

**QWEST Communications  
International Inc.  
Technical Publication**

**DIVERSITY AND AVOIDANCE**

## NOTICE

This document describes QWEST Diversity and Avoidance service enhancement options, offered by QWEST Communications International Inc. appropriate for the majority of applications. Sufficient technical detail is provided to allow a customer, such as an Interexchange Carrier or End-User, to select and order the appropriate options to enhance the reliability of the end-to-end communications circuit. It is not the intent of this document to provide specific ordering information, but to describe the technical features of this service enhancement. Diversity and Avoidance paths are provided via the provision of additional, separately identified (numbered) circuits, legs and/or telephone numbers.

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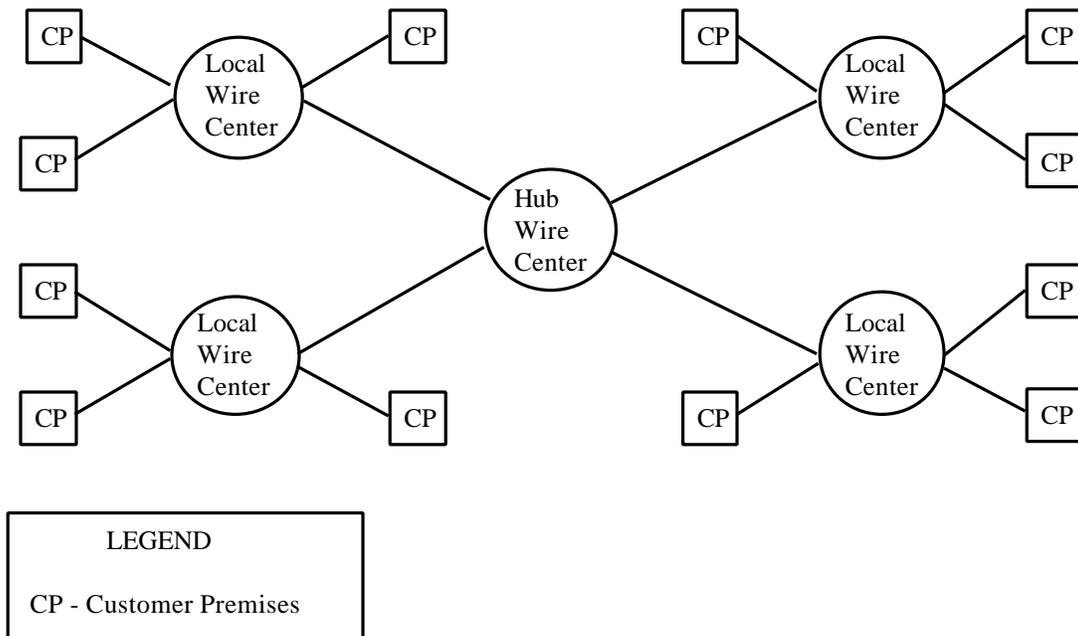
## 1. Introduction

### 1.1 Purpose

This document describes QWEST Communications International Inc. (QWEST) Diversity and Avoidance service enhancement options, offered by QWEST, appropriate for the majority of applications. Sufficient technical detail is provided to allow a customer, such as an Interexchange Carrier or End-User, to select and order the appropriate options to enhance the reliability of the end-to-end communications circuit. It is not the intent of this document to provide specific ordering information, but to describe the technical features of this service enhancement. Diversity and Avoidance paths are provided via the provision of additional, separately identified (numbered) circuits, legs and/or telephone numbers.

