BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF DETERMINING PRICES	)	
FOR UNBUNDLED NETWORK ELEMENTS (UNEs)	)	
IN QWEST CORPORATION'S STATEMENT	)	DOCKET NO. TC01-098
OF GENERALLY AVAILABLE TERMS (SGAT)	)	

REBUTTAL TESTIMONY

OF

DENNIS PAPPAS

QWEST CORPORATION

JULY 28, 2003

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I. IDENTIFICATION OF WITNESS

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

A. My name is Dennis Pappas. I am employed by Qwest Corporation as a Director in the Technical-Regulatory Group of the Local Network Organization. My business address is 700 W. Mineral Avenue, Room MNH19.15, Littleton, Colorado 80120.

Q. ARE YOU THE SAME DENNIS PAPPAS THAT SUBMITTED DIRECT TESTIMONY IN THIS PROCEEDING?

A. Yes I am.

II. OVERVIEW OF TESTIMONY

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE SOUTH DAKOTA PUBLIC UTILITIES COMMISSION?

A. Yes I have. I testified on behalf of Qwest in the matter of the investigation into Qwest Corporation's compliance with section 271 (c) of the Telecommunication Act of 1996 in Docket – TC01-165.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. Section III of this rebuttal testimony responds to the testimony of Sidney L. Morrison, who appears on behalf of the South Dakota Commission Staff ("Staff"). More specifically, I rebut his testimony on efficiency issues, efficient technology, loop conditioning, and collocation.

In Section IV, I address the issues raised by Timothy J. Gates, who also representing the Staff. My rebuttal of Mr. Gates' direct testimony focuses on Mr. Gates' unsupported assumptions regarding Qwest's cost model, LoopMod3 ("LM3").

Q. PLEASE PROVIDE A BRIEF SUMMARY OF YOUR REBUTTAL TESTIMONY.

Testifying from actual experience, I demonstrate that the network-related inputs in LM3 are reasonable and based upon forward-looking engineering practices. My testimony points out that the LM3 engineering assumptions are interdependent; meaning that if one engineering assumption or input is modified, other related and/or dependent engineering assumptions or inputs must be analyzed to determine if they are also affected by the modification. Such analysis insures consistency in network design and architecture. It is important to emphasize that these network and engineering assumptions are used in a TELRIC-based cost model. A TELRIC model, as opposed to a "growth" model assumes that Qwest would be constructing a replacement network. This replacement network would be built in areas with existing structures in place, both above and below ground. Consideration must be given, therefore, to how the presence of these structures affects placement methods and therefore, engineering assumptions and inputs.

My testimony relating to LM3 also addresses critical inputs and assumptions relating to the design of feeder and distribution plant.

III. REBUTTAL OF SIDNEY L. MORRISON TESTIMONY

A. EFFICIENT TECHNOLOGY

1. ORDER FLOW THROUGH

Q. MR. MORRISON WOULD HAVE YOU BELIEVE THAT ALL ORDERS SUBMITTED TO QWEST, FOR PROVISIONING OF AN UNBUNDLED ELEMENT, ARE ERROR FREE AND THEREFORE, VERIFICATION OF THE INFORMATION ON THE ORDER IS NOT NEEDED. IS HIS ASSERTION CORRECT?

A. No it is not. As an example, a central office technician will have to review, verify, validate, and analyze an order to ensure the Cable Facility Assignment ("CFA") placed on the order by the CLEC is indeed spare. If an order were submitted to Qwest with CFA that is in use by another CLEC service, this error would never be caught prior to the order being written and assigned since the CLEC is solely responsible for these assignments. Address verification is yet another issue where inaccuracies can occur and it is not until the field dispatch that a technician is able to determine the correct/accurate address. Once again, a scenario that is beyond either company's control yet impacts the possibility of having 100% accuracy in order when they hit the Qwest service order processor.

Q. IN YOUR EXPERIENCE ON THE CLEC SIDE, WERE YOU ABLE TO SECURE A MEDIATION SYSTEM THAT WOULD ALLOW FOR 100% FLOW THROUGH?

A. The director of our Information Technologies ("IT") organization was tasked with researching and procuring a system that would have the capabilities of 100% flow through with no luck. The fact is, no such system exists nor will it as long as you have customers, both retail end users and CLECs, responsible for providing information on addresses and facilities. As much as Mr. Morrison wishes it true, it continues to appear that the integration of customer information, billing information and facilities information is far more complex than he is willing to admit. It even appears that Mr. Morrison is not aware of such a working mediation system when you consider the last sentence in footnote 3 on page 10 of his testimony. He states, "Mediation systems bring flow through provisioning a step closer to reality." I would have to assume from that comment therefore, that this type of system is not reality yet and he gives no indication, examples, or time line of when or if it may occur.

2. AUTOMATED DISTRIBUTING FRAME

Q. BEGINNING ON PAGE 18 OF HIS DIRECT TESTIMONY, MR. MORRISON REFERS TO "NEW" TECHNOLOGY BEING AVAILABLE FOR PERFORMING MANUAL CENTRAL OFFICE CROSS CONNECTIONS KNOWN AS "AUTOMATED DISTRIBUTING FRAME" ("ADF"). HAS QWEST INVESTIGATED AND DEPLOYED THIS "NEW" TECHNOLOGY?

A. Qwest conducted laboratory tests on two different types of ADFs and evaluated each based on a set of requirements. In essence, Qwest has evaluated the specific type of equipment described by Mr. Morrison and determined that the ADF did not meet Qwest's basic requirements for network equipment therefore, it was not deployed. In short, the equipment was not able to provide bandwidths greater than one Megahertz ("MHz") nor was it able to accept power levels in excess of plus or minus 130 volts DC. To put this in perspective, DS1 facilities provide a bandwidth of 1.544 MHz and require power levels of up to (plus or minus) 230 volts DC.

The device Mr. Morrison proposes Qwest use in place of manual cross-connects and the current central office main distribution frame behaves much like a fuse or circuit breaker in an electrical circuit. When the metallic cross-connect voltage limits are reached, the cross-connect breaks, causing the circuit to open and go out of service since the cross-connect is no longer in place.

Q. MR. MORRISON STATES THAT THESE SAME TYPES OF DEVICES ARE AVAILABLE FOR FIELD DEPLOYMENT AT REMOTE TERMINALS. HAS QWEST ATTEMPTED TO DEPLOY A MECHANICAL CROSS-CONNECT DEVICE WITHIN ITS OUTSIDE PLANT AND IF SO, WHAT WERE THE RESULTS OF THE TEST?

A. Qwest has deployed and attempted to use a device much like the one noted on page 19, line 435 of Mr. Morrison's testimony. The result was disappointing. From the initial deployment of the device, Qwest experienced problems with bent pins at the Feeder/Distribution Interface ("FDI") due to heat issues and its impact on the "intelligent routing software". Failures in the internal modem limited Qwest's ability to communicate with the device remotely whereby resulting in field dispatches. Each of these field tested problems would have resulted in a field dispatch so, in addition to the cost of the device suggested by Mr. Morrison, which he also asserts in his testimony would save Qwest a dispatch, Qwest would have incurred the additional cost associated with a field dispatch. Eventually, the magnitude of these problems was so extensive that the manufacturer pulled the product off the shelf and has manufacturer discontinued it. Mr. Paul Zipps, a staff engineer in the Qwest Lab, was central to the discussions around product selection and has provided the attached summary expanding on the selection and the problems that have occurred since the installation of the type of technology Mr. Morrison touts. **(Exhibit DP-REB1)**

3. WORK FLOW ENGINES

Q. IN ADDITION TO THE ADF, MR. MORRISON ALSO TOUTS THE EFFECIENCY GAINS BY IMPLEMENTING WORK FLOW ENGINE. DO YOU HAVE ANY THOUGHTS ON THIS CONCEPT?

A. The ADFs tested in the lab have manufacturer specific and proprietary operating systems which will not work with many of the legacy ILEC OSS systems' different operating systems - I am still not aware of any company that has developed an interface that will integrate the capabilities of these differing systems with any type of verifiable success. Mr. Morrison, when asked about this at the time of the Washington cost docket, was also not aware of any company that has successfully integrated these systems together. These systems simply do not work as described by Mr. Morrison. Many CLECs have attempted to implement them and found trouble with their capacity to handle large amount of orders and integrate with existing systems. They certainly do not eliminate a large amount of manual activity and they require constant review of the accuracy of any internal system updates. Given all these flaws, it seems inconceivable that this software would help reduce manual activity at a company as large as Qwest. Furthermore, without evidence from Mr. Morrison that successful integration has been achieved in actual field conditions, I find his claim of pending system integration unrealistic and unsupported.

B. TASK TIMES

Q. MR. MORRISON ASSERTS THAT AN EXPERIENCED TECHNICIAN WOULD NOT HAVE TO VERIFY EVERY PIECE OF INFORMATION RELATIVE TO A JOB. ARE HIS ASSERTIONS CORRECT AND IF NOT, WHAT WERE YOUR EXPERIENCES AS A TECHNICIAN?

A. While the fundamental tasks of a certain type of order may be repetitive, this in no way eliminates the need for an experienced technician to review and verify each aspect of a specific job. What is the address of the FDI? Do I have to place cross-connects at the FDI in order to connect feeder and distribution facilities? Are the cable counts labeled correctly in the FDI – is the pair assigned on the order going to work? What, specifically, is the end user requesting and what type of access arrangements were established during the order taking process?

C. LOOP CONDITIONING

Q. MR. MORRISON COMMENTS, ON PAGES 32 – 36 OF HIS DIRECT TESTIMONY, ON QWEST'S ABILITY TO CHARGE FOR LOOP CONDITIONING. WHAT IS QWEST CURRENT POSITION ON CHARGING FOR LOOP CONDITIONING?

A. Qwest presented CR #022403-2 as part of the Change Management Process ("CMP") on February 24, 2003 proposing to discontinue charging for loop conditioning for a yet to be determined period of time. This CR was implemented on April 15, 2003. Any CLEC requesting loop conditioning after April 15 will not be assessed a conditioning charge until further notice.

Q. IF A CLEC'S REQUEST TO CONDITION A LOOP AFFECTS THE END USER'S VOICE SERVICE, WILL THERE BE A CHARGE TO "RE-CONDITION" THE LINE?

A. Yes there would be a charge for the rework. It is up to the CLEC engineer to determine if the physical characteristics of the loop will meet the technical parameters of the data services they are providing to their end user. As such, if a loop is conditioned at the CLEC's request, Qwest does so with the understanding that the CLEC has done its engineering and design work to ensure that removal of load coils from the loop will not jeopardize the integrity of the voice service.

The approved CMP CR #022403-2 states: "Once CLEC/DLEC/Reseller Conditioning has been requested and performed, if the end-user's Voice Grade service is degraded beyond Voice capability, the necessary Load Coils will be restored and the CLEC who requested the conditioning will be billed for this restoral."

Q. BY IMPLEMENTING CR#022403-2, IS QWEST CONTENDING THAT THERE IS NO COST ASSOCIATED WITH CONDITIONING A LOOP?

A. Certainly not. The fact is, any time Qwest dispatches a technician to the field to add or remove elements from the network, there is a cost associated with the work activity. I have been on numerous jobs where it takes at least 4 hours to remove one load from a single pair/loop due to set-up, purging and gaining access to the pair. Now consider an average of three load coils on a loop extending 18Kft in length, it is reasonable to take up to a day and a half to finish this type of work.

D. COLLOCATION

1. INTERMEDIATE DISTRIBUTION FRAMES

Q. BEGINNING ON PAGE 37 OF HIS DIRECT TESTIMONY, MR. MORRISON BEGINS TO DISCUSS HOW USE OF AN INTERMEDIATE DISTRIBUTION FRAME ("IDF") IS NOT IN THE BEST INTEREST OF THE CLECS. DO YOU HAVE ANY THOUGHTS ON HIS ASSERTION?

A. Mr. Morrison's qualifications and central office background should make him very aware of the benefits of implementing an IDF within a central office. In fact, it is an integral frame in the Bellcore design when a COSMIC™ is installed. The IDF is intended to alleviate congestion on the COSMIC™ frame. This is also a configuration used in AT&T's drawings of their collocation layouts but they use a different term - Point of Termination ("POT") frames. Whatever the name, the fact is both provide the same functionality. Today these frames are used by Qwest, other ILECs and CLECs alike as an efficient manner in which to traverse a central office with tie cables, reduce cross connect activity at other frames and relieve congestion at the main distribution frame ("MDF") or COSMIC™ frame.

Q. MR. MORRISON ASKS THIS COMMISSION TO PHASE OUT INTERMEDIATE FRAMES. DON'T CLECS IN SOUTH DAKOTA ALREADY HAVE AN OPTION AVAILABLE TO THEM OF CONNECTING DIRECTLY TO THE MDF OR COSMIC™ FRAME?

A. Yes. Qwest allows CLECs to choose between placing its terminations on an IDF or having direct connections to the COSMIC™ frame or other frames. Eliminating the rate element for IDF would limit CLECs' choices for collocation methods.

Q. GIVEN YOUR HISTORY WITH COLLOCATION ON BOTH THE ILEC AND CLEC SIDE, WHAT IS YOUR OPINION ON THE PRACTICALITY OF ELIMATING USE OF AN IDF?

A. Eliminating the IDF concept would drive additional upfront cost into a CLEC's request for collocation. During my assignments as the Collocation Group Lead and then President of a facility based CLEC, I was able to determine that the tie pair utilization percentages would be far greater in a shared frame (IDF) environment rather than a dedicated or direct connection scenario. Let me explain further. When requesting a direct connection, the

CLEC is responsible for the tie cables between its collocation equipment and the MDF or COSMIC™ frame. Assume, for this example, that the CLEC is marketing to a company with a high percentage of facilities working in a single module of the COSMIC™ and once those CLEC tie pairs are occupied on that module and perhaps the module on either side of it, the CLEC must order a tie pair augment which would entail placing additional facilities across the COSMIC™ again. **(Exhibit DP-REB2)** Eventually, some modules will have far greater utilization than others and this disparity will lead to a smaller percentage of utilization overall.

Conversely, when tie cables are terminated at an IDF – the shared environment – the CLEC has ultimate control over assignment and utilization of their tie pairs and sections of the cables do not fill prematurely while others go unused. More importantly, direct connections between the collocation and the MDF require the CLECs pay for all terminations up-front. Connecting to a shared IDF only requires fractional up-front payment and then payment as you order each termination to the unbundled loop.

2. BATTERY DISTRIBUTION FUSE BAY ("BDFB")

Q. DO YOU HAVE ANY CONCERNS WITH MR. MORRISON'S BDFB CONFIGURATION?

A. In general, BDFBs are used to distribute power throughout the office to both CLEC collocated equipment and Qwest equipment. The BDFB configuration depicted in Mr. Morrison's exhibit SLM_005 fails to consider that a "combination" BDFB might more efficiently serve all the equipment in a central office as compared to his proposal to place a second BDFB simply to provide short cable lengths to collocation sites. South Dakota specific information along with the information in Exhibit SLM_005 can make my point. There are currently 16 collocation sites spread out among Qwest's 42 central offices in South Dakota. Collocation exists in six of those offices and there is an average of 2.7 collocations per office. If you assume that each CLEC uses 60 amps per collocation, there would be a total of approximately 162 amps used in each office. Placing an additional 600 amp BDFB be unwarranted if capacity existed on the "combination" BDFB. The underutilization derived from this suggested architecture would directly conflict with a majority of Mr. Morrison's testimony as well as Qwest goal to achieve more efficient use of its network. Any power cable savings achieved through Mr. Morrison's proposal would be offset by the additional cost of the new BDFB with lower utilization.

Q. DO YOU HAVE ANY OTHER ISSUES WITH MR. MORRISON'S PROPOSALS PERTAINING TO PLACEMENT OF THE BDFB?

A. Yes. Mr. Morrison is asking this Commission to disregard the efficient placement of a BDFB to serve all the equipment in the central office and move it to a location where it efficiently serves only the lucky few that surround it or in the case of only 2.7 collocations per central office, placed next to it. As demonstrated, the new BDFB, in his exhibit, is placed adjacent to the six cages thereby minimizing the lengths of the cables supplying power to "only" those cages. These six Collocators receive the benefits of reduced costs resulting from the reduction in power cable lengths due to the placement of the BDFB. The shorter power cables may lower their overall cost but will increase the cost of serving other collocators and Qwest equipment. While its placement will certainly benefit those six collocators in his example, all other power cables serving areas other than these specific collocation cages will be much longer resulting in additional costs as noted in Mr. Morrison's testimony. Mr. Morrison's argument ignores that an efficient carrier will place the BDFB to serve all the differing types of equipment in a particular areas of the central office. In this real world scenario, a request for collocation at a later date would result in a longer length of power cable from the existing BDFB unless Mr. Morrison is suggesting that the CLEC will also pick up the cost of placing a new BDFB in addition to the shorter cable length.

3. SECURITY CHARGE

Q. PLEASE DESCRIBE WHY SECURITY IS CONSIDERED A PHYSICAL COLLOCATION ELEMENT AND THEN THE STEPS THAT A CLEC MUST FOLLOW TO HAVE A BADGE ISSUED.

