Case No. 99-C-0529

Panel Testimony of
Leo Maese and August Ankum

ATTACHMENT I

CV OF DR. AUGUST H. ANKUM

Curriculum Vitae
August H. Ankum, Ph.D.
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I am an economist and consultant, specializing in public utility regulation. In this capacity, I have provided consulting services in the major telecommunications markets of the United States, such as New York, Texas, Illinois, Michigan, Tennessee, Georgia, and in a variety of smaller states. My consulting activities focus mostly on telecommunications regulation. Specifically, I work with corporate clients, such as MCI, AT&T, AT&T Wireless, and smaller clients, such as Brooks Fiber and PCS providers before state and federal regulatory agencies in various proceedings concerning the introduction of competition in telecommunications markets. Recently, these proceedings focus largely on the implementation of the pro-competition provisions of Telecommunications Act of 1996.

Professional experience:

My professional background includes work experiences in private industry, a state regulatory agency, and academia. I have worked for MCI Telecommunications Corporation ("MCI") as a senior economist. At MCI, I provided expert witness testimony and conducted economic analyses for internal purposes. Prior to joining MCI in early 1995, I worked for Teleport Communications Group, Inc. ("TCG"), as a Manager in the Regulatory and External Affairs Division. In this capacity, I testified on behalf of TCG in proceedings concerning local exchange competition issues. From 1986 until early 1994, I was employed as an economist by the Public Utility Commission of Texas ("PUCT") where I worked on a variety of electric power and telecommunications issues. During my last year at the PUCT I held the position of chief economist. Prior to joining the PUCT, I taught undergraduate courses in economics as an Assistant Instructor at the University of Texas from 1984 to 1986.

Education:

I received a Ph.D. in Economics from the University of Texas at Austin in 1992, an M.A. in Economics from the University of Texas at Austin in 1987, and a B.A. in Economics from Quincy College, Illinois, in 1982.

PROCEEDINGS IN WHICH DR. ANKUM HAS FILED EXPERT WITNESS TESTIMONY:

New York

Commission Investigation into Resale, Universal Service and Link and Port Pricing, New York Public Service Commission, Case Nos. 95-C-0657, 94-C-0095, and 91-C-1174, July 4, 1996. On behalf of MCI Telecommunications Corporation.

Texas

Petition of The General Counsel for an Evidentiary Proceeding to Determine Market Dominance, PUC of Texas, Docket No. 7790, Direct Testimony, June 1988. On behalf of the Public Utility Commission of Texas.

Application of Southwestern Bell Telephone Company for Revisions to the Customer Specific Pricing Plan Tariff, PUC of Texas, Docket No. 8665, Direct Testimony, July 1989. On behalf of the Public Utility Commission of Texas.

Application of Southwestern Bell Telephone Company to Amend its Existing Customer Specific Pricing Plan Tariff: As it Relates to Local Exchange Access through Integrated Voice/Data Multiplexers, PUC of Texas, Docket No. 8478, Direct Testimony, August 1989. On behalf of the Public Utility Commission of Texas.

Application of Southwestern Bell Telephone Company to Provide Custom Service to Specific Customers, PUC of Texas, Docket No. 8672, Direct Testimony, September 1989. On behalf of the Public Utility Commission of Texas.

Inquiry of the General Counsel into the Reasonableness of the Rates and Services of Southwestern Bell Telephone Company, PUC of Texas, Docket No. 8585, Direct Testimony, November 1989. On behalf of the Public Utility Commission of Texas.

Southwestern Bell Telephone Company Application to Declare the Service Market for CO LAN Service to be Subject to Significant Competition, PUC of Texas, Docket No. 9301, Direct Testimony, June 1990. On behalf of the Public Utility Commission of Texas.

Petition of Southwestern Bell Telephone Company for Authority to Change Rates, PUC of Texas, Docket No. 10382, Direct Testimony, September 1991. On behalf of the Public Utility Commission of Texas.

Application of Southwestern Bell Telephone Company, GTE Southwest, Inc., and Contel of Texas, Inc. For Approval of Flat-rated Local Exchange Resale Tariffs Pursuant to PURA 1995 Section 3.2532, Public Utility Commission of Texas, Docket No. 14658, January 24, 1996. On behalf of Office of Public Utility Counsel of Texas.

Application of Southwestern Bell Telephone Company, GTE Southwest, Inc., and Contel of Texas, Inc. For Interim Number Portability Pursuant to Section 3.455 of the Public Utility Regulatory Act, Public Utility Commission of Texas, Docket No. 14658, March 22, 1996. On behalf of Office of Public Utility Counsel of Texas.

Application of AT&T Communications for Compulsory Arbitration to Establish an Interconnection Agreement Between AT&T and Southwestern Bell Telephone Company, and Petition of MCI for Arbitration under the FTA96, Public Utility Commission of Texas, Consl. Docket Nos. 16226 and 16285. September 15, 1997. On behalf of AT&T and MCI.

Illinois

Adoption of Rules on Line-Side Interconnection and Reciprocal Interconnection, Illinois Commerce Commission, Docket No. 94-0048. September 30, 1994. On behalf of Teleport Communications Group, Inc.

Proposed Introduction of a Trial of Ameritech's Customer First Plan in Illinois, Illinois Commerce Commission, Docket No. 94-0096. September 30, 1994. On behalf of Teleport Communications Group, Inc.

Addendum to Proposed Introduction of a Trial of Ameritech's Customer First Plan in Illinois, Illinois Commerce Commission, Docket No. 94-0117. September 30, 1994. On behalf of Teleport Communications Group, Inc.

AT&T's Petition for an Investigation and Order Establishing Conditions Necessary to Permit Effective Exchange Competition to the Extent Feasible in Areas Served by Illinois Bell Telephone Company, Illinois Commerce Commission, Docket No. 94-0146. September 30, 1994. On behalf of Teleport Communications Group, Inc.

Proposed Reclassification of Bands B and C Business Usage and Business Operator Assistance/Credit Surcharges to Competitive Status, Illinois Commerce Commission, Docket No. 95-0315, May 19, 1995. On behalf of MCI Telecommunications Corporation.

