

# ICL 2900 Series

## MANAGEMENT SUMMARY

**UPDATE:** In 1985, ICL introduced the 2900 Model 39 systems which include the 2958, 2966, and 2988 of the 2900 range. These models have been incorporated with many of the capabilities of the ICL Series 39 systems. They have OSLAN and CAFS-ISP features and support peripheral products of the ICL Series 39. ICL has also made it possible for 2900 Series machines to make use of the FDS 2500 disk units and the new LP 2000 printer.

Designed for medium and large users, the ICL 2900 Series is a compatible, field-upgradable range of 5 mainframe computers: the 2953, 2957, 2958, 2966, and 2988. The entry-level 2953 was introduced to the series in 1984 as a replacement for the 2955 model which was incompatible with the other systems.

All 2900 systems operate under the Virtual Machine Extended (VME) operating system. Most models can be extended from a single configuration to form a dual or superdual system that provides greater fault tolerance capabilities and increased power. CAFS-ISP (Content Addressable File Store—Information Search Processor), an intelligent disk subsystem which reduces data retrieval time, can be fitted to all 2900 systems. Networking facilities are provided to link other ICL products, as well as other manufacturers' machines, to the 2900.

The 2900 Series is part of ICL's Network Product Line. Other members include ICL Series 39, Distributed Resource System (DRS), System 25 minicomputer, PERQ graphics workstation, One-Per-Desk (OPD), and ICL Personal Computer. The systems within the Network Product Line share common standards and can be networked together through ICL's Information Processing Architecture (IPA).

In order to provide flexible upgrading capabilities, ICL offers single, dual, and superdual versions of most 2900



The ICL 2966 mainframe computers can be configured with single or dual processors having up to 32M bytes of store, each.

ICL's 2900 Series of 5 upgradable mainframes is designed for medium to large users. CAFS-ISP (Contents Addressable File Store—Information Search Processor) is incorporated into all models and provides fast access to large amounts of data. The 2900 machines can be used as central DP systems, network nodes, or as distributed standalone systems.

**MODELS:** 2953, 2957, 2958, 2966, 2988; 2900 Model 39 (covering the 2958, 2966, and 2988 which incorporate many features of ICL Series 39).

**CONFIGURATIONS:** 4MB to 64MB main memory, up to 6 device control units for I/O, and from 1 to 4 Order Code Processors.

**COMPETITION:** IBM 4300, 303X, and 308X families, and comparable ranges from other manufacturers.

**PRICE:** From approximately £110,000 to over £1,000,000.

## CHARACTERISTICS

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▷ systems. A single machine contains an Order Code Processor (OCP) as the central processing unit and handles internal functions such as program instructions and interrupt control, but not input/output. ICL employs separate I/O controllers within the 2900 Series.

A dual machine contains two OCPs, giving approximately 1.8 times the power of one OCP. This method provides a low-cost performance upgrade to a single processor system and resilience in case of an OCP failure. A dual system can be operated as a fault-tolerant machine consisting of two single systems if duplicate peripherals are purchased.

A superdual is an extension of the dual concept and provides a higher level of automatic recovery. Since each system component is duplicated, operation can continue during a failure without the malfunctioning part. This feature is especially useful in systems supporting a large number of online users.

All models are available in single configurations. The 2957, 2959, and 2966 can also be configured in dual and superdual versions, and the 2988 is also available as a superdual system.

In 1985, ICL introduced the 2900 Model 39 systems which are models in the 2900 Series (2958, 2966, and 2988) that incorporate many features of the ICL Series 39. They have been equipped with OSLAN local area networking capabilities and the CAFS-ISP and can be used with Series 39 peripheral products. At the present time, the 2900 Model 39 systems are filling the power gap that exists between Level 30 and Level 80 of the Series 39. Existing 2900 models can be field-upgraded to Model 39 and will be capable of supporting FDS 2500 disk devices. They can also make use of ICL's new LP2000 printer.

CAFS-ISP units can be optionally used with all 2900 systems and are standard with the 2900 Model 39 Series. CAFS-ISP enables data to be retrieved by attributes and values rather than by location, and random access to the data is provided. CAFS-ISP can search unstructured data and can be used with a query language for simple text handling.

CAFS-ISP performs the file retrieval procedure as a self-contained task, independent of the central processor. Its targeted market area includes personnel inquiries, telephone directory inquiries, analysis of reports of operating incidents, or any field with a high incidence of queries.

ICL currently provides 4 ways of exploiting the search capabilities of CAFS-ISP:

- QueryMaster, an online general inquiry package;
- RCI, Relational CAFS Interface, which offers an efficient and simple tool for Cobol programmers;
- Programming Interface for expert programmers and software houses; and

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**DISTRIBUTORS:** ICL also has offices in the following countries: Barbados, Fiji, Ghana, Iraq, Jamaica, Kenya, Malawi, Malaysia, Mauritius, Mexico, Nigeria, Pakistan, Papua New Guinea, Saudi Arabia, Singapore, Sudan, Swaziland, Tanzania, Trinidad, Uganda, United Arab Emirates, Zambia, and Zimbabwe.

**MODELS:** ICL 2953, 2957, 2958, 2966, and 2988; 2900 Model 39 systems (2958, 2966, and 2988 which incorporate many features of the ICL Series 39 systems).

