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National Marketing Division—Orange Tabs

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**GENERAL PROGRAMMING
INFORMATION**
1 October 81

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5719-AM2 RPS Indexed Access Method Version 2 Series/1 2.2

5719-AS1 Program Preparation Subsystem Version 1 Series/1 2.7

5719-AS2 Program Preparation Subsystem Version 2 Series/1 2.9

5719-AS3 Program Preparation Subsystem Version 3 Series/1 2.10

5719-AS4 Program Preparation Subsystem Version 4 Series/1 2.12

5719-AS5 Program Preparation Subsystem Version 5 Series/1 2.13

5719-CA1 Series/1-System/370 Channel Attachment Series/1 2.17

5719-CB1 RPS COBOL Compiler & Resident Library Version 1 Series/1 2.18

5719-CB2 RPS COBOL Transient Library Version 1 Series/1 2.18

5719-CB7 RPS COBOL Compiler and Resident Library Version 2 Series/1 2.26

5719-CB8 RPS COBOL Transient Library Version 2 Series/1 2.26

5719-CM1 Communications Monitor for the Series/1 Series/1 2.33

5719-CS0 Programmable Comm. Subsystem Preparation Facility Series/1 2.37

5719-CS1 Programmable Comm. Subsystem Execution Support Series/1 2.38

5719-CS2 Programmable Comm. Subsystem Extended Execution Support Series/1 2.39

5719-FO1 FORTRAN IV Compiler and Object Support Library Version 1 Series/1 2.43

5719-FO2 FORTRAN IV Compiler and Object Support Library Version 2 Series/1 2.48

5719-FO3 FORTRAN IV Realtime Subroutine Library Version 1 Series/1 2.43

5719-FO4 FORTRAN IV Realtime Subroutine Library Version 2 Series/1 2.43

5719-LM1 Mathematical and Functional Subroutine Library Version 1 Series/1 2.51

5719-LM2 Mathematical and Functional Subroutine Library Version 2 Series/1 2.54

5719-MT1 RPS Multiple Terminal Manager Version 3 Series/1 2.62

5719-PC1 Realtime Programming System Version 1 Series/1 3.1

5719-PC2 Realtime Programming System Version 2 Series/1 3.8

5719-PC3 Realtime Programming System Version 3 Series/1 3.11

5719-PC4 Realtime Programming System Version 4 Series/1 3.15

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5719-PL1 RPS PL/I Compiler and Resident Library Version 1 Series/1 4.1

5719-PL2 RPS PL/I Compiler and Resident Library Version 2 Series/1 4.6

5719-PL3 RPS PL/I Transient Library Version 1 Series/1 4.1

5719-PL4 RPS PL/I Transient Library Version 2 Series/1 4.6

5719-RJ6 RPS Advanced Remote Job Entry Series/1 4.17

5719-SF1 RPS Screen Format Design Aid Utility Series/1 4.21

5719-SF2 RPS Presentation Support Series/1 4.21

5719-SM1 RPS Sort/Merge Series/1 5.1

5719-SN1 SNA Extended Support Series/1 5.4

5719-TA1 5250 Information Display System Attachment Support Series/1 5.8

5719-TA4 4969 Magnetic Tape Subsystem Support Series/1 5.10

5719-XR2 RPS Query Series/1 5.29

Realtime Programming System PRPQs



5799-TBK	Remote Job Entry (P82575).....	Series/1 6.17
5799-TBL	Disk Spooling Version 1 (P82574).....	Series/1 6.18
5799-TBM	4978 Display Support Version 1 (P82572).....	Series/1 6.19
5799-TBN	Indexed Access Method Version 1 (P82570).....	Series/1 6.21
5799-TBP	Basic Sort (P82573).....	Series/1 6.22
5799-TBY	Address Translator Transient Support Version 3 (P82585).....	Series/1 6.25
5799-TCA	Indexed Access Method Version 2 (P82570).....	Series/1 6.21
5799-TCB	Indexed Access Method Version 3 (P82570).....	Series/1 6.21
5799-TCD	4978 Display Support Version 2 (P82572).....	Series/1 6.19
5799-TCE	4978 Display Support Version 3 (P82572).....	Series/1 6.19
5799-TCG	Disk Spooling Version 2 (P82574).....	Series/1 6.18
5799-TCH	Disk Spooling Version 3 (P82574).....	Series/1 6.18
5799-TCX	Communication Monitor for Series/1 (P82598).....	Series/1 6.26
5799-TCY	Multiple Terminal Manager Version 1 (P82596).....	Series/1 6.28
5799-TDG	Transient Activity Tool Version 1 (P82606).....	Series/1 6.32
5799-TDH	Remote Management Utility (P82597).....	Series/1 6.33
5799-TDX	Multiple Terminal Manager Version 2 (P82622).....	Series/1 6.36
5799-TEC	Job Stream Processor (P82635).....	Series/1 6.40
5799-TEF	SNA Remote Management Utility (P82639).....	Series/1 6.40
5799-TEP	Host COBOL for the Series/1 (P82648).....	Series/1 6.47

Event Driven Executive Licensed Programs

5719-AM3	EDX Indexed Access Method Version 1.....	Series/1 2.4
5719-AM4	EDX Indexed Access Method Version 2.....	Series/1 2.6
5719-ASA	EDX Macro Assembler.....	Series/1 2.15
5719-CB3	EDX COBOL Compiler and Resident Library Version 1.....	Series/1 2.20
5719-CB4	EDX COBOL Transient Library Version 1.....	Series/1 2.20
5719-CB5	EDX COBOL Compiler and Resident Library Version 2.....	Series/1 2.23
5719-CB6	EDX COBOL Transient Library Version 2.....	Series/1 2.23
5719-CF1	EDX Communications Facility.....	Series/1 2.30
5719-CX1	EDX System/370 Channel Attachment Program.....	Series/1 2.41
5719-FO2	FORTTRAN IV Compiler and Object Support Library Version 2.....	Series/1 2.48
5719-LM3	EDX Mathematical and Functional Subroutine Library.....	Series/1 2.56
5719-LM5	Macro Library Version 1.....	Series/1 5.31
5719-LM6	Macro Library Version 2.....	Series/1 5.35
5719-LM7	Macro Library Version 3.....	Series/1 5.38
5719-MS1	EDX Multiple Terminal Manager Version 1.....	Series/1 2.58
5719-MS2	EDX Multiple Terminal Manager Version 2.....	Series/1 2.60
5719-PL5	EDX PL/I Compiler & Resident Library.....	Series/1 4.12
5719-PL6	EDX PL/I Transient Library.....	Series/1 4.12
5719-SM2	EDX Sort/Merge.....	Series/1 5.3
5719-SX1	EDX Systems Network Architecture.....	Series/1 5.5
5719-SX2	EDX Systems Network Architecture RJE.....	Series/1 5.7
5719-UT3	Utilities Version 1.....	Series/1 5.31
5719-UT4	Utilities Version 2.....	Series/1 5.35



5719-UT5	Utilities Version 3	Series/1 5.38
5719-XR1	EDX Query	Series/1 5.27
5719-XS1	Basic Supervisor and Emulator Version 1	Series/1 5.31
5719-XS2	Basic Supervisor and Emulator Version 2	Series/1 5.35
5719-XS3	Basic Supervisor and Emulator Version 3	Series/1 5.38
5719-XX2	Program Preparation Facility Version 1	Series/1 5.31
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5740-LM2	Macro Library/Host Version 1	Series/1 5.31
5740-LM3	Macro Library/Host Version 2	Series/1 5.35
5740-LM4	Macro Library/Host Version 3	Series/1 5.38

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5799-TDE	Data Collection Interactive (P82600)	Series/1 6.31
5799-TEL	Host COBOL for the Series/1 (P82647)	Series/1 6.46

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5799-TAA	Control Program Support (P82508)	Series/1 6.1
5799-TAE	4979 Display Station Support (P82515)	Series/1 6.2
5799-TAF	BSC-Communications (P82516)	Series/1 6.3
5799-TAH	Indexed Access Method (P82519)	Series/1 6.4
5799-TAJ	4991-201 Magnetic Stripe Card Reader (P82504)	Series/1 6.4
5799-TAK	4978/4979 Display Station (P82520)	Series/1 6.6
5799-TAL	CPS Extension I (P82525)	Series/1 6.7
5799-TAQ	CPS Extension II (P82526)	Series/1 6.8
5799-TAT	Sort/Merge (P82527)	Series/1 6.9
5799-TAW	Disk Table of Contents (P82528)	Series/1 6.10
5799-TAY	Disk Spooling (P82529)	Series/1 6.11
5799-TBA	Format/Print (P82530)	Series/1 6.12
5799-TBB	Operator Station/Debug Package (P82532)	Series/1 6.13
5799-TBC	Auto-call (P82533)	Series/1 6.14
5799-TBD	Commercial Arithmetic (P82534)	Series/1 6.15
5799-TBE	4978/4979 Display Map (P82531)	Series/1 6.16
5799-TBQ	CPS Extended Function (P82535)	Series/1 6.23
5799-TBT	Address Relocation Translator (P82536)	Series/1 6.24
5799-TCZ	4963 Disk Subsystem Support (P82541)	Series/1 6.30
5799-TDK	4963/4966 Save/Restore (P82539)	Series/1 6.34
5799-TDW	4969 Magnetic Tape Subsystem Support (P82621)	Series/1 6.35
5799-TEK	4965 Diskette Drive (P82636)	Series/1 6.42

Other Series/1 Programming

5719-CR1	Structured Program Facility, MVS/VTAM	Series/1 2.35
5719-CR2	Structured Program Facility, MVS/TCAM	Series/1 2.36
5719-ED1	Series/1 Structured Programming Facility	Series/1 2.42
5719-PA1	Base Program Preparation Facilities	Series/1 2.64
5719-SC2	Stand-alone Disk Utilities	Series/1 4.19



5719-U11	Facility Control/Power Management 1	Series/1 5.11
5719-U12	Facility Control/Power Management 2	Series/1 5.13
5719-U12 FC 6000, 6001	Facility Control/Power Management 3	Series/1 5.16
5719-U13	Facility Control/Power Management 4	Series/1 5.17
5719-U14	Facility Control/Power Management 2M	Series/1 5.20
5719-U14 FC 6000, 6001	Facility Control/Power Management 3	Series/1 5.16
5719-U15	Facility Control/Power Management 4M	Series/1 5.23
5719-U20	Audio Distribution System	Series/1 5.26

**IBM SERIES/1 REALTIME PROGRAMMING SYSTEM
(5719-PC1)**

The IBM Series/1 Realtime Programming System provides operating, system functions for realtime operations, with optional batch program preparation. This licensed program allows the generation of a multi-partition system as well as smaller configurations in a consistent and compatible manner. The Realtime Programming System includes multitasking facilities, storage management, data management, system operator station support, timer support, and communications facilities.

The Realtime Programming System supervisor, when combined with the Program Preparation Subsystem, enables a Series/1 to operate in a realtime online preparation environment or, if realtime is not required, in a simple batch environment.

The IBM Series/1 Realtime Programming System provides an operating system that has been optimized for predictable response and rich function. The IBM Series/1 Realtime Programming System addresses the needs of users who require realtime control functions:

- Supervisory Services
 - Task Management
 - Primary and Secondary Tasks
 - Dynamic Task Control Block Management
 - Prioritization by Hardware Level, Software Sublevel
 - Storage Management
 - Fixed Partitions
 - Overlays from Disk
 - Buffer Pooling
 - Task Set Management
 - Rollout/Rollin
 - Chaining of Task Sets
 - Queuing of Task Sets to Partitions
 - Optional Binding at Task Set Install Time
 - Scheduling Task Set Execution
 - Event Management
 - WAIT/POST (Simple, Iterative, Multiple)
 - Wait on Timer
 - Wait on I/O
 - Queue Management
 - Priority Queues in Storage
 - FIFO Queues on Disk and in Storage
 - Timer Management
 - Time-of-Day, Date
 - Time Delay
 - Asynchronous Timers
 - Serially Reusable Resource Management
 - REQUEST/RELEASE
 - Interrupt Management
 - I/O Interrupts
 - Class Interrupts
 - Error Management
 - Error Logging and Reporting
 - Task Error Exits
 - Storage Dump
 - System Reload and Restart
 - System Termination
 - Abnormal Termination of a Task

Operator Interface
 Command Processing
 Message Processing
 Floating Point Emulator Support

• Data Management

Data Set Management
 Basic I/O Access (EXIO)
 Physical Access (READ/WRITE)
 Logical Access (GET/PUT)
 Sequential and Direct Access Methods
 Consecutive, Direct, and Partitioned Organization
 OPEN/CLOSE
 CREATE/DELETE/RENAME
 NOTE/POINT

DPIO Support

IBM 4962 Disk Storage Unit
 IBM 4964 Diskette Unit
 IBM 4979 Display Station
 IBM 4973 Line Printer
 IBM 4974 Printer

Special Feature #7850, Teletypewriter Attachment
 Message Buffering for User-selected Output Devices

Sensor I/O Support

Analog I/O (Single or Multiple Point)
 Digital I/O (Single or Multiple Point)
 Process Interrupt

Communications Features Support

Asynchronous Communications Single Line Control (#1610)
 Asynchronous Communications 8-Line Control (#2091)
 Asynchronous Communications 4-Line Adapter (#2092)
 Binary Synchronous Communications Single Line Control (#2074)
 Binary Synchronous Communications Single Line Control/High Speed (#2075)
 Binary Synchronous Communications 8-Line Control (#2093)
 Binary Synchronous Communications 4-Line Adapter (#2094)

Communications Terminals and Systems Support

Via Start/Stop (Asynchronous) Communications:

- IBM 2740 Communications Terminal, Model 1, in point-to-point switched and point-to-point nonswitched connections. Record Checking (#6114), Dial Up (#3255), and Transmit Control (#8028) Special Features are supported.
- Teletype® Models ASR 33/35 Data Terminals in point-to-point nonswitched connections

Via Binary Synchronous Communications:

- IBM System/370 using OS/VS1 or OS/VS2 (SVS or MVS) BTAM in point-to-point switched and point-to-point nonswitched connections (Series/1 as System/3).

• Utility Package

Stand-alone Utility Functions
 Storage-Diskette Dump
 Disk Initialization
 System Build

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System Utility Functions

- Compress (Partitioned Data Set or Volume)
- Copy
- Define (Create, Delete and Rename, Logical Volumes, Data Sets, Members)
- Initialize Diskette
- Prepare Diskette to IPL Stand-alone Dump
- Assign Realtime Programming System to be loaded by IPL Merge (PDS or Volumes)
- Patch
- Report (Print Disk/Diskette Directories, Disk/Diskette Data or Storage Dump)
- Service Aids
 - I/O Trace
 - Storage Patch and Dump
 - SVC Trace
- Generation Facilities
- System Initialization

Description

- Storage Management and Task Set Management

Realtime Programming System supports multiple partitions. One partition (Number 0) is for the nucleus (System task set). Another partition may, at the user's option, contain a shared task set and be used as a shared partition containing data and other resources which may be used by programs in other partitions. The user may specify the number and sizes of the partitions at SYSGEN time and may alter his specifications at IPL time. Each partition must be a multiple of 2048 bytes. Up to 12 user partitions (besides Partition 0) may be created until the total storage requirements reach the maximum 64K bytes. Programs executing in user partitions are organized into task sets. One task set at a time may occupy a user partition. One partition (selectable at SYSGEN or IPL time) may have a task set rolled out to disk to make way for a higher priority task set. A task set to be rolled out must have been identified as such at Application Build time. Only one task set at a time may be rolled out.

Task sets may use overlays from disk. Overlay areas may be shared between tasks only as serially reusable resources under user control.

A task set may chain to another task set which will replace it as the executing task set in the same partition. A partition GLOBAL area is maintained during this exchange, allowing several task sets to operate in sequence as a single logical operation using the same data. This facility supports the FORTRAN function "INVOKE" and the PL/1 function "TRANSFER." Each task set has one primary task which executes following task set load. A buffer pooling facility allows reservation of a pool of storage in a task set for dynamic allocation of buffer to task on request.

Supervisory Functions

- Task Management
- Realtime Programming System is capable of supporting as many concurrent tasks as the user has processor storage areas (up to 64K) in which to execute the tasks. The user may have as many disk-resident programs as he can store on his disks. Tasks are dispatched in response to hardware interrupts, user requests from the system operator station, program requests, or timer services. Realtime Programming

System supports the dispatching of independent tasks from other tasks.

Realtime Programming System provides up to 256 preemptive priority sub-levels within each of the four hardware levels. A task may be assigned to any level and sub-level. Multiple tasks may be assigned the same priority level. Several tasks can be simultaneously suspended on a level.

The programmer specifies whether a program is serially reusable, reenterable, refreshable, or non-reusable through the use of the program preparation facilities.

- Timer Services

Realtime Programming System manages all physical and logical timers. The system supports multiple logical timers per physical timer. Realtime Programming System requires a dedicated physical timer attachment for its own use in order to provide Time-of-Day and Date and logical timer services when required. No timers are required for batch-only systems running Program Preparation Subsystem. The other timers are available to the user as I/O devices through the READ/WRITE interface. The programmer is provided with a facility so that he may request his program to be suspended for a specified time interval or until a specified time.

The system provides a Time-of-Day Clock (TOD) and DATE. The DATE may be requested from the system in any of the following formats: Julian (YYDDD), MM DD YY, and YY MM DD. The user is provided a facility for setting the DATE and TOD clock through the system operator station or from a program.

Scheduler services are provided so that a person may schedule a task set to be executed on a periodic basis, at a particular time of day, or after a specified time interval. A facility is provided to add and delete task sets from the scheduler table of program requests and from the system operator station.

- Interrupt Handler

An interrupt handler is provided for the initial handling of machine level interrupts and the dispatching of interrupt service routines. The programmer has the ability to assign task sets and events to specific bits within a process interrupt group through console or program request. Programs may dynamically connect and disconnect process interrupt bits. The programs dispatched may be storage-resident (a waiting task) or disk-resident (a task set to be queued). The user specifies the priority level at which the service task will execute.

The user is able to provide a program to be executed when the programmer console interrupt switch is depressed.

- Event Services

The programmer may define events and cause resumption of a suspended task upon the occurrence of an event. A Wait/Post facility is provided for the synchronization of tasks.

Events that are supported include I/O completion, timer, user-defined, and adding an element to a queue. The three event types supported are simple, iterative and multiple. A task may be suspended until a single event occurs or any of a list of events occurs.

- Floating Point Emulator

The Floating Point Emulator duplicates the execution of the floating point instructions when the Floating Point Processor is not attached to the system. The user specifies whether the emulator is to be resident or transient when the system is configured.

- Queuing Services

The user has the facility of defining storage and disk queues. These queues may be used for passing data from one task to another. The system provides for priority queues, while entries with the same priority are maintained on a FIFO basis. The user may add and remove entries from the queues. A copy queue entry facility is provided so entries may be added from a transient area. Provision is made for warm restart (queue elements retained) or cold restart (queue cleared) of disk queues after system shutdown. Queues may be "Public," that is, serviced by multiple tasks in a task set; or "Private," that is, serviced only by the task owning it.

- Resource Management

The system provides the user with a facility for management of serially reusable resources. Once the resource is freed from the current task, control is given to the highest priority task waiting on the resource.

- Command Language Processor

The functions supported through the system operator station using the command language are:

Execute a task set

Terminate a task set

Delete a task set from the partition queue(s)

Add and delete entries from the scheduler table, that is, task sets that will execute on TOD, on a periodic basis, after a time delay, etc.

Set and display TOD Clock and DATE

Put I/O devices on and off line

Devices may be reassigned by the operator in the event of a permanent I/O Error.

Assign logical device numbers to physical device addresses

Define and Delete Error Logs

Mount and Demount IBM 4964 Diskettes

Start and Stop the I/O Trace

Start and Stop the SVC Trace

Display up to 56 bytes of processor-storage

Patch up to 20 bytes of processor-storage

Make ABEND dump data set or member available for reuse

Set operating mode to Attended or Unattended

Reply to a WRITE-TO-CONSOLE message with an identifying number.

Define partitions (as part of IPL sequence).

Activate support for physical devices (as part of IPL sequence).

A facility is provided so the user may select and add system operator station functions that he desires at SYSGEN.

Data Management Functions

- DP I/O Support

Realtime Programming System Data Management provides the user with services which are described below:

- Device Service Routines

Device Service Routines are provided for supported devices. Character data conversion between EBCDIC and TTY ASCII is provided.

The system performs all physical I/O upon request by the user program. Realtime Programming System provides optional I/O timeout for systems with hardware timers with times dependent on the device type. The programmer is able to read into his program the programmer console data buffer upon request. The programmer also has the ability to write to the programmer console lights. The DP I/O user-interface is either GET/PUT or READ/WRITE. For Sensor I/O it is READ/WRITE. There is also a third level of access (EXIO) which is primarily for device manipulation such as diagnostic programs perform. Data files may exist on either fixed disk or removable diskette.

The data set organizations supported for sectorized devices are:

Consecutive
Random
Partitioned

The user may add and update records to a consecutive DASD file. The user may have multiple data sets per volume. Multivolume files (diskettes only) are supported only for Basic Exchange Format Files. When using random data sets, the user may also access the records by relative record number.

The partitioned data set support is provided for user and system libraries. Realtime Programming System provides facilities for the creation, deletion, and maintenance of the partitioned data sets.

Realtime Programming System supports the fixed heads option in the IBM 4962 Disk Storage Unit file to the extent that the user may place data sets under the fixed heads at his discretion.

Data sets may be shared among tasks in the system. Management of sensor I/O is supported to the extent described under Sensor I/O. DP I/O may be shared among any tasks in the system. Management of shared I/O devices is the responsibility of the programmer. Management of disk message buffering is handled by Realtime Programming System.

The user has the option of accessing Series/1 I/O devices at the READ/WRITE, and GET/PUT level (sensor I/O at the READ/WRITE level only). The user is provided with device independence at the GET/PUT level. All hard copy devices logically support the ASA Control characters. This option allows the user to direct a print file to the disk or diskette for later printing. A write with read verify option may be a parameter on the open MACRO only.

The record types supported are:

Fixed



- Fixed Block
- Fixed Blocked Spanned
- Variable
- Variable Blocked
- Variable Blocked Spanned (Including Text Compression)

Data sets may be created and deleted via online system utility functions and from program requests (including the Program Preparation Subsystems).

Support of the IBM 4964 diskettes:

- Provides users with a usable removable programming medium
- Enhances data security, integrity, and privacy

The system user can copy, via online system utility functions, a diskette to the fixed disk and utilize the stored data of the diskette as if it had always been on disk. When the user's operations are completed, a copy of the disk data may be transferred to diskette. The diskettes may contain multiple files, files may span multiple diskettes, and many diskettes/files may be copied to fixed disk at one time. The user will have the convenience and privacy that removable diskette modules provide him, while the system is able to utilize the speed and reliability offered by a fixed disk. The expiration date, which is a user option on diskettes, is honored by Realtime Programming System.

The user has the option to bind I/O devices and data sets during:

- A. Program Preparation
- B. Task Set Installation
- C. Execution (OPEN) Time

Options A and B provide the Realtime Programming System user with the ability to achieve higher performance by requiring a minimum number of disk reads to locate programs and data.

- Sensor Input/Output

Note: Multiple points (AI, AO, DI, DO) may be accessed via one supervisor request.

Process Interrupt

As defined under Interrupt Handler.

Analog Input

Realtime Programming System supports Analog Input including the programmable gain amplifier, and the automatic zero correction option. The user has a choice of either sequential or random access at the READ/WRITE level. A single point can be handled under either of the access forms by specifying a count of one.

Analog Output

Realtime Programming System supports analog output including maintaining the present output value of each point. The user has a choice of either sequential or random access at the READ/WRITE level. A single point can be handled under either of the access forms by specifying a count of one.

Digital Input

Realtime Programming System supports sequential and random access at the READ/WRITE level. Logical groups may be defined as contiguous DI points in a physical group composed of 16 points. This allows the user to place DI

points among different devices and/or programs. A single point or group can be handled under either of the access forms by specifying a count of one.

Digital Output

Realtime Programming System supports sequential and random access at the READ/WRITE level. Digital Output points may be defined in a logical group as in Digital Input above.

- Communications Support

Communications support is an integral part of Realtime Programming System data management and is accessed via the Read/Write interface. The support directs the transfer of data between user programs and remote stations. A remote station may be either a supported start/stop terminal or another computer system via binary synchronous communication. Facilities are provided to:

- Establish, control, and terminate user program access to remote stations.
- Transfer data between user programs and remote stations on point-to-point lines (either switched or nonswitched).

The start/stop terminals supported are:

- IBM 2740 Communications Terminal, Model 1, in point-to-point switched and point-to-point nonswitched connections. Record checking, Dial Up, and Transmit Control Optional Special Features are supported.
- Teletype® Models ASR 33 and 35 Data Terminals or equivalent ASCII device in point-to-point nonswitched connections.

Binary Synchronous communications is supported to IBM System/370's using OS/VS1 or OS/VS2 (SVS or MVS) BTAM in point-to-point switched and point-to-point nonswitched connections (Series/1 as System/3).

A function is provided (TRANSLATE macro) to facilitate code conversion between EBCDIC and commonly used line codes: ASCII, PTTC/EBCD, PTTC/BCD, PTTC/Correspondence, and 8-Level TWX.

For switched line processing, provision is made for connection via:

- Manual Call
- Manual Answer
- Auto Answer

ID exchange is supported for binary synchronous communications.

In normal operation with the IBM 2740, or binary synchronous, the support will automatically include the proper line control (framing) characters. However, insertion and deletion of terminal control characters (carriage return, line feed, for example) are the responsibility of the user. Support for the Teletype® Models ASR 33 and 35 is limited to making and maintaining half-duplex line connection, transmitting user-furnished buffers on the line, receiving data from the line and filling user-furnished buffers, and recognizing user supplied change-of-direction character on receive as end of data. No Model ASR 33/35 features are supported. Features such as Echo Mode, Answer Back, Full-duplex, etc., must be supported through user programming.

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• Storage Protection

Realtime Programming System protects the Realtime Programming System supervisor and, optionally, both the Control Module and Protected Dynamic Storage with user task sets from all application programs. Realtime Programming System uses the Series/1 hardware to achieve this protection. The IBM 4953 processor does not have hardware storage protection. Realtime Programming System systems running in IBM 4953 are not storage protected.

• Message Buffering

Realtime Programming System provides a disk message buffering facility, supporting the following sequential output devices:

- Operator Station
- IBM 4973 Line Printer
- IBM 4974 Printer
- Communication Devices

Other devices may use the message buffering facility. The system will print a complete message before starting another message.

Initial Program Load (IPL)

A capability is provided to IPL from the following devices:

- IBM 4964 Diskette (IPL Stand-alone Utilities)
- IBM 4962 (IPL Realtime Programming System)

After Realtime Programming System is loaded in the system, Realtime Programming System processes a user specified command data set which may be used to start user task sets or perform any valid operator command.

Utilities

A set of utilities is provided for the proper installation and maintenance of application programs and data. Certain utilities may run concurrently with the user application programs and others that run offline (that is, stand-alone—not concurrently with user programs or under Realtime Programming System).

The stand-alone utilities are loaded from an IBM 4964 diskette.

The following stand-alone utilities are provided:

System Build

This utility prepares a disk device to IPL the Realtime Programming System starter system and execute Realtime Programming System online system utilities. System build is executed prior to system generation as part of the Realtime Programming System installation process and at other times to restore the Realtime Programming System starter system and Realtime Programming System online system utilities.

