SERVICE NET-2000: AN INTELLIGENT NETWORK EVOLUTION

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Rapid technological changes in the computing and telecommunications industries are expanding customer expectations and service requirements for the public network. Meeting these needs will require several major changes in the network, notably in the areas of high-bandwidth services, faster service-provisioning times (i.e., improved operations, administration, maintenance, and provisioning), and increased network intelligence. In this paper, we describe how AT&T Network Systems plans to use Service Net-2000 to support these changes. The Service Net-2000 architecture will integrate high-capacity switching and data-networking elements with synchronous optical network (SONET) transmission elements under a unified, customer-oriented, common control structure. Because it is evolving directly from today's 5ESS® switch, Service Net-2000 will incorporate all the capabilities of today's real-world intelligent network. By using intelligent network adjuncts, service circuit nodes, and service control points within this architecture, we will be able to offer a broad range of services faster and easier than we can today. These concepts form the basis for future service offerings that will create a more responsive, service-rich public network ready to meet the information movement needs of end users.

Forces Driving the Public Networks

Technological advances and the needs of the marketplace are shaping the design and deployment of an intelligent, high-bandwidth architecture for advanced information networking. The forces at work include customers' demands for increasing service flexibility and

Panel 1. Abbreviations, Acronyms, and Terms

adjunct	a local database that contains service logic
AIU	access-interface unit
ASN.1	abstract syntax notation
ATM	asynchronous transfer mode
BISDN	Broadband Integrated Services Digital Network
BNS	Broadband Networking Services
BRT	business remote terminal
CAD	computer-aided design
CAM	computer-aided manufacturing
DACS	Digital Access and Cross-Connect System
DCC	data-communications channel
DDM	digital data multiplexer
DNU	digital networking unit
DT	distant terminal
frame relay	fast packet switching technology optimized for T1 rates and below
IP	intelligent peripheral
ISDN	Integrated Services Digital Network
kb/s	kilobits per second
LEC	local exchange carrier
LOM	local operations manager
Mb/s	megabits per second
OAM&P	operations, administration, maintenance, and provisioning
OC	optical carrier
PBX	private branch exchange
PCN	Personal Communications Network
POTS	plain old telephone services
PSTN	public switched-telephone network
RSM	remote-switching module
RT	remote terminal
SCN	service circuit node
SCP	service control point
SLC	subscriber loop carrier
SM	switching module
SMDS	switched multimegabit data services
SONET	synchronous optical network
SS7	Signaling System 7; a signaling protocol that follows Bellcore technical requirements and ANSI standards
STS-1	Synchronous Transport Signal-1
UIS	Universal Information Services
VT1.5	Virtual Tributary (1.5)

availability, a changing regulatory environment, and the financial pressures placed on service providers because of the growing number of competitive alternatives. As the sophistication of business and residential customers increases, they are demanding shorter intervals between the need for a new service and its availability; they are also demanding more real-time control of the network.

Many of the new end-user services of the 1990s will require higher bandwidths and faster response times. Services such as switched-digital television, video-on-demand, or high-speed data transport require bandwidths as high as 155 megabits per second (Mb/s), and possibly higher. (See Panel 1 for definitions of abbreviations, acronyms, and terms.) Services such as speech recognition, instantaneous voice translations, and interactive computer-aided design/computer-aided manufacturing (CAD/CAM) need very fast network response time. At the same time, the ever-increasing pace of technology is pushing the public switched-telephone network (PSTN) toward more programmable service intelligence and a robust, distributed, high-bandwidth architecture that is system independent. As technology continues to shape new long-term network architectures, planning for these changes will become an increasing challenge.

These industry trends are addressed by AT&T's long-term vision of networking, called Universal Information Services (UIS).[1,2] Its goal is to provide users everywhere with access to any kind of voice, data, or image

service from any place, at any time, in any combination — with maximum convenience and economy. This vision continues to guide our product decisions. Integrated Services Digital Network (ISDN) was the first step toward this vision. The next step, Service Net-2000, integrates high-capacity switching and sophisticated data-networking components with SONET transmission elements under a common, unified control structure.

Service Net-2000 Architecture

Service Net-2000 is AT&T's next-generation network architecture, for the 1990s and beyond. Its service-ready infrastructure further integrates transmission, switching, and data-networking functions under consistent, unified operations. This integration controls cost by reducing the number of network elements needed and by reducing or eliminating manual operations. It also provides the platform on which the intelligent network will evolve, and, therefore, will enable network providers to introduce new services at lower incremental cost than is currently possible.

