
guess 1182:10; 1236:17; 1249:25; 1255:24
guideline 1221:1; 1247:10
guidelines 1219:5,7; 1237:2; 1244:21; 1274:17; 1276:16
guys 1262:21

H

hadn't 1224:13
HAI 1181:23; 1218:10; 1220:2,19; 1257:16; 1268:13; 1274:25
half 1252:21; 1261:3; 1275:2; 1276:24
Handbook 1219:2
happens 1238:22; 1240:2; 1244:1
hard 1262:8
HATCH 1185:9
Hatfield 1218:10; 1220:1,11,14,22; 1221:6; 1222:2; 1228:13; 1257:11; 1266:3; 1267:10; 1268:3,7,19,24; 1269:4,6,12,17,22; 1270:6; 1275:3,19; 1277:4,12,23; 1282:20
head 1268:21
headed 1274:23
hear 1265:14
heard 1218:14; 1220:7; 1230:9; 1246:14
HEARING 1178:16; 1282:8; 1267:25; 1268:25
heavily 1248:18
help 1251:22; 1256:12
hemisphere 1252:11
Henry 1179:6; 1180:18
heretofore 1179:1
high 1218:19; 1222:14; 1241:6; 1243:4,21; 1277:2
higher 1241:11
historically 1262:11
home 1250:14
hot 1250:22
house 1241:14; 1242:19
household 1233:24; 1244:19
households 1238:22,25; 1239:2; 1246:2; 1247:13; 1249:7; 1250:24
housing 1229:3,4,5,7,19,24,25; 1240:5,9,20; 1244:3
hypo 1256:6
hypotenuse 1261:3
hypothetical 1236:6,23; 1237:4,5,7; 1254:25; 1255:25; 1256:9,15,18,25; 1258:8,9,12,17; 1260:25

I

I'll 1186:24; 1237:7; 1254:25; 1255:14,20; 1256:25
I've 1187:9; 1223:8,20; 1224:13; 1230:9; 1251:1,8; 1256:15; 1258:24; 1263:12; 1268:20
I.D 1179:14
identical 1188:12
identification 1189:7,18
identified 1186:19,21; 1189:7,12
ILECs 1241:13
ILECs' 1241:17
illustrative 1221:11
impact 1284:2
imply 1221:2
important 1226:20; 1232:17,17; 1275:7
impression 1238:12
inadequate 1221:16
inappropriate 1248:23
Inc 1186:4
include 1228:7; 1229:18,22; 1230:2
includes 1187:6
including 1229:23
incorporated 1188:22
increase 1274:20
increments 1260:15
independent 1186:15
INDETEC 1186:16; 1244:12
indicate 1223:14; 1225:25
indicated 1228:19; 1228:4,15; 1260:24; 1269:3; 1276:21; 1277:6
indicates 1244:15; 1248:1; 1268:3; 1283:23
indicating 1245:9
industry 1218:19,25; 1219:19; 1222:10
inefficient 1250:25
inference 1231:15,21,24
information 1221:12
informs 1250:18
initial 1247:3; 1263:6
initially 1182:12,16,21
inputs 1225:12
inserted 1179:10,11; 1184:15; 1189:3,4
instance 1242:12; 1255:7; 1272:22; 1273:14
instances 1249:4; 1270:25
instead 1250:1,4,20
integrated 1230:7,17,22; 1231:4,14,23; 1232:1
integrating 1231:2
interface 1229:24
international 1186:16; 1244:12
internet 1221:24; 1279:10,12
investment 1220:18
involves 1223:10; 1229:3
isn't 1223:5; 1229:13; 1233:19,23; 1235:16; 1236:22; 1241:9; 1242:4,12; 1247:22; 1248:1; 1254:13; 1260:13,16,20; 1262:12; 1269:25; 1271:5,22
issue 1237:23; 1240:23; 1241:17; 1265:12,16; 1268:12; 1275:19,25; 1277:14,16,20; 1280:3; 1284:3
issues 1218:11,14; 1262:4; 1278:20
items 1250:8,10
iteration 1241:1
iterative 1244:21; 1245:14
its 1185:24; 1225:5; 1248:12; 1255:6; 1260:13; 1265:21; 1268:4,10; 1271:6; 1272:1; 1275:1,10,11; 1276:22
itself 1237:16; 1249:20

J

JACOBS 1178:21; 1183:7; 1184:10
JOE 1178:20
JOHNSON 1178:17; 1180:20; 1183:6; 1184:12,17,23,25; 1185:6,14,19,23; 1189:4,8,12,15; 1222:19; 1251:4; 1261:15,18,22
JR 1178:21
judgment 1233:13; 1249:18; 1250:2,16,18; 1253:6
JULIA 1178:17

K

keep 1274:1
key 1253:18; 1275:18; 1278:20; 1280:11
Keyer 1179:9; 1184:14,21,24; 1185:2,24; 1186:7; 1189:1,5,10,14; 1218:1; 1222:17; 1257:3,8
kicks 1239:19
kids 1253:1
kilobit 1281:6
kilobits 1279:21; 1281:7; 1283:3,9
kilofeet 1280:25; 1281:1
kind 1183:18; 1281:9

