Data General Nova 4 Series
(Preliminary Report)

MANAGEMENT SUMMARY

Data General has introduced a family of three Nova 4 computers that feature "up to 50 percent faster speed than the Nova 3, improved reliability/maintainability, and greater economy than ever available in the Nova line." It would appear that the new line will replace the Nova 3's.

The new models include the compact Nova 4/C, featuring a complete 64K-byte computer on a single circuit board; the standard Nova 4/S, a higher-performance model with up to 64K bytes of memory implemented on two boards; and the extended memory Nova 4/X, which features a standard memory management and protection capability, allowing a 256K-byte computer to reside on two boards.

In a computational environment such as semiconductor testing, the Nova 4/C can be incorporated into automated test equipment. When higher performance is needed, as in a front-end image processing system, the speed and I/O capabilities of the Nova 4/S can meet the requirements. The Nova 4/X can support dual operations under the RDOS operating system in retail or other commercial applications. This capability allows it to run a multi-terminal data entry program in the foreground while processing a remote job entry or local batch program in the background. ▷

The new Nova 4 family of computers consists of the Nova 4/C, featuring a complete 64K-byte computer on a single circuit board; the Nova 4/S, a higher-performance model with up to 64K bytes on two boards; and the extended-memory Nova 4/X with a standard memory management and protection capability, allowing a 256K-byte computer to reside on two boards.

CHARACTERISTICS

MANUFACTURER: Data General Corporation, Route 9, Westboro, Massachusetts 01581. Telephone (617) 366-8911.

Data General is a leading manufacturer of minicomputers, peripherals, and associated equipment. The company maintains sales offices in most major North American cities and in South America, Europe, and Australia. Manufacturing operations are located in Southboro, Massachusetts; Westbrook, Maine; Portsmouth, New Hampshire; and Sunnyvale, California. Assembly operations are also performed in Hong Kong and in Thailand.

MODELS: Nova 4/C, 4/S, and 4/X.

DATE ANNOUNCED: December 1978.

AVAILABILITY: Nova 4/S and 4/X, 90 days; Nova 4/X, 150 days. ▶

The Nova 4 computers feature up to 50 percent higher speeds than the Nova 3's. The microprogrammed Nova 4 Series incorporates the architectural features of the Nova 3 computers, including hardware stack and frame pointer, high-speed direct memory access (DMA) channel, and 16-level priority interrupt structure.

PRELIMINARY REPORT: This presentation on the Data General Nova 4 Series is based on limited information that was supplied by the manufacturer, and on comments from other industry sources. As such, it is incomplete and subject to change. A full report on the Nova 4 will be published when full documentation and pricing is released.

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▷ All three Nova 4 computers offer significant enhancements over the Nova 3 line in performance, function, and economy, according to Data General. The Nova 4/C packs the speed of a Nova 3 computer on a single board, and the Nova 4/S and 4/X models feature 50 percent higher speed than the Nova 3. Increased performance also results from instruction set enhancements, which add new byte manipulation and integer arithmetic capabilities to the Nova 3 instruction set.

The Nova 4 CPU board contains an asynchronous terminal interface, real-time clock (optional in the Nova 4/C), memory management and protection unit (Nova 4/X only), automatic program load, power fail/auto restart, virtual console, and optional hardware multiply/divide. In the Nova 4/C, the CPU board also contains up to 64K bytes of MOS memory.

The microprogrammed Nova 4 line incorporates most of the architectural features of the Nova 3 computers, including hardware stack and frame pointer, high-speed direct memory access (DMA) channel, and 16-level priority interrupt structure. The Nova 4/S and 4/X models have a number of advanced performance features. A pre-fetch processor boosts performance by storing instructions in a high-speed buffer in the CPU, eliminating the memory fetch cycle in most cases. High-speed 400-nanosecond memories are accelerated with standard four-way interleaving, allowing the pre-fetch processor to load instructions at a 20-megabyte/second rate and reducing memory conflicts on memory modification instructions. These features result in typical instruction execution times of 400 nanoseconds for a store and 200 nanoseconds for an add. Performance can also be increased with the optional Floating-Point Unit (FPU), which operates in parallel with the CPU and is considerably faster than previous Nova FPU's. For example, the FPU executes a double-precision store in 200 nanoseconds and a double-precision add in 1.6 microseconds.