Today's network already incorporates many of the components required for intelligent network services, and others are being introduced rapidly. It is becoming a distributed intelligent network, one in which network intelligence resides at different locations.[3-7] Databases for intelligent network services have also appeared. The technology offered by Signaling System 7 (SS7) forms the backbone of the intelligent network. SS7 makes intelligent network services accessible end to end and promises reliable network performance. This intelligent network is based on 64 kilobits per second (kb/s) switching technology for voice communications, and up to T1 rate (1.54 Mb/s) point-to-point technology for data services, transported by high-bandwidth interoffice connections (i.e., fiber-optic terminals). Its operations environment is divided into many technology-oriented, independent work centers. As we rapidly deploy digital transmission, digital switching, and common-channel signaling, optical systems capable of carrying information in the range of gigabits per second are becoming available. ISDN combines voice and data on a single path, extends digital connectivity from the switch to the end user, and provides a feature-rich, message-based signaling system. High-speed data-networking services, including fractional T1, frame-relay services at the T1 rate, and switched multimegabit data services (SMDS) at the T1 and T3 rates, are currently being used on a trial basis or planned for introduction within the next year.

Today's network will evolve gracefully into Service Net-2000, a network with real-time, high-bandwidth switching; distributed intelligence under unified control; and integrated operations. In the Service Net-2000 architecture, a wire center will become a fiber center whose elements will evolve into a more integrated system. It will combine the traditional roles of transmission, switching, and data networking under a common operations umbrella. Thus, rates from 64 kb/s through broadband will be switched by elements under unified control, thereby reducing the complexity and cost of operating the network. SONET interfaces will be integrated into the switches, and intelligence will be distributed to network elements. This integration will reduce the need for separate overlay control networks.

The Service Net-2000 architecture is evolving toward dynamic networks and consolidated operations of network elements. Within a dynamic network, many traditional operations, administration, maintenance, and provisioning (OAM&P) functions are moved into or near the network element that provides the service. This gives external operations systems the flexibility to consolidate information and provide end-to-end network-management capabilities.

Service nodes and access nodes in the Service Net-2000 architecture, each of which contains a number of network elements, will be:

- Self-aware, i.e., they will "understand" their current states and roles within a network;
- Self-adapting to changing demands on the network, such as resource allocation, load balancing, dynamic

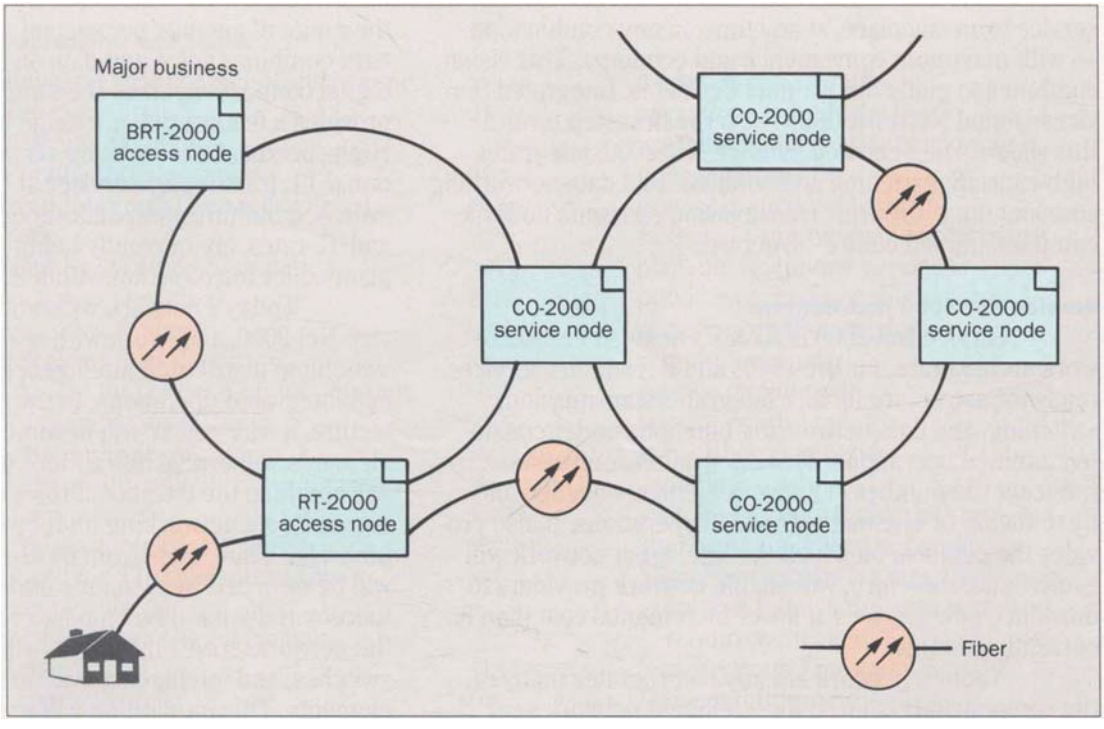

Figure 1. The main architectural components of Service Net-2000 are its service nodes and access nodes, which are connected by high-bandwidth optical fiber or copper cables.

routing, and fault recovery;
- Self-provisioning, i.e., much more responsive to shortening service-order intervals and improving network integrity.