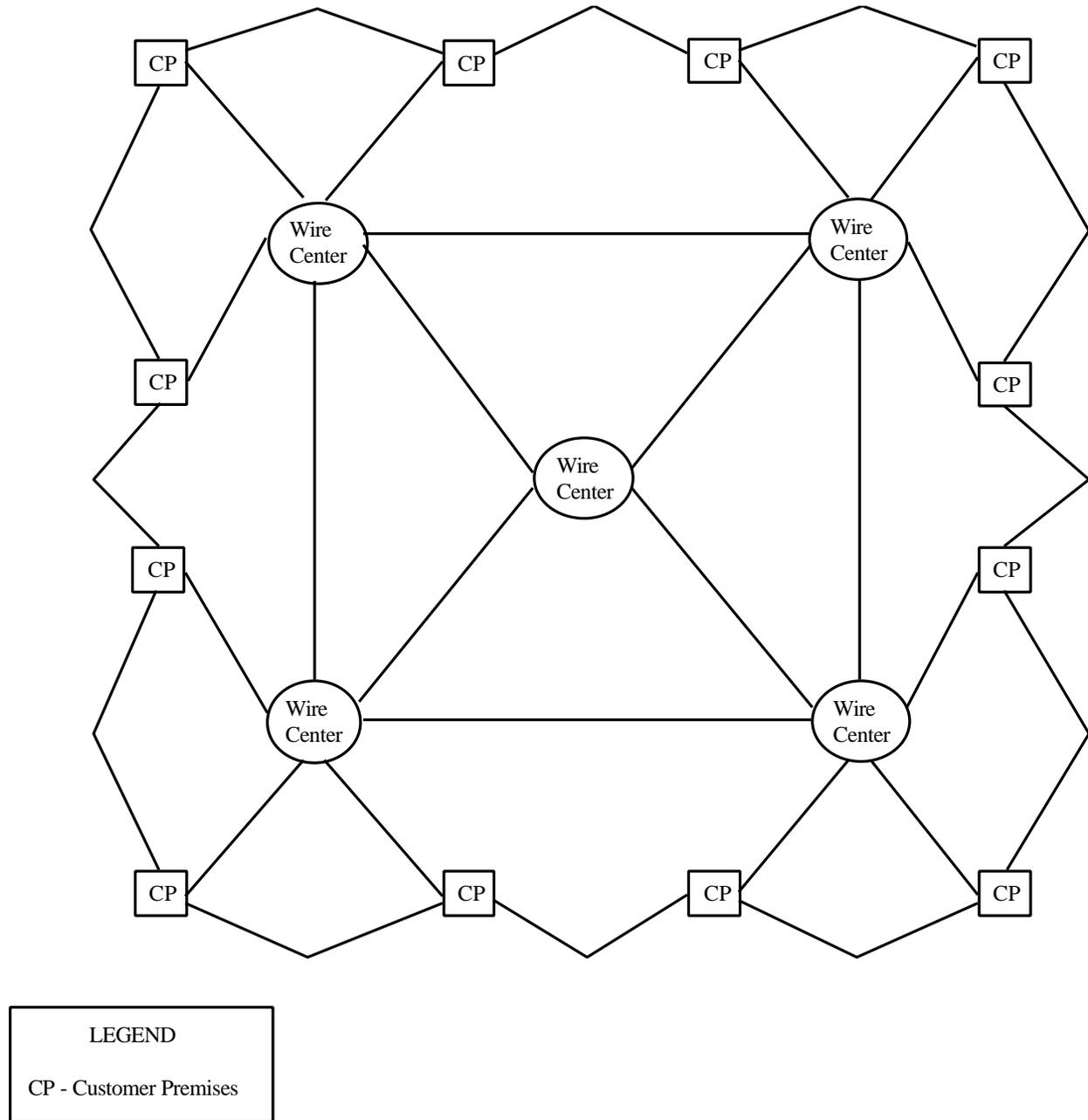
### 1.2 General

The telephone industry has spent many years developing a network which is based on a star topology (Figure 1-1).



**Figure 1-1** Star Topology

Provision of Diversity and Avoidance requires that the topology presently in place (star) be modified to integrate the service enhancement. To provide Diversity and Avoidance, the network must evolve towards the ring topology (Figure 1-2) which will enable it to provide the additionally offered survivability.



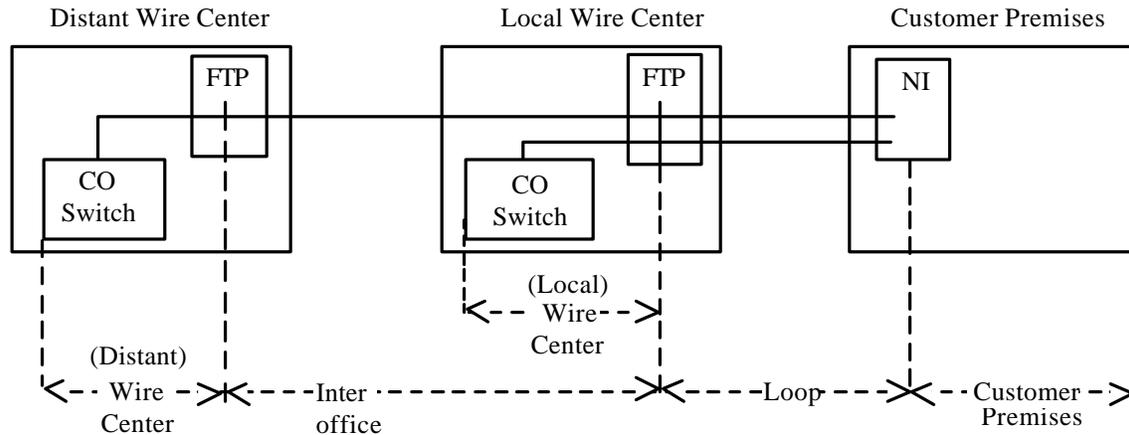
**Figure 1-2** Ring Topology

Some of the present systems supporting the interoffice and loop network are not capable of identifying and maintaining the identification of circuits which require a minimum 25 feet of separation. Therefore, this activity must be done manually and checked regularly. The required manual intervention adds significantly to the recurring costs involved with Diversity and Avoidance.

There are four areas of vulnerability for any customer circuit (Figure 1-3):

- The Loop - facilities\* from in the Local Wire Center to the Network Interface (NI) at the customer premises.
- The Wire Center - equipment within the Wire Center from the Central Office (CO switch), local or distant, to the FTP.
- The Interoffice Facilities - facilities\* from the FTP in the Serving Wire Center (Local) to the FTP in another Wire Center (Distant).
- The Customer Premises - includes anything beyond (on the customers side) the Network Interface (NI) at the customers building or location. Customer Premises (CP) is the customer's responsibility and is not provided through the regulated operations of U S WEST.