A. For the protection of the network and to ensure service quality, Qwest has restricted central office access to employees and authorized contractors only.

With the implementation of physical collocation, CLECs need access to their collocated equipment within Qwest's central offices; therefore, access is granted to CLEC employees and their contractors as well. The same access to Qwest central offices will be provided to CLEC technicians as is provided to Qwest technicians. That is, Qwest has deployed electronic card readers at central office entrances that, when activated by a technician's ID badge will unlock the doors and allow entry. It is necessary for CLEC employees who require access to the central office to go through a security check before they are issued ID Badges. This security check is part of the physical collocation request process. The security check generally takes three to ten days, and it involves CLECs e-mailing the appropriate access e-mail form to ICCBadge@qwest.com group. The access group pulls the e-mails and verifies that each CLEC is operating under a valid interconnection agreement. This group also does a background check. The security group completes the background check and forwards either an approval or denial back to the physical access control group. The physical access control group e-mails the CLEC with the status of its access card application. In addition to advising the CLEC of the status, the physical access control group also distributes the information to the local access control center. The local access control center processes the e-mail, creates the badge and mails the access card/cards to the CLEC. The local centers are in seven different locations within Qwest's territory. Qwest's collocation cost studies include costs for these essential security steps.

Q. MR. MORRISON'S TESTIMONY CRITICIZES THE AMOUNT CHARGED BY QWEST FOR SECURITY WHEN A CLEC SEEKS ACCESS TO A QWEST CENTRAL OFFICE. CAN YOU COMMENT ON THIS ISSUE?

A. The Qwest cost study shows a rate of .94 cents per card issued on a recurring basis and $8.73 recurring per card for each office where access is requested. These charges are reasonable considering what is involved in implementing a system capable of tracking the entry of hundreds of personnel 24 hours a day, seven days a week. Qwest has one Full Time Employee and a support group of 12 others who spend time working issues relating to central office access across the region. This group produces monthly reports which track and monitor which individuals have access to which offices based on the status of their access badge. In addition Qwest must incur the cost of a card reader, which includes a controller (LNL2000) in each central office that links back to a server in Denver, Salt Lake City or Omaha. Each of these servers ties back to a common database system in Denver. Other costs include the wiring between each reader and the Lenel 2000 panel and the labor associated with the installation of the entire system. The Lenel panel is the controller for the card reader. Qwest budgets approximately $7,000 per office for all of the above labor and equipment and allocates an additional $3,000 per central office entrance for each additional reader.

Q. DID THE FCC RECOGNIZE SECURITY AS A NECESSARY REQUIREMENT FOR PHYSICAL COLLOCATION?

A. Yes. The FCC's orders and related rules recognize the importance of protecting the public switched network. The FCC's rules state:[1]

> *"As provided herein, an incumbent LEC may require reasonable security arrangements to protect its equipment and ensure network reliability. An incumbent LEC may only impose security arrangements that are stringent as the security arrangements that incumbent LECs maintain at their own premises for their own employees or authorized contractors. An incumbent LEC must allow collocating parties to access their collocated equipment 24 hours a day, seven days a week, without requiring either a security escort or any kind or delaying a competitor's employees' entry into the incumbent LEC's premises..."*

The security access arrangements for CLECs' employees or contractors are the same as the access arrangements used for Qwest's employees and contractors. In addition, since the September 11 terrorist attacks, there has been a heightened concern for the security of the public switched network, which only reinforces the need for background checks and the security measures that Qwest has in place.

4. QUOTE PREPARATION FEE

[1] See 47 C.F.R. § 51.323(1)(2)(i).

Q. MR. MORRISON EXPRESSES DOUBT ABOUT THE TIME ESTIMATED FOR RESEARCH AND EVALUATION OF A COLLOCATION APPLICATION COVERED BY THE QUOTE PREPARATION FEE ("QPF"). CAN YOU PLEASE COMMENT ON HIS CONCERNS?

A. It is important to understand that the fee assessed for a QPF consists of numerous steps involving six different departments. The process begins in the Collocation Project Management Center ("CPMC") receipt of the collocation application and progresses to down stream groups once certain work steps have been completed. Also included in this work are the OSP planning and engineering group, field engineering, Common Systems Planning ("CSPEC"), real estate and transmission engineering. Each of these workgroups, and the work steps they conduct are described in the following portion of my testimony.

Q. PLEASE BREIFLY DESCRIBE EACH OF THE SIX DIFFERENT DEPARTMENTS THAT ARE INVOLVED IN RESEARCHING AND EVALUATING A COLLOCATION REQUEST AND DESCRIBE THE WORK COMPLETED AT EACH STAGE.

A. **Collocation Project Management Center ("CPMC") (referred to in the cost study as the Infrastructure Availability Center (IAC)** – This group is responsible for reviewing all of the information on the 12-page application. If the application is incomplete, discrepancies are identified or if the CPMC team has questions about the types of equipment being collocated in the central office, this team will contact the CLEC to resolve these issues. Once the application is complete, the CPMC will determine the appropriate internal contacts in engineering, CSPEC and real estate and notify them of the pending request. At the same time, the CPMC is making copies of the order for distribution to these internal contacts for a kick-off meeting. The completed application is then logged into the tracking database and all applicable critical dates are assigned. At the CLEC's request, a "48-hour meeting" is held (within 48 hours of receipt of the application) to review the request, answer questions, identify and resolve any issues. Parties to this call include CSPEC, Product Management, CPMC, Project Manager, a network representative and an account team representative.[2] At the conclusion of this meeting, corrections/modifications are made to the application, if needed, and it is distributed to the Single Point of Contact ("SPOC") in each department. Each department then evaluates the time frames and verifies if they can be met or whether escalation is needed. Finally, there is a letter put together for the Wholesale Project Manager summarizing the application and its timeline.

Outside Plant ("OSP") Planning and Engineering – This group of engineers is responsible for determining the best location for the Collocation Point of Interconnection ("C-POI") and the infrastructure that either exists or needs to be placed in order to accommodate a CLEC's entrance facility into the Qwest Central Office ("CO"). Planning must be made for conduit, inner duct and spare

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[2] In the cost study, these are referred to as Product Management Implementation and IAC.

fiber for splicing to the CLEC fiber. Upon determining infrastructure availability, a decision is made on the exact configuration (dual or single entrance; express or shared fiber entrance). Once these decisions have been made, this group arrives at a preliminary cost and quote for the work to be performed.

Field Engineering – The field engineer is actually the eyes in the field. This group is responsible for traveling to a central office to review what the planner has drawn compared with the actual field conditions and verify the C-POI location and the feasibility of building the collocation as drawn. Field engineering also schedule markings of other facilities in the area to determine if they pose a problem to the planned activity. If Right of Way (ROW) is an issue, this group arranges and secures ROW. Most importantly, this group verifies that infrastructure such as spare ducts, fiber and the path between the C-POI and the vault that marked spare and "usable" in the records are actually available and undamaged in the field. Their findings are provided back to the OSP planner and, if required, records are updated to reflect new information.

Common Systems Planning Engineering Coordination Group ("CSPEC") – This group is responsible for all central office planning. They evaluate the location and review floor and ceiling loading capabilities along with support systems such as heating, ventilation and air conditioning (HVAC). The CSPEC creates a common planning document ("CPD"), which is an expansive list of materials specifically for a particular collocation. Central office space is evaluated and space is selected for the collocation equipment. Each site requires power and this group also determines, based on CO layout and CLEC needs, if the power will come off of a BDFB or from the power distribution board. There is also a need to determine the route that the power will take across the CO and the amount of racking that will be required in order to make it between these different points. Racking will also be required for tie cable capacity and the fiber feeding the CLEC's collocation equipment. Once this work is completed, the group updates and completes the CPD and draws up the Design Work Package ("DWP").

Real Estate – This group is responsible for the project management of the collocation build-out within the Qwest central office. If additional environmental conditioning is required, this group is responsible for its implementation.

Transmission/Collocation Engineering Group – This group reviews the request and prepares cost for the CPMC. They conduct a walk-through and load all of the information into COE-FM. Upon completing the loading of the information into the system, job feasibility and a quote is prepared for the CLEC including systems quotes.

Q. YOU HAVE BEEN CLOSELY INVOLVED WITH COLLOCATION SINCE ITS INFANTCY. IN YOUR PROFESSIONAL OPINION AND

EXPERIENCE, DOES IT ACTUALLY TAKE THIS MANY WORK STEPS TO ARRIVE AT A QUOTE FOR A CLEC REQUESTING COLLOCATION?

A. Yes it does. By working through a multitude of collocations first as a state Interconnection Manager, collocation team lead and then Director of the Wholesale Product organization, I am well aware that collocation touches many facets of the network and that with a network the size of Qwest's, it requires the involvement of many groups with specific disciplines. The inputs provided to come up with the QPF in the collocation cost study are reasonable and accurate and align with my experiences.

Q. IN READING MR. MORRISON'S TESTIMONY, HE PAINTS THE PICTURE OF ONE PERSON WORKING THE COLLOCATION APPLICATION FROM RECEIPT TO QUOTE. IS THAT AN ACCURATE DEPICTION?

A. No. As stated earlier, the collocation process touches many different groups internally at Qwest. Some of the processes are sequential, while others are parallel. Some of the tasks can be worked on the same day within different groups while others require completion of a single step before moving on to the next step. Multiple persons spend an extended period of time working on a single job. Qwest is measured on its ability to meet very specific time frame for responding to a request for collocation and performs at a very high level. There are multiple resources focused on a single request in order to make those time frames and keep our commitment to the CLEC community.

5. FLOOR SPACE CHARGE

Q. WHAT HAS BEEN YOUR PAST EXPERIENCE WHEN RESEARCHING THE COST OF COLLOCATION SPACE BOTH WITHIN AND OUTSIDE OF A QWEST CENTRAL OFFICE?

A. The monthly recurring rate in South Dakota as of July 2, 2003 is $2.75 per square foot. Mr. Morrison's research into the space leasing issue fails to identify or acknowledge rates charged by other companies offering the same type of conditioned space that Qwest is offering CLECs today, which I will refer to as "technology" space. Class A, B, and C types of space are generally administrative space in nature, which differs greatly from the equipment space within a central office. Regular office (i.e., administrative space) is wholly unsuitable for use as space for central office equipment (i.e., "technology space").

Technology space, and the cost associated with it, depends on several factors – perhaps most important is how "hard" the building is. Floor load rating requirements far exceed those of administrative space, as does the general infrastructure requirements such as power, services and HVAC. During a past meeting I had with Collo.Com, a company specializing in collocation leases, the Manager of that site stated that the construction cost of their technology space cost between $225 - $275 per square foot to build. Turner Construction was the company responsible for building the Collo.Com facilities and its project manager validated the per square foot amount. It is my expectation that the cost of constructing technology space in South Dakota would be similar to the amounts experienced in the past in other states.

IV. REBUTTAL OF TIMOTHY J. GATES TESTIMONY

A. NETWORK ASSUMPTIONS

1. REPLACEMENT NETWORK

Q. WHAT IS YOUR GENERAL UNDERSTANDING OF BUILDING A REPLACEMENT NETWORK UNDER A TELRIC METHODOLOGY?

A. Quite simply, it is the replacement of the network components from the central office to the end-user using the most efficient technology actually available to an ILEC today. The FCC's First Interconnection Order[3] discusses wire center locations staying the same while the local network is reconstructed. Mr. Gates cites the FCC's Inputs Order and quotes the FCC as saying that "[I]t is also necessary to assume that the telephone industry will have at least the same opportunity to share the cost of building plant that existed when the plant was first built." Under the scorched node concept, opportunities for sharing,

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3 The First Report and Order, "In the Matter of Implementation of the Local Competition Provisions of the Telecommunications Act of 1996," CC Docket No. 96-98, ("First Interconnection Order"), FCC 96-325, Rel. August 9, 1996, ¶ 685.

especially during the time when plant is newly constructed, remains as limited today as it was in the past.

2. STRUCTURE SHARING

Q. MR. GATES TAKES ISSUE WITH QWEST'S 5 PERCENT SHARING FIGURE WHICH IS REFLECTED IN QWEST'S STUDY FOR UNDERGROUND. PLEASE COMMENT ON YOUR EXPERIENCES AS A TECHNICIAN FOR QWEST.

A. In all my years as an Outside Plant Technician, Cable Repair and Network Technician, I have never observed or placed another utility's facilities along with telecommunications facilities within the underground conduit system that originates at the central office and connects the vast Qwest manhole system. Due to the inherent danger of mixing electrical lines with other utility's facilities or utility's manhole, especially one that is known to be a collection point for differing gases, I would be surprised if it was a practice that was widely used today. I am of the opinion that the sharing percentage used in the Qwest cost study is very conservative, i.e., over estimates the amount of sharing that would actually occur. I base this opinion not only on my professional experience and observations made during my time in the field but on the fact that when you walk from street to street around many of the cities in which we live, you do not observe a single manhole cover containing all facilities but multiple utility holes denoting telephone, electrical, sewer and CATV. Since each utility hole is marked individually, I would have to draw the conclusion that these differing networks infrastructure was constructed for the sole use of each company's facilities.

Q. ISN'T IT TRUE THAT QWEST HAS LEASED INNERDUCT SPACE TO OTHER PROVIDERS IN ORDER FOR THEM TO EXTEND FACILITIES TO SOME NUMBER OF END USER CUSTOMERS?

A. Innerduct leasing has taken place in the past and continues to take place today however; one should not confuse leasing of an individual Innerduct with structure sharing. The comparison would be similar to building of an apartment complex vs. renting one of the units. While one party assumes all the risk and expense of building the structure, a renter only pays for a prorated portion of the structure they are living in or renting. While at TESS Communications, we planned on utilizing Qwest's inner-duct to connect our facilities between the Qwest CO, and our collocation equipment, and a TESS Feeder/Distribution Interface ("FDI") within a development. However, placing facilities in this manner proved cost prohibitive and we were able to conserve cash by leasing the same type of facilities, from Qwest, between these same locations. The only true way that Qwest will see a marked increase in "sharing" of the underground systems is if more truly facility-based companies go into business. I am of the opinion currently, and the capital markets sustain my opinion, that true facility based competition in the telecommunications sector is not occurring at the rate the FCC had envisioned and at these present levels, a sharing percentage of even 5% appears to be very generous.

Q. ARE THERE ANY OTHER REASONS WHY MR. GATES' PROPOSED STRUCTURE SHARING PERCENTAGES ARE UNREALISTIC?

A. When considering a build under the "scorched node" concept, in which only the central office remains in place and all plant is to be replaced, it is reasonable to assume that Qwest would experience obstacles that would not be experienced in a "green field" scenario, which doesn't have real-world obstacles like streets, sidewalks, and other facilities. In fact, this would be more the rule than the exception. The direct result of having existing obstacles is higher placement costs resulting from alternative placement methods, *e.g.*, directional boring. Both Qwest and AT&T Broadband relied heavily on directional boring as network expansion and upgrades took place during the mid to late 1990s. The existences of obstacles that any company would experience during network expansion or modernization requires economic decisions of this nature. The recommended boring percentages contained in the chart on pages 28 and 29 of Mr. Gate's testimony do not recognize the fact that companies building in the existing environment will encounter obstacles and should be rejected, therefore, as unrealistic.

Q. MR. GATES DISCUSSES LOCAL MUNICIPALITES AND THE COORDINATION THAT TAKES PLACE TO MAKE SURE THE

STREETS ARE ONLY DUG UP A SINGLE TIME. WHAT IS YOUR EXPERIENCE IN THIS AREA?

A. In my experience, this does not happen. In fact, anyone that has driven around a central office in many of Qwest's cities has been rerouted to accommodate the construction schedule of multiple CLEC companies as they expanded their networks into the Qwest wire center can confirm this. Nor am I aware that one CLEC would wait for another CLEC in order for both to be able to gain access to a central office (and the customer base) at the same time. This would seem to be contrary to the competitive advantage of the CLEC that is first ready to attack the market. The simple fact is that different CLECs have/had different deployment schedules that have not allowed for sharing of construction activities and an individual only has to travel these roads frequently to experience the lack of coordination that actually took place during the construction phase of those jobs.

Q. IS STRUCTURE SHARING MORE PREVALENT IN THE PORTION OF THE NETWORK BEYOND THE UNDERGROUND SYSTEM?

A. In my experience, while the opportunity for sharing may be greater once you leave the underground system, it certainly is not at the levels advocated by Mr. Gates. As stated in earlier testimony, the sharing percentage in Qwest's underground conduit systems is almost non-existent due to the nature of where different facilities originate meaning that it is unlikely to have the telecommunication, CATV, electrical, sewer, gas and water all originate from a common point. Because of that, the opportunity to share facilities in those areas nearest their point of origin is very limited. Mr. Buckley presents two examples of the experience of facilities-based companies constructing plant is in his testimony – the first is Dakota Cable and their experiences as they rebuilt the Bismarck, North Dakota cable television network. That company was only able to share approximately 2% of the time. The second is the experience of AT&T as related by its legal counsel to the Utah Commission on October 22, 2002.[4] Both examples further substantiate the fact that while sharing may occur, the opportunities are limited at best.