Currently, network elements are treated as separate entities with respect to OAM&P. Service Net-2000 will integrate network elements by using common alarm panels, common craft interfaces, and SONET performance monitoring for transmission equipment. Switching, transmission, and data networking will combine to produce a single craft access and integrated diagnostics. Ultimately, the consolidation will extend beyond network elements to a network view of a distributed central office. Rather than being operated as a series of independent elements, the network will focus on end-to-end services and individual customer services.

Figure 1 shows the main architectural components of Service Net-2000, the service node and the access node, which are connected by high-bandwidth media.

The Service Node. The service node integrates switching, transmission, data networking, and operations. It also consolidates wire center functions. This proposed service node architecture allows predeployment, that is, one can deploy any of today's elements (e.g., the 5ESS switch, DACS IV-2000, BNS-2000) for immediate benefits. The network elements can then evolve gracefully into the Service Net-2000 architecture.

Key components of the service node are the AT&T 2000 family of transport products, the 5ESS-2000 switching system, the BNS–2000 family of broadband networking products (described later), and the local operations manager (LOM).

AT&T's 2000 family of transport products. The high-bandwidth networking capabilities of Service Net-2000 are based on the emerging SONET standards and the need to offer new high-bandwidth services to end users. The wide acceptance of SONET standards has created a new operating environment for the fiber network. SONET supports a family of transmission rates at multiples of 51.84 Mb/s. Its flexible mapping and frame structure simplifies multiplexing and demultiplexing. This allows easy access to low-speed channels and supports growth to higher transmission rates. Its overhead channel has standardized OAM&P capabilities and facilitates network-wide service restoration. In summary, SONET provides a great deal of the bandwidth and flexibility needed for the wide variety of services that the network will provide in the near future.

SONET is supported by AT&T's 2000 transport product family. This family includes the digital data multiplexer (DDM-2000), FT-2000 lightwave systems, Digital Access and Cross-Connect System (DACS) IV-2000, DACS III-2000 Cross-Connect System, and DACScan™-2000 controller. DACScan-2000 is a workstation-based system that administers cross-connect systems in the network.

DACS IV-2000 is an electronic cross-connect system that operates at the DS1/VT1.5 rate to provide non-blocking cross connection. The DACS IV-2000 facilitates grooming (i.e., the ability to group services by type), rapid provisioning, network restoration, remote surveillance, and test access. One of its major attributes is its flexibility. The system's modular, software-based frame controller enables subscribers to customize their configurations and add features. For example, in the foreseeable future, the capacity of the DACS IV-2000 will increase fourfold. This capacity increase will be available as an in-service upgrade.

"SONET Ready" is another of the DACS IV-2000's major attributes. Although today's network handles only asynchronous (DS1 and DS3) interfaces, the DACS IV-2000 cross-connect fabric has been designed to accommodate the higher-speed VT (virtual tributary) 1.5 channels required for SONET. Therefore, the DACS IV-2000 will be able to handle SONET by adding SONET interfaces. These interfaces will soon evolve to direct optical interfaces. In addition, the DACS IV-2000 will act as a gateway to connect SONET and non-SONET facilities. These features make the DACS IV-2000 and the DACS III-2000 excellent office-facility managers. [DACS III-2000 is similar in design to the DACS IV-2000, except that it is a DS3/Synchronous Transport Signal–1 (STS-1) level cross connect].

5ESS-2000 switching system. The 5ESS-2000 switch will integrate the Broadband Networking Services-2000 (BNS-2000) and 2000 transport product family into the 5ESS switch architecture. (See Figure 2.) This approach retains the existing strengths of the 5ESS switch, which include its distributed architecture, capacity, remote capability, and richness of customer and operations features, while extending the 5ESS capabilities. For example, in the near future, the 5ESS-2000 switch will support one million busy-hour calls with a mix of 250,000 lines and 64,000 trunks.

The 5ESS-2000 switch will have an enhanced switching module (SM-2000) that can host new line- and trunk-interface units. The SM-2000 will have a significantly expanded switching fabric, capable of expanding from 3000 to 33,000 time slots in 3000-time-slot increments. Its powerful microprocessors will perform virtually all call-processing activities and will function as a remote office (EXM-2000) with stand-alone capability.