**Note:** Facilities may include fiber optic cable, copper cable, microwave, etc.

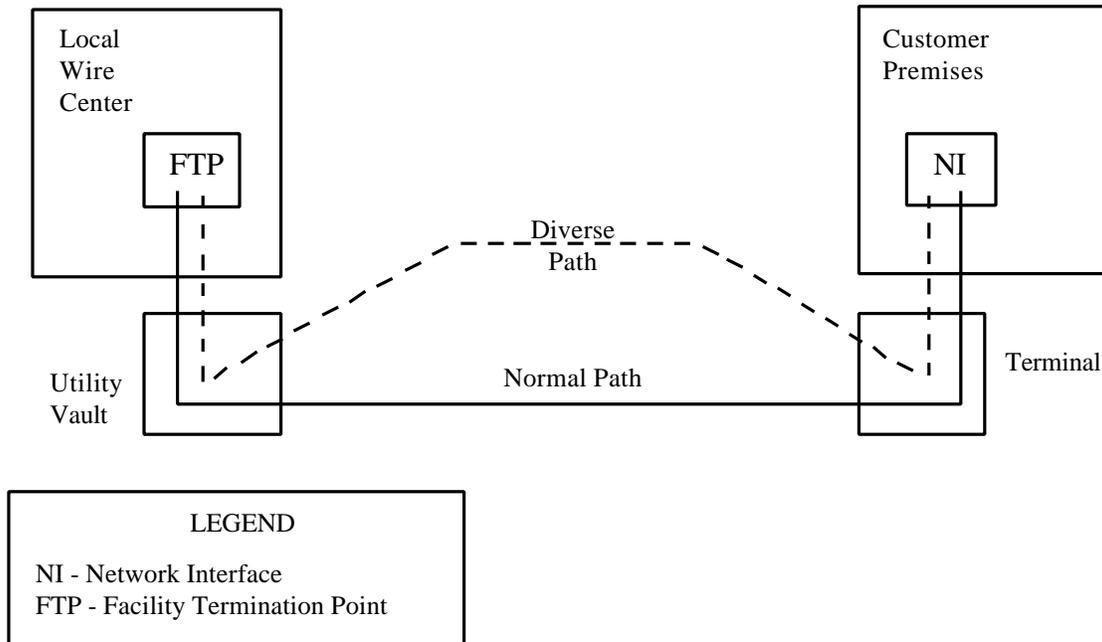


**Figure 1-3** Areas of Vulnerability

### 1.3 Options

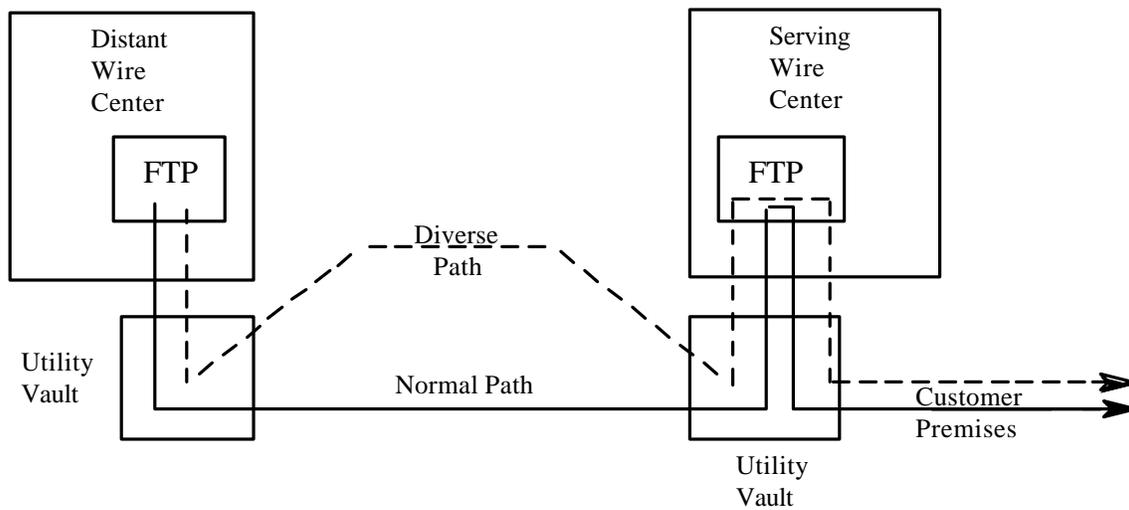
Six options for increasing the survivability of business telecommunication service are available. Three options are specifically related to Diversity and Avoidance, which will be addressed in detail in this document, and three are fiber optic stand-by and ring topology services.

- Loop Diversity - Provides a second path from the first utility vault outside the local wire center to the last terminal prior to the customer premises (Figure 1-4).



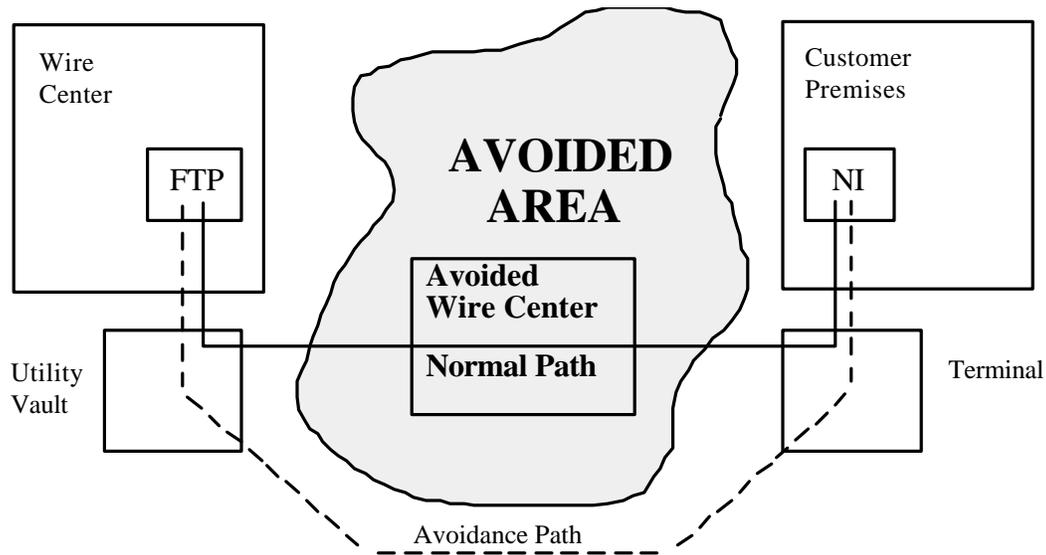
**Figure 1-4** Loop Diversity

- **Interoffice Route Diversity** - (Route Diversity) provides a second path between the first utility vault outside the Serving Wire Center to the first utility vault outside the Distant Wire Center (Figure 1-5).



**Figure 1-5** Interoffice Route Diversity

- Avoidance - Physical avoidance of a given geographical area and/or wire center (Figure 1-6).



**Figure 1-6** Avoidance

- **Protect Path Diversity** - provided over fiber optic facilities only. This service provides a "standby" protect fiber path, which is routed over facilities separated, from the normal path, by 25 feet or more. Fiber optic facility separation is from the first utility vault outside the serving wire center to the last terminal prior to the customer's premises. Protect Path Diversity provides loop diversity only (from the serving wire center to the customer's premises).
- **Self Healing Alternate Route Protection (SHARP)** - an optional service that improves the reliability of DS1 or DS3 services that are transported over fiber Optic facilities. Protection is routed through an alternate Wire Center. See QWEST PUB 77340 titled "Self Healing Alternate Route Protection" for additional information.
- **Self Healing Network Services (SHNS)** - a ring topology that connects several customer locations and, at a minimum, one QWEST Wire Center. Provides switching to protection ring (path) upon detection of a failure on the main ring (path). See QWEST PUB 77332 titled "Self Healing Network Service" for additional information.

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## 2. Description

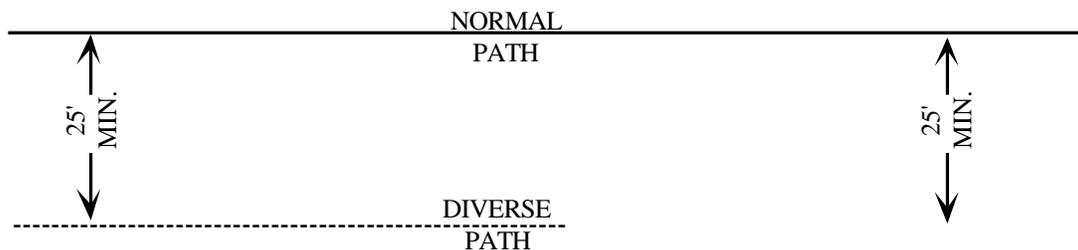
### 2.1 Applicability of Technical Specifications

The technical specifications presented in this document are applicable to service enhancements available with QWEST Diversity and Avoidance options. They do not attempt to describe the various types of transmission equipment and facilities required to provide this service enhancement.

