OLD COVERAGE IN PSB-6031			IS REPLACED BY PRACTICE 290-
VOL.	SECT.	TITLE	
I	1	OVERVIEW	000-100
I	2	FUNCTIONS	400-100, 400-180 500-100, 500-180
II	3	INSTALLATION	400-203 500-203
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III	8	OPERATION	000-300, 000-301, 000-302, 000-306, 000-350
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III	12	MAINTENANCE	000-509

MASTER NUMERICAL INDEX

1. GENERAL

1.01 This section provides the master numerical index to the complete ITS series of Vidar System Practices.

1.02 The system configurations documented by these practices include the following:

ITS4	Toll Switch	Class 4
ITS5	Local Switch	Class 5
ITS4/5	Combination Toll/Local Switch	Class 4/5

1.03 All ITS System publications are organized by sections. Each section is categorized by the content and is identified by a 9-digit number, i.e., 290-000-100. These sections are also generally referred to as practices.

1.04 The first three digits (290) indicate the major division, ITS Systems. The second group of three digits indicates a subdivision of information. The ITS series of practices includes the following subdivisions:

(a) When the middle digits are 000, the practice pertains to all ITS System configurations.

(b) When the middle digits are 400, the practice pertains to ITS4, toll switch, applications (base switch equipment).

(c) When the middle digits are 500, the practice pertains to ITS5, local switch, applications (subscriber switch equipment).

(d) When the middle digits are 600, the practice pertains to the VB3, voice bank, equipment used with ITS Systems.

(e) A combination toll/local switch, ITS4/5, will require all of the ITS4 and ITS5 practices.

1.05 The last three digits indicate the content of the practice and generally relate to specific craft activities or categories. These categories are defined as:

Series 000: General information, indexes, description of customer services, etc.

Series 100: General descriptions, software description, list of terms and abbreviations

Series 150: Applications, functional description, signaling states and logic, interfacing, capacities, features and services, reliability, maintenance plan, and OEM equipment

Series 200: Installation, planning, initial testing, acceptance testing and cutover

Series 300: Operation, office data administration, traffic measurement, traffic reports and line assignment

Series 500: Maintenance, reference practice for equipment location, trouble-shooting, error code tables, diagnostic tests, trunk maintenance testing, preventive maintenance routines, and subscriber line testing procedures

1.06 Practices listed in the ITS series may be ordered by contacting:

TRW Vidar
Technical Publications
Distribution Department
77 Ortega Avenue
Mountain View, CA 94040
(415) 961-1000

2. NUMERICAL INDEX

Section	Title	Availability/Status or Issue Date
290-000-000	Master Numerical Index	Nov. 1978
290-000-001	Customer Services	Jan. 1979
290-000-100	System Overview (Formerly 100-100-100)	Dec. 1977
290-000-120	Data Base Program Description	Jan. 1979
290-000-121	Call Processing Software Description	Feb. 1979
290-000-122	Diagnostic Software Description	Feb. 1979
290-000-123	Memory Test Software Description	March 1979
290-000-140	List of Terms and Abbreviations	Oct. 1978
290-000-150	Transmission Specifications	Oct. 1978
290-000-182	Trunk Interfaces	April 1979
290-000-184	Trunk Signaling	April 1979
290-000-185	Network Synchronization	April 1979
290-000-186	Reliability and Availability	March 1979
290-000-189	Maintenance Plan	March 1979
290-000-191	Network/System Administration Applications Guide	March 1979
290-000-200	Installation Overview	June 1979

Section	Title	Availability/Status or Issue Date
290-000-201	Installation Planning	March 1979
290-000-202	Shipping and Receiving	Dec. 1978
290-000-204	Initial Turnon and Testing	Nov. 1978
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290-000-300	Operation Overview	Dec. 1978
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290-000-302	Call Trace and Call Activity Tracing Procedures	Oct. 1978
290-000-303	ODA User's Guide	Dec. 1978
290-000-306	System Command Summary	Nov. 1978
290-000-307	Traffic Measurement and Reports	Jan. 1979
290-000-350	Emergency Procedures	Nov. 1978
290-000-500	Maintenance Overview	Oct. 1978
290-000-501	Equipment Locations	Oct. 1978
290-000-502	Error Code List	Oct. 1978
290-000-503	System Diagnostics	Oct. 1978
290-000-504	System Controller Maintenance	Oct. 1978
290-000-505	Memory Test Procedure	Oct. 1978
290-000-506	ITS Maintenance - Matrix Equipment	Oct. 1978
290-000-507	ITS Maintenance - Peripheral Equipment	Oct. 1978
290-000-508	Trunk Maintenance Testing	Dec. 1978
290-000-509	Preventive Maintenance Procedures	Oct. 1978
290-000-510	Equipment Numbers	Oct. 1978
290-400-100	General Description and Operation	July 1979
290-400-150	System Specifications	Jan. 1979
290-400-180	Functional Description (Formerly 100-100-104)	Dec. 1977