A 5ESS-2000 switching system will support many switching modules (SM-2000s), which can start out small and grow as needed. With the addition of the SM-2000, the 5ESS-2000 switch will be able to grow both within each switching module, by incrementally adding time slots, and by adding new switching modules. This is particularly important for remote applications.

By virtue of its distributed intelligence, this architecture is inherently more reliable. Each switching module, including remote modules, can operate independently. Services within each module and trunking to

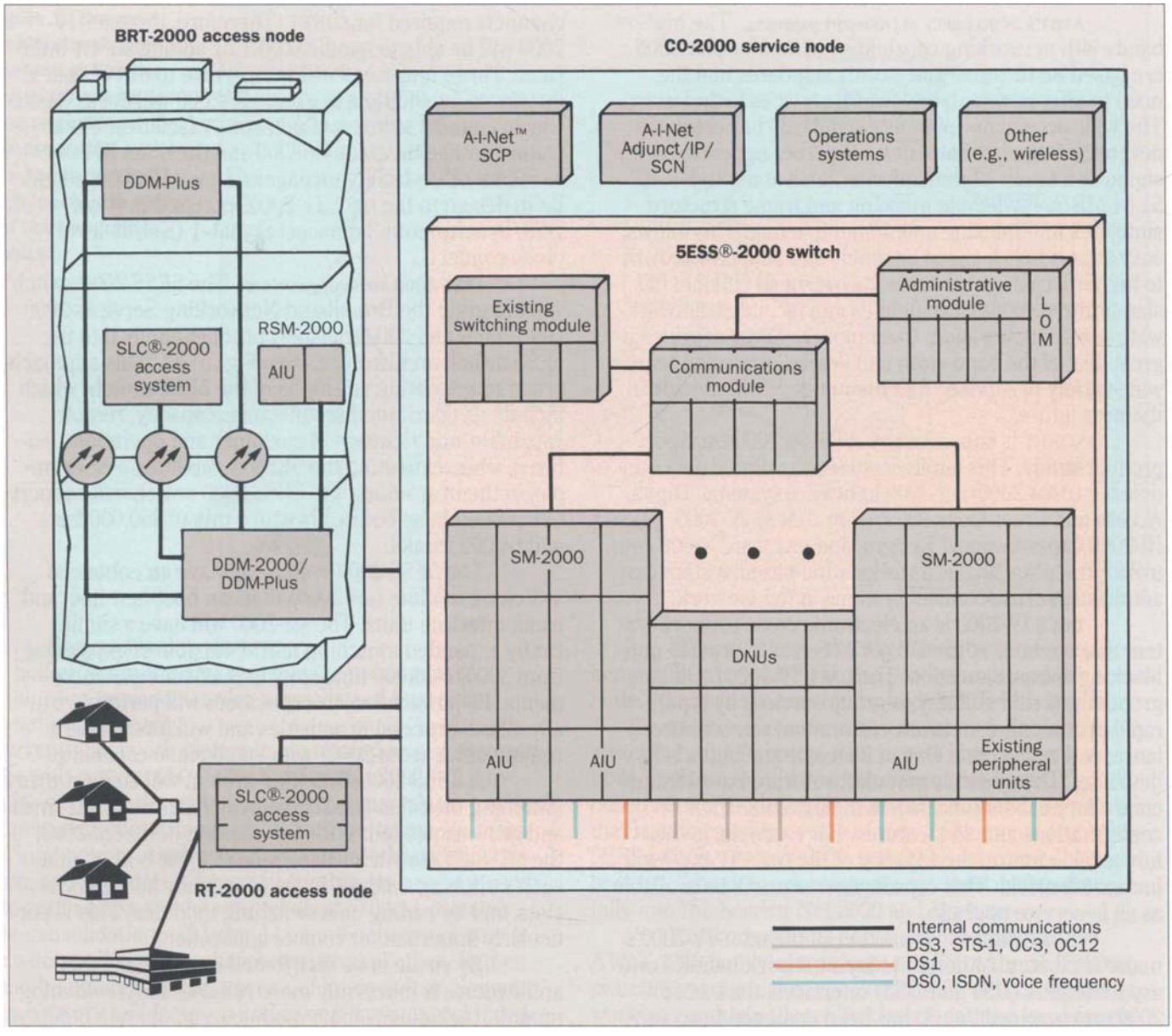
BRT-2000 access node
CO-2000 service node
DDM-Plus
A-I-Net™ SCP
A-I-Net Adjunct/IP/ SCN
Operations systems
Other (e.g., wireless)
5ESS®-2000 switch
Existing switching module
Administrative module
L O M
RSM-2000
SLC®-2000 access system
AIU
Communications module
SM-2000
SM-2000
DDM-2000/ DDM-Plus
DNUs
AIU
AIU
AIU
Existing peripheral units
SLC®-2000 access system
RT-2000 access node
Internal communications
DS3, STS-1, OC3, OC12
DS1
DS0, ISDN, voice frequency