### 2.2 Product Description

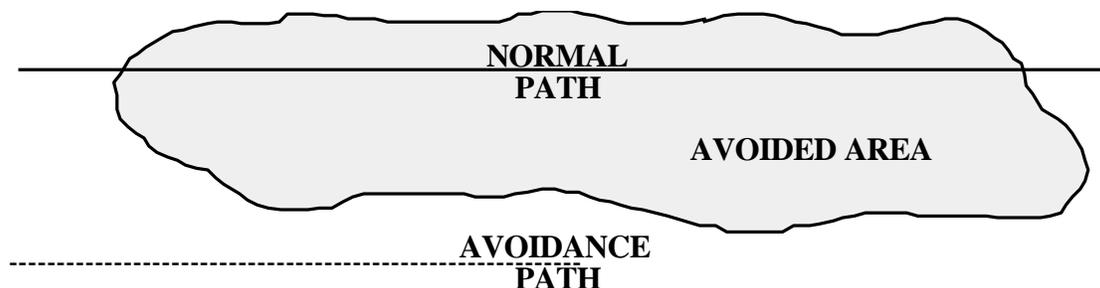
QWEST Diversity and Avoidance offers enhancements to switched and non-switched service products such as voice grade service, Digital Data Service, DS1, video service, etc. The primary application for Diversity and Avoidance is, in the event of a failure in the network, to provide continued communications by means of an alternate and/or redundant network. Diversity and Avoidance enhancements may be applied to similar (e.g., 2 ring downs) or dissimilar (e.g., 1 ring down and 1 analog data) services.

- Diversity - the routing of two fully functional services over facilities separated by a minimum of twenty-five (25) feet (Figure 2-1).



**Figure 2-1** Diversity Separation Requirement

- Avoidance - the routing of a facility to avoid a customer defined geographical area and/or Wire Center (Figure 2-2).



**Figure 2-2** Avoidance Requirement

### 2.3 Configurations

Diversity can be separated into three distinct components:

- **Loop Diversity** - routing of two fully functional services over equivalent loop facilities separated by a minimum of twenty-five (25) feet. Loop diversity is from the first utility vault outside the Serving Wire Center (generally all facilities leave a Wire Center, to the first utility vault, within the same conduit, cable sheath, etc.) to the last terminal prior to the customer's premises. Loop diversity protects the customer against an accidental cutting of the normal path facility (cable). It does not normally protect the customer from a failure in the Serving Wire Center, including the Facility Termination Point (FTP), cable from the FTP to the Cable Entrance Facility (CEF), Cable Entrance Facility, cable from the CEF to the first utility vault or first utility vault outside the Serving Wire Center (Figure 2-3).

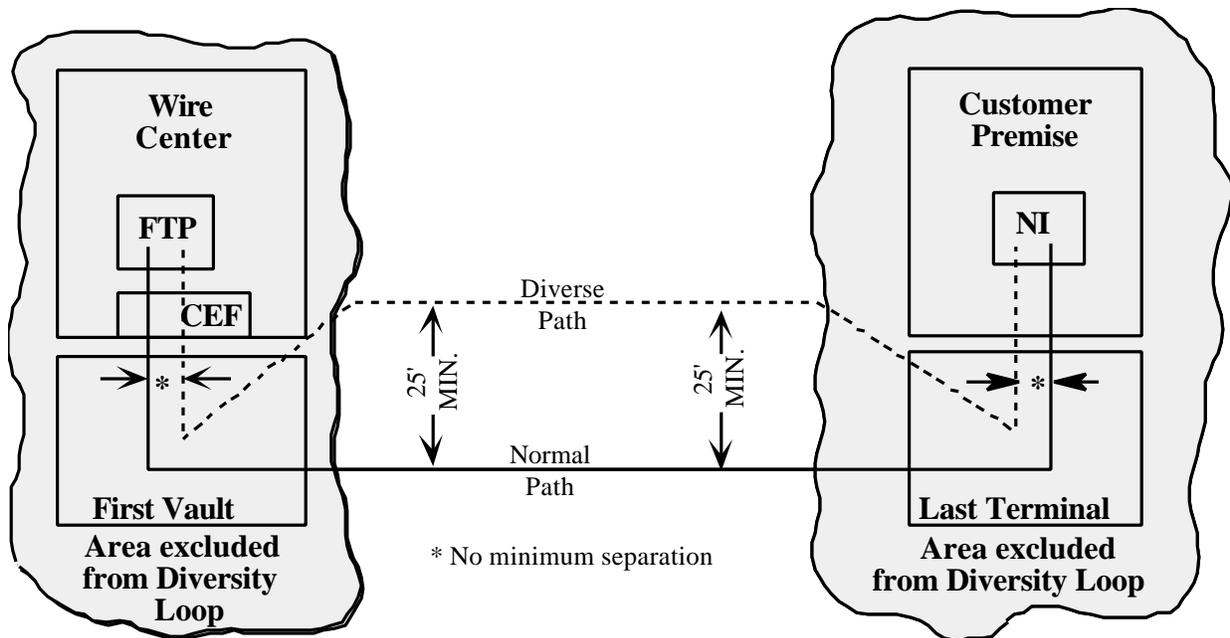
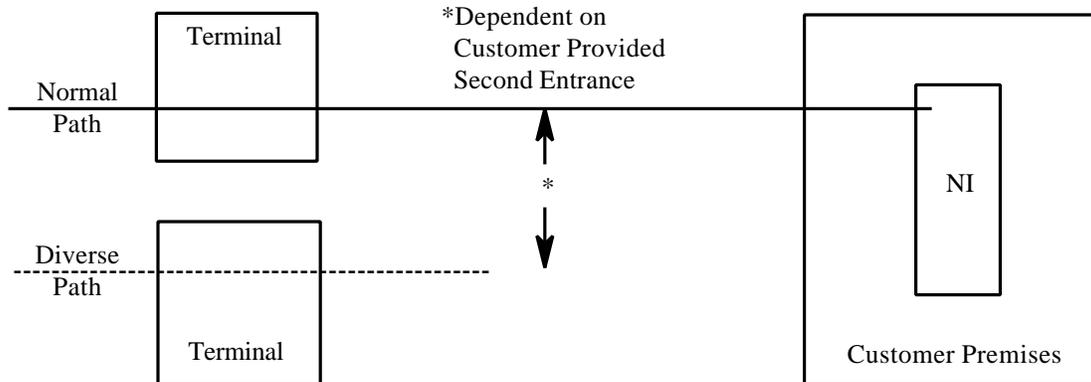