L

l-o-a-d 1264:2
Laboratories 1187:2
large 1221:7; 1223:14; 1241:6; 1242:16; 1251:17; 1275:22; 1276:2
larger 1181:12; 1220:21,24; 1241:14; 1242:23; 1249:21
largest 1242:3
last 1225:20; 1261:5; 1283:7
Late-filed 1179:16; 1185:1,4,11,21
latitude 1234:5,9,11; 1235:15; 1236:2,21
lay 1236:14
least 1181:8; 1241:10; 1281:9
least-cost 1218:20; 1220:25; 1221:2; 1224:8; 1227:10; 1228:23
leave 1238:12; 1240:22; 1248:21; 1249:22; 1254:25; 1261:14
leaves 1248:9
leaving 1249:7
left 1253:18
left-hand 1234:21
legislation 1181:2
Legislature 1181:20
length 1219:22,22; 1220:4,24; 1259:12; 1262:24; 1268:8; 1270:18; 1274:20; 1275:13; 1278:19; 1280:13; 1284:2
lengths 1279:13
LEON 1178:21
less 1220:14; 1233:24; 1239:5; 1257:13,14; 1264:19; 1265:15; 1266:8,21,22; 1267:10,24; 1268:4,5; 1269:5; 1273:17
let's 1244:10; 1252:8; 1253:21,24; 1254:10,11; 1258:17
level 1181:23; 1182:3,5,6,13,22; 1231:6,7
life 1228:2; 1232:19
likewise 1233:10; 1246:13
limit 1237:24; 1238:1; 1239:18; 1240:24; 1266:5,25; 1270:4; 1279:13; 1281:5
limitation 1270:14
limits 1219:20; 1238:2
line 1181:5,8,14,19; 1183:22; 1188:3,4,10,16,18; 1219:22; 1220:19,24; 1225:25; 1227:24; 1231:15,19,21; 1236:21; 1244:19; 1251:2; 1256:17,22; 1265:5,7; 1274:19; 1275:16,20,24; 1276:17,19
lines 1181:16; 1225:17; 1234:10; 1235:16; 1236:2; 1240:6,6,9,13,20; 1241:6,15; 1242:1,14,15,16; 1244:17; 1245:14,23; 1247:3; 1263:12; 1268:8,11; 1275:25; 1276:3
lines, 1188:20
list 1188:7,9; 1278:16
listed 1188:8; 1230:3; 1238:10
Litespan 1242:14,17; 1243:7,22; 1274:12,14
little 1182:25; 1186:22; 1252:14,16,20; 1256:12
Littleton 1186:12
load 1264:11,21; 1265:2,6
loaded 1262:18; 1263:4,6,19; 1264:1,2,8; 1265:9,21,24
loading 1266:2
local 1178:8; 1187:3; 1220:1; 1221:19
locate 1271:10; 1279:12
located 1218:12; 1227:21; 1228:1; 1235:3; 1248:12; 1255:23; 1256:17,22; 1258:12,13; 1271:17,24; 1272:12,15
locating 1218:15; 1237:20
location 1226:21; 1228:1; 1232:21; 1233:20; 1238:18; 1251:13; 1253:5; 1255:7,15; 1261:1; 1271:25; 1272:1
locations 1251:15; 1258:2
long 1220:13; 1252:9; 1262:6,19; 1264:12,17; 1270:22; 1271:20; 1272:24; 1273:15; 1275:8,10; 1277:7; 1279:14; 1280:12; 1283:20
longer 1228:14,18,20; 1229:6; 1239:9; 1249:22; 1263:7; 1264:14; 1266:17; 1267:2; 1270:24; 1271:3; 1272:9; 1274:6, 1275:3; 1277:15; 1278:8; 1281:2,12,13; 1282:5,6; 1284:3,5
longitude 1234:5,9,11; 1235:16; 1236:2
look 1181:17; 1239:20; 1240:11; 1241:22; 1250:7,7,8,9; 1278:22
looked 1236:25; 1266:6
looking 1246:1
looks 1250:13; 1255:22
loop 1187:10; 1219:6,8; 1220:1; 1227:18,22; 1229:4,14,19; 1230:6,8,10,14,16,17,22,22; 1231:1,2,5,14,23,24; 1232:2,7,12,15,19,21; 1233:11; 1235:17; 1240:12,16; 1241:10,12; 1242:5; 1243:21; 1244:2; 1247:9,11; 1248:16,19,24; 1249:6,16,21,24; 1250:5,23; 1255:6; 1257:23; 1259:24; 1260:1; 1262:7,19;

1263:8,19; 1264:1,13; 1267:13,14,15,16; 1268:24; 1269:6,7; 1270:6,7; 1271:11,16,20,25; 1272:8,24; 1273:9; 1275:13,14; 1279:6,9; 1281:2; 1282:6; 1283:1; 1284:3,5
loops 1219:21; 1220:3,8,13; 1226:15,18,20; 1229:7; 1238:2; 1249:22; 1262:6,11; 1264:12,14,17; 1265:9,21; 1266:2,6,9,14,17,20,22; 1267:2,4,12,18,24; 1268:4,18; 1269:11,21; 1270:1,3,8,15,21,23; 1271:3; 1272:10,16; 1273:15; 1274:8,20; 1275:3,9,10,11,20,21; 1276:1,6; 1277:1,1,7,15,19,22; 1278:8,16,22; 1279:1,2,13,14; 1280:15; 1281:10,12,14; 1282:6,19; 1283:20; 1284:3
loss 1219:22; 1265:15; 1269:1
lost 1235:21; 1256:15
lot 1184:4; 1223:11; 1246:14; 1259:18; 1263:14; 1272:2
lots 1271:9
low 1276:23; 1277:1
lower 1234:21
lump 1281:18