Section	Title	Availability/Status or Issue Date
290-400-181	Applications	June 1979
290-400-183	Common Channel Interoffice Signaling	April 1979
290-400-187	Traffic Capacity	Feb. 1979
290-400-188	Features and Services	Feb. 1979
290-400-203	Installation Instructions - Base Switch	Nov. 1978
290-400-205	Acceptance Test Procedures	Dec. 1978
290-500-100	General Description and Operation	July 1979
290-500-124	CDO-POTS Software Description	April 1979
290-500-150	System Specifications	Jan. 1979
290-500-180	Functional Description	March 1979
290-500-181	Applications	June 1979
290-500-187	Traffic Capacity	Feb. 1979
290-500-188	Features and Services	Feb. 1979
290-500-190	Subscriber Lines	April 1979
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290-500-205	Acceptance Test Procedures	Sept. 1978
290-500-304	Line Assignment User's Guide	Nov. 1978
290-500-511	Subscriber Line Maintenance	Dec. 1978
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290-600-103	Functional Description - Trunk Unit IM122	Feb. 1979

Section	Title	Availability/Status or Issue Date
290-600-104	Functional Description - Trunk Unit IM123	Feb. 1979
290-600-105	Functional Description - Trunk Unit IM124	Feb. 1979
290-600-106	Functional Description - Trunk Unit IM125	Feb. 1979
290-600-107	Functional Description - Trunk Unit 6527	Feb. 1979
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290-600-150	System Specifications	Feb. 1979
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290-600-502	System Alignment and Adjustment	Feb. 1979
290-600-503	System Testing and Troubleshooting	Feb. 1979

ITS SYSTEMS
OVERVIEW

1. INTRODUCTION

1.001 The telephone network is undergoing a significant change from analog to digital technology in transmission and switching system design. This evolution began in the early 1960s when the transmission plant began using digital, pulse code modulated (PCM) T1 carrier systems. As the first supplier of T1 carrier equipment to the independent telephone industry, TRW Vidar has been a leader in PCM transmission systems since 1965.

1.002 Using its PCM transmission background and momentum, along with technological opportunities created by real-time software system development and large-scale integration (LSI) of circuits, TRW Vidar conceived and planned the Integrated Transmission and Switching (ITS) Systems. These systems make available a full family of building block transmission and switching system elements for a wide range of network applications. The first ITS System was placed in service in an independent telephone company central office (CO) in early 1976.

1.003 TRW Vidar is committed to serving its customers as THE INTEGRATED SUPPLIER of complete telecommunications networks:

a. Integrated horizontally from telephone drop to long-haul carriers.

b. Integrated vertically from TRW components to complete telecommunication networks.

c. Integrated in technology using PCM for transmission and switching.

1.004 Behind this commitment is a comprehensive, unified plan for integrated PCM transmission and switching products. **Figure 100-1** provides an overview of this plan.

1.005 The plan starts at the telephone drops (left side of **Figure 100-1**), where subscribers connect to subscriber switches. This is the point at which a subscriber conversation is converted between analog loop currents and a digital PCM bitstream -- beginning the "digital connection." Subscribers are also served by digital subscriber carrier systems which bring the point of analog-to-digital (A/D) conversion closer to the subscriber, thereby shortening the loop.

1.006 The subscriber switches are controlled by, and interconnected to, a base switch. Subscriber switch services are then provided through the base switch. The subscriber switches may either be collocated with their base switch, or located remotely (up to the limits of T1 carrier engineering). Thus, the plan provides for comprehensive, integrated subscriber transmission and switching at the Class 5 office level.

1.007 Base switches interconnect with each other and with Class 4 toll/tandem switches in the network. Increasingly, these interconnections will be made through PCM transmission elements.