Investigation Into Amending the Physical Collocation Requirements of 83 Ill. Adm. Code 790, Illinois Commerce Commission, Docket 94-480, July 13, 1995. On behalf of MCI Telecommunications Corporation.

Petition for a Total Local Exchange Wholesale Tariff from Illinois Bell Telephone Company d/b/a Ameritech Illinois and Central Telephone Company Pursuant to Section 13-505.5 of the Illinois Public Utilities Act, Illinois Commerce Commission, Docket No. 95-0458, December 1995. On behalf of MCI Telecommunications Corporation.

Citation to Investigate Illinois Bell Telephone Company's Rates, Rules and regulations For its

Unbundled Network Component Elements, Local Transport Facilities, and End office Integration Services, Illinois Commerce Commission, Docket No. 95-0296, January 4, 1996. On behalf of MCI Telecommunications Corporation.

In the Matter of MCI Telecommunications Corporation Petition for Arbitration Pursuant to Section 252(b) of the Telecommunications Act of 1996 to Establish and Interconnection Agreement with Illinois Bell Telephone Company d/b/a Ameritech Illinois, Illinois Commerce Commission, Docket No. 96-AB-006, October, 1996. On behalf of MCI Telecommunications Corporation.

In the Matter of MCI Telecommunications Corporation Petition for Arbitration Pursuant to Section 252(b) of the Telecommunications Act of 1996 to Establish and Interconnection Agreement with Central Telephone Company of Illinois ("Sprint"), Illinois Commerce Commission, Docket No. 96-AB-007, January, 1997. On behalf of MCI Telecommunications Corporation.

Investigation into forward looking cost studies and rates of Ameritech Illinois for interconnection, network elements, transport and termination of traffic. Illinois Commerce Commission, Docket No. 96-0486, February, 1997. On behalf of MCI Telecommunications Corporation

Massachusetts

NYNEX/MCI Arbitration, Common Wealth of Massachusetts, Department of Public Utilities, D.P.U. 96-83, October 1996. On behalf of MCI Telecommunications Corporation.

New Mexico

Brooks Fiber Communications of New Mexico, Inc. Petition for Arbitration, New Mexico State Corporation Commission, Docket No. 96-307-TC, December, 1996. On behalf of Brooks Fiber Communications of New Mexico, Inc.

Michigan

In the Matter of the Application of City Signal, Inc. for an Order Establishing and Approving Interconnection Arrangements with Michigan Bell Telephone Company, Michigan Public Service Commission, Case No. U-10647, October 12, 1994. On behalf of Teleport Communications Group, Inc.

In the Matter, on the Commission's Own Motion, to Establish Permanent Interconnection Arrangements Between Basic Local Exchange Providers, Michigan Public Service Commission,

Case No. U-10860, July 24, 1995. On behalf of MCI Telecommunications Corporation.

In the Matter, on the Commission's Own Motion, to consider the total service long run incremental costs and to determine the prices for unbundled network elements, interconnection services, resold services, and basic local exchange services for Ameritech Michigan, Michigan Public Service Commission, Case No. U-11280, March 31, 1997. On behalf of MCI Telecommunications Corporation.

In the matter of the application under Section 310(2) and 204, and the complaint under Section 205(2) and 203, of MCI Telecommunications Corporation against AMERITECH requesting a reduction in intrastate switched access charges, Case No. U-11366. April, 1997. On behalf of MCI Telecommunications Corporation.

Ohio

In the Matter of MCI Telecommunications Corporation Petition for Arbitration Pursuant to Section 252(b) of the Telecommunications Act of 1996 to Establish and Interconnection Agreement with Ameritech Ohio, The Public Utilities Commission of Ohio, Case No. 96-888-TP-ARB, October, 1996. On behalf of MCI Telecommunications Corporation.

In the matter of the review of Ameritech Ohio's economic costs for interconnection, unbundled network elements, and reciprocal compensation for transport and termination of local telecommunications traffic, The Public Utilities Commission of Ohio, Case No. 96-922-TP-UNC, Jan 17, 1997. On behalf of MCI Telecommunications Corporation.

Indiana

In the matter of the Petition of MCI Telecommunications Corporation for the Commission to Modify its Existing Certificate of Public Convenience and Necessity and to Authorize the Petitioner to Provide certain Centrex-like Intra-Exchange Services in the Indianapolis LATA Pursuant to I.C. 8-1-2-88, and to Decline the Exercise in Part of its Jurisdiction over Petitioner's Provision of such Service, Pursuant to I.C. 8-1-2.6., Indiana Regulatory Commission, Cause No. 39948, March 20, 1995. On behalf of MCI Telecommunications Corporation.

In the matter of the Petition of Indiana Bell Telephone company, Inc. For Authorization to Apply a Customer Specific Offering Tariff to Provide the Business Exchange Services Portion of Centrex and PBX Trunking Services and for the Commission to Decline to Exercise in Part Jurisdiction over the Petitioner's Provision of such Services, Pursuant to I.C. 8-1-2.6, Indiana regulatory Commission, Cause No. 40178, October 1995. On behalf of MCI Telecommunications Corporation.

MCI Telecommunications Corporation Petition for Arbitration Pursuant to Section 252(b) of the Telecommunications Act of 1996 to Establish and Interconnection Agreement with Indiana Bell Telephone Company d/b/a Ameritech Indiana, Indiana Public Utility Regulatory Commission, Cause No. 40603-INT-01, October 1996. On behalf of MCI Telecommunications Corporation.
In the matter of the Commission Investigation and Generic Proceeding on Ameritech Indiana's Rates for Interconnection Service, Unbundled Elements and Transport and Termination under the Telecommunications Act of 1996 and Related Indiana Statutes, Indiana Public Utility Regulatory Commission, Cause No. 40611. April 18, 1997. On behalf of MCI Telecommunications Corporation.

In the Matter of the Commission Investigation and Generic Proceeding on GTE's Rates for Interconnection, Service, Unbundled Elements, and Transport under the FTA 96 and related Indiana Statutes, Indiana Public Utility Regulatory Commission, Cause No. 40618. October 10, 1997. On behalf of MCI Telecommunication Corporation.