M

ma'am 1165:9; 1261:20
macrogrid 1233:25; 1234:2,18; 1235:8; 1237:21; 1238:22; 1239:8; 1244:18,22; 1245:15; 1246:16; 1247:3,10; 1248:2,16; 1251:18; 1252:1,24; 1253:10; 1254:1; 1255:4; 1256:20,21; 1258:1,6; 1260:21; 1271:8,21; 1273:10,16
macrogrids 1234:4; 1238:14,17,19; 1252:11
Madam 1184:21; 1185:3,9; 1189:1
maintain 1219:16
major 1241:10
majority 1271:7; 1272:19,20; 1276:2,3; 1283:7,11,23
make 1183:13; 1184:9; 1225:10; 1243:8; 1248:13; 1255:9; 1261:23; 1262:20; 1264:17; 1272:5; 1281:10,21; 1282:7,8
maker 1274:12
makes 1182:12; 1236:7; 1242:19; 1243:8,10,11; 1274:14
making 1284:6
mandate 1183:3
manner 1254:20
manufacturer 1221:13,14
marked 1189:7,17
marry 1230:24
MARTIN 1179:5; 1180:5,23; 1183:8; 1185:12
MARY 1178:28
master's 1186:25
match 1231:8
Matter 1178:5; 1183:7; 1269:18; 1272:18
maximum 1240:11,21; 1242:12; 1270:21
may 1218:24; 1238:17; 1240:4; 1245:17; 1246:18; 1247:15; 1248:10,13,18; 1250:9; 1251:20; 1254:19; 1262:19; 1263:10
maybe 1183:17; 1230:3; 1252:17,21,25; 1256:24
mean 1180:8; 1221:2; 1226:8; 1243:16; 1257:12; 1258:6; 1260:9; 1280:4,6; 1283:17
meaning 1227:4; 1263:15
means 1236:1; 1264:2
meant 1269:3
measured 1260:14,17
mechanism 1183:19; 1264:16,18
meet 1183:2
meets 1222:5; 1231:24
mention 1280:22
mentioned 1224:7; 1237:20; 1263:3
merit 1248:12; 1249:20
Mesa 1242:13; 1243:5
met 1237:2
method 1218:8,17; 1265:7
methodology 1245:12
microgrid 1231:17; 1252:6; 1253:13,15; 1254:15,24; 1260:19; 1261:2
microgrids 1234:14; 1244:20; 1251:12,22; 1253:16; 1254:14; 1255:22
microphone 1251:5
middle 1235:21; 1244:15
mile 1260:9,10; 1261:4
mileage 1261:7,10,11,12
miles 1251:25; 1252:14,15,16,21,21; 1254:1,4,8; 1260:14,17,24
million 1188:17
mind 1228:8; 1277:16
minimalist 1221:6; 1222:3
minimize 1221:3; 1273:12
minutes 1281:17
missing 1227:3
Missouri 1188:9,11
model 1187:8,12; 1218:10; 1220:1,2,11,14; 1221:6; 1222:9; 1224:15,17; 1225:9,13,16,22,23; 1226:6,8,14,20; 1228:16,19; 1230:12,21; 1236:9,14,18; 1237:12,14; 1238:25; 1239:8,12; 1241:4; 1242:4,22; 1243:8,23; 1244:11; 1245:12,14; 1246:15; 1249:8; 1255:19; 1257:11,22; 1266:15; 1267:1,10,16,17; 1268:4,7,10,13,19; 1269:6,7,12,14,17,22; 1270:1,16; 1271:6; 1274:2,6,25; 1275:19; 1276:4; 1277:4,24; 1282:20
model's 1222:2; 1236:20; 1248:6
modeled 1218:13; 1227:5
modeling 1270:14
models 1187:8,10; 1218:9; 1219:9; 1223:10,15,21,24; 1224:14,20,20,22,24; 1225:3; 1228:2,10; 1265:18,21; 1267:3,12,24
modem 1222:6; 1277:8; 1279:8,14,21; 1281:6,9,19; 1282:1,7,11; 1283:8,11,19; 1284:6
modems 1221:24; 1222:3; 1277:12,15,18; 1278:7;
1281:13; 1282:24; 1283:2
moment 1183:9; 1245:17
morning 1251:11; 1254:21; 1260:5,18; 1272:3
morning's 1251:23
move 1184:15; 1189:2
moving 1260:5
MST 1185:8,10
multiply 1181:16

N

NAME 1179:4; 1180:23; 1186:8,10
namely 1232:11
necessarily 1234:24; 1249:19; 1250:25
necessary 1227:6; 1230:21; 1250:20; 1276:6
necessity 1228:4
need 1180:9,15; 1181:18,20; 1219:14; 1225:9; 1228:23; 1233:10,14; 1238:6; 1240:5; 1242:6; 1248:15; 1250:5; 1251:4,6,9; 1254:10
needed 1225:3; 1230:23
needing 1220:23
needs 1227:10
NEEL 1178:28
neighbor 1253:1
network 1218:13,13,16,20,21,22; 1219:16; 1220:5,10,15,19,20,22; 1221:1,3,14,16,23; 1222:5,7,13,14; 1224:3,9,12,16; 1225:1,2,4,7; 1226:1,6,15,24,25; 1227:4,4,6,8,13,16,18,22; 1228:5,24; 1232:6; 1233:16; 1241:19; 1264:9; 1265:13; 1266:7; 1269:4,5; 1273:12,13; 1277:12
network's 1222:3
networks 1219:12,15; 1221:20; 1222:11; 1223:7,10,11,19,20,25; 1224:6,14,21,24,25; 1225:1; 1265:25
new 1185:12
next 1185:13,24; 1230:7,17,22; 1231:1,23; 1259:6
NID 1230:3
nine 1280:25; 1281:1
nominal 1270:19
non-loaded 1274:20
non-next-generation 1232:1
None 1253:22
note 1184:2
noted 1179:1
notes 1253:25; 1274:17
nothing 1281:14
NUMBER 1179:14; 1181:16; 1185:4,13; 1218:11,12,18,20; 1230:11; 1240:4; 1241:3; 1243:4,21; 1246:23; 1247:3; 1250:8; 1251:21; 1268:22; 1269:14; 1276:5; 1280:15
numbers 1188:3; 1242:16; 1246:7

O

objection 1184:18
occur 1234:9; 1237:6; 1273:6
occurrence 1273:6,8
occurs 1261:1
October 1178:22
offices 1264:21
offset 1220:23
offsetting 1180:11
often 1274:19; 1275:4,7
Oh 1247:24; 1262:17
Okay 1184:24; 1189:8; 1226:11; 1240:22; 1242:17; 1244:10; 1246:10,19; 1247:8; 1251:3,8; 1252:8; 1254:2,10,19; 1255:9,24; 1257:18; 1260:4; 1261:5,14,22; 1263:1; 1265:19; 1267:18; 1269:20,25; 1270:12; 1279:4; 1282:17
one 1182:13; 1183:16; 1184:1,5; 1185:12; 1187:12; 1188:1,15; 1218:11,18,24; 1220:17; 1221:3; 1226:6,9,15,21; 1232:24; 1233:11,14; 1235:13,15,17,25; 1236:1,1,2,5,8,20; 1237:3,10; 1239:8; 1240:13,15,15; 1243:8; 1244:2,17; 1246:3,17; 1247:8,20; 1248:11,16,18,20,24,25,25; 1249:1,4,6,9,19,23; 1250:1,11,19,20; 1251:1,20; 1252:25; 1253:2; 1254:2,12; 1255:13; 1259:5,23; 1261:23; 1265:7; 1271:9; 1272:6,21,22; 1273:20; 1274:9; 1275:18; 1278:19; 1279:2,15,19; 1281:1; 1282:15,24,25
ones 1221:19; 1224:7; 1238:15
onto 1253:19
opinion 1181:3
optimum 1279:22
order 1220:6; 1233:1; 1235:19
origin 1234:11,20
original 1243:25
others 1271:15
otherwise 1230:24; 1273:17
output 1239:5
outputs 1239:1
Outside 1219:2,10; 1223:21; 1257:8
overlaid 1234:4; 1235:2; 1256:8
overlap 1237:15
overlaying 1253:19
overlays 1236:12
own 1180:6; 1248:12; 1283:21

