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The New Apple II

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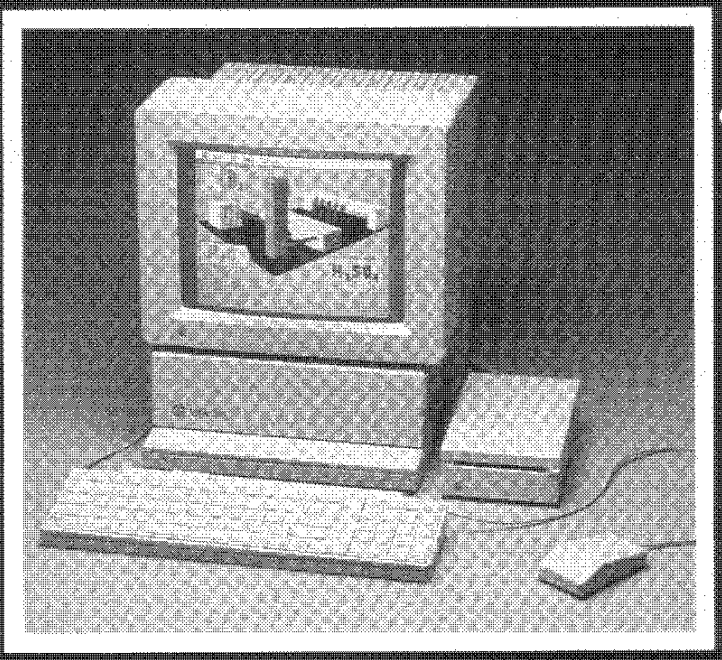

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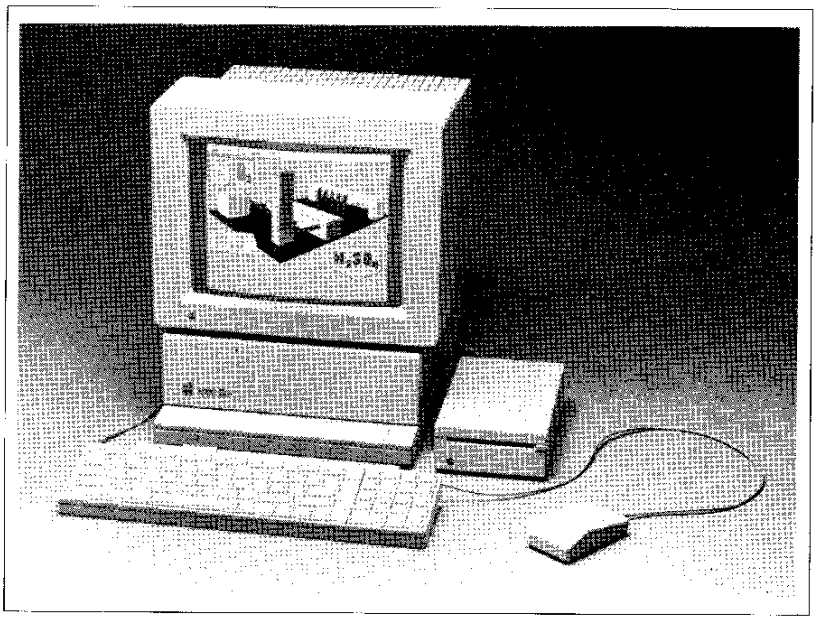
Features

The Apple II Evolves: First Impressions of the New Apple IIGS

Don Elman



THE rumors have been around for years. Someday, many astute observers believed, Apple was bound to come out with a 16-bit model of the Apple II. Eight-bit microprocessors like the 6502 are approaching an advanced stage of obsolescence, and all the major players among micro manufacturers are proudly hawking their competing 16-bit (or greater) models—including Apple's own Macintosh. The advantages of the newer microprocessor technology, in terms of both speed and direct memory capacity, are obvious to anyone who understands the difference between a bus and a byte.