Q. MR. GATES ALSO SUGGESTS AN INCREASE IN THE AMOUNT OF AERIAL FACILITIES PLACED FROM 14% TO 20%. IN THE RESEARCH YOU HAVE CONDUCTED, IS THE PERCENTAGE OF AERIAL PLANT INCREASING OR DECREASING AND IF YOUR RESONSE IS DECREASING, WHAT IS THE CAUSE?

A. It has been my experience that a number of local municipalities have implemented rules governing the placement of aerial facilities even in those instances where aerial facilities are being replaced. First, from an esthetics standpoint, local communities find buried plant more appealing. Second, and probably more importantly, the opportunity for cable damage due to downed trees, hungry squirrels and garbage trucks is reduced dramatically if the facility is buried.

B. DROP STUDY

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4 See South Dakota Rebuttal Testimony of Mr. Richard Buckley at Pg. 3, Lines 4-6

Q. QWEST PROPOSES DIFFERING DROP LENGTHS DEPENDING ON DENSITY GROUPS. WHO, SPECIFICALLY, WILL BE PROVIDING COMMENT ON DENSITY GROUPS?

A. Mr. Buckley will address any issues associate with Qwest's designation of density groups and the drop lengths reflected within the cost study.

Q. DID QWEST CONDUCT A DROP STUDY IN SOUTH DAKOTA AND IF SO, WHAT WERE THE FINDINGS?

A. Qwest did not conduct a drop study in South Dakota but average drop lengths in other states with similar demographics would indicate that the footages suggested by Mr. Gates are unrealistically low. In both Wyoming and North Dakota, Qwest physically visited 1,356 sites and at each location, the Qwest technician was asked to pace off the distance between the pedestal and the house and then report that distance. The average length of a drop during this survey in North Dakota was 199 feet while in Wyoming it was 143 feet. **(Exhibit DP-REB3)** It is my opinion is that the measurements taken by the technicians in these states were conservative because by pacing off the distance between the house and pedestal, the technician was assuming a direct line between these two points (the shortest distance) when the drop could have taken a different route due to obstacles that may have been present at the time of placement. In addition, of the drops reviewed in excess of 500 feet, Qwest assumed only 500 feet and by folding this maximum assumption into the calculation, it make the estimate all that more conservative. I am not aware of any study conducted by Mr. Gates that would support the drop lengths that he advocates.

Q. DURING THE TIME SPENT AS AN INSTALLATION AND MAINTENANCE TECHNICIAN, DID YOU HAVE OPPORTUNITIES TO WORK AT LOCATIONS THAT WOULD HAVE FALLEN INTO THE DG-4 OR DG-5 DESIGNATION?

A. Yes. I had numerous opportunities to work in all of the density groups. My primary area of responsibility as an Installation and Maintenance Technician for approximately 18 months was the foothills area west of Fort Collins, Colorado. In my travels through South Dakota, it appeared to be very similar to the areas where I have installed services during this period of time. Many of the locations to which I was dispatched during my workday were on lots in excess of ½ acre and ranged up to ranches of several hundred acres. I was not aware of one homeowner that was concerned about where telecommunication facilities were placed let alone this being a determining factor of where their home was constructed. What I do remember is placing aerial drop for multiple spans in order to provide service to homes that were in many cases nowhere close to the road. Pole lines, in general, are constructed along county roads with easy access for pole setting and cable placement operations. It is up to the landowner to determine where the driveway is placed. In my experience, many times the physical structure is 2 – 3 spans away from the distribution pedestal. In such a case, additional poles are set in order to extend services to the structure.

Q. MR. GATES ADVOCATES THE PLACEMENT OF INDIVIDUAL DROPS TO STRUCTURES IN DENSITY GROUPS ("DG") 1 AND 2.

WHEN YOU WORKED AS A TECHNICIAN, WHAT DID YOU OBSERVE IN THOSE DGS?

A. In almost every case, the Multi-tenant dwellings are fed by black-sheathed cable – a 25 pair minimum that is a common architecture in structures in both DG-1 and DG-2. The cost and time associated with placing and terminating possibly 6-12 individual drops at a location is not a reasonable assumption when you understand what really occurs in the field.

C. DROP MOBILIZATION CHARGE

Q. MR. GATES, ON PAGE 73 OF HIS TESTIMONY, ASSERTS THAT THE MOBILIZATION CHARGE SHOULD NOT BE ALLOWED AS AN INPUT. WHAT DOES THE MOBILIZATION CHARGE COVER?

A. The mobilization charge covers the cost of a trip to the end user's premises if the trip is non-productive for reasons beyond Qwest's (or its contractor's) control i.e., where they cannot place the drop on their initial visit. Some likely examples of this are animals in the yard that did not allow access or firewood stacked up against the house covering the network interface device ("NID"), which also would deny access.

Q. MR. GATES MAKES THE ASSUMPTION THAT QWEST USES FULL TIME EMPLOYEES TO PLACE DROPS IN SOUTH DAKOTA. DOES QWEST USE EMPLOYEES OR CONTRACTORS TO PLACE DROPS?

A. Qwest typically uses contractors to bury drops in South Dakota. Qwest has attempted, at different times, to establish drop placement crews in South Dakota, however, it is more cost effective to use contractors and not maintain the expensive construction equipment and traveling crews. Also, with the importance placed on completing the daily load, Qwest made a business decision to allocate that work to contractors and focus Qwest resources for installation and repair completion. This approach is consistent with efficient engineering practices.

Q. NOW THAT YOU HAVE VERIFIED THAT QWEST USES CONTRACTORS FOR DROP PLACEMENT, SHOULD THE MOBILIZATION CHARGE STILL BE APPLICABLE FOR NON-PRODUCTIVE DISPATCHES?

A. Qwest's ability to assess a mobilization charge does not hinge on who is responsible for drop placement. When a truck is dispatched to a location to perform a work task, the act of rolling the truck and technician comes at a cost. While Qwest agrees with Mr. Gates that this does not occur often, there are non-productive dispatches so the mobilization charge should be considered a factor when considering drop placement costs.

D. DIGITAL LOOP CARRIER ASSUMPTIONS

Q. MR. GATES PROVIDES SEVERAL DOCUMENTS THAT DISCUSS HOW UNBUNDLED LOOPS CAN BE PROVIDED WHEN

DEINTEGRATING AN INTEGRATED PAIR GAIN SYSTEMS - INCLUDING GR-303. AFTER REVIEWING THESE DOCUMENTS, DO YOU HAVE ANY COMMENTS?

A. I found all the articles interesting but these pieces from DSC and PulseCom are nothing more than sales and marketing papers. Both of these companies potentially benefit when new opportunities are identified to sell new products. With the ILECs requirement to unbundle the network, they are attempting to create an opportunity to sell additional products. Their supposed remedy for accessing an unbundled loop does not eliminate the need for the ILEC to perform some degree of grooming – if fact, both articles specifically note "grooming of CLEC services" within the text. At the bottom of page 1 and continuing on page 2 of the PulseCom article it states "The LIU-403/2 can be used to groom ISDN, Special Services, and unbundled wire pair circuits more cost-effectively than Universal DLCs or other alternatives". Neither article explicitly states that grooming is no longer necessary if this type of equipment is purchased and implemented within the network.

Q. MR. GATES ASSUMES THAT BY USING GR-303 IT ELIMINATES QWEST'S GROOMING CHARGES. DOES MR. GATES TAKE INTO ACCOUNT THAT IDLC UNBUNDLING USING GR-303 REQUIRES A SINGLE DS1 HANDOFF FROM THE CENTRAL OFFICE MULTIPLEXER DIRECTLY TO THE CLEC COLLOCATION?

A. No. Mr. Gates does not acknowledge that the solution he touts may be cost effective for only those CLECs having a "critical mass" of subscribers served by the remote terminal, i.e., 24 subscribers to a virtual interface group ("VIG") so that the CLEC can efficiently purchase a DS-1 running from the FDI to the collocation point. He simply targets the Qwest "grooming charge" associated with deriving a single DS0 circuit out of an IDLC system.

Q. DO ALL CLEC CUSTOMERS HAVE THE SAME NEEDS AND REQUIREMENTS FOR CAPACITY?

A. No. Not all CLECs would have 24 subscribers out of a remote terminal. This is primarily why the industry has defined several configurations for loop unbundling, including the options Qwest proposes in its cost study. In fact, the advantages to grooming are realized if the CLEC is not fully utilizing a DS1. It appears that Mr. Gates is suggesting an architecture that assumes a "one size fits all" scenario.

Q. ARE GR-303 VIG GROUPS PROVIDED IN LIMITED NUMBERS?

A. Yes. As stated in a white paper written by David Ehreth of Westwave Communications, "GR-303 is not scalable for unbundling". **(Exhibit DP-REB4)** The original GR-303 standard assumed 8 VIG groups. However, no vendor, that I am aware of, has met this number. The Litespan system, for example, has only 4 VIG groups. Specifically, Qwest does not use GR-303 for unbundling because this architecture is not scalable beyond certain practical limits; the architecture does not have the capacity to handle the universe of CLECs. For this reason, the architecture that Mr. Gates is touring is not a viable option. Qwest simply cannot offer a service to some CLECs and not others.

Q. DID MR. EHRETH HAVE ANY OTHER CONCERNS THAT HE NOTED IN HIS WHITE PAPER?

A. There was a single paragraph, on page three of the white paper, that truly highlights the potential problems with what Mr. Gates is recommending:

> "A summary of the issues with using GR-303 as an unbundling tool reveals two major problems. First is the issue that GR-303 is not scalable for unbundling. Second, there are significant operational issues concerning shared databases that could lead to catastrophic system failures."

He continues later on the same page and states:

"Specifically, this architecture is not scalable beyond certain practical limits."

There are several reasons for this.

First, the amount of computing resources to manage the Q.931 resource is not infinitely expandable within a given remote terminal ("RT"). The second reason is that both of the TMCs on each interface group require a physical link to terminate the High-Level Data Link Protocol ("HDLC") used as the link-layer transport methodology. Each HDLC termination requires an allocation of physical space that reaches certain practical limits within the constraints of the RT and the central office terminal ("COT"). For example, if a COT were to service a chain of four remote terminals and each of these terminal was equipped with four interface groups, the COT would be required to manage 16 active and 16 stand-by data links to support 16 different service providers.

Note, however, that if a provider had subscribers on all of the RTs (such as an incumbent carrier) it would consume four of the 16 interface groups on the COT, leaving only 12 for other providers. If a second provider (say CLEC-A) also had subscribers on all of the RTs, if would consume four more interface groups on the COT as well. That would leave only eight interface groups. If CLEC-B and DLEC-1 have subscribers on all the RTs, these four providers would consume all 32 data links.

If there were subscribers to a fifth service provider, these stranded subscribers could only be made available on a "universal interface." A universal interface has a 1:1 mapping or connection between a subscriber terminal and a trunk circuit in an "always connected" mode. This defeats the purpose of GR-303, which is to eliminate the high cost and low efficiency of the universal mode.

Q. DOES MR. GATES UNDERSTAND THE COST RAMIFICATIONS OF UTILIZING, AND/OR CREATING A VIG WITH GR-303?

A. It does not appear from Mr. Gates testimony that he has considered the costs associated with building VIGs between each remote terminal ("RT") and the CLEC switch. By creating a VIG, the CLEC is using a full T1's worth of bandwidth between each RT and the CLEC collocation. In addition, the CLEC is basically using 25% of the capacity of the time slot interchanger ("TSI") and 1/84th of the capacity of the OC3 feeding the system.

Q. IS THERE GROOMING THAT OCCURS IN THE GR-303 ARCHITECTURE?

A. Yes. While a product has not been defined nor priced to offer this type of unbundling, the fiber between the central office and the RT must go through an electrical to optical ("E/O") conversion and then be multiplexed down to the DS1 level and ultimately down to a DS-0 level. This is ultimately the same thing as DS1 to DS0 "grooming." Both architectures require electronics to hand it off at the DS1 or DS0 level. So, Mr. Gates' argument is really a moot point. If Qwest were to deploy GR-303 across the network, the need to groom individual loops out of the system would remain.

Q. WILL THE GR-303 ARCHITECTURE MR. GATES DISCUSSES DECREASE THE NEED FOR A CROSS-CONNECT AT THE TSI?

A. No. Just because the CLEC has a VIG assigned to it does not mean it can move a customer to its own VIG. This is done through the element management systems ("EMS"). The EMS associated with these Next Generation DLCs are not partitionable. In other words, the "brains" of the system are static meaning that they cannot handle multiple users. There are no vendors, that I am aware of, that provide a multi-carrier, partitionable EMS. Therefore, Qwest will still incur the labor cost associated with making cross-connects at the RT, through the use of a laptop computer at the RT, on the CLECs behalf.

Q. MR. GATES BASICALLY PROPOSES, ON PAGE 79 OF HIS TESTIMONY, THAT QWEST IMPLEMENT GR-303 IDLC SYSTEMS ACROSS THE BOARD IN SOUTH DAKOTA IN ORDER TO BE FORWARD LOOKING, COST EFFECTIVE AND EFFECIENT. IS THERE A FLAW IN WHAT HE IS SUGGESTING?

A. There are certainly two flaws that deserve further discussion. The first is that you must have a universal interface in order to provision non-switched service. A non-switched service is perhaps a Special Service Circuit or an unbundled loop. So without any form of universal interface, it would be impossible to provision the types of services that CLECs have been ordering for years. The second flaw seems to be a conflict in his direct testimony. Mr. Gates repeatedly speaks about least cost, forward-looking technology deployed in an efficient manner. The problem is, with the size of some of the wire centers in South Dakota, is would be impossible to use a system of GR-303 in an efficient manner – you simply do not have the large concentration of customers that would make efficient use of this type of system.

Q. ARE THERE OTHER ISSUES ASSOCIATED WITH THE GR-303 UNBUNDLING ARCHITECTURE?

A. Yes. There are a variety of other issues, including; provisioning, alarm reporting, sharing of test resources, etc., that are currently being addressed by the industry.

E. CONCENTRATION RATIOS

Q. KNOWING THAT QWEST DOES UNBUNDLE IDLC TO PROVISION UNBUNLED LOOP REQUESTS, MR. GATES THEN ARGUES THAT QWEST USES A CONCENTRATION RATE WELL BELOW THE EQUIPMENT'S CAPABILITIES. DO YOU KNOW WHAT CONCENTRATION RATE QWEST CURRENTLY USING?

A. In researching this issue I was able to ascertain and validate Mr. Gates' claim that Qwest currently uses a concentration rate of 4:1, which is an industry standard when considering call blocking rates. By deploying the IDLC in this manner, Qwest and its customers, both wholesale and retail are assured that calls within the network will be served efficiently while meeting these industry standards. Mr. Gates' proposal presents this Commission with a risk scenario. Mr. Gates is asks that the Commission risk service efficiency for a minimal reduction in transport costs. The cost savings of considering Mr. Gates' proposed 6:1 concentration will be discussed further in the testimony of Mr. Buckley.

V. CONCLUSION

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes it does.

Qwest.

Qwest Corporation
Docket TC01-098
Exhibit to Rebuttal Testimony of
Dennis Pappas
Exhibit DP-REB1

MEMORANDUM

DATE: **5/29/2003**

TO: **Dennis Pappas**

FROM: **Paul Zipps**

RE: **Remote Cross-Connect Systems**

Dennis.

The lab had reviewed a number remote cross-connect systems in late 1999 stemming from a request for product (RFP) that was issued to several vendors at that time. Due primarily to issues related to environmental hardening and spectral interference, The RFP selection process narrowed the respondents to a single vendor, CON-X Corporation.

Of the two unsuccessful submittals, Oki and Network Access Solutions (NAS), Oki's submittal was similar in technology to the CON-X product and required a much smaller (one third) the footprint but did not meet the environmental or the spectral interference requirements. The NAS product had similar limitations in the environmental requirements and, being a relay based platform, required manual intervention once its cross-connect matrix limits were reached.

The results of the evaluation found a number of engineering, operational, security and maintenance issues that were being addressed when the CON-X Corporation was purchased by the Krone Corporation. The subsequent acquisition resulted in the shelving of the CON-X cross-connect product and the loss of further coordination in the evaluation.

Qwest.

The CON-X 103 robotic cross-connect system was installed at a juncture point in the QITF labs Cable Test Field where it resides today. Since the product support was pulled, a number of access server software issues have incapacitated the system and plans have been made for it's removal within the next few months.

Due to the remaining open issues and the fact that the product and it's support was no longer available, the evaluation request was cancelled and no Lab report issued but, as stated earlier, the robotic systems proposed by met with a number of problems that have yet to be resolved including:

Engineering:

The system did not allow for more that a 3600 pair cross-box, consisting of three 1200 pair modules. Each module terminated 400 "IN" pair a 800 "OUT" pair with a finite number of inter-panel connections that required an engineering procedure similar to that used by COSMIC Meld assignments. In addition, unlike existing cabinets, this technology also required that the remote cross boxes be equipped with commercial power in order to supply the robotic systems.

Operational

Linkage between the MACSWare operating system and Qwests Legacy systems was still under development when the product was shelved and the evaluation halted. In addition to the lack of system inter-operability, there were issues with limitation in the number of cross-connections that were possible in high-density scenarios.