Figure 2-3 Loop Diversity Exclusions

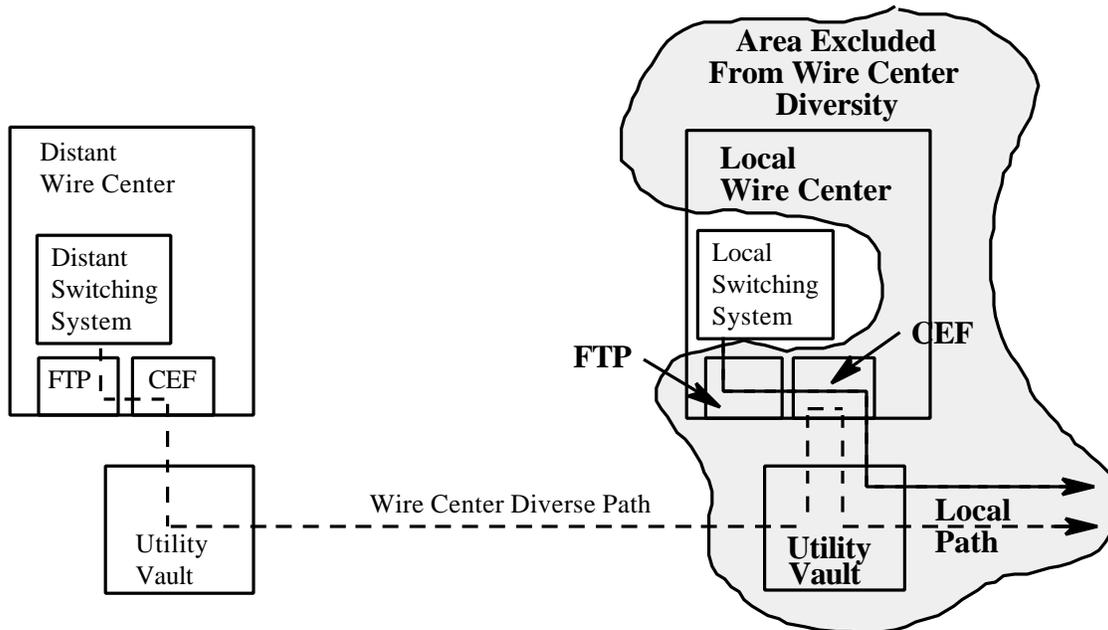
Additional loop diversity may be provided via a second entrance to the customer's premises. Provision of a second entrance, which meets existing QWEST Entrance Facility standards applicable to the primary service, is the responsibility of the customer (Figure 2-4).



**Figure 2-4** Customer Entrance Cable Diversity

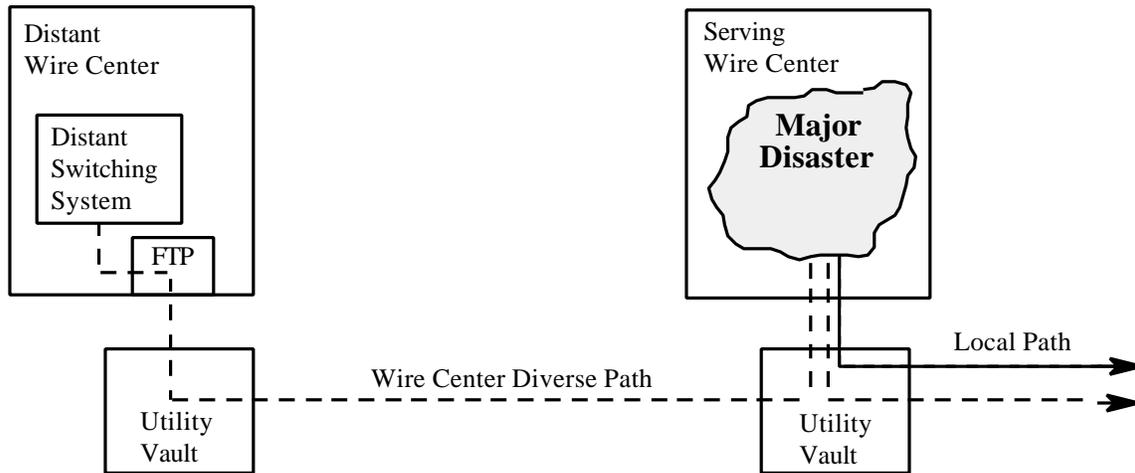
The customer may duplicate services (redundant route) over the two routes or they may wish to provide part of their services over one route and the remainder over the second route (alternate route).

- **Wire Center Diversity** - provides alternate access to the public switched network via a Distant Wire Center. Wire Center Diversity includes the central office switching system only. The Serving Wire Center Facility Termination Point (FTP), cable from the FTP to the Cable Entrance Facility (CEF), Cable Entrance Facility, cable from the CEF to the first utility vault outside the wire center and the first utility vault are not included (Figure 2-5).