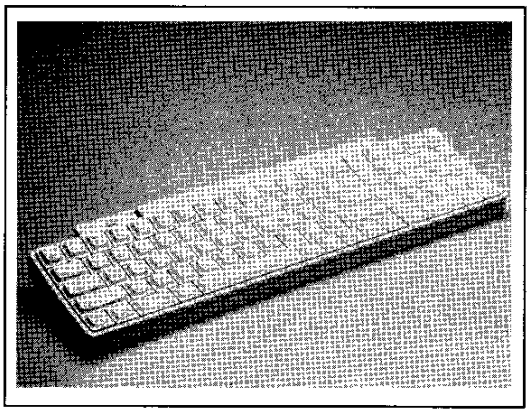
Well, on September 15th, Apple finally turned the rumors into reality. With the introduction of the IIGS, the Apple II family has reached its highest stage of evolution, sporting a new and improved CPU, new audio and video output capabilities, a totally new external appearance, and a human interface modeled after the Macintosh (with the bonus of color). Yet, the IIGS retains solid ties with the massive, existing base of Apple II software and hardware, while providing a greater degree of hardware compatibility with the current Macintosh—at least to the extent of similar ports, shared peripherals, etc. All in all, it's a pretty slick package. Now let's take a closer look at what it could mean for you, the user, and for the microcomputer market in general.

What's In a Name?

To fully appreciate the significance of the new computer, you should understand three things about how a big corporation like Apple operates in the realm of product development. First, there are always many more projects being planned or developed than ever see the light of day. Only those judged commercially viable are likely to reach the final stages of production and marketing. Second, the company tries to impose absolute secrecy on any advance public information about new products or features being developed—right up to the official announcement day. Presumably, this tight security helps to slow down the competitors and heighten the product's impact when it is finally revealed. Third, it's practically inevitable

that marketing considerations will heavily influence the shape, name, price, and manner of introduction for any product that is brought out.

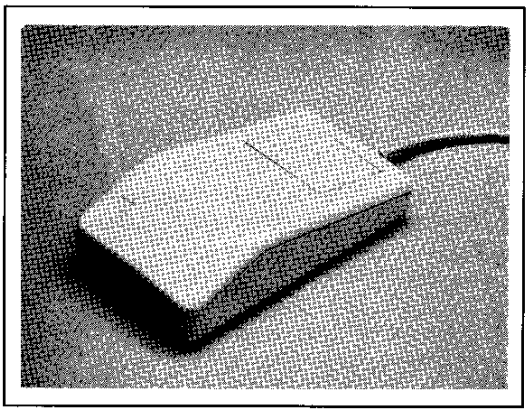
Long-time Apple observers began hearing hints of a secret, 16-bit "Apple IIx" at least two or three years ago, back when Steve "Woz" Wozniak still devoted most of his time to the company he helped start. There has even been speculation that Woz's disenchantment with the corporation was related to decisions that placed the "IIx" project on a lukewarm back burner while massive resources were channeled into beefing up the Macintosh, which was Steve Jobs' favored computer. Since the highly-publicized corporate shakeup one year ago—which left John Sculley sitting at the top of Silicon Mountain and Jobs fending for himself in other parts of the Valley—several important things have happened: Apple has produced a well-received, full-strength Macintosh (the Mac Plus), Woz has warmed up to the company again, and now a significant, new Apple II has been born.



While being developed within Apple's inner think tank, the new computer was known by the code name "Cortland" (another variety of apples—the edible kind, that is). Perhaps there was some consideration of leaving that working name on the final product and spawning a new family of Apples (the computer kind), in light of the strong name recognition that developed for the Macintosh. But rather than go out on a limb, the more conservative Apple Computer, Inc. of today choose a less novel name that conveys continuity with the established Apple II line while hinting at two major areas of improvement: Graphics and Sound.

What Does It Look Like?

There are really two answers to this question, because there are two forms in which you can obtain a IIGS. If you purchase an "upgrade" that converts your IIe to a IIGS ($499), then only the insides will be swapped and your "new" computer will essentially look like a IIe with a mouse and somewhat different rear ports.



On the other hand, if you buy a brand new IIGS ($999) you'll get a hardware package quite unlike anything Apple has made before. There's a new color scheme —platinum—that was chosen, they say, to be compatible with Apple's previous beige and white hardware. At the center of the system is a rectangular CPU box that does nothing visible except connect with all the other pieces. The detachable, ergonomically-curved keyboard has the equivalent of all the IIe keys plus a numeric keypad on the side, and seems more like a well-designed IBM-style keyboard than that of a traditional Apple II or a Macintosh. Also packed in the carton are: an Apple-style mouse, a keyboard cable that (lefties rejoice!) can attach to either side of the keyboard, a set of manuals, and a couple of 3.5" disks full of system, utility, and training programs.