### DATA FORMATS

**BASIC UNIT:** 8-bit byte. Each byte can represent one alphanumeric character, 2 BCD digits of 8 binary bits. The word of 32 bits is formed from four consecutive bytes.

**FIXED POINT OPERANDS:** 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode: one word (32 bits) or one double word (64 bits) in binary mode.

**FLOATING POINT OPERANDS:** A word consisting of a 24-bit (6 hex digit) fractional part plus a 7-bit hexadecimal exponent in long form or, in extended form, 4 words with 112-bit fractional part (28 hex digits) plus 7-bit hexadecimal exponent.

**INSTRUCTIONS:** 2 or 4 bytes in length. Most instructions are available in both forms. There also are three instruction formats. Primary format instructions are either computational or miscellaneous. Secondary format instructions are store-to-store instructions. Tertiary format instructions are conditional jump instructions.

**INTERNAL CODE:** EBCDIC (Extended Binary-Coded Decimal Interchange Code).

### MAIN STORAGE

Main storage on the 2900 series consists of at least one Store Module. Each Store Module contains up to 16MB of 64K-chip memory in 2MB or 8MB blocks.

**STORAGE TYPE:** 64K MOS chips.

**CHECKING:** All data paths between the central processor and main storage are parity checked by byte. When data is stored, an error-correcting code is substituted for the parity bits. (An 8-bit modified Hamming code is appended to each 8-byte doubleword of data.) When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected.

**STORAGE PROTECTION:** Each segment of virtual storage is protected by three codes: a 1-bit Execution Permission key, an 8-bit Read access key, and an 8-bit Write access key. Only code associated with an Execution Permission bit can be executed. When a store access is made, the contents of the Access Control Register (ACR) are compared with either the read or write key of the segment. Sixteen levels of privilege are used. Values of 0 to 9 are set by the system software and values 10 to 15 by the applications programs. Access is granted when the contents of the ACR are equal to, or less than, the key assigned to the segment.

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TABLE 1. MASS STORAGE

Subsystems	FDS 640	FDS 160	EDS 80	FDS 2500
Cabinets per subsystem	Up to 63	Up to 30	Up to 30	1 to 4
Disk packs/HDA's per cabinet	1 HDA	2 HDA's	2 HDA's	1 to 24
Capacity, MB	651.2	160.1 per HDA	79.2 per HDA	2500 MB
Average access time, msec.	25	30	30	15
Average rotational delay msec.	8.3	8.3	8.3	8.3
Data transfer rate MB/s	1.2	1.2	1.2	3.0
Controller model	DCU 1 DCU 2 DSC	DCU 1 DCU 2 DSC	DCU 1 DCU 2 DSC	HSDC

- • Pre-Selective Access Method (PSAM) which enables an existing program without recompilation to use CAFS-ISP to select records.

All 2900 models are based on the same central processing unit and provide upgrading capabilities from the entry-level 2953 to the top end 2988. The models in the lower end of the line adapt well to groups of users who are concentrating primarily on database applications. The top-of-the-line 2988 is suitable for larger users, such as universities and public utility organizations.

Model differences within the series revolve around main memory and peripheral capabilities. Main memory on the 2953 ranges from 4M bytes to 8M bytes. The 2957 and 2958 have a basic memory of 4M bytes, expandable to 16M bytes for a 2957 and 32M bytes for a 2958 superdual version. Main memory on the 2966 and 2988 extends from 8M bytes to 64M bytes in the superdual configuration.

All five models support virtual memory and virtual machine processing and use microcoded instructions. To optimize processing speed, pipelining techniques are applied throughout the range.

In order to provide software compatibility to customers of ICL's earlier 1900 and System 4 ranges, emulation capability is available on certain 2900 processors.

A large variety of peripherals is available for the 2900, with the accent on medium- to large-capacity disk drives, and on flexibility in control. In addition to disk drives, ICL offers magnetic tape drives, printers, and card and paper tape devices.

A variety of terminals are offered and connections are provided to link other members of ICL's Network Product Line, including the DRS system, System 25, PERQ, One-Per-Desk (OPD), and the ICL Personal Computer. Through IPA, terminals on these systems can access 2900 systems.

For the management of peripherals, ICL provides three control units termed DCU (Device Control Unit) 1, DCU 2, and DSC (Decision Support Controller). The DCU 1 is a general-purpose controller, while the DCU 2 has been developed to handle a very large number of disks and magnetic tapes and can have one or two CAFS-ISP modules associated with it. The DSC is similar to the DCU 2, but additionally has a CAFS-ISP fitted as standard. Periph-

► **CENTRAL PROCESSORS**

The 2953, 2957, 2958, 2966, and 2988 encompass a wide range of power and processing facilities. They are all pipeline processors permitting the overlapping of up to 6 instructions. In addition, slave stores are used. Processing speed is also enhanced by the use of 17-layer printed circuit boards which provide matched interconnections and minimize pulse distortion. High-speed, low-power LSI circuits also contribute to the same end.

Optimization of these 2900 models is further supplemented by the use of modular units, each devoted to a specialist function—such as instruction processing or store access control. These and other units can work concurrently, thus enhancing throughput.