The ability of the system to make multiple cross connections in high temperature, typically greater than 90 degrees F, caused extensive delays due to the internal operational temperatures which automatically shut down the robotic mechanisms for varying periods of time.

Qwest.

Security

Security was a major concern due to Qwest's corporate plan to eliminate dial-up modem access to any network elements. In the case of the CON-X technology, each remote system required a local access number and was equipped with a v.90 modem for remote access.

Maintenance

The lack of local access and the potential failure of either the local access line the modem or the individual module controller was a concern. There were also a number of issues, primarily relating to broken cross-connect "pins" which caused a number of potential problems ranging from physical faults to "bridge-tap-like" conditions, which were difficult to identify and repair.

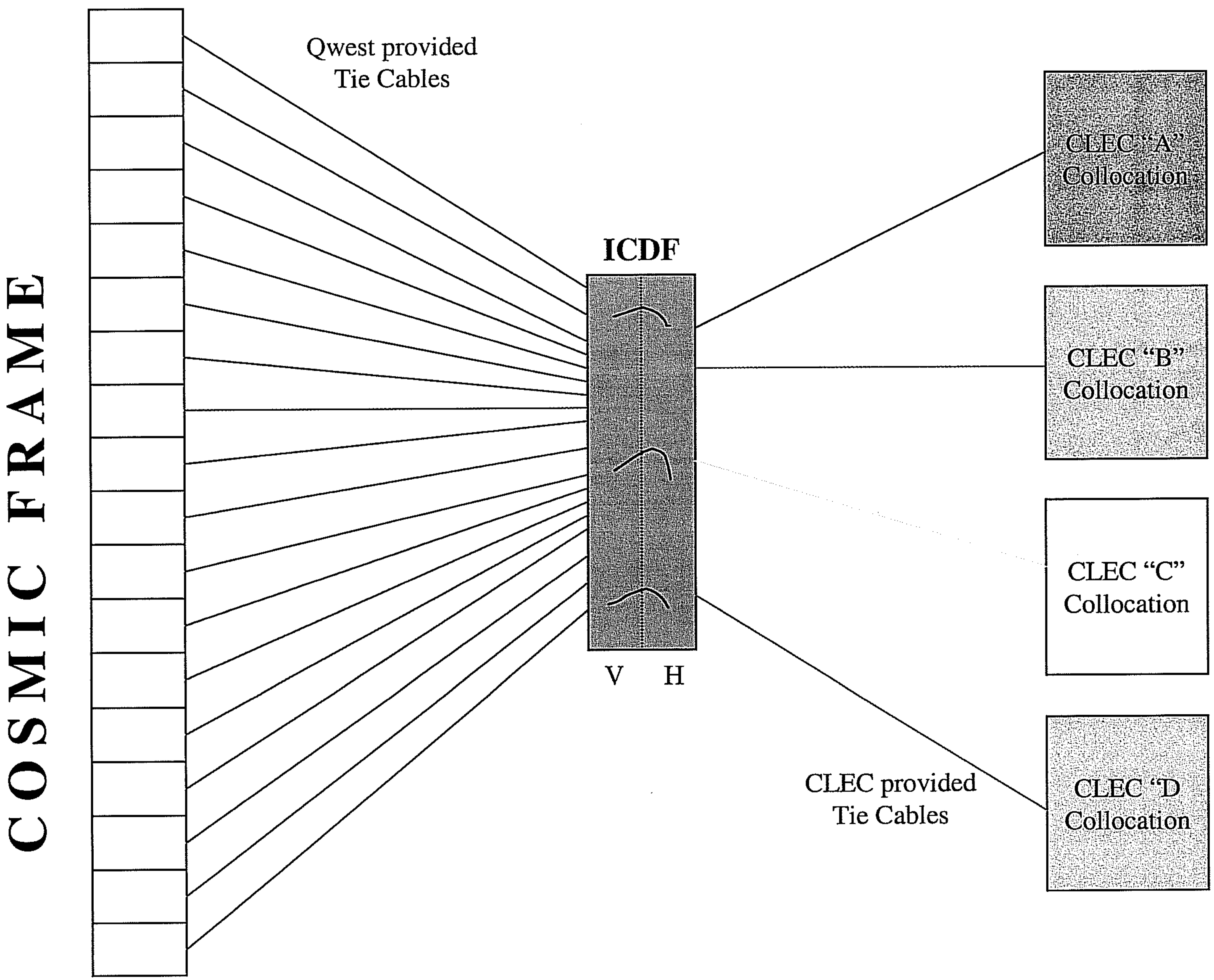
Paul Zipps

Staff Engineer - QITF Lab

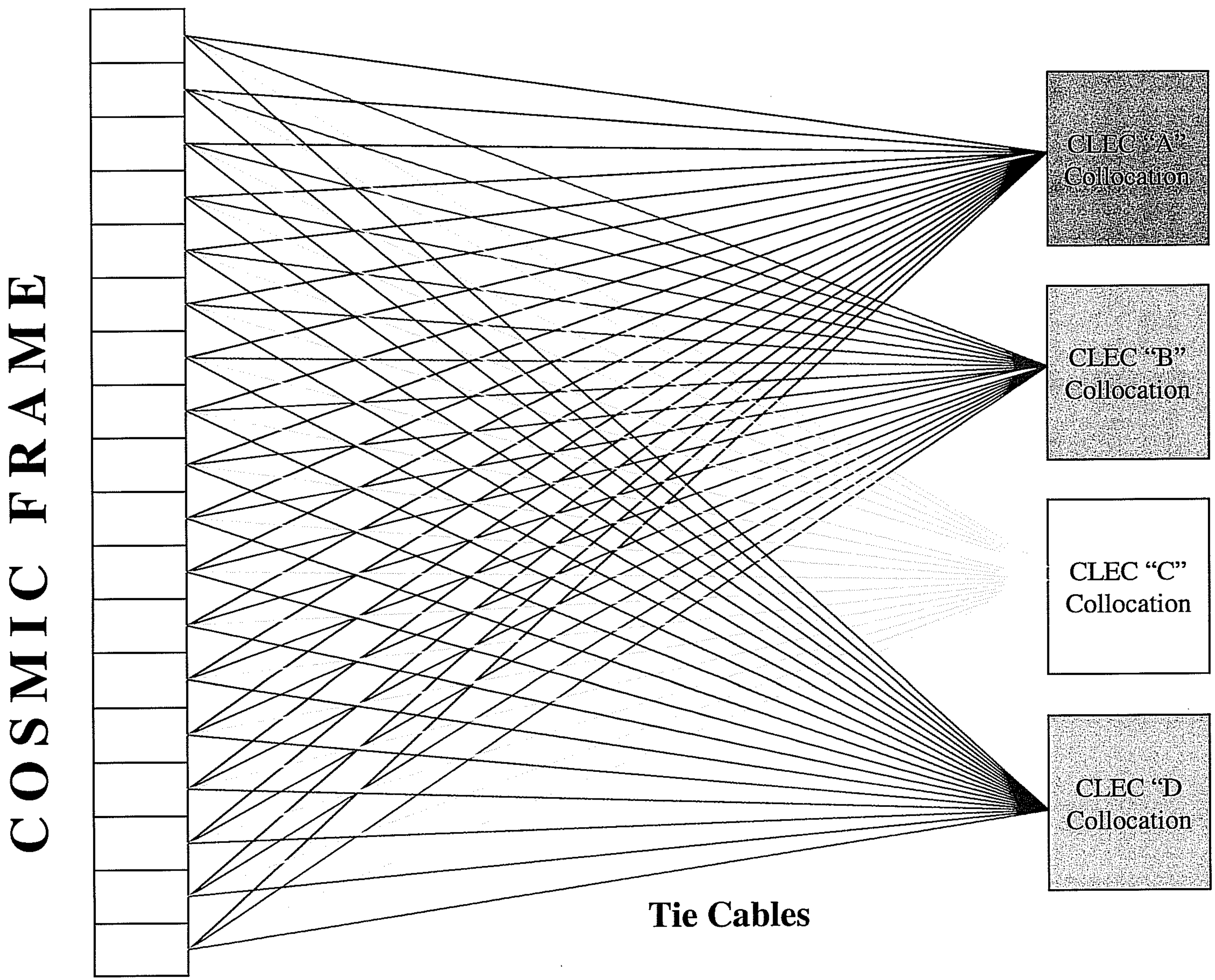
(303) 707-5510

Qwest Corporation
Docket No. TC01-098
Exhibit to Rebuttal Testimony of
Dennis Pappas
Exhibit DP-REB2, Page 1

CLEC Access to UBL with ICDF



CLEC Access to UBL without ICDF



Item	WIRE CENTER	ADDRESS	Drop Length	Lot Type	Aerial/Buried
1	701-227	123 SPRUCE	60	1	BURIED
2	701-227	1234 EUNCE	195	1	BURIED
3	701-227	1334 14 ST W	225	1	BURIED
4	701-227	1352 14 ST W	350	1	BURIED
5	701-227	1365 N ST W	150	1	BURIED
6	701-227	1776 PERIORA	200	1	BURIED
7	701-227	200-18 ST	1400	3	BURIED
8	701-227	205 20S W	290	1	AERIAL
9	701-227	243 60 ST	220	1	AERIAL
10	701-227	3055 100 AV W	655	2	BURIED
11	701-227	3611 LOKBOUGH	750	3	BURIED
12	701-227	4860 104 ROW SE	1400	3	BURIED
13	701-227	570 500 SW	290	1	BURIED
14	701-227	60114 ST SE	1000	2	BURIED
15	701-227	637 100 SE	240	1	BURIED
16	701-227	637 1ST NE	190	1	BURIED
17	701-227	648 2ND	110	1	BURIED
18	701-227	67775 34 ST	1500	3	BURIED
19	701-227	9881 PONORSA	200	1	AERIAL
20	701-343	INT	250	1	BURIED
21	701-343	LOT 56	200	1	BURIED
22	701-343	LOT 75	50	1	BURIED
23	701-343	RIBBON	300	3	BURIED
24	701-343	RURAL	9000	3	BURIED
25	701-343	317 EASTVIEW	200	1	BURIED
26	701-543	214 8TH ST	200	1	BOTH
27	701-543	319 BAKER	150	1	BURIED
28	701-543	514 6 AVE	75	1	AERIAL
29	701-575	1142 R100 SEC 21	15800	3	BURIED
30	701-575	12626 HWY	1550	2	BURIED
31	701-575	12757 39 ST SW	2656	3	BURIED
32	701-575	12851 39 R ST W	37754	3	BURIED
33	701-575	13497 36 ST SW	825	3	BURIED
34	701-575	205 2ND AVE NE	77	1	BURIED
35	701-575	206 1ST AVE NE	105	1	AERIAL
36	701-575	209 4TH ST SE	88	1	BURIED
37	701-575	227 N MAIN ST	120	1	AERIAL
38	701-575	304 HWY 85 N	580	2	BURIED
39	701-575	310 5TH ST	320	1	BURIED
40	701-575	3727 136 ST SW	235	2	BURIED
41	701-575	4245 127 R AVE SW	4463	3	BURIED
42	701-575	BELLE ND	460	3	BURIED
43	701-575	FAIRFIELD	280	2	BURIED
44	701-575	FAIRFIELD ND	310	2	BURIED
45	701-575	FRYBURG	2160	3	BURIED
46	701-575	FRYBURG	513	2	BURIED
47	701-587	803 LAUDREL	150	1	AERIAL
48	701-587	RURAL	226	3	BURIED
49	701-587	RURAL	5000	3	BURIED
50	701-645	5520 155 R NW	474	3	BURIED
51	701-772	2505 HANA	700	1	BURIED

52	701-775	2002 west st	175	1	BURIED
53	701-775	2618 CHERRY	150	1	BURIED
54	701-775	523 cannon view	100	1	AERIAL
55	701-775	612 4 ST S	75	1	AERIAL
56	701-775	678 LAKE VIEW`	100	1	BURIED
57	701-775	223 PARK	150	1	AERIAL
58	701-786	1221 ST NW	150	1	AERIAL
59	701-786	201 ST NE	100	1	AERIAL
60	701-786	315 2 AVE SW	200	1	AERIAL
61	701-786	3514 AVE NW	100	1	AERIAL
62	701-786	RURAL	226	3	BURIED
63	701-786	RURAL	10000	3	BURIED
64	701-786	RURAL	2500	3	BURIED
65	701-847	RURAL	2500	3	BURIED
66	BAKER	RR1 BOX 6	800	3	BURIED
67	BELFIELD	3425 128 AV SW	336	3	BURIED
68	BELFIELD	3525 127 R AV SW	292	3	BURIED
69	BELFIELD	3618 HWY 10 W	180	3	BURIED
70	BELFIELD	8080 126 R AV W	366	3	BURIED
71	BISMARK	101 W MAIN	52	1	BURIED
72	BISMARK	10201 HWY 10	1500	3	BURIED
73	BISMARK	105 DELAWARE	74	1	BURIED
74	BISMARK	1521 IMPERIAL DR	186	1	BURIED
75	BISMARK	1530 COLUMBIA	61	1	BURIED
76	BISMARK	1935 AND 1937 N 19	123	1	BURIED
77	BISMARK	2021 BOSTON DR	150	1	BURIED
78	BISMARK	209 PHEASENT ST	100	1	BURIED
79	BISMARK	224 APOLLO	132	1	BURIED
80	BISMARK	224 RENO AV	172	1	BURIED
81	BISMARK	2300 MORRISON	150	1	BURIED
82	BISMARK	2500 DOMINO DR	84	1	BURIED
83	BISMARK	3100 MANCHESTER	285	1	BURIED
84	BISMARK	3102 MANCHESTER	285	1	BURIED
85	BISMARK	3104 MANCHESTER	285	1	BURIED
86	BISMARK	3106 MANCHESTER	245	1	BURIED
87	BISMARK	333 E BRANDON	321	1	BURIED
88	BISMARK	357 S BRANDON	290	1	BURIED
89	BISMARK	3637 E REGENT	225	1	BURIED
90	BISMARK	3918ENGLAND ST	165	1	BURIED
91	BISMARK	4521 RIVERBEND	366	3	BURIED
92	BISMARK	4TH AND WASHINGTON	489	1	BURIED
93	BISMARK	5404 PONDEROSA AV	223	1	BURIED
94	BISMARK	600 S 9ST	177	1	BURIED
95	BISMARK	700 5TH ST NW	200	1	AERIAL
96	BISMARK	8200 ARCATA DR	161	1	BURIED
97	BISMARK	8601 SOUTH FORK	818	1	BURIED
98	BISMARK	8610 SAGEBRUSH	386	1	BURIED
99	BISMARK	8881 SIBLEY DR	208	1	BURIED
100	BISMARK	8950 LINCOLN RD	769	1	BURIED
101	BISMARK	9801 APPLE CREEK RD	238	1	BURIED
102	BISMARK	HWY 83 N AND BALDWIN	2291	3	BURIED
103	BRECK	224 9 ST S	90	1	AERIAL

104	BRECK	3008 GREAGOR	100	1	BURIED
105	BRECK	RR	500	3	BURIED
106	BRECKENRIDGE	122 N 12 ST	110	1	BURIED
107	BRECKENRIDGE	1240 BUFFALO	210	2	BURIED
108	BRECKENRIDGE	320 12 ST N	125	1	AERIAL
109	BRECKENRIDGE	320 DULUTH	105	1	BURIED
110	BRECKENRIDGE	3210 12 ST N	175	1	AERIAL
111	BRECKENRIDGE	618 2 5 ST	190	1	BURIED
112	BRECKENRIDGE	618 N ST S	190	1	BURIED
113	BRECKENRIDGE	711 S 7TH ST	75	1	BURIED
114	BRECKENRIDGE	724 35 ST S	50	1	BURIED
115	BRECKENRIDGE	RR	6000	3	BURIED
116	BRECKENRIDGE	RR	200	1	BURIED
117	BRECKENRIDGE	RR BOX 221	275	3	BURIED
118	CASSELTON	102 3 AV S	160	1	BURIED
119	CASSELTON	1052 2 ST N	156	3	BURIED
120	CASSELTON	106 3 AV S	130	1	BURIED
121	CASSELTON	110 3 AV S	100	1	BURIED
122	CASSELTON	112 3 AV S	185	1	BURIED
123	CASSELTON	15807 88 R ST SE	290	3	BURIED
124	CASSELTON	3521 151 R AV SE	1080	3	BURIED
125	CASSELTON	4385 162 R AV SE	94	3	BURIED
126	CASSELTON	631 8 AV S	100	1	BURIED
127	CASSELTON	642 8 AV 5	200	1	BURIED
128	CASSELTON	801 12 AV N	250	1	BURIED
129	CASSELTON	8151 150 R AV SE	157	3	BURIED
130	CASSLETOWN	15191 85ST SE	1590	3	BURIED
131	CASSLETOWN	15879 24 R ST	2680	3	BURIED
132	CHASETON	1024 FRONT	150	1	AERIAL
133	CHASETON	106 8 AV	150	1	BURIED
134	CHASETON	1556 8 R ST	450	2	AERIAL
135	CHASETON	2521 151 R AV	1120	3	BURIED
136	CHASETON	703 FRONT	550	2	AERIAL
137	CHASETON	8 6 AV NW	100	1	AERIAL
138	DICKINSON	1032 2 AVE E	88	1	BURIED
139	DICKINSON	1071 5 ST W	364	1	BURIED
140	DICKINSON	116 R AV SW	94	1	BURIED
141	DICKINSON	1625 MAIN ST	382	1	BURIED
142	DICKINSON	3465 R AV SW	200	3	BURIED
143	DICKINSON	847 26 ST W	300	1	BURIED
144	DICKINSON	9810 67 RS AZ	135	3	BURIED
145	DICKINSON	T139 R96 529	30	3	BURIED
146	DICKINSON	T140 T95 55	130	3	BURIED
147	EMARDAO	102 BRAWELL DR	170	1	BURIED
148	EMARDAO	1713 22ST	340	1	BURIED
149	EMARDAO	2254 21 AV	1644	3	BURIED
150	EMARDAO	DONALD ZATKE	415	3	BURIED
151	FAIRMONT	110 MILLON	100	1	AERIAL
152	FAIRMONT	203 FRONT ST	100	1	BURIED
153	FAIRMONT	304 M ILLION	90	1	AERIAL
154	FAIRMONT	9332 CO RD 7	600	2	BURIED
155	FAIRMONT	9340 CO RD 7	220	1	BURIED