Neither a disk drive nor a monitor is included as standard equipment, allowing freedom of choice as to disk and video format. Although Apple is clearly trying to encourage the use of 3.5" disks, the IIGS will function perfectly well with 5.25" drives if that suits your needs. A new 800K "Apple 3.5" drive ($399) is also being introduced which connects directly to either the IIGS or the Macintosh. Any standard monitor will presumably work fine with the 'GS, or you can choose either a new RGB color monitor ($499) or a new black-and-white (i.e. not green or amber) monitor ($129) to take full advantage of its improved output.

What's Inside the Package?

The major design goals for the IIGS system appear to include:

(1) compatibility with existing Apple II software and peripherals, including open slots for plug-in cards,

(2) improved performance in both speed and memory capacity, and

(3) enhanced graphic and sound output capabilities.

Ideally, the machine should also be competitive in both features and cost with such other new-technology computers as Atari's ST and Commodore's Amiga.

The first two goals were accomplished by building the IIGS around the 16-bit 65C816 microprocessor, which can operate in either of two modes. The "emulation" mode mimics the 6502's speed and machine-language instruction set, thus handling nearly all standard Apple II software. The "native" mode, however, runs about 2 to 3 times faster and can potentially access up to 8 or more megabytes of direct memory. Although the basic system comes with only 256K RAM and 128K ROM, expansion cards will be available from Apple and third parties. Since the native mode includes many more instructions than the 6502, only software designed specifically for the 65816 can take full advantage of its power.

To enhance the video and audio output, new auxiliary

chips are employed. A Video Graphics Controller chip supports all the graphic modes currently available on the IIe and IIc, and adds a new Super High Resolution mode that can produce up to 320 x 200 pixels with 16 colors per scan line or 640 x 200 with 4 colors per line. (Compared to the Macintosh's monochrome-only screen of 512 x 342 pixels, the IIGS has slightly better resolution on the horizontal dimension, but much worse than the Mac on the vertical dimension.) A sophisticated sound synthesizer chip made by Ensoniq has 32 oscillators which, practically speaking, can generate up to 15 voices simultaneously.

By consolidating several functions into fewer chips and using "surface mount technology" which allows components to attach on both sides of a circuit board, all this computing power—as well as 7 expansion slots—fits on a logic board the same size and shape as that of a IIe. Like the IIc, most of the commonly used ports are built into the IIGS' rear panel: video, sound, disk drive, serial (including Appletalk network interface), and game controller, as well as a special "Apple Desktop Bus" (ADB) port for the keyboard, mouse or other input device. Thus, a IIe to IIGS upgrade will essentially

consist of exchanging the logic board, rear panel, and bottom plate. (*For more details on the IIGS architecture and its implications for programming, see the next article by Rick Sutcliffe.*)

The IIGS incorporates the Macintosh's highly successful mouse, icon, and pull-down-menu human interface system. This doesn't mean, however, that all software running on the 'GS will automatically work in a Mac-like mode. Current Apple II software will look just as it always has, but newly developed programs specifically designed to utilize this interface will make the 'GS feel just like a Macintosh, with the added dimension of full color. However, because of the fundamental differences between the 65816 and the Mac's 68000 CPU, it is not possible to take a Macintosh program disk and run it on the IIGS. There probably won't be a large body of software designed to take full advantage of the IIGS's features and interface for several months, but at least you'll be able to run existing Apple II software to help ease the wait. (*See the sidebar for a sample of IIGS software that is on its way.*)

Who's It Designed For?

From what we have heard, it appears that the IIGS was produced to satisfy the needs and demands of at least three major constituencies. First and foremost is the school market, where the Apple II has always held a solid foothold

Third Party Products for the IIGS

As you might expect, there are many third party (non-Apple) software and peripheral products already being developed for the IIGS. Here's a sample of those we have heard about as of press time. Not all of these will necessarily be available right away, and we expect the list to grow rapidly in the coming months. Prices are approximate only. For the latest information, watch The Marketplace and reviews in future issues of *Call-A.P.P.L.E.*

ACTIVISION (Mountain View, CA): **Paintworks Plus**, a newly-designed graphics program similar to MacPaint but with full animation and color control, including a color mixing palate, about $80. **Writer's Choice** elite, a new word processor modeled after MacWrite, with multiple color capabilities, about $100. Both scheduled for fall availability. A 'GS version of **Music Studio** is also being planned.

APPLIED ENGINEERING (Carrollton, TX): Two RAM expansion cards designed for the 'GS memory expansion slot--**GS-RAM** for 256K to 1.5 Meg, and **GS-RAM Plus** for 1 to 6 or 8 Meg.