The advantage of this modular approach is that systems can be more closely matched to user requirements and reconfiguration is also easier. Each modular unit can be isolated for repair or maintenance without interrupting operation of the system as a whole.

All models are microprogrammed and use an integrated storage system in which the main memory comprises one or more modules. Since these modules are constructed without access control circuits, they simply become blocks of memory.

These microprogrammed processors are two-stage pipeline processors consisting of an instruction scheduler to fetch and decode instructions, and microcode processor to handle operands and arithmetic instructions.

Instruction scheduling time (the time taken to fetch instructions and data) is minimized by the application of block fetch techniques.

Microcoded processors can optimize frequently used code. On ICL systems, a separate microcode exists for each operating system.

ICL refers to the central processing units as Order Code Processors to emphasize that the units do not deal with I/O but handle only program instructions, arithmetic, logic, data manipulation, and interrupts.

**SLAVE STORES:** To explain slave stores, it is necessary to examine the pipelining processes favored by ICL.

The objective of pipelining and slave stores is to speed up the execution time of instructions. This goal is achieved by dividing the Order Code Processor (OCP) into three main units—the Instruction Scheduler, the Microcode Processor, and the Store Accessing Unit.

The underlying idea of this division is to enable as much overlap as possible to take place between these three units. If overlapping within a unit can also take place, so much the better.

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eral devices are connected via couplers to interface modules on the DCU 1, DCU 2, and DSC. Management of the FDS 2500 high-capacity fixed disk is accomplished through the High-Speed Disk Controller (HSDC).

Communications couplers are available for DCU 1 which support a small 2900 network. A Network Processor System (NPS) provides communications facilities for large networks. An Open System Gateway product (OSG/2900) provides a gateway from 2900 systems into the OSLAN local area network.

The DCUs, DSC, communications couplers, NPS, and OSG/2900 can all be connected to ICL's Information Processing Architecture (IPA) for communication and networking purposes. IPA provides facilities for remote terminal access, file transfer, and automatic message routing for Transaction Processing Systems.

Disk storage comprises three fixed drives and one exchangeable drive. Access to CAFS-ISP, which offers a powerful extension to the disk drives, is provided.

Disk capacities are 160MB on the FDS 160 fixed disk, 651MB on the FDS 640 fixed disk, and 79MB on the EDS 80 exchangeable disk pack drive. With the introduction of the FDS 2500 fixed disk, which is also used on the Series 39, to the 2900 Series, mass storage capabilities have been greatly enhanced with the FDS 2500's capacity of 2500MB. The FDS 2500 disk attaches to MACROLAN through the HDSC, a microprogrammed controller, constructed on CMOS C8000 logic. Up to four FDS 2500 units can be attached to a single High-Speed Disk Controller (HSDC).

A number of magnetic tape drives, with transfer rates ranging from 60 kilobytes per second to 780 kilobytes per second are provided. All tapes are 9-track with many of them offering compressed recording capability together with features such as autoloading with tape cartridges.

Five line printers, with speeds ranging from 220 lines per minute with a 96-character set to 2000 lpm with a 48-character set, are available with the 2900 Series (see Table 2). The most recent addition to the range of printers is the LP 2000 which is also used with the Series 39.

OCR B Range Y output can be achieved by the LP1440 and LP2000 line printers if ICL-recommended stationery and printer ribbons are used. Print bands are available for use with the medium-duty LP1440 line printer that offer Danish, English, French, German, Italian, Portuguese, Spanish, Swedish, and U.S. repertoires, and in different array sizes; print bands are available for use with the heavy-duty LP2000 line printers that offer English, French, German, and Swedish repertoires and different array sizes.

ICL also markets a laser printer whose printing mechanism produces page printing rather than working on a line-by-line basis. The speed is equivalent to 21,000 lines per minute with 12 lines to the inch.

The Instruction Scheduler forms the first part of the pipeline. Its job is primarily to fetch instructions from storage and decode them—i.e., break them down into their component parts, such as operands, registers used, and addresses.

Operands are passed to the second unit, the Microcode Processor, which breaks the operands down further and executes them in part. It also performs arithmetic and other operations. Overlap between the first two units frequently occurs. When an instruction is being decoded by the Instruction Scheduler, the second unit, the Microcode Processor, is completing the processing of the previous instruction.

The third unit, the Store Accessing Unit, provides the interface between the OCP and the main store. To optimize the accesses to store, the Store Accessing Unit is equipped with two fast-access slave stores—the Data Slave and the Current Page Registers.

The Data Slave consists of 64 cells, arranged in pairs. Each cell pair can hold up to 32 bytes of data and 32 bytes of addressing information—the object being to “slave” any two 16-byte areas in virtual storage that fulfill certain conditions. Since virtual memory is large and the slave memory small, a statistical process is applied with an algorithm, resulting in new information always being placed in the cell with the least-recently used coded address. The coded address itself is worked out using a so-called “hashing” algorithm, whereby virtual storage is partially mapped on to the slave storage through the use of selected bits of the virtual storage address. To prevent errors, information left in a cell, after slaving some other part of virtual storage, is marked invalid.