P

PAGE 1179:4; 1188:2,16; 1225:14,17,19,21; 1244:10,13; 1245:7; 1278:2,11,15,23; 1280:12,14; 1283:6
Pages 1178:15; 1187:16,17
paragraph 1244:16; 1274:18,23,24; 1275:5; 1283:5
parameters 1225:2; 1263:23
parents 1252:25
part 1223:14; 1225:12; 1227:7; 1229:20; 1246:23; 1253:18,22; 1258:16
partial 1271:1; 1273:19
participated 1187:11; 1253:6

particular 1181:5; 1227:17; 1231:8,22; 1251:15; 1271:7
particularly 1228:23; 1229:6
parties 1266:1,16
partitioned 1244:18
partitions 1244:21; 1245:15
penalize 1280:25
people 1222:14; 1236:3; 1242:6,9; 1247:10,12; 1248:2; 1251:12,19; 1252:23,25; 1253:7; 1254:13,19; 1258:4; 1260:5,18; 1261:11; 1263:13; 1264:13,17,22; 1269:21,23; 1271:11; 1272:19,20,25; 1273:17; 1275:8; 1276:24; 1277:5; 1283:13,23
per 1181:5,8,14,19; 1220:19; 1227:20; 1279:21; 1281:7,8; 1283:3,9
percent 1275:3; 1276:24
Percentage 1179:16; 1185:16; 1243:3,20
Perez 1280:17
Perez's 1283:4; 1284:2
performance 1279:15; 1280:16; 1281:13,16; 1283:20
performed 1187:9
perhaps 1183:9
perspective 1225:15,21; 1226:5,14
PETER 1179:5
PFM-1 1179:15; 1184:15
phones 1220:6
piece 1242:3
pieces 1182:9,25; 1258:24
PLACE 1178:24; 1255:8; 1259:2; 1273:8; 1276:5
placed 1219:18; 1229:20
planning 1219:7
Plant 1219:2,10; 1223:21; 1227:5; 1229:2; 1232:15; 1254:11; 1260:6
play 1235:22
please 1186:8,21; 1218:4
pockets 1238:6
point 1180:8; 1221:21; 1234:20; 1235:1; 1237:19; 1240:22,23; 1255:2; 1265:23; 1272:5; 1278:25; 1280:11,18; 1281:1
points 1218:24; 1260:24; 1280:15,25; 1281:3,5
policies 1219:17
populated 1248:19
populous 1272:25
port 1231:8,9,12,13,16,17,20,20,2
portion 1223:9; 1229:2; 1232:14; 1245:11; 1251:13; 1252:11; 1255:15; 1274:11
portions 1227:13,18
posited 1260:13
position 1277:4,4
possible 1183:16
possibly 1182:14; 1250:9
potential 1250:9
potentially 1272:24
power 1219:22; 1220:11; 1267:10,11,19; 1269:1,5,8; 1270:8
practical 1253:8
practice 1273:8; 1274:11
practices 1220:2
pre-electronics 1264:15
precept 1249:9; 1250:1
precise 1276:8
precisely 1252:18; 1283:12,24
predecessors 1187:13
Prefiled 1179:10,11
preliminary 1261:24
premise 1249:14
prepared 1187:21; 1218:2
preprocessing 1254:17
presentation 1251:13,23
presented 1218:9
presently 1241:12
presumably 1228:16; 1283:19
presuming 1236:10
pretty 1262:19
prevent 1267:1
previous 1232:4
previously 1224:19,23
prime 1279:15
printed 1245:6
prior 1223:1
probably 1224:4; 1245:6; 1261:17,24; 1263:17; 1266:9; 1276:12
problem 1182:16; 1236:22; 1237:4
problems 1267:1; 1268:25
proceeding 1186:17; 1226:10,13; 1233:19; 1266:13
PROCEEDINGS 1178:16; 1219:4
process 1232:25; 1236:7,12; 1237:17,18; 1238:5,9; 1239:15,16; 1240:7,18; 1244:21; 1245:14,21,25,25; 1246:5,9,24; 1247:18; 1253:19,23; 1258:11; 1281:3
produced 1225:8
producers 1241:10
producing 1225:7
product 1253:4
products 1274:12
promulgated 1241:1
proper 1267:7
properly 1266:23
proposition 1278:7
prove 1183:12
provide 1221:16; 1228:23,24; 1262:11; 1263:11; 1266:14,17,23; 1267:4; 1276:23; 1277:8
provided 1220:16; 1221:12; 1256:20; 1276:25; 1278:6; 1282:14
providers 1279:11,12
provides 1218:22; 1226:2,7,16; 1283:21
providing 1276:9; 1278:21
provision 1264:3
proxies 1219:9
Proxy 1225:22; 1267:1
PUBLIC 1178:2; 1180:24
published 1219:3; 1244:11
pull 1273:16
pulled 1273:21
purpose 1237:13; 1278:21; 1279:17
purposes 1226:13; 1227:24; 1228:2; 1247:4; 1266:12; 1271:2; 1273:22; 1279:7
pursuant 1178:9
put 1183:19; 1233:5,10; 1243:1; 1247:12; 1248:19,20; 1249:19,21; 1255:18; 1258:20; 1259:16; 1264:11,21; 1265:2; 1272:8; 1275:21; 1281:22
puts 1272:18; 1276:8
putting 1182:9,25; 1265:6