BRODERBUND SOFTWARE (San Rafael, CA): **Newsmaker**, a new, mouse-based, entry-level page layout program for the non-professional desktop publisher, about $90. **The Drawing Table**, a new, object-oriented drawing program similar to MacDraw, with zoom, color, and other features, about $90. **Print Shop**, a newly-developed, mouse-driven version of the bestseller, with such added features as multicolor imaging, graphic resizing, and free graphic placement, about $70. **Fantavision**, an upgraded version of this animation program utilizing the 'GS's enhanced sound, color, speed, and super hi-res screen, about $60. Available fall or later.

ELECTRONIC ARTS (San Mateo, CA): **DeluxePaint** and **Deluxe Music Construction Set**, both reconfigured versions of award-winning Amiga programs.

LEARNINGWAYS, INC. (Cambridge, MA): Upgraded version of **Explorer Story**, a children's reading/writing series, with enhanced speed and color graphics.

MECA (West Port, CT): Upgraded version of **Managing Your Money**.

ROGER WAGNER PUBLISHING (Santee, CA): New version of **Mouse Write** word processor, compatible with IIGS.

SCHOLASTIC SOFTWARE (New York, NY): Upgraded version of **Talking Text Writer**, an educational program that combines word processing with speech synthesis to sound out words as they are typed. Features mouse cursor control and multiple color highlights on screen. Currently requires Echo sound board, but future versions planned to use built-in 'GS sound chip for speech output.

UNITED SOFTWARE INDUSTRIES (Canoga Park, CA): **ASCII Express Mousetalk**, an upgraded version of a popular telecommunications program, using the IIGS mouse-icon interface.

but could be in danger of fading as the state of technology rises around the huge installed base of IIe's, IIc's and II+'s. The types of features that seem to matter most to educators, both now and in the foreseeable future, include: color graphics and animation, complex sound capabilities (particularly clear speech synthesis and possibly voice recognition), sophisticated programs that incorporate "expert systems" principles to guide academic progress, easy access to local networks and large databases, reliability and durability of both the software medium and the hardware, and the potential for utilizing emerging CD-ROM and interactive video technologies. While the older Apple II's are limited in each of these areas, the IIGS was designed both to expand these horizons and to preserve the schools' prior investment through software compatibility and a hardware upgrade path.

The second, more heterogeneous group is the "consumer market," i.e., private computer owners including: hobbyists who program for fun (if not always for profit), families who strive to keep up with the newest trends, and individuals who want a flexible computer that can be used for business as well as other applications. Apple believes that the IIGS, with its versatility, power, and wide software base, could become the computer of choice for people who want multiple applications ranging from education and entertainment to the management of finances and personal data. For families with school-age children, correspondence be-tween the home and school-based computer experience can also be a major factor in deciding to buy an Apple II. It's also possible that the IIGS might satisfy the needs of many small businesses, especially those with an investment in older Apple II's.

A third category of people whose interests helped to shape the IIGS consists of software developers and programmers. Apple knows that a a computer cannot thrive without a continously expanding and improving software base, yet many long-time Apple II developers have turned their efforts toward the greater challenges of the Macintosh and other 16-bit machines. A 1985 survey of the Apple developer community revealed that the features most wanted in a new Apple II model were: improved mass storage, faster CPU, more memory, expansion capability (slots), better graphics and sound, and compatibility with other systems (both within and, if possible, outside the Apple II family). By delivering on these desires with the IIGS and sponsoring a new Apple Programmer's and Developer's Association (APDA), from which all the new programming tools will be available to members almost as fast as machines are delivered, Apple is counting on renewed excitement among serious programmers to sustain the Apple II into the 1990's.

Where Does It Leave the Macintosh?

If you remember the early, slightly irreverent, anti-establishment slogan for the Macintosh, "The computer for the rest of us," then you probably appreciate how far the Mac has come in less than three years. When first introduced with its highly innovative shape and operating system, the Mac was largely crippled by its limited memory, nonexistent software base, and lack of compatibility with other systems. Now with at least 512K and lots of high-quality software to choose from, the Mac has become well accepted among a wide range of users. In particular, the Mac Plus is making significant inroads into the corporate world and establishing solid niche's in such areas as desktop publishing, desktop engineering, and higher education. The easy-to-learn icon interface has proven its worth, and has been mimicked by so many other manufacturers that Apple has taken legal action to preserve its proprietary rights.