Rhode Island

Comprehensive Review of Intrastate Telecommunications Competition, State of Rhode Island and Providence Plantations Public Utilities Commission, Docket No. 2252, November, 1995. On behalf of MCI Telecommunications Corporation.

Vermont

Investigation into NET's tariff filing re: Open Network Architecture, including the Unbundling of NET's Network, Expanded Interconnection, and Intelligent Networks, Vermont Public Service Board, Docket No. 5713, June 8, 1995. On behalf of MCI Telecommunications Corporation.

Wisconsin

Investigation of the Appropriate Standards to Promote Effective Competition in the Local Exchange Telecommunications Market in Wisconsin, Public Service Commission of Wisconsin, Cause No. 05-TI-138, November, 1995. On behalf of MCI Telecommunications Corporation.

Matters relating to the satisfaction of conditions for offering interLATA services (Wisconsin Bell, Inc. d/b/a Ameritech Wisconsin) Wisconsin Public Service Commission, 670-TI-120, March 25, 1997. On behalf of MCI Telecommunications Corporation.

In the Matter of MCI Telecommunications Corporation Petition for Arbitration Pursuant to Section 252(b) of the Telecommunications Act of 1996 to Establish an Interconnection Agreement with Wisconsin Bell, Inc. d/b/a Ameritech Wisconsin, Wisconsin Public Service Commission, Docket Nos. 6720-MA-104 and 3258-MA-101. On behalf of MCI Telecommunications Corporation.

Pennsylvania

In Re: Formal Investigation to Examine Updated Universal Service Principles and Policies for telecommunications Services in the Commonwealth Interlocutory order, Initiation of Oral Hearing Phase, Pennsylvania Public Utility Commission, Docket No. I-00940035, February 28, 1996. On behalf of MCI Telecommunications Corporation.

Georgia

AT&T Petition for the Commission to Establish Resale Rules, Rates and terms and Conditions and the Initial Unbundling of Services, Georgia Public Service Commission, Docket No. 6352-U, March 22, 1996.On behalf of MCI Telecommunications Corporation.

Tennessee

Avoidable Costs of Providing Bundled Services for Resale by Local Exchange Telephone Companies, Tennessee Public Service Commission, Docket No. 96-00067, May 31, 1996. On behalf of MCI Telecommunications Corporation.

Commonwealth of Puerto Rico

Petition for Arbitration Pursuant to 47 U.S.C. & (b) and the Puerto Rico Telecommunications Act of 1996, regarding Interconnection Rates Terms and Conditions with Puerto Rico Telephone Company, Puerto Rico Telecommunications Regulatory Board, Docket No. 97-0034-AR, April 15, 1997. On behalf of Cellular Communications of Puerto Rico, Inc.
Cellular Communications of Puerto Rico, Inc.

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Panel Testimony of
Leo Maese and August Ankum

REDACTED

ATTACHMENT II

GEOGRAPHIC DISPERSION OF LIGHTPATH'S CUSTOMERS ACROSS FIVE ZONES IN NEW YORK

REDACTED
(CONFIDENTIAL ATTACHMENT)

Case No. 99-C-0529

Panel Testimony of
Leo Maese and August Ankum

CONFIDENTIAL

ATTACHMENT III

BELL ATLANTIC'S ACCESS TANDEMS IN LATA 132

REDACTED
(CONFIDENTIAL ATTACHMENT)

Case No. 99-C-0529 Panel Testimony of Leo Maese and August Ankum **CONFIDENTIAL**

ATTACHMENT IV

CABLEVISION'S ISPs CUSTOMERS AND OTHER CUSTOMERS WITH LARGE VOLUMES OF TERMINATING TRAFFIC [NON-EXHAUSTIVE LIST]

REDACTED
(CONFIDENTIAL ATTACHMENT)

Case No. 99-C-0529

Panel Testimony of
Leo Maese and August Ankum

CONFIDENTIAL

ATTACHMENT V

NETWORK SCHEMATIC

REDACTED
(CONFIDENTIAL ATTACHMENT)

Case No. 99-C-0529

Panel Testimony of
Leo Maese and August Ankum

ATTACHMENT VI

DESCRIPTION OF LIGHTPATH'S NETWORK TECHNOLOGIES

Products

DDM 2000 Multiplexer Solution ◀ 4 of 6 ▶

Features

DDM-2000 FiberReach
DDM-2000 FiberReach is the Lucent Technologies OC-1 (51.84 Mb/s) SONET multiplexer. The 9" high shelf consists of a narrowband and a wideband shelf. The narrowband shelf supports a multitude of DS0 based services based on Lucent Technologies digital loop carrier system circuit packs for the SLC ® -2000 Access System. Each narrowband shelf can support up to 48 DS0 services. The wideband shelf supports up to 28 DS1's in a single shelf.

DDM-2000 OC-3 Multiplexer
The DDM-2000 OC-3 (155 Mb/s) Multiplexer provides up to three DS3 (84 DS1) equivalents in a single 8.5-inch shelf space. The DDM-2000 OC-3 supports DS1, DS-3, EC-1, OC-1 and OC-3 low speed interfaces and is typically used in loop (access), interoffice (transport) and customer location applications.

DDM-2000 OC-12 Multiplexer
The DDM-2000 OC-12 (622 Mb/s) provides 12 DS3 equivalents in a 14-inch shelf space. DDM-2000 OC-12 supports DS3, EC-1 and OC-3 low speed interfaces and is typically used in loop (access), interoffice (transport), and customer location applications.

Application

The Lucent Technologies DDM-2000 solution consists of three SONET multiplexers: An OC-1 system, an OC-3 system and an OC-12 system. Each product may be used in SONET ring, linear or hubbed topologies.

Product Description

Lucent Technologies' DDM-2000 Multiplexer Solution consists of a flexible and highly efficient system that helps you to optimize your current network while providing a graceful and cost-effective path to growth and enhancement.

The DDM-2000 solution is a widely deployed, field-proven, powerful platform that enables you to deliver the services your customers need.

download fact sheet ▼

Features

As the demands on today's synchronous networks increase, you need solutions for increasing speed and capacity.