1.008 Toll/tandem switches use essentially the same base switch elements as Class 5 switches. Class 4/5 toll/local switches with distributed subscribers are therefore an important part of the plan and offer efficiencies not found in earlier network architectures. Both local and centralized automatic message accounting (LAMA and CAMA) are included in the plan.

1.009 All base switches (Class 5, Class 4, Class 4/5) may be accessed from remote locations for maintenance support and for dial administration. Remote maintenance and administration centers are planned to provide operating companies the ability to concentrate, in one central location, the network maintenance and administration for many smaller switching entities.

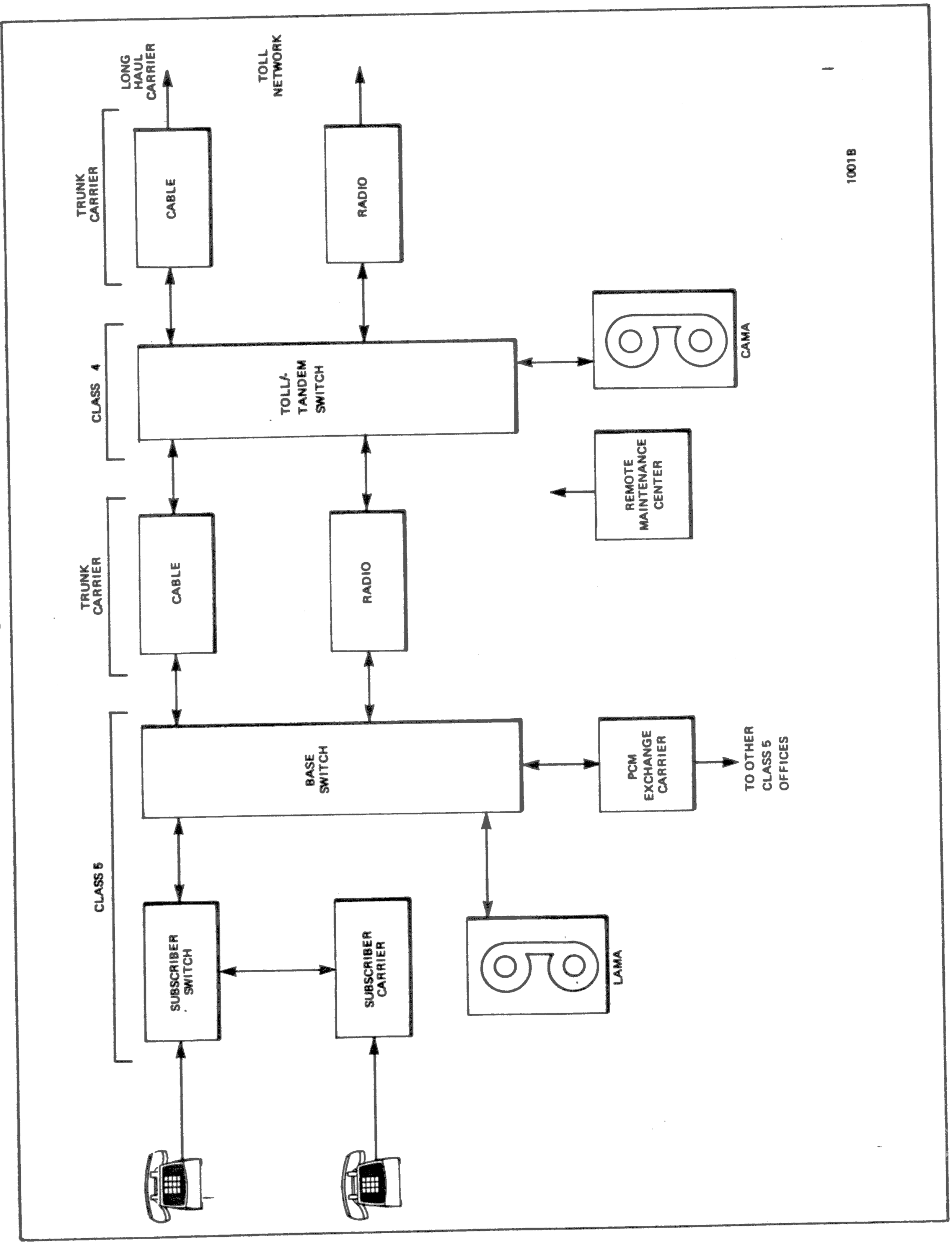

Figure 100-1

ITS System Overview

2. SYSTEM OBJECTIVES AND BENEFITS

2.001 During ITS System planning, technical and marketing studies led to establishment of a number of objectives. The ITS System objectives result in a number of benefits with economic, service and compatibility implications. These are listed in **Table 100-1.**