Disk Initialization

This utility initializes the fixed disks. It performs surface analysis and allows alternate sector assignments.

Storage-to-Diskette Dump

This utility is used for APAR submission and dumps all of storage except for the area where the utility is loaded from the IBM 4964 Diskette. This utility also dumps all the system's registers and status indicators. The online system REPORT utility may be used to obtain a printout of the dump on a hardcopy device. Additional dump diskettes may be created

using the online system IPLMAINT utility. Diskette initialization is provided. This utility provides online initialization of diskettes.

DEFINE/CREATE/BUILD/DELETE/RENAME Data Sets

These utilities perform the following functions:

- DEFINE—The function of defining a disk or diskette to be in Realtime Programming System format containing logical volumes.
- CREATE—The function of assigning space on sectorized devices including creation of logical volumes, partitioned data sets, consecutive or direct data sets, or members.
- BUILD—The function of building data set definitions in a task set library.
- DELETE—The function of deleting volumes, data sets, members, or data set definitions on sectorized devices including the management of TOCs and partitioned data set directories.
- RENAME—The function of renaming a volume, data set, or member, including the handling of TOCs and partitioned data set directories.
- COMPRESS—This utility performs the function of copying partitioned data sets or volumes in place on sectorized devices to consolidate all available free space within one contiguous area.
- PATCH DISK/DISKETTE—This utility provides the functions of applying permanent fixes to the DASD devices. Visual verification of the data to be replaced is provided before the users enter the new data.
- REPORT—This utility provides the ability to print data from the diskette and disk files to any of the Series/1 hard copy output devices. The user has the ability to print the file (or data set), TOCs, and partitioned data set directories. This utility also provides the ability to print a formatted dump of storage. The dump was previously taken either stand-alone or online.
- COPY—The COPY utility provides the function of doing either a selective or volume copy. The user has the ability to copy as follows:

From	To
Diskette, Disk	Diskette, Disk Printer, Teletypewriter, Display

Selective copies allow the user to copy data sets, volumes, or members of data sets. Records may also be added to the end of a consecutive data set.

- MERGE—This utility provides the function of combining two partitioned data sets or volumes into a third partitioned data set or volume.
- IPLMAINT—This utility provides the functions to:
 - prepare a diskette to IPL the stand-alone storage-to-diskette dump utility, and
 - establish the system to be loaded from disk at IPL time.

Realtime Programming System RAS Characteristics

The Realtime Programming System provides a set of facilities to help ensure system reliability, availability, and serviceability (RAS). Additional facilities may be optionally included to amass an extensive set of RAS functions.

Error Response

Detection of machine check or program check conditions, error logging, and message generation are performed by supervisory functions in Realtime Programming System.

System Recovery

Error recovery procedures provide the system with the ability to continue operating, if at all possible, in the case of software, hardware, and power failures. Task set and system restart and reloading are provided. If the system cannot continue normal execution, the system user is able to specify execution of a program which utilizes minimum system resources and can notify and prepare the external environment for the imminent loss of the system.

Failure of the disk module that contains the system task set does not cause total system failure or initiate a reload of the supervisor. In the event of disk failure, programs that do not require that disk module are able to continue operation. Disk service to other disk modules continues. However, the next request for a system transient, with the exception of error logging, may cause an abnormal termination of the system.

Hardware Service Aids

Maintaining error logs is a means of assessing hardware and software reliability. By using hardware error recording to monitor the system, user personnel are made aware of marginally operating equipment. The type of intermittent failures of devices, channels, and CPU will be optionally recorded on an IBM 4962 disk. The error logs are used by customer engineers and user personnel for diagnostic purposes. The user and the customer engineer are able to obtain dumps of disk recorded log areas.

Realtime Programming System provides the following functions:

- Routines to handle the occurrence of a machine check. These routines provide the option of returning control to a user routine after the check has been cleared and optionally logged. The system passes the pertinent error data to the user.
- Support of Automatic Restart after Power Failure. Upon power restoration a user-specified load module is loaded.
- Support of Battery Backup Feature. Systems with the Battery Backup Feature and Timer Support notify the user of a power failure by dispatching a user-specified program. When the power is restored, Realtime Programming System dispatches a user-specified program and passes the duration of the power failure in minutes, seconds, and milliseconds. If the battery is exhausted, results will be the same as if the system does not have the Battery Backup Feature.
- In addition to the general purpose RAS aids, additional optional aids are provided for communications:
 - Communications Trace program which, when activated under user control, is designed to continuously record current communications activity in main storage. This

facility works in conjunction with the general purpose I/O trace facility.

- Communications Online Test is an optional facility which provides a means of testing attached 2740 Model 1 terminals concurrent with user operation and determining proper operation of the communication link (lines and modems) as well as the terminal and system programming support.

Device Support

The Realtime Programming System supports the IBM 4953 and IBM 4955 Processors, all of the following Series/1 standard I/O devices and the following processor options:

- Floating Point Processor
- Programmer's Console

Multiples of the following devices and features are supported.

IBM 4962	Model 1, 1F, 2, and 2F	Disk
IBM 4964	Model 1	Diskette
IBM 4974	Model 1	Printer
IBM 4973	Models 1 and 2	Line Printer
IBM 4982	Model 1	Sensor I/O
IBM 4979	Model 1	Display Station
IBM 4999	Models 1 and 2	Battery Back-up
#7840	— Timer	
#7850	— Teletypewriter attachment (supported for use with Teletype® Models ASR 33/35)	
#1560	— Integrated DI/DO	
#1610	— Asynchronous Communications Single Line Control	
#2091	— Asynchronous Communications 8-line Control	
#2092	— Asynchronous Communications 4-line Adapter	
#2074	— Binary Synchronous Communications Single Line Control	
#2075	— Binary Synchronous Communications Single Line Control/High Speed	
#2093	— Binary Synchronous Communications 8-line Control	
#2094	— Binary Synchronous Communications 4-line Adapter	

Note: Device and feature performance is dependent upon hardware configuration, IBM Series/1 Realtime Programming System generation options, and application program design.

Specified Operating Environment

Support will be provided for this licensed program when it is operated in the following environment:

System Requirements: The minimum system after initially loading the disk and when the application program executes without hard copy output, system console operations, and data interchange, is:

Processor	IBM 4953 or IBM 4955 Processor
Storage	48K bytes
Disk	1—IBM 4962 Model 1 or 1F Disk Storage Unit

The minimum hardware configuration to support System Generation is:

Processor	IBM 4953 or 4955 Processor
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- Storage** 48K bytes
- Disk/Diskette** 1—IBM 4962 Model 2 or 2F Disk Storage Unit (Combination disk/diskette unit)
OR
1—IBM 4962 Model 1 or 1F Disk Storage Unit
AND
1—IBM 4964 Diskette Unit
- Printer** 1—IBM 4973 Line Printer
OR
1—IBM 4974 Printer
- Operator Station** 1—IBM 4979 Display Station
OR
1—Teletypewriter Adapter #7850 with Teletype® Models ASR 33/35

The actual configuration required by the user depends on his application needs. In addition to the above hardware, the Communications Indicator Panel (#2000) is recommended for configurations which contain communications features.

Note: The configuration must have the following standard address assignments in order to satisfy the minimum system requirements. (The starter system supports the minimum system requirements.)

Description	Decimal Address
IBM 4962 Disk Unit	03
IBM 4964 Diskette	02
IBM 4973 Line Printer	33
IBM 4974 Printer	01
IBM 4979 Display Station	04
#7850 Teletypewriter Attachment	00

Programming Requirements: None

Charges

This program will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu therefore, a one-time charge. Under either payment option, the licensed program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs.

If the monthly charge option is chosen, credit will be accrued during a continuous license period towards the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferable to other customers or between licenses whether they are for programs which have a different program number or the same program number.

In addition there is a one-time process charge to cover the cost of distributing basic machine readable material including service updates.

Customer Responsibility

The customer is responsible for the installation and use of this licensed program.

Programming RPQs

PRPQs will be accepted. Response time will depend upon complexity.

Marketing Publications

- IBM Series/1 Realtime Programming System: Licensed Program Specifications GC34-0101
- IBM Series/1 Realtime Programming System: Introduction GC34-0102
- IBM Series/1 Realtime Programming System: Supervisor; User's Guide SC34-0103
- IBM Series/1 Realtime Programming System: Data Management; User's Guide SC34-0104
- IBM Series/1 Realtime Programming System: Communications; User's Guide SC34-0105
- IBM Series/1 Realtime Programming System: Macro Reference SC34-0106
- IBM Series/1 Realtime Programming System: Operator Commands and Utilities SC34-0107
- IBM Series/1 Realtime Programming System: Messages and Codes SC34-0109
- IBM Series/1 Realtime Programming System: Generation and Installation Procedures SC34-0110
- IBM Series/1 Realtime Programming System: Problem Determination and Control Blocks SC34-0111

**REALTIME PROGRAMMING SYSTEM VERSION 2
(5719-PC2)**

The IBM Series/1 Realtime Programming System Version 2 (5719-PC2) provides all the facilities of "version 1" of the IBM Series/1 Realtime Programming System (5719-PC1) plus the following additional features:

- System support for the IBM 4962 Disk Storage Unit Models 3 and 4 with a capacity of 13,962,240 bytes.
- Storage Overlays: Storage above 64K can be used to enhance the performance of user task sets by allowing more user-written program segments to be resident in storage at one time.
 - Uses Overlay Manager provided by 5719-AS2, or equivalent.
 - Invoked by CALL statement.
 - Faster than disk overlay.
 - Reduces DASD load, compared to using disk overlays.
- Secondary storage (above 64K) assigned to partitions at SYSGEN with optional IPL override.
- Supports up to 128K of physical storage.
- Storage overlays loaded at task set load time.
- Fully compatible with rollout/rollin capability.

Debug Package

The interactive debug package provides a set of functions to assist in program debugging. These functions are invoked and controlled from the system console. The following functions are provided:

- Display/Modify Storage
- Display/Modify Registers
- Display/Modify Floating Point Registers
- Display/Modify Segmentation Registers
- Print Control Blocks
- Print Storage
- Print Storage Overlays
- Hexadecimal Addition and Subtraction
- Decimal-Hexadecimal Conversion
- Set Break Point
- Display Break Points
- Reset Break Point
- Branch
- Execute
- Trace Storage Contents
- Display/Modify Disk
- Display/Modify Diskette
- Display/Modify Program
- Display/Modify Overlay
- Display/Modify Transient
- Load/Unload Transient

Automatic Device Backup

This facility provides automatic switching from a failing primary device to a secondary device. If an irrecoverable I/O error occurs on a device with automatic device backup, data is redirected from that device to its backup. The following combinations are supported for automatic device backup:

Teletypewriter primary to Teletypewriter backup (output only)

Line Printer to line printer, matrix printer, or teletypewriter

Matrix printer to matrix printer, line printer, or teletypewriter

Write with Read Verify Option

This facility allows Data Set Definitions (DSDs) to contain an indication that all write operations to a particular data set (on disk or diskette) defined by the DSDs are to be verified. This option may also be exercised by a parameter in the OPEN macro.

BSC Initial Program Load (IPL)

An IPL bootstrap program is provided so that a user program in a host Series/1 under the IBM Series/1 Realtime Programming System can transmit this bootstrap to a suitably configured remote Series/1 over a BSC line and cause the remote Series/1 to IPL from its own system residence device.

BSC Dump

This facility allows a remote Series/1, at the request of the host Series/1, to transmit the contents of its dump data set to the host Series/1 for subsequent printing.

Terminal and Systems Support

The IBM Series/1 Realtime Programming System Version 2 (5719-PC2) extends the communications support of "version 1" (5719-PC1) by adding:

- START/STOP (Asynchronous) Communications support of:
 - Teletype® Models ASR 33/35 Data Terminals or equivalent in point-to-point switched connections. Determination of equivalency is a user responsibility.
- Binary Synchronous Communications
 - To another IBM Series/1 using IBM Series/1 Realtime Programming System Versions 2, 3, or 4 in point-to-point switched or nonswitched connections.
 - To an IBM System/3 using CCP or RPG in point-to-point switched or nonswitched connections (Series/1 as System/3).
 - To an IBM System/370 using DOS/VS BTAM or VTAM in point-to-point switched or nonswitched connections (Series/1 as System/3).
- EXIO Support for Communications

This facility allows the user to access the Binary Synchronous and Asynchronous communications features at a basic level (EXIO). This basic access allows access to all facilities supported by the hardware features. The EXIO and the READ/WRITE support are mutually exclusive for an attachment.

Customers ordering the IBM 4962 Disk Storage Unit Models 3 and 4 should order the IBM Series/1 Realtime Programming System Version 2 (5719-PC2) and the IBM Series/1 Program Preparation Subsystem Version 2 (5719-AS2).

The Storage Overlay Feature can enhance performance of applications by permitting more program segments to be in storage at one time. These can be located in storage above 64K (secondary storage) and accessed by Supervisor control of the contents of segmentation registers provided by the Storage Address Relocation (#6335). Storage overlay areas are loaded at task set load time, and the programs are executed when called.

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Compatibility

Files

Complete compatibility is provided with files supported by "version 1" of the IBM Series/1 Realtime Programming System (5719-PC1). Any data file written by either of these systems is directly usable by the other.

Compatibility with external (to Series/1) devices is maintained by using the diskette interchange architecture.

Programs

The IBM Series/1 Realtime Programming System Version 2 (5719-PC2) is functionally upward compatible with the first version of the IBM Series/1 Realtime Programming System (5719-PC1).

Problem-state source programs that compile and execute on version 1 of the IBM Series/1 Realtime Programming System will compile and execute on the IBM Series/1 Realtime Programming System Version 2.

Customer-written programs included with the supervisor must be written in accordance with the internal supervisor programming conventions and interfaces. In some areas these are different from those of the earlier IBM Series/1 Realtime Programming System (5719-PC1).

All tasks sets built to execute in the initial IBM Series/1 Realtime Programming System (5719-PC1) environment must be rebuilt to execute in the IBM Series/1 Realtime Programming System Version 2 (5719-PC2) environment.

Preparation

The IBM Series/1 Program Preparation Subsystem Version 2 (5719-AS2) can prepare programs to execute with version 1 of the IBM Series/1 Realtime Programming System (5719-PC1) and with Version 2 (5719-PC2). In contrast, version 1 of the IBM Series/1 Program Preparation Subsystem (5719-AS1) can prepare programs that will run only on version 1 of the IBM Series/1 Realtime Programming System.

The following IBM Series/1 support programs can be used to prepare programs to execute with version 1 of the IBM Series/1 Realtime Programming System (5719-PC1) or the IBM Series/1 Realtime Programming System Version 2 (5719-PC2).

- IBM Series/1 FORTRAN IV Compiler and Object Support Library (5719-FO1)
- IBM Series/1 FORTRAN IV Realtime Subroutine Library (5719-FO3)
- IBM Series/1 Mathematical and Functional Subroutine Library (5719-LM1)
- IBM Series/1 Mathematical and Functional Subroutine Library Version 2 (5719-LM2)
- IBM Series/1 PL/I Compiler and Resident Library (5719-PL1)
- IBM Series/1 PL/I Transient Library (5719-PL3)

The IBM Series/1 Base Program Preparation Facilities (5719-PA1) cannot be used to prepare programs to run with the IBM Series/1 Realtime Programming System Version 2 (5719-PC2).

Device Support

The Realtime Programming System Version 2 supports the IBM 4953 and IBM 4955 Processors and the following processor options:

- #3920 Floating Point Processor (IBM 4955 only)
- #5650 Programmer's Console
- #6335 Storage Address Relocation Translator (IBM 4955 only)

In addition, multiples of the following devices and features are supported.

IBM 4962 Models 1, 1F, 2, 2F, 3 and 4	Disk
IBM 4964 Model 1	Diskette
IBM 4974 Model 1	Printer
IBM 4973 Models 1 and 2	Line Printer
IBM 4979 Model 1	Display Station
IBM 4982 Model 1	Sensor I/O
IBM 4999 Models 1 and 2*	Battery Backup

*Only one is supported.

Features

- #1560 - Integrated DI/DO
- #7840 - Timer
- #7850 - Teletypewriter Attachment, Supported for use with Teletype® Models ASR 33/35
- #1610 - Asynchronous Communications Single Line Control
- #2091 - Asynchronous Communications 8-Line Control
- #2092 - Asynchronous Communications 4-Line Adapter
- #2074 - Binary Synchronous Communications Single Line Control
- #2075 - Binary Synchronous Communications Single Line Control/High Speed
- #2093 - Binary Synchronous Communications 8-Line Control
- #2094 - Binary Synchronous Communications 4-Line Adapter

Note: Device and feature performance is dependent upon hardware configuration, Realtime Programming System generation options, and application program design.

Specified Operating Environment

Support will be provided for this licensed program when it is operated in the following environment:

System Requirements: The minimum system after initially loading the disk and when the application program executes without hard copy output, system console operations, and data interchange is:

Processor	IBM 4953 or IBM 4955 Processor
Storage	48K bytes
Disk	1—IBM 4962 Model 1, 1F, or 3 Disk Storage Unit



The minimum hardware configuration to support System Generation and System Installation is:

Processor	IBM 4953 or IBM 4955 Processor
Storage	48 bytes
Disk/Diskette	1—IBM 4962 Model 2, 2F or 4 Disk Storage Unit (Combination disk/diskette unit) OR 1—IBM 4962 Model 1, 1F or 3 Disk Storage Unit AND 1—IBM 4964 Diskette Unit
Printer	1—IBM 4973 Line Printer OR 1—IBM 4974 Printer
Operator Station	1—IBM 4979 Display Station OR 1—Teletypewriter Adapter #7850 Supported for use with Teletype® Models ASR 33/35

To support BSC IPL and BSC DUMP, the host system must have any of the BSC communications features (#2074, #2075, #2093/#2094). The remote system must have one of the BSC single line features (#2074 or #2075).

The hardware requirement for the storage overlay capability includes the Storage Address Relocation Translator (#6335), and a minimum of 64K of physical storage.

The Communications Indication Panel (#2000) is recommended for configurations which include communications features. The actual configuration required by the user depends on his application needs in addition to the above hardware.

Note: The configuration must have the following address assignments in order to satisfy the minimum system requirements. (The starter system supports the minimum system requirements.)

Description	Decimal Address
IBM 4962 Disk Unit	03
IBM 4964 Diskette	02
IBM 4973 Line Printer	33
IBM 4974 Printer	01
IBM 4979 Display Station	04
#7850 Teletypewriter Attachment	00

Programming Requirements: None

Required EC Levels

The required engineering change level for 5719-PC2 for the 4962 Disk Unit is EC 829868 and EC 578573. This applies to the IBM 4962 Disk Unit serial numbers 10001 through 10188.

Charges

This program will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, the licensed program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs.

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If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferable to other customers or between licenses whether they are for programs which have a different program number or the same program number.

In addition, there is a one-time process charge to cover the cost of distributing basic machine readable material including service updates.

Customer Responsibility

The customer is responsible for the installation and use of this licensed program.

Programming RPOs

PRPOs will be accepted. Response time will depend upon complexity.

Marketing Publications

IBM Series/1 Realtime Programming System Version 2: Licensed Program Specifications	GC34-0168
IBM Series/1 Realtime Programming System Version 2: Introduction	GC34-0114
IBM Series/1 Realtime Programming System Version 2: Supervisor; User's Guide	SC34-0163
IBM Series/1 Realtime Programming System Version 2: Data Management; User's Guide	SC34-0164
IBM Series/1 Realtime Programming System Version 2: Communications; User's Guide	SC34-0165
IBM Series/1 Realtime Programming System Version 2: Macro Reference	SC34-0169
IBM Series/1 Realtime Programming System Version 2: Operator Commands and Utilities	SC34-0166
IBM Series/1 Realtime Programming System Version 2: Messages and Codes	SC34-0167
IBM Series/1 Realtime Programming System Version 2: Generation and Installation Procedures	SC34-0162
IBM Series/1 Realtime Programming System Version 2: Problem Determination and Control Blocks	SC34-0170

**IBM SERIES/1 REALTIME PROGRAMMING SYSTEM
VERSION 3 (5719-PC3)**

The IBM Series/1 Realtime Programming System Version 3 (5719-PC3) provides all the facilities of the Realtime Programming System Version 2 (5719-PC2) plus the additional function to manage up to 256K bytes of processor storage. Features of Version 3 are:

- Dynamic partitions which can be created upon demand.
- Relocatable task sets which can be executed in a partition other than the one for which the task set was built.
- Multiple address space management to provide isolation between task sets and the flexible use of up to 256K bytes.
- Multiple address space partitions which allow a shared task set to be shared system wide.
- System wide events and queues via the shared tasks set.
- Up to 15 user partitions.
- Up to 64K byte user partition size.
- Separation of system instructions and data to permit the system partition to occupy two address spaces and therefore exceed 64K bytes (Instruction/Data Split System). The new maximum size is 126K bytes: 64K bytes maximum for data and 62K bytes maximum for instructions.

Compatibility*Files*

Complete compatibility is provided with files supported by "version 1" of the IBM Series/1 Realtime Programming System (5719-PC1) or by Version 2 (5719-PC2). Any data file written by any of these systems is directly usable by the others. Compatibility with external (to Series/1) devices is maintained by using Basic Data Exchange. See the *IBM Diskette General Information Manual, GA21-9182*.

Programs

Problem-state source programs which assemble or compile and execute on version 1 of the IBM Series/1 Realtime Programming System (5719-PC1) or on Version 2 (5719-PC2) may require source modifications to assemble or compile and execute on the IBM Series/1 Realtime Programming System Version 3 (5719-PC3).

Customer-written programs included with the supervisor must be written in accordance with the internal supervisor programming conventions, which are different from those of 5719-PC1 and 5719-PC2.

The following IBM Series/1 programs are compatible with the IBM Series/1 Realtime Programming System Version 3. For details on these programs, refer to the pertinent programming pages in this manual.

- IBM Series/1 Program Preparation Subsystem Version 3 (5719-AS3)
- IBM Series/1 FORTRAN IV Compiler and Object Support Library (5719-FO1)
- IBM Series/1 FORTRAN IV Realtime Subroutine Library (5719-FO3)
- IBM Series/1 FORTRAN IV Realtime Subroutine Library Version 2 (5719-FO4)
- IBM Series/1 Mathematical and Functional Subroutine Library (5719-LM1)

- IBM Series/1 Mathematical and Functional Subroutine Library Version 2 (5719-LM2)
- IBM Series/1 PL/I Compiler and Resident Library (5719-PL1)
- IBM Series/1 PL/I Transient Library (5719-PL3)
- IBM Series/1 COBOL Compiler and Resident Library (5719-CB1)
- IBM Series/1 COBOL Transient Library (5719-CB2)
- IBM Series/1 Index Access Method (5719-AM1)
- IBM Series/1 Sort/Merge (5719-SM1)
- IBM Series/1 4987 Programmable Communications Subsystem Preparation Facility (5719-CS0)
- IBM Series/1 4987 Programmable Communications Subsystem Execution Support (5719-CS1)
- IBM Series/1—System/370 Channel Attachment Program (5719-CA1)

The following IBM Series/1 Programming RPQs are compatible with the IBM Series/1 Realtime Programming System Version 3. For details on these Programming RPQs, refer to the pertinent programming pages in this manual.

- IBMSeries/1 Realtime Programming System Basic Sort Programming RPQ P82573 (5799-TBP)
- IBM Series/1 Remote Job Entry Programming RPQ P82575 (5799-TBK)
- IBM Series/1 Realtime Programming System Indexed Access Method Programming RPQ P82570 Version 3 (5799-TCB)
- IBM Series/1 Realtime Programming System IBM 4978 Display Station Support Programming RPQ P82572 Version 3 (5799-TCE)
- IBM Series/1 Realtime Programming System Disk Spooling Programming RPQ P82574 Version 3 (5799-TCH)
- IBM Series/1 Realtime Programming System Address Translator Transient Support Programming RPQ P82585 Version 3 (5799-TBY)

Preparation

The IBM Series/1 Program Preparation Subsystem Version 3 (5719-AS3) is required to prepare programs to execute on the IBM Series/1 Realtime Programming System Version 3 (5719-PC3).

The IBM Series/1 Base Program Preparation Facilities (5719-PA1) cannot be used to prepare programs to run with the Realtime Programming System.

Highlights

This program is a version of the Realtime Programming System, whose purpose is to provide an operating system which fully supports Series/1 configurations containing the Storage Address Relocation Translator feature. It allows the flexible use of physical storage greater than 64K. It also provides an increased degree of isolation of individual programs from other programs.

The option of splitting supervisory data and supervisory instructions into two address spaces (0 and 1) permits larger configurations and more capable systems than would be possible under a 64K size limitation. The new maximum size is 126K, with a 64K maximum on data and on instructions, including 2K mapped identically into each address space. The additional space may be variously used for such items as making more transients resident for improved performance, more control module space to support more user partitions and



more complex task sets, support for more I/O, and more user-provided programming to be included in the supervisor.

Description

The Supervisor manages systemwide objects that are recognized across address space boundaries:

- A. Events designated in a shared task set. (Other events are recognized within the task set in which they are defined.)
- B. Task sets which can be queued for execution by tasks executing in different address spaces from the one the requested task set will execute in.
- C. Queues in the shared task set whose elements may be either placed into a queue or removed from a queue by any task executing in a task set using the shared task set.

Systemwide objects are referenced by name so that:

- User programs refer to them symbolically.
- Program preparation steps recognize them as shared objects.
- At execution time supervisory services perform the requested function across the address space boundaries.

There is a single shared task set. The purpose of the shared task set is to allow a single storage-resident copy of routines such as those in the Mathematical and Functional Subroutine Library (5719-LM1) program to serve calling programs in all address spaces using the shared task set and to allow systemwide sharing of data and objects located in the shared task set.

Systemwide Timer Services

The system maintains a single realtime clock. Other timer services are also consolidated for all tasks in the system.

Storage Management Functions

All the storage management functions of Series/1 Realtime Programming System Version 2 (5719-PC2) are available in this Version 3.

Storage overlay is the capability of the supervisor to control the contents of the segmentation registers which are associated at task set load time with a storage overlay area in a task set (2K or a multiple of 2K in size). These registers may be pointed to different blocks of physical storage to provide a logical overlay with faster response than that obtainable from disk overlays and without performing any I/O operation. The blocks of storage which compose the overlays are initialized at task set load time. The control operations are invoked by an SVC within the user program.

Disk overlays are available to each task set in the same manner as in Realtime Programming System Version 2 (5719-PC2).

The system will support up to 15 user partitions.

The relocatable task set feature allows task sets to execute in a partition (including a dynamic partition) or with an origin address other than the one it was built for. At task set load time the loader will perform the relocation. A relocatable task set may do anything that any other task set may do with the following exceptions:

- a. It may not be pre-bound through task set installation unless it is being bound to the partition (number and origin) for which it was built; that is, a task set will not be relocated during task set installation.

- b. It may not be a shared task set. (It may, however, make use of a shared task set.)

The supervisor cannot be altered or referred to by user programs executing in a problem state.

Programs and data residing in user-controlled sections of storage mapped exclusively to a single address space may not be altered or referred to by user programs residing in storage mapped to another address space because of addressability.

Task and Task Set Management

Task Management

Task management is the same as that provided in Realtime Programming System Version 2 (5719-PC2).

Each task will compete for execution by its numerical priority (level and sublevel) against all others in the system.

Task Set Management

A task set is what is loaded for execution into a partition, as in Realtime Programming System Version 2 (5719-PC2), with the extension that storage overlays can now be included in the task set.