The Current Page Register Slave also comprises 64-cells with each cell containing 32 bytes of data. Each cell can contain a virtual address and the corresponding real address in main store. The associative addresses are formed in a manner similar to that used in the Data Slave and through the application of a comparable optimizing “hashing” algorithm. To avoid difficulties with accessing, this Current Page Register Slave storage is updated whenever its cells do not hold the virtual-to-real address translation required for the current main storage access.

**REGISTERS:** An effectively unlimited number of 32-bit general purpose registers is available to users in the stack assigned to each virtual machine.

**ADDRESSING:** Only the stack and certain hardware registers can be addressed directly. All virtual addresses must be translated. A 64-bit Descriptor Register (DR) is used to expedite the handling of arrays and strings, as well as passing of control between tasks. There are 7 types of descriptors, each comprised of 32 bits of control information and a 32-bit address.

The virtual address of an item identifies its location by segment, by page within the segment, and by its displacement from the beginning of the page. When the address translation hardware is asked for the real address of the item, it first makes a parallel search of the Current Segment and Page Registers which hold information on items currently in either the slave store or in main memory. If the address is not in these registers, the translation hardware then searches the Segment and Page Tables to find the item's location on disk.

**INSTRUCTION REPERTOIRE:** The order code includes 113 instructions for fixed point, floating point, and decimal arithmetic, for handling character strings, for performing logical operations, and for manipulating information contained in the stack and in the stack registers. There are 43 arithmetic instructions, 14 store-to-store instructions, 3 conditional jump instructions, and 51 miscellaneous instructions.

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TABLE 2. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed Inches/Sec.	Transfer Rate, Bytes/Sec.
GTS2 310	9	6250	GCR	50	310
	9	1600	PE	50	80
	9	800	NRZI	50	40
GTS2 470	9	6250	GCR	75	470
	9	1600	PE	75	120
	9	800	NRZI	75	60
GTS2 780	9	6250	GCR	125	780
	9	1600	PE	125	200
	9	800	NRZI	125	100
MTS 61	9	1600	PE	37.5	60
Printers	Printing Speed	Print Positions	Horizontal Spacing, Chars./Inch	Vertical Spacing, Lines/Inch	Form Size, Inches
LP360	360 (48)	132	10	6 or 8	4 to 16.75 wide 8 to 14 long
	300 (64)				
	220 (96)				
LP720	720 (48)	132	10	6 or 8	4 to 16.75 wide 8 to 14 long
	600 (64)				
	440 (96)				
LP1130	1130 (48)	132	10	6 or 8	4 to 16.75 wide 8 to 14 long
	900 (64)				
	600 (96)				
LP1440	1440 (48)	132	10	6 or 8	4 to 16.75 wide 8 to 14 long
	1200 (64)				
	829 (96)				
LP2000	1440 (48)	132	10	6 or 8	—
	1640 (64)				
	1200 (96)				
LPS 14	max 21000	136/163/204	10/12/15	6/8/12	max 16 wide
Laser Printer	—	—	—	—	3 to 14 long
MICR/OCR Reader/Sorters	Type Font	Speed, Documents/Min.	Number of Stackers	Document Size, Inches	Options
CP 60	80	60	NA	NA	NA
CR 300	80	300	1000	1000	Card Image Mode
CR 1000	80	1000	1000	1000	Card Image Mode

NA—Not available.

➤ Two card readers are offered—one at 300 cards per minute and the other at 1,000 cards per minute. Both use photo-electric means of reading the cards' input.

Virtual Machine Environment (VME) is the operating system for ICL's 2900 Series. The system runs on all 2900 machines, including earlier models, and provides full program compatibility across the range. For users of earlier ICL 1900 and System 4 machines, emulation of object programs is provided under Direct Machine Environment (DME). Concurrent Machine Environment (CME) allows VME and DME to run side by side on the same processor.

VME consists of a base and a series of options which enhance throughput and control. VME is designed to handle mixed batch, teleprocessing, and interactive inputs. ➤

➤ **PHYSICAL SPECIFICATIONS**

The main cabinet of models 2953, 2957, 2958, and 2966, containing an Order Code Processor (OCP), a System Control Unit (SCU), a Device Control Unit (DCU), a Decision Support Controller (DSC) or a second DCU, and main memory, measures 170.5 by 202 by 79 cm<sup>3</sup> (height by width by depth), and weighs approximately 1,110 kg.

The main cabinet in a 2988 system contains the same modules as in the less powerful models, but is larger, measuring 170 by 268 by 79 cm<sup>3</sup> and weighing 1,480 kg.

**CONFIGURATION RULES**

All models are available in single configurations, except for the dual-machine 2953 and 2988, and the 2957, 2958, 2966, and 2988 that are offered as single or superdual systems, the difference between the dual and superdual system being that ➤

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▷ Since VME is file-oriented, ICL states that it can be used to take a central part in networks, supporting large numbers of terminals.

The virtual machine concept used by VME is designed to reduce overhead. It also prevents each job from corrupting other jobs or the system software. When a job is loaded, the operating system determines which files, services, and facilities are needed for the job. The operating system checks its catalog to be sure the job hasn't made any unauthorized requests and then defines a system that exactly meets the job's needs. At runtime, any attempt by the job to use facilities not included in its virtual machine will trigger an interrupt and halt processing of the job until appropriate action is taken.