156	FAIRMONT	9949 180 R AVE	800	3	BURIED
157	FARGO	102 N UNIVERSITY	50	1	AERIAL
158	FARGO	102 PRAIRIE WOOD DR	130	1	BURIED
159	FARGO	10308 6 ST S	320	2	BURIED
160	FARGO	10411 6 ST S	180	2	BURIED
161	FARGO	10412 6 ST S	180	2	BURIED
162	FARGO	107 OAK MANIR TRLR COURT	60	1	BURIED
163	FARGO	1102 S 49A	60	1	BURIED
164	FARGO	1104 43 AVE N	115	1	BURIED
165	FARGO	1109 5 ST AVE	120	1	AERIAL
166	FARGO	115 PRARIEWOOD DR	155	1	BURIED
167	FARGO	118 S 49A	100	1	BURIED
168	FARGO	1207 19 1/2 ST S	100	1	AERIAL
169	FARGO	1208 41 AVE N	95	1	BURIED
170	FARGO	1209 18 1/2 ST N	160	1	BURIED
171	FARGO	1214 41 AVE N	185	1	BURIED
172	FARGO	1220 76 AVE S	220	1	BURIED
173	FARGO	1221 8 ST N	160	1	AERIAL
174	FARGO	1222 433 AVE N	75	1	BURIED
175	FARGO	1329 16 ST S	95	1	AERIAL
176	FARGO	1338 10 AVE S	60	1	BURIED
177	FARGO	1338 9 AV S	100	1	AERIAL
178	FARGO	1339 13 ST SO	120	1	AERIAL
179	FARGO	13391 10 AVE S	60	1	BURIED
180	FARGO	1345 15 ST S	135	1	BURIED
181	FARGO	13669 ELM CIRCLE NE	20	1	BURIED
182	FARGO	1402 13 1/2	40	1	AERIAL
183	FARGO	1405 16 1/2 ST S	218	1	BURIED
184	FARGO	1405 S 16TH	100	1	BURIED
185	FARGO	1421 8 AV S	110	1	AERIAL
186	FARGO	1421 BONES	120	1	AERIAL
187	FARGO	1428 S 17	185	1	BURIED
188	FARGO	1429 10 AV S	90	1	AERIAL
189	FARGO	143 A PRARIE WOOD DR	280	1	BURIED
190	FARGO	1434 20 ST SW	90	1	AERIAL
191	FARGO	1436 4 AAVE N	85	1	BURIED
192	FARGO	1502 19 1/2 ST S	165	1	BURIED
193	FARGO	1524 9 AVE S	56	1	BURIED
194	FARGO	1530 16 1/2 ST S	100	1	AERIAL
195	FARGO	1531 5 AVE N	200	1	BURIED
196	FARGO	1532 4 ST N	140	1	BURIED
197	FARGO	154 PRAIRIE WOOD DR	340	1	BURIED
198	FARGO	1545 10 TH ST S	50	1	AERIAL
199	FARGO	1604 8 ST S	40	1	BURIED
200	FARGO	1604 S	75	1	BURIED
201	FARGO	1605 28 1/2 A ST	40	1	BURIED
202	FARGO	1610 88 AV S	255	2	BURIED
203	FARGO	1613 37 1/2	70	1	BURIED
204	FARGO	1613 AMERIACAN WAY SW	146	1	BURIED
205	FARGO	1703 ROSECREEK PRKWY E	225	1	BURIED
206	FARGO	17102 WEST ST	150	1	AERIAL
207	FARGO	1715 ROSE CREEK PRKWY E	230	1	BURIED

208	FARGO	1742 S 14TH ST	85	1	AERIAL
209	FARGO	1752 PRARIE LN	100	1	BURIED
210	FARGO	1755 ARK BLVD	85	1	BURIED
211	FARGO	1809 S 5A	90	1	AERIAL
212	FARGO	1813 17 ST S	100	1	BURIED
213	FARGO	1821 ROSE CREEK PRKWY	80	1	BURIED
214	FARGO	19 BRIARWOOD PL	310	2	BURIED
215	FARGO	1912 56 AVE S	110	1	BURIED
216	FARGO	1914 N 9	70	1	AERIAL
217	FARGO	1915 ROSS CREEK PRKWY E	85	1	BURIED
218	FARGO	1917 SS AVE	90	1	BURIED
219	FARGO	1922 ROSE CIRCLE PRKWY E	180	1	BURIED
220	FARGO	1927 ROSECREEK PRKWY E	165	1	BURIED
221	FARGO	1933 ROSE CREEK PRKWY	90	1	BURIED
222	FARGO	1946 ROSE GREEK PRKWY	95	1	BURIED
223	FARGO	2002 39 1/2 AVE S	50	1	BURIED
224	FARGO	2005 N 91/2	70	1	AERIAL
225	FARGO	2007 N 91/2	70	1	AERIAL
226	FARGO	2015 28 AVE 5	67	1	BURIED
227	FARGO	209 OAK MANOR TRLR CT	197	1	BURIED
228	FARGO	2111 32 AVE SO	55	1	BURIED
229	FARGO	2114 28 BA S	60	1	BURIED
230	FARGO	2118 7 ST N	100	1	AERIAL
231	FARGO	2121 9 TH AVE S	120	1	AERIAL
232	FARGO	2141 STERLING ROSE LANE	162	1	BURIED
233	FARGO	2173 VICTORIA LANE	168	1	BURIED
234	FARGO	2173 VICTORIA ROSE DR	23	1	BURIED
235	FARGO	2212 30 AVE S	60	1	BURIED
236	FARGO	222 22 ST S	105	1	AERIAL
237	FARGO	2243 32 ST AVE S	75	1	BURIED
238	FARGO	2253 SO UNIV	135	2	BURIED
239	FARGO	2253 UNIV	60	1	BURIED
240	FARGO	23 11 ST N	125	1	AERIAL
241	FARGO	230 FOREST AV	260	1	BURIED
242	FARGO	2308 261/2 AVE S	165	1	BURIED
243	FARGO	2313 10ST S	165	1	BURIED
244	FARGO	2313 17 AVE S	140	1	BURIED
245	FARGO	2313 35 AVE S	55	1	BURIED
246	FARGO	2501 7 AV NW	80	1	AERIAL
247	FARGO	2520 9 ST S	100	1	BURIED
248	FARGO	2525 33 ST SW	90	1	BURIED
249	FARGO	2536 32 ST SW	75	1	BURIED
250	FARGO	2544 32 ST S	75	1	BURIED
251	FARGO	2608 38 1/2 AV	100	1	BURIED
252	FARGO	2614 PACIFIC DR S	128	1	BURIED
253	FARGO	2615 N MILLER	125	1	BURIED
254	FARGO	2626 24 AVE S	120	1	BURIED
255	FARGO	2703 18 ST S	70	1	BURIED
256	FARGO	2713 26 AV SW	218	1	BURIED
257	FARGO	2719 26 AV SW	160	1	BURIED
258	FARGO	2725 26 ST SW	75	1	BURIED
259	FARGO	2727 34 AVE SW	120	1	BURIED

260	FARGO	2734 18 ST S	250	1 BURIED
261	FARGO	2736 18 ST S	180	1 BURIED
262	FARGO	2807 PARKVIEEW DR	85	1 BURIED
263	FARGO	2818 WHEATLAND DR SW	95	1 BURIED
264	FARGO	2819 PARK VIEW	50	1 BURIED
265	FARGO	2823 WHEATLAND	90	1 BURIED
266	FARGO	2834 PARVIEW DR	163	1 BURIED
267	FARGO	2849 2 ST N	165	1 BURIED
268	FARGO	2914 SOUTH BAY DR	222	1 BURIED
269	FARGO	2915 SIUTH BAY	105	1 BURIED
270	FARGO	2917 DAKOTA PARK CIRCLE	155	1 BURIED
271	FARGO	2920 SOUTH DR SW	56	1 BURIED
272	FARGO	2926 EDGEWOOD	363	1 BURIED
273	FARGO	2955 PETERSON PKWY NE	70	1 BURIED
274	FARGO	2956 28 TH AVE	125	1 BURIED
275	FARGO	3 32 AVE NE	65	1 BURIED
276	FARGO	30 36 ST SW	170	1 BURIED
277	FARGO	300 7 AV	70	1 BURIED
278	FARGO	3002 37 AVE SW	160	1 BURIED
279	FARGO	3002 71/2 AV NW	100	1 BURIED
280	FARGO	3002 N 71/2	60	1 BURIED
281	FARGO	3003 DAKOTA PARK CIRCLE	155	1 BURIED
282	FARGO	3004 22 STS	100	1 BURIED
283	FARGO	3005 DAKOTA PARK CIRCLE	155	1 BURIED
284	FARGO	3009 DAKOTA PARK CIRCLE	155	1 BURIED
285	FARGO	3011 DAKOTA PARK CIRCLE	155	1 BURIED
286	FARGO	3014 7TH ST N	701	1 BURIED
287	FARGO	3015 DAKOTA PARK CIRCLE	155	1 BURIED
288	FARGO	3016 18TH ST	100	1 BURIED
289	FARGO	3017 DAKOTA PARK CIRCLE	155	1 BURIED
290	FARGO	3018 35 1/2 COUNT AV SW	160	1 BURIED
291	FARGO	3021 DAKOTA PARK CIRCLE	155	1 BURIED
292	FARGO	3023 DAKOTA PARK CIRCLE	155	1 BURIED
293	FARGO	3033 38 1/2 AVE SW	173	1 BURIED
294	FARGO	3038 20 ST S	70	1 BURIED
295	FARGO	3044 32 ST S	228	1 BURIED
296	FARGO	3056 32 ST S	220	1 BURIED
297	FARGO	3102 32 ST S	220	1 BURIED
298	FARGO	3110 17 ST S	245	1 BURIED
299	FARGO	3110 32 ST SW	220	1 BURIED
300	FARGO	3114 PETERSON PRKWY NE	125	1 BURIED
301	FARGO	3116 TIMBERLINE	100	1 BURIED
302	FARGO	3118 17 ST S	245	1 BURIED
303	FARGO	3126 37 1/2 ANE SW	252	1 BURIED
304	FARGO	3150 24 TH AVE S	50	1 BURIED
305	FARGO	3202 35 1/2 CT AVE	150	1 BURIED
306	FARGO	3202 37 AVE SW	140	1 BURIED
307	FARGO	3204 15 AVE NW	188	1 BURIED
308	FARGO	321 FOREST	60	1 BURIED
309	FARGO	3214 43 AVE SW	115	1 BURIED
310	FARGO	3216 44 AVE SW	165	1 BURIED
311	FARGO	3220 12 AVE N LOT 43	50	1 BURIED

312	FARGO	3220 12 AVE NW	25	1	BURIED
313	FARGO	3222 44 AVE S	110	1	BURIED
314	FARGO	3222 44 AVE SE	80	1	BURIED
315	FARGO	3228 42 AV SW	100	1	BURIED
316	FARGO	3228 44 AVE SW	165	1	BURIED
317	FARGO	3241 35 1/2 CT AVE	150	1	BURIED
318	FARGO	3243 37 AVE SW	140	1	BURIED
319	FARGO	3250 EVERGREEN CIRCLE N	170	1	BURIED
320	FARGO	3300 33 ST SW	130	2	BURIED
321	FARGO	3301 39 AVE SW	140	1	BURIED
322	FARGO	3305 39 AVE SW	60	1	BURIED
323	FARGO	3309 39 AVE SW	60	1	BURIED
324	FARGO	3311 39 AVE SW	145	1	BURIED
325	FARGO	3311 PARKVIEW LANE	90	1	BURIED
326	FARGO	3317 PARKVIEWLANE	160	1	BURIED
327	FARGO	3321 17 ST S	245	1	BURIED
328	FARGO	3323 17 ST S	60	1	BURIED
329	FARGO	3325 18 ST S	65	1	BURIED
330	FARGO	3325 43 AVE SW	75	1	BURIED
331	FARGO	3326 RIVER DR	195	1	BURIED
332	FARGO	3328 44 AVE SW	135	1	BURIED
333	FARGO	3331 43 AV SW	165	1	BURIED
334	FARGO	3339 42 AVE SW	105	1	BURIED
335	FARGO	3355 39 AVE SW	165	1	BURIED
336	FARGO	3433 RIVER DR	160	1	BURIED
337	FARGO	3502 RIVER DR	50	1	BURIED
338	FARGO	3503 31 ST NW	55	1	BURIED
339	FARGO	3510 30 ST SO	110	1	BURIED
340	FARGO	3519 30 ST SW	130	1	BURIED
341	FARGO	3532 11 ST S	345	1	BURIED
342	FARGO	3602 11 TH	80	1	BURIED
343	FARGO	3610 RIVER DR SO	170	1	BURIED
344	FARGO	3629 22 ST S	162	1	BURIED
345	FARGO	3638 22 ST S	165	1	BURIED
346	FARGO	3644 FAIRWAY DR	70	1	BURIED
347	FARGO	3664 10 ST N	95	1	BURIED
348	FARGO	3673 22 ST S	95	1	BURIED
349	FARGO	3702 RIVER DR	130	2	BURIED
350	FARGO	3705 22 ST S	103	1	BURIED
351	FARGO	3716 22 ST SO	75	1	BURIED
352	FARGO	3814 15 ST S	110	1	BURIED
353	FARGO	3824 22 ST S	175	1	BURIED
354	FARGO	3825 10 ST N	95	1	BURIED
355	FARGO	3917 21 ST S	125	1	BURIED
356	FARGO	3924 33 ST S	70	1	BURIED
357	FARGO	3925 RIVER DR S	400	1	BURIED
358	FARGO	4007 32 ST SW	245	1	BURIED
359	FARGO	4009 32 ST SW	165	1	BURIED
360	FARGO	401 HARWOOD DR	317	1	BURIED
361	FARGO	4021 COPPER FIELD	125	1	BURIED
362	FARGO	4025 2 1/2 ST S	230	1	BURIED
363	FARGO	4025 32 ST S	669	1	BURIED

364	FARGO	4027 32 ST SW	120	1	BURIED
365	FARGO	4033 32 ST SO	260	1	BURIED
366	FARGO	4033 COPPERFIELD COURT	324	1	BURIED
367	FARGO	418 100 AVE S	230	2	BURIED
368	FARGO	4202 TIMBERLINE DR	330	1	BURIED
369	FARGO	4218 TIMBERLINE DR SW	200	1	BURIED
370	FARGO	4226 TIMBERLINE DR SW	135	1	BURIED
371	FARGO	4303 TIMBERLINE DR SW	172	1	BURIED
372	FARGO	4603 ROSE CREEK PRKWY	130	1	BURIED
373	FARGO	4738 ROSECREEK PRKWY	78	1	BURIED
374	FARGO	4906 COUNTY RD 31 N	257	2	BURIED
375	FARGO	501 14 AV N	150	2	BURIED
376	FARGO	5010 MEDOW ORDER	100	1	BURIED
377	FARGO	5040 ROSECREEK PRKWY	110	1	BURIED
378	FARGO	5046 ROSE DALE	120	1	BURIED
379	FARGO	5046 ROSECREEK PRKWY	115	1	BURIED
380	FARGO	5054 ROSE DALE	150	1	BURIED
381	FARGO	507 15 AV N	110	1	BURIED
382	FARGO	507 APPLE	165	2	BURIED
383	FARGO	5109 ROSE CREEK PRKWY	85	1	BURIED
384	FARGO	5131 ROSECREEK PRKWY	90	1	BURIED
385	FARGO	5138 ROSECREEK PRKWY	180	1	BURIED
386	FARGO	5150 ROSECREEK PRKWY	130	1	BURIED
387	FARGO	527 COUNTRYSIDE TRLR CT	30	1	BURIED
388	FARGO	5408 18 ST S	125	1	BURIED
389	FARGO	5506 18 ST S	85	1	BURIED
390	FARGO	5510 19 ST S	65	1	BURIED
391	FARGO	5521 19 ST S	130	1	BURIED
392	FARGO	5523 18 ST S	120	1	BURIED
393	FARGO	5529 19 ST S	70	1	BURIED
394	FARGO	5534 19 ST S	110	1	BURIED
395	FARGO	5535 18 ST S	90	1	BURIED
396	FARGO	5536 18 ST	40	1	BURIED
397	FARGO	5601 35 ST S	185	1	BURIED
398	FARGO	5602 34 ST S	375	1	BURIED
399	FARGO	5602 35 ST S	265	2	BURIED
400	FARGO	5820 1 ST S	150	1	BURIED
401	FARGO	6 BRIARWOOD PLACE	285	2	BURIED
402	FARGO	606 211 ST 6	200	1	AERIAL
403	FARGO	606 SOUTHWOOD DR	70	1	BURIED
404	FARGO	61 PRAIREWOOD DR	270	1	BURIED
405	FARGO	613 2 ST N	75	1	AERIAL
406	FARGO	63 SO TERRACE	110	1	AERIAL
407	FARGO	6307 14 ST N	100	1	BURIED
408	FARGO	64 FOREST RIVER DR	525	1	BURIED
409	FARGO	6414 14 ST S	215	1	BURIED
410	FARGO	6465 13 ST N	150	1	BURIED
411	FARGO	6469 13 ST N	150	2	BURIED
412	FARGO	648 CNTY RF	90	1	BURIED
413	FARGO	69 WOODLAWN	50	1	BURIED
414	FARGO	701 29 AVE N	110	1	AERIAL
415	FARGO	7017 CHRISAN BLVD	275	1	BURIED