3. SYSTEM ARCHITECTURE

3.001 The overall System architecture which evolved from the above objectives is shown in **Figure 100-2.** System architecture is critical to system performance, and also to the success of the family of products offered over the life of a system. In telephone central office equipment, this life cycle is generally 20 years or longer.

3.002 The elements available to configure ITS Systems are summarized in **Table 100-2.** As an example of assembling the building block elements of **Table 100-2** into an integrated system, consider the Vidar ITS System architecture of **Figure 100-2.** The first building block of ITS System architecture is a base switch with DS-1 interfaces and terminations. These are segregated for lines and trunks. All trunk-to-trunk switching is non-blocking. The only blocking in the system appears in the subscriber switch.

3.003 A key feature of the architecture is the interface to the base switch. All interfaces are at the North American standard 1.544 Mb/s T1 rate. These are referred to as DS-1 interfaces, since they operate at the Data Speed 1 rate. No conversion devices are needed at this interface point, since the base switch operates internally at the DS-1 rate.

3.004 Beginning at the bottom of **Figure 100-2**, it is possible to provide a direct digital interface between the base switch and Switched Digital Network (SDN). The ITS System architecture was designed to include this inherent ability to integrate with the SDN. Note that there is a substantial economic benefit in directly interconnecting two or more digital switches, since interswitch channel banks are then completely eliminated.

3.005 Thus, digital trunks (to other digital switches) are available without additional interfaces. The Bell System has established a nationwide plan for digital switching synchronization, where more than one digital switch operates in a "switched digital network." ITS Systems are compatible with this plan. When two digital switches are interconnected, synchronization between the two system clocks ~~will~~ be provided as an option, in accordance with the Bell System SDN master plan.

3.006 Continuing at the lower part of **Figure 100-2,** analog trunks interface the base switch through VB3 Voice Banks. If this were the only interface to the switch, the power of the digital switch would not be used to integrate transmission and switching or provide subscriber terminations. The first step in the integration of transmission and switching is shown in the third line from the bottom of **Figure 100-2.** There, a D bank interfaces with the base switch over a T1 repeatered line.

3.007 When the D bank is remoted over the span line, the cost of remoting is merely the cost of the T1 line. Therefore, T1 carrier proves-in over physical facilities based only on the cost of the span line, rather than the cost of the span line plus the cost of two banks. T1 carrier proves-in at a much shorter distance in this environment.

3.008 The first three lines from the bottom of **Figure 100-2** illustrate the system interfaces to digital trunks, analog trunks and combination trunks, respectively. Digital and combination trunks interface the base switch digitally at the DS-1 level. Analog trunks interface the base switch at analog levels. This completes the building blocks required for trunk switching.

3.009 Continuing the discussion of building blocks, consider the next block in **Figure 100-2** (the local subscriber switch, LSS). The local subscriber switch interfaces up to 336 subscriber lines and switches them into two DS-1 lines interfacing the base switch. (Remember that the base switch interfaces DS-1 lines directly.) The base switch provides a non-blocking, full-availability matrix for each of the digitally derived time slots.

3.010 A subscriber carrier terminal (SCT) is shown on the fifth line from the bottom in **Figure 100-2.** There, 24 subscriber lines are remoted from the LSS to provide a pair gain system. The cost of this pair gain system is the incremental cost of the T1 span line and the cabinet for the SCT. Thus, the point of conversion from analog to digital voice is placed in the subscriber feeder plant.

3.011 Some applications require a concentrated form of subscriber carrier to serve a large concentration of subscribers. This can be a pair gain system or a CDO rehoming application. This function is accomplished with the remote subscriber switch (RSS). The RSS differs from the LSS, in that it must have the capability to stand alone if the T1 lines to the base switch are cut. Thus, the RSS must have capabilities for intra-links, directory number translation, DTMF and stand alone POTS (Plain Old Telephone Service) capability independent of the base switch.