Although a job can share system and application software with other jobs, it links itself to this code in such a way that all parameters, addresses, and variable data are stored in the job's own stack of registers, making this information inaccessible to other jobs.

In addition to the system software, ICL offers development tools including the 4th generation Application Master, a system generator for online databases. Integrated database management software based on IDMSX and ICL's Data Dictionary includes query and report facilities supported by CAFS-ISP.

A wide range of applications software is available from ICL and third-party suppliers for financial accounting and business planning, retail and manufacturing, and office systems such as electronic mail, private viewdata, and diary systems.

### COMPETITIVE POSITION

The major competition to the 2900 Series comes from IBM with the 4300, 303X, and 308X Series.

### ADVANTAGES AND RESTRICTIONS

The ICL 2900 Series is a versatile system, capable of meeting the needs of medium and large users. The smaller systems in the series adapt quite well to groups of users interested in database applications. The larger systems in the series can be used in installations with high-volume processing, such as public utility facilities.

The inclusion of a CAFS-ISP controller with the ICL machines facilitates the retrieval of file information through a system in which information is retrieved directly, rather than through a conventional string of related indices. This task is also accomplished independently of the central processor.

Users of the 2900 Series can also benefit from the capability of the range of being configured in single, dual, and superdual versions. As needs change, users can upgrade into the dual or the superdual systems. The dual system can function as a fault-tolerant machine composed of two single systems if duplicate peripherals are attached. The super-

▷ OCPs and DCUs are not cross-connected in superdual machines. Each single system comprises 1 Order Control Processor (OCP), 1 System Control Unit (SCU), 1 or 2 System Control Processors (SCPs), main memory, and a number of Device Control Units (DCUs) and Decision Support Controllers (DSCs). Dual and superdual versions contain 2 OCPs, 2 SCUs, and 2 SCPs, in addition to main memory, and DCUs and DSCs. The High-Speed Disk Controller (HSDC) is used when the FDS 2500 disk drive is selected for a configuration. Up to four FDS 2500 units can be attached to a single HSDC.

The 2953 entry model comprises a minimum of 4MB main memory and a single DCU which can be extended to include 8MB main memory and 3 more DCUs or DSCs.

In addition to the OCPs, SCUs, and SCPs, the basic 2957 single model contains 4MB of main memory, and a DCU. This can be upgraded to 8MB of main memory and 3 DSCs or additional DCUs. In the dual and superdual configurations, main memory can be extended from 8MB to 16MB.

The 2958 single system offers 4MB of main memory, extendable to 16MB, while the dual and superdual configurations provide between 8MB and 32MB. DCU and DSC limits are the same as for the 2957.

The single 2966 model contains 8MB to 16MB of main memory and a maximum of 4 DCUs, or a single DCU and 3 DSCs. In the dual and superdual versions, main memory extends from 16MB to 64MB, and up to 6 DCUs can be supported.

The top-end model, the 2988, contains a duplex OCP in both the single- and superdual configurations. The single system provides between 8MB and 16MB of main memory, and up to 4 DCUs; 3 DCUs can be replaced by DSCs. The superdual 2988 offers main memory capacity of 16MB to 64MB, and between 2 and 6 DCUs.

The CAFS-ISP can be optionally used with all 2900 systems and is standard with the 2900 Model 39 Series. CAFS-ISP enables data to be retrieved by attributes and values rather than by location, and random access to the data is provided. CAFS-ISP can search unstructured data and can be used with a query language for simple text handling.

**COMPATIBILITY:** VME software is compatible across all the 2900 models. For users of ICL's earlier 1900 and System 4 computers which have different order codes, an emulation facility allows the existing programs to run unchanged. Various conversion tools are available for customers wishing to convert programs or data to VME formats.

Emulation is provided in the form of microcoded operating system packages, with the microcode resident in the OCPs. The 2953, 2957, 2958, and 2966 can run both ordinary 2900 Series programs and emulation programs simultaneously through the use of Concurrent Machine Environment (CME). This feature allows two operating systems to be run together—Direct Machine Environment (DME) for the old machines and Virtual Machines Environment (VME) for the 2900 Series. CME is available in various forms to accommodate differing combinations of old and new machine software.

### INPUT/OUTPUT CONTROL

**DEVICE CONTROL UNIT 1 (DCU 1):** The DCU 1 is a microprocessor-controlled general purpose controller which is available on all five members of the series. It can be configured to a user's specific peripheral and communications needs. Connection of devices to the DCU 1 is effected through specialized couplers which support: up to 16 fixed (FDS) or exchangeable (EDS) disk drives and/or up to 7

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▷ dual version offers a higher level of automatic recovery features than the dual because each system component has been duplicated. A superdual system is quite beneficial to installations with a great number of online users.

Running under the VME operating system, the ICL 2900 Series can accommodate a variety of applications including mixed batch, teleprocessing, and interactive. A file-oriented system, VME can play a key role in supporting networks with large numbers of terminals. A vast amount of software can be run under VME from ICL and third parties.

The introduction of the 2900 Model 39 concept into three of the current models in the ICL 2900 series offers users a smooth upgrade path to the new ICL Series 39.

ICL has incorporated common standards and networking capabilities into its Network Product Line consisting of the DRS systems, System 25 minicomputer, PERQ graphics workstation, One-Per-Desk, and ICL's Personal Computer, assuring users of compatibility.