The dynamic partition feature allows task sets to be executed without requiring that a pre-specified fixed partition be available. Task sets queued for execution without designating a partition number or specifying an undefined partition number will be brought into execution in a dynamic partition, provided that:

- a. Sufficient unallocated storage is available (not necessarily contiguous).
- b. There is a partition number (1-15) which is not defined during IPL.
- c. There is an address key (2-7 in instruction/data split system) which did not have a partition defined in it at IPL time.

Task set queuing may be performed by either console request or program request.

Communications Support

All communications capabilities provided by the Realtime Programming System Version 2 (5719-PC2) are also provided under this Version 3.

In addition, under the Realtime Programming System Version 3 (5719-PC3), the support for the Binary Synchronous Communications features (#2074, #2093, #2094) has been verified for operation in the following environments:

- *System/32* using point-to-point BSC under RPG programming facilities as an IBM System/3.
- *System/34* using point-to-point BSC under RPG programming facilities and the BSC Equivalence Link feature of the System Support Program Interactive Communications Feature as an IBM System/3.
- *5260 Retail System* via the 5265 Models A12, A22, A42, B12, B22, B42 using point-to-point BSC discipline as an IBM System 3.
- *System/370 OS/VS1, OS/VS2 TCAM* using point-to-point BSC discipline as an IBM System/3. (Non-conversational mode only.)



- *System/370 OS/VS1, OS/VS2, DOS/VS CICS/VS* using point-to-point BSC discipline as an IBM System/3. (BTAM only).
- *System/370 OS/VS1, OS/VS2 IMS/VS* using point-to-point BSC discipline. (BTAM only.) IMS/VS support is via IRSS (Independent Remote Subsystem Support) an IMS/VS protocol for the support of remote systems. A Series/1 user-written application program under the Realtime Programming System is required for the formatting and handling of messages in the proper IMS/IRSS formats.

Initial Program Load (IPL)

IPL in this program will perform the same functions as IPL in the Realtime Programming System Version 2 (5719-PC2). It will also allocate storage for the storage overlay function to partitions and assign partitions to address spaces as specified by the user.

Utilities

The utilities contain all the functions available in the Realtime Programming System Version 2 (5719-PC2).

Message Buffering

The message buffering capability is the same as that provided in Realtime Programming System Version 2 (5719-PC2).

Device Support

The Realtime Programming System Version 3 supports the IBM 4955 Processor and the following processor options:

- #3920 Floating Point Processor
- #5650 Programmer's Console
- #6335 Storage Address Relocation Translator (IBM 4955 Models B and D only)

In addition, multiples of the following devices and features are supported.

IBM 4962 Models 1, 1F, 2, 2F, 3 and 4	Disk
IBM 4964 Model 1	Diskette
IBM 4974 Model 1	Printer
IBM 4973 Models 1 and 2	Line Printer
IBM 4979 Model 1	Display Station
IBM 4982 Model 1	Sensor I/O
IBM 4999 Models 1 and 2	Battery Backup

Features

- #1560 - Integrated DI/DO
- #7840 - Timer
- #7850 - Teletypewriter Attachment supported for use with Teletype® Models ASR 33/35
- #1610 - Asynchronous Communications Single Line Control
- #2091 - Asynchronous Communications 8-Line Control
- #2092 - Asynchronous Communications 4-Line Adapter
- #2074 - Binary Synchronous Communications Single Line Control
- #2075 - Binary Synchronous Communications Single Line Control/High Speed
- #2093 - Binary Synchronous Communications 8-Line Control
- #2094 - Binary Synchronous Communications 4-Line Adapter

Specified Operating Environment

Support will be provided for this licensed program when it is operated in the following environment:

System Requirements: The minimum system after initially loading the disk and when the application program executes without hard copy input, system console operations, and data interchange is:

Processor IBM 4955 Processor Models
B or D with Storage Address
Relocation Translator #6335
OR
IBM 4955 Model E
OR
IBM 4952

Storage 64K bytes

Disk 1 IBM 4962 Model 1, 1F, or 3
Disk Storage Unit

Here is the minimum hardware configuration to support System Generation and System Installation:

Processor IBM 4955 Processor Models
B or D with Storage Address
Relocation Translator #6335
OR
IBM 4955 Model E
OR
IBM 4952

Storage 64K bytes

Disk/Diskette 1—IBM 4962 Model 2, 2F or 4
Disk Storage Unit (Combination
disk/diskette unit)
OR
1—IBM 4962 Model 1, 1F
or 3 Disk Storage Unit
AND
1—IBM 4964 Diskette Unit

Printer 1—IBM 4973 Line Printer
OR
1—IBM 4974 Printer

Operator Station 1—IBM 4979 Display Station
OR
1—Teletypewriter Adapter #7850
with Teletype® Models ASR 33/35

The Communications Indication Panel (#2000) is recommended for configurations which include communications features. The actual configuration required by the user depends on his application needs in addition to the above hardware.

To support BSC IPL and BSC DUMP, the host system must have any of the BSC communications features (#2074, #2075, #2093/#2094). The remote system must have one of the BSC single line features (#2074, #2075).

The configuration must have the following standard address assignments in order to satisfy the minimum system requirements. (The starter system supports the minimum system requirements.)

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Description	Decimal Address		
IBM 4962 Disk Unit	03	IBM Series/1 Realtime Programming System Version 3: Communications Macro, Programmer's Guide	SC34-0197
IBM 4964 Diskette	02	IBM Series/1 Realtime Programming System Version 3: Design Guide	SC34-0191
IBM 4973 Line Printer	33	IBM Series/1 Realtime Programming System Version 3: Macro Reference	SC34-0201
IBM 4974 Printer	01	IBM Series/1 Realtime Programming System Version 3: Operator Commands and Utilities	SC34-0198
IBM 4979 Display Station	04	IBM Series/1 Realtime Programming System Version 3: Messages and Codes	SC34-0199
#7850 Teletypewriter Attachment	00	IBM Series/1 Realtime Programming System Version 3: Generation and Installation Procedures	SC34-0194
<i>Programming Requirements: None</i>		IBM Series/1 Realtime Programming System Version 3: Problem Determination	SC34-0200
Required EC Levels		IBM Series/1 Realtime Programming System Version 3: Control Blocks	SC34-0218
The required engineering change levels for 5719-PC3 for the IBM 4962 Disk Unit are EC 829868 and EC 578573. This applies to the IBM 4962 Disk Unit serial numbers 10001 through 10188.		IBM Series/1 Authorized Program Analysis Report (APAR), User's Guide	GC34-0099
The required engineering change level for 5719-PC3 for all models of the 4955 is EC 375013. The 4955 Model B must also have EC 578550.			
Charges			
This program will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, the licensed program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs.			
If the monthly charge option is chosen, credit will be accrued during a continuous license period towards the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferable to other customers or between licenses whether they are for programs which have a different program number or the same program number.			
In addition, there is a one-time process charge to cover the cost of distributing basic machine readable material including service updates.			
Customers should be informed that even if the license fee for "version 1" or Version 2 is already paid, another license fee will have to be paid if Version 3 is needed in the future. Neither the one-time charge nor the accrued license credits for 5719-PC1 or 5719-PC2 are transferable to 5719-PC3.			
Customer Responsibility			
The customer is responsible for the installation and use of this licensed program.			
Programming RPQs			
PRPQs will be accepted. Response time will depend upon complexity.			
Marketing Publications			
IBM Series/1 Realtime Programming System Version 3: Licensed Program Specifications	GC34-0192		
IBM Series/1 Realtime Programming System Version 3: Introduction	GC34-0193		
IBM Series/1 Realtime Programming System Version 3: Supervisor Macro, Programmer's Guide	SC34-0195		
IBM Series/1 Realtime Programming System Version 3: Data Management Macro, Programmer's Guide	SC34-0196		

**IBM SERIES/1 REALTIME PROGRAMMING SYSTEM
VERSION 4 (5719-PC4)**

The IBM Series/1 Realtime Programming System Version 4 (5719-PC4) provides operating system functions for realtime operations with either multiuser online or batch program preparation. The Realtime Programming System allows the generation of a multipartition system as well as smaller configurations in a consistent and compatible manner. The Realtime Programming System includes multitasking facilities, storage management, data management, system operator station support timer support, and communications facilities.

The Realtime Programming System supervisor, when combined with the Program Preparation Subsystem, allows Series/1 to operate in a realtime online preparation environment or, if realtime is not required, in a simple batch environment.

Realtime Programming System Function Summary

• Supervisory Services

Task Management

- Primary and Secondary Tasks
- Dynamic Control Block Management
- Prioritization by Hardware Level, Software Sublevel

Storage Management

- Fixed Partitions
- Dynamic partitions
- Overlays from Disk
- Buffer Pooling

Task Set Management

- Rollout/Rollin of Task Sets
- Chaining of Task Sets
- Queueing of Task Sets to Partitions
- Optional Binding at Task Set Install Time
- Scheduling Task Set Execution
- Shared Task Set
- Relocatable Task Sets

Event Management

- WAIT/POST (Simple, Iterative, Multiple)
- Wait on Timer
- Wait on I/O

Queue Management

- Priority Queues in Storage
- FIFO Queues on Disk and in Storage

Timer Management

- Time-of-Day, Date
- Time Delay
- Asynchronous Timers

Serially Reusable Resource Management

- REQUEST/RELEASE

Interrupt Management

- I/O Interrupts
- Class Interrupts

Error Management

- Error Logging and Reporting
- Task Error Exists
- Storage Dump
- System Reload and Restart
- System Termination
- Abnormal Termination of a Task
- Command Language Facility
- Series/1 EXEC Interpreter

- Series/1 EXEC Language Terminal Handler Command (see Highlights)

Operator Interface

- Command Processing
- Message Processing

Floating Point Emulator Support

• Data Management

Data Set Management

- Basic I/O Access (EXIO)
- Physical Access (READ/WRITE)
- Logical Access (GET/PUT)
- Sequential and Direct Access Methods
- Consecutive, Direct, and Partitioned Organization
- OPEN/CLOSE
- CREATE/DELETE/RENAME
- NOTE/POINT
- Data Set Definition (DSD) support

DPIO Support

- IBM 4962 and IBM 4963
- IBM 4978 (as a 4979)
- IBM 4964 and IBM 4966 Diskette Unit
- IBM 4979 Display Station
- IBM 4973 Line Printer
- IBM 4974 Printer
- Special Feature #7850, Teletypewriter Attachment Message Buffering for User-selected Output Devices
- IBM 3101 Display Terminal

Communications Support

- Binary Synchronous Control Support
- START/STOP Asynchronous Support
- Systems Network Architecture Support

Sensor I/O Support

- Analog I/O (Single or Multiple Point)

Digital Input/Digital Output

• Stand-alone Utility Functions

- Storage Dump Diskette
- Disk Initialization
- System Build

• System Utility Functions

- Compress (Partitioned Data Set or Volume)
- Copy
- Define (Create, Delete and Rename, Logical Volumes, Data Sets, Members)
- Initialize Diskette
- Prepare Diskette to IPL Stand-alone Dump
- Assign Realtime Programming System to be loaded by IPL Merge (PDS or Volumes)
- Patch
- Report (Print Disk/Diskette Directories, Disk/Diskette Data or Storage Dump)

• Service Aids

- I/O Trace
- Storage Patch and Dump
- SVC Trace

• Generation Facilities

• System Initialization



Realtime Programming System Function Description

- Multiple Address Space Management

The IBM Series/1 Realtime Programming System Version 4 provides an operating system which fully supports Series/1 configurations containing the Storage Address Relocation Translator feature. It allows the flexible use of physical storage greater than 64K. It also provides an increased degree of isolation of individual programs from other programs.

The option of splitting supervisor data and supervisor instructions into two address spaces (0 and 1) permits larger configurations and more functions than would be possible under a 64K size limitation. The maximum supervisor size is 126K with a 64K maximum on data and 62K on instructions. The additional space may be used for such items as making more transients resident for improved performance, more control module space to support more user partitions, support for more I/O, and more user-provided programming to be included in the supervisor.

- Single Address Space Management

This program optionally supports a Single Address Space Management configuration and manages up to 64K of storage. Storage above 64K can be used for overlays to enhance the performance of user task sets by allowing more user-written program segments to be resident in storage at one time.

- Storage Management and Task Set Management

Realtime Programming System supports multiple partitions. Partition 0 is for the System task set. Another partition may, at the user's option, contain a shared task set and be used as a shared partition containing data and other resources which may be used by programs in other partitions. The user may specify the number and sizes of the partitions at SYSGEN time and may alter his specifications at IPL time. Each partition must be a multiple of 2048 bytes. Up to 15 user partitions (besides Partition 0) may be created until the total storage requirements reach the maximum of 256K bytes. Programs to be run in user partitions are organized into task sets. One task set at a time may occupy a user partition. One partition (selectable at SYSGEN or IPL time) may have a task set rolled out to disk to make way for a higher priority task set. A task set to be rolled out must have been so specified and identified at Application Build time. Only one task set at a time may be rolled out.

Task sets may use overlays from disk. Overlay areas may be shared between tasks only as serially reusable resources under user control.

Storage overlays are loaded in unaddressable physical storage when the associated task set is started. When an overlay is called by an executing task set, the system accesses it through manipulation of the segmentation registers. Storage overlays are faster than disk overlays, since no I/O operations are involved.

A task set may chain to another task set which will replace it as the executing task set in the same partition. A partition GLOBAL area is maintained during this exchange, allowing several task sets to operate in sequence as a single logical operation using the same data. This facility supports the FORTRAN function "INVOKE" and the PL/I function

"TRANSFER." Each task set has one primary task which executes after task set load. A buffer pooling facility allows reservation of a pool of storage in a task set for dynamic allocation of buffer to task on request.

Supervisory Functions

- Task Management

Realtime Programming System is capable of supporting as many concurrent tasks as the user has processor storage areas (totaling up to 256K) in which to execute the tasks. The user may have as many disk-resident programs as he can store on his disks. Tasks are dispatched in response to hardware interrupts, user requests from the system operator station, program requests, or timer services. Realtime Programming System supports the dispatching of independent tasks from other tasks.

Realtime Programming System provides up to 256 preemptive priority sublevels within each of the four hardware levels. A task may be assigned to any level and sublevel. Multiple tasks may be assigned the same priority level. Several tasks can be simultaneously suspended on a level.

The programmer specifies whether a program is serially reusable, reenterable, refreshable, or non-reusable through the program macro.

- Timer Services

Realtime Programming System manages all physical and logical timers. The system supports multiple logical timers per physical timer. Realtime Programming System requires a dedicated physical timer attachment for its own use in order to provide time of day and date, and logical timer services when required. No timers are required for batch-only systems running Program Preparation Subsystem. The other timers are available to the user as I/O devices through the READ/WRITE interface. The programmer is provided with a facility so that he may request his program to be suspended for a specified time interval or until a specified time is reached.

The system provides support for time-of-day (TOD) clock and date. The date may be requested from the system in any of the following formats: Julian (YYDDD), MM DD YY, and YY MM DD. The user is provided a facility of setting the date and TOD through the system operator station or from a program.

Scheduler services are provided so that a user may schedule a task set to execute periodically, at a particular TOD, or after a specified time interval. A facility is provided to add and delete task sets from the scheduler table.

- Interrupt Handler

An interrupt handler is provided for the initial handling of machine level interrupts and the dispatching of interrupt service routines. The user specifies the priority level at which the interrupt service task will execute.

The user may provide a routine to be executed when the console interrupt button of the programmer's console is depressed.



• Event Services

The programmer may define events and cause resumption of a suspended task upon the occurrence of an event. A Wait/Post facility is provided for the synchronization of tasks.

Events that are supported include I/O completion, timer, user-defined, and adding an element to a queue. The three event types supported are simple, iterative and multiple. A task may be suspended until a single event occurs or a list of events occurs.

• Floating Point Emulator

The Floating Point Emulator duplicates the execution of the floating point instructions when the Floating Point Processor is not attached to the system. The user specifies whether the emulator is to be resident or transient when the system is configured.

• Queuing Services

The user has the facility of defining storage and disk queues. These queues may be used for passing data from one task to another. The system provides for priority queues, while entries with the same priority are maintained on a FIFO basis. The user may add and remove entries from the queues. A copy queue entry facility is provided so entries may be added from a transient area. Provision is made for warm restart (queue elements retained) or cold restart (queue cleared) of disk queues after system shutdown. Queues may be "Public," that is, accessed by multiple tasks in a task set; or "Private," that is, accessed only by the task owning it.

• Resource Management

The system provides the user with a facility for management of serially reusable resources. Once the resource is freed from the current task, control is given to the highest priority task waiting on the resource.

• Operator Commands

These are the functions supported through the system operator station while using the command language:

- Execute a task set
- Terminate a task set
- Delete a task set from the partition queue(s)
- Add and delete entries from the scheduler table; that is, task sets that will execute on TOD, on a periodic basis, after a time delay, etc.
- Set and display TOD and DATE
- Put I/O devices on and off line
- Devices may be reassigned by the operator in the event of a permanent I/O Error
- Assign logical device numbers to physical device addresses
- Define and Delete Error Logs
- Mount and Demount Diskettes
- Start and Stop the I/O Trace
- Start and Stop the SVC Trace
- Display up to 56 bytes of processor storage
- Patch up to 20 bytes of processor storage
- Make ABEND dump data set or member available for reuse
- Set operating mode to Attended or Unattended
- Reply to a WRITE-TO-CONSOLE message with an identifying number

- Define partitions (as part of IPL sequence)
- Activate support for physical devices (as part of IPL sequence)

A facility is provided so that the user may select and add system operator station functions at SYSGEN.

Data Management Functions

Realtime Programming System Data Management provides the user with services which are described below:

• Device Service Routines

Device Service Routines are provided for supported devices. Character data conversion between EBCDIC and TTY ASCII is provided.

• Data Set Management

The system performs all physical I/O upon request by the user program. Realtime Programming System provides optional I/O time out for systems having hardware timers which are times dependent on specified device type times. The programmer is able to read into a program the programmer console data buffer upon request. The programmer also has the ability to write to the programmer console lights. The DP I/O user interface is either GET/PUT or READ/WRITE. For Sensor I/O it is READ/WRITE. There is also a third level of access (EXIO) which is primarily for device manipulation required in diagnostic programs. Data files may exist on either fixed disk or removable diskette.

The data set organizations supported for sectorized devices are:

- Consecutive
- Random
- Partitioned

The user may add records to and update records in a consecutive DASD file. The user may have multiple data sets per volume. Multivolume files (diskettes only) are supported only for Basic Exchange Format Files. When using random data sets, the user may also access the records by relative record number.

The partitioned data set supported is provided for user and system libraries. Realtime Programming System provides facilities for the creation, deletion, and maintenance of the partitioned data sets.

Realtime Programming System supports the fixed heads option in the IBM 4962 and 4963 Disk Storage Unit.

Data sets may be shared among tasks in the system. Management of shared I/O devices is the responsibility of the programmer. Management of disk message buffering is handled by the Realtime Programming System.

The user has the option of accessing Series/1 I/O devices at the READ/WRITE and GET/PUT level (sensor I/O at the READ/WRITE level only). The user is provided with device independence at the GET/PUT level. All hard copy devices logically support the ASA Control characters. This option allows the user to direct a print file to the disk or diskette for later printing.



The record types supported are:

- Fixed
- Fixed Block
- Fixed Blocked Spanned
- Variable
- Variable Blocked
- Variable Blocked Spanned (including Data Compression)

Data sets may be created and deleted via online system utility functions and from program requests.

Write with Read Verify Option

This facility allows Data Set Definitions (DSDs) to contain an indication that all write operations to a particular data set (on disk or diskette) are to be verified. (In "version 1", the write with read verify option may be exercised only by an option in the OPEN macro.)

Support of the IBM 4964 and 4966 diskette units

- Provides users with a removable magnetic storage medium
- Enhances data security, integrity, and privacy

The system user can copy, via online system utility functions, a diskette to the fixed disk and utilize the stored data of the diskette as if it had always been on disk. When the user's operations are completed, a copy of the disk data may be transferred back to diskette. The diskettes may contain multiple files; files may span multiple diskettes; and many diskettes/files may be copied to fixed disk at one time. The user will have the convenience and privacy that removable diskettes provide him, while the system is able to utilize the speed and reliability offered by a fixed disk. The expiration date, which is a user option on diskettes, is honored by Realtime Programming System.

The user has the option to bind I/O devices and data sets during:

- A. Program Preparation
- B. Task Set Installation
- C. Execution (OPEN) Time

Options A and B provide the Realtime Programming System user with the ability to achieve higher performance by requiring a minimum number of disk reads to locate programs and data.

- Sensor I/O

Analog Input

The Realtime Programming System supports Analog Input, including the programmable gain amplifier, and the automatic zero correction option. The user has a choice of either sequential or random access at the READ/WRITE level. A single point can be handled under either of the access forms by specifying a count of one.

Analog Output

The Realtime Programming System supports analog output, including maintaining the present output value of each point. The user has a choice of either sequential or random access at the READ/WRITE level. A single point can be handled under either of the access forms by specifying a count of one.

Digital Input

The Realtime Programming System supports sequential and random access at the READ/WRITE level. Logical groups may be defined as contiguous DI points in a physical group, composed of 16 points. This allows the user to place DI points among different devices and/or programs. A single point or group can be handled under either of the access forms by specifying a count of one.

Digital Output

Realtime Programming System supports sequential and random access at the READ/WRITE level. Digital Output points may be defined in a logical group as in Digital Input above.

- Storage Protection

The IBM 4953 processor does not have hardware storage protection. Programming System systems running in IBM 4953 are not storage protected.

- Message Buffering

Realtime Programming System provides a disk message buffering facility, supporting the following sequential output devices:

- Operator Station
- IBM 4973 Line Printer
- IBM 4974 Printer
- Communication Devices

Other devices may use the message buffering facility. The system will print a complete message before starting another message.

Initial Program Load (IPL)

A capability is provided to IPL from the following devices:

- IBM 4964 or 4966 Diskette (IPL Stand-alone Utilities)
- IBM 4962 or 4963 (IPL Realtime Programming System)

After Realtime Programming System is loaded, it processes a user specified command data set which may be used to start user task sets or perform any valid operator command.

Utilities

A set of utilities is provided for the proper installation and maintenance of application programs and data. Certain utilities may run concurrently with the user application program, and others may run offline (that is, stand-alone—not concurrently with user programs or under Realtime Programming System).

The stand-alone utilities are loaded from an IBM 4964 diskette. The following stand-alone utilities are provided:

- System Build

This utility prepares a disk device to IPL the Realtime Programming System starter system and execute Realtime Programming System online system utilities. System build is executed prior to system generation as part of the Realtime Programming System installation process and at other times to restore the Realtime Programming System starter system and Realtime Programming System online system utilities.

- Disk Initialization

This utility initializes the 4962 fixed disks. It performs surface analysis and allows alternate sector assignments.

Storage-to-Diskette Dump

This utility is used for APAR submission and dumps all of storage except for the area where the utility is loaded from the IBM 4964 Diskette. This utility also dumps all the system's registers and status indicators. The online system REPORT utility may be used to obtain a printout of the dump on a hardcopy device. Additional dump diskettes may be created with the online system IPLMAINT utility.

- Display/Modify Storage
- Display/Modify Registers
- Display/Modify Floating Point Registers
- Display/Modify Segmentation Registers
- Print Control Blocks
- Print Storage
- Print Storage Overlays
- Hexadecimal Addition and Subtraction
- Decimal-Hexadecimal Conversion
- Set Break Point
- Display Break Points
- Reset Break Point
- Branch
- Execute
- Trace Storage Contents
- Display/Modify Disk
- Display/Modify Diskette
- Display/Modify Program
- Display/Modify Overlay
- Display/Modify Transient
- Load/Unload Transient

Debug Package

The interactive debug package provides a set of functions to assist in program debugging. These functions are invoked and controlled from the system console. The following online utilities are provided:

- DISKETTE INITIALIZATION

This utility provides online initialization of diskettes.
- DEFINE/CREATE/BUILD/DELETE/RENAME DATA SETS

These utilities perform the following functions:

 - DEFINE—The function of defining a disk or diskette containing logical volumes must be in Realtime Programming System format.
 - CREATE—The function of assigning space on sectorized devices, including creation of logical volumes, partitioned data sets, consecutive or direct data sets, or members.
 - BUILD—The function of building data set definitions in a task set library.
 - DELETE—The function of deleting volumes, data sets, members, or data set definitions on sectorized devices including the management of TOCs and partitioned data set directories.
 - RENAME—The function of renaming a volume, data set, or member, including the handling of TOCs and partitioned data set directories.
 - COMPRESS—This utility performs the function of copying partitioned data sets of volumes in place on sectorized devices to consolidate all available free space within one contiguous area.
 - PATCH DISK/DISKETTE—This utility provides the functions of applying permanent fixes to data sets on DASD devices. Visual verification of the data to be replaced is provided before the users enter the new data.

- REPORT—This utility provides the ability to route data from the diskette and disk files to any of the Series/1 hard copy output devices. The user has the ability to print the file (or data set), TOCs, and partitioned data set directories. This utility also provides the ability to print a formatted dump for storage. The dump was previously taken either stand-alone or online
- COPY—This utility provides the function of doing either a selective or volume copy. The user has the ability to copy as follows:

<i>From</i>	<i>To</i>
Diskette, Disk	Diskette, Disk Printer, Teletypewriter, Display

Selective copies allow the user to copy data sets, volumes, or members of data sets. Records may also be added to the end of a consecutive data set.

- MERGE—This utility provides the function of combining two partitioned data sets or volumes into a third partitioned data set or volume.
- IPLMAINT—This utility provides the functions to:
 - Prepare a diskette to IPL the stand-alone storage-to-diskette dump utility
 - Establish the system to be loaded from disk at IPL time.

Communications

- Communications Support

Communications support is an integral part of Realtime Programming System data management and is accessed via the READ/WRITE interface. The support directs the transfer of data between user programs and remote stations. A remote station may be either a supported terminal or another computer system linked via binary synchronous communication. Facilities are provided to:

 - Establish, control, and terminate user program access to remote stations.
 - Transfer data between user programs and remote stations on point-to-point lines (either switched or nonswitched) or multipoint lines.
 - The multipoint control support (for 2740 and 3270) provides capabilities for autopoll and poll list modification.
- EXIO Support for Communications

This facility allows the user to access the Binary Synchronous and Asynchronous communications features at a Basic level (EXIO). This basic access allows access to all facilities supported by the hardware features. The EXIO and the READ/WRITE support are mutually exclusive for an attachment.
- BSC Initial Program Load (IPL)

An IPL bootstrap program is provided so that a user program in a host Series/1 under the IBM Series/1 Realtime Programming System can transmit this bootstrap to a suitably configured remote Series/1 over a BSC line and cause the remote Series/1 to IPL from its own system residence device.



- BSC Dump

This facility allows a remote Series/1 at the request of the host Series/1, to transmit the contents of its dump data set to the host Series/1 for subsequent printing.

- SNA Support

The Realtime Programming System SNA support for the Series/1 user controls the management of sessions and the flow of data in an SNA network between a user program in the System/370 Host and a user program in the Series/1 operating as a cluster controller. This support provides for:

- System definition services
- Network attachment, activation, or deactivation services
- Session and message exchange services
- Activation of a Series/1 task set from the host

The Realtime Programming System provides a Data Flow Control level interface for support of multiple physical units (cluster controller) with multiple logical units in an SNA network controlled by a System/370 using OS/VS2 (SVS or MVS) and ACF/VTAM or ACF/TCAM, or in a network controlled by a System/370 using OS/VS2 with IMS/VS Version 1 Advanced Function for Communications. This allows multiple Series/1 user programs to be in session with multiple System/370 user programs.