Q

quadrant 1244:6; 1247:14; 1248:21; 1259:20,21,22,24; 1260:1; 1261:7,9,10
quadrants 1239:14; 1244:15; 1245:21,22; 1246:19; 1247:2,4; 1248:3,5,10,11,17,18,22; 1261:10
quality 1218:13,20; 1221:4; 1222:6,14; 1226:25; 1227:6,8; 1228:24; 1262:4,12; 1263:14; 1265:13; 1266:7,20,24; 1267:2,5; 1275:12,19; 1276:7,10
quarter 1252:17
question 1181:1; 1182:8; 1183:14; 1218:7; 1223:13; 1231:10; 1232:4; 1235:22; 1236:7,17; 1237:5; 1241:20; 1243:25; 1245:19; 1247:8; 1253:11; 1254:22; 1255:17; 1256:16; 1257:2,20,24; 1260:4,16; 1261:5; 1262:23,24; 1265:14; 1269:20,23; 1271:14; 1280:23; 1281:25
questioning 1227:25; 1231:22; 1251:2
questions 1180:19; 1183:5; 1188:22

R

raised 1240:23
range 1220:23; 1265:10; 1275:16,20,24; 1276:5,17,19,23,25; 1278:23; 1279:21; 1283:12,13
rare 1271:2; 1273:6
rate 1180:11,14,15; 1277:21; 1278:18,20; 1280:19; 1282:16; 1283:1,8,24
rates 1180:10; 1279:8,20; 1283:12
ratio 1240:8
read 1188:6; 1189:3; 1245:12,17; 1246:23; 1281:4
reading 1278:15
reads 1188:19
ready 1184:12
real 1221:10; 1224:24,25; 1225:8; 1228:2; 1232:19; 1235:11; 1237:8,9,9,23
realize 1283:8
really 1181:18; 1224:2; 1227:22; 1231:2; 1239:3; 1253:11; 1254:9; 1257:8; 1268:22
reason 1237:24; 1239:11,24; 1240:1
reasons 1218:18; 1265:20; 1270:15
rebalancing 1180:14
Rebuttal 1179:11,21; 1187:18,25; 1188:16,23; 1189:2,8,13,15; 1274:10
recall 1226:21,25; 1254:8; 1268:8; 1270:19
Receive 1279:20,20
received 1184:20
recent 1219:5
recess 1261:21
recollection 1245:13,20
record 1184:18; 1189:3; 1261:23
redirect 1184:13,14
redo 1184:7
reduced 1180:10; 1258:25; 1259:7,12
reductions 1180:11
reference 1227:20; 1284:1
referenced 1227:9; 1238:9; 1246:3
referencing 1239:2
referred 1231:4
refinement 1246:9
reflect 1225:9
reflected 1183:25
reflective 1255:1
refresh 1245:12,20
Regarding 1218:25; 1219:17; 1220:25; 1221:21
regular 1242:20
reinforce 1219:15
related 1249:11; 1265:20
relates 1181:1
relating 1280:12
relevant 1231:9
RELTEC 1242:19
remembering 1255:17
remote 1219:23; 1221:13; 1229:19; 1232:12
REPORTED 1178:28
represent 1228:8
representative 1279:10
represented 1187:13; 1237:1
representing 1180:24; 1186:16; 1222:22
represents 1227:22; 1234:24,24
request 1182:14; 1220:16
requested 1185:5,11,15,16
require 1279:25
required 1235:12; 1250:1; 1266:2,6
requires 1231:5; 1249:9; 1274:19
Residential 1179:18; 1185:17,18
response 1220:16; 1223:13; 1253:6
responses 1182:14
rest 1232:15; 1239:19; 1283:2
result 1220:5,10
results 1188:12; 1220:18
right 1182:9; 1183:21; 1189:10; 1229:23; 1233:15; 1247:1; 1248:9; 1250:17; 1252:19,22; 1255:24; 1257:1,13; 1272:20
right-hand 1259:20
rise 1271:20
RMB 1274:10
RMB-1 1179:20,21; 1189:8,15
RMB-3 1179:21; 1188:2; 1274:10; 1278:2
RMB-4 1179:20; 1227:12
road 1183:18,23; 1184:7; 1250:13; 1252:24; 1253:9,13,16; 1254:15; 1258:4,18,23,24,25; 1259:3,3,6,9,12,12; 1261:7,10,11,12; 1271:6,12; 1272:2; 1273:9
roads 1246:20; 1250:10; 1253:16; 1254:22,24; 1271:7,9,10,18,18; 1272:3,6
roadway 1256:17
ROBERT 1179:8; 1185:25; 1186:2,10
Room 1178:25
roughly 1268:4

Rowland 1186:11
RPR 1178:28
RT 1229:18,23
rules 1218:19; 1219:1,19; 1221:15; 1235:12,24; 1236:3
run 1249:22; 1272:16
runs 1252:24; 1258:5; 1279:22
rural 1221:25; 1233:18; 1234:16,19; 1235:8; 1237:20; 1238:15; 1251:18; 1254:5; 1255:4; 1256:2; 1260:21; 1263:10; 1280:3,9,10
Ruscus 1179:12; 1222:21,22,24; 1251:6,8; 1256:20; 1257:19; 1261:17,20; 1262:2,24; 1263:16,25; 1264:2; 1265:8; 1271:5