TRW VIDAR

Table 100-1

ITS System Objectives

System Objectives	Benefits/Implications					Comments
	Lower First Cost	Lower Recurring Cost	Incremental Revenue	Improved Grade of Service	Compatability	
1. Integrated toll, local and combined toll/local operation.	X	X		X	X	Class 4/5 system configuration offers economies by sharing toll/local functions with one set of common equipment.
2. Modular, building block system architecture with elements interconnected by North American Standard Interface. See Table 100-2.	X	X		X	X	Modular hardware and software program structure allows cost of optional features to be deferred until required, then added economically. Standard North American interfaces (DS-1 rate, 1,544 Mb/s) are used on all system elements. No rate conversion equipment is required. Standard T1 repeaters are used for digital transmission to remote subscriber switch and subscriber carrier terminals. D3 transmission quality on both subscriber lines and trunks. Commonality of equipment among family elements minimizes spares and reduces training costs.
3. Integrated digital subscriber carrier(non-concentrating)with direct digital interface to concentrating subscriber switches.	X	X		X	X	Integrated transmission and switching, for both trunks and subscriber carrier, requires minimum equipment: Analog/digital conversion is required only once — at the subscriber loop. Since a digital subscriber carrier interfaces directly with the digital subscriber switch over a T1 line, the function of the CO portion of a subscriber carrier system is integrated into the switch. The resulting lower-cost subscriber carrier will favor digital electronics over resistance design in many more instances. Thus, the integration of subscriber carrier and switching provides the additional benefit of subscriber plant cost savings. Digital subscriber carrier gives lower loop loss. More than 65% of the subscriber loops in the North American Network are candidates for subscriber carrier.
4. Segregated line and trunk terminations.	X	X				Simplifies dial administration and traffic engineering. Simplifies toll/local operations.

Table 100-1

ITS System Objectives (Con't)

System Objectives	Benefits/Implications					Comments
	Lower First Cost	Lower Recurring Cost	Incremental Revenue	Improved Grade of Service	Compatability	
5. Non-blocking, full-availability base switch matrix.	X	X		X		Requires fewer trunk circuits and facilities for equivalent traffic capacity. Improved call completion rate.
6. Capacities: As toll switch: 3072 trunk terminations As local switch: 12,768 lines with 1104 trunks (9%)	X					System architecture allows economic prove-in over a broad economic size range in offices serving from a few hundred lines to full capacity.
7. Physical Size: Less than 20% of the size of existing electromechanical toll systems.	X	X				Building space conservation or recovery defers or eliminates building additions.
8. Availability: Less than one hour downtime in 20 years.				X		Redundancy protection against single-point failures in all critical system functions.
9. Maintainability: Less than 0.5 hours MTTR (Mean-Time-to-Repair).		X		X		High equipment reliability results in longer MTBMA (Mean-Time-Between-Maintenance-Actions). Extensive self-testing and trouble reports reduce maintenance MTTR. Maintenance costs are reduced by using reliable digital logic and eliminating electromechanical or other analog components in call switching.
10. Transmission: Toll to AT&T's "Bluebook" Network Standards including: – VNL (Via Net Loss) plan compatibility – FL (Fixed Loss) plan compatibility				X	X	Real-time traffic and trouble reports aid in rapid identification of marginal or defective lines and trunks. D3 transmission quality on both subscriber lines and trunks.
11. Signaling: Toll to AT&T's "Bluebook" Network Standards including: – D3 compatibility – CCIS options					X	Network compatibility.

Table 100-1

ITS System Objectives (Con't)

System Objectives	Benefits/Implications					Comments
	Lower First Cost	Lower Recur- ring Cost	Incre- mental Revenue	Improved Grade of Service	Compat- ability	
12. Billing: (AMA recorders): – Accuracy: Less than 3 errors per 10,000 call records – Resolution: 1 second timing – Associated entry		X	X	X		
13. Compatibility: With existing and future toll and local, analog and digital, transmission and switching equipment.		X	X		X	
14. Fully stored program control using microprocessors.	X				X	Microprocessor stored program control technology is used. No minicomputer training of personnel is necessary, and packaging of controller is uniform with all other system elements.
15. Packaging: Compatible with standard office aisle layouts.	X				X	Equipment can be installed to replace existing CO equipment.
16. Environment: Standard CO: 0°C to 50°C. (32°F to 122°F) Outside Equipment: -40°C to 60° (-40°F to +140°F)	X	X				
17. No cooling fans in equipment.						Fan failures, maintenance and power are eliminated.