- SNA Compatibility: The Realtime Programming System SNA support provides the following functions, as defined by Systems Network Architecture:

- SNA Physical Unit Type 2 Support
- SNA Function Management Profiles 3 and 4 Support
- SNA Transmission Subsystem Profiles 3 and 4 Support
- SDLC Secondary Station Support

This set of functional support allows the Series/1 to be defined as a Cluster Controller on an SNA/SDLC network controlled by a System/370 using OS/VS2 (SVS or MVS) and ACF/VTAM or ACF/TCAM through an IBM 3705 Communications Controller using the Network Control Program (ACF/NCP/VS). This support also allows operation in a network controlled by a System/370 using OS/VS2 with IMS/VS Version 1 Advanced Function for Communications.

The following start/stop (Asynchronous) terminals are supported via feature #1610, or via #2091 and #2092:

- IBM 2740 Communications Terminal, Model 1, in point-to-point switched, point-to-point nonswitched, multipoint connections.
- IBM 2740 Communications Terminal, Model 2, in multipoint connections.
- IBM 2741 Communications Terminal in point-to-point switched and point-to-point nonswitched connections.
- Teletype® Models ASR 33/35 Data Terminals, or equivalent, in point-to-point switched or point-to-point nonswitched connections. Determination of equivalency is a user responsibility.

The following start/stop (asynchronous) terminals are supported via features #2095 and #2096.

- Teletype® Models ASR 33/35 Data terminals, or equivalent, in point-to-point switched or point-to-point nonswitched connections. Determination of equivalency is a user responsibility.

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- IBM 3101 Display Terminal, Models 10, 12, 13, 20, 22, and 23 in EIA RS232-C/CCITT V.24 mode operating on point-to-point switched or nonswitched lines. Supported as a Teletype® Models 33/35 equivalent device.

The following Binary Synchronous Terminals are supported via feature #2074, or via #2093 and #2094.

- BSC support for 3271 Control Unit Models 1 and 2 with attached 3277, 3284, 3286, and 3288 terminals on a multipoint line.

Note: 3270 support is limited to communications support and does not include mapping services

- BSC support for 3275 Display Station (Model 1 and Model 2) on a switched point-to-point or a multipoint line.
- BSC support for 3274 Control Unit, Models 1C and 51C with attached 3277 and 3278 Display Stations; 3279 Color Display Stations; and 3284, 3286, 3287, 3288, and 3289 Printers on a nonswitched point-to-point or multipoint line.
- BSC support for 3276 Control Unit Display Station, Models 1, 2, 3, and 4 with attached 3278 Display Stations; 3279 Color Display Stations; and 3278 and 3289 Printers on a nonswitched point-to-point or multipoint line.
- 5260 Retail System via the 5265 Models A12, A22, A42, B12, B22, B42 using point-to-point BSC discipline as an IBM System/3.
- IBM 5280 Distributed Data System via Communications Adapter (#2500).
- IBM 6670 Information Distributor with BSC feature in a switched or nonswitched point-to-point line.
- IBM 3684 Point-of-Sale Control Unit (Model 1 or 2) with BSC on a switched or nonswitched point-to-point or nonswitched multi-point facility (as an IBM System/3). A user-written 3684 program or the Host Command Processor in the 3684 can communicate with a user-written program in the Series/1 through Realtime Programming System Read/Write communications support.

The following Binary Synchronous CPU-to-CPU communications are supported via feature #2074, or #2075 (not System/32 or System/34), or #2093 and #2094. Series/1 appears as an IBM System/3.

- CPU-to-CPU point-to-point (switched or nonswitched)
 - Another Series/1 using the Series/1 Realtime Programming System Versions 2, 3 or 4.
 - System/370 BTAM OS/VS1, OS/VS2 (SVS or MVS), or DOS/VS.
 - System/370 TCAM OS/VS1 or OS/VS2 (TCAM does not support conversational mode).
 - System/370 VTAM, DOS/VS
 - System/370 CICS/VS, OS/VS1 or OS/VS2 or DOS/VS (BTAM only)
 - System/32 under RPG programming facilities.
 - System/34 under RPG programming facilities and the BSC Equivalence Link feature of the SSP Interactive Communications Feature.
 - System/3 using CCP or RPG.

- CPU-to-CPU, Series/1 as a multipoint tributary
 - System/370 BTAM OS/VS1
 - System/370 IMS/VS OS/VS1 or OS/VS2 (BTAM only). IMS/VS support is via IRSS (Intelligent Remote Station Support) an IMS/VS protocol for the support of remote systems. A Series/1 user-written application program is required for the formatting and handling of messages in the proper IMS/IRSS formats.

Realtime Programming System RAS Characteristics

The Realtime Programming System provides a set of facilities to help ensure system reliability, availability and serviceability (RAS). Additional facilities may be optionally included to amass an extensive set of RAS functions.

Error Response

Detection of machine check or program check conditions, error logging, and message generation are performed by supervisory functions in the Realtime Programming System.

System Recovery

Error recovery procedures provide the system with the ability to continue operating, if at all possible, in the case of software, hardware, and power failures. Task set and system restart and reloading are provided. If the system cannot continue normal execution, the system user is able to specify execution of a program which utilizes minimum system resources and can notify and prepare the external environment for the imminent loss of the system.

Failure of the disk unit that contains the system task set does not cause total system failure or initiate a reload of the supervisor. In the event of disk failure, programs that do not require that disk unit are able to continue operation. Disk service to other disk units continues. However, the next request for a system transient, with the exception of error logging, may cause an abnormal termination of the system.

Automatic Device Backup

This facility provides automatic switching from a failing primary device to a secondary device. If an irrecoverable I/O error occurs on a device with automatic backup, data is redirected from that device to its backup. The following combinations are supported for automatic device backup:

Teletypewriter primary to Teletypewriter backup (output only)

Hardware Service Aids

Maintaining error logs is a means of assessing hardware and software reliability. By using hardware error recording to monitor the system, users are made aware of marginally operating equipment. The type of intermittent failures of devices, channels, and CPU will be optionally recorded on an IBM 4962 and 4963 disk. The error logs are used by customer engineers and users for diagnostic purposes. The user and the customer engineer are able to obtain dumps of disk recorded logs.

The Realtime Programming System provides the following functions:

- Routines to handle the occurrence of a machine check. These routines provide the option of returning control to a user routine after the check has been cleared and optionally logged. The system passes the pertinent error data to the user.
- Support of Automatic Restart after Power Failures. Upon power restoration a user-specified module is loaded.
- Support of Battery Backup Feature. Systems with the Battery Backup Feature and Timer Support notify the user of a power failure by dispatching a user-specified program. When the power is restored, Realtime Programming System dispatches a user-specified program and passes the duration of the power failure in minutes, seconds, and milliseconds. If the battery is exhausted, results will be the same as if the system does not have the Battery Backup Feature.
- In addition to the general purpose RAS aids, additional optional aids are provided for communications:
 - Communications Trace program which, when activated under user control, is designed to continuously record current communications activity in main storage. This facility works in conjunction with the general purpose I/O trace facility.
 - Communications Online Test is an optional facility which provides a means of testing attached 2740 Model 1 terminals concurrent with user operation and determining proper operation of the communication link (lines and modems) as well as the terminal and system programming support.

Version 4 Enhancements

Version 4 of the Realtime Programming System provides all the function included in the initial program release (5719-PC1), Version 2 (5719-PC2), and Version 3 (5719-PC3) plus the following function:

- Support for the IBM 4963 Disk Subsystem.
- Support for the IBM 4966 Diskette Magazine Unit.
- Support for attachment of a Series/1 as a Cluster Controller to a System/370 SNA network.
- Enhancements to BSC and START/STOP Communications which include support of multipoint lines.
- A Command Language Facility which provides concurrent users at supported terminal devices with a simple, easy-to-use interface to system software services. (See note at the end of the "Charges" paragraph.)
- System dynamic allocation of control blocks which removes the need for users to determine requirements and pre-allocate control block stacks at application build and SYSGEN time.
- A dynamic device configuration capability which allows users to add devices to an operational system without the requirement to re-SYSGEN.
- Support for either a single address space or multiple address space environment. (Selected at SYSGEN.)
- A dynamic transient pool facility which greatly improves system performance through the automatic retention in

unmapped storage of frequently used supervisor transient programs. (Optional at SYSGEN for a multiple address space management system only.)

- Expanded data management facilities which support increased diskette capacity and automatic sequencing of multi-volume diskette data sets.
- External DSD table support which allows multiple copies of a single task set on disk to be loaded and executed concurrently with each copy utilizing different data set definitions and devices.
- An INSTALL command, available with the Command Language Facility, which greatly simplifies the installation of certain related licensed programs by automatically performing the required install procedures for the user.
- A much simplified and improved SYSGEN facility which significantly reduces the number of procedural steps and decisions required to be made by the user.
- Support of a system global DSD table which provides users with a type of system catalog facility for data set definitions (DSDs).
- Support of a dummy DSD which provides users with an easy way to suppress unneeded application output such as a voluminous printout.
- Expanded and enhanced utilities which include the removal of the requirement for the user to specify PARMs=() when taking utility function defaults.
- Support of a generic system residence device name which reduces the number of DSDs that must be updated by the user whenever the system residence device is changed.
- Distribution of a Single Address Space Management Starter System and a Multiple Address Space Management Starter System which should meet the initial needs of most users such that a SYSGEN will not be required to create a system on which to begin.

Highlights

- SNA Support

The Realtime Programming System SNA support provides management of sessions and the flow of data in the SNA network between a user program in the System/370 host and a user program in the Series/1. This support provides for:

- Systems definition services
- Network activation/deactivation services
- Session activation/deactivation and message exchange services
- Activation of a Series/1 task set from the host

The Realtime Programming System provides a Data Flow Control level interface for support as multiple Logical Unit Cluster Controller on an SNA network controlled by a System/370 using DOS/VS, OS/VS1 or OS/VS2 (SVS or MVS), and ACF/VTAM or ACF/TCAM with ACF/NCP/VS, or VTAM 2.0, or TCAM 10 with NCP 5.0. This allows multiple user programs to be in session with multiple System/370 user programs. This support may also be used to interface with IMS/VS Version 1. Multiple physical units may be active in the Series/1 at one time permitting simultaneous sessions with multiple System/370s.

- SNA Compatibility

The Realtime Programming System SNA support provides the following functions, as defined by Systems Network Architecture:

- SDLC Secondary Station Support
- SNA Physical Unit Type 2 Support
- SNA Function Management Profiles 3 and 4 Support
- SNA Transmission Subsystem Profiles 3 and 4 Support

- Multiple Address Space and Single Address Space Support

Either a multiple address space system or a single address space system may be generated. A multiple address space system requires a Storage Address Relocation Translator. A single address space system is restricted to 48K and 64K of storage unless the Storage Address Relocation Translator is used.

- IBM 4963 and 4966 Support

The IBM 4963 Disk Subsystem is supported for all functions previously supported on the IBM 4962 Disk and with expanded utility functions. Ability to provide back-up for the disk is enhanced by the availability of the IBM 4966 Diskette Magazine Unit and the new utility functions.

- Communications Enhancements

(For a complete list of communications support, see the "Communications" section earlier in these pages.) Additional communications support in Version 4 includes the following:

- Start/Stop (Asynchronous) Terminal Support

- IBM 2740 Communications Terminal, Models 1 and 2, in multipoint connections.
- IBM 2741 Communications Terminal in point-to-point switched and nonswitched connections.
- Teletype® Models ASR 33/35 Data Terminal or equivalent, in point-to-point switched or nonswitched connections, via the IBM Series/1 Programmable Multi-Line Communications Attachment (#2095 and #2096). (Determination of equivalency is a user responsibility.)
- IBM 3101 Display Terminal, Models 10, 12, 13, 20, 22, and 23 in EIA RS232-C/CCITT V.24 mode operating on point-to-point switched or nonswitched lines. Supported as a Teletype® Model 33/35 equivalent device.

- Binary Synchronous Support

- IBM 3271 Control Unit (Models 1 and 2) with attached 3277, 3284, 3286, and 3288 terminals on a multipoint line.
- IBM 3275 Display Station (Models 1 and 2) on a switched point-to-point or multipoint line.
- BSC support for 3274 Control Unit, Models 1C and 51C with attached 3277 and 3278 Display Stations; 3279 Color Display Stations; and 3284, 3286, 3287, 3288, and 3289 Printers on a nonswitched point-to-point or multipoint line.
- BSC support for 3276 Control Unit Display Station, Models 1, 2, 3, and 4 with attached 3278 Display Stations; 3279 Color Display Stations; and 3278 and

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3289 Printers on a nonswitched point-to-point or multipoint line.

Note: 3270 support is limited to communications support and does not include mapping services.

- IBM 5280 Distributed Data System via Communications Adapter (#2500).
- IBM 6670 Information Distributor with BSC feature on a switched or nonswitched point-to-point line.
- IBM System/370 OS/VS1, OS/VS2 IMS/VS (BTAM only) in point-to-point switched and nonswitched connections. IMS/VS support is via IRSS (Intelligent Remote Station Support), an IMS/VS protocol for the support of remote systems. A Series/1 user-written application program is required for the formatting and handling of messages in the proper IMS/IRSS formats.
- IBM System/370 OS/VS1 BTAM, Series/1 as a multipoint tributary.

- **Dynamic Transient Pool Management**

Dynamic Transient Pool Management maintains a pool of the most recently used system transients in unmapped storage. While in the pool, these transient programs will be executed with the performance advantage of a resident program. The dynamic transient pool handler will retain the most frequently used programs in storage, thereby reducing the number of disk I/O refreshes required.

Note: The Dynamic Transient Pool Management facility is a SYSGEN selectable option for a multiple address space environment system only. This support is not available for a single address space environment system or for user transients.

- **Expanded Diskette Data Management (for 4963/4966 SAVE/RESTORE)**

Single density diskettes are supported and double density diskettes are supported on the 4966 diskette unit only.

A 512-byte physical sector size is also supported for non-system formatted diskette data sets at all levels of access. A 1,024-byte physical sector size is supported at the EXIO level only.

Volume sequencing support is now available for multivolume diskette data set processing.

- **Command Language Facility**

The IBM Series/1 Command Language Facility significantly enhances the Realtime Programming System's user interface. The Command Language Facility provides online programming development and production system support to multiple users through a simplified command language interface.

Commands are processed in realtime by an interpretive compiler, which establishes the necessary execution environment prior to invoking requested services such as the IBM Series/1 Text Editor, PL/I, COBOL, FORTRAN compilers, macro assembler or Application Builder, or user application programs. The ease of use of these commands reduces the amount of pre-planning and system knowledge required to use system services.

Programmer and operator productivity is significantly increased through minimization of keystrokes required for command entry. This is achieved by user-sensitive command syntax and effective default values within the logic of the commands. In addition, the multiterminal capability of this facility can increase productivity by supporting concurrent program development.

IBM provides a basic set of commands which may be modified or expanded through use of the Series/1 Exec language, which is also provided. This permits users to write new commands, customized for their needs, not only for the purpose of aiding the program development process but for generating commands that constitute production jobs and tasks. With the appropriate environmental setup, these commands can execute on production-oriented Series/1 systems.

The Command Language Facility executes with, and is part of, the Realtime Programming System Version 4 (5719-PC4) and requires the Program Preparation Subsystem Version 4 (5719-AS4) for some of its system facilities. It executes in a partition of the Realtime Programming System as a separate task set.

Note: See special instructions in the "Charges" paragraph for those customers who have already ordered or plan to order the Realtime Programming System Version 4.

- **External DSD Tables**

An external DSD table is one that resides outside a task set library volume, on any direct access storage device, as any named data set or member of a partitioned data set. The use of an external DSD table may be optionally specified at task set execution time. This facility allows multiple copies of the same task set to be executed concurrently with each copy having a different DSD table active in order to access different data sets and devices.

- **System Global DSD Table**

The System Global DSD Table support allows the DSD table (DSDT) in the system task set to serve as a system-wide DSD table for all task sets. This provides a type of system catalog facility in that users can maintain all their Data Set Definitions in a single system data set that is automatically searched at execution time. The order of the system search for a given DSD is as follows:

1. The active DSDT of the appropriate executing task set.

2. The active DSDT of the currently active shared task set, if applicable.
3. The DSDT of the active System Task Set.

- DSD Dummy

With DSD DEV=DUMMY support, Data Set and Device Management services will provide successful return codes without actually performing the required I/O access functions if the generic device name DUMMY is specified in the corresponding DSD. This allows application programs to be tested without the need to patch out or remove I/O calls to the system for devices which may be unavailable or inoperative and provides an easy way to suppress application output such as unneeded voluminous printout.

- Generic System Residence Device Name

The device name DISK is a generic name for the device from which system IPL occurs and from which the system task set is loaded into storage. All DSD references to the device name DISK will automatically go to the system resident device regardless of the actual name assigned at system generation time.

- Improved SYSGEN

A greatly simplified SYSGEN is part of Version 4. This SYSGEN reduces considerably the number of procedure steps required prior to SYSGEN by automatically creating the work files, specification files, Systems Residence Volume, DSDs, control block requirements, rollin/rollout requirements and TPLIB size. New tuning options exist which reduce the number of lines displayed to the user and the number of decision points during the question and answer session. Also answers are checked for inconsistencies, duplicate names, addresses, omissions and proper combinations.

- Utility Enhancements

The online system utilities:

- Now provide facilities for obtaining a formatted report of the contents of a DSD table.
- No longer require the user to specify PARMS=() when taking the utility function defaults.
- No longer automatically terminates a utility session for "data set or DSD not found" conditions which are detected while processing a "delete" command entered from a data set on a non-interactive device such as a disk or diskette.

Stand-alone disk/diskette SAVE/RESTORE facilities are available for the following device combinations:

- IBM 4963 Disk Subsystem/IBM 4966 Diskette Magazine Unit.
- IBM 4962 fixed disk storage unit/IBM 4964 diskette unit.

- Install Command

A new INSTALL command, operating under the Command Language Facility, greatly facilitates the installation of certain licensed programs prior to or after SYSGEN. If you issue the command and specify the program order number, the Command Language Facility and associated programs will proceed with the installation procedure.

- Dynamic Device Configuration

Devices of the type specified during SYSGEN may dynamically be added "online" to an already operational system. This enhancement, applicable for most IBM supported devices, will eliminate the requirement to do a system generation to add devices of like type, thereby decreasing SYSGEN time and output. Start-Device commands for these devices may be placed into the "IPL Data-Set" and processed at IPL time or may be issued later from the Operator Console. Thus, the user may increase the number of I/O devices in the system dynamically without the need to re-SYSGEN.

- Dynamic Control Blocks

The system will dynamically allocate control blocks required during execution of an application. The user (optionally) no longer needs to specify, at Application Build, the number of control blocks required.

For a system task set control blocks are allocated for dynamic storage of the system partition which is specified at installation time via the IPL MAINT utility command for a user task set, control blocks are allocated from the Variable Control Block Area (VCBA) specified at application build time.

- Pre-Packaged Systems

A single address space management system is distributed to support users of 4952, 4953 and 4955 processors with 64K bytes of storage and without the Storage Address Relocation Translator.

A multiple address space management system is distributed to support users of 4955 processors with at least 96K bytes of storage, and with the Storage Address Relocation Translator.

These pre-packaged systems should meet most user's needs, thus removing the requirement for a customized SYSGEN. By taking advantage of the Dynamic Device Configuration feature and the Dynamic Transient Pool Management features, persons can use these systems for both program development and production work.

Compatibility

Files

Complete compatibility is provided with files supported by "version 1" of the IBM Series/1 Realtime Programming System (5719-PC1), Version 2 (5719-PC2), or Version 3 (5719-PC3).

Any data file written by any of these systems is directly usable by the others. Compatibility with external (to Series/1) diskette devices is maintained by using Basic Exchange format. See the *IBM Diskette General Information Manual* GA21-9187.

Programs

Problem-state source programs which assemble or compile and execute on the Realtime Programming System Version 3 (5719-PC3) will also assemble or compile and execute on The Realtime Programming System Version 4 (5719-PC4).

Problem-state source programs which assemble or compile and execute on version 1 of the Realtime Programming System (5719-PC1) or on Version 2 (5719-PC2) may require source modifications to assemble or compile and execute on the Realtime Programming System Version 4 (5719-PC4).

In any case, version 1 or Version 2 problem-state programs require reassembling and rebuilding to prepare them to execute on Version 4.

In contrast, Version 3 problem state programs, with the exception of those programs using the BSC IPL bootstrap facilities, require no reassembling. Most Version 3 problem state programs need only be installed on a Version 4 system to execute. In some cases, VCBA Space may need to be increased.

Results and output generated from selected Realtime Programming System-based programs invoked under the Command Language Facility are identical to that which would be experienced when invoking these programs and functions via alternate means (for example, Job Stream Processor).

Note: Only Version 4 of the Program Preparation Subsystem supports the Command Language Facility.

Customer-written programs included with the supervisor must be written in accordance with the internal supervisor programming conventions for 5719-PC4, which are different from those of 5719-PC1, 5719-PC2, and 5719-PC3.

The following IBM Series/1 programs are compatible with the IBM Series/1 Realtime Programming System Version 4.

- IBM Series/1 Program Preparation Subsystem Version 3 (5719-AS3)
- IBM Series/1 Program Preparation Subsystem Version 4 (5719-AS4)
- IBM Series/1 FORTRAN IV Compiler and Object Support Library (5719-FO1) Version 1.3
- IBM Series/1 FORTRAN IV Realtime Subroutine Library (5719-FO3) Version 1.2
- IBM Series/1 FORTRAN IV Realtime Subroutine Library (5719-FO4) Version 2.0
- IBM Series/1 Mathematical and Functional Subroutine Library (5719-LM1) Version 1.2
- IBM Series/1 Mathematical and Functional Subroutine Library (5719-LM2) Version 2.2
- IBM Series/1 PL/I Compiler and Resident Library (5719-PL1) Version 1.2
- IBM Series/1 PL/I Transient Library (5719-PL3) Version 1.2
- IBM Series/1 COBOL Compiler and Resident Library (5719-CB1)
- IBM Series/1 COBOL Transient Library (5719-CB2)
- IBM Series/1 Sort/Merge (5719-SM1)
- IBM Series/1 4987 Programmable Communications Subsystem Preparation Facility (5719-CS0)
- IBM Series/1 4987 Programmable Communications Subsystem Execution Support (5719-CS1)
- IBM Series/1 4987 Programmable Communications Subsystem Extended Execution Support (5719-CS2)
- IBM Series/1 Indexed Access Method (5719-AM1)
- IBM Series/1 5250 Information Display System (5719-TA1)

- IBM Series/1-System/370 Channel Attach Program (5719-CA1)
- IBM Series/1 4969 Magnetic Tape Drive (5719-TA4)

The following IBM Series/1 Programming RPQs are compatible with the IBM Series/1 Realtime Programming System Version 4 (5719-PC4). For details on these PRPQs, refer to the pertinent programming pages in this manual.

- IBM Series/1 Realtime Programming System Basic Sort Programming RPQ P82573 (5799-TBP) Version 1 Modification Level 1
- IBM Series/1 Remote Job Entry Programming RPQ P82575 (5799-TBK)
- IBM Series/1 Realtime Programming System Indexed Access Method Programming RPQ P82570 Version 3 (5799-TCB)
- IBM Series/1 Realtime Programming System IBM 4978 Display Station Support Programming RPQ P2572 (5799-TCE) Version 3
- IBM Series/1 Realtime Programming System Disk Spooling Programming RPQ P82574 Version 3 (5799-TCH)
- IBM Series/1 Realtime Programming System Transient Activity Tool Programming RPQ P82606 Version 1 (5799-TDG).
- IBM Series/1 Realtime Programming System Multiple Terminal Manager RPQ P82596 (5799-TCY)

Program Preparation (5799-TCL)

The IBM Series/1 Program Preparation Subsystem Version 3 (5719-AS3) or the IBM Series/1 Program Preparation Subsystem Version 4 (5719-AS4) is required to prepare programs to execute on the IBM Series/1 Realtime Programming System Version 4 (5719-PC4). If the Command Language Facility will be used, then 5719-AS4 is required, as commands have been written to the Program Preparation Subsystem Version 4 function level.

The IBM Series/1 Base Program Preparation Facilities (5719-PA1) cannot be used to prepare programs to run with the Realtime Programming System.

Devices

The 4963 Disk Subsystem and IBM 4966 Diskette Magazine Unit are functionally compatible with the IBM 4962 Disk Storage Unit and the IBM 4964 Diskette Unit, respectively. Therefore, any program using the IBM 4962 and IBM 4964 through the operating system GET/PUT or READ/WRITE support will run with the new devices in a similar fashion.

This applies to the Series/1 FORTRAN, PL/I and COBOL compilers which produce object programs that access the new devices through the operating system interfaces.

Note: EXIO access is by definition device dependent and is therefore not transparent to the user.

**Device Support**

The Realtime Programming System Version 4 supports the IBM 4952, 4953 or 4955 Processors and the following processor options:

- #3920 Floating Point Processor (IBM 4955 only)
- #5650 Programmer's Console
- #6335 Storage Address Relocation Translator (IBM 4955 Models B and D only)

In addition, multiples of the following devices and features are supported:

IBM 4962 Models 1, 1F, 2, 2F, 3 and 4	Disk
IBM 4963 Models 23A, 23B, 29A, 29B, 58A, 58B, 64A and 64B	Disk Subsystem
IBM 4964 Model 1	Diskette
IBM 4966 Model 1	Diskette Magazine Unit
IBM 4969	Magnetic Tape Drive**
IBM 4973 Models 1 and 2	Line Printer
IBM 4974 Model 1	Printer
IBM 4978	Display (as 4979) or Programming RPQ
IBM 4979 Model 1	Display Station
IBM 3101	Display Terminal (as Teletype® Model ASR 33/35 equivalent device)
IBM 4982 Model 1	Sensor I/O
IBM 4987	Programmable Communica- tions Subsystem**
IBM 4993	Channel Attach
IBM 4999 Models 1 and 2	Battery Backup

Features

#1200	System/370 Channel Attachment **
#1210	5250 Information Display System Attachment**
#1560	Integrated DI/DO
#1565	Channel Repower
#1610	Asynchronous Communications Single Line Control
#2091	Asynchronous Communications 8-Line Control
#2092	Asynchronous Communications 4-Line Adapter
#2074	Binary Synchronous Communications Single Line Control
#2075	Binary Synchronous Communications Single Line Control/High Speed
#2093	Binary Synchronous Communications 8-Line Control
#2094	Binary Synchronous Communications 4-Line Adapter
#2090	SDLC Single Line Control
#2095	Feature-Programmable 8-Line Multi-Line Communications Controller

#2096	Feature-Programmable 4-Line Multi-Line Communications Attachment
#7840	Timer
#7850	Teletypewriter Attachment (supported for use with Teletype® Models ASR 33/35)

Note: Device and feature performance is dependent upon hardware configuration, Realtime Programming System generation options, and application program design.

Specified Operating Environment

Support will be provided for this program when it is operated in the following environment:

System Requirements: The minimum system after initially loading the disk and when the application program executes without hard copy output, system console operations, and data interchange is:

Processor	IBM 4952, 4953, 4955 for a single address space management environment system or IBM 4952 or 4955 (Model B or D equipped with Storage Address Relocation Translator #6335 or Model E) for a multiple address space management environment system.
Storage	48K bytes (64K bytes required for multiple address space environment).
Disk	1—IBM 4962 Model 1, 1F or 3 or 4963 Disk Storage Unit.