Memory boards are available in 32K- and 64K-byte increments for the Nova 4/S and in 32K-, 64K-, 128K-, and 256K-byte increments for the 4/X. The Nova 4/C is available with 16K, 32K, or 64K bytes of memory on the CPU board. Memory management and protection hardware in the Nova 4/X performs logical-to-physical address translation, providing user programs with access to 256K bytes of main memory through four address extension tables, or maps: two program maps and two data channel maps. The Memory Management and Protection Unit (MMPU) also supports privileged instructions, I/O device protection, and main memory write and validity protection. This allows multi-user activities to occur in a hardware-protected environment.

Nova 4 system and application software is executed under Data General's multitasking Real-Time Disk Operating System (RDOS), Real-Time Operating System (RTOS), or Disk Operating System (DOS). Nova 4 language support includes FORTRAN IV with ISA real-time extensions, globally/locally optimizing FORTRAN 5, Business BASIC, single- and multi-user

▶ DATA FORMATS

BASIC UNIT: 16-bit word or 8-bit byte.

FIXED-POINT OPERANDS: 16-bit words can be interpreted as signed or unsigned binary numbers, logical words, memory addresses, or portions of decimal character strings.

FLOATING-POINT OPERANDS: All Nova processors can implement single- and double-precision floating-point arithmetic through software subroutines. With the optional Floating-Point Unit (FPU) on the 4/S and 4/X, single- and double-precision arithmetic can be handled by the hardware.

INSTRUCTIONS: One-word instructions. There are four basic instruction types; each with a different format: Jump and Modify Memory, Move Data, I/O, and Arithmetic and Logic. The instruction repertoire includes the Nova 3 instruction set plus local byte, store byte, and signed multiply and divide.

MAIN STORAGE

TYPE: 4K-chip MOS RAM for 64K-byte memory increments, 16K-chip MOS RAM for 128K- and 256K-byte memory increments; both chips employ N-channel, silicon-gate technology.

CYCLE TIME: 400 nanoseconds, with four-way memory interleaving.

CAPACITY: 16,384, 32,768, or 65,536 bytes for the Nova 4/C; 32,768 or 65,536 bytes for the Nova 4/S; 131,072 to 262,144 bytes for the Nova 4/X.

STORAGE PROTECTION: A memory management and protection unit (MMPU) is available on the Nova 4/X for expanding the memory capacity to 256K bytes, protecting memory, and restricting physical-level I/O device access from user programs. The MMPU divides main memory into 2K-byte pages.

RESERVED STORAGE: Certain low-end memory locations are reserved for use during interrupt servicing, MMPU protection processing, stack fault processing, and power failure. Sixteen locations are reserved for increment and decrement registers.

CENTRAL PROCESSORS

GENERAL: The Nova 4 high-density architecture allows a 64K-byte Nova 4/C to be configured on one board, and a 64K-byte Nova 4/S or 256K Nova 4/X to be configured on two boards. The Nova 4's feature Nova 3 stack capabilities, similar to those of the Eclipse series. The Nova 4/C is housed in a 5-slot chassis, and the Nova 4/S and 4/X are housed in a 16-slot chassis. The Nova 4's use a horizontally microcoded CPU implementation for overlap, and a look-ahead prefetch processor also increases performance. An optional battery back-up system can support a single board of memory for 30 minutes on the 4/C and for 90 minutes on the 4/S and 4/X.

CONTROL STORAGE: None.

REGISTERS: All Nova 4 processors have four 16-bit accumulators and a 15-bit program counter. Two accumulators can be used for address indexing.

ADDRESSING MODES: Direct addressing of 1024 words via absolute, relative, and indexed modes; multilevel indirect addressing of 32,768 words; stack addressing on a last-in, first-out basis and on a random-indexed basis. ▶

▷ extended BASIC, and ALGOL. Communications support includes the Communications Access Manager (CAM), the Sensor Access Manager (SAM), and the RJE 80 (IBM 2780/3780) and HASP II remote batch terminal emulators.□

▶ **INSTRUCTION REPERTOIRE:** All Nova 4's have the same basic complement of 4 Jump and Modify Memory instructions, 2 Move Data instructions, 2 byte manipulation instructions, 7 stack processing instructions, 16 I/O instructions, and 8 arithmetic and logic instructions. (There are 256 variations on each of the arithmetic and logic instructions.) Hardware multiply/divide instructions are available as options.

The optional Floating-Point Unit adds 31 I/O-format instructions to the basic set; this option is not available for the Nova 4/X.

INSTRUCTION TIMINGS: Not available.