S

save 1246:1
savings 1220:21
saw 1235:12,24
saying 1182:19; 1249:13; 1273:1,2
says 1181:11; 1188:11; 1226:18; 1239:12; 1240:8; 1274:18; 1275:21; 1278:16,17; 1279:23; 1280:24; 1281:4,14; 1283:7,10
schematic 1227:12,16,17; 1229:18; 1251:10
scope 1257:9
scoring 1280:13,15
scratch 1224:9
se 1227:20
second 1180:5; 1226:24; 1244:16; 1274:19; 1278:15; 1279:21; 1281:7,8; 1283:3,9
Section 1178:9,10
sense 1182:12; 1184:9; 1224:2,3; 1236:7; 1251:22
sentence 1188:4,11; 1278:15; 1283:7
Separate 1247:1; 1249:10,10; 1273:18
September 1187:18
sequence 1180:2; 1185:13; 1284:7
serve 1233:2; 1235:19,25; 1236:4,16,19,21; 1237:10; 1239:9; 1240:12; 1242:15; 1247:9; 1255:6; 1273:12
serveable 1242:1
served 1229:14; 1237:16; 1238:7; 1242:6,9; 1244:2; 1249:5,13,15,16,23; 1250:23; 1259:13; 1262:6; 1273:18; 1276:1; 1277:1,2
serves 1253:3,4
SERVICE 1178:2,9; 1179:19; 1180:24; 1181:18,21; 1185:18; 1218:9,18; 1219:16; 1220:3; 1221:4,17; 1222:9; 1226:2,7,16; 1262:4,12; 1263:14,18; 1265:11; 1266:17,20,24; 1267:2,5; 1268:15; 1275:12; 1276:7,10; 1279:10,12; 1282:9; 1283:21
services 1218:23; 1221:21; 1222:1,12; 1263:11; 1265:20,24; 1266:14; 1276:12,13,14,17; 1277:8; 1279:25; 1280:4,6,8; 1281:10,15,16,19,19; 1282:2
serving 1219:20; 1220:8,22; 1221:8; 1229:15,17,21; 1232:11,13,19,22; 1233:8,17,21,23; 1234:1,3,16; 1235:14,18,25; 1236:5,8,11,13,16; 1237:1,3,10,14,19,22; 1238:7,13; 1239:1,6,9,13,16,17,21; 1240:13,21; 1244:1,7; 1245:24; 1246:1,16,17,22,24; 1247:5,20,21,23,25; 1248:7,12,13,22; 1250:13,24; 1270:19; 1271:2; 1272:1,7,16; 1273:22; 1274:17,25
set 1180:9; 1183:17; 1221:11; 1234:25; 1236:1,9,11; 1237:14; 1242:3; 1245:2
sets 1235:18,19; 1249:10
several 1183:16
short 1252:8; 1261:21; 1279:9; 1283:2,13
shot 1255:14,20
showed 1220:18
shown 1220:15; 1253:22
shows 1280:14; 1282:10
side 1259:8; 1279:2
sides 1271:21
signal 1264:1
signals 1229:5
Similar 1219:5
simplifies 1256:10
simply 1256:10
simulate 1279:6
single 1239:9; 1273:7
sir 1184:19; 1245:18
site 1258:20; 1259:24; 1260:2,7,12,22; 1271:25; 1272:8
sites 1260:14; 1276:2
situate 1233:1
situation 1241:25; 1272:7; 1273:7
six 1244:17; 1254:1,7; 1281:4; 1283:5
size 1219:20; 1220:24; 1237:25; 1238:1,3,13,17; 1240:11; 1241:6,15; 1249:13,20; 1256:5,7; 1259:8,17,18
sized 1244:22; 1245:15
slightly 1281:2
small 1182:6; 1249:16; 1251:21; 1273:16; 1275:25; 1276:5
smaller 1181:23,25; 1182:3; 1238:7; 1244:18; 1260:14; 1275:23
something 1181:6; 1183:23; 1184:8; 1246:11; 1266:8
somewhat 1241:24
sorry 1185:14; 1235:21; 1244:25; 1250:17; 1252:3; 1273:23
sound 1221:14
sounds 1246:7; 1252:22
speak 1266:3
special 1264:3
specifically 1263:21; 1266:9; 1267:14
specifications 1266:17
specifies 1221:25
specify 1276:16
speed 1279:22
speeds 1281:6
spent 1223:8,14
spits 1219:25
sponsors 1241:19
spots 1250:22
spread 1253:15
Sprint 1244:13
square 1251:17; 1254:1,4,8; 1259:15,16; 1260:9,10
Staff 1180:20,24; 1183:4
standard 1218:19,25; 1219:19,23; 1220:4,9; 1240:15; 1241:18,21,23; 1243:2; 1266:25; 1269:15; 1273:8; 1275:1; 1281:9
standards 1219:1,10; 1220:1; 1222:5,10
standpoint 1228:6; 1241:17
start 1249:5
starting 1265:23
state 1187:7; 1188:9,11; 1225:14; 1257:4
stated 1223:1; 1273:15; 1276:22
statement 1233:22; 1267:9; 1274:22; 1278:11
states 1188:5,7,8; 1219:12; 1220:16; 1234:25
statute 1181:11
Statutes 1178:11
statutory 1183:2
stayed 1253:1
Stephen 1222:22
stretches 1258:7
Strike 1224:22
string 1264:16,20
strung 1265:1
studies 1187:5,9
study 1220:15; 1282:1
subfeeder 1249:11
subgrids 1244:22; 1245:16
subject 1231:22
Subscribe 1179:17; 1185:17
suffice 1233:12
sufficient 1247:9; 1267:8
suggests 1247:11
summary 1218:2,4; 1223:2; 1226:19; 1227:3; 1267:9; 1269:4; 1277:10
supply 1235:17; 1247:11
support 1183:24; 1184:7; 1276:6
suppose 1272:11
surprise 1269:13
surprised 1282:22
SUSAN 1178:19
switch 1187:10; 1227:18,20,21; 1228:1,6; 1229:5; 1230:20,24; 1231:3,6,6,7,12,13,16,16,17,1 1232:7,16; 1279:7
switches 1228:7,8,11; 1279:13
switching 1262:2
sworn 1186:4
system 1230:25; 1231:3,13; 1232:22; 1234:23; 1235:1,4,7; 1236:15; 1241:15; 1242:18; 1244:3; 1247:9,14; 1248:13,16,20; 1249:17,24; 1255:8; 1275:23,25; 1280:13,15,18,18
systems 1229:4; 1230:7,8,10,12,14,17,18,23; 1231:2; 1233:11,14; 1240:16; 1241:12; 1242:5; 1243:10,11,22; 1247:12; 1248:24; 1249:21; 1250:5,23; 1257:23; 1275:22; 1276:3,3