The minimum hardware configurations to support System Generation and System Installation using the supplied Starter Systems is:

Processor	IBM 4952, 4953 or IBM 4955 for a single address space management environment system or an IBM 4955 (Model B or D equipped with Storage Address Allocation Translator #6335 or Model E) for a multiple address space management environment system.
Storage	64K bytes for single address space management environment or 96K for multiple address space management environment.
Disk/Diskette	1 each—diskette and disk drive in any combination, selected from supported models of IBM 4962 Disk Storage Unit, IBM 4963 Disk Subsystem, IBM 4964 Diskette Unit, and IBM 4966 Diskette Magazine Unit.
Printer	1—IBM 4973 Line Printer OR 1—IBM 4974 Printer
Operator Station	1—IBM 4979 Display Station OR 1—IBM 4978 Display Station (as 4979 only) OR 1—IBM 3101 Display Terminal

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** Requires separate licensed program.



(as Teletype® Models
ASR 33/35 equivalent device)

OR

1—Teletypewriter Adapter #7850
with Teletype® Models
ASR 33/35 or equivalent device

Attachment to an SNA network requires SDLC Single Line Control (#2090).

To support BSC IPL and BSC DUMP, the Series/1 host system must have any of the BSC communications features (#2074, #2075, #2093/#2094). The remote system must have one of the BSC single line features (#2074, #2075).

The hardware requirements for the storage overlay capability include the Storage Address Relocation Translator Feature #6335 in a 4955 B or D or 4955 Model E and a minimum of 64K bytes of physical storage.

Programming Requirements: None

Required EC Levels

The required engineering change level for all models of the 4955 is EC 375013. The 4955 Model B must also have EC 578550.

The required engineering change levels for 5719-PC4 for the IBM 4962 Disk Unit are EC 829868 and EC 578573. This applies to the IBM 4962 Disk Unit Serial numbers 10001 through 10188.

Note: Implementation of engineering changes is handled by Customer Engineering.

Charges

This program will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, the licensed program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs.

If the monthly charge option is chosen, credit will be accrued during a continuous licensed period towards the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferable to other customers or between licenses, whether they are for programs which have a different program number or the same program number. In addition there is a one-time process charge to cover the cost of distributing basic machine readable material including service updates.

Customers should be informed that even if the license fee for "Version 1", Version 2, or Version 3 already is paid, another license fee will have to be paid if Version 4 is needed in the future. Neither the one-time charge nor accrued license credits for version 1, Version 2, or Version 3 are transferable to Version 4 or from/to the Version 4 alternate feature. *Note:* Customers who do not wish to avail themselves of the Command Language Facility improvements may receive the previously announced product content at the original price by specifying #9572 or #9573.

Customer Responsibility

The customer is responsible for the installation and use of this licensed program.

Programming RPOs

PRPOs will be accepted. Response time will depend upon complexity.

Marketing Publications

IBM Series/1 Programming System Summary	GC34-0285
IBM Series/1 Realtime Programming System Version 4: Supervisor Macro Programmer's Guide	SC34-0205
IBM Series/1 Realtime Programming System Version 4: Data Management Macro Programmer's Guide	SC34-0206
IBM Series/1 Realtime Programming System Version 4: Binary Synchronous and Start/Stop Communications Macro Programmer's Guide	SC34-0207
IBM Series/1 Realtime Programming System Version 4: Operator Commands and Utilities	SC34-0208
IBM Series/1 Realtime Programming System Version 4: Generation and Installation Procedures	SC34-0204
IBM Series/1 Realtime Programming System Version 4: Macro Reference	SC34-0211
IBM Series/1 Realtime Programming System Version 4: Messages and Codes	SC34-0209
IBM Series/1 Realtime Programming System Version 4: Problem Determination	SC34-0219
IBM Series/1 Realtime Programming System Version 4: Control Blocks	SC34-0210
IBM Series/1 Realtime Programming System Version 4: System Network Architecture Support Macro Programmer's Guide	SC34-0228
IBM Series/1 Realtime Programming System Version 4: Command Language Facility User's Guide	SC34-0299
IBM Series/1 Realtime Programming System Version 4: Command Language Facility Command Reference Summary	SX34-0026
IBM Series/1 Realtime Programming System Version 4: Command Language Facility Language Reference Summary	SX34-0027
IBM Series/1 Realtime Programming System Version 4: Design Guide	SC34-0242



IBM Series/1 Realtime Programming
System Version 4: Licensed
Program Specification

GC34-0202

IBM Series/1 Authorized Program
Analysis Report (APAR) User's
Guide

GC34-0099

IBM SERIES/1 REALTIME PROGRAMMING SYSTEM VERSION 5 (5719-PC5)

The IBM Series/1 Realtime Programming System (also referred to as the operating system) is a control system through which a user can install, operate, and maintain system programs, application programs, and data. It is a full function multiprogramming, multitasking, event driven, disk/diskette system. The operating system manages physical resources: processor, storage, and devices. Its supervisor, data management, and communications services are a controlled interface between application programs and the Series/1 hardware. The operating system supports the terminal-transaction environment and supplies the environment for both realtime and batch applications.

The Realtime Programming System Version 5 (5719-PC5) operates in a multiple address space environment only. Multiple address space management provides for isolation between task sets and the use of up to 512K bytes of processor storage.

- Multiprogramming/Multitasking

The operating system is a multiprogramming/multitasking system. It allows multiple programs within the system to be processed concurrently by interleaving their execution.

- Event Driven

Task sets are collections of programs, data, and control information which reside in partitions—one per partition.

Task sets are queued for execution in partitions based on the occurrence of the following events:

- External (process interrupt)
- Time of day
- Time interval, either single or repetitive
- Operator request
- Program request
- Host request for session establishment with an assigned logical unit (LU)

- Disk/Diskette Storage

The control system consists of resident and transient programs. These programs reside in a system task set library on disk or diskette. User task set libraries can also reside on disk or diskette.

Diskette-based systems will have less capacity and performance than disk-based systems and must be custom generated and tuned for specific application environments. Customers should contact their marketing representative for assistance in determining whether a diskette-based system can be generated to satisfactorily meet their requirements.

- Supervisor Services

The supervisor controls the allocation and distribution of the physical resources of the system: storage, processor, and devices. It manages programs and their interaction through a set of system management services that manipulate resources and programs on a logical level. The supervisor performs services and functions such as:

- Primary and secondary storage management
- Partition and task set management
- Multiple dynamic partitions per address space
- Multiple concurrent shared task sets
- Task and program management



- Dynamic transient pool management for supervisor transients
- Event and queue management
- Global queue services (across partitions)
- Serially reusable resource management
- Timer management and services
 - Feature number 7840
 - IBM 4952 Native Clock/comparator
- Error management and logging
- Class interrupt management
- Operator interface management
- Management of the interface between subsystems and terminals
- Data Management
 - Data set management provides services such as:
 - Three levels of access—basic, physical, and logical
 - Two access methods—sequential and direct
 - Three data set organizations—consecutive, random, and partitioned.
 - DPIO Support
 - IBM 3101 Display Terminal
 - IBM 4962 and IBM 4963 Disks
 - IBM 4964 and IBM 4966 Diskette Unit
 - IBM 4965 Diskette Drive and I/O Expansion Unit (also IBM 4952 Model C Diskette Drive)
 - IBM 4969 Magnetic Tape**
 - IBM 4973 Line Printer
 - IBM 4974 Printer
 - IBM 4975 Printer
 - IBM 4978 Display
 - IBM 4979 Display Station
 - IBM 5225 Printer**
 - IBM 5251 Models 1 and 2 Display Terminals**
 - IBM 5252 Model 1 Display Terminal**
 - IBM 5256 Models 1, 2, and 3 Printers**
 - (#7850) Teletypewriter Attachment
 - ** Separate licensed program
- Sensor I/O Support
 - Analog I/O (Single or Multiple Point)
 - Digital I/O
- Utilities
 - The operating system has a set of utilities for the installation and maintenance of programs and data. Included are the Transient Activity and the Automatic Patch Application Tool.
- Command Language Facility (Optional)
 - The Realtime Programming System Version 5 command language facility consists of an initialization task set, the S1/EXEC interpreter with a language, and a set of IBM-supplied commands written in the S1/EXEC language. The facility provides such functions as:
 - Multiple concurrent user capability
 - Commands processed by a realtime interpreter which invokes requested services
 - Tutorial support
 - A set of commands which may be supplemented by user-written commands
 - Command capability to perform I/O to/from data sets or printers, as well as user terminals

- Problem Determination

The operating system has debugging aids that enable a user to find and correct errors in problem and supervisor programs. Through the interactive debug facility, a user can display and modify a register, processor storage, disk, and diskette, as well as set address stops to monitor the status of executing programs.

- Service Aids

- I/O Trace
- Storage Patch and Dump
- SVC Trace
- Online Error Log Report
- Patch Application Tool

- System Initialization

- SNA Support

The Realtime Programming System base SNA support provides the following functions, as defined by Systems Network Architecture:

- SNA Physical Unit Type 2 support
- SNA Function Management Profiles 3 and 4 Support
- SNA Transmission Subsystem Profiles 3 and 4 Support
- SDLC Secondary Station Support
- Data Flow Control level interface
- Multiple physical and logical units
- System definition services
- Network attachment, activation, or deactivation services
- Session and message exchange services
- Activation of a Series/1 task set from the host

This set of functional support allows the Series/1 to be defined as a Cluster Controller on an SNA/SDLC network controlled by a System/370 using OS/VS2 (SVS or MVS) with one of the following access methods:

- ACF/VTAM
- ACF/TCAM
- VTAM Version 2
- TCAM Version 10

through an IBM 3705 Communications Controller using the appropriate version of the Network Control Program.

This support also allows operation in a network controlled by a System/370 using OS/VS2 with IMS/VS Version 1 Advanced Function for Communications and System/370 CICS/VS Version 1.5.

- Start/Stop Support

The following start/stop (Asynchronous) terminals are supported via feature #1610, or via #2091 and #2092:

- IBM 2740 Communications Terminal, Model 1, in point-to-point switched, point-to-point nonswitched, multipoint connections.
- IBM 2740 Communications Terminal, Model 1 or 2, in multipoint connections.
- IBM 2741 Communications Terminal in point-to-point switched and point-to-point nonswitched connections
- IBM 3101 Display Terminal, Models 10, 12, 13, 20, 22, and 23 (in character or block mode), or equivalent device, in point-to-point switched or nonswitched connections. Determination of equivalency is a user responsibility.

The following start/stop (asynchronous) terminals are supported via features #1310, #2095/#2096:



- IBM 3101 Display Terminal, Models 10, 12, 13, 20, 22, and 23 (in character or block mode), or equivalent devices in point-to-point switched or nonswitched connections. Determination of equivalency is a user responsibility.

The following systems are supported via features #1610, #2091/#2092, or #2095/#2096:

- IBM Personal Computer with the Asynchronous Communications Adapter, in switched and point-to-point nonswitched connections. The IBM Personal Computer program entitled Asynchronous Communications Support, or a user-written IBM Personal Computer program, can communicate with a user-written program in the Series/1 using Realtime Programming System Read/Write communications support.
- IBM System/23 Datamaster with the Communications Adapter Feature and utilizing the Asynchronous Communications program, in switched and point-to-point nonswitched connections.

The following system is supported via features #1310, #1610, #2091/#2092, or #2095/#2096:

- IBM Displaywriter with a Communications Adapter and utilizing the Asynchronous Communications program, in switched and point-to-point nonswitched connections. The Displaywriter can operate in either of two asynchronous communications modes: 2741 (emulates the IBM 2741 Communications Terminal), and TTY (emulates a teletypewriter).

- BSC Support

The following Binary Synchronous Terminals are supported via features #1310, #2074, #2075, #2080 or #2093 and #2094:

- BSC support for 3271 Control Unit Models 1 and 2 with attached 3277, 3284, 3286, and 3288 terminals on a multipoint line.
Note: 3270 support is limited to communications support and does not include mapping services.
- BSC support for 3275 Display Station (Models 1 and 2) on a switched point-to-point or a multipoint line.
- BSC support for 3274 Control Unit, Models 1C and 51C with attached 3277 and 3278 Display Stations; 3279 Color Display Stations; and 3284, 3286, 3287, 3288, and 3289 Printers on a nonswitched point-to-point or multipoint line.
- BSC support for 3276 Control Unit Display Station, Models 1, 2, 3, and 4 with attached 3278 Display Stations; 3279 Color Display Stations; and 3287 and 3289 Printers on a nonswitched point-to-point or multipoint line.
- IBM 3741 Data Station on a switched or nonswitched point-to-point line with the Expanded Communications Feature (#1685).
- 5260 Retail System via the 5265 Models A12, A22, A42, B12, B22, B42 using point-to-point BSC discipline as an IBM System/3.
- IBM 5280 Distributed Data System via the 5285 or 5288 with Communications Adapter Feature (#2500) on a switched point-to-point or nonswitched point-to-point or multipoint line. (5280 appears as a 3741.)
- IBM 6670 Information Distributor with BSC Feature in a switched or nonswitched point-to-point line. (See the Programmer's Guide for Communicating with the IBM 6670 Information Distributor (BSC Environment) for details on the 6670.)

- IBM 3684 Point-of-Sale Control Unit (Models 1 or 2 with BSC Communications on a switched or nonswitched point-to-point or nonswitched multipoint facility (as an IBM System/3). A user-written 3684 program or the Host Command Processor (HCP) facility in the 3684 can communicate with a user-written program in the Series/1 utilizing Realtime Programming System Read/Write Communications support. (See the "white pages" Consultants' Manual for details on the 3684.)
- IBM 4975 Models 01R, 02R via #1310 only.

The following system is supported via features #2074 or #2093/#2094:

- IBM System/23 Datamaster with the Communications Adapter Feature and utilizing the Binary Synchronous Communications licensed program, in switched and point-to-point nonswitched connections. The System/23 Datamaster supports the line protocol of the IBM 3741 Data Station.

The following system is supported via features #1310, #2074, or #2093/#2094:

- IBM Displaywriter System with a Communications Adapter and utilizing the Binary Synchronous Communications licensed program, in switched and point-to-point nonswitched connections. The Displaywriter System emulates 2770/3780 line protocol.

The following Binary Synchronous CPU-to-CPU communications is supported via features #1310, #2074, #2075, or #2080 (not System/32) or #2093 and #2094 Series/1 appears as an IBM System/3.

- CPU-to-CPU point-to-point (switched or nonswitched)
 - Another Series/1 using the Series/1 Realtime Programming System Versions 2, 3, 4, or 5.
 - System/370 BTAM OS/VS1, OS/VS2 (SVS or MVS), or DOS/VS.
 - System/370 TCAM OS/VS1 or OS/VS2 (TCAM does not support conversational mode).
 - System/370 VTAM, DOS/VS.
 - System/370 CICS/VS, OS/VS1, OS/VS2, or DOS/VS (BTAM only)
 - System/32 under RPG programming facilities.
 - System/34 under RPG programming facilities and the BSCCEL (BSC Equivalence Link) feature of the SSP-ICF (Interactive Communications Feature).
 - System/3 using CCP or RPG.
 - System/38 via RPG III or COBOL application programs.
- CPU-to-CPU, Series/1 as a multipoint tributary.
 - System/370 BTAM OS/VS1.
 - System/370 IMS/VS, OS/VS1, or OS/VS2 (BTAM only). IMS/VS support is via Intelligent Remote Station Support (IRSS), an IMS/VS protocol for the support of remote systems. A Series/1 user-written application program is required for the formatting and handling of messages in the proper IMS/IRSS formats.

Version 5 Enhancements

Version 5 of the Realtime Programming System provides all the functions included in "version 1" (5719-PC1), Version 2 (5719-PC2), Version 3 (5719-PC3), and Version 4 (5719-PC4), excluding single address space management, and the following additional functions:

- Support for New Series/1 Large System Processor
 - 4955 Model F Support

Version 5 is designed to effectively support the larger 4955 Model F processor.

This larger processor provides a maximum of 512K of storage. The additional storage will allow room for more programs and data, multiple Shared Task Sets, larger and more applications, and increased number of Command Language Facility users in logically expanded D-Space.

- Logically Expanded D-Space

Supervisor Data Space (D-Space) has been logically extended beyond its current 64K byte limit by employing unmapped storage to hold user control modules. The effect of this is to provide a greater capacity for more devices and task sets.

- Secondary Storage Services

With the introduction of a new facility called "Secondary Storage Services", a partition size may be extended beyond 64K bytes by requesting that a pool of additional processor storage be allocated at Task Set load time.

- Multiple Shared Task Sets

More than one shared task set can be active at a time. This allows each shared task set to be tailored to the requirements of the applications which share it and avoids the need to combine all sharable data and programs into one large task set. This new capability can also result in more of the address space being available to the application program.

- More Effective Support of Small Processors
 - 4952 Model C Support

As a result of several enhancements, Version 5 more effectively supports the 4952 processor with a maximum of 128K bytes of storage. These enhancements are: full support of the integrated clock/comparator, better storage utilization by making more functions SYSGENable, and loadable Binary Synchronous or Asynchronous communications support.

- Diskette Based System Option

Because some systems do not require a disk device it is now possible to SYSGEN a diskette based system, enabling the use of the operating system in a configuration without a disk. Customers should be made aware, however, that such a system has limited capability and performance. Contact IBM for guidance.

- Improved SYSGEN and Installation
 - Integrated Products

Version 5 has greatly improved in the area of SYSGEN and installation. The 4978 display support, Spool function, and Transient Activity Tool support previously offered as separately licensed programs have been fully integrated into Version 5. In addition, to fully provide what is needed for application development, the User Macro Library, SYSGEN programs, and the Command Language Facility are now packaged in Version 5 of the IBM Series/1 Program Preparation Subsystem (5719-AS5). The Command Language Facility also remains as an option in Version 5 of the Realtime Programming System for production system use. Command Language Facility disk space requirements have been reduced for the non-development environments.

- Standard System

To reduce the need to SYSGEN, a standard (pre-built) system is provided. This system is quite comprehensive and will normally support a large number of different development configurations and uses, as well as having application to many production system environments. The minimum processor storage required by the standard system is 192K bytes. An installation system residing on diskette will also be provided and may be used to install a customized system on a processor with 128K bytes or more storage.

- SYSGEN Improvements

If the need exists to generate a customized system, various improvements to SYSGEN have been made. A SYSGEN will be easier, more accurate, and faster through reduced questions, automatic answer verification, fewer assemblies, and the ability to restart SYSGEN at various points.

- Patch Application Tool Enhancements

To facilitate installing APAR fixes, the Patch Application Tool supports all Realtime Programming System based products which have Central Service support and automatically allocates and maintains a single patch log. It will also automatically allocate a system patch back-up volume if needed.

- Improved System Usability and Application Productivity
 - SNA Enhancements

Improved usability and productivity is a key objective in Version 5. The segmentation of messages is now provided in the Systems Network Architecture (SNA) support. To provide increased connectivity to System/370 system facilities, Unbind/Hold and Full Duplex are also provided. In addition, the SNA buffer pool has been removed from supervisor data space (D-space) to reduce the SNA demands on this limited resource and to support more Logical Units (LU's).

- New Operator Commands

To improve usability and the operational characteristics of the system, additional System operator commands are supplied to display the System Scheduler Table, set the date in Gregorian format showing month, day, and year, and to IPL a Realtime Programming System. In addition, there are commands to display spooling jobs, delete,



hold, expedite, or release a spool job, and define subsystem and terminals to the Terminal Controller.

- Common Terminal Controller

In view of the increased processor sizes now supported, several subsystems (IBM and User) may typically co-exist on a single processor. To facilitate users switching between subsystems, a Common Terminal Controller has been provided. The controller will dynamically connect a terminal to a specific subsystem when a user logs on (LOGON) and later disconnect and reconnect it to another subsystem. This support is SYSGENable. The Command Language Facility and the Multiple Terminal Manager PRPQ Version 2.1 support the Common Terminal Controller.

- Dynamic Partitions

- Multiple dynamic partitions are now allowed in an address space.

- Interpartition Communication

Because larger applications will be possible, communication between portions of an application, specifically task sets, will become desirable. The new global queue facility provides cross partition communication without the need for a shared taskset.

- Command Language Facility Enhancements

Additional commands and changed commands have been provided with the Command Language Facility to define a line or matrix printer, invoke a character FONT definition task set, invoke the Patch Application Tool, simplify dumping a 4969 Magnetic tape data set, print the formatted online error log report, and to queue a task set for execution. Also provided are the Series/1 EXEC System commands to read or write to the user's terminal, create a DSD and clear or query the console stack. There are also extended capabilities that can be used in writing commands such as the ability to perform I/O from an EXEC command file. The latter will allow a user to write extremely powerful Series/1 EXEC command procedures. In addition, the Install command can be used to install all supported licensed programs.

- Improved Publications

Many of the existing publications have been split to improve usability. New publications have been introduced to better accelerate understanding of the Realtime Programming System Version 5 features and facilities.

- Debug

To improve usability, the Debug Facility has been enhanced to support multiple users to provide commands for HELP and single instruction step, and to allow single command syntax and hardcopy input.

- Online Error Log Report Facility

This new facility will execute "online" under the operating system. This utility will format and print the system error logs without requiring the system operation to be terminated.

- Spool Enhancements

With the inclusion of the improved SPOOL function into Version 5, certain key enhancements have been made. They are as follows:

- Multiple Output Classes
- Forms Control
- Multiple Copies Control
- Improved Separator Page Support
- Spooling of System Messages
- Reduction of dynamic storage requirements in system data space

• New I/O Device Support

Support under Version 5 of the Realtime Programming System is provided for the following new I/O devices:

Model/Feature	Device
#1310	Multifunction Attachment
#1400	Local Communications Controller**
#2080	Synchronous Communications Single Line Control/High Speed Printer (all models)
4975	Diskette Drive and I/O Expansion Unit (also included in 4952 C)
4965	
3101 Model 20, 22, 23	Display Terminal, models 20, 22 or 23 in full screen mode Printer**
5225 (as a 5256) (via RPQ D02322)	

Compatibility

Files

Complete compatibility is provided with files supported by "version 1" of the IBM Series/1 Realtime Programming System (5719-PC1), Version 2 (5719-PC2), Version 3 (5719-PC3), or Version 4 (5719-PC4). Any data file written by any of these systems is directly usable by the others. Compatibility with external (to Series/1) diskette devices is maintained by using Basic Exchange format. See the *IBM Diskette General Information Manual* (GA21-9187).

Programs

Single Address Space Systems (64Kb or less) are not supported by this Version of the Realtime Programming System.

Problem state source programs which assemble (or compile) and execute on the Realtime Programming System Version 3 (5719-PC3) or on a Version 4 (5719-PC4) Multiple Address Space Management (MASM) system will also assemble (or compile) and execute on the Realtime Programming System Version 5 (5719-PC5).

In any case, Versions 1 or 2 problem state programs require reassembly and rebuilding to prepare them to execute on Version 5.

With the availability of logically expanded "D Space", Version 5 problem state programs may need to increase VCBA space.

In addition, Versions 3 and 4 problem state programs (with the exception of those programs using the BSC IPL bootstrap facilities) require no reassembly to execute on Version 5. Most Version 3 and 4 problem state programs need only be installed

** Supported by separate licensed programs



on a Version 5 system to execute. In some cases, VCBA space may need to be increased.

Customer written programs included with the supervisor must be written in accordance with the internal supervisor programming conventions for 5719-PC5. These are different from those of 5719-PC1, 5719-PC2, 5719-PC3, and 5719-PC4 and may result in changes to existing user written extensions.

Programs using the SVC interface to SPOOL commands will not operate on Version 5; using the TMON Macro of the Transient Activity Tool require assembly and rebuilding with Version 5. Programs written to execute using the 4978 Programming RPQ may require code changes, reassembly, and rebuilding with Version 5 to emulate the Programming RPQ processing.

The following IBM Series/1 Licensed Programs are compatible with the IBM Series/1 Realtime Programming System Version 5:

- IBM Series/1 Indexed Access Method (5719-AM1)*
- IBM Series/1 Indexed Access Method Version 2 (5719-AM2)**
- IBM Series/1 Program Preparation Subsystem Version 5 (5719-AS5)
- IBM Series/1 System/370 Channel Attach Program (5719-CA1)*
- IBM Series/1 COBOL Compiler and Resident Library (5719-CB1)
- IBM Series/1 COBOL Transient Library (5719-CB2)
- IBM Series/1 COBOL Compiler and Resident Library Version 2 (5719-CB7)**
- IBM Series/1 COBOL Transient Library Version 2 (5719-CB8)**
- IBM Series/1 Communications Monitor Version 1 (5719-CM1)*
- IBM Series/1 4987 Programmable Communications Subsystem Preparation Facility (5719-CS0)
- IBM Series/1 4987 Programmable Communications Subsystem Extended Function Support (5719-CS2)*
- IBM Series/1 FORTRAN IV Compiler and Object Support Library (5719-FO2) Version 2.0
- IBM Series/1 FORTRAN IV Realtime Subroutine Library (5719-FO4) Version 2
- IBM Series/1 Mathematical and Functional Subroutine Library (5719-LM2) Version 2
- IBM Series/1 PL/I Compiler and Resident Library (5719-PL2) Version 2
- IBM Series/1 PL/I Transient Library (5719-PL4) Version 2
- IBM Series/1 Realtime Programming System Screen Format Design Aid Utility (5719-SF1)
- IBM Series/1 Realtime Programming System Screen Format Presentation Support (5719-SF2)*
- IBM Series/1 Sort/Merge (5719-SM1)
- IBM Series/1 Realtime Programming System SNA Extended Support (5719-SN1)*
- IBM Series/1 5250 Information Display System (5719-TA1)*

IBM Series/1 4969 Magnetic Tape Drive (5719-TA4)

The following IBM Series/1 PRPQs are compatible with the IBM Series/1 Realtime Programming System Version 5 (5719-PC5).

- IBM Series/1 Remote Job Entry Programming RPQ P82575 (5799-TBK)
- IBM Series/1 Packet Network Support Programming RPQ P10008 (5799-TCP)*
- IBM Series/1 Remote Management Utility Programming RPQ P82597 (5799-TDH)
- IBM Series/1 Realtime Programming System Multiple Terminal Manager Programming RPQ P82622 (5799-TDX) Version 2
- IBM Series/1 Job Stream Processor Programming RPQ P82635 (5799-TEC)
- IBM Series/1 SNA Remote Management Utility Programming RPQ P82639 (5799-TEF)*

Program Preparation

The IBM Series/1 Program Preparation Subsystem Version 5 (5719-AS5) is required to prepare programs to execute on the IBM Series/1 Realtime Programming System Version 5 (5719-PC5)

The Base Program Preparation Facilities (5719-PA1) cannot be used to prepare programs to run with the Realtime Programming System.

Devices

The IBM 4975 Printer and the IBM 4965 Diskette Drive and I/O Expansion Unit are functionally compatible with the IBM 4974 Printer and the IBM 4964 Diskette Unit, respectively. Any program using the IBM 4974 or IBM 4964 through the operating system GET/PUT or READ/WRITE support will run with the new devices in a similar fashion. Use of the additional features provided by the 4975 printers will require appropriate program changes.

This applies to the Series/1 FORTRAN, PL/I, and COBOL compilers which produce object programs that access the new devices through the operating system interfaces.

Note: EXIO access is by definition device dependent and is therefore not transparent to the user.