**Figure 2-5** Wire Center Diversity Exclusions

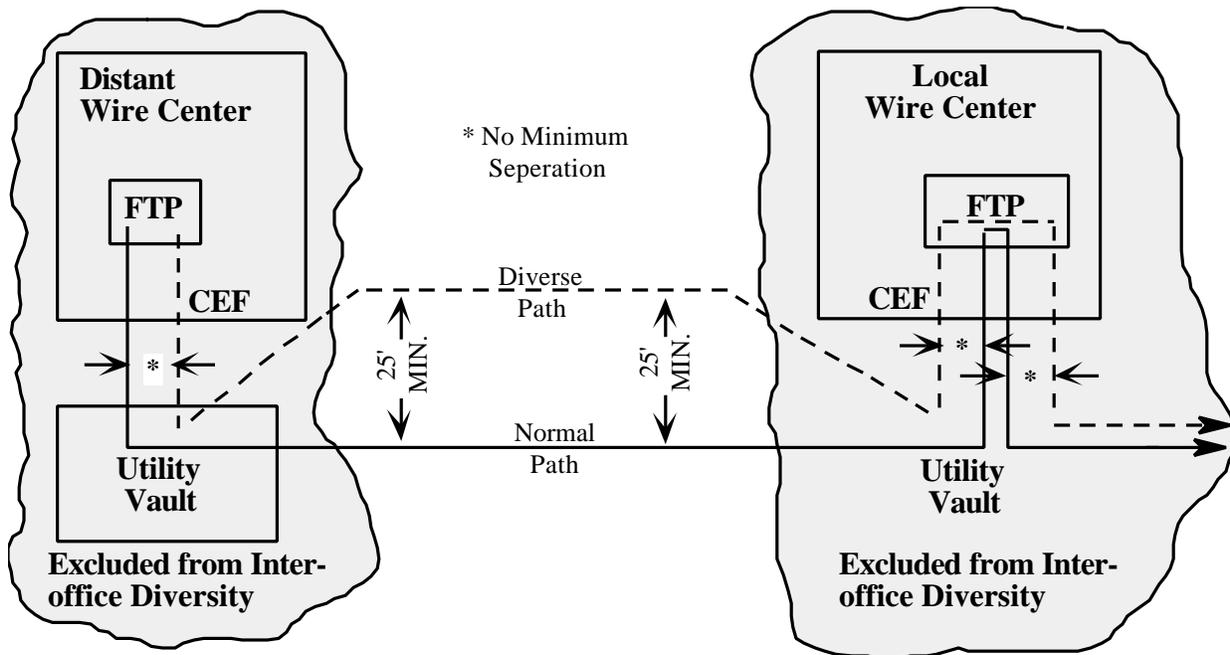
Wire Center Diversity (Distant Wire Center), in itself, does not provide a fully diverse route, and should not be interpreted as a service that bypasses (avoids) the Serving Wire Center. Distant Wire Center will provide the customer with dial tone if the Serving Wire Center switching system fails. However, if the Serving Wire Center experiences a major disaster, such as a fire or flood, the Distant Wire Center service may also be lost, because its wiring passes through the Serving Wire Center (Figure 2-4).



**Figure 2-6** Local Wire Center Disaster

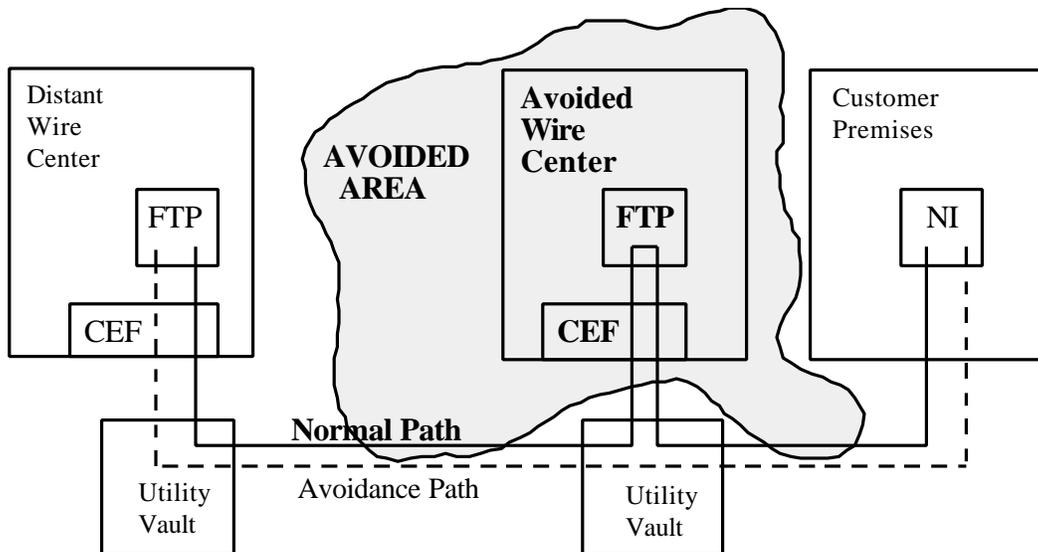
- **Interoffice Diversity** - includes the facilities connecting Wire Centers from the first utility vault outside the Serving Wire Center (Local) to the first utility vault outside a Distant Wire Center.

Interoffice diversity provides routing of two fully functional services over equivalent facilities separated by a minimum of twenty-five (25) feet. Interoffice diversity is from the first utility vault outside the Serving Wire Center (Local) to be the first utility vault outside the Distant Wire Center. Interoffice diversity protects the customer against an accidental cutting of the normal path facility between Wire Centers. It does not normally protect the customer from a failure in the Wire Centers, including the Facility Termination Point (FTP), cable from the FTP to the Cable Entrance Facility (CEF), Cable Entrance Facility, cable from the CEF to the first utility vault or first utility vault outside the Wire Centers (Figure 2-7).



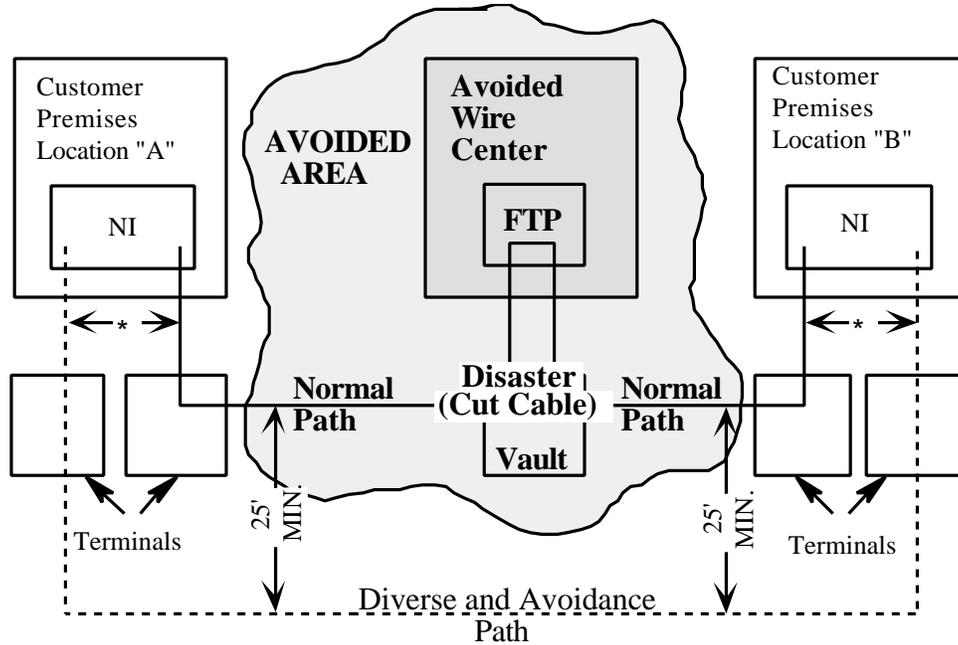
**Figure 2-7** Interoffice Diversity Exclusions