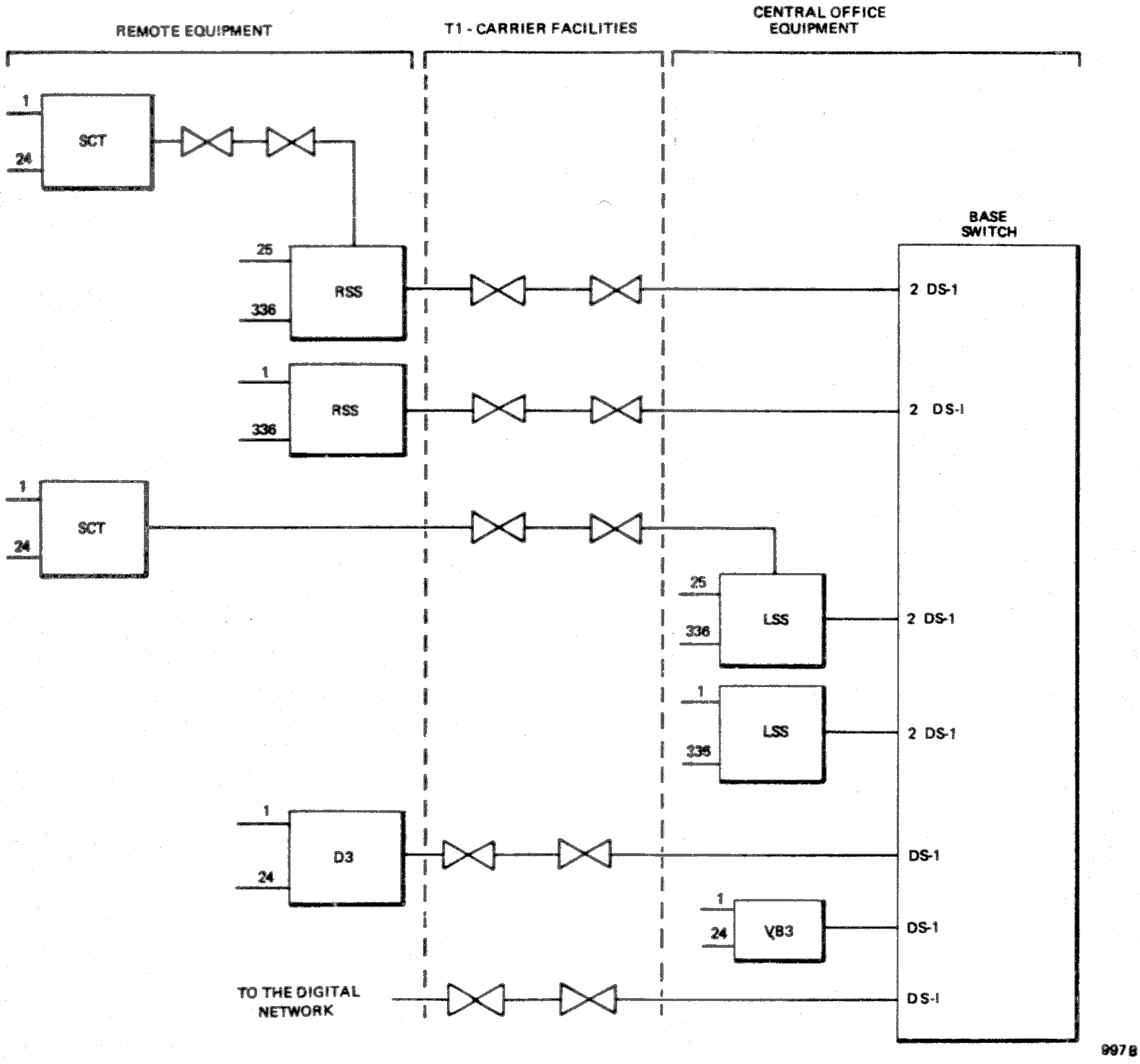

Figure 100-2 ITS System Architecture

Table 100-2

ITS System Elements

Element	Symbol	Function	Capacity
Base Switch	BSW	System control (Stored program) PCM matrix (non-blocking) PCM interface to all other system elements and to the Switched Digital Network Service circuits AMA recorder (option)	128 DS-1's (3072 time slots)
Digital Interface	DS-1	Digital interface at Data Speed 1 (T1) rate (1.544 Mb/s) PCM interface between all system elements and to other Switched Digital Network elements	1 T1 line (24 time slots)
Voice Bank	VB3	Analog trunk interface (local, at base switch)	24 voice frequency trunks
Channel Bank	D3	Analog trunk interface (remote from base	24 voice frequency trunks
Local Subscriber Switch	LSS	Subscriber line interface Connects subscriber to base switch Subscriber line concentration	336 lines; 2 DS-1's (48 time slots)
Remote Subscriber Switch	RSS	Subscriber line interface Connects subscribers to base switch Subscriber line concentration CDO POTS Local links Pair gain	336 lines; 2 DS-1's (48 time slots)
Subscriber Carrier Terminal	SCT	Subscriber line interface to RSS or LSS Extends subscriber line functions over a T1 line Pair gain Non-concentrating	24 subscriber lines 1 T1 line (24 time slots)

3.012 The ITS System architecture also provides for subscriber carrier capability from a remote subscriber switch, as shown in the top line of **Figure 100-2**. An SCT is shown associated with an RSS, which in turn is remotely connected to a base switch. This architecture is possible because, once the voice is converted into digital format, there is no transmission loss from the SCT through the RSS to the base switch. This architecture would not be possible in an analog environment because of the loss which would exist. Distances involved between the SCT and the RSS, and the RSS and the base switch are the standard distances for practical T1 repeatered line design.

4. PROGRAM STRUCTURE (SOFTWARE)

4.001 The ITS System is controlled by a fully-stored program controller using microprocessor technology. The programs stored in this controller are modular in nature.

4.002 The term "programs" refers to software supplied by TRW Vidar (on a right-to-use basis). No programming is required on the customer's part. Programs in an ITS System can be divided into the following categories:

a. Call Processing

b. Supervision and Scheduling

c. System Input/Output

d. Input/Output

e. Administrative

f. Traffic Measurement

g. Diagnostics