The platforms of the FT-2000 OC-48 Lightwave System allow you to support a wide range of applications where capacity, protection, and flexibility are critical.

The overall system provides multiplexing, demultiplexing, and transport for up to 48 DS3 equivalent signals over two high-speed OC-48 lines. It accepts a combination of asychronous and SONET environment and will help provide a smooth transition to emerging DWDM networks.

Application

With the FT-2000 OC-48 Lightwave System, you'll have a flexible solution for a wide variety of applications such as:

- Interoffice applications
- Outstate links
- Long haul environments
- High-capacity loops

Product Description

The FT-2000 OC-48 Lightwave System is a high-capacity SONET-based lightwave system that transmits digitally encoded information through single-mode optical fibers at the OC-48 signal rate of 2.488 Gb/s.

The system consists of three equipment and software configurations designed to support several high-speed transport applications. These configurations include:

- FT-2000 OC-48 Add/Drop Ring Terminal
- FT-2000 OC-48 Dual Lightwave Terminating Bay
- FT-2000 OC-48 Repeater Bay

To give you maximum flexibility, the system software is designed to allow upgrades to new features as they become available.

FT-2000 Lightwave System

Products

united states/canada

Welcome to the World of Optical Networking

As one of the largest deployers of DWDM equipment worldwide, we can provide a full range of [illegible] to today, tomorrow and the millennium beyond. Our portfolio will include Dense Wavelength Division Multiplexing (DWDM) capabilities, Optical Cross-Connect Systems and Optical Network Management Systems.

Our portfolio will enable you to provide your customers with services whenever and wherever they are required. Whether you need to transport Wireless, Video, Telephony, IP or ATM signals, our systems will allow you to meet the challenges of the information superhighway. From access multiplexers to ultra-high-speed DWDM transmission equipment, we provide the full range of systems required for any optical networking application.

WaveStar™ Bandwidth Manager

The Lucent Technologies WaveStar Bandwidth Manager is now your one-stop solution for [illegible] network element, dramatically simplifying the way you manage voice, data and video traffic in your central office.

WaveStar™ OLS 400G

Thanks to cutting-edge research and engineering skills, Lucent Technologies is leading the way in optical networking. You can count on our WaveStar OLS 400G to help you meet the high-capacity demands of tomorrow's customers.

WaveStar™ OLS 40G

The WaveStar OLS 40G is a flexible, high-[illegible] Dense Wavelength Division Multiplexing (DWDM) lightwave system. It started the DWDM revolution as the industry's first in 1996. Today, it's the most widely deployed DWDM system worldwide.

DDM-2000 Multiplexer Solution

Lucent Technologies' DDM-2000 [illegible] and digital equipment by using that helps you to optimize your current

network while providing a graceful and cost-effective path to growth and enhancement.

FT-2000 OC-48 Lightwave System
The FT-2000 OC-48 Lightwave System is a high capacity SONET-based lightwave system that transmits digitally-encoded information through single-mode optical fibers at the OC-48 signal rate of 2.488 Gb/s

Metro OLS
The Metropolitan Solution uses Optical Line System (OLS) terminals so you can benefit from Dense Wavelength Division Multiplexing (DWDM) technology. In this technology, each fiber can carry up to 15 channels over different bands of the spectrum.

who, what, where

product overview

Lucent Technologies
Bell Labs Innovations

find a solution • products • around the world • global locator • community

Systems for Network Operators

Optical Networking

For more information go to http://www.lucent.com/opticalnet/

Cross Connect Systems

WaveStar DACS 4/4/1
is a large-capacity SDH digital access and cross-connect system. It can operate in broadband (4/4,3/3), wideband (4/3/1), or broadband and wideband (4/4/3/1) mode. It provides flexible bandwidth management in an SDH environment. The system can be equipped with various SDH transmission interfaces, and supports extensive grooming and restoration capabilities. The WaveStar DACS 4/4/1 provides benefits that include increased network reliability, flexibility and protection. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

WaveStar LXC 16/1
is a revolutionary new local cross-connect. Its key features include a connection capacity of 64 STM-1 equivalents. Its connectivity is full, non-blocking, bi- and unidirectional as well as broadcast. This connectivi-ty is at all levels: VC-12, VC-2, VC-3, and VC-4. In spite of its compact size, the switch matrix has the ability to connect 6 x 63 = 032 VC-12 connections directly from the STM-16 level. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

Multiplexers

DDM-2000 Multiplexer Solution
consists of three SONET multiplexers:, an OC-1 system, an OC-3 system, and an OC-12 system. The DDM-2000 Multiplexers offer a range of network configurations, such as point-to-point, linear drop, hubbing, add/drop, and self-healing path-switched rings. Lucent's DDM-2000 Multiplexers use path-switched rings to transmit a SONET signal from the ring entry point simultaneously in both rotations around the ring to the exit node, which monitors both rotations and selects the signal with the highest quality. Major benefits of the DDM-2000 Multiplexer include flexibility, easy installation and operation, and protection against service outages. (Available in United States, Canada)

WaveStar ADM 4/1
is a compact and cost-effective add/drop SDH multiplexer able to multiplex plesiochronous or synchronous tributary signals into one or two 155 Mbps STM-1 aggregate signals, optical or electrical. It can also multiplex them into two 622 Mbps STM-4 aggregate signals. It offers also a full capacity STM-1 Tributary interface (63 VC12 or 3 VC3 or 1 VC4). It is a modular

and flexible SDH network element that can be used in multiplexing configurations and network applications such as STM-1 mode and STM-4 mode. The system has advanced protection mechanisms to ensure network and system reliability. Its major benefits are flexibility, modularity and protection. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

WaveStar ADM 16/1
is a high-capacity, intelligent multiplexer and transport system able to multiplex standard PDH and SDH bit rates to a higher level up to 2.5 Gbps (STM-16). Because of this wide range in capacity this system is a useful element in building efficient and flexible networks. The main strengths of the WaveStar ADM 16/1 are massive add/drop capacity, compact design, flexibility in applications and protection capabilities, and easy installation and maintenance. These features make the WaveStar ADM 16/1 one of the most cost-effective and flexible network elements available on the market today. Although the system is designed primarily for STM-16 applications, it can also be used in STM-4 and STM-1 networks. Capacity, a compact and flexible design, flexible applications, protection, and ease of operation are some of the major customer benefits derived from the features of the WaveStar ADM 16/1. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

WaveStar™ ADM 40G
is the world's fastest single-laser optical transmission system. It will be the first commercial system capable of delivering 40 gigabits per second (Gb/s) of capacity with a single laser over a single wavelength on a single fiber-optic cable, making it four times faster than today's commercially available single-laser systems (which support a maximum capacity of 10 Gb/s).