Device Support

The Realtime Programming System Version 5 supports the IBM 4952 Models A, B, and C; the IBM 4955 Models D, E, and F; and the following processor options:

- #3920 Floating Point Processor (IBM 4955 only)
- #5650 Programmer's Console
- #6335 Storage Address Relocation Translator (IBM 4955 Model D only)

In addition, multiples of the following devices and features are supported:

IBM 3101 Models (10, 12,13,20,22,23) Display Terminals

IBM 4962 Models 1, 1F, 2, 2F, 3, and 4 Disk

* Requires SYSGEN; not included in prebuilt standard system.

** Requires Realtime Programming System support.



IBM 4963 Models 23A, 23B, 29A, 29B, 58A, 58A, 58B, 64A and 64B	Disk Subsystem	#2080	Synchronous Communications Single Line Control/ High Speed
IBM 4964 Model 1	Diskette	#2090	SDLC Single Line Control
IBM 4965	Diskette Drive and I/O Expansion Unit	#2091	Asynchronous Communications 8-Line Control
IBM 4966 Model 1	Diskette Magazine Unit	#2092	Asynchronous Communications 4-Line Adapter
IBM 4969 Model 1	+Magnetic Tape Drive**	#2093	Binary Synchronous Communications 8-Line Control
IBM 4973 Models 1 and 2	Line Printer	#2094	Binary Synchronous Communications 4-Line Adapter
IBM 4974 Model 1	Printer	#2095	Feature Programmable 8-Line Multiline Communications Controller
IBM 4975 Models 1L, 2L, 1R, 2R	Printer	#2096	Feature-Programmable 4-Line Multiline Communications Attachment
IBM 4978	Display	#7840	Timer
IBM 4979 Model 1	Display Station	#7850	Teletypewriter Attachment (supported for use with the IBM 3101 Model 1 or 2 Display Terminal or the Teletype® Models 33/35 as a 4979 or 3101 equivalent
IBM 4982 Model 1	+Sensor I/O	D02038	4978 Attachment (RPQ)
IBM 4987	+Programmable Communications Subsystem**	** Available in separately licensed program	
IBM 4993	Channel Attachment	+ Not within the prebuilt standard system; requires Custom SYSGEN to include support included in the prebuilt	
IBM 4999 Models 1 and 2	Battery Backup	® Registered Trademark of the Teletype Corporation	
IBM 5225 as a 5256 (via RPQ D02322)	+Printer**	<i>Note:</i> Device and feature performance is dependent upon hardware configuration, Realtime Programming System generation options, and application program design.	
IBM 5251 Models 1 and 2	+Information Display Stations**	Specified Operating Environment	
IBM 5252 Model 1	+Information Display Station**	Support will be provided for this program when it is operated in the following environment:	
IBM 5256 Models 1, 2, and 3	+Printers**	<i>Note:</i> It is possible to SYSGEN a diskette based system. However because of its limited capability, and possible limited performance, such a system requires a thorough-going appraisal—on paper—to determine whether the proposed system can satisfy the customer's requirements. Contact IBM for guidance.	
Features			
#1200	+System/370 Channel Attachment**	<i>System Requirements:</i> The minimum system after installation of the system and when the application program executes without hard copy output, system console operations, and data interchange is:	
#1210	+5250 Information Display System Attachment**	Processor	IBM 4952 or 4955 (Model D equipped with Storage Address Relocation Translator #6335 or Models E or F)
#1310	Multifunction Attachment	Storage	128K bytes
#1400	+Local Communications Controller**		
#1560	+Integrated DI/DO		
#1565	Channel Repower		
#1610	Asynchronous Communications Single Line Control		
#2000	Communications Indicator Panel		
#2074	Binary Synchronous Communications Single Line Control		
#2075	Binary Synchronous Communications Single Line Control/High Speed		



Disk* 1—IBM 4962 Disk Storage Unit (all models) or a 4963 Disk Subsystem (all models)

* See prior note regarding diskette based system

Here is the minimum hardware configuration to support System Generation when assisted by the supplied Standard System:

Processor	IBM 4955 Models E or F
Storage	192K bytes minimum
Disk/ Diskette	1 each—diskette and disk drive in any combination, selected from supported models of IBM 4962 models 3 or 4 Disk Storage Unit, IBM 4963 Disk Subsystem, IBM 4964 Diskette Drive or 4965 Diskette Drive and I/O Expansion Unit and IBM 4966 Diskette Magazine Unit
Printer	1—IBM 4973 Line Printer OR 1—IBM 4974 Printer OR 1—IBM 4975 Printer
System Console	1—IBM 4979 Display Station OR 1—IBM 4978 Display Station OR 1—IBM 3101 Display Station attached via: <ul style="list-style-type: none"> • #1310 Multifunction Attachment (IBM 3101 Models 10, 12, 13, 20, 22 or 23 on the first address, IBM 3101 Models 13 or 23 on any address) • #1610 Asynchronous Communications Single Line Control (IBM Models 10, 12, 13, 20, 22 or 23) • #2091/#2092 Asynchronous Communication 8-line control and 4-line adapter (IBM 3101 Models 10, 12, 13, 20, 22 or 23) • #2095/#2096 Feature-Programmable 8-line multiline communications controller and 4-line attachment (IBM 3101 Models 10, 12, 13, 20, 22 or 23) OR 1—Teletypewriter Adapter (#7850) with the IBM 3101 Model 10, 12, 13, 20, 22, 23 Display or equivalent Teletypewriter device.

Attachment to an SNA network requires SDLC Single Line Control (#2090) or Synchronous Communications Single Line Control/High Speed (C2080).

To support BSC IPL and BSC DUMP, the Series/1 host system must have any of the BSC communications features (#1310, #2074, #2075, #2080, #2093/#2094). The remote system must have one of the BSC single line features

(#1310, #2074, #2075, #2080). BSC IPL and BSC DUMP are not supported on multipoint lines.

Programming Requirements: None

Device Address Assignment

The configuration must also have the following standard address assignments. The Standard System supports these minimum requirements:

Description	Decimal Address	Hexadecimal Address
IBM 4962 Disk Unit	03	03
IBM 4963 Disk Subsystem	72	48
IBM diskette drive available in		
IBM 4952 Processor, Model C.	68	44
IBM 4964 Diskette	02	02
IBM 4965 Diskette Drive and I/O Expansion Unit	68	44
IBM 4966 Diskette Magazine	34	22
IBM 4973 Line Printer	33	21
IBM 4974 Printer	01	01
IBM 4975 Printer(see #1310)		
IBM 4978 Display Station	36	24
IBM 4979 Display Station	04	04
#1310 Multifunction Attachment	88	58
• 3101 Models 13 or 23 (EIA RS-422A interface)	89	59
• 4975 Model 01L	90	5A
• 4975 Model 02L	91	5B
#1610 Asynchronous Communications Single Control	08	08
#2091/#2092 Asynchronous Communications Multi-Control	96	60
#2095/#2096 Feat. Programmable Comm.	96	60
#7850 Teletypewriter Attachment	00	00

Charges

This program will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, the licensed program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs.

If the monthly charge is chosen, credit will be accrued during a continuous licensed period towards the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the

accrued license credits are transferable to other customers or between licenses whether they are for programs which have a different program number or the same program number. In addition there is a one-time process charge to cover the cost of distribution of basic machine-readable material including service updates.

Customers should be informed that even if the license fee for Versions 1, 2, 3, or 4 is already paid, another license fee will have to be paid if Version 5 is needed in the future. Neither the one-time charge nor accrued license credits for Versions 1, 2, 3, or 4 are transferable to Version 5 or from/to the Version 5 alternate feature. *Note:* Customers who do not wish to avail themselves of the Command Language Facility may receive Version 5 without this option.

Customer Responsibility

The customer is responsible for the installation and use of this licensed program.

Systems Engineering Services

See the Machine Price List tab, and the "Service Offering Price List" page, for Systems Engineering Services rates. Service will be provided on an as available basis.

Programming RPQs

PRPQs will be accepted. Response time will depend upon complexity.

Marketing Publications

IBM Series/1 Authorized Program Analysis Report (APAR) User's Guide	GC34-0099
IBM Series/1 Programming System Summary	GC34-0285
IBM Series/1 Realtime Programming System Version 5:	
IBM Series/1 Realtime Programming System Version 5:	
Reference Summary	SX34-0061
Glossary and Subject Index	GC34-0350
Licensed Program Specifications	GC34-0351
Concepts and Facilities	GC34-0358
Standard System Installation Guide	SC34-0359
Command Language Facility User's Guide	SC34-0362
Supervisor Services Programming Guide	SC34-0363
Operator Commands and Utilities	SC34-0364
Data Management Programming Guide	SC34-0365
Macro Reference	SC34-0367
Messages and Codes	SC34-0368
Systems Network Architecture Support Programming Guide	SC34-0370
Systems Network Architecture Support Installation Guide	SC34-0371
Problem Determination	SC34-0372
Control Blocks	SC34-0373
Binary Synchronous and Start/Stop Communications Programming Guide	SC34-0422

**IBM SERIES/1 REALTIME PROGRAMMING SYSTEM
PL/I COMPILER AND RESIDENT LIBRARY (5719-PL1)
VERSION 1****IBM SERIES/1 REALTIME PROGRAMMING SYSTEM
PL/I TRANSIENT LIBRARY VERSION 1 (5719-PL3)**

The IBM Series/1 PL/I is a subset of American National Standard Programming Language PL/I (ANS X3.53 1976) plus additional language functions to support coding realtime applications. The PL/I compiler permits programmers to use the full capability of the hardware and operating system functions. The language has full function capabilities that can be used for real time, scientific, and commercial applications. Series/1 PL/I is extremely useful in writing applications for plant and laboratory automation, process control, report generation, problem solution, and sensor-based developments.

PL/I allows the programmer to express in a "natural" syntax many functions of the IBM Series/1 Realtime Programming System which would require CALLs in FORTRAN or require assembler language usage. As a result, the user's application programs are easier to read, understand, debug, maintain, and modify.

The IBM Series/1 PL/I consists of two programs working together: (1) a compiler and resident subroutine library and (2) a transient subroutine library. The resident library contains frequently used routines of an application. These routines are included in the user's task set during execution of the Application Builder; as a result, the performance of a user's application is significantly enhanced by eliminating loading of these functions during execution time. The transient library contains less frequently used routines such as I/O transmission, error handling, and conversion routines. These functions are dynamically loaded into a user's shared task set at execution time, thus permitting storage savings in a user's partition with minimal impact on performance.

Description

The functional breadth of the IBM Series/1 PL/I language is intended to enable users to develop application programs that can be extended or changed. Highlights of the PL/I offering include:

- Language (Realtime) Extensions
- Input/Output (I/O) Capability
- Message Buffering
- Multiple Data Types and Organizations
- Easy Data Manipulation Features
- Additional Features

Realtime Language Extensions

One of the key features of the IBM Series/1 PL/I offering is the capability of allowing the user to develop a complete realtime application without the need to know assembler language. The requirement has been expressed by the user for a language that offers realtime facilities as part of its syntax; that is, not through subroutine calls. To achieve this goal a set of PL/I realtime language extensions were developed which allow starting of asynchronous tasks and programs and synchronization of their execution. Event handling and resource control statements allow you to easily code applications that invoke response to realtime events and resolution of resource

contention. The following contains an explanation of these extensions.

Features*Multitasking Services*

The statements associated with multitasking and their functions are:

- RUN Invokes a task or program.
- STOP Causes termination of a program or task.
- UNSCHEDULE Eliminates the scheduling of a task or program that has already been scheduled.
- TRANSFER TO Stops the current program and activates another program in the same partition.

The PL/I coder is able to terminate a program or task when control for the task reaches a RETURN or END statement for the procedure invoked as a TASK or when control for any task reaches a STOP statement.

PL/I permits users to share data between tasks in a user partition; through the Application Builder facilities PL/I users can also take advantage of sharing data across partitions.

Timer Services

The programmer is provided with a facility to request a program to be suspended for a specified time interval. The user is provided a CALL facility for setting the DATE and TOD clock.

The PL/I coder may schedule a program or task to execute on a periodic basis, at a particular time-of-day, and after a specified timer interval. A facility is provided to add and delete programs or tasks from the scheduler services on program request.

Resource Management

The programmer is provided a facility to synchronize tasks and programs by using locks. The language is extended to allow the user to control serially reusable resources and to request/release resources for task synchronization. This provides users with a deadlock avoidance facility and permits effective utilization of the system resources. In a multitasking environment several tasks may want to update a file simultaneously. With this facility a user may ensure that only one task can be executed at a time to ensure proper file update.

Event Facilities

The PL/I programmer may define events and start/resume execution of a particular program upon the occurrence of an event. Facilities are provided for the synchronization of task execution through WAIT/POST facilities. Thus event handling facilities provide some predefined relationship between PL/I tasks running asynchronously.

Events that are supported are I/O completion, task completion, timer, and user-defined. The user is able to suspend a task until a single event occurs or any of a list of events occur.



Built-in Functions

The multitasking built-in functions are used during multitasking and during asynchronous I/O operations. They allow the user to investigate the current state of execution of a task or asynchronous I/O operation. The function names and definitions are:

- **COMPLETION** Returns the completion value of a given event that can be associated with completion of a task or completion of an I/O operation.
- **STATUS** Returns the status value of a given event.
- **PRIORITY** Returns the priority of a task.

PL/I Sensor I/O

PL/I permits the user to utilize current PL/I record I/O to access analog and digital data for both input and output. Sensor I/O records, which are described in the ENVIRONMENT attribute, may be either type S (sequential sampling) or type R (random sampling). PL/I access to records in an Analog or Digital I/O file can be Sequential, Keyed Sequential, or Direct.

PL/I supports Series/1 sensor I/O and also provides a GAIN option with a scaling factor (range code) that can override the standard representation.

I/O Capability

The IBM Series/1 Realtime Programming System Data Management provides the PL/I user with I/O services. The PL/I user has facilities to access standard Series/1 I/O devices. PL/I uses both physical and logical I/O (that is, READ/WRITE or GET/PUT). The file types supported include Sequential, Direct, and Transient with data file record formats FFB, FBS, FVB, and VBS being supported. Data files may exist on two types of magnetic medium, fixed disk and removable diskette.

The IBM Series/1 PL/I includes both stream I/O and record I/O capabilities. Stream I/O statements read and write data with a minimum of programming effort because automatic formatting and conversion are provided. The following specific options are available:

- **List-directed I/O.** This facility allows you to input and output data with automatic formatting and conversion.
- **Edit-directed I/O.** A full range of format items, including picture qualifications and control, allow you to generate complex reports with a minimum of programming effort.

Record I/O statements allow you to have more control over your I/O. The following options are available:

- **Consecutive I/O.** This facility is available through the use of the READ, WRITE, and REWRITE statements. You can improve your execution-time performance by using the EVENT options for asynchronous I/O.
- **Regional I/O.** This facility is available through the use of the READ, WRITE, DELETE, and REWRITE statements with the KEY option. Asynchronous direct I/O is also permitted.
- **Sensor I/O.** The facility for handling both sequential and random sampling of analog and digital I/O is available through the use of the READ and REWRITE statements.

- **Transient Files.** This form of file organization allows the user to communicate data with the IBM Series/1 Realtime Programming System Data queues by using PL/I READ and WRITE statements. The PL/I program can detect and handle the empty queue situation by coding an ON-unit for the PENDING ON condition.

The file types supported for sectorized devices (fixed disk and removable diskette) are:

- Sequential
- Direct
- Partitioned

The PL/I user has the capability to add and update records to a sequential DASD file. When using direct files, the user has the ability to access a record by relative record number. The user has the capability of supporting direct data files containing over 250,000 records.

The PL/I user has the option of binding I/O devices and data sets (1) during program preparation and maintenance, that is, while running a compile, link-edit, library store, system generation, and pre-execution utility; as well as (2) during execution, that is, during open time. Option 1 provides the user with the ability to meet higher performance requirements with a minimum storage penalty and minimum disk reads to find the location of programs and data.

Message Buffering

The IBM Series/1 Realtime Programming System provides a disk message buffering facility to the following sequential output devices:

- TTY Operator Station
- IBM 4974 Printer
- IBM 4973 Printer

In addition, an interface is available to the message buffering function to allow the user to interface additional devices to the message buffering facility. The message buffering facility is handled logically as a priority queue. The system will complete presenting a message before starting to print another message.

Message buffering in the operating system is a transparent facility to PL/I and as such is available to the PL/I user.

Data Types and Organization

The IBM Series/1 PL/I supports arithmetic data, string data, arrays, structures, and program control data. The wide variety of data types and array handling supported allow PL/I users to implement a large collection of programs such as system type applications, data base applications, manipulation of large collections of different types of data, scientific applications requiring arithmetic and floating point operation, and commercial applications using PICTURE formatting and decimal arithmetic. In addition the ability to organize data in a PL/I program, through PL/I structures, for example, has an added benefit as a documentation aid. With PL/I, the different data types can be organized and structured much more easily than with other languages.

Some of the different PL/I data types:

- Arithmetic data can be represented in either binary or decimal radix and can be either fixed or floating point.



- Fixed point binary word and double word precisions are supported. Decimal fixed point data can have up to 15 digit positions.
 - String data can be either bit or character, with fixed or varying length attributes.
 - Program control data can be label, event, activation, lock, or pointer. Entry and file parameters are also supported.
 - PL/I data may be organized into arrays of up to 15 dimensions, or in structures (hierarchical collections of data, not necessarily of the same type).
 - Conversion condition checking and fix-up capability of execution data
 - The user is not required to write assembler language code in order to compile and execute PL/I programs. A user may choose, of course, to write assembler code, generally as callable subprograms, to achieve code secrecy, faster execution speed, tighter code, or some non-PL/I supported function.
- PL/I and PL/I coded programs use only the data set organizations and access methods defined by the operating system.

Data Manipulation Features

The IBM Series/1 PL/I supports major PL/I operators, data types, and statements. Of particular interest are these:

- String operations, including substrings, concatenation, and general Boolean operations.
- Full set of language built-in functions, including mathematical functions, string functions, and array functions.
- Structure assignment.
- Automatic data conversion in expressions.
- Generalized subscripting.
- Full support for internal and external procedures.
- Control structures including IF-THEN, IF-THEN-ELSE, DO, and DO-WHILE.

Here are other Series/1 PL/I capabilities that make it suitable as a general application development tool:

- PL/I coded programs have the capability for entering a user-written error-handling block (entering an ON unit) when an execution error is detected. This can be for device or format errors in I/O, subscript range, and string size range as well as a wide variety of other language defined error conditions. The ON handling facility provides PL/I users with extensive run time error-handling facilities. As a result, users are able to check out program errors and install their application.
- PL/I supports both the 64 character set and the restricted 48 character set.
- The following features are supported in PL/I:
 - Conversion of mixed data types in expressions
 - Disk read and write
 - Repetitive specification of data items (GET and PUT)
 - General Condition names (ON, REVERT, and SIGNAL)
- Storage efficiency gained by the generation of reenterable code and support for automatic storage allocation.
- Program modularity and interface checking provided by the PL/I block structure and scope rules and the ENTRY attribute.
- The following user-oriented debugging aids are provided:
 - Extensive compiler error messages
 - Extensive compiler listing aids
 - Snap shot trace
 - Subscript range checking at execution time
 - String range checking at execution time

Data Security

PL/I object program structure and language provide controlled addressability to user data. Data with the internal attribute, for example, is not known outside the declaration block. This facility permits users to access data in a fashion which is consistent with declared data attributes and source language scope.

In addition, the PL/I STRINGRANGE and SUBSCRIPTRANGE error conditions restrict the application program from referring to data which lies beyond the declared extents and lengths of arrays and strings.

Communications with FORTRAN and Assembler

Subject to certain rules the compiler allows communication between PL/I object modules and FORTRAN or assembler object modules. Data may be passed as arguments and must conform to standard interface conventions.

PL/I RAS

The IBM Series/1 PL/I supplies compile time error detection to analyze statement syntax and program structure errors.

The compiler provides debugging aids to decrease the time and effort required for program checkout. It permits efficient use of the language with respect to both compilation and execution. You can use options to request optional compiler facilities.

Syntax errors, errors of consistency such as contradictory variable declarations, and detectable semantic errors occurring in the source program are all diagnosed and reported in a meaningful form.

The IBM Series/1 PL/I supplies comprehensive diagnostics at execution time to test for and recognize I/O and arithmetic function errors and pass control to user-defined error routines. It also provides a calling trace facility, subscript range checking, and string range checking (option).

Specified Operating Environment

Support will be provided for these programs when they are operated in the following environment:

System Requirements: The PL/I compiler operates in the batch environment of the IBM Series/1 Program Preparation Subsystem under the IBM Series/1 Realtime Programming System. The PL/I generated object code, after processing by the Application Builder, runs as either a batch Task Set or as a Realtime Task Set under control of the IBM Series/1 Realtime Programming System.

The compiler operates on the IBM 4952, IBM 4953, or IBM 4955 Processors in the batch environment of the IBM Series/1 Program Preparation Subsystem and uses the floating-point emulator of the IBM Series/1 Realtime Programming System when the floating-point feature is not



installed if floating point operations are required. Programs heavily using floating point arithmetic and running with the Floating Point Emulator will experience performance degradation relative to the same program using the floating point hardware feature. Use of decimal arithmetic instead of floating point is strongly recommended when the floating point hardware feature (#3920) is not available.

Floating point support is required at compilation time and execution time if the PL/I program contains either floating point data or binary data of precision 16 or greater.

The minimum system required for compilation or Application Build is:

- Processor** IBM 4952 (Models A or B), IBM 4953 (Models A, B, C, or D), or IBM 4955 Processor (Models A, B, C, D, or E)
- Storage** Compilation: 64K minimum system including at least a 28K partition for the Compiler
Application Build: 48K minimum system including at least a 16K partition for the Application Builder
- Disk/Diskette** 1—IBM 4962 Model 2 or 2F or 4 Disk Storage Unit (combination disk/diskette unit)
OR
1—IBM 4962 Model 1 or 1F or 3 Disk Storage Unit
OR
1—IBM 4963 Disk Subsystem may be used
AND
1—IBM 4964 Diskette Unit
OR
1—IBM 4966 Diskette Magazine Unit
- Printer** 1—IBM 4974 Printer
OR
1—IBM 4973 Line Printer
- Operator Station** IBM 4979 Display Station
OR
1—Teletypewriter Adapter #7850 supported for use with Teletype ® Models ASR 33/35

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The minimum system required to execute in a realtime or batch partition is:

- Processor** IBM 4952, IBM 4953 or IBM 4955 Processor
- Storage** 48K minimum system

- Diskette** 1—IBM 4962 Models 1 or 1F or 3 Disk Storage
OR
1—IBM 4963 Disk Subsystem
AND
1—IBM 4964 Diskette Unit
OR
1—IBM 4966 Diskette Magazine Unit
- Operator Station** IBM 4979 Display Station
OR
1—Teletypewriter Adapter #7850 with Teletype® Models ASR 33/35 or an ASCII equivalent device

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Programming Requirements, programs required for compilation and application build:

- IBM Series/1 Realtime Programming System Version 1 Modification Level 1 (5719-PC1)
OR
- IBM Series/1 Realtime Programming System Version 2 (5719-PC2)
OR
- IBM Series/1 Realtime Programming System Version 3 (5719-PC3)
OR
- IBM Series/1 Realtime Programming System Version 4 (5719-PC4)
- IBM Series/1 Program Preparation Subsystem Version 1 Modification Level 1 (5719-AS1)
OR
- IBM Series/1 Program Preparation Subsystem Version 2 (5719-AS2)
OR
- IBM Series/1 Program Preparation Subsystem Version 3 (5719-AS3)
OR
- IBM Series/1 Program Preparation Subsystem Version 4 (5719-AS4)
- IBM Series/1 PL/I Compiler and Resident Library (5719-PL1)

Execution in a Realtime Partition:

- IBM Series/1 Realtime Programming System Version 1 Modification Level 1 (5719-PC1)
OR
- IBM Series/1 Realtime Programming System Version 2 (5719-PC2)
OR
- IBM Series/1 Realtime Programming System Version 3 (5719-PC3)
OR
- IBM Series/1 Realtime Programming System Version 4 (5719-PC4)
- IBM Series/1 PL/I Transient Library (5719-PL3)



Execution in a Batch Partition:

- IBM Series/1 Realtime Programming System
Version 1 Modification Level 1 (5719-PC1)
OR
- IBM Series/1 Realtime Programming System
Version 2 (5719-PC2)
OR
- IBM Series/1 Realtime Programming System
Version 3 (5719-PC3)
OR
- IBM Series/1 Realtime Programming System
Version 4 (5719-PC4)
- IBM Series/1 Program Preparation Subsystem
Version 1 Modification Level 1 (5719-AS1)
OR
- IBM Series/1 Program Preparation Subsystem
Version 2 (5719-AS2)
OR
- IBM Series/1 Program Preparation Subsystem
Version 3 (5719-AS3)
OR
- IBM Series/1 Program Preparation Subsystem
Version 4 (5719-AS4)
- IBM Series/1 PL/I Transient Library
(5719-PL3)

- IBM Series/1 PL/I Transient
Library: Licensed Program
Specifications GC34-0092
- IBM Series/1 PL/I:
Execution Logic Manual SY34-0086

Charges

These programs will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, the programs remain the property of IBM and are subject to the provisions of the Agreement for IBM Licensed Programs.

If the monthly charge is chosen, credit will be accrued during a continuous license period towards the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferable to other customers or between licenses, whether they are for programs which have a different program number or the same program number.

In addition, there is a one-time process charge to cover the cost of distributing basic machine readable material including service updates.

Customer Responsibility

The customer is responsible for the installation and use of this licensed program.

Programming RPQs

PRPQs will be accepted. Response time will depend upon complexity.

Marketing Publications

- IBM Series/1 PL/I: Introduction GC34-0084
- IBM Series/1 PL/I: Language
Reference Manual GC34-0085
- IBM Series/1 PL/I: User's Guide SC34-0086
- IBM Series/1 PL/I: Messages SC34-0088
- IBM Series/1 PL/I Compiler and
Resident Library: Licensed
Program Specifications GC34-0090

**IBM SERIES/1 REALTIME PROGRAMMING SYSTEM
PL/I COMPILER AND RESIDENT LIBRARY VERSION 2
(5719-PL2)****IBM SERIES/1 REALTIME PROGRAMMING SYSTEM
PL/I TRANSIENT LIBRARY VERSION 2 (5719-PL4)**

The IBM Series/1 PL/I Version 2 is a subset of American National Standard Programming Language PL/I (ANSI X3.53 — 1976) plus additional language functions to support coding realtime applications. The PL/I compiler permits programmers to use the full capability of the hardware and operating system functions. The language has full function capabilities that can be used for realtime, scientific, and commercial applications. Series/1 PL/I is extremely useful in writing interactive applications for plant and laboratory automation, process control, report generation, problem solution, and sensor-based developments.

IBM Series/1 PL/I Version 2 represents a significant advantage for the Series/1 high-level language user. Users can write entire applications in a high-level language that provides interactive terminal handling facilities, communications via binary synchronous or Start/Stop disciplines to other processors and to terminals, and an index capability for data base management: all with highly optimized Series/1 code. The objective of this product is to allow Series/1 users with little knowledge of the actual hardware or operating system to develop sophisticated applications with high productivity characteristics. In addition to the ANSI X3.53-1976 standard language facilities available in Version 1 of Series/1 PL/I, this product also provides more language capability which brings the product closer to the full ANSI X3.53 standard as understood and interpreted by IBM as of September, 1979.