Figure 2. The Service Net-2000 will integrate the 5ESS switch with the BNS-2000 and the 2000 transport product family. The 5ESS-2000 switch will soon be able to support one million busy-hour calls with a mixture of 250,000 lines and 64,000 trunks. The SM-2000, which can host new line- and trunk-interface units, will be expandable from 3000 to 33,000 time slots. The 5ESS switch can increase its capacity by adding lines within an SM-2000, or by adding more SM-2000s.

other switching systems are independent of other failures that might occur within the office. All hardware is duplicated; the software is modular and incorporates an escalating recovery strategy to identify and isolate faults to minimize their impact. The 5ESS-2000 switch provides low-level, focused recovery actions to resolve the problem and to minimize escalation to more severe fault levels.

A series of digital networking units (DNUs) supply the new high-speed interfaces for the 5ESS-2000 switch. A DNU represents the consolidation of the 5ESS switch with key complementary products, such as the DACS IV-2000 and the BNS-2000 cell switch. A new line interface, called the access interface unit (AIU), will be based on the subscriber loop carrier (SLC®)-2000 access system, described later in this paper.

The DNU-IV (based on the DACS IV-2000) will provide new high-speed trunk and line interfaces. In this capacity, the DNU-IV will act as both office-facility manager and a high-speed switch interface. This functional consolidation will eliminate the copper bottleneck in today's central office by reducing multiplexing and operational difficulties. In addition, OAM&P control for the various switching and transmission elements will be merged. The 5ESS switch will be able to control the DNU-IV fabric, which will then perform switching on DS1 and some DS3 channels. The SM-2000 will also contain a direct trunk interface for remote applications.

In the near future, the 5ESS control structure will be extended to the DACS III-2000 (DNU-III). Based on the BNS-2000 cell switch, the DNU packet will form the core of the Broadband Integrated Services Digital Network (BISDN) platform. In the future, the 5ESS control structure will be extended to encompass DACS III-2000 control (DNU-III). These enhancements will complement the evolving intelligent network architecture.

BNS-2000 broadband networking products. The family of BNS-2000 broadband networking products forms the base for supporting key emerging data services. These services include frame relay (a point-to-point, connection-oriented packet data service with ≤ T1 access, as defined by ANSI and CCITT) and SMDS (a switched, connectionless packet data service with T1 and T3 access, as defined by Bellcore). The product family will evolve to include BISDN services (with higher speed, 155-Mb/s access).

The product family includes the BNS-2000 cell switch and DNU packet, which integrates the BNS-2000 cell switch with the 5ESS-2000 switch, as described earlier. The BNS-2000 cell switch complies with standards defined in SMDS/IEEE 802.6. It consists of both low-speed port carriers, operating at 8 Mb/s, and high-speed switching shelves, operating at ≥200 Mb/s.[8,9] They support a wide variety of plug-in interface modules that offer diverse services. The low-speed shelves accept all the plug-in modules of the Datakit® II virtual circuit switch. New modules that support a range of trunking (DS1 and DS3) and access (DS1 and DS3 SMDS) options will be available for the high-speed shelf. The robust architecture of the BNS-2000 cell switch will simultaneously support connection-oriented (e.g., frame relay), connectionless (e.g., SMDS), and isochronous (circuit-like) services.

SMDS is an early broadband service supported by the BNS-2000. It is a high-speed (DS1/DS3), connectionless service based on IEEE 802.6. SMDS is expected to help the local exchange carriers (LECs) enter the high-speed data market.

Local operations manager. The local operations manager conducts OAM&P for the entire Service Net-2000 wire center. All network elements under its control respond to OAM&P activity as a single system. For

example, the local operations manager can provision a service involving multiple network elements based on a single service request. The local operations manager will support a common interface between craft and network elements across Service Net-2000. The LOM is integrated with a 5ESS-2000 switch and uses an open interface (e.g., ASN.1) to existing operations systems.