A great deal of attention has been paid to communications capabilities in the series. The Synchronous Multi-Line Communications Coupler handles small to medium communications requirements and supports ICL's XBM protocol. Adapters are offered for X.25. ICL also offers an IBM 2780/3780 protocol converter and an ICL Bulletin Link Unit to be used with the Bulletin private viewdata system.

The Network Processor System supports a range of networking facilities, including ICL's XBM and X.25. The Information Processing Architecture (IPA) corresponds to IBM's SNA. The Open Systems Gateway enables 2900 computers to be linked into the OSLAN local area network.

The recent introduction of the FDS 2500 fixed disk subsystem, equipped with a capacity of 2500MB, into the 2900 Series more than doubles the storage capacity that was previously available to users. ICL's decision to release some of the peripherals developed for the Series 39, such as the FDS 2500 and the LP2000 line printer, for use with the 2900 Series demonstrate the firm's commitment to enhancing the 2900 line and facilitating the migration of users who choose to do so into the 39 Series.

The ICL 2900 Series sold well during 1985, testifying to its strength in the market. Its broad range of peripherals and software are attractive features to buyers, as well as its competitive pricing.

### USER REACTION

The most recent Datapro Survey of British Users of Mainframes elicited responses from 161 users of the ICL 2900 Series. The average life of the system totaled 35.35 months.

Major applications areas for all models included accounting/billing, payroll/personnel, order processing/inventory control, and purchasing. Database management systems were used by 61.49 percent of the respondent. Integrated office automation functions were in operation on 12.42

▶ serial devices such as magnetic tape drives and printers, together with up to 15 communications lines via two Synchronous Multi-Line Communications Couplers (SMLCCs).

**DEVICE CONTROL UNIT 2 (DCU2):** The DCU2 has a very high throughput rate (4 megabytes/second) and can support up to 32 disk drives—giving, for example, well over 20 gigabytes of FDS 640. Connections are also provided for line printers, card readers, magnetic tape units, and the CAFS-ISP units.

**DECISION SUPPORT CONTROLLER (DSC):** The DSC is similar to the DCU2, but also contains the CAFS-ISP unit within it.

**HIGH-SPEED DISK CONTROLLER (HSDC):** The High-Speed Disk Controller (HSDC) is used with the FDS 2500 high-capacity fixed disk. The HSDC is a microprogrammed controller constructed around CMOS C8000 logic. Up to four FDS 2500 units can be attached to a single HSDC.

**MASS STORAGE:** See Table 1.

**INPUT/OUTPUT UNITS:** See Table 2.

### COMMUNICATIONS

**SYNCHRONOUS MULTI-LINE COMMUNICATIONS COUPLER (SMLCC):** The SMLCC is designed for small- to medium-extent communication requirements. A maximum of two SMLCCs can be fitted to a DCU1, and these can have up to 15 lines attached with a maximum line speed of 9600 bits per second (bps). ICL's XBM protocol is supported. Adapters are available for other protocols including X.25. One SMLCC is included in each 2900 system.

An IBM 2780/3780 protocol converter is available, as is the ICL Bulletin Link Unit (BLU) for use with the Bulletin private viewdata system.

**NETWORK PROCESSOR SYSTEM (NPS):** A communications processor provides a range of networking facilities. Up to four 2900 systems can be linked together. The basic cabinet contains the main processor, main memory, dual diskette drives, up to 4 high speed local mainframe interfaces, and network interfaces for a maximum of 24 communications lines. A video console is provided for system control. The addition of 4 expansion cabinets provides a total of 256 communications lines.

The Network Processor's operating system (NP-OS) is loaded from one of the host mainframes and establishes the environment to control the user's network and to route messages and data between devices. Protocols supported are ICL's XBM, asynchronous, and X.25.

**INFORMATION PROCESSING ARCHITECTURE (IPA):** Corresponding to IBM's SNA, IPA offers a wide range of facilities for distributed computing and for networking most of the ICL product range. These facilities include the ability to transfer jobs, program code and bulk output from one system to another, distribute TP applications between a number of cooperating systems, and provide access to a remote service through a user's local system. IPA will be the reference point for future ICL communications and networking products in both the hardware and software areas.

**OPEN SYSTEMS GATEWAY (OSG/2900):** OSG/2900 enables 2900 mainframes to be linked into the OSLAN local area network. OSG/2900 can be interfaced to a DCU or DSC. All IPA facilities can be used on the link with OSLAN to support file transfers and applications interworking.

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▷ percent of the systems. Information Centers had been initiated on 18.01 percent of the installations. Micro-to-Mainframe links had been established by 67.70 percent of the users.

In response to the question "Did the system do what you expected it to do?", 87.58 percent of the users answered affirmatively.

To the question "Would you recommend the system to another user?", 72.67 percent responded affirmatively.

Users were asked to evaluate the different aspects of their systems under the headings Excellent, Good, Fair, and Poor. The weighted average obtained is based on a scale of 4.0 for Excellent. The system ratings are summarized in the following table.