INTERRUPTS: A 16-level programmed priority interrupt facility is used to recognize interrupts for I/O operations.

PHYSICAL SPECIFICATIONS: All Nova processors are housed in either 5.25-inch (5-slot) or 10.5-inch (16-slot) high chassis which are 19 inches wide and approximately 28 inches deep. Weights vary from 40 to 130 pounds fully loaded. The expansion chassis weighs 130 pounds fully loaded. Four AC line voltages are available: 100v, 120v, 220v, or 240v, all operable within the range of 47 to 63 Hz at maximum load. Power consumption is 1000 watts for a fully loaded 16-slot chassis. Recommended operating environment for the Nova 4 computer systems is between 68°F (20°C) and 86°F (30°C), but temperatures between 32°F (0°C) and 130°F (55°C) can be tolerated. Non-condensing humidity of up to 90% can be tolerated.

INPUT/OUTPUT CONTROL

One (4/C) or two (4/S and 4/X) memory busses and a Direct Memory Access (DMA) channel are standard on all Novas. Various high-speed options are available. The DMA data channel provides a multiplexer-like capability and can be seized by any device through a data channel request to handle 16-bit data transfers to and from main memory. In high-speed mode, the maximum word transfer rates per second are: Nova 4/C—625K in, 500K out; Nova 4/S and 4/X—1000K in, 710K out.

CONFIGURATION RULES

The actual number of devices that can be attached to a particular Nova depends upon the available slots in the basic chassis and any available chassis extensions. The expansion chassis provides an additional 12 slots and mounts above the computer chassis.

In general, all peripheral I/O interface subassemblies/controllers require one slot. These include applicable units for reel-to-reel magnetic tape drives, cassette drives, printers, punched card equipment, paper tape units, terminals, plotters, and disc units. Also requiring one slot each are the I/O interface subassembly for the real-time clock, the bus control card, and various communications controllers.

MASS STORAGE

All Data General disc subsystems can be accessed by two controllers to allow dual-processor, shared-disc systems.

6030 FLOPPY DISC SUBSYSTEM: Consists of a four-drive controller and either a 6030 single drive or a 6031 dual drive. Maximum storage capacity is 1.26 million bytes on a four-drive subsystem.

6063 AND 6064 FIXED-HEAD DG/DISC SUBSYSTEMS: Consist of a four-drive controller plus up to four 1-megabyte 6063-A disc drives or up to four 2-megabyte 6064-A drives. Either subsystem can be expanded with 1- or 2-megabyte drives for a total of from 4 to 8 megabytes.

6045/46/47/48 CARTRIDGE DISC SUBSYSTEMS: Each subsystem consists of a controller and up to four 10-megabyte, top-loading cartridge disc drives. These subsystems, configured with one, two, three, and four cartridge disc drives, are respectively designated the Model 6045, 6046, 6047, and 6048.

6070 CARTRIDGE DISC SUBSYSTEM: Consists of essentially the same components and specifications as the 6045 subsystem, except for a doubled recording density resulting in twice the storage capacity and a doubled data transfer rate.

6060, 6061, AND 6067 DG/DISC STORAGE SUBSYSTEMS: Consist of a 96-, 190-, or 50-megabyte disc pack drive and a controller for up to four drives. Thus, the same controller can handle from 50 to 760 megabytes of on-line storage.

INPUT/OUTPUT UNITS

Peripherals include two 75-ips vacuum-column tape subsystems featuring 800-bpi seven- or nine-track recording or 800/1600-bpi switch-selectable nine-track recording. Data General also offers the Dasher display family, 30- and 60-cps Dasher terminal printers, and a 180-cps bidirectional line printer, as well as the Communications Subsystem (DG/CS), Data Acquisition and Control Subsystem (DG/DAC), intercomputer adapters, direct IBM 360/370 interfaces, and a line of paper tape reader/punch equipment. Also available is a family of 300-, 600- and 900-lpm line printers, and a card reader.

COMMUNICATIONS CONTROL

The DG/CS Communications Subsystem is a hardware and software system that is modular in nature. It is composed of the ALM-16 and ALM-8 Series asynchronous multiplexers, the SLM-2 Series asynchronous multiplexers, the 4251 Communications Chassis, and the DCU/50 Data Control Unit. The CAM Communications Access Manager provides software support for teletypewriter terminals and Bisync line protocol.