4.003 Call Processing programs contain the logical functions which control the sequence of events required to process calls through the system. They control the logical states which a line or trunk termination passes through from the moment it is seized until it returns to idle. Call Processing programs also perform the following functions:

a. Controlling the functions required for all line and trunk types.

b. Determining which paths through the switch should be set up or dropped.

c. Controlling the selection and assignment of dial-pulse registers, multifrequency senders and receivers, trunks, Operator Number Identification (ONI) trunks and announcement trunks.

d. Determining the translation required for routing.

e. Determining what information should be outpulsed to the network (or what tones to attach to trunks or lines).

f. Collecting information for Automatic Message Accounting (AMA) recording.

4.004 Supervision and Scheduling programs maintain the work and timing queues. They control the priorities of jobs to be executed. Error messages are analyzed and appropriate actions determined.

4.005 System Input/Output (I/O) programs control all messages sent between the system controller and other subsystems. Messages are prioritized and formatted appropriately, and analyzed for validity.

4.006 Input/Output programs contain all routines which drive the various I/O devices. These programs provide the interface between the hardware and other programs which require reading or writing on magnetic tape cartridges and recorders. Also, programs needing to send messages to (or receive messages from) the CRT/keyboard terminal (or system printer) are interfaced to the hardware.

4.007 Administrative programs consist of various routines necessary to perform data base changes, normal line and trunk maintenance, and periodic routines, such as AMA recorder tape changes.

4.008 Traffic Measurement programs collect and print out traffic data. The interval of the traffic reports can be selected to match current requirements.

4.009 Diagnostic programs exercise all elements of the ITS System, as an aid in isolating problems.

4.010 In addition to the programs described above, a data base is compiled for each ITS System when it is installed. This data base contains the information required to completely configure an office, including:

a. Termination (line and trunk) assignments.

b. Termination class of service information.

c. Termination signalling information (DP/DTMF on lines; DP/MF on trunks).

d. Translation and routing tables.

3.011 This data base resides in the on-line memories of the ITS System controllers. The data base may be changed by use of an editing program, which permits the system operator to perform dial administration through the system's CRT terminal and printer.