416	FARGO	714 29 ST SW	276	1	BURIED
417	FARGO	714 HARENBROOK	100	1	BURIED
418	FARGO	719 21 ST S	285	1	BURIED
419	FARGO	7201 CTY RD 31	210	1	BURIED
420	FARGO	7211 COUNTY ROAD 31N	340	2	BURIED
421	FARGO	722 7 ST N	70	1	AERIAL
422	FARGO	7325 COUNTY ROAD 31 N	815	2	BURIED
423	FARGO	7802 SCORPIO CORCLE	225	2	BURIED
424	FARGO	7818 SCORPIO CIRCLE	185	2	BURIED
425	FARGO	820 9 S N	100	1	AERIAL
426	FARGO	821 3 ST N	135	1	BURIED
427	FARGO	90 23 AV N	60	1	AERIAL
428	FARGO	905 N 7TH ST	115	1	BURIED
429	FARGO	909 43 AVE N	100	1	BURIED
430	FARGO	913 PARK	80	1	AERIAL
431	FARGO	914 24 AVE S	245	1	BURIED
432	FARGO	914 7TH AVE	75	1	BURIED
433	FARGO	916 43 AVE N	225	1	BURIED
434	FARGO	918 SOUTHWOOD DR	65	1	BURIED
435	FARGO	921 21 ST S	150	1	BURIED
436	FARGO	9844 21 ST S	220	1	BURIED
437	FARGO	RR2 BAYSIDE	2000	3	BURIED
438	GARDNER	16542 27 R ST	7500	3	BURIED
439	GARDNER	RRI	8000	2	BURIED
440	GRAND FORKS	1022 23 AV 5	172	1	BURIED
441	GRAND FORKS	107 CONKIN AV	187	1	BURIED
442	GRAND FORKS	1250 46 ST	600	1	BURIED
443	GRAND FORKS	1323 8 AV N	160	1	BURIED
444	GRAND FORKS	1394 38 AV S	186	1	BURIED
445	GRAND FORKS	14 VAIL CIR	218	1	BURIED
446	GRAND FORKS	1521 WALNUT ST	122	1	BURIED
447	GRAND FORKS	1619 6 ST N	150	1	BURIED
448	GRAND FORKS	2030 2 AV N	134	1	BURIED
449	GRAND FORKS	2257 FALLCREEK	112	1	BURIED
450	GRAND FORKS	2308 SPRING BROOK CT	141	1	BURIED
451	GRAND FORKS	2326 BELMONT RD	344	1	BURIED
452	GRAND FORKS	2542 LAWNDALE RD	130	1	BURIED
453	GRAND FORKS	2616 GATEWAY DR	320	1	BURIED
454	GRAND FORKS	2708 10 ST S	183	1	BURIED
455	GRAND FORKS	362 GEASY HILLS	206	1	BURIED
456	GRAND FORKS	386 CIR DR E	152	1	BURIED
457	GRAND FORKS	4051 GATEWAY	668	1	BURIED
458	GRAND FORKS	406 LEVEL PLAONS	165	1	BURIED
459	GRAND FORKS	4214 COTTONWOOD	84	1	BURIED
460	GRAND FORKS	507 SCHORDER	176	1	BURIED
461	GRAND FORKS	602 SCHORDER DR	212	1	BURIED
462	GRAND FORKS	614 TERRACE	90	1	BURIED
463	GRAND FORKS	635 GREAT PLAIN CT	266	1	BURIED
464	GRAND FORKS	702 BIG SKY CIR	70	1	BURIED
465	GRAND FORKS	837 24 ST S	145	1	BURIED
466	GRAND FORKS	9 VAIL CIR	216	1	BURIED
467	GRAND FORKS	902 SHAKESPHERE	266	1	BURIED

468	GRAND FORKS	RR1	438	3 BURIED
469	GRAND FORKS	RR2	482	3 BURIED
470	GRAND FORKS	RR3 BOX 294	612	3 BURIED
471	GRAND FORKS	RR3 BOX 299	559	3 BURIED
472	GRAND FORKS	RT 1 BOX 63	520	3 BURIED
473	GRAND FORKS	T151 R51 510	556	3 BURIED
474	GRAND FORKS	T152 R51 533	275	3 BURIED
475	GRAFTON	102 GRIGGS	212	1 BURIED
476	GRAFTON	1515 WESTER AV	876	1 BURIED
477	GRAFTON	625 15 ST N	90	1 BURIED
478	GRAFTON	7021 CITY 8	115	3 BURIED
479	GRAFTON	743 COOPER AV	150	1 BURIED
480	GRAFTON	HILL AV	204	1 BURIED
481	GRAFTON	HWY 81 N	110	3 BURIED
482	GRAFTON	RR	5334	3 BURIED
483	GRAFTON	RR1 BOX 97	3324	3 BURIED
484	GRAFTON	T156 R53 515	839	3 BURIED
485	GRAFTON	T158 R52 517	962	3 BURIED
486	GRAFTON	T158 R52 535	1052	3 BURIED
487	GWINNER	1 ST N SE	186	1 BURIED
488	GWINNER	108 1 ST NW	418	1 BURIED
489	GWINNER	110 8 AV SE	180	1 BURIED
490	GWINNER	18 8 AV SW	207	1 BURIED
491	GWINNER	20 4 AV SW	299	1 BURIED
492	GWINNER	301 1 ST NE	112	1 BURIED
493	GWINNER	4 8 AV SE	285	1 BURIED
494	GWINNER	403 MAIN ST	252	1 BURIED
495	GWINNER	8 8 AV SW	112	1 BURIED
496	GWINNER	303 2ND ST	85	1 BURIED
497	HALTON	BEVERLY TILLETT	190	3 BURIED
498	HALTON	DARRELL STORMOE	210	3 BURIED
499	HALTON	GOLDEN LAKE	68	3 BURIED
500	HALTON	HALTON AIR SPRAY	3150	3 BURIED
501	HALTON	STONES MOBILE RADIO	500	3 BURIED
502	HISBORO	23 3 AV SW	170	1 BURIED
503	HISBORO	24 8 AV SW	110	1 BURIED
504	HISBORO	309 S AMIN	80	1 BURIED
505	HISBORO	310 1 ST SW	150	1 BURIED
506	HISBORO	313 S MAIN	90	1 BURIED
507	HISBORO	4 4 AV SW	110	1 BURIED
508	HISBORO	7 3 AV SW	90	1 BURIED
509	HISBORO	AIRPORT	620	3 BURIED
510	HISBORO	BRUCE BOEDDEKER	1150	3 BURIED
511	HISBORO	CALDONIA	354	3 BURIED
512	HISBORO	DAN HOAGANSON	250	3 BURIED
513	HISBORO	JAKE KMETS	1400	3 BURIED
514	HISBORO	JAMES ANDRE	1250	3 BURIED
515	HISBORO	JERRY LITTLE	100	3 BURIED
516	HISBORO	JOHN LUNDBY	80	3 BURIED
517	HISBORO	ROBERT LORCH	150	3 BURIED
518	HISBORO	SHERRI L	184	3 BURIED
519	HISBORO	TIM LEE	171	3 BURIED

520	HOARCE	4977 KILTAKE	350	2 BURIED
521	HORACE	17495 49 R ST SE	240	2 BURIED
522	HORACE	2914 124 AVE SO	290	3 BURIED
523	HORACE	4410 124 AVE SO	340	2 BURIED
524	HORACE	5324 172 R AVE SE	325	3 BURIED
525	HORACE	9832 21 ST S	230	3 BURIED
526	IDAHO	6620 4 STRING	200	2 BURIED
527	KINDERD	472 ELM	300	1 AERIAL
528	KINDERED	110 MAPLE	50	1 BURIED
529	KINDERED	16095 48 R ST SE	2374	3 BURIED
530	KINDERED	16707 54 R ST SE	942	3 BURIED
531	KINDERED	16838 52 R ST SE	1549	3 BURIED
532	KINDERED	201 SHEYENNE ST	110	1 BURIED
533	KINDERED	4723 161 R AV SE	3626	3 BURIED
534	KINDERED	HWY 46	994	3 BURIED
535	KINDERED	ROGER LARSON	3138	3 BURIED
536	KINDERED	RR2	298	3 BURIED
537	KINDERED	SW OF KINDRED	1620	3 BURIED
538	KINDRED	191 5 AV W	230	1 BURIED
539	KINRED	102 SPRUCE	75	1 BURIED
540	LARIMORE	3118 US 2	836	3 BURIED
541	LARIMORE	T150 N RS4W S10	246	3 BURIED
542	LEONARD	RR1	900	1 BURIED
543	LISBON	1006 MAPLE	274	1 BURIED
544	LISBON	2489 135 AV SE	170	3 BURIED
545	LISBON	309 10 AVE W	75	1 AERIAL
546	LISBON	6473 HWY 34	625	3 BURIED
547	LISBON	6653 137 AVE SE	170	3 BURIED
548	LISBON	6909 13 AV SE	2070	3 BURIED
549	LISBON	7496 125 AVE SE	222	3 BURIED
550	LISBON	RR	245	3 BURIED
551	MANDAN	1617 7 STS	75	1 BURIED
552	MANDAN	103 MEDOZA	53	1 BURIED
553	MANDAN	2205 SOMMIER DR N	255	1 BURIED
554	MANDAN	2501 TWIN CITY DR	256	1 BURIED
555	MANDAN	3410 27 AV NW	632	1 BURIED
556	MANDAN	3992 35 AV SW	426	1 BURIED
557	MANDAN	4201 34 AV NW	112	1 BURIED
558	MANDAN	709 17 AV NW	105	1 BURIED
559	MANDAN	711 SWEETBRIAR RD	123	1 BURIED
560	MANDAN	S OF MANDAN	261	3 BURIED
561	MANUEL	504 12 ST	110	1 BURIED
562	MANUEL	BOX 115	135	3 BURIED
563	MANUEL	RR	198	3 BURIED
564	MANUEL	RR	176	3 BURIED
565	MANUEL	T154 R51 535	246	3 BURIED
566	MANDAN	102 E MAIN	85	1 AERIAL
567	MANDAN	106 11 AV NW	150	1 AERIAL
568	MANDAN	208 4 AVE NE	150	1 AERIAL
569	MANDAN	3120 CORD 140	850	3 BURIED
570	MANDAN	3270 30 AV	4700	3 BURIED
571	MANDAN	709 SWEETMAR RD	90	1 BURIED

572	MANDAN	800 E MIN	200	1 AERIAL
573	MANDAN	815 3 AVE NE	125	1 AERIAL
574	MAYVILLE	ARNGUARD	160	3 BURIED
575	MAYVILLE	CITY OF PORTLAND	430	1 BURIED
576	MAYVILLE	HANSON	450	3 BURIED
577	MAYVILLE	JENSON	50	3 BURIED
578	MAYVILLE	LARTOON	100	3 BURIED
579	MAYVILLE	MILLER	150	3 BURIED
580	MAYVILLE	STEWARD	50	3 BURIED
581	MAYVILLE	T146 R52 S20	455	3 BURIED
582	MAYVILLE	T146 R52 S32	370	3 BURIED
583	MAYVILLE	T146 R54 S8	2238	3 BURIED
584	MAYVILLE	T146 R55 S8	300	3 BURIED
585	MOORHEAD	1123 VAI;	100	1 AERIAL
586	MOORHEAD	1125 7 ST N	125	1 AERIAL
587	MOORHEAD	1623 ELM ST	80	1 AERIAL
588	MOORHEAD	1712 5TH AND 6TH	150	1 AERIAL
589	MOORHEAD	1817 160 AVE S	120	1 AERIAL
590	MOORHEAD	217 38TH AVE	75	1 BURIED
591	MOORHEAD	2203 S 19TH ST	200	1 BURIED
592	MOORHEAD	2701 43 AV	200	3 BURIED
593	MOORHEAD	287 IRVING	100	1 AERIAL
594	MOORHEAD	2917 16 AVE S	80	1 BURIED
595	MOORHEAD	309 71 AVE R	150	2 BURIED
596	MOORHEAD	526 BIRCH	80	1 AERIAL
597	MOORHEAD	5701 39TH	150	2 BURIED
598	MOORHEAD	5904 4 STRING	200	2 BURIED
599	MOORHEAD	6620 41 ST N	80	1 BURIED
600	MOORHEAD	722 5 ST S	150	1 AERIAL
601	MOORHEAD	725 32 AVE S	100	1 AERIAL
602	MOORHEAD	806 HWY 10 E	125	1 BURIED
603	MOORHEAD	RR1	400	2 BURIED
604	MOORHEAD	RR1	200	3 BURIED
605	MOORHEAD	RR1 BOX 259	3000	3 BURIED
606	MINTO	211 STOLTMAN CT	154	1 BURIED
607	MINTO	226 STOTLMAN ST	160	1 BURIED
608	MINTO	321 7 ST	246	1 BURIED
609	MINTO	T155 R53 518	764	3 BURIED
610	MOORHEAD	1 AVON ST	200	1 AERIAL
611	MOORHEAD	106 16TH AVE	200	1 AERIAL
612	MOORHEAD	1524 8 AVE N	100	1 AERIAL
613	MOORHEAD	1611 17ST S	100	1 AERIAL
614	MOORHEAD	1700 3RD AVE	250	1 BURIED
615	MOORHEAD	1903 13 AVE S	100	2 BURIED
616	MOORHEAD	224 6TH ST S	100	1 BURIED
617	MOORHEAD	2919 4 AVE	120	1 BURIED
618	MOORHEAD	3509 RIVERSHORE	100	1 BURIED
619	MOORHEAD	3616 VILL GREEN	150	1 BURIED
620	MOORHEAD	506 2 AVE DULUTH	140	1 AERIAL
621	MOORHEAD	734 19 TH ST N	75	1 AERIAL
622	MOORHEAD	1012 62 AV	70	1 BURIED
623	MOORHEAD	119 12 N	90	1 AERIAL