T

T1 1231:7
table 1183:20; 1278:22; 1279:23; 1282:12
taken 1221:11; 1255:25
takes 1221:6
taking 1182:24
talk 1182:14; 1220:12; 1221:22; 1222:15; 1238:21; 1246:15; 1262:3; 1264:10,13; 1265:3; 1266:5; 1268:21; 1280:2
talked 1260:4,18; 1263:12,16; 1272:2
talking 1220:11; 1224:7; 1225:4; 1234:20; 1241:16,24; 1242:2; 1251:18; 1263:10; 1266:13; 1267:10,11,19; 1269:1,5; 1270:8; 1274:18; 1278:18
talks 1244:13; 1278:17
Tallahassee 1178:27
technical 1251:6; 1262:22; 1281:9
technologies 1230:13; 1232:20
technology 1219:6; 1228:5,9,21,22; 1229:3
telecommunications 1178:8; 1186:4; 1187:1,5; 1221:25; 1223:6,10,18,20; 1279:24; 1283:16
Telephone 1187:2; 1218:13; 1219:11; 1221:4,16,20,23; 1222:11; 1223:7; 1224:6,12; 1263:9,14
telephones 1220:12
telephony 1264:10
tell 1186:22; 1230:20; 1241:2; 1250:2; 1251:25; 1252:2; 1282:18
ten-minute 1261:19
tend 1273:15
tends 1281:13
tens 1263:21
tenth 1260:5,9,10
term 1229:11; 1230:9,19; 1231:9,12,17; 1262:4
termed 1233:25
terminal 1219:23; 1221:13; 1229:14,19; 1232:12; 1249:6
terminals 1232:13; 1262:7
terminate 1231:13
terminates 1231:16
terms 1182:18; 1183:15; 1230:10; 1236:22; 1252:13
terrain 1250:10,13
TERRY 1178:18
test 1279:3; 1280:20,22; 1283:4
testified 1186:5,18; 1254:3,20; 1266:19
testify 1255:2
Testimony 1179:10,11; 1187:7,16,18,21,25; 1188:2,16,24; 1189:2; 1218:2; 1225:14,18,20; 1226:17; 1227:9; 1229:12; 1238:10; 1243:13; 1245:5; 1255:1; 1257:5; 1262:5; 1265:16; 1268:3,18; 1272:4; 1275:2; 1276:15; 1277:10; 1278:2; 1280:14
testing 1247:4
tests 1248:6
Thank 1183:4, 1184:11,19,24; 1185:2,22,23; 1189:5; 1222:16, 1230:5; 1231:21; 1249:3; 1261:14
Thanks 1180:19

that's 1180:8; 1181:18,20; 1182:8; 1183:14,21,25; 1189:10; 1223:4; 1226:17; 1227:4,8,22; 1228:20; 1229:18,20; 1231:23; 1232:3,15,24; 1233:6; 1234:13; 1235:4,9; 1236:13; 1238:1,3,8,9; 1239:2,11; 1240:1,4,13; 1246:21; 1249:8,18; 1250:20; 1251:3; 1253:22; 1254:15,23; 1255:11,24; 1256:17; 1257:2,24; 1258:7,22; 1259:15; 1260:25; 1261:13; 1262:19; 1264:7,22; 1265:22; 1266:4; 1267:6; 1268:6; 1269:19; 1271:12,17,18; 1272:13,17,19; 1273:11,11; 1276:2; 1277:3; 1278:10,19,20; 1279:2,15,17,23; 1280:20; 1281:20; 1282:23; 1283:10,12,21,25
themselves 1224:20; 1247:5
there's 1184:1; 1227:2; 1233:10,13; 1259:3,3,10; 1261:10; 1269:1; 1277:16; 1278:11
Therefore 1270:23
They're 1232:17; 1254:12; 1258:13; 1262:16; 1268:24; 1273:21; 1275:17
they've 1276:25
thick 1264:18
thicker 1264:19
thing 1247:25; 1255:19; 1259:6; 1264:24; 1265:5; 1271:19
things 1232:24; 1270:10
think 1181:7,15,18; 1182:12,21; 1184:4,12; 1224:13; 1226:17; 1230:15; 1234:7,23; 1245:1; 1250:21; 1254:23; 1257:13,20; 1259:25; 1260:9; 1264:4; 1265:19; 1266:1,18,19; 1268:6,20; 1269:23; 1271:11,14; 1273:18; 1274:12,16; 1275:7; 1276:20; 1277:11,14,18; 1280:3; 1283:19,25
thinking 1256:24
third 1221:21; 1227:2; 1244:16
thought 1254:23
thousand 1275:8
thousands 1263:22
three 1183:17; 1187:18; 1189:14; 1218:18,21; 1243:8; 1244:17; 1247:16; 1248:21; 1249:1,23; 1251:20; 1252:23,25; 1253:7; 1255:5,6,11; 1257:25; 1259:16,17; 1281:3
threshold 1265:16
tie 1251:22
tied 1232:10
TIME 1178:23; 1182:20; 1183:17; 1218:24; 1241:5,9; 1245:1; 1246:17; 1282:8
times 1181:16; 1249:15; 1259:11
title 1227:22
today 1180:25; 1186:19; 1187:14; 1188:23; 1225:5; 1229:12; 1234:15
together 1182:9,25; 1232:7; 1248:10,22
told 1244:5
tomorrow 1262:1
Tone 1179:19; 1185:18
top 1278:12,23
total 1181:4,17; 1184:3; 1188:20; 1243:3,21; 1259:17
total, 1188:18
towards 1235:2; 1271:12; 1272:21
tracks 1182:13
Tracy 1185:15
tradition 1247:11
training 1223:8,11
Transcript 1180:2; 1284:7
transition 1183:18
translate 1229:4
transmission 1221:8,10,16; 1229:5; 1284:12
transmit 1262:23,25
transmitted 1263:18
transport 1187:10
tried 1265:2
trouble 1267:25
true 1233:19,23; 1235:16; 1238:25; 1241:9; 1242:4,12; 1247:22; 1248:1; 1254:13; 1259:21; 1260:20; 1267:6,12; 1269:25; 1271:5
try 1183:18; 1264:17; 1279:12; 1280:18; 1281:10
trying 1223:23; 1249:12; 1250:22; 1272:5; 1273:12,25; 1279:5,6,17
Tuesday 1178:22
turn 1227:14; 1244:10; 1274:9; 1278:1
twenties 1263:21
two 1183:17; 1186:1,13,14; 1218:9,11,12,20; 1225:17; 1226:20; 1235:17,18,19; 1236:4,22; 1237:11; 1239:7; 1241:10; 1244:4,17; 1247:12,13,16; 1248:25; 1249:8; 1250:5,20; 1251:20; 1252:14,16,17,20; 1255:24; 1258:15; 1260:24
type 1226:4; 1231:8,20,20
typically 1273:19