With the advent of the IIGS, what kind of distinction does Apple intend to maintain between the Apple II and the Macintosh product lines? To me, the corporate messages seem a bit mixed. Prior to Apple's restructuring last year, there were two quite separate divisions—almost, at times, seeming to compete against each other. The unified Apple of today still insists that it produces two parallel but distinct product families, each with its own character and market appeal: the Apple II family for education and home applications, and the Macintosh for business and professional uses.

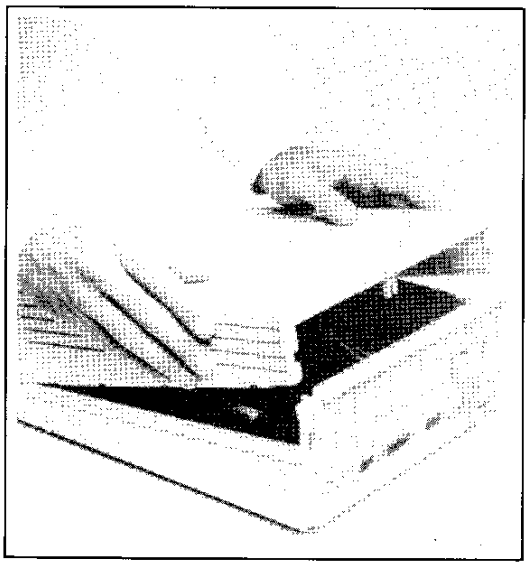
The Macintosh's main advantages over the IIGS seem to be a significantly faster processing speed for "power computing" situations, and a solid, rapidly-growing base of software. The IIGS, on the other hand, has color, better sound, expansion capabilities, a lower basic price, and compatibility with a huge —though aging—body of software. The IIGS was explicitly built to incorporate many of the Mac's desirable features, and on the surface appears to blur the differences between the two machines. As more Mac-like software comes out for the 'GS, it might become increasingly difficult for potential Macintosh buyers to make a choice. Of course, there may be new Macintosh models in development that will considerably change the picture in the months ahead.

Will the IIGS Survive?

With this new model, it appears that Apple Computer has done just about everything necessary to keep its Apple II line alive and well for quite some time. Although there seems to be little or nothing in the IIGS's technical performance that hasn't already been seen or exceeded in either the Macintosh, Amiga, or Atari ST, at least this new entry is in the same technological ball park as its competitors. In an industry that is rampant with corporate uncertainty and new products that last about as long as a shooting star, the IIGS has two undeniably powerful selling points. First, the company is now recognized as financially stable with a dependable future. Second, as Apple President John Sculley said, this is the first time a new computer has been introduced with 10,000 software applications immediately available. For the natural selection that will inevitably occur in the coming months and years, these assets just might be the critical attributes needed to insure survival.

Features

Under the Hood of the Apple IIGS



Rick Sutcliffe

You read it here first. The earliest descriptions in print of the next-generation Apple II product appeared in two of my 1984 articles (including "The Northern Spy" in the April 1984 *Call-A.P.P.L.E.*). I expressed confidence that Apple could, by 1985, sell over a million units annually of what was variously termed the IIf or IIx (the latter name caught on among rumormongers).

It would, I wrote, have a 65816 chip, a new graphics display and memory handler, take advantage of better drives, (finally) have a keypad on its improved keyboard, and have Mac-like capabilities. Even then there was a real machine, but both the Jonathan and the Phoenix projects failed to see the light of day.

But the corporate struggles are over, the Apple II is back in normal favor, and the new machine has finally made it to the marketplace battle. Until recently code-named the Cortland, but to be marketed as the IIGS ("G" for graphics, "S" for sound), this new device is the fulfillment of the "Apple II forever" promises. But, nostalgia aside, let's take a look at what we actually got. (Consult the accompanying spec chart as we go along).

The 65C816

The 65C816 MPU runs most (but not all) of the IIGS. This chip lives a dual life—it believes itself to be a mild-mannered 65C02 when the power switch is first turned on, and must be told otherwise in software before its *true* power is revealed.

```
CLC
XCE             ; clear 6502 emulation mode
REP   #$30      ; set A and X to 16 bits
```

Note that setting the emulation mode to one—as on power up—automatically sets A and X to eight bits.)

The 65C816, therefore, has the potential to run all the old Apple IIe, IIc, II+ and II software, provided there are no exotic calls to the addresses of ROM routines which have been demolished or moved. Since the supporting hardware of

the old Apple II machines has been preserved in the IIGS, calls to all published entry points in the old Monitor and all Applesoft commands still work, of course.