624	MOORHEAD	1212 2 S	100	1 AERIAL
625	MOORHEAD	1703 18TH ST	200	1 AERIAL
626	MOORHEAD	1705 1ST AVE S	200	2 BURIED
627	MOORHEAD	1724 1 AV N	190	1 BURIED
628	MOORHEAD	2910 22 STS	65	1 BURIED
629	MOORHEAD	3318 39TH ST	150	1 BURIED
630	MOORHEAD	507 APPLE TREE	100	1 AERIAL
631	MOORHEAD	529 CEDAR LNS	120	1 AERIAL
632	MOORHEAD	612 WOLF ST AVE	100	2 BURIED
633	MOORHEAD	633 9ST N	80	1 BURIED
634	MOORHEAD	902 13 ST S	60	1 BURIED
635	MOORHEAD	905 9TH AVE S	150	1 AERIAL
636	MOORHEAD	RURAL	750	3 BURIED
637	MOORHEAD	2913 16TH AVE	60	1 BURIED
638	MOORHEAD	2411 BROOK DALE	100	1 AERIAL
639	MHD	2427 33 AVE	90	1 BURIED
640	ROLLA	1012 NEAMEYER DR	168	1 BURIED
641	ROLLA	EAGLE VIEW	174	3 BURIED
642	ROLLA	HWY 5 WESTEDGE OF ROLLA	160	1 BURIED
643	ROLLA	T162 R70 52	437	3 BURIED
644	ROLLA	T162 R70 S18	90	3 BURIED
645	ROLLA	T162N R70W 52	484	3 BURIED
646	ROLLA	T162N R70W SW 10	687	3 BURIED
647	ROLLA	T163 R70 S27	726	3 BURIED
648	THOMPSON	305 CRESCENT DR	133	1 BURIED
649	THOMPSON	533 8 ST	105	1 BURIED
650	THOMPSON	618 WOODLAND D R	175	1 BURIED
651	W FARGO	1201 4 AVE	75	1 BURIED
652	W FARGO	1460 12 ST ST	100	1 BURIED
653	W FARGO	1614 4 AV L	75	1 BURIED
654	W FARGO	1780 CALSWOOD	750	2 BURIED
655	W FARGO	18 3 ST SE	50	1 BURIED
656	W FARGO	3501 HIDDEN CIR	200	2 BURIED
657	W FARGO	3504 14 ST N	100	1 BURIED
658	W FARGO	404 40 ST SW	500	2 BURIED
659	W FARGO	4936 9 AV NE	100	1 BURIED
660	W FARGO	5006 57 SW	500	2 BURIED
661	W FARGO	COMM ST HWY	200	2 BURIED
662	WAFERONT	177380 80 R ST E	800	3 BURIED
663	WAHETON	1603 10 ST N	55	1 BURIED
664	WAHETON	330 7TH ST S	45	1 BURIED
665	WAHETON	4114 4 ST S	65	1 BURIED
666	WAHETON	425 4 ST S	75	1 BURIED
667	WAHETON	503 SIEMAN	70	1 BURIED
668	WAHETON	700 3RD	30	1 BURIED
669	WAHETON	728 4 ST S	75	1 BURIED
670	WAHETON	731 2ND ST	35	1 BURIED
671	WAHETON	735 7 ST S	60	1 BURIED
672	WAHETON	7675 172 R AVE	220	3 BURIED
673	WAHETON	807 S2 ST	180	1 BURIED
674	WAHETON	RR	2000	3 BURIED
675	WAHPETON	1402 SPRUCE DR	108	1 BURIED

676	WAHPETON	18130 88 R ST	1330	3	BURIED
677	WAHPETON	2100 9ST N	6200	1	BURIED
678	WAHPETON	302 8 ST S	150	1	BURIED
679	WAHPETON	7935 177 R AV	630	3	BURIED
680	WAHPETON	817 5 ST S	90	1	BURIED
681	WAHPETON	8480 182 R AV SE	1304	3	BURIED
682	WAHPETON	893 25 AV N	458	1	BURIED
683	WAPHETON	1340 BUFFLO	125	1	BURIED
684	WAPHETON	1427 14 AV N	85	1	BURIED
685	WAPHETON	1514 OAKWOOD	310	1	BURIED
686	WAPHETON	1602 N WOODS	130	1	BURIED
687	WAPHETON	1625 4 ST N	100	1	BURIED
688	WAPHETON	223 9 ST N	70	1	BURIED
689	WAPHETON	232 MAIN	110	1	BURIED
690	WAPHETON	308 NEB	80	1	AERIAL
691	WAPHETON	308 OREGON	72	1	BURIED
692	WAPHETON	311 7 ST S	50	1	BURIED
693	WAPHETON	4219 4 ST N	90	1	BURIED
694	WAPHETON	512 5 ST N	85	1	BURIED
695	WAPHETON	621 NEB	90	1	BURIED
696	WAPHETON	712 3 ST S	24	1	BURIED
697	WAPHETON	RR	320	2	BURIED
698	WEST FARGO	101 WARREN	56	1	BURIED
699	WEST FARGO	10-40 ST SW	75	1	BURIED
700	WEST FARGO	105-8 AV NW	100	1	BURIED
701	WEST FARGO	1174 7 AV NW	75	1	BURIED
702	WEST FARGO	121 17 AV W	81	1	BURIED
703	WEST FARGO	126 2ND AVE N	80	1	AERIAL
704	WEST FARGO	129 17 AV W	88	1	BURIED
705	WEST FARGO	1313 14 ST SW	125	2	AERIAL
706	WEST FARGO	137 17 AVW	125	1	BURIED
707	WEST FARGO	1422 MAIN AV	420	1	BURIED
708	WEST FARGO	1431 4 AV E	90	1	BURIED
709	WEST FARGO	1435 6 ST E	25	1	BURIED
710	WEST FARGO	1438 CHEYENNE	75	1	BURIED
711	WEST FARGO	1467 8 ST E	75	1	BURIED
712	WEST FARGO	1605 MAPLE PL	130	1	BURIED
713	WEST FARGO	1609 15 AVE E	90	1	BURIED
714	WEST FARGO	1621 BRICHWOOD LN	115	1	BURIED
715	WEST FARGO	16666 45 ST	7500	2	BURIED
716	WEST FARGO	1750 CHARLESWOOD	175	1	BURIED
717	WEST FARGO	1780 CHARLESWOOD	170	1	BURIED
718	WEST FARGO	1810 CULVER	270	1	BURIED
719	WEST FARGO	1827 BRENTWOOD CT	95	1	BURIED
720	WEST FARGO	1858 CHARLESWOOD	145	1	BURIED
721	WEST FARGO	2100 MAIN	160	1	BURIED
722	WEST FARGO	2138 4TH AVE	80	1	BURIED
723	WEST FARGO	232 11 AV W	110	1	BURIED
724	WEST FARGO	2402 24 AVE S	100	1	BURIED
725	WEST FARGO	2813 27 ST SW	140	1	BURIED
726	WEST FARGO	2823 33 ST SW	120	1	BURIED
727	WEST FARGO	292 7 AVE	130	1	BURIED

728	WEST FARGO	301 RAMONA DR	245	1	BURIED
729	WEST FARGO	302 40 TH	75	1	BURIED
730	WEST FARGO	307 RIVERTREE	160	3	BURIED
731	WEST FARGO	3071 163 R AV SE	323	3	BURIED
732	WEST FARGO	3214 57 ST N	568	3	BURIED
733	WEST FARGO	3644 9 AV S	75	1	BURIED
734	WEST FARGO	3900 44 AV SW	560	3	BURIED
735	WEST FARGO	4030 165 R AVE MPTN	1694	3	BURIED
736	WEST FARGO	4511 68 ST S	295	3	BURIED
737	WEST FARGO	4680 8 AV SW	100	3	BURIED
738	WEST FARGO	4750 165 R AV SE	1632	3	BURIED
739	WEST FARGO	4952 9 AV S	70	1	BURIED
740	WEST FARGO	5006 51 ST N	85	1	BURIED
741	WEST FARGO	5028 9 AV S	90	1	BURIED
742	WEST FARGO	5063 9 AV S	90	1	BURIED
743	WEST FARGO	514 8 AV W	125	1	BURIED
744	WEST FARGO	543 SOMMERSET	79	1	BURIED
745	WEST FARGO	629 3 ST	35	3	BURIED
746	WEST FARGO	636 SOMMERSET	70	1	BURIED
747	WEST FARGO	637 SOMMERSET	55	1	BURIED
748	WEST FARGO	6614 50 ADES	110	2	BURIED
749	WEST FARGO	6706 50 AV S	140	3	BURIED
750	WEST FARGO	700 SOMMERSET	115	1	BURIED
751	WEST FARGO	714 13 AV	180	1	BURIED
752	WEST FARGO	719 15 AVE	100	1	BURIED
753	WEST FARGO	729 12 AV W	150	1	BURIED
754	WEST FARGO	737 15 AVE	121	1	BURIED
755	WEST FARGO	738 15 AVE	155	1	BURIED
756	WEST FARGO	765 50 ST S	50	1	BURIED
757	WEST FARGO	7714 FOREST RIVER	110	1	BURIED
758	WEST FARGO	7905 38 ST S	1087	3	BURIED
759	WEST FARGO	8111 BRINK DR	145	3	BURIED
760	WEST FARGO	823 15 AVE	65	1	BURIED
761	WEST FARGO	851 12 AVE	127	1	BURIED
762	WEST FARGO	911 7 AV N	120	1	AERIAL
763	WEST FARGO	HWY 10 6 AV	192	3	BURIED
764	WEST FARGO	MAPLETON	105	3	BURIED
765	WEST FARGO	W OF HIGHWAY HOST	1380	1	BURIED
766	WINDMORE	15390 HWY 13	600	3	BURIED
767	WYNDAMORE	15687 HWY 13	350	3	BURIED
768	WYNDAMORE	458 4 ST	75	1	AERIAL
769	WYNDAMORE	4970 157 BRUSE	600	3	BURIED
770	WYNDAMORE	85 HUGHES	75	1	BURIED
771	WYNDAMORE	RR 31	350	3	BURIED
772	WYNDMEE	17 DAKOTA AV	137	1	BURIED
773	WYNDMEE	7293 186 AV SE	150	3	BURIED
774	WYNDMEE	RR	70	3	BURIED

Lot Type	Description	Number of Obs	Mean	Lower Bound
1	Normal Lot Size (appx 100'x100')	571	148	140
2	Multi-Acre Lot	52	294	254

	3 Rural Lot (Ranch or Farm Type ar	151	360	334
All Types		774	199	189

Length Cap 500
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WHITE PAPER

Strategies for Unbundling Remote Access Terminals

By David Ehreth

Background

In the last decade, large numbers of Next Generation Digital Loop Carriers (NGDLC) were deployed throughout the country. NGDLCs are part of a larger plan to deliver voice services with a high degree of efficiency and economy. The purpose of an NGDLC is to act as an "extension cord" for a Class 5 central office voice switch. By multiplexing up to 2,000 voice paths on a fiber optic connection, a large amount of money was saved on copper and other outside plant facilities. Thus, the savings in facility costs that were realized justified the cost of NGDLC.

NGDLCs have two terminals, one located in the central office and one located in a remote location near a community of users. Some NGDLCs can be configured in rings or in chains that have facility cost or reliability benefits. The remote terminal of an NGDLC has a number of circuit cards that are connected to end user devices such as telephones and PBXs. The remote terminal is "hardened", meaning that it will work in harsh environments of heat, cold and humidity. The remote terminal is located on street corners, sidewalks, telephone poles or in remote "huts" near end users.

An important protocol was developed in the late 1980s and early 1990s that facilitated the use of NGDLCs. This protocol, today known as GR-303, was used to connect the NGDLC to the Class 5 switch. To gain even greater economies, a technique known as "concentration" was used in GR-303. Concentration is a technique that enables some number of telephone users to employ a smaller number of trunk paths to the switch. The principle is that not everybody uses his or her telephone at the same time. By taking advantage of this fact, a reduction in actual size of the Class 5 switch could be realized by concentration at the remote terminal of the NGDLC. As an example, 2,000 telephones could be served by as few as 400 trunk paths to the switch without any noticeable degradation of the quality of service.

Concentration brought with it a basic change in Digital Loop Carriers (DLC) that separated the traditional DLC from the NGDLC. Because NGDLCs could perform concentration, they have a primitive level of switching as part of their inherent make up. The Class 5 switch that is connected to an NGDLC controls the switching (concentration) function at the NGDLC through a control link defined in GR-303.

Because an NGDLC could map (or switch) a subscriber to a trunk path, another capability became inherent to the design of a GR-303-based NGDLC. This was the capability to host multiple GR 303 "virtual" groups inside of a single physical platform. This capability is particularly useful for load balancing traffic in order to achieve the optimum concentration ratio. Each virtual GR 303 group requires a data link for control, the Time Slot Management Channel (TMC) and a provisioning link known as an Embedded Operations Channel (EOC). System provisioning commands pass through the EOC that allow the NGDLC to be configured by Operations Support Systems (OSS) that interface to the switch. By administering a system through the switch, the OSS didn't need to have a great deal of knowledge about the NGDLC. This reduced the overall complexity of OSS procedures and leveraged the switch as an agent in the provisioning process.

The Impact of Increased Data Traffic on Access

During the decade of the 1990's when NGDLCs were being installed, consumers were learning how to use the Internet and new demand for data services emerged. Network operators who owned NGDLCs saw an opportunity to use these platforms as delivery vehicles for advanced services such as data communications. As a result, most of the NGDLC vendors equipped their products with the ability to handle one or more data protocols. Further, the NGDLCs were designed or enhanced to offer digital subscriber line services or fiber optic services.

In 1996, the Telecommunications Reform Act (TR-96) opened the local service market to competition. Competitive Local Exchange Carriers (CLEC) were allowed to sell services over "unbundled" facilities. In the case of copper wire facilities, the process is fairly straightforward. A CLEC sells a service to a customer, notifies the Incumbent Local Exchange Carrier (ILEC) that he has made the sale, and the ILEC is required to locate the copper wire that serves that customer and deliver it to the CLEC at the central office. This simple process becomes somewhat more complicated when the customer is served from an NGDLC over what is called an "electronically-derived loop." The actual practice of unbundling electronically-derived loops was left by the TR-96 Telecom Act to be clarified later after the matter had been studied and a "technically feasible" solution found. It was left to each of the states to develop a satisfactory policy on electronic loop unbundling. In spite of this, work is ongoing at the Federal Communications Commission to find technically feasible solutions to electronic loop unbundling.

As part of the opening of competition in the communications markets, Congress and the FCC have ruled that ILECs who have in the past been beneficiaries of local telephone monopolies may not, themselves, provide data communications services. However, ILECs have been allowed to operate unregulated subsidiary businesses that may provide data services. Meanwhile, a large number of CLECs and Data Local Exchange Carriers (DLEC) have begun to offer data services.

Because there has been no general clarification on the issue of unbundling electronically-derived loops and because the ILEC operators have been restricted from providing data services, remote terminals of NGDLCs have not been extensively used for delivery of data services. This is unfortunate for two reasons. First, NGDLCs are the ideal location to launch data services because they are located a short distance from end users. Second, there are alternatives to unbundling remote terminal facilities that, while fair to CLECs, allow ILEC owners to retain a significant ability to provide all network service providers, subsidiaries and CLECs alike, with high value services.

Strategies for Unbundling

GR-303: Limitations on Scalability, Limitations of Shared Databases

At a glance, it might seem as if GR-303 provided a good solution for unbundling services from an NGDLC remote terminal (RT). Virtual GR-303 groups could be created for each CLEC that wanted to have virtual access to the RT. These groups are defined in the GR-303 standard as "Interface Groups." Each interface group is logically portioned so that it behaves as a separate resource. These groups could be delivered to the CLEC point of presence (POP) in the ILEC central office near the central office terminal (COT) of the NGDLC. Each CLEC could then transport its GR-303 group along with TMC and EOC to its remote switch center where it would connect to its own Class 5 switch. At a glance, this would seem to give the CLEC the ability to control both feature offerings and switch resources. However, on closer examination, GR-303 presents some significant challenges when used as a multi-tenant solution for unbundling.

A summary of the issues with using GR-303 as an unbundling tool reveals two major problems. First is the issue that GR-303 is not scalable for unbundling. Second, there are significant operational issues concerning shared databases that could lead to catastrophic system failures. The following will examine these two issues.

Load Balancing Using Interface Groups

It should be noted that the original intent of the interface groups was to perform a function known as "load balancing." Since GR-303 is a concentrating interface, high-traffic customers can potentially upset the concentration ratio between line resources and trunk resources. A high-traffic user can congest a system that has allocated one trunk resource to every four line appearances. To solve this potential problem and to get the best economics out of concentration, GR-303 offered the possibility of multiple interface groups being created on a single RT. This would enable a network operator to virtually gather his high-traffic users together on a single interface group with a low concentration ratio, let's say 2:1, while leaving the low-traffic users (usually the majority) on high concentration ratio interface groups, say 4:1. GR-303 allows for eight interface groups, maximum. The most commonly deployed digital loop carrier systems, the Alcatel Litespan 2000 and the Advanced Fibre Communications UMC 1000 allow for 4 and 6 interface groups per RT, respectively.

Each interface group uses a redundant TMC. Each TMC occupies one 64Kb/s channel in a T1 trunk. The GR-303 TMC uses the ISDN call processing protocol Q.931. The use of Q.931 is ideal for the original intent of GR-303: to perform concentration on the remote terminal. However, as a means of unbundling a remote terminal, the use of individual protocol stacks for each interface group presents an additional problem. Specifically, this architecture is not scalable beyond certain practical limits. There are several reasons for this.

First, the amount of computing resource to manage the Q.931 resource is not infinitely expandable within a given RT. The second reason is that both of the two TMCs on each interface group require a physical link to terminate the High-Level Data Link Protocol (HDLC) used as the link-layer transport methodology. Each HDLC termination requires an allocation of physical space which reaches certain practical limits within the constraints of the RT and the COT. For example, if a COT were to service a chain of four remote terminals and each of these terminals was equipped with four interface groups, the

COT would be required to manage 16 active and 16 stand-by data links to support 16 different service providers.

Note, however, that if a provider had subscribers on all of the RTs (such as an incumbent carrier), it would consume four of the 16 interface groups on the COT, leaving only 12 for other providers.

If a second provider (say, CLEC-A) also had subscribers on all of the RTs, it would consume four more interface groups on the COT as well. That would leave only eight interface groups. If CLEC-B and DLEC-1 have subscribers on all the RTs, these four providers would consume all 32 data links.