The Access Node. A major element of Service Net-2000 is its access-network architecture, which extends Service Net-2000 as close to the customer as possible. The architecture is flexible, supporting services that vary from plain old telephone service (POTS) to high-speed services such as frame relay, SMDS, and video transport (e.g., cable TV). It supports a wide range of customers, from residential and small-business customers to large corporate customers, as well as a full range of access-topology options, such as star, taper, hub, and ring topologies. The modular architecture complies with standards, including SONET's and Bellcore's TR-303,[10] and is consistent with the access architecture of others. Its design will evolve to support new capabilities, such as broadband ISDN and wireless Personal Communications Networks (PCNs).

There are two versions of the access node: the Remote Terminal-2000 (RT-2000) and the Business Remote Terminal-2000 (BRT-2000). High-speed fiber cables will connect service nodes and access nodes using standard SONET formats.

The RT-2000 is designed specifically for use in residences and small businesses. Its basic component, AT&T's Subscriber Loop Carrier (SLC®-2000) access system (or SLC series 5 carrier system), offers POTS, ISDN, high-speed transport, and all special services (e.g., private lines, PBX trunks). The transmission can be distributed over either metallic or fiber media. The service interfaces extend to distant terminals (DTs) at or near the customer location to support narrowband, wideband, and video services. The DTs, the RT, and the service node use the same channel units to lower inventory requirements and minimize craft training. The interface to the central office supports the SONET rate (155 Mb/s), with a 622-Mb/s upgrade for connection to the central office. The high-speed feeder component of the SLC-2000 can accept most plug-in modules and technology of AT&T's SONET products (e.g., DDM-2000).

The BRT-2000 access node is designed specifically for medium and large business locations, where it is crucial to provide faster development and deployment of a wide variety of narrowband and high-bandwidth services than we can achieve today. For these reasons, the BRT-2000 access node is installed at the customer's location. Service interfaces include POTS, special services, SMDS, frame relay, high-speed transport, local switching using RSM-2000, and optical and metallic extensions for connections within and between buildings.

Optical Fiber Links. A broad spectrum of fiber products provides efficient splicing and improved strength and resistance to environmental attack. To minimize the number of cables entering the central office, the cables offered in these products contain large numbers of fibers (e.g., up to approximately 200 cables). The optical fiber products increase cost-effectiveness by using software control, offering an extremely dense optical interface, and reducing the number of repeaters needed.

Intelligent Network Control

Several papers in this issue have described the intelligent network in detail. They have shown that the intelligent network is an advanced-control architecture that is applicable to a wide variety of networks, such as the PSTN, data, cellular/PCN, ISDN, and broadband ISDN. As part of the Service Net-2000 infrastructure, the intelligent network offers both the flexibility to introduce services rapidly and the architectural freedom to implement them. The intelligent network contains a rich set of functions, which gives network providers a large number of services and service-creation capabilities. This section highlights some of the major features of Service Net-2000, which uses the intelligent network as an integral part of its service-ready framework.

One of the main features of Service Net-2000 is

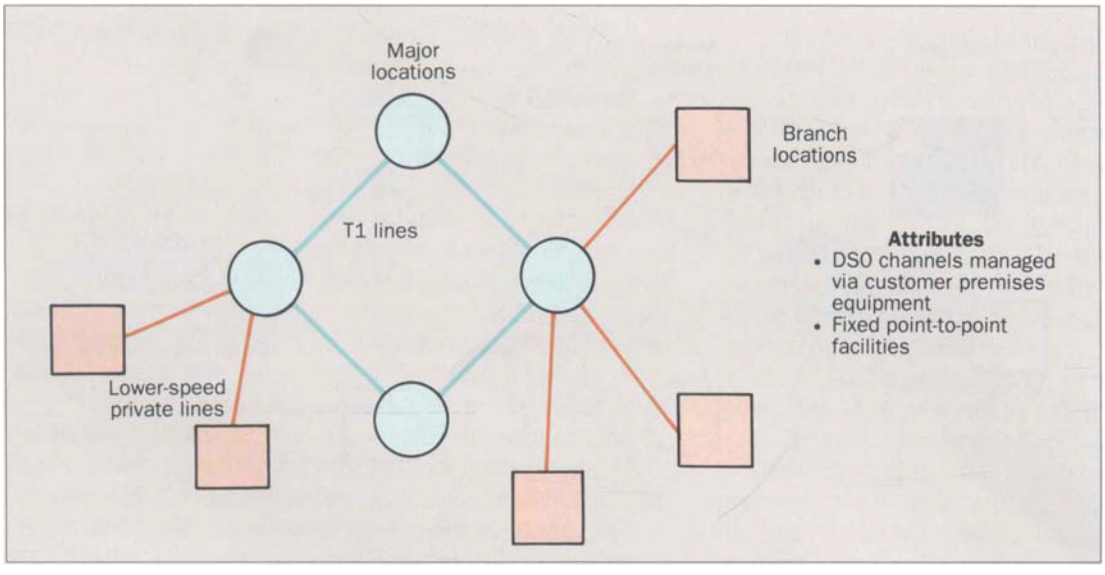

Figure 3. Today's typical private network contains a set of T1 private lines, with lower-speed lines emanating from branch offices. Changing the configuration is currently a slow process.