Lucent's 40 Gb/s Time Division Multiplexing (TDM) technology enables the WaveStar 40G to transmit the equivalent of 500,000 simultaneous phone calls per second over a single wavelength. This will enable service providers to offer cost-effective data networking, dramatically faster Internet access and other advanced telecommunications services.

WaveStar™ 2.5G
is a new generation SONET transport system and is one of the main building blocks of future SONET networks. The system multiplexes asynchronous DS3 and synchronous EC-1, OC-3, and OC-12 traffic onto the system's OC-48 Bi-directional Line Switched Ring (BLSR) for transport to distant OC-48 multiplexers on the BLSR. The WaveStar™ 2.5G is a single shelf system with a 576 STS-1/Nc STM Switch Fabric and supports a maximum interface capacity of 192 STS-1 equivalents.

WaveStar™ 10G ADM
multiplexes asynchronous DS3 and synchronous EC-1, OC-3,OC-12, and OC-48 traffic onto the OC-192 BLSR for transport to distant OC-192 mulitplexers on the BLSR. The WaveStar™ 10G ADM is a multi-shelf system comprised of an OC-192 shelf and up to four WaveStar™ 2.5G tributary shelves.

The three strong customer benefits of the WaveStar™ 2.5G and the WaveStar™ 10G ADM are network element consolidation, investment protection, and interoperability. The first benefit, network element

consolidation, features cost savings and increased reliability due to compact size and multi-ring capabilities. The compact size of the 2.5G/10G provides substantial reduction in floor space and hence lowers cost and increases reliability. The 10G's multi-ring capabilities provide equipment savings over the current generation. The 2.5G/10G also protects customer investments by interworking with an embedded base. It operates with Lucent PF-2000 and other standards-based vendors as well as with the WaveStar™ OLS 40G and WaveStar™ OLS 400G via compatible optics.

PHASE
is a flexible and modular SDH system that can easily be configured as a terminal multiplexer or as a linear and ring add/drop multiplexer, as well as a local cross-connect with the same basic range of hardware units. For example, the same shelf can be used for capacity expansion from STM-1 to STM-16. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

Intelligent Synchronous Multiplexer (ISM)
is a versatile multiplexer primarily designed to flexibly multiplex signals of 2, 34, 140, or 155 Mbps tributaries into STM-l or STM-4 signals. It supports a wide range of fea-tures. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

Synchronous Line Multiplexer (SLM)
is a high-capacity opti-cal line system which multiplexes 4 or 16 STM-l or 140 Mbps tributaries into an STM-16 optical signal. The SLM system can work in point-to-point and ring add/drop applications, operating with the MS-Spring protection mechanism. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

Lightwave Terminals

FT-2000 OC-48 Lightwave System
is a high-capacity SONET-based lightwave system that multiplexes, demultiplexes, and transports digitally-encoded information through single-mode fibers at the OC-48 signal rate of 2.488 Gbps. The FT-2000 System provides STS-1 granularity time slot assignment across an OC-48 signal. In protection access applications, half the capacity of the high-speed line (24 channels) is assigned to service traffic and half is assigned to protection of those channels. The FT-2000 System provides a field proven solution for high-speed transport offering flexibility for a wide variety of applications such as interoffice applications, outside links, long haul environments, high capacity loops, and broadband service support. The major customer benefits of the FT-2000 are capacity, flexibility, protection, space-saving footprint, and operations support systems. (Available in United States, Canada)

DWDM Optical Networking Systems

WaveStar OLS 40G
is a flexible, high capacity, 16 wavelength DWDM lightwave system. WaveStar OLS 40G supports wavelength growth from 1 to 16 channels and, when equipped with the Optical Translator (OT), a highly flexible form of Wavelength Add/Drop (WAD) is also possible. Wavelength growth increases capacity and decreases the need for fibers, especially useful in cases of fiber exhaust. As a member of the WaveStar OLS Product Family,

the WaveStar OLS 40G addresses an application domain that extends from long haul transport to regional/interoffice facility transport. The WaveStar OLS 400G system, with its higher capacity and support for up to 80 wavelengths, primarily addresses long haul transport applications. The major customer benefits of the WaveStar OLS 40G are capacity, modularity, and flexibility. (Available in United States, Canada)

WaveStar OLS 80G
is a flexible, high capacity, 16 wavelength DWDM lightwave system. WaveStar OLS 80G supports wavelength growth from 1 to 16 channels and, when equipped with the Optical Translator (OT), a highly flexible form of Wavelength Add/Drop (WAD) is also possible. Wavelength growth increases capacity and decreases the need for fibers, especially useful in cases of fiber exhaust. As a member of the WaveStar OLS product family, the WaveStar OLS 80G addresses an application domain that extends from long haul transport to regional/interoffice facility transport. The WaveStar OLS 400G system, with its higher capacity and support for up to 80 wavelengths, primarily addresses long haul transport applications. The major customer benefits of the WaveStar OLS 80G are capacity, modularity, and flexibility. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

WaveStar OLS 400G
is the latest generation in Lucent's DWDM Optical Line System (OLS) family supporting up to 80 channels and up to 400 gigabits or information over a single fiber. It offers maximum capacity, modularity, and flexibility. By incorporating a modular design, the WaveStar OLS 400G enables customers to purchase a customized system that satisfies current network demands without requiring the installation of a system intended for a much larger network. This reduces the initial start up costs. As network demands increase, the WaveStar OLS 400G can be easily and modularly expanded to support forecasted levels up to 400 gigabits. Its modular nature permits additional services to be brought online without affecting existing service. (Available in Asia, China, Australia, Europe, Africa, Central America, South America, United States, Canada)