PL/I programs can be used with the IBM Series/1 Multiple Terminal Manager Programming RPQ (5799-TCY). These facilities offer another alternative to allow PL/I programs to execute in an interactive environment where one or more applications can run concurrently with more than one terminal.

PL/I allows the programmer to express in a "natural" syntax many functions of the IBM Series/1 Realtime Programming System which would require CALLs in FORTRAN or require assembler language usage. As a result, the user's application programs are easier to read, understand, debug, maintain, and modify.

IBM Series/1 PL/I Version 2 consists of two programs working together: (1) a compiler and resident library and (2) a transient library. The resident library contains frequently used routines of an application. These routines are included in the user's task set during execution of the Application Builder; as a result, the performance of the application is significantly enhanced because loading these functions during execution time has been eliminated. The transient library contains less frequently used routines such as I/O transmission, error handling, and conversion routines. These functions are dynamically loaded into a shared task set at execution time, thus permitting storage savings in a user's partition with minimal impact on performance.

These products provide all the facilities of and are extensions of "Version 1" of the IBM Series/1 PL/I products (5719-PL1 and 5719-PL3 respectively). The Series/1 PL/I Version 2 compiler and application programs execute under Version 3 or Version 4 (5719-PC3 or 5719-PC4) of the IBM Series/1 Realtime Programming System and Version 3 (5719-AS3) or Version 4 (5719-AS4) of the Program Preparation Subsystem.

Compatibility

- PL/I Version 2 (5719-PL2 and 5719-PL4) is upward compatible with PL/I Version 1 (5719-PL1 and 5719-PL3) at the source program level.
- PL/I Version 2 is a compatible subset of ANS PL/I with realtime language extensions added.

Description

The IBM Series/1 PL/I Version 2 language is extensive in function, aimed at allowing users to develop application programs that can be easily modified and maintained. Highlights of PL/I Version 2 include:

- Full Screen Support
- Extended Coverage of ANSI PL/I
- Code Optimization
- New Device Support (IBM 4969 Magnetic Tape Subsystem and IBM 5250 Information Display System)
- Language (Realtime) Extensions
- Input/Output (I/O) Capability
- Communications Support
- Indexed Access Method Support
- Multiple Data Types and Organizations
- Easy Data Manipulation Features
- Additional Language Features (not available in PL/I Version 1, 5719-PL1 and 5719-PL3)
- Sort/Merge Support

Features*Full Screen Support*

Full screen support under PL/I Version 2 is a subset of Record I/O and Stream I/O where the user can access terminal devices (IBM 4978, 4979 and 5251) that are accessible through the Realtime Programming System. Access to this I/O mode is controlled through the use of ENVIRONMENT options in a FILE declaration statement.

- Record I/O

This support significantly extends PL/I user control of these devices and permits Regional data sets to be directed to the screen, in addition to Consecutive data sets. With this capability, users can deal with the whole screen, split the screen, control coordinate (X,Y) positions, write-protect selected fields to the screen, scatter write, sound the tone alarm, and scroll, depending on device type. Program function keys may also be associated with PL/I event variables.

- Stream I/O

In stream I/O an INTERACTIVE mode is now provided. In this mode GET and PUT statements may be directed to a single open stream file. Automatic buffer purging is provided when a GET statement follows a PUT to the same file. This allows user supplied prompting messages to appear in the proper sequence.

Additional Data Attributes

The additional data attributes being provided are:



- PICTURE
- DEFINED and POSITION
- AUTOMATIC with INITIAL
- FILE VARIABLE
- ENTRY VARIABLE
- PROGRAM VARIABLE

These are useful features required in commercial applications which are also common in PL/I products available on larger IBM systems. The inclusion of these facilities will also provide easier migration of a majority of existing PL/I programs from larger IBM data processing systems to Series/1.

Allocate/Free Statements

A new function is added to the compiler to allow the PL/I programmer to control the allocation and freeing of dynamic storage during execution. The statements supported are:

- ALLOCATE
- FREE

In the event that insufficient storage is available to fill a request for allocation, the STORAGE condition is raised and the user may decide how he wishes to proceed, as with other PL/I error conditions.

Fixed Block Regional

Fixed block (FB) is accepted as a valid environment option for a Regional file. This feature permits short length records to be blocked within 256 byte sector boundaries and thus allows users to optimize space on Series/1 direct access devices.

Built-In Functions (BIF's)

The new built-in functions expand the productivity of the PL/I programmer in handling arithmetic, string, and array data.

- Arithmetic BIF's (built in functions)
 - ADD - FLOOR - ROUND
 - ATANH - MAX - SINH
 - CEIL - MIN - SUBTRACT
 - COSH - MOD - TANH
 - DIVIDE - MULTIPLY - TRUNC
- String BIF's
 - TRANSLATE
 - VALID
 - VERIFY
- Array BIF
 - SUM
- I/O BIF
 - PAGENO

Pointer Qualification

Explicit pointer qualification is now available. This extension facilitates list processing applications.

Generated Code Optimization

The PL/I Version 2 compiler analyzes object-code logic and then eliminates many unnecessary instructions. This results in saving execution time and storage space. Code optimizations provided include:

- Improved register allocation

- Anchor pointing in compound IFs
- Use of byte immediate instructions in place of word immediate instructions where applicable
- Use of storage-to-storage operations
- Use of MVWS instruction where offsets and registers permit
- Use of Jump instruction for short Branch instructions
- Library call code improvements

PL/I Sort Capability

Sort/merge functions available with the IBM Series/1 Sort/Merge program (5719-SM1) are now supported via the CALL PLISRT interface.

Realtime Extensions

One of the key features of the IBM Series/1 PL/I offering is the capability of allowing the user to develop a complete realtime application without the need to know assembler language. The requirement has been expressed by the user for a language that offers realtime facilities as part of its syntax; that is, not through subroutine calls. To achieve this goal a set of PL/I realtime language extensions are provided which allow starting of asynchronous tasks and programs and synchronization of their execution. Event handling and resource control statements allow users to easily code applications that invoke response to realtime events and resolution of resource contention. The following contains an explanation of these extensions.

Multitasking Services

The statements associated with multitasking and their functions are:

- RUN Invokes a task or program
- STOP Causes termination of a program or task
- UNSCHEDULE Eliminates the scheduling of a task or program that has already been scheduled by the RUN statement
- TRANSFER TO Stops the current program and activates another program in the same partition

The PL/I programmer is able to terminate a program or task when control for the task reaches a RETURN or END statement for the procedure invoked as a TASK or when control for any task reaches a STOP statement.

PL/I permits users to share data between tasks in a user partition through the Application Builder facilities. PL/I users can also take advantage of sharing data and subroutines across partitions through the shared task set.

Timer Services

The programmer is provided with a PL/I language facility to request a program to be suspended for a specified time interval. The user is provided a CALL facility for setting the DATE and TOD (time-of-day) clock.

The PL/I programmer may schedule a program or task to execute on a periodic basis, at a particular time-of-day, and after a specified time interval. A facility is provided to add and delete programs or tasks from the scheduler services on



program request. Programs and tasks may also be scheduled to run on the occurrence of a process interruption.

Resource Management

The language is extended to allow the user to control serially reusable resources and to request/release resources for task synchronization by the introduction of a LOCK variable. This provides users with a deadlock avoidance facility and permits effective utilization of the system resources. For example, in a multitasking environment several tasks may want to update a file simultaneously; with this facility a user may ensure that only one task can execute the file update at one time.

Event Facilities

The PL/I programmer may define events and start/resume execution of a particular task upon the occurrence of an event. Facilities are provided for the synchronization of task execution through WAIT/POST facilities. Thus event handling facilities can provide some predefined relationship between PL/I tasks running asynchronously.

Events that are supported are I/O completion, task completion, time of day, time interval, process control, display device function key, and user-defined. The user is able to suspend a task until a single event occurs or any of a list of events occur.

Built-in Functions

The multitasking built-in functions are used during multitasking and during asynchronous I/O operations. They allow the user to investigate the current state of execution of a task or asynchronous I/O operation. The function names and definitions are:

- **COMPLETION** Returns the completion value of a given event that can be associated with completion of a task or completion of an I/O operation.
- **STATUS** Returns the status value of a given event.
- **PRIORITY** Returns the priority of a task.

PL/I Sensor I/O

PL/I permits the user to utilize current PL/I record I/O to access analog and digital data for both input and output. Sensor I/O records, which are described in the ENVIRONMENT attribute, may be either type S (sequential sampling) or type R (random sampling). PL/I access to records in an Analog or Digital I/O file can be Sequential, Keyed Sequential, or Direct.

PL/I sensor I/O also provides a GAIN option with a scaling factor (range code) that can override the standard representation.

I/O Capability

The IBM Series/1 Realtime Programming System Data Management provides the PL/I user with I/O services. The PL/I user has facilities to access standard Series/1 I/O devices. PL/I uses both physical and logical I/O (that is, READ/WRITE or GET/PUT). The file types supported include Sequential, Direct, and Transient, with data file record formats F, FB, FBS, V, VB, and VBS being supported. Data files may exist on three types of magnetic medium:

1. Fixed Disk

2. Removable Diskette

3. Magnetic Tape (Excludes Spanned Records)

The IBM Series/1 PL/I includes both stream I/O and record I/O capabilities. Stream I/O statements read and write data with a minimum of programming effort, because automatic formatting and conversion are provided. The following specific options are available:

- List-directed I/O. This facility allows you to input and output data with automatic formatting and conversion.
- Edit-directed I/O. A full range of format items, including picture formats and control formats, allow users to generate complex reports with a minimum of programming effort.

Record I/O statements allow more control over I/O. The following options are available:

- Sequential I/O. This facility is available through the use of READ, WRITE, DELETE, and REWRITE statements. It is often possible to improve execution-time performance by using the EVENT options for asynchronous I/O.
- Direct I/O. This facility is available through the use of READ, WRITE, DELETE, and REWRITE statements with the KEY option. Asynchronous direct I/O is also permitted.
- Sensor I/O. This facility for handling both sequential and random sampling of analog and digital I/O is available through the use of the READ and REWRITE statements.
- Transient Files. This form of file organization allows the user to communicate data with the IBM Series/1 Realtime Programming System data queues by using PL/I READ and WRITE statements. The PL/I program can detect and handle the empty queue situation by coding an ON-unit for the PENDING ON condition.

Communications

A PL/I facility gives the user the ability to communicate with Binary Synchronous and START/STOP devices through the Realtime Programming System communications interfaces. All communications are a subset of Record I/O with no new language, only new ENVIRONMENT options. This facility is provided through a direct PL/I interface to normal operating system/subsystem functions.

These communication functions allow flexibility in developing terminal applications in PL/I and will permit:

- Communications between multiple Series/1 machines
- Series/1 to System/370 communication
- Installation of PL/I programs in Binary Synchronous and Start/Stop environments

Indexed Access Method Support

The PL/I compiler now supports Indexed (keyed) files in addition to Consecutive and Regional files. This support includes new file environment options and support for non-numeric keys. Record types are fixed format, blocked or unblocked. Indexes associated with the data set are used by the Indexed Access Method to locate records when the key is supplied. Both the Indexed Access Method program (5719-AM1) and the Indexed Access Method PRPQ (5799-TCB) are supported. Both sequential and direct processing of indexed files is permitted.



The file types supported for sectorized devices (fixed disk and removable diskette) are:

- Sequential
- Direct
- Partitioned

The PL/I user has the capability to add and update records to a sequential DASD file. When using direct files, the user has the ability to access a record by relative record number. The user has the capability of supporting direct data files containing over 250,000 records.

The PL/I user has the option of binding I/O devices and data sets (1) during program preparation, that is, compile, application build, and install; as well as (2) during execution, that is, during open time. Option 1 provides the user with the ability to meet higher performance requirements with a minimum storage penalty and minimum disk reads to find the location of programs and data. Option 2 allows flexibility in assigning different data sets to a file at execution time.

Data Types and Organization

IBM Series/1 PL/I Version 2 supports arithmetic data, string data, arrays, structures, and program control data. The wide variety of data types and array handling supported allow PL/I users to implement a large collection of programs such as system type applications, data base applications, manipulation of large collections of different types of data, scientific applications requiring arithmetic and floating point operation, and commercial applications using PICTURE variables and formatting and decimal arithmetic. In addition the ability to organize data in a PL/I program, through PL/I structures, has an added benefit as a documentation aid. With PL/I the different data types can be organized and structured much more easily than with other languages.

Some of the different PL/I Version 2 data types:

- Arithmetic data can be represented in either binary or decimal radix and can be either fixed or floating point.
- Fixed point binary word and double word precisions are supported. Decimal fixed point data can have up to 15 digit positions.
- String data can be either bit or character, with fixed or varying length attributes.
- Program control data can be label, format, event, file, activation, program, lock, entry, or pointer.
- PL/I data may be organized into arrays of up to 15 dimensions, or in structures (hierarchical collections of data, not necessarily of the same type).

Data Manipulation Features

IBM Series/1 PL/I supports major PL/I operators, data types, and statements. Of particular interest are these:

- String operations, including substrings, concatenation, and general Boolean operations.
- Full set of language built-in functions, including mathematical functions, string functions, and array functions.
- Structure assignment.
- Automatic data conversion in expressions.

- Generalized subscripting.
- Full support for internal and external procedures.
- Control structures including IF-THEN, IF-THEN-ELSE, DO, and DO-WHILE.

Here are other Series/1 PL/I Version 2 capabilities that make it suitable as a general application development tool:

- PL/I coded programs have the capability for entering a user-written error-handling block (entering an ON unit) when an execution error is detected. This can be for device or format errors in I/O, subscript range, and string size range as well as a wide variety of other language defined error conditions. The ON handling facility provides PL/I users with extensive run time error-handling facilities. As a result, users are able to check out program errors and install their application.
- PL/I supports both the 64 character set and the restricted 48 character set.
- The following features are supported in PL/I:
 - Conversion of mixed data types in expressions
 - Repetitive specification of data items (GET and PUT)
 - General condition names (ON, REVERT, and SIGNAL)
- Storage efficiency gained by the generation of reenterable code and support for automatic storage allocation.
- Program modularity and interface checking provided by the PL/I block structure and scope rules and the ENTRY attribute.
- The following user-oriented debugging aids are provided:
 - Extensive compiler error messages
 - Extensive compiler listing aids
 - SNAP on an ON statement
 - Subscript range checking at execution time
 - String range checking at execution time
 - Conversion condition checking and fix up capability of execution data
- The user is not required to write assembler language code in order to compile or execute PL/I-coded programs. A user may choose, of course, to write assembler code, generally as Callable subprograms, to achieve code secrecy, faster execution speed, lower storage requirements, or some non-PL/I supported function.

PL/I and PL/I-coded programs use only the data set organizations and access methods defined by the operating system.

Data Security

PL/I object program structure and language provide controlled addressability to user data. Data with the internal attribute, for example, is not known outside the declaration block. This facility permits users to access data in a fashion which is consistent with declared data attributes and source language scope.

In addition, the PL/I STRINGRANGE and SUBSCRIPTRANGE conditions can be used to restrict the application program from referring to data which lies beyond the declared extents and lengths of arrays and strings.

**Communications with FORTRAN, COBOL, and Assembler**

Subject to certain rules the compiler allows communication between PL/I object modules and FORTRAN, COBOL or assembler object modules. Data may be passed as arguments and must conform to standard interface conventions. PL/I register conventions and error handling conventions must also be preserved.

PL/I RAS

IBM Series/1 PL/I Version 2 supplies compile-time error detection to analyze statement syntax and program structure errors.

The compiler provides debugging aids to decrease the time and effort required for program checkout. It permits efficient use of the language with respect to both compilation and execution. You can use options to request optional compiler facilities.

Syntax errors, errors of consistency such as contradictory variable declarations, and detectable semantic errors occurring in the source program are all diagnosed and reported in a meaningful form.

IBM Series/1 PL/I Version 2 supplies comprehensive diagnostics at execution time to test for and recognize I/O and arithmetic function errors and to pass control to user-defined error routines. It also provides a calling trace (using the ON-SNAP condition), subscript range checking, and string range checking (option).

Devices Supported

The IBM products supported are the following:

Processors	4952, 4953, 4955
Diskette	4964, 4966
Fixed Disk	4962, 4963
Printer	4973, 4974, 5256
CRT/Keyboard	4979, 4978, 5251, 5252
Magnetic Tape Subsystem	4969
Sensor I/O	4982

Features:

- Floating Point Processor — #3920
- Storage Address Translator — #6335
- Teletypewriter Adapter — #7850 (supported for use with Teletype® models ASR 33/35 or equivalent device)
- Timer — #7840
- Native Attach Sensor I/O — #1560
- Binary Synchronous Communications — point to point, switched and nonswitched
 - IBM Series/1 to System/370
 - Series/1 to Series/1
- Start/Stop (asynchronous) Communications Terminal Support
 - IBM 2740 Model 1 communication terminals
 - Teletype® Models ASR 33/35 or equivalent device

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All I/O devices are accessed through Realtime Programming System services, and all disks and diskettes supported by Versions 3 or 4 of Realtime Programming System are supported. Floating point is required, either by hardware feature or by emulation (performance degradation may occur if emulation is used).

Specified Operating Environment

Support will be provided for these programs when they are operated in the following environment.

System Requirements: In addition to the minimum requirement for the IBM Series/1 Version 3 or 4 of the Realtime Programming System and Version 3 or Version 4 of the Program Preparation Subsystem, the storage requirements are as follows:

- For compilation using Realtime Programming System Version 3 or 4 with Multiple Address Space Management, a 64K system including at least a 26K partition for the compiler and 2K control module in the operating system partition.
- For compilation using Realtime Programming System Version 4 with Single Address Space Management, a 64K system including at least a 28K partition for the compiler.

The minimum system required to execute a PL/I Version 2 object program in a realtime partition or batch partition is:

Processor IBM 4952 or 4953 or 4955

Storage 48K (64K on 4952)

Disk 1 — IBM 4962 or 4963

For details on system requirements for the IBM Series/1 Realtime Programming System Version 3 or 4 and the IBM Series/1 Program Preparation Subsystem Version 3 or 4, see the pertinent program descriptions in this manual.

Programming Requirements: The following support programs are required if the associated PL/I language function is used:

- Sort/Merge (5719-SM1) to support calling the Sort facility.
- Indexed Access Method Programming RPQ (5799-TCB) either for Realtime Programming System Version 3 or Version 4

OR

 Indexed Access Method (5719-AM1), for Realtime Programming System Version 3 or Version 4, to support indexed I/O.
- IBM 4978 Display Support Version 3 PRPQ (5799-TCE) for the extended features of screen support on the 4978
- IBM 5250 Information Display System Licensed Program (5719-TA1) for 5250 support
- IBM 4969 Magnetic Tape Subsystem (5719-TA4) for using magnetic tape

Charges

These programs will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, the licensed program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs.

If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferable to other customers



or between licenses, whether they are for programs which have a different program number or the same program number.

In addition, there is a one-time process charge to cover the cost of distributing basic machine-readable material, including service updates.

Customer Responsibility

The customer is responsible for the installation and use of this licensed program.

Programming RPQs

PRPQs will be accepted. Response time will depend upon complexity.

Marketing Publications

IBM Series/1 Realtime Programming System PL/1
Compiler and Resident Library Version 2:

Licensed Program Specifications GC34-0281

IBM Series/1 Realtime Programming System PL/1
Transient Library Version 2: Licensed

Program Specifications GC34-0282

IBM Series/1 PL/1: Realtime Programming System
Language Reference

GC34-0085

IBM Series/1 PL/1: Realtime Programming System
User's Guide

SC34-0086

IBM Series/1 PL/1: Realtime Programming System
Execution Logic Manual

SY34-0086

IBM Series/1 PL/1: Messages

SC34-0088

Ordering Instructions

Contact IBM.

**IBM SERIES/1 EVENT DRIVEN EXECUTIVE PL/I
COMPILER AND RESIDENT LIBRARY (5719-PL5)****IBM SERIES/1 EVENT DRIVEN EXECUTIVE PL/I
TRANSIENT LIBRARY (5719-PL6)**

These products are licensed programs working together under the Event Driven Executive Basic Supervisor and Emulator Versions 1.1 or 2.

The IBM Series/1 Event Driven Executive PL/I is a subset of American National Standards Institute Programming Language PL/I (ANSI X3.53 1976), as understood and interpreted by IBM as of July 1979, plus additional language functions to support coding multitasking applications. The PL/I compiler permits programmers to use the functional capability of the operating system for commercial, scientific, and interactive applications.

PL/I allows the programmer to express in a "natural" syntax many functions of the IBM Series/1 Event Driven Executive operating system which would require CALLs in FORTRAN or require assembler language or Event Driven language usage. As a result, the user's application programs are easier to read, understand, debug, maintain, and modify.

IBM Series/1 Event Driven Executive PL/I represents a significant advantage for the Series/1 high-level language user. Users can write entire applications in a high-level language that provides interactive terminal handling facilities, communications via binary synchronous or START/STOP disciplines to other processors and terminals, and indexed files for data base management. This product allows Series/1 users with little knowledge of the actual hardware or operating system to develop sophisticated applications with high programmer productivity.

PL/I programs can be used with the IBM Series/1 Event Driven Executive Multiple Terminal Manager program (5719-MS1). This facility offers another alternative to allow PL/I programs to execute in an interactive environment where one or more applications can run concurrently.

IBM Series/1 Event Driven Executive PL/I consists of two programs working together: (1) a compiler and resident library and (2) a transient library. The resident library contains frequently used routines which are combined with the user's program through the linkage editor. As a result, performance of a user's application is significantly enhanced because loading these functions during program execution has been eliminated. The transient library, required for program execution, contains less frequently used routines such as I/O transmission, error handling, and conversion routines. These functions are dynamically loaded during program execution and remain in storage only as long as they are required by the program. This permits storage savings in a user's partition with minimal impact on performance.

Compatibility

- Event Driven Executive PL/I (5719-PL5 and 5719-PL6) is a compatible subset of PL/I Version 2 (5719-PL2 and 5719-PL4) running on the Realtime Programming System at the source program level.
- Event Driven Executive PL/I is a compatible subset of ANSI PL/I if the Series/1 realtime extension features are not used.

Description

The functional breadth of the IBM Series/1 Event Driven Executive PL/I language is intended to enable users to develop application programs that can be easily modified and maintained. Highlights include:

- Multitasking Extensions
- I/O Capability
 - Stream I/O
 - Record I/O
 - Communication Support
 - Indexed Access Method Support
 - Full Screen Support
 - Magnetic Tape Subsystem
- Data Types and Organization
- Data Manipulation Features
- Extensive Coverage of ANSI PL/I
- Code Optimization
- Language (Realtime) Extensions

Multitasking Extensions

One of the key features of the IBM Series/1 PL/I is the capability of allowing the user to develop a complete multitasking application without the need to know assembler language. The requirement has been expressed by the user for a language that offers multitasking facilities as part of its syntax; that is, not through subroutine calls. To achieve this goal a set of PL/I multitasking language extensions are provided which allow starting of asynchronous tasks and programs and synchronization of their execution. Event handling and resource control statements allow you to easily code applications that invoke response to events and resolution of resource contention. The following contains an explanation of these extensions.

- Multitasking Services

The statements associated with multitasking and their functions are:

RUN Invokes a task or program

STOP Causes termination of the issuing task

The PL/I programmer is able to terminate a program or task when control for the task reaches a RETURN or END statement for the procedure invoked as a TASK or when control for any task reaches a STOP statement.

In addition, the CALL statement may be used to access subroutines written in Event Driven Language instructions.

- Resource Management

The language is extended to allow the user to control serially reusable resources and to request/release resources for task synchronization by the introduction of a LOCK variable. This provides users with a deadlock avoidance facility and permits effective utilization of the system resources. In a multitasking environment several tasks may want to update a file simultaneously. With this facility a user may ensure that only one task can be executed at a time to ensure proper file update.



The statements associated with these functions are:

LOCK Request a LOCK variable
UNLOCK Release a LOCK variable

- Event Facilities

The PL/I programmer may define events and start/resume execution of a particular task upon the occurrence of an event. Facilities are provided for the synchronization of task execution through WAIT/POST facilities. Thus, event handling facilities provide some predefined relationship between PL/I tasks running asynchronously.

Events that are supported are I/O completion, task completion, and user-defined. The user is able to suspend a task until an event occurs.

- Reenterable Programs

All programs produced by the compiler are reenterable. This allows common code to be shared among multiple tasks.

- Built-in Functions

The multitasking built-in functions are used during multitasking and during asynchronous I/O operations. They allow the user to investigate the current state of execution of a task or asynchronous I/O operation. The function names and definitions are:

COMPLETION Returns the completion value of a given event. The event can be associated with completion of a task or completion of an I/O operation.

STATUS Returns the status value of a given event.

PRIORITY Returns the priority of a task.

I/O Capability

The IBM Series/1 Event Driven Executive Data Management provides the I/O services used by PL/I. The PL/I user has facilities to access standard Series/1 I/O devices through PL/I files. The file types supported include Sequential and Direct files. Data files may exist on three types of magnetic medium:

1. Fixed disk
2. Removable diskette
3. Magnetic tape (available with Event Driven Executive Version 2)

The IBM Series/1 PL/I includes both stream I/O and record I/O capabilities. Stream I/O statements read and write data with a minimum of programming effort, because automatic formatting and conversion are provided. The following specific options are available:

- List-directed I/O. This facility allows users to input and output data with automatic formatting and conversion.
- Edit-directed I/O. A full range of format items, including picture formats and control formats, allow users to generate complex reports with a minimum of programming effort.
- Stream I/O is to printers and terminals only.

Record I/O statements allow users to have more control over I/O. The following options are available:

- Consecutive I/O. This facility is available through the use of the READ, WRITE, and REWRITE statements. Often users

can improve execution-time performance by using the EVENT options for asynchronous I/O.

- Regional I/O. This facility is available through the use of READ, WRITE, DELETE, and REWRITE statements with the opportunity of specifying the relative record number using the key option. Asynchronous direct I/O is also permitted.
- Blocking of Consecutive and Regional files is supported.
- Record I/O is to disk(ette) and tape only, with the exception of Record I/O full screen support.
- Communications I/O. A PL/I facility provides the ability to communicate with binary synchronous and Start/Stop devices through the Event Driven Executive communications interfaces. Communications support is a subset of RECORD I/O with no new language, only new ENVIRONMENT options. This facility is provided through a direct PL/I interface to the operating system/subsystem function.

These communication functions allow greater flexibility in developing terminal applications in PL/I and will permit:

- Communication between multiple Series/1s
- Series/1 to System/370 communication
- Use of PL/I programs in other binary synchronous and start/stop environments

- Indexed Access Method I/O The PL/I compiler supports Indexed files in addition to Consecutive and Regional files. This support includes file environment options to describe the length and location of alphanumeric keys within the data records. Record types are fixed format, blocked or unblocked. Use of this support requires the Indexed Access Method program (5719-AM3).

Full Screen Support

Full screen support is provided through Record I/O and Stream I/O where the user can access the IBM 4978 and 4979 Display Terminals. Access is controlled through the use of ENVIRONMENT options in a FILE declaration statement.

- Record I/O

This support significantly extends application control of these devices by permitting Regional data sets to be directed to the display. With this capability, users can deal with the whole screen, control coordinate (X,Y) positions, write-protect selected fields on the screen, and scatter write. The program can also deal with program function keys using PL/I EVENT variables.