its ability to use the 5ESS-2000 switch to control both switched and nonswitched services (circuit, ATM, X.25, etc.) and channels of varying bandwidths (e.g., DS0, DS1, DS3, OC3). Because it supports the intelligent network, the service node of Service Net-2000 could make available to nonswitched services and high-bandwidth circuits the same capabilities that today are limited to ordinary switched-voice circuits. Then, a larger variety of information services with multimedia technology (e.g., video teleconferencing, imaging) could be offered by using the intelligent networking aspects of Service Net-2000. New services could be created from a pool of service-independent capabilities on the Service Net-2000 platform.

As an example, the intelligent network capabilities of the Service Net-2000 architecture could provide flexible provisioning of special services ranging from low-speed specials to DS1/DS3 services, as well as network-based restoration services. As depicted in Figure 3, a typical private-line network contains a "backbone" set of T1 private lines with lower-speed lines from "branch" offices. In today's environment, a change in configuration of these networks (requiring the reallocation of point-to-point facilities) requires only a slow provisioning process. This is inefficient for networks whose traffic demands change in a predictable manner (e.g., a distinct day and night pattern). Given a Service Net-2000 environment in which private lines could be controlled and routed like today's phone calls, one can envision an intelligent network element that has many network (routing) maps. These network elements could, at various times of the day, send the necessary commands to implement a particular network map to the affected network node. The nodes, in turn, could reallocate the facilities to reflect these changed patterns (see Figure 4). This process could be expanded to disaster recovery and/or to a self-healing network. Implementing network maps could redirect traffic (both private line and switched voice and data) around either a major failure in a customer's premises (as in the case of a data or telemarketing center) or a network failure (such as a facility break).

Intelligent network capabilities of Service Net-2000 could also arrange specialized billing for high-

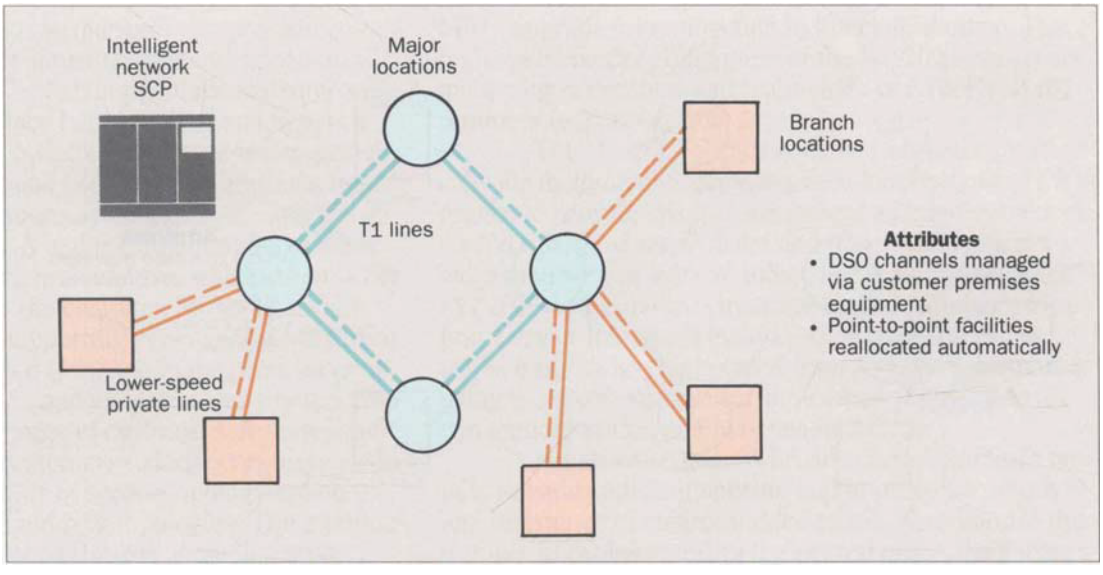

Figure 4. In a Service Net-2000 environment that contains both major and branch locations, it will be possible to reconfigure the network as needed to match the anticipated traffic pattern. Network maps could redirect traffic around a major failure in a network or a customer's premises.

bandwidth services. Distance-learning applications could use the network-routing capabilities of the intelligent network in conjunction with the real-time DS1 switching capabilities of Service Net-2000. For example, potential users of a university's services could be given an "800" number to inquire about various distance-learning course offerings. When this 800 number is dialed, it would be translated to the directory number of the correct distance-learning center. This location could vary from week to week, depending on guest lecturers, special facilities, etc. The university could gather the information in an administrative report to help bill their clients. Then, the corporate clients would receive only one bill for their distance-learning expenses.