WaveStar AllMetro™
AllMetroTM series is Lucent's latest Dense Wave Division Multiplexing (DWDM) system to offer highly flexible, maximum capacity solution for Metropolitan Optical Networks. As the most versatile solution in optical line systems, WaveStar AllMetro OLS is the first to offer systems of varying node sizes and add/drop capabilities. WaveStar AllMetro offers the customer flexibility and scalability for matching system capacity needs to demand by offering the option to m ix and match different node sizes. WaveStar AllMetro OLS is unique in the marketplace since it allows deployment in smaller enterprises as well as large interoffice applications. With the WaveGuardTM option, WaveStar AllMetro allows any individual wavelength to be protected in the event of a fiber cut or other network failure. Utilizing the DWDM WaveStar AllMetro provides an "easy to use," seamless integration of voice, data, and video signals - at a best in class cost structure.

Bandwidth Management Systems

WaveStar BandWidth Manager
is a new modular net-working system capable of integrating all access and

interoffice trans-port facilities into a single network element-dramatically simplifying the management voice, data, or video traffic in a central office. Self-healing ring interfaces within this system integrate traditionally separate network elements such as stand-alone add/drop multiplexers; broadband, wideband, and asynchronous transfer mode (ATM) digital cross-connect systems; and ATM and IP core switches/routers. Multiple 4-fiber BLSRs enable central office consolidation, eliminating the need for numerous standalone OC-48 add/drop multiplexers. The WaveStar BandWidth Manager helps prevent obsolescence in your network by providing a scalable platform to easily respond to demands for network growth. (Available in Asia, China, Australia, Europe, Africa, Central America, South America, United States, Canada)

Network Management

ITM-NM
is a network layer management system that provides comprehensive and integrated management of an entire transport network from a single operator location. It supports the TMN Fault, configuration, performance, security, and accounting functions at the network manage-ment layer. The type of network supported by ITM-NM varies from backbone to overlay, and class-of-service ranges from private-leased-lines to public-switched ITM-NM interfaces with ITM-SC (the ITM element manager) and IT M-XM (the cross-connect manager). (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

ITM-SC
is part of our ITM family of network management software. It is a centralized network element management system for SDH network element equip-ment. It supports fault, configuration, performance, and security functions at the network element layer. It can also provide services to the network management layer. It includes features, which facilitate its operation for both user and administrator of the ITM-SC computer facility. (Available in Asia, China, Australia, Europe, Central America, South America)

Digital Video Systems

WaveStar MPEG-2 Digital Video System
compresses and multiplexes video, audio, and data signals into a single digital stream and performs all network interfacing and decoding functions. It can handle any combination of 1-20 channels of encoding and up to 44 channels of decoding. The WaveStar DVS allows you to compress the broadcast video signal for real-time transmission or for storage and later retrieval. You can also adjust the compression rate, depending on the application or the source to deliver the maximum image quality at the lowest possible network bandwidth. Among the major customer benefits provided by the WaveStar DVS are lower implementation costs, consistently high video and audio quality, more capacity and lower per-program costs, and increased compatibility (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

Clock Supply Equipment

Clock Supply Equipment (CSE) Family

is a versatile, modular, redundant, highly stable clock supply. It is intended for synchronization, clock generation, and clock distribution in telecommunication and data networks. Soon to be available, the CSE-4 (Primary Reference Clock) will have integrated GPS. The ACDS (Active Clock Distribution System) is a low-cost solution for distribution of a single timing source to multiple network elements. (Available in Asia, China, Australia, Europe, Africa, Central America, South America)

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Systems for Network Operators

Switching and Access Solutions

Switching Systems
For more information go to www.lucent.com/netsys/5ESS/products.html

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

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

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

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

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

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

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

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

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

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

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

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

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

System.

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

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

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

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

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

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

- **ADSL for the AnyMedia Access System** Using ADSL application packs that fit in the AnyMedia Access System in both CO and Outside Plant environments, this solution supports both Full-rate and Lite versions of ADSL using ATM over DMT.
- **ADSL for the 5ESS AnyMedia System** Using ADSL application packs that fit in the 5ESS Switch-Integrated AnyMedia Express module, this solution supports both Full-rate and Lite versions of ADSL using ATM over DMT.
- **5ESS® LinkReach™ Access System** Using a switch-integrated Westell SuperVision™ shelf, this ATM over DMT solution supports both Full-rate and Lite versions of ADSL.
- **SLC LinkReach™ Access System** Plug-in channel units for Lucent's SLC-2000 and SLC Series 5 Access Systems that support Full-rate and Lite version of ADSL using ATM over DMT.
- **DSLAM LinkReach™ Access System** A standalone, CO-based DSLAM that supports Full-rate and Lite versions of ADSL using

ATM over DMT.

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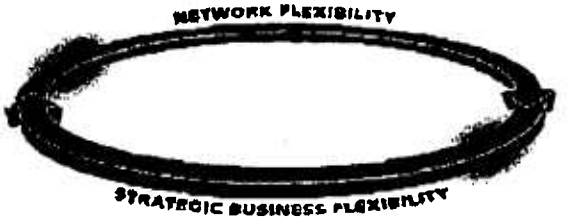
The AnyMedia™ Platform

There's a reason why the 5ESS®-2000 Switch serves over 70 million subscribers in more than 40 countries.

Widely recognized as the industry's most flexible architecture, the 5ESS®-2000 Switch and its **unique AnyMedia™ capability -- the ability to offer any media off the same switch** -- offers a solution to short-term market needs, such as coping with internet demand as well as a solid foundation for long-term growth. With Lucent Technologies as your strategic partner and the 5ESS®-2000 Switch at the heart of a network, one can achieve the level of network flexibility needed for a business to succeed in today's rapidly changing marketplace.

The 5ESS®-2000 Switch stands alone as the only platform in the industry capable of simultaneously supporting any combination of wireline, wireless, voice, data and video services off the same switch. This unique concept -- what we call the AnyMedia™ Network Solution -- enables the 5ESS®-2000 Switch to deliver the total strategic **flexibility** and cost-effectiveness that a business requires and that no other platform can match.