If there were subscribers to a fifth service provider, these stranded subscribers could only be made available on a "universal interface." A universal interface has a 1:1 mapping or connection between a subscriber terminal and a trunk circuit in an "always connected" mode. This defeats the purpose of GR-303 which is to eliminate the high cost and low efficiency of the universal mode.

Having a GR-303 interface available to a small number of network operators and a universal interface available to other operators would create a fundamentally unbalanced system of costs for RT unbundling. On the other hand, forcing everyone to the universal interface would set the clock back significantly in terms of cost and architecture.

Flawless Master/Flawless Slave?

Another issue with the use of multiple GR-303 interface groups for the purpose of RT unbundling is the general database architecture of GR-303. There exists a "master/slave" relationship between the LDS and the NGDLC where the LDS is the master and the NGDLC is the slave.

The master/slave relationship in GR-303 architecture provides a very efficient method for the LDS to control the resources of the NGDLC. GR-303 was created with the assumption that, while there may be several interface groups, there would be only one network operator and only one provisioning system. Thus, the LDS could be certain that it knows what resources exist within an RT. Also, the LDS can manage the different interface groups created by a single provisioning system, each with its own database. If there were an error in the provisioning (for example, one interface group claimed resources within another interface group), a significant malfunction would occur. This malfunction could include symptoms as minor as the loss of a call to the loss of an entire interface group. It is possible for a system to be brought down by such a database error. Because of this, a great deal of caution is used when building system databases. Even when in use, a system of database "auditors" runs in the background to cross-check the integrity of the databases. Database integrity is one of the most complex elements of system design for a GR-303 system. Failure of database integrity can cause catastrophic results.

When an RT has been unbundled and is a slave to many switches, it must be presumed that one of these switches is the database master and that the other switches are database slaves. If each switch (representing different service providers) were free to provision the RT, it would not be possible to use GR-303 because no one would be able to insure what resources belonged where.

. Theoretically, problem of database integrity can be solved by making one of the switches the master of the system database. The master switch would then be responsible for passing that database information to each of the other switches in a carefully coordinated manner. Although this method is theoretically possible, coordination between the switches and their respective owners would be difficult, if not altogether impossible, to achieve. The operations support systems for each of the switches would need to be electronically bonded in a way that would make the owner of a "slave" switch subject to the commands of a master switch. In practical terms, the owner of the master switch would most probably be the ILEC and the owner of the slave switch would be the CLEC. The ability of the CLEC to operate his network would depend entirely on the flawless performance of the operations support systems and the ability of the ILEC to provision the system flawlessly. The ILEC would depend on the flawless performance of the CLEC's operations support system to insure that the "real" database information was activated in the slave switch at some predetermined time across all of the slave switches.

Coordinating Operating Support Systems (OSS)

Further complicating the master/slave switch approach would be the need to coordinate the operations support systems themselves. There are many different approaches in the industry to operations support systems, and there are many different vendors of products in this area. These operations support systems need to be fully inter-operable, but, the practicality of such an arrangement is small. The probability that competing business interests could find an agreeable common solution that is both technically acceptable and highly robust is slim.

To summarize, there are two major problems with using GR-303 as an unbundling tool. First, GR-303 does not scale well for unbundling. Second, sharing critical databases between master and slave switches could lead to catastrophic failures. At best, it would be highly problematic. Both of these issues highlight the fact that GR-303 was not designed to solve the unbundling problem.

The Access Switch Approach

Another approach that has been developed for unbundling RTs is the concept of "access switching." Access switching solves both the scalability problem and the shared database problems outlined above. Access switching is a new technology that has evolved from many of the standards bodies that have been studying the evolution of the network from a single-owner, single-service network to a multi-owner, multi-service network. Access switching was, in fact, designed specifically for the need to unbundle RTs, while preserving the fundamental physical architecture of RTs and leveraging some of their latent capabilities.

There are two important principles to access switching. First is the idea of making the control intelligence separate from the physical service delivery layer of the network. Second is the idea of "virtualizing" both services and ownership.

Separation of Control and Physical Layers

The best example of the first principle, separation of the control layer from the physical layer, is in the computer industry where this principle is commonly applied. In the computer field, it is common that the control layer (the operating system) is separated from the hardware (the physical computer). This independence allows services to continue to evolve on the same physical platform without having to change the actual hardware. The access switch provides this kind of capability to existing RTs, thus enabling new kinds of services to appear without having to change existing hardware.

Virtualization of Services and Ownership

Again, the computer industry has provided a model for the second principle; "virtualizing" services and ownership. Many of us work in corporate LAN (local area network) environments. In this mode, we share resources such as printers and file servers. When we look at these resources through our desktop computers, they appear to be resources that we own, but in fact, they are resources that are physically shared amongst many users on the LAN. In this way, we have "virtual" ownership of these resources. We use them as if they were ours, but they are, in fact, shared.

An access switch creates this ability to share the resources of an RT in much the same way, through the use of the independent control layer. An access switch creates the ability to have unlimited "virtual" owners who functionally control the RT resources, even though the physical RT resources are shared.

The most significant aspect of this architecture compared to the GR-303 architecture is that the access switch architecture is designed with unbundling in mind so that it solves both the scalability issue and the shared database issue.

In the access switched architecture, the actual physical connections to end-users are made at the RT as done today by ILECs. This layer of the architecture, the service delivery or media layer, is in place today and carries the actual "bearer" traffic.

Control of the service delivery or media layer is done at the control layer by an access switch. An access switch is a body of software running on a dedicated computer that provides control and signaling to the service delivery device, typically an NGDLC RT. An access switch enables switching and routing to be done at the NGDLC RT. The access switch's database enables virtual subdivision of the physical RT resources. The access switch, in turn, interfaces to the applications layer. At the applications layer are devices known as feature servers. The feature servers are like the access switch in that they are bodies of software that run on dedicated computers. The feature servers provide the applications and features for end-users who are connected to the service delivery layer to use.

To understand how this architecture is actually implemented in a network, it is important to understand several points. First, a single access switch controls many service delivery devices such as RTs. One access switch can control up to 100,000 subscribers connected to many RTs. Second, an access switch can be connected to a large number of feature servers. Finally, a single feature server can be connected to many access switches simultaneously.

The network configuration shown in Figure 4 creates the ability to unbundle the NGDLC RT down to the individual service circuit level without imposing any limitations on the number of virtual owner/operators that can operate resources in the RT. In addition, it provides the owner of the physical system with the ability to wholesale an extensive range of services over and above the basic unbundling requirements. While providing many value-added opportunities to the owner of the physical system, the access-switching strategy provides profound functional and cost advantages to the virtual owners.

There are two broad categories of unbundling contained within the single subject of RT unbundling. They are the unbundling of regular POTS and the unbundling of digital services, most notably DSL. The access switching architecture addresses both of these classes of service. Before examining these two branches, it would be good to build an understanding of the operational theory of access switched architecture.

Capabilities of the Access Switched Architecture

The access switched architecture gets its name from the fact that switching, the "dialtone function," is done at the RT, the access point of the network. This differs from the traditional monolithic Class 5 switch model. The benefits of unbundling of the access switch architecture come from "disaggregation" of the network architecture. In the present method of operation, switching, features and hardware are locked together in a single, inaccessible Class 5 switch package. By separating these three functions into three layers, it becomes possible to create "virtual" ownership of network resources. As discussed earlier, it is helpful to think of the corporate LAN environment of shared virtual resources to understand the impact of the access switched network architecture.

The access switch itself creates dialtone, performs call processing and network signaling for voice traffic and performs connection control and signaling for packet-based traffic. The access switch contains a database that holds an image of the physical system. The call or connection processing depends on this databasebecause it holds information that tells the system what resources are available and which have been assigned to virtual owners.

Feature servers interconnect to the access switch over a packet network, such as an IP network. The access switch itself performs control functions but has no internal ability to provide features. When a subscriber invokes a feature, either by a sequence of keys or by generating a data message, the access switch consults a database that tells it which virtual owner is associated with the subscriber. Once the owner is determined, the access switch locates another database where the virtual owner's "feature table" is kept. The feature table correlates subscriber keystrokes or messages to feature servers where the feature software is physically located. The virtual owner can configure the feature table according to his business interests. The feature table provides the access switch with the address of the virtual operator's feature server. The access switch contacts the feature server and executes the feature server's directions such as:

- give tone
- collect digits
- set up a session
- any other features required

When a feature sequence is complete, the call control returns to the access switch. Because they are connected over a packet network, there is no limit to the number of feature servers that can provide features to the access switch and to the subscribers.

Network signaling can be done for voice and data by an access switch. For voice, the access switch provides a convenient aggregation point for Signaling System 7 (SS7). One SS7 A-Link connected to an access switch will service a highly physically distributed group of RTs.

Using SVCs to Release "Stranded Bandwith" in PVCs and to Add Scalability

For DSL served from an RT, an access switch can serve as a "proxy signaling agent." Most DSL configurations today rely upon ATM transport. An access switch can serve as the ATM proxy signaling agent. Proxy signaling uses ATM Forum UNI 4.0 signaling between subscriber terminals and the proxy work required to upgrade an NGDLC to work with an access switch is at the COT where trunk groups are formed. Little, if any, new hardware is required at the RT.

Using the Access Switch Architecture to Unbundle DSL in RTs

Using network elements and signaling paths to unbundle DSL circuits in an RT accomplishes two purposes. First, it provides a robust method for unbundling the DSL facility. Ownership of the physical platform remains intact. Virtual division of the RT facility is aided by the use of an external OSS system that can receive orders for circuits from many CLECs and translate those orders into specific provisioning commands for configuring the access switch's database. The database synchronization problem is eliminated by having only one facility database per switch.

Second, because this configuration is inherently capable of proxy signaling, each DSL circuit can be switched according to service needs. This makes DSL using ATM transport scalable. Use of PVCs has left large amounts of bandwidth stranded because there has been no way to turn a connection off and on. Proxy signaling solves this problem. When implemented in the access switch architecture, proxy signaling also solves the problem of creating scalable virtual ownership. Each DSL circuit in an RT can be assigned to a different virtual owner. No special data links are required to add virtual owners.

A summary of benefits for using access switch architecture to unbundle DSL circuits:

1. Provides equal access to an indefinite number of virtual owner/operators
2. Provides scalable bandwidth, an advantage over PVCs
3. Provides unified database management which eliminates synchronization errors
4. Allows each virtual owner/operator to run their features and feature servers
5. Allows the owner of the physical system to sell value-added services to virtual owner/operators

Using the Access Switch Architecture to Unbundle POTS in RTs

The same general criteria that apply to DSL also apply to POTS. Each circuit in an RT can be identified as to virtual ownership. The individual circuits can then be associated with the feature server of the owner/operator. Switching of POTS circuits can result either in circuits being terminated on the RT for inter-RT calls, or on circuits terminated on an IMT towards the network. SS7 signaling is performed on behalf of the distributed system by the access switch.

The access switched architecture can also be used to unbundle POTS circuits in an RT. In this mode, the RT can use the access switch to perform the proxy signaling for DSL described in the previous section while processing voice calls on behalf of many virtual owners. The assumption in this configuration is that there is a single physical owner of the RT and the access switch. The operator of these facilities employs a multi-client provisioning system that enables work orders to be processed through the physical system operator.

The feature tables that are used to correlate feature invocation to feature servers are built through the multi-client OAM&P system at the time that the virtual owner initiates service on the RT. These tables will have a template form that can be easily downloaded. The feature tables themselves are small data structures making the number of feature tables present at any one time practically unlimited. The feature tables can be modified without affecting operation of any other service provider. The dialing plans for initiating a feature are contained in these tables. Corresponding to any feature entry is the network signaling agent in the access switch. When the subscriber signals for a connection, the access switch call agent works with the feature server of the subscriber's virtual owner to find the service. Once the network location for the service has been determined, the call agent acts as an ATM proxy signaling agent to establish the virtual connection. This enables DSL to have virtual ownership at the RT and to be switched, giving DSL a level of scalability that it does not have when used in permanent virtual circuit mode (PVC).

When DSL is used to provide voice over DSL (VoDSL), the access switch manages calls either as ATM connections or as TDM connections. In either case, the access switch provides capability to manage the subscriber end of the call as ATM or TDM and the trunk side of the call as TDM, ATM or IP. In each case, the trunk protocol choice is made on a call-by-call basis by the virtual owner of the subscriber.

An access switch can control all or part of an RT. If an RT is connected to a Class 5 switch over TR-08 or GR-303, that connection can remain while other parts of the RT can be controlled by an access switch. Thus, an RT can be unbundled progressively without disturbing the configuration of the original owner or operator.

Inter-machine trunks (IMT) connect the time division multiplexed (TDM) voice traffic coming from the NGDLC to the network. IMTs are the traditional trunk type that connects today's Class 5 switches to the network. These trunks can be segregated as to ownership or can carry mixed traffic. IMTs can be connected directly to Class 4 Tandem switches or pre-sorted and aggregated through cross connects.

Optical connections are available to carry high-speed data traffic from the NGDLC into the network. These connections can be engineered to meet the needs of the services that they carry such as asynchronous transfer mode (ATM), Internet protocol (IP) or others.

Because the access switch is separated from the network service delivery hardware, it is not dedicated to a particular type of connection management or switching. Rather, the access switch readily adapts to new network protocols. Thus, an access switch can be useful to voice switching, and at the same time, can manage switched virtual circuits (SVCs) for ATM.

Connecting Feature Servers to Access Switches

Feature servers do not particularly care how many access switches are connected to them. Their only real limitation is how much feature traffic their computer can handle at any one time. They use any of several protocols to communicate with access switches, and rely on packet networks to carry instructions back and forth between the feature server and the access switch. Because of this, a network operator can have a single feature server connected to unbundled RTs and at the same time, can use this feature server with co-located access devices under the control of an access switch. The co-located access device is used by CLECs to electronically gather unbundled loops inside an ILEC wire center. Most often, the access device is an NGDLC of the type used as an RT. This creates the potential for a uniform feature delivery system for a CLEC, even though the physical circumstances may vary widely.

The service delivery or media layer of the network, the NGDLC RT, is a widely-deployed technology. Most NGDLCs have powerful, latent capabilities that enable them to perform voice switching and ATM routing. Many are able to serve a plethora of services ranging from POTS to DSL. Most RTs can be upgraded easily to manage DSL and ATM. To upgrade an NGDLC RT to work with an access switch only requires a little additional hardware for decoding tone dialing and for generating tones. Most of the address of the feature server that provides the service. The access switch, depending on which feature server-to-access switch protocol is being used, supplies necessary information so that the feature server can take control of the call during the feature sequence.

The access switch is able to provide all of the usual information regarding traffic, call peg counts, status and alarm information. It is a relatively easy matter to sort this information by owner so that each owner/operator can get access to the kind of information that would be expected from a traditional switch.

It should be noted that GR-303 interface groups can work alongside the access switched portion of the RT. This would enable incumbent operators who rely on GR-303 today to continue operation in the current mode without disruption of their business model. It allows some small number of other operators to use GR-303 interface groups subject to the same limitations noted in the section on unbundling with GR-303.

A summary of the benefits of using the access switch architecture to unbundle RTs:

1. Scales to an unlimited number of owner operators.
2. Eliminates database synchronization issues presented by GR-303.
3. Allows an operator to continue their current business model ininteruppted.
4. Provides dialtone at a fraction of the cost of traditional Class 5 alternatives.
5. Eliminates the need for complicated physical arrangements to be made, such as space sharing.
6. Provides new operators the ability to provide services and features of their choosing.
7. Leverages current infrastructure for the benefit of all.
8. Retains the physical system operator's ability to sell value-added capabilities beyond those of basic unbundled loops.
9. Simplifies the problems associated with loop testing in a multi-owner, electronic loop environment.
10. Requires a minimum modification of existing network facilities and can be done quickly.
11. Positions the network for continued evolution to advanced services while not disadvantaging any one network service provider.

Other Features of the Access Switched Architecture

The access switch is fundamentally a media gateway controller. As such, it is assumed that a variety of transport methodologies will be employed on both the line and trunk sides of the RT. The line-side technologies might include all forms of DSL, fiber optics, wireless and just POTS. Each of these line technologies might use transport protocols such as TDM, IP or ATM. The transport protocols are executed at the media gateway (physically, the RT). Control of the protocols is executed at the media gateway controller (the access switch).

Using this architecture then enables choices of protocol technologies to be associated with line-side technologies on demand. As was discussed in the example of ATM proxy signaling for DSL, the access switch makes an ideal location for matching service characteristics to media characteristics, thus insuring the greatest possible flexibility in providing advanced features.

Each virtual owner/operator has equal access to resources, thereby fostering both services and competition. The kinds of services that will be available with access-switched architecture include:

1. Voice over TDM.
2. Voice over IP.
3. Voice over ATM.
4. Voice over DSL (using TDM, IP or ATM)
5. ATM proxy signaling.
6. Dialtone for data calls.

Summary

The access switching architecture provides a match for the current need to address competitive issues and RT unbundling. It not only provides a simple answer that provides benefits to all network users, it provides a major step in the direction of the next generation network architecture, in which multi-owner, multi-service issues will be the predominant drivers.

For more information on access switching, its capabilities and applications to network opportunities, please contact Westwave Communications.

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