- Stream I/O

In stream I/O an INTERACTIVE mode is now provided to simplify writing a prompt message to the display and reading the responses. In this mode, GET and PUT statements may be directed to a single open stream file and thereby eliminate the requirement for two separate files—one for input and one for output. Automatic buffer purging is provided when a GET statement follows a PUT to the same file so that the output data is written to the display before the read request is sent to the device.

Magnetic Tape Subsystem Support

The PL/I programmer can sequentially access data stored on the IBM 4969 Magnetic Tape Subsystem by using the Series/1 Magnetic Tape support available with the Event Driven Executive Version 2 (5719-XS2).



Data Types and Organization

IBM Series/1 PL/I supports arithmetic data, string data, arrays, structures, and program control data. The wide variety of data types and array handling supported allow PL/I users to implement a large collection of programs such as system functions, data base applications, manipulation of large collections of different data types, scientific applications requiring arithmetic and floating point operation, and commercial applications using PICTURE variables and formatting and decimal arithmetic. In addition, the ability to organize data in a PL/I program, through PL/I structures, has an added benefit as a documentation aid. With PL/I the different data types can be organized and structured much more easily than with most other languages.

Some of the different PL/I data types:

- Arithmetic data can be represented in either binary or decimal radix and can be either fixed or floating point.
- Fixed point binary word and double word precisions are supported. Decimal fixed point data can have up to 15 digit positions.
- String data can be either bit or character, with fixed or varying length attributes.
- Program control data can be label, format, event, file, entry, activation, program, lock, or pointer.
- PL/I data may be organized into arrays of up to 15 dimensions, or in structures (hierarchical collections of data, not necessarily of the same type).

Data Manipulation Features

IBM Series/1 PL/I supports major PL/I operators, data types, and statements. Of particular interest are these:

- String operations, including substrings, concatenation, and general Boolean operations.
- A set of language built-in functions, including mathematical functions, string functions, and array functions.
- Structure assignment.
- Automatic data conversion in expressions.
- Generalized subscripting.
- Control structures including IF-THEN, IF-THEN-ELSE, DO, and DO-WHILE.

Here are other Series/1 PL/I capabilities that make it suitable as a general application development tool:

- PL/I-coded programs have the capability for entering a user-written error-handling block (entering an ON unit) when an execution error is detected. This can be for device or format errors in I/O, subscript range, and string size range as well as a wide variety of other language-defined error conditions. The ON handling facility provides PL/I users with extensive run time error-handling facilities. As a result, users are able easily to check out program errors and install their application.
- PL/I supports both the 64 character set and the restricted 48 character set.
- The following features are supported:
 - Conversion of mixed data types in expressions
 - Repetitive specification of data items (GET and PUT)
 - General condition names (ON, REVERT, and SIGNAL)

- Storage efficiency gained by the generation of reenterable code and support for automatic storage allocation.
- Program modularity and interface checking provided by the PL/I block structure and scope rules and the ENTRY attribute.
- The following user-oriented debugging aids are provided:
 - Extensive compiler error messages
 - Extensive compiler listing aids
 - Snap option on an ON-statement
 - Subscript range checking at execution time
 - String range checking at execution time
 - Conversion condition checking and fix up capability of execution data
- The user is not required to write assembler language code in order to compile or execute PL/I-coded program(s). A user may choose, of course, to write assembler code, generally as callable subroutines, to achieve code secrecy, faster execution speed, lower storage requirements, or some non-PL/I supported function.
- Extensive coverage of ANSI PL/I

These additional data attributes from ANSI PL/I are being provided to the Series/1 Event Driven Executive PL/I:

- PICTURE
- DEFINED and POSITION
- AUTOMATIC with INITIAL
- FILE VARIABLE
- PROGRAM VARIABLE
- ENTRY VARIABLE

These useful features, which are also common in PL/I products available on larger IBM systems, are required in most commercial applications. The inclusion of these facilities also provides easier conversion of some existing PL/I programs from larger IBM data processing systems to Series/1.

Allocate/Free Statements

A new function is added to the compiler to allow the PL/I programmer to dynamically control the allocation and freeing of storage during execution. The statements supported are:

ALLOCATE

FREE

In the event that insufficient storage is available to fill a request for allocation, the STORAGE condition is raised, and the program may decide how to proceed, as with other PL/I error conditions.

Built-in Functions (BIFs)

The built-in functions expand the productivity of the PL/I programmer in handling arithmetic, string, and array data.

- Arithmetic BIFs (built-in functions)

ADD	FLOOR	ROUND
ATANH	MAX	SINH
CEIL	MIN	SUBTRACT
COSH	MOD	TANH
DIVIDE	MULTIPLE	TRUNC
- String BIFs



VERIFY
TRANSLATE
VALID

- Array BIF
SUM
- I/O BIF
PAGENO

Pointer Qualification

The explicit pointer qualification operator is available. This extension facilitates list processing applications.

Code Optimization

The PL/I compiler analyzes program logic and then eliminates many unnecessary instructions. This results in saving execution time and storage space. Code optimization provided includes:

- Improved register allocation
- Anchor pointing in compound IFs
- Use of byte immediate instructions in place of word immediate instructions
- Use of storage-to-storage operations
- Use of MVWS instruction where offsets and registers permit
- Use of Jump instruction for short Branch instructions
- Library call code improvements

PL/I—Sort Capability

Sort/merge functions available with the IBM Series/1 Sort/Merge program (5719-SM2) are now supported via the CALL PLISRT interface.

Support for Event Driven Executive Operating System Services

Although PL/I supplies extensive coverage of operating system services through the PL/I language, certain applications may require additional system services. The CALL statement may be used to access system services unique to a user's application by calling a user subroutine written in Event Driven language.

PL/I RAS

IBM Series/1 PL/I supplies compile-time error detection to analyze statement syntax and program structure errors.

The compiler provides debugging aids to decrease the time and effort required for program checkout. It permits efficient use of the language with respect to both compilation and execution.

Syntax errors, errors of consistency such as contradictory variable declarations, and detectable semantic errors occurring in the source program are all diagnosed and reported in a meaningful form.

IBM Series/1 PL/I supplies comprehensive diagnostics at execution time to test for I/O and arithmetic function errors and to pass control to user-defined error routines. It also provides a calling trace (using the ON-SNAP feature), subscript range checking, and string range checking (option).

Data Security

PL/I object program structure and language provide controlled addressability to user data. Data with the internal attribute, for example, is not known outside the declaration block. This facility permits users to access data in a fashion which is consistent with declared data attributes and source language scope.

In addition, the PL/I STRINGRANGE and SUBSCRIPTRANGE error conditions restrict the application program from referring data which lies beyond the declared extents and lengths of arrays and strings.

Communication with Other Languages

Subject to certain rules the compiler allows communication between PL/I object modules and FORTRAN, COBOL, Macro Assembler, or Event Driven Executive language programs. Data may be passed as arguments and must conform to standard interface conventions. PL/I register conventions and error handling conventions must be preserved.

All I/O devices are accessed through the Event Driven Executive control program services.

Specified Operating Environment

Support will be provided for these programs when they are operated in the following environment.

System Requirements. In addition to the minimum requirement for the IBM Series/1 Event Driven Executive Basic Supervisor and Emulator Versions 1.1 or 2, the storage requirements are:

- For compilation using Event Driven Executive Versions 1.1 or 2, the minimum system for native program preparation plus at least 28K of storage for the compiler.

The minimum system required to execute an Event Driven Executive PL/I object program is:

Processor	IBM 4952 or 4953 or 4955
Storage	64K
Disk	1—IBM 4962 or 4963
Diskette	IBM 4964, 4966
Printer	IBM 4973, 4974
Keyboard/CRT	IBM 4979, 4978
Magnetic Tape Subsystem	IBM 4969

Teletypewriter Adapter #7850 supported for use with Teletype® models ASR 33/35 or equivalent device



Features

- Floating Point feature—#3920 (4955 only)
- Storage Address Translator—#6335 (4955 B only)
- Timer—#7840
- Binary Synchronous Communication—
 - Series/1 remote communication to Series/1 or System/370 via point-to-point (switched or nonswitched) binary synchronous line
- Asynchronous Communication (Start/Stop)
 - Series/1 remote connection to 2741 or Teletypewriter Adapter #7850 via point-to-point (nonswitched) start/stop line

Programming Requirements, programs required for the following purposes:

Compilation

- IBM Series/1 Event Driven Executive Basic Supervisor and Emulator Version 1.1 (5719-XS1) or Version 2 (5719-XS2)
- IBM Series/1 Event Driven Executive PL/I Compiler and Resident Library (5719-PL5)
- IBM Series/1 Event Driven Executive Utilities Version 1.1 or 2 (5719-UT3 or 5719-UT4)

Program Preparation

- IBM Series/1 Event Driven Executive Basic Supervisor and Emulator Version 1.1 (5719-XS1) or Version 2 (5719-XS2)
- IBM Series/1 Event Driven Executive Program Preparation Facility (5719-XX2) or Event Driven Executive Macro Assembler (5719-ASA)
- IBM Series/1 Event Driven Executive PL/I Compiler and Resident Library (5719-PL5)
- IBM Series/1 Event Driven Executive Utilities (5719-UT3 or 5719-UT4)

Program Execution

- IBM Series/1 Event Driven Executive Basic Supervisor and Emulator Version 1.1 (5719-XS1) or Version 2 (5719-XS2)
- IBM Series/1 Event Driven Executive PL/I Transient Library (5719-PL6)
- IBM Series/1 Event Driven Executive Utilities Version 1.1 or 2 (5719-UT3 or 5719-UT4)

Enhanced Operation

The following licensed programs are required if the associated functions are used:

- Sort/Merge (5719-SM2)
 - Required support for CALL PLISRT
- Indexed Access Method (5719-AM3)
 - Required support for indexed I/O
- IBM 4969 Magnetic Tape Subsystem for using tape available with Event Driven Executive Version 2 (5719-XS2)

- IBM Series/1 Event Driven Executive Multiple Terminal Manager (5719-SM1) Optional Support for terminal I/O and screen support handling

Charges

These programs will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, the programs remain the property of IBM and are subject to the provisions of the Agreement for IBM Licensed Programs.

If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferable to other customers or between licenses, whether they are for programs which have a different program number or the same program number. In addition, there is a one-time process charge to cover the cost of distributing basic machine readable material, including service updates.

Customer Responsibility

The customer is responsible for the installation and use of this licensed program.

Systems Engineering Services

See the Machine Price List tab, and the "Service Offering Price List" page, for Systems Engineering Service rates. Service will be provided on an *as available* basis.

Programming RPQs

PRPQs will be accepted. Response time will depend upon complexity.

Marketing Publications

IBM Series/1 Event Driven Executive PL/I Messages	SC34-0156
IBM Series/1 Event Driven Executive PL/I Language Reference	GC34-0147
IBM Series/1 Event Driven Executive PL/I User's Guide	SC34-0148
IBM Series/1 Event Driven Executive PL/I Licensed Program Specifications for Compiler and Resident Library (5719-PL5)	GC34-0145
IBM Series/1 Event Driven Executive PL/I Licensed Program Specification for Transient Library (5719-PL6)	GC34-0146
IBM Series/1 Event Driven Executive PL/I Execution Logic Manual	GC34-0149

Ordering Instructions

Contact IBM.



**IBM SERIES/1 REALTIME PROGRAMMING SYSTEM
ADVANCED REMOTE JOB ENTRY PROGRAM (5719-RJ6)**

The Advanced Remote Job Entry (ARJE) program runs as an application program under the IBM Series/1 Realtime Programming System. The ARJE program enables an IBM Series/1 to operate as a remote job entry work station using either Systems Network Architecture (SNA) or Multileaving Binary Synchronous Communications (BSC).

The Advanced Remote Job Entry program supports:

- **MRJE**
Multileaving Remote Job Entry (MRJE) support for Binary Synchronous Communications (BSC)
- **SNA RJE**
Multiple Logical Unit Systems Network Architecture (SNA) support for Synchronous Data Link Control (SDLC)
- **Unattended Operation**
ARJE allows unattended operation by having ARJE commands on disk/diskette, and support for dynamic punch file allocation, and delayed activation.
- **Full Function RJE**
In addition to standard RJE capabilities, ARJE has full function console support with status reporting and journaling, data decompression, and printer form support.
- **ARJE Commands**
ARJE commands have been designed for ease of use and are identical for MRJE or SNA RJE operation.
- **Host Remote Job Entry Subsystems**
ARJE supports the following:

BSC	SDLC
OS/VS2 JES2	OS/VS2 JES2
OS/VS2 JES3	OS/VS2 JES3
VM/370 RSCS	DOS/VSE VSE/POWER

Highlights

The ARJE program is loaded as an application program by the terminal operator or another Realtime Programming System application program. The purpose of ARJE is to provide the Realtime Programming System user with the ability to participate in an SNA network or BSC environment as an RJE work station. It will allow the user who has created a job stream via Realtime Programming System edit facilities to transmit that job stream to a host job entry subsystem for processing. When the processing is complete, the output from the job stream(s) will normally be sent back to the work station for punching (routed to a Realtime Programming System data set) and/or printing.

- **MRJE**
The support for point-to-point Binary Synchronous Communication (switched or non-switched) is with the ARJE Multileaving Remote Job Entry (MRJE) option. Multileaving is a term which describes a computer-to-computer communications technique developed for use by the HASP system. It has since been implemented by other IBM RJE programming systems. It permits the intermixing of input and output data streams on the communication lines. It is fully synchronized, two directional transmission of a variable number of data streams between the Series/1 and a host system. The Series/1 appears as a System/3 with console support to the host job entry subsystems.

- **SNA RJE**
The Systems Network Architecture (SNA) RJE option of ARJE supports (switched or non-switched) point-to-point or multipoint Synchronous Data Link Control protocol. The Series/1 ARJE has Multiple Logical Unit support under a single work station providing up to four LU to LU sessions. ARJE uses Logical Unit Type 1 protocols for session communication with the host job entry subsystems.
- **Unattended Operation**
Three ARJE capabilities, i.e., ARJE commands in a disk/diskette data set, dynamic punch file allocation, and delayed activation, enable the work station to operate without the user being physically present.

The ARJE user can place ARJE commands in a disk/diskette data set in addition to entering them at his work station display terminal. These ARJE commands will be read in and processed just as if they were entered at the display.

The user can also activate ARJE in a "wait" state, delayed activation, to establish the connection with the host job entry subsystem when a call is received from the host.

The punched output received by ARJE is always placed in a Realtime Programming System disk/diskette data set. This data set is allocated by ARJE (dynamic allocation).
- **Full Function RJE**
The work station console function gives the user the ability to query the host system as to the status of a submitted job and/or query the host for any other normally allowed information (e.g., system status). Facilities are also provided to allow a user to record ARJE console activity in a Realtime Programming System data set for subsequent printing (called journaling).

The print output received by ARJE may be either printed directly on an available physical printer or, through the use of the Realtime Programming System spool function, placed in a disk/diskette spool data set for printing at a later time. The use of the spool facility to store output on a diskette allows the user to transport that data to another Realtime Programming System Series/1 for printing. Facilities exist in the Realtime Programming System spool function to allow the user to control the printing of specific jobs from the spool processor output queue. ARJE supports 3211/3203-4 Forms Control Blocks for printed data. The FCB parameters are: lines per inch, form end (page length), and page line to channel assignments (i.e., for each "select vertical channel" command received from the host, ARJE will skip to a specific line on the current printer page). A utility will be provided with ARJE to allow the user to define FCBs corresponding to the FCB/forms requests that may be sent by the host.
- **ARJE Commands**
The ARJE commands are single line commands with parameters that can be specified by the user. These commands are summarized below:
 - Help—print a list of the commands
 - Readfile—identify a command/data file to be processed
 - Print—alter current ARJE printer assignment
 - Punch—modify punch specifications
 - Library—change library environment



- Attend—change operational mode to attended from unattended and vice versa
- Status—report current ARJE status
- Journal—turn on/off journal activity
- Operator—transmit host operator command

Specified Operating Environment

Support will be provided for this licensed program when it is operated in the following environment:

System Requirements: The Series/1 Realtime Programming System, Advanced Remote Job Entry program requires the following hardware for installation:

- A Series/1 4954 or 4955 processor with a minimum of 192K bytes of storage
- One of the following disk/diskette devices:
 - 4962 Disk Storage Unit (All models)
 - 4963 Disk Storage Unit (All models)
 - 4964 Diskette Storage Unit
 - 4965 Diskette and I/O Expansion Unit (including the 4954C processor/diskette)
 - 4966 Diskette Magazine Unit
- One of the following interactive devices:
 - 4978 Display Station
 - 4979 Display Station
 - 3101 Model 1 or 2 Display terminal or Typewriter Models ASR33/ASR35 or equivalent teletypewriter device attached by any of the following:
 - #7850-Teletypewriter Adapter (3101 or ASR33/35 or equivalent)
 - #2095/#2096-Feature-Programmable Adapter D02350 (3101 only)
 - #1610-Asynchronous Single Line Adapter (3101 only)
 - #2091/-Asynchronous Multi-line Adapter (3101 only)
 - #2092
 - #1310-Multi-Function Attachment
- One of the following adapters:
 - #1310-Multi-function Attachment (BSC mode)
 - #2074-Binary Synchronous Communications Single Line Control
 - #2075-Binary Synchronous Communications Single Line Control
 - #2080-X.21 Adapter (BSC/SDLC mode) under V.35 Interface
 - #2093/#2094-Binary Synchronous Communications 8 Line Control and Binary Synchronous Communications 4 Line Adapter
 - #2090-Synchronous Data Link Control-Single Line Control
- Optionally, one of the following:
 - 4973 Line Printer
 - 4974 Matrix Printer
 - 4975 Matrix Printer (via #1310 MFA)

Programming Requirements: The following IBM licensed programs or functionally equivalent programs are prerequisites for the installation of the IBM Series/1 Realtime Programming System, Advanced Remote Job Entry program (5719-RJ6):

- IBM Series/1 Realtime Programming System Version 5.2 (5719-PC5)

For SNA RJE option only of ARJE,

- IBM Series/1 Realtime Programming System, Systems Network Architecture Extended Support program (5719-SN1).

The Series/1 Realtime Programming System, Advanced Remote Job Entry program requires an additional 26K bytes of storage.

Note: The Realtime Programming System Version 5.2 is a maintenance release made available in April 1982.

Charges

These programs will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, the programs remain the property of IBM and are subject to the provisions of the Agreement for IBM Licensed Programs.

If the monthly charge is chosen, credit will be accrued during a continuous license period towards the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferrable to other customers or between licenses, whether they are for programs which have a different program number or the same program number.

In addition, there is a one-time process charge to cover the cost of distributing basic machine-readable material including service updates.

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The customer is responsible for the installation and use of this licensed program.

Systems Engineering Services

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Programming RPQs

PRPQs will be accepted. Response time will depend upon complexity.

Marketing Publications

IBM Series/1 Realtime Programming System, Advanced Remote Job Entry Licensed Program Specification

IBM Series/1 Advanced Remote Job Entry, User's Guide

IBM Series/1 Advanced Remote Job Entry, Reference Card

**STAND-ALONE DISK UTILITIES (5719-SC2)**

Normal SCP provisions apply. For a detailed description of programming service classifications, contact IBM.

Highlights

- Prompting messages issued through the operator station to facilitate use.
- Utilities can be loaded by name.
- Recoverable errors print message identifying error and reissue prompts.
- Irrecoverable errors print message identifying error and print termination message.
- Distributed from PID on a diskette.

Functions*Diskette IPL Bootstrap*

The Diskette IPL Bootstrap Utility loads the contents of cylinder 1, head 0, into the high end of storage.

Disk IPL Bootstrap/Loader

The IPL Bootstrap/Loader Disk Utility loads programs from the disk into main storage.

Diskette Initialization

The Diskette Initialization Utility initializes the diskette by writing record IDs, checking for bad cylinders, and assigning alternative cylinders. The program initializes for Basic Exchange Format and formats sectors to 128 bytes.

Disk Initialization

The Disk Initialization Utility initializes the disk by writing sector IDs, checking for defective sectors, and assigning alternative sectors. The program provides for user specified alternative sector assignment.

Create Diskette HDR1

The Create Diskette HDR1 utility creates a HDR1 record on track 0 for a diskette, with information specified. The format of HDR1 maintains Basic Exchange Format.

Delete Diskette HDR1

The Delete Diskette HDR1 Utility deletes the HDR1 record for a specified diskette data file.

Diskette to Disk Copy

The Diskette to Disk Copy Utility copies data from a specified diskette file to a specified disk file.

Disk to Diskette Copy

The Disk to Diskette Copy Utility copies data from a specified disk file to a specified diskette file.

Diskette to Printer Dump

The Diskette to Printer Dump Utility dumps the contents of a specified area on the diskette to the printer.

Disk to Printer Dump

The Disk to Printer Dump Utility dumps the contents of a specified data area on the disk to the printer.

Operator Station to Diskette Patch

The Operator Station to Diskette Patch Utility applies a patch entered at the operator station to a specified location on the diskette.

Operator Station to Disk Patch

The Operator Station to Disk Patch Utility applies a patch entered at the operator station to a specified location on the disk.

Stand-alone Storage to Diskette Dump

Pressing the LOAD key on the console loads this utility into main storage from a dedicated prebuilt diskette. The utility then dumps the contents of the Instruction Address Register, the general purpose registers, the level status register, and the contents of storage for each level to that same diskette.

Stand-alone Storage to Printer Dump

Pressing the LOAD key on the console loads this utility from a dedicated prebuilt diskette. The utility then dumps the contents of storage, the contents of the Instruction Address Register, the general purpose registers, and the level status register for each level on the printer.

Automatic System Build

The Automatic System Build program copies to disk the diskettes shipped from PID. A copy of this program resides on each diskette shipped from PID. The diskettes can be loaded in any sequence.

System Verification

The System Verification program ensures that the system is built properly by cross-checking each module on the system disk against a table containing expected module names. If any are missing, a message is printed to indicate which specific program is not at its expected disk address.

Error Logging Facilities

Error logging facilities are enhancements provided to log execution time errors. The facilities offer the user the ability to format a printable error record for processor errors, device I/O request errors, and device interrupt errors. The user provides the area in which the record will be built. The user must also provide his own I/O routine to display the record on a console or printer device or to write it on a disk or diskette for intermediate storage. When the log is on disk or diskette, the Stand-alone Utilities provide facilities for printing the log on the console or printer device.

**Specified Operating Environment**

Support is provided for this licensed program when it is operated in the following environment:

System Requirements:

Processor	IBM 4953 Processor (32K bytes minimum) OR IBM 4955 Processor (32K bytes minimum)
Disk/ Diskettes	1—IBM 4962 Model 2 or 2F Disk Storage Unit (Combination disk/diskette unit) OR 1—IBM 4962 Model 1 or 1F Disk Storage Unit AND 1—IBM 4964 Diskette Unit
Printer	1—IBM 4974 Printer
Operator Station	1—Teletypewriter Adapter #7850 with Teletype® Models ASR 33/35 or an ASCII equivalent device.

Programming Requirements: None.

Marketing Publications

Series/1 Stand-alone Utilities User's Guide	GC34-0070
IBM Series/1 Stand-alone Utilities PLM	GY34-0071
Memo to Licensees, Program Directory, and one copy of the IBM Series/1 Stand-alone Utilities Guide will be supplied automatically with the basic machine-readable material.	
IBM Series/1 Stand-alone Utilities User's Guide	GC34-0070
IBM Series/1 Stand-alone Utilities Program Logic Manual	GY34-0071
IBM Series/1 Stand-alone Utilities Microfiche	GDJ1-1813

Ordering Instructions

Contact IBM.



REALTIME PROGRAMMING SYSTEM SCREEN FORMAT DESIGN AID UTILITY (5719-SF1)

REALTIME PROGRAMMING SYSTEM PRESENTATION SUPPORT (5719-SF2)

Used in conjunction with Version 4 of the Realtime Programming System (5719-PC4), the Screen Format Design Aid Utility (5719-SF1) and Presentation Support (5719-SF2) provide the user with definition and execution-time facilities for the creation, maintenance, and usage of screen formats for IBM 4978, 4979, and 5250 Display Stations attached to the Series/1.

The Screen Format Design Aid Utility (5719-SF1) executes in a 16K byte partition. It is menu driven and interactive. It is used to create, change, test and save screen formats in libraries on disk or diskette, and requires the Presentation Support program (5719-SF2).

Presentation Support (5719-SF2) is used on production systems [Screen Format Design Aid Utility (5719-SF1) is not required] and operates as supervisor code. A CALL Interface is provided for Assembler and high-level languages (COBOL, PL/I, or FORTRAN). Application programs may use multiple display stations. Presentation Support provides the following functions:

- RETRIEVE format (from a predefined and created screen format library)
- PUT format (write format to display)
- PUT structure (write unprotected data on display device)
- GET structure (read unprotected data from display device)

Highlights

Screen Format Design Aid Utility (5719-SF1)

- Interactive
- Option Driven
- Display device attribute characters are defined
- Hard copy of screen formats for reference and update

Presentation Support (5719-SF2)

- Supports multiple displays per application program
- Designed to improve user productivity
- Assembler and high-level language interface (COBOL, PL/I and FORTRAN)
- Display device independence of user application programs (except for editing attributes of the 5250)

Specified Operating Environment

Support will be provided for these programs when they are operated in the following environment:

System Requirements: The minimum system requirements are the same as for the Series/1 Realtime Programming System Version 4 (5719-PC4). Additionally, an IBM 4978, 4979, or 5250 Display Station is required. The storage requirement for the Screen Format Design Utility (5719-SF1) is 16K bytes. Presentation Support (5719-SF2) executes as supervisor transients, but may be specified as resident during SYSGEN (requires an additional 6K bytes of supervisor space).

Programming Requirements: The Screen Format Design Aid Utility (5719-SF1) and Presentation Support (5719-SF2) require the following Series/1 licensed programs:

- Realtime Programming System Version 4 (5719-PC4)
- Program Preparation Subsystem Version 3 or 4 (5719-AS3 or 5719-AS4)—not required for execution of user applications.
- IBM 4978 Support Programming RPO Version 3 (5799-TCE)—required if IBM 4978 is installed.
- IBM 5250 Information Display System Attachment Support (5719-TA1)—required if IBM 5250 installed.
- FORTRAN IV Compiler and Object Support Library (5719-FO1 and 5719-FO2) and Realtime Subroutine Library (5719-FO3 and 5719-FO4)
- COBOL Compiler and Resident Library (5719-CB1) and Transient Library (5719-CB2)
- PL/I Compiler and Resident Library (5719-PL1) and Transient Library (5719-PL3)
- PL/I Compiler and Resident Library Version 2 (5719-PL2) and Transient Library Version 2 (5719-PL4)

Charges

These programs will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. Under either payment option, these programs remain the property of IBM, and are subject to the provisions of the Agreement for IBM Licensed Programs.

If the monthly charge is chosen, credit will be accrued during a continuous license period towards the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Neither the one-time charge nor the accrued license credits are transferable to other customers or between licenses, whether they are for programs which have a different program number or the same program number.

In addition, there is a one-time process charge for Presentation Support (5719-SF2) to cover the cost of distributing basic machine-readable material, including service updates.

Customer Responsibility

The customer is responsible for the installation and use of these licensed programs.

Programming RPOs

PRPQs will be accepted. Response time will depend upon complexity.

Marketing Publications

IBM Series/1 Realtime Programming System Screen Formatter User's Guide	SC34-0327
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IBM Series/1 Realtime Programming System Screen Format Design Aid Utility (5719-SF1) and Presentation Support (5719-SF2) Licensed Program Specifications	GC34-0326
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