Low-to-medium-performance applications use the appropriate multiplexers in the 4251 chassis, which is connected directly to the host computer I/O bus. For high-performance applications, the DCU/50 is inserted as a "peripheral processor" between the host CPU and the communications subsystem.

The DG/CS is supported by the RDOS, mapped RDOS, and RTOS operating systems. Other software support includes Data General's HASP Work Station Emulator, DCU-resident physical I/O routines, and the aforementioned CAM.

DCU/50 DATA CONTROL UNIT: Provides a dedicated communications controller consisting of a Nova processor with 4K words of local memory on a single card that plugs into the host computer chassis.

COMMUNICATIONS SOFTWARE

COMMUNICATIONS ACCESS MANAGER (CAM): Supports all types of communications, with or without the DCU/50 Data Control Unit. SLM-2, ALM-8, and ALM-16 are supported under CAM, as well as the DCU/50. ▶

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▶ REMOTE JOB ENTRY CONTROL PROGRAM (RJE80): Allows for remote job entry and communications between Nova processors and other Data General computers.

SOFTWARE

Three levels of system control programming are available for various configurations of the Nova systems. Each of these includes an appropriate level of language processors and utility programs.

Real-Time Disc Operating System (RDOS) is a full-scale operating system that supports multi-tasking. It can schedule and allocate program resources to many different sub-program tasks.

Real-Time Operating System (RTOS) is an upward-compatible subset of the Real-Time Disc Operating System (RDOS). RTOS provides standard interrupt servicing, device handling, and executive scheduling functions. RTOS is modular and re-entrant, and provides the user with a library of modules for system, task, and device processing. It also provides executive functions that schedule task execution.

Disc Operating System (DOS) is another upward-compatible subset of the Real-Time Disc Operating System (RDOS). Features provided by DOS include a comprehensive disc and tape file system, device-independent file transparency, multi-tasking facilities, user program segmentation, and interactive program development via the DOS Command Line Interpreter (CLI). Besides CLI, DOS operates with other Data General system software including the test editor, library file editor, and relocatable loader. DOS supports up to 32K words of memory and the full range of peripherals available from Data General.

Please refer to Report M11-304-101, on the Data General Nova Series, for more detail on RDOS, RTOS, and DOS.

LANGUAGES: Four high-level compiler languages are available for use on the Nova 4 computers: FORTRAN 5, single- and multi-user Extended BASIC, Business BASIC, and ALGOL.

FORTRAN 5 is a superset of Data General's FORTRAN IV, ANSI FORTRAN, IBM FORTRAN IV (H Extended), and Univac FORTRAN V. Special compiler features include global code optimization, comprehensive error checking and diagnostics, and re-entrant code.

Extended BASIC is the enhanced version developed at Dartmouth College. It is an interpretive system that provides interactive program entry, debugging, and execution. Extended BASIC is a scientific language including powerful matrix handling, full math and trig function support, and string manipulation extensions.

Business BASIC, developed as a spin-off of the still-viable RDOS Extended BASIC, can be run under RDOS or Mapped RDOS. Mapped RDOS users can run Business BASIC as a time-sharing system in one partition while concurrently running a batch, time-sharing, or real-time job in the second partition.

Extended ALGOL is a superset of ALGOL 60 with capabilities that allow simplified, free-form I/O or formatted output, bit manipulation, manipulation of character-string data, recursive and re-entrant procedures, dynamic storage allocation, n-dimensional arrays, multi-precision arithmetic, dynamic type conversion for program variables, and explication diagnostics.

PRICING

POLICY: Data General offers the Nova series on a purchase-only basis.

EQUIPMENT: The following system purchase prices include all required control units, adapters, and cables.

MODEL 8390-H: Consists of a Nova 4/C with 64K bytes of MOS memory, asynchronous interface, automatic program load, power fail/auto restart, and 5-slot chassis. Purchase price is $3,500.

MODEL 8393-H: Consists of a Nova 4/S with 64K bytes of MOS memory, asynchronous interface, real-time clock, automatic program load, power fail/auto restart, and 16-slot chassis. Purchase price is $7,600.

MODEL 8395-N: Consists of a Nova 4/X with 256K bytes of MOS memory, floating-point processor, MMPU, asynchronous interface, real-time clock, automatic program load, power fail/auto restart, 16-slot chassis, battery backup, 20-megabyte disc with six cartridges, 800-bpi, 75-ips magnetic tape subsystem, 180-cps LP2 printer, four 6053 displays, and 2-bay cabinet. Purchase price is $56,886. ■