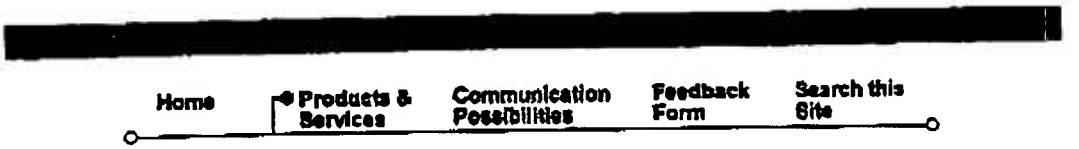


Whether a service provider modernizes switches, flattens a network hierarchy through consolidation or builds an entirely new network, 5ESS®-2000 Switch is an ideal choice. As the most cost-effective, flexible switching platform on the market today -- and **the only switch** to offer AnyMedia™ capability -- it can meet short-term market needs while providing a solid foundation for long-term business growth.

Today's telecommunications industry is marked by constant change. Advancing technology and shifting customer demands have had a significant impact on business operations. The 1996 Telecom Act and the resulting increase in competition have had great ramifications for network design. In this dynamic environment, it's imperative that to build a network that can quickly adapt to changes in business strategy, technology and customer demands.

More details are available through Lucent Technologies customer representatives

or by email request to this Home Page site.



5ESS®-2000 Switch

The 5ESS® Switch is a most flexible digital exchange for use in the global switching network. Digital switches replaced earlier electromechanical and analog switching systems. The 5ESS® equipment switches ISDN voice and data, local voice calls, long distance calls, Internet access, wireless PCS, Advanced Intelligent Network services, interactive video and multimedia services...moving any media on the public switched network. This means the 5ESS® Switch provides the system, services and software to transform current networks into multi-functional networks that meet the needs of today's home, business and community. By 1992, the next generation 2000 Switch was created at Bell Laboratories and added to networks worldwide.

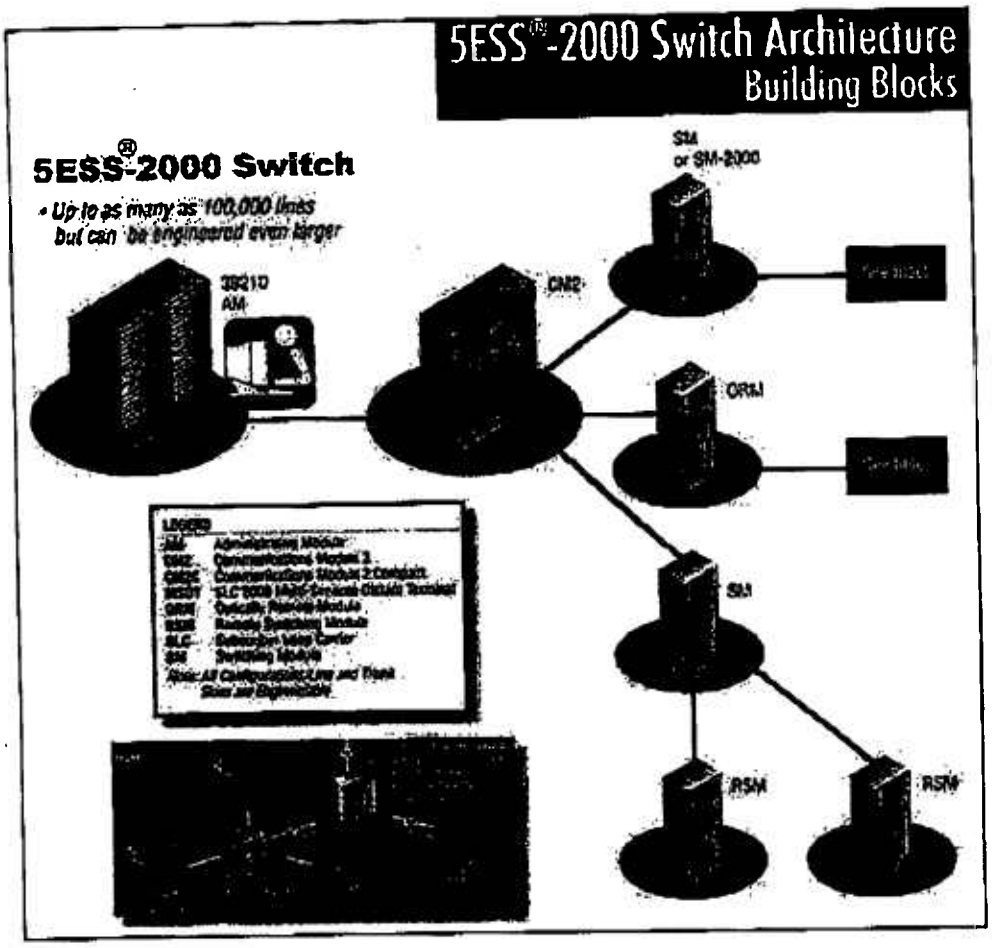
A digital switch is a single system with multiple applications such as local, toll, operator services. The switch architecture is a modular, distributed architecture with an administrative module, a communications module, and a varying number of switching modules that provide the major processing power in the total communication system. This switch design will allow network providers to offer their customers voice, computer, fax, data, and visual services.

FCC (Federal Communication Commission) required quality monitoring process has shown the 5ESS® Switch is highly reliable, in fact the 5ESS®-2000 switch is four times more reliable than its nearest competitor. Today the 5ESS® switch is considered the workhorse of the public telecommunications network in the United States with its lower life cycle costs and its proven record of reliability.

Modular Design Advantage

An advantage, when deploying the 5ESS® Switch, continues to be its modular design. This modularity allows for ease of implementing ongoing enhancements and allows service providers the ability to change their communication network quickly.

The value of the current 5ESS® Switch modular architecture and the ease with which is adapts to new technologies has been repeatedly demonstrated. Administrations can deploy new 5ESS® Switches in their network, only to find their business requires additional hardware modules and the associated software releases. The new hardware can easily be added to the network's standard growth and modernization plans. The result is an easy, effective, and economical upgrade to a 5ESS®-2000 Switch without service disruption.