When new software is written, speed gains are possible, because the accumulator and index registers can be made 16-bits wide and will then load or store two consecutive memory locations simultaneously. Well, almost—the '816 part means that multiplexing is used as in the 8088 chip. So, eight bits at a time go on the data bus, but this fact is transparent to the user. It is possible that a 6516 or 6532 chip may someday be offered, but accommodating this would require substantial redesign of the Apple II. Sixteen bit registers, coupled with new and more efficient MPU instructions and addressing modes, could result in gains of up to 30% over similar programs coded in 6502.

In addition, the particular model of chip used in the IIGS boasts a 2.8 MHz clock speed, versus the 1 MHz speed of the IIe and company. To properly compare this with other chips, recall that typical instructions in 65xx chips require half the number of cycles to execute, as compared to corresponding instructions in an 80xx series chip. However, some cycles are used to refresh RAM, so RAM-based applications are effectively reduced to 2.5 MHz. Overall, these factors should result in performance somewhat better than a typical 8088 at its 4.77 MHz.

The 65C816 can address 16M of memory organized in a series of 256 consecutively numbered 64K banks. Supplied memory in the IIGS is only 256K of RAM and 128K of ROM, but the RAM can be expanded with a multi-megabyte board and the ROM can also be boosted by 1M in the same way. The plan is for much of the latter to be (eventually) a ROM disk of quickly loadable tools and/or applications.

What's in Memory?

Now, 128K is a lot of ROM for an (old) Apple IIe, so there are a lot of new things to describe. For starters, we have enhanced monitor routines with new commands and a complete 65C816 disassembler and mini-assembler which supports all 20 addressing modes and all 256 opcodes. As a bonus, ProDOS MLI calls are correctly disassembled, instead of being presented as gibberish.

Naturally, there are support routines for all the old hardware (text and graphics modes). In addition there is a new "super hi-res" color mode (the IIGS default), some toolbox routines which are much like those of a Macintosh, and support for the built-in ports, slots, and Appletalk. The Tool Locator, Memory Manager, SANE numerics, Quickdraw II, DeskAccessory Manager, Event Manager, Sound Manager, Integer Math Tools, Text Screen Tools, and Scheduler are all in ROM. These are not identical to their Mac-like counterparts, but are similar enough so that many Mac applications should port to the IIGS with an acceptable amount of labor.

Some toolbox routines (Menu Manager, Window Manager, Control Manager, Line Editor, Dialog Manager, Scrap Manager, Print Manager) are loaded into RAM (of which there is 256K to begin with). The Tool Locator finds a tool when its use is required. There is no difference between a ROM and a RAM toolbox routine, and in later models these could be burnt-in without affecting application calls. A plug-in card can add 4M of RAM and/or 1M of ROM. Because the details of memory management are entirely invisible to applications (call the Memory Manager), the latter will not have to be concerned with this—an

IIGS Technical Specifications

CPU:
65C816

Speed:
1 MHz or 2.5 MHz

ROM:
128K (expandable to 1M); standard Applesoft and expanded Monitor included

RAM:
supplied 256K

IIe text screens:
40, 80 columns

Video:
analog RGB and NTSC compatible

Color text & border:
RGB only

IIe graphics mode:
low-res, hi-res, double hi-res

Color pixelmap graphics:
200 by 320 (16 colors per scan line)
200 by 640 (4 colors per scan line)

Ports

Serial ports:
two—as IIc

Disk port:
one—like IIc for four 5.25" or 3.5" type drives

Expansion slots:
seven—as IIe

Game I/O port:
as IIe

Sound:
15 voice digital synthesizer with 64K RAM

Front desk bus:
for detached keyboard, mouse, etc.

Clock:
real time with battery (not Thunderclock)

Keyboard:
detached, with pad & 8 configurable layouts

Programmer development environment: ProDOS/16

IIGS Programmer Workshop:
editor, debugger, linker, & utilities

Language compilers:
Assembly (ORCA), Pascal (ProDOS, not UCSD), C

application which loads has already had memory assigned to it and its subsequent requests for additional real estate will either be answered or denied by the Memory Manager.

Compatibility— Only the Shadow Knows

The Apple IIGS contains all the Apple IIc text and graphics modes controlled in the same way as before. When the 65C816 is in its native mode, the screen memory ($800-$5FFF) and I/O sections ($C000 - $CFFF) are in banks $E0 and $E1. Thus, the full address of the keyboard location is $E0C000, for instance. For IIe compatibility reasons, code which writes into these two ("slow RAM") banks does so at the old 1 MHz speed—this, of course, includes I/O code located on peripheral cards. Reads from banks $E0 and $E1 are at the higher speed. Incidentally, if the user wishes a program to run entirely at the slow (1 MHz) speed, this choice can be set on the control panel, which stores its settings in a special battery backed-up RAM.