	<u>Weighted Average</u>
Ease of Operation	2.83
Reliability of Mainframe	3.11
Reliability of Peripherals	2.98
Maintenance Service:	
Responsiveness	2.93
Effectiveness	2.90
Technical Support:	
Troubleshooting	2.41
Education	2.76
Documentation	2.36
Manufacturer's Software:	
Operating System	3.17
Compilers & Assemblers	3.04
Applications Programs	2.41
Ease of Programming	2.70
Ease of Conversion	2.44
Overall Satisfaction	2.80 □

### ► SOFTWARE

**OPERATING SYSTEM:** All 2900 systems run under the VME (Virtual Machine Environment) operating system which offers facilities for the provision and control of a powerful mixed-mode computing service to users with differing needs.

VME offers a number of methods of working that can be used in any combination:

- Multiple Access Computing (MAC)
- Transaction Processing Management (TPM)
- Local Batch
- Remote Job Entry (RJE).

MAC enables users to have immediate interactive access to the system via local or remote terminals. It includes HELP, screen editing, and program development facilities.

The VME Transaction Processing Management System (TPMS) provides direct connection between the terminal user and applications software. TPMS supports multiple applications within one service while VME will support

multiple TP services if required. Data and message security and recovery features are available within TPMS. TPMS provides facilities to interface to ICL's IDMS database system, using high-level languages.

Batch facilities are controlled from an operator's local or remote workstations. Remote job entry provides a method of submitting batch work from a remote location and receiving output back if required.

The DME (Direct Machine Environment) operating system, which permits emulation of earlier ICL products such as the 1900 and System 4 machines, can run concurrently with VME under CME (Concurrent Machine Environment). CME is optionally available with the 2900 Series.

**LANGUAGES:** Algol, APL, Basic, Cobol, Fortran, Pascal, and RPG II compilers are available.

**Basic:** The Basic interpreter follows the informal standards set by Dartmouth Basic and by the National Computing Centre and incorporates a number of capabilities not included in earlier ICL versions of the language.

**Cobol:** This compiler follows the guidelines used in developing American National Standard (ANS) Cobol-74 and offers capabilities equal to the highest level of all ANS modules except Report Writer and Communications, which are not implemented. Report Master can be used for preparing reports, and the ACCEPT and DISPLAY verbs can be used to provide transaction processing facilities. ICL has added a number of extensions to the standard, including floating-point arithmetic, and has removed a number of restrictions.

**Fortran:** This compiler is based on American National Standard (ANS) Fortran, and includes, among its enhancements, facilities for handling direct-access files. ICL also offers an Optimizing Fortran Compiler (OFC) that produces more efficient code but requires longer compilation times.

**Pascal:** The Pascal compiler is fully compatible with ISO standards, and conforms to the Jensen and Wirth compiler.

**DATABASE MANAGEMENT:** ICL offers an integrated set of products constructed around the Data Dictionary System (DDS), which is a complete system for the documentation of all aspects of applications development.

**IDMS (Integrated Database Management System):** IDMS is a Codasyl implementation. An enhanced version, IDMSX, is available for high-throughput systems that require advanced recovery facilities.

**ReportMaster:** This system assists in the generation of reports and extraction of information from files.

**QueryMaster:** An online inquiry facility, QueryMaster can utilize the power of CAFS-ISP to speed up inquiries.

**PDS (Personal Data System):** PDS enables non-DP personnel to maintain their own data files. It includes data manipulation and enquiry facilities. Both PDS and QueryMaster use the same language which gives a relational view of the data.

**RCI (Relational CAFS Interface):** RCI offers Cobol programs a relational interface to IDMS data and other files. CAFS-ISP is used to provide fast access.

**APPLICATIONS PROGRAMS:** ICL offers a variety of packages under VME for many areas, including accounting, business, central and local government, information processing, manufacturing industries, and management sciences. Brief descriptions of some of the programs follow: ►

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- ▶ **BACSTER (Bankers Automated Clearing Services Transfer Exchange Routines):** A system of accounting, payroll, and personnel;
- BUDGET 29:** Budgeting program which gives management and variance accounts, and includes individual company and account structures;
- FINAPL:** A financial modeling package under APL;
- PROSPER STAR:** A table-based financial modeling package;
- DILIS:** Direct labor management package for local government;
- HMIS:** Housing management system for local government housing, which includes management of rentals and repairs;
- LAFIS:** Financial package including ledgers, analysis, budgeting, and statistical functions;
- PLANAPS:** Planning Application System which generates minutes, reports, and letters;
- SOCSIS:** On-line Social Services System which holds records and offers assessment features;
- UHBS:** Unified Housing Benefit System which automates handling of the U.K. Housing Benefits legislation;
- BULLETIN:** ICL's private viewdata system which provides a window facility;
- COMMITTEE MINUTES:** Storage and retrieval of meeting minutes and reports;
- EXECUTIVE ACTION:** An office system that includes electronic filing, diary, mail, and telephone directory facilities;
- STATUS:** A system for storing large files of text and retrieving selective information from these files;
- OMAC 29:** A group of packages for online manufacturing which includes database, materials requirement, and multiple site/stock planning systems;
- PLANNED MAINTENANCE:** Repair and maintenance scheduling system;
- ICL ADVISER:** A program that offers specialized techniques for understanding regulations or procedures, including those requiring links to TP systems and databases;
- PACKAGE X:** A system for the analysis and management of numerical data;
- PERT:** A management system for the planning and control of projects;
- REVEAL:** An advanced planning, forecasting, and analysis system for managers and professionals;
- Application Master:** A 4th generation system generator for online database systems;
- Quickbuild:** A fast application development system for departmental applications;

- Program Master:** An integrated package for Cobol program development;
- STRUCTURES:** An engineering package that performs analyses of skeletal structures for member and restraint reaction, forces and moments, as well as joint, linear, and rotational displacements; and
- GINO:** A suite of programs containing routines which produce graphics charts and 2-D and 3-D drawings.