Telephone administrations are often concerned with:

- Increasing busy hour call completion capacity
- Minimizing floor space requirements
- Enabling growth in small increments
- Integrating multiple applications in one exchange
- Reducing power consumption and operational costs

The 5ESS®-2000 Switch architecture and software addresses each of these concerns. Economical access to advanced services via the 5ESS®-2000 Switch can be provided to all subscribers no matter where they are located; in metropolitan, suburban or rural areas.

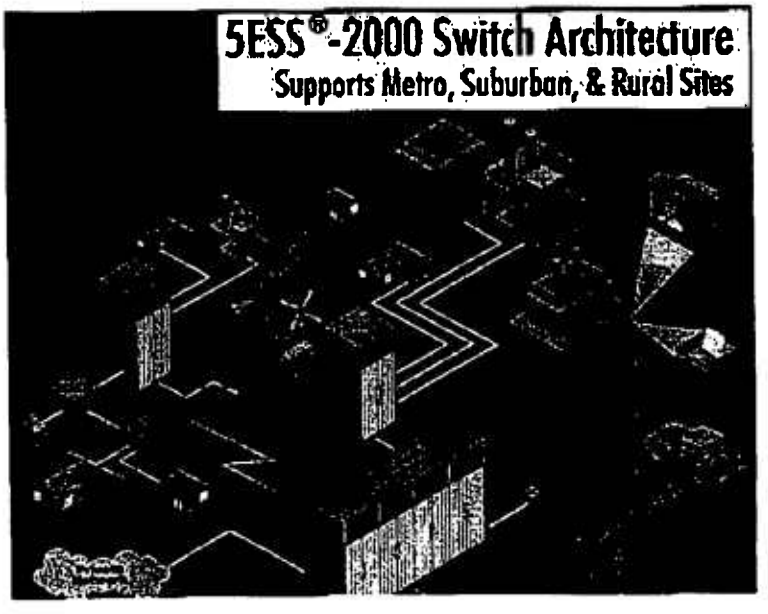
A Distributed Architecture

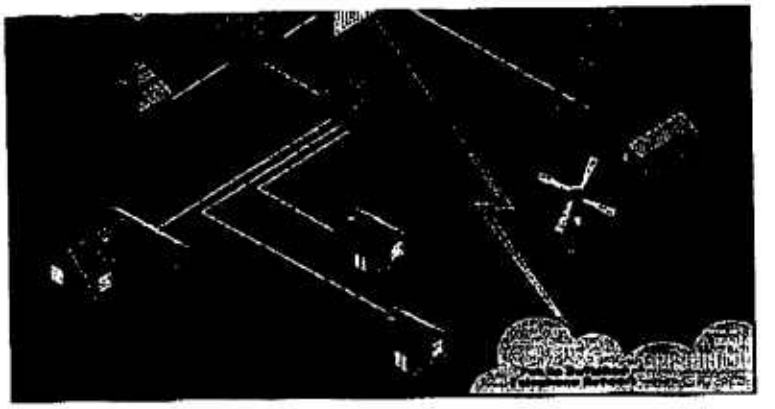
The 5ESS®-2000 Switch also features a distributed architecture that employs modular components in all systems and subsystems. This readily accommodates a broad array of growth and configuration options that allow you to easily and economically evolve your network as subscriber demand grows. This flexibility enables you to maintain your competitive edge while saving on sparing, training and documentation.

Internet Capacity

Reliability and customer satisfaction are especially important with respect to internet services, since the extensive growth of the Internet has caused an increase in network blockages on existing central offices. However, a new capability, which Lucent refers to as *Project Renaissance* , helps service providers avoid this problem in a least costly fashion. Today the 5ESS®-2000 Switch is the first switch to handle both wireline and wireless traffic. Project Renaissance will modernize and consolidate central offices and networks by using the SM2000 with Digital Network Unit -- SONET-- and the Access Interface Unit to provide increased trunk and line capacity for the service provider's network. Project Renaissance also reuses some existing central office equipment. This increased capacity affords opportunities not only for a lower cost structure and simplified network operations, but also a better grade of service with less probability of internet and voice calls being blocked as a result of high internet hold times.

- **Access Interface Unit (AIU)** - A new cost-effective non-blocking line unit for the 5ESS® Switch that will be generally available in 1996. This line unit initially supports enhanced performance and reduced operational costs for analog connections, but will also support ISDN and ADSL in the future.
- **ISDN PRI Expansion** - The 5ESS® Switch SM-2000 can be expanded to handle more PRI terminations in 1996. This capability will lower service provider operational and first-time costs.
- **Provisioning Solutions** - The Switch Element Manager Operations Systems will shadow a switch's translation/feature database, making it easier and faster to provision ISDN lines without placing strain on the embedded switch call processors. In early 1997, additional Applications Software will be made available to further enhance the ISDN provisioning process. Provisioning audit services are available to pinpoint trouble spots.





Small Exchanges and Remote Capabilities

Remote line units can support basic and supplementary services and ISDN capabilities. Remote switching systems provide all the duplex switch services of the host exchange and can sustain complete stand alone functionality if remote-to-host facilities are out of service.

Small autonomous exchanges, like CDX and VCDX, are configured to support exchange sites where deployment of remotes may be unsuitable. In addition to typical host exchange configurations, the 5ESS® Switch offers full service remote switch solutions and interchangeable models to configure the smallest to the largest exchange sites. This simplifies training, documentation, and spare parts while increasing flexibility and services. No longer must network providers procure differing systems for small sites versus large metropolitan exchanges.

Over the past seven years the switch has increased busy hour call capacity more than fivefold. The architecture lets the switch add processing power as needed to add extra call capacity. A network service provider need buy only as much capacity as needed to start, then expand later to meet business demands or to bring more features to customers in their market. Thus as business expands, the service provider need only upgrade the modules directly involved, rather than add whole new switches.

More details are available through Lucent Technologies customer representatives or by email request to this Home Page site.

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