Since IIe emulation programs actually reside in banks $00 and $01, during emulation, all writes into these first two banks are "shadowed" (duplicated automatically) into banks $E0 and $E1. RAM beyond 128K is unavailable to old Apple IIe programs running in emulation mode—except, of course, that it can be configured as a RAM drive and accessed by ProDOS. (The size of any corresponding ProDOS/16 RAM drive is set on the control panel.)

On the other hand, when new applications are executing, and shadowing from banks $00/01 to $E0/E1 is turned off, all screen video is handled by memory in $E0/E1 which frees bank $00 for the (relocatable) 65C816 zero-page and stack. (ProDOS/16 starts the stack at $008000 and works down, but an application can obtain stack space of its own in this bank.) The only shadowing which now takes place is that of the language card, I/O space, and text page 1 of bank $00 (the screen holes required for interrupts and peripheral cards).

All of this means that the memory map of banks $E0 and $E1 is identical to that of an old Apple IIe at all times, except that new applications use the new super hi-res as their default display and this requires 32K of RAM from bank $E1. Here, the memory map is linear. (All frustrated IIe hi-res graphics people may stand and cheer.) QuickDraw routines write directly to banks $E0 and $E1, so there is no need to shadow the super hi-res portion, though it can be.

Incidentally, the register location to control shadowing is at $C029, and each bit will be significant.

The Shadow Register

BitFunction 1 = Inhibit

0 Text pages 1 and 1X
1 Hi-res graphics Page 1
2 Hi-res graphics Page 2
3 Super Hi-res graphics space
4 Auxiliary Hi-res pages
5 Reserved, must write 0
6 I/O and Language Card operation
7 Reserved, must write 0

It should also be noted that, while it is obviously still possible to program "on the bare iron" and all former and new soft-switches are available and documented, it will in most cases be advisable to leave the settings in either a standard Apple II or standard IIGS configuration. Mixing and matching shadowing and display combinations is a sure way to guarantee later incompatibilities. Likewise, memory squatters must learn new habits, for the only legal way to register real estate is with the Memory Manager, and it is not obligated to tell you where the memory it finds is located—not even that for a running program. (Writers of self-modifying code, beware—some new tricks are needed.)

Switching between native mode and emulation mode will also require some care. Not only do the register widths need to be handled carefully, the location of the native mode stack will also have to be stored, as its middle byte is always set to 1 when native mode is entered.

Well, we could talk forever about the control section, but let's move on to how the IIGS talks to the world outside.

Any Port in a Storm

By this time, you may be wondering whether the accompanying spec sheet contains some misprints. How can the IIGS have two serial ports, a disk port for four devices, Appletalk, and a clock, and still have seven IIe-style slots? Won't at least five slots (PR#n style) be taken by the built-ins?

In fact, there are IIc-style serial devices mapped to slots 1 and 2, one of which will be seized for use by the built-in Appletalk interface if it is activated, and the smart disk port does map its four floppy devices (any kind, any size) to slots five and six. But the physical slots are still there, and if one wants to plug some other peripheral card into a slot, the machine is simply informed via the control panel. This arrangement offers the best of both worlds, with no more choices made *for* us—we now have both built-ins and open architecture.

However, it should be noted that these serial ports are not Super Serial Cards, and existing software which expects to use the Super Serial Card registers will not work.

The detachable keyboard and the mouse are controlled by the front end "Apple desktop bus" (ADB), which has its own microprocessor rather than using up slots. This arrangement allows for a completely passive mouse, requires no overhead for the 65C816, and even has expansion possibilities for other types of input devices.

Sound is also handled by a self-contained subsystem employing an Ensoniq chip, with its own RAM. This is capable of 15 voice synthesis, and has an independent volume control. It should not be difficult for third parties to add MIDI capabilities to the IIGS, and such a product would meet with wide acceptance. Even as it stands, this is Apple's most sophisticated sound system to date.

For our last word on hardware, we note the built-in battery-backed-up real-time clock. This is a new device and will normally be accessed via ProDOS/16, or set from the control panel. It is not Thunderclock compatible.

Want more? Well, there are all those lovely slots just waiting for your favorite old cards (most, if not all, should still work). There will also be many new things to plug in, so the add-on types are going to have fun with this one.