Avoidance is the routing of circuits to avoid or bypass a customer defined geographical area and/or Wire Center (Figure 2-8).



**Figure 2-8** Avoidance Route

- In the event of a disaster, Diversity (Loop, Wire Center and Interoffice) in conjunction with Avoidance, can significantly increase the survivability of a portion of the customer's services (Figure 2-9).



\* Separation dependent on Customer Provided Second Entrance.

**Figure 2-9** Diversity and Avoidance Survivability

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### 3. Network Interfaces

#### 3.1 Description of Interfaces

QWEST Diversity and Avoidance are enhancements to existing service offerings, and as such, do not require creation of new Network Interfaces. Interfaces developed for existing services are used on the Diverse/Avoidance circuits.

Network Interface types and descriptions are addressed in the respective QWEST and Telcordia Technical Publications listed below.

#### **QWEST Documents:**

- PUB 77309-Voice Grade Special Service Basic Voice Transmission Parameters, Limits and Interface Combinations
- PUB 77311-Analog Channels for Non-Access Service
- PUB 77312-QWEST Digital Data Service, Technical Product Description, Transmission Parameter Limits, and Interface Combinations
- PUB 77324-QWEST DS3 Service
- PUB 77326-QWEST Private Line Commercial Video Service
- PUB 77332-Self Healing Network Service
- PUB 77340-Self Healing Alternate Route Protection

#### **Telcordia Documents:**

- TR-NPL-000054-High-Capacity Digital Service (1.544 Mbit/s) Interface Generic Requirements for End Users

**Note:** Paragraph 3.5.1 of TR-NPL-000054 is suspended and the customer signal at the Network Interface (NI) shall conform to the following: The Customer signal at the NI may be attenuated by the Line Build Out (LBO) of the registered terminal equipment, by any value required to meet requirements of FCC Rules and Regulations Part 68.308 for CSU Line-Build Out adjustment. Customer cable and wire attenuation between the CSU and NI must not exceed 5.5 dB. Customer calculations for setting the LBO option switch of their terminal equipment shall treat their cable and wiring attenuation as LBO for determining the final value needed.

- TA-TSY-000342-High-Capacity Digital Service Access Service Transmission - Parameter Limits and Interface Combinations
- TR-NPL-000338-Television Special Access and Local Channel Services Transmission Parameters

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## 4. Performance Specifications

### 4.1 Availability

Diversity: available for all classes of service including exchange service (e.g., 1FB, Trunks, Centrex type lines, etc.), voice grade private line (e.g., ring down, analog data, etc.) and digital services (e.g., 2.4kbit, 9.6kbit, DS1, DS3, etc.).

- Diversity is subject to availability of facilities.
- When facilities are not available, Special Construction charges may be assessed.

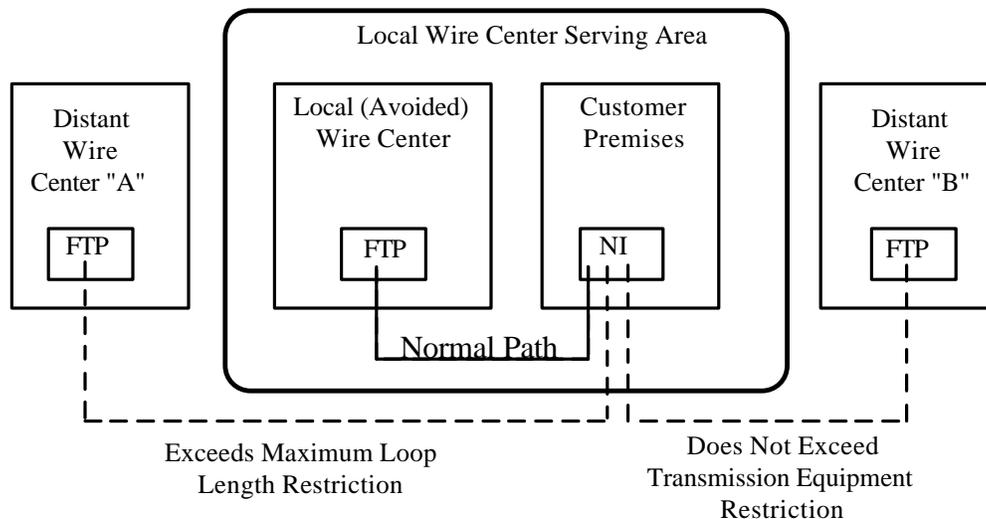
Avoidance: available for all classes of service including exchange service (e.g., 1FB, Trunks, Centrex type lines, etc.), voice grade private line (e.g., ring down, analog data, etc.) and digital services (e.g., 2.4kbit, 9.6kbit, DS1, DS3, etc.).

- Avoidance is subject to availability of facilities.
- When facilities are not available, Special Construction charges may be assessed.

### 4.2 Transmission Restriction

Service enhancements offered and provided by Diversity and Avoidance must meet existing QWEST transmission requirements as defined in the appropriate QWEST Technical Publications.

For some services, the long copper loop lengths required to bypass a Local Wire Center may, in some cases, make Avoidance technically impossible to provide (Figure 4-1).