A wide range of third-party software is also available, covering applications for accounting, banks, central and local government, information processing, management sciences, manufacturing industries, and retail and distribution.

Packages are also supplied by ICL and third parties to run under the DME operating system.

### PRICING AND SUPPORT

**DIAGNOSTICS:** ICL's service and support strategy is based upon Service Desks and the Remote Support Centre. Automatic Diagnosis and Error Management System (ADEMS), running under VME, serves as the onsite software component of this support strategy. Within the ADEMS framework, ICL provides analytical tools and diagnostic aids, maintenance and media control facilities, control of online test software, and an incident management system with up-to-date information about all incidents under investigation.

ADEMS maintains its own online database containing details of all system-detected events, as well as the observed incidents reported to it by operations staff. The database assists in the local or remote management of problem resolution and preventative maintenance.

ICL maintains a central Maintenance Database which holds details of all known problems and corrections available. Information from this database is used by ICL Support Centers and customers.

**MAINTENANCE:** For purchased or leased systems, the minimum period of maintenance is 8 consecutive hours between 8 a.m. and 6 p.m. Monday to Friday. Charges outside this period vary according to specific configurations. Hours of service can vary from country to country.

**EDUCATION:** Courses, which must be paid for separately by the user, cover systems appreciation, programming, and operations. Training for all levels of management is also available. In some cases, training can be conducted on customer premises. Video and cassette training modules for onsite or home use can be obtained from ICL.

**DOCUMENTATION:** A comprehensive range of documentation is available to cover all products within the 2900 Series. Some manuals are supplied with the products, but generally documentation is priced separately.

### PRICING

The ICL 2900 Series systems are available for purchase or lease on an unbundled basis. All software is subject to a license fee, normally charged on a quarterly basis but sometimes structured on a capital basis either instead of, or in combination with, monthly charges. Maintenance charges are also not included. ▶

## ICL 2900 Series

### EQUIPMENT PRICES

	Purchase Price (£)	Quarterly Hire (5 yr.) (£)	Quarterly Maint. (£)
<b>ICL 2953 VME ENTRY LEVEL</b>			
Processor, 4MB main memory, Device Control Unit (DCU), Operating station, Peripheral couplers with Synchronous Multiline Comms. Coupler for 7 lines 3 x FDS 160 fixed disks of 160MB each: 2 x EDS 80 exchangeable disk of 80MB: LP 360 printer	112,427	Not possible	2,783
Basic systems software license including VME, Cobol, DDS	2,403/qtr.	—	—
<b>ICL 2957/VME SYSTEM</b>			
Processor, 4MB main memory, 1 x DCU 1, 1 x DSC, 1 x SMLCC for 7 lines, 2 x MDSS fixed/exchangeable disk drives with 80MB on exchangeable disk and 160MB fixed disk, one MT60 magnetic tape, one LP 360 lpm line printer	224,719	14,658	3,538
Basic systems software license, including VME, Cobol, DDS	2,403/qtr.	—	—
<b>ICL 2958 VME SYSTEM</b>			
Processor, 4MB main memory, 1 x DCU 1, 1 x DSC, operating station, peripheral couplers with a Synchronous Multiline Comms. Coupler for 7 lines 2 x FDS 160 160MB fixed disk drives, 2 x EDS 80 80MB exchangeable disk drives, 2 x FDS 640 640MB fixed disk drives, 2 x GTS 310 magnetic tape drives, 1 x LP 720 printer	362,285	23,628	4,873
Basic systems software license	3,195/qtr.	—	—
<b>ICL 2966 VME SYSTEM</b>			
Processor, 8MB main memory, 1 x DCU 1, 1 x DSC, operating station, peripheral couplers and Synchronous Multiline Comms. Coupler for 15 lines, 2 x FDS 160 160MB fixed disk drives, 2 x EDS 80 80MB exchangeable disk drives, 4 x FDS 640 640MB fixed disk drives, 2x GTS 470 470KB/sec. magnetic tape drives, LP 1130 printer	558,958	36,462	5,841
Basic systems software license	4,782/qtr.	—	—
<b>ICL 2988 VME SYSTEM</b>			
Two processors (duplex), 8MB main memory, 1 x DCU 1, 2 x DSC, operating station, peripheral couplers and Synchronous Multiline Comms. Couplers for 15 lines, 2 x FDS 160 160MB fixed disk drives, 2 x EDS 80 exchangeable disk drives, 6 x FDS 640 640MB fixed disk drives, 2 x GTS 780 780KB/sec. magnetic tape drives, 1 x LP 1130 printer	814,368	53,124	7,534
Basic systems software license	6,207/qtr.	—	—