U

U.S 1187:3,10,11; 1244:13
Uh-huh 1185:8
ultimate 1237:1,25; 1238:8,14; 1239:18,20; 1246:2,5,9; 1247:19,22,24; 1256:10,13,17; 1256:8; 1258:21; 1271:1; 1273:21
ultimately 1180:10; 1181:19
unattainable 1221:10
unclear 1276:12
underestimate 1221:15
underlying 1244:20
understand 1184:10; 1230:19; 1255:9; 1257:6,7,11; 1258:14; 1260:18; 1271:14; 1276:5
understanding 1180:7; 1226:4,12; 1230:5; 1238:23; 1239:14; 1253:7,9; 1254:16; 1256:3,13; 1258:14,18; 1261:6; 1277:3
unit 1236:1; 1239:24,25; 1241:6
United 1219:12; 1234:25
units 1233:24; 1239:3,4,5,7,19; 1240:5,10,20; 1244:3; 1246:16
universal 1181:17,21; 1218:8,18; 1222:9; 1226:2,16
unusual 1243:1
upon 1249:1; 1254:22
upper 1255:24; 1259:20
urban 1222:2; 1280:3,8
use 1218:25; 1219:19; 1221:23; 1223:21; 1228:15,24; 1229:1,3; 1242:2,21; 1251:4; 1264:18; 1267:8; 1270:18; 1275:20,24
used 1181:2; 1182:3; 1219:9; 1221:19; 1222:10; 1228:9,11,16,19; 1230:9; 1238:6; 1240:7,15; 1241:20; 1245:21; 1246:5; 1264:9; 1267:21; 1278:10
users 1283:8,11
uses 1275:1,3,15,16
using 1181:22; 1221:7; 1257:10; 1276:19

V

validity 1236:18
vast 1262:12,14
vendor 1219:8
verifiable 1225:7
Version 1218:10; 1225:22; 1244:24; 1245:5
versions 1241:3
versus 1220:20
view 1271:19; 1272:23
violate 1221:14
virtue 1268:10
voice 1229:4; 1262:12,23,25; 1263:9; 1265:10; 1276:12
voice-grade 1263:18; 1267:5; 1275:12; 1276:7,17
VOLUME 1178:14; 1179:3,13; 1180:3; 1284:7

W

want 1221:22,23; 1233:14; 1238:12; 1242:24; 1250:17; 1262:14; 1265:24; 1275:6; 1283:24
wanted 1181:15; 1251:14; 1264:23
warranted 1244:19
ways 1183:16; 1184:1
We'll 1261:14,22
we're 1181:2; 1184:12; 1223:23; 1224:2,7; 1225:4; 1231:2; 1234:20; 1241:24; 1242:2; 1251:18; 1255:4; 1256:2; 1260:23; 1261:18,24; 1266:13; 1280:12
we've 1238:23
weighted 1272:2
weighting 1271:6; 1272:13
Wells 1276:22
Wells' 1219:25; 1277:3
West 1186:11; 1187:3,10; 1244:13
West's 1187:11
Whenever 1180:9
wherever 1261:6
whether 1223:17; 1233:14; 1239:20; 1245:13; 1253:3; 1269:21; 1276:13; 1277:17; 1282:19
whichever 1261:7
whole 1236:14,18; 1237:13; 1253:25
whom 1186:13
why 1181:10; 1182:11; 1225:22; 1238:3; 1240:1,24; 1266:4; 1269:16; 1283:25
will 1180:9,11; 1184:2,25; 1185:19; 1189:4,12,16; 1218:15; 1222:3,6; 1224:16; 1226:6; 1228:24; 1229:12; 1231:21; 1239:6,9,13,22,22; 1242:19; 1245:1; 1261:15; 1271:10; 1276:11,13,15; 1281:11; 1283:8
wire 1181:9,11,12,24,25; 1182:3,6,9,13,22; 1183:1; 1227:21,25; 1231:3; 1234:21,24; 1264:19,19; 1267:8,20
wish 1265:20
within 1232:7,11; 1235:12,14; 1236:9; 1239:17; 1242:1,6; 1246:2; 1248:20; 1253:10,13; 1254:1,12,24; 1256:10; 1258:2; 1260:5,19,19; 1261:1; 1267:3; 1270:16,21; 1271:25; 1274:5; 1275:4; 1276:16; 1283:15
without 1184:18; 1280:16
WITNESS 1180:8,17; 1183:14; 1185:5,25; 1186:3; 1256:23; 1257:16; 1263:3,7; 1264:7; 1265:1,6; 1270:17; 1276:22
WITNESSES 1179:3; 1258:15
word 1188:16,17
words 1225:20; 1263:15; 1271:9
work 1222:4; 1235:12; 1261:25; 1262:20,22; 1263:9; 1264:16; 1276:11,12,13,15; 1277:12,15,17,19,21; 1281:10; 1282:7,8,24; 1283:3; 1284:4,6
worked 1223:6; 1224:13
working 1186:15; 1235:10
works 1181:21; 1254:17; 1257:12,13
world 1221:10; 1224:24,25; 1225:8; 1235:11; 1237:8,9,9
wouldn't 1267:25; 1269:13,16
written 1253:24
wrong 1238:24; 1277:11; 1278:5

X

Xs 1258:13

Y

years 1183:17; 1184:6; 1187:1; 1230:11; 1241:3; 1263:12; 1264:10
yell 1220:6
You'll 1251:4
you're 1182:8,9,24; 1230:21; 1236:10; 1239:2,15; 1241:16; 1243:12; 1245:22; 1246:4,17; 1249:13,22; 1250:12; 1257:21; 1260:6,12; 1272:5,14; 1273:1,2; 1274:17; 1276:9,21; 1282:12
You've 1218:13; 1223:5; 1228:15; 1248:2; 1255:25; 1256:18; 1257:12; 1258:1; 1260:7; 1277:6
yourself 1186:23