Other services and applications could include:

- Multimedia teleconferencing
- High-speed order processing
- PCNs.

Another important aspect of Service Net-2000 is the architectural flexibility it provides in offering intelligent network services and capabilities. Functions and capabilities in a distributed intelligent network architecture should be designed and deployed to be adaptable to the needs of telephone companies and end users. As these needs evolve, the robust nature of the Service Net-2000 framework will allow functions and network elements and services to be redistributed or moved. Capabilities may no longer be viewed as static and may migrate as services mature. The design of Service Net-2000 will be based on the flexible, dynamic allocation of network resources. The Service Net-2000 infrastructure distributes service logic and its control. It provides a "service-ready infrastructure" and a platform of true network intelligence.

More specifically, consider the 5ESS-2000 switch, the intelligent network adjuncts, service circuit nodes (SCNs), the intelligent peripheral (IP), and the service control point (SCP) in the Service Net-2000 complex. Each of these systems has unique capabilities, but perhaps more importantly, these systems work together to form a truly distributed, application-rich network.

Systems Coordination

This section details the advantages and strengths of the 5ESS-2000 switching system; the intelligent network adjunct, service circuit node, and intelligent peripheral; and the intelligent network service control point.

5ESS-2000 Switching System. The 5ESS-2000 switching system can be used to provide high-performance applications, support a finer level of control and data access, and provide many line-/terminal-specific features. Its integrated environment executes service logic in the intelligent network and also supports market-proven network features that are migrated back to the switch.

Intelligent Network Adjunct, SCN, IP. Working as a team, the intelligent network adjunct, the service circuit node, and the intelligent peripheral can store large amounts of data (such as customer data, or electronic or voice messages) on customer premises or in the network. They can coordinate call control with extensive information (e.g., multi-media) delivery and support rapid trial of new technology and local services. If any of these systems is unavailable because of service problems, there is a less adverse impact on the network (i.e., more limited geographic extent than an intelligent network service-control-point outage). The systems can provide control capabilities for applications that may require high-bandwidth connectivity, and is more responsive, allowing for the introduction and deployment of services requiring new user interface technology (e.g., automatic speech recognition).

Intelligent Network SCP. The intelligent network service control point:

- Supports network-wide services from network databases
- Provides applications over multiple locations
- Supports trial of new technology and network services
- Uses the flexibility of SS7 connectivity, which increases network reliability
- Maintains global information for centralization and service access.

As an example of the architectural flexibility of Service Net-2000, consider an automatic call-distributor service within the Service Net-2000 infrastructure. The intelligent network service control point could supply the service intelligence for network-wide call distribution. Calls could be routed to different network locations based on time of day, day of week, distribution of traffic, or availability of facilities. The intelligent network adjunct or service circuit node of Service Net-2000 could perform more localized service functions, such as incoming call screening, intragroup call distribution, customer data retrieval, and screen display. In addition, the 5ESS-2000 switching system contains a rich set of supplementary services (e.g., call forwarding, call waiting, call hold, conference calling, etc.) that interact with the intelligent network in a complementary fashion. Once proven and mature, the services of the intelligent network adjunct or service circuit node could be moved back to the 5ESS-2000 switching system.

In summary, the attributes of Service Net-2000 will enhance the functionality of the intelligent network. The distributed-service-logic elements (i.e., adjuncts, service circuit nodes, service control points, intelligent peripherals) can take advantage of the high bandwidth, reliable transport capabilities of the Service Net-2000 transport elements. This may remove some of the performance constraints that currently limit the intelligent network architecture. In addition, the new switching module, SM-2000, with its increased call capacity, will enhance the service-logic execution of the 5ESS-2000 switch, allowing for even more sophisticated services and more customization.

Conclusions

This paper has summarized the forces that are shaping the network of the future. The Service Net-2000 architectural framework will provide a cost-effective network infrastructure that incorporates the A-I-Net™ intelligent network control architecture. Its benefits include

the flexibility to define these services and the architectural flexibility to implement them. The intelligent network and Service Net-2000 are being developed concurrently and represent a major step in achieving AT&T's Universal Information Services vision. As part of our continuing commitment to our customers, we are working toward delivering a flexible, service-ready network that will meet the demands of the Information Age.

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Biographies (continued)

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