**Figure 4-1** Transmission Restriction

### **4.3 Performance Requirements**

The Diversity and Avoidance options offered by QWEST provide significantly increased circuit survivability during major and minor disasters. During a disaster (cut cable, fire, flood, etc.), the increased survivability provided will depend on the Diversity and Avoidance options requested by the customer.

Performance will meet existing requirements as specified in the appropriate QWEST Technical Publications.

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## **5. Maintenance**

### **5.1 Customer Responsibilities**

- The customer is responsible for all equipment and cable on the customer side of the Network Interface.
- The customer's responsibilities are further detailed in documentation pertaining to the primary service description.

### **5.2 QWEST Responsibilities**

- QWEST is responsible for all equipment and cable on the QWEST side of the Network Interface.
- Specific QWEST responsibilities are further detailed in documentation pertaining to the primary service description.

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## **6. Definitions**

### **6.1 Acronyms**

CEF	Cable Entrance Facility
CO	Central Office
CP	Customer Premises
FTP	Facility Termination Point
LBO	Line Build Out
NI	Network Interface
SHARP	Self Healing Alternate Route Protection
SHNS	Self Healing Network Services

### **6.2 Glossary**

#### **Alternate Route**

Places part of a customers services over one route and the remainder of the services over a second route.

#### **Avoidance**

Bypassing a customer specified geographical area and/or Wire Center.

#### **Cable Entrance Facility**

Room generally located inside the Wire Center (Central Office Building) or just outside the building. It is the point of interface between the Outside Plant cable network and the cables leading to a Facility Termination Point.

#### **Central Office**

A local switching system (or a portion thereof) and its associated equipment located at a wire center

#### **Central Office Building**

See Wire Center.

#### **Customer Loop**

See Loop.

#### **Customer Entrance Cable**

Cable from the last terminal outside the Customer's Premises to the Network Interface.

**Diversity**

Routing of customer circuits or access lines over physically separated facilities.

**Facility**

Any cable, poles, conduit, microwave, carrier equipment, wire center distributing frames, central office switching equipment, computers (both hardware and software), business machines, etc., utilized to provide (1) the services offered by the Telephone Company, or (2) the services provided by an IC for its own use or for an IC end-user's use.

**Facility Termination Point**

Generic term for the point of termination, in the Wire Center, for a cable pair, optic fiber, microwave signal, etc.

**Foreign Exchange**

Telephone company line arrangement where calls placed into the switched network, from a customer location, enter the network through a Central Office located in a Wire Center (Foreign Wire Center) which is different than the one which normally serves the customer location.

**Foreign Wire Center**

Building in which the Foreign Central Office is located.

**Local Loop**

See Loop.

**Local Wire Center**

The Wire Center which normally provides service to a customer.

**Loop**

The facility which connects the Local Wire Center to the customer's location.

**Main Distribution Frame**

(MDF) The physical location, in the Wire Center, where circuits on copper pairs are bridged, cross-connected or terminated.

**Network**

The interconnected telecommunications equipment and facilities.

**Network Interface**

The point of demarcation on the end user's premises at which the Telephone Company's responsibility for the provision of Access Service ends.

**Outside Plant**

All telephone company materials (cable, utility vaults, poles, terminals, underground conduit, etc.) beginning at the FTP, in the Local Wire Center, and ending at the Network Interface at the customer premises.

**Redundant Route**

Places the same customer services over two separate routes.

**Route**

The physical path established through a network for a particular circuit.

**Serving Area**

Geographic Area which is normally provided telecommunication services via one Wire Center.

**Serving Wire Center**

The term "Serving Wire Center" denotes a QWEST Central Office from which a dial tone for the Local Exchange Service would normally be provided to the demarcation point on the property at which the customer is served.

**Tandem Office**

Major switching center for the switched telephone network. Interconnects local central offices as a central office interconnects individual customer lines.

**Terminal**

In the loop, predetermined points of access designed to facilitate connection of the Customer Entrance Cable to the Outside Plant Facility.

**Utility Vault**

An underground vault which is large enough for a person to work in, and into which cables enter. Previously referred to as a Manhole.

**Wire Center**

The location of one or more local switching systems (or a portion thereof). A location at which customer loops converge.

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## 7. References

### 7.1 Bellcore Documents:

TR-NPL-000054      *High-Capacity Digital Service (1.544 Mbit/s) Interface Generic Requirements for End Users, Issue 1, 1989*

**Note:** Paragraph 3.5.1 of TR-NPL-000054 is suspended and the customer signal at the Network Interface (NI) shall conform to the following: The Customer signal at the NI may be attenuated by the Line Build Out (LBO) of the registered terminal equipment, by any value required to meet requirements of FCC Rules and Regulations Part 68.308 for CSU Line-Build Out adjustment. Customer cable and wire attenuation between the CSU and NI must not exceed 5.5 dB. Customer calculations for setting the LBO option switch of their terminal equipment shall treat their cable and wiring attenuation as LBO for determining the final value needed.

TA-INS-000342      *High-Capacity Digital Special Access Service Transmission - Parameter Limits and Interface Combinations, Issue 1, February 1991*

TR-NPL-000338      *Television Special Access and Local Channel Services Transmission Parameter Limits and Interface Combinations, Issue 2, 1993*

### 7.2 QWEST Documents:

PUB 77309            *Voice Grade Special Service Basic Voice Transmission Parameters, Limits and Interface Combinations, Issue C, September 2001*

PUB 77311            *Analog Channels for Non-Access Service, Issue D, - July 2001*

PUB 77312            *QWEST Digital Data Service, Technical Product Description, Transmission Parameter Limits, and Interface Combinations, Issue G, September 2001*

PUB 77324            *QWEST DS3 Service, Issue D, September 2001*

PUB 77326            *QWEST Private Line Commercial Video Service, Issue E, September 2001*

PUB 77332            *Self Healing Network Service, Issue L, January 2001*

PUB 77340            *Self Healing Alternate Route Protections, Issue F, September 2001*

PUB 77375            *1.544 Mbit/s Channel Interfaces Technical Specifications for Network Channel Interface Codes Describing Electrical Interfaces at Customer Premises and at QWEST Communications International Inc. Central Offices, Issue D, September 2001*

### 7.3 Ordering Information

All documents are subject to change and their citation in this document reflects the most current information available at the time of printing. Readers are advised to check status and availability of all documents.

Those who are not QWEST employees may order;

American National Standards Institute (ANSI) documents from:

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