ProDOS/16

Now, the first thing to say about this new operating system is that it works like the old ProDOS but it is *not* a superset of it. All calls to ProDOS/16 have new call numbers and differently structured parameter lists. (More of

them can overlap, and thus do double duty.) There is no global page in ProDOS/16; all information must be passed in parameter lists. Consequently, applications making MLI calls from ProDOS must actually be rewritten to use ProDOS/16; they cannot simply be ported "as is" on a temporary basis.

Moreover, old ProDOS applications have to be run under ProDOS/8 on the IIGS. This is a special version of ProDOS designed for maximum compatibility on the new machine. All three versions of ProDOS use the same file format and can read each other's files, except that old ProDOS cannot read the type .SYS16 ($B3) used as system files by ProDOS/16.

Because ProDOS/16 was not ready for developers' use, a kludged workalike called ProDOS/12 has been used as a bridge to get new applications on stream. When ProDOS/16 is finally released, disk operations should be considerably speeded up.

It should also be noted that the Apple IIGS finder can be used to format disks for any current Apple II operating system including DOS 3.3 and Pascal 1.3. When running old applications in one of the latter, however, one cannot expect (in most cases) to return to the finder when the application is exited—without a software patch.

The Development Environment

This contains the facilities for editing, compiling and linking programs written in various languages. In theory, segments of programs can be written in any language for subsequent linking. Once linked, the loader is responsible for finding memory for the various segments. The languages which are initially planned as part of this environment are Assembler, Pascal (not UCSD), and C. Although I didn't notice it in the documents, the 65C816 will place an upper limit of 64K on a single code segment, because code execution on this chip wraps around in each bank in which it is located. However, this is not true of indexed access to data, which sails over bank boundaries as if they did not exist. This is because the Program Bank Register (PBR) on the chip is *not* incremented when the high byte of the Program Counter (PC) overflows, but the Data Bank Register (DBR) is added in 24 bits to the register offset and the instruction argument to calculate an effective address. Mind you, in this modular age, anyone who designed a more than 64K code segment needs a sanity test anyway—this is not, in fact, a limitation on total program size at all.

Implications for Programmers

Most existing Apple II programs will run on the IIGS, including those customized for the IIc or enhanced IIe, *provided* they use a standard interface to the hardware (no fancy, sneaky calls which bypass standard entries). For example, many existing terminal and printer drivers will probably have to be rewritten.

A development firm that wishes to take quick advantage of the new environment can modify the old applications to utilize IIGS's tools. These are called hybrid programs, and providing that checks are done to see which machine they are currently living in, a hybird program will run in any Apple II.

Programs written specifically for the new environment will not run on the old Apples, even if equipped with a third-party 65C816 board such as the one from Checkmate Technology, because the default super hi-res graphics and the shadowing concept would be lacking.

People with experience on the Mac will find this environment easy to work with. Those who come from an old Apple environment will have a fairly steep learning curve, but their anchors to the familiar will help get them up to speed without excessive grief. One thing to get used to will be interrupt handling. There are sixteen possible kinds of interrupts on a IIGS, whereas because of bugs, older Apples had difficulty handling any.

What's Been Left Out?

Apple has done a good, even an excellent, job with the IIGS. There is enough in this box to keep hobbyists and educators busy for years—with built in utility that exceeds an IBM PC and comes close to challenging the Mac. (The sound is better.)

However, the 2.8 MHz clock speed seems low. I understand that Apple felt that the higher speed chips were not available in sufficient and reliable quantities. At this speed, comparable applications are unlikely to perform as quickly as on an 8 MHz "Turbo" PC.

I am personally disappointed that Modula-2 is apparently not to be in the initial releases of the programming tools. Given the use of relocatable segmented code in the IIGS, this would have been a better choice than either Pascal or C as the main high-level language. Indeed, the machine seems almost to have been made for Modula-2; I'm sure it won't be long before several people produce compatible compilers.

Memory expansion capabilities are adequate (4M+ !), but supplying only 256K with the base machine seems shortsighted. One megabyte of RAM will soon be the practical minimum.

There is no built-in SCSI port for a hard drive, so a card plus external unit seems indicated. At current prices, most serious computers will soon be bought with a hard drive.

To earn the "GS", the graphics could have had an even higher resolution, and the sound subsystem should have included a complete MIDI interface.

The Bottom Line

But, these are small criticisms of an otherwise very sound piece of work. It will take some time to unfold the technical aspects of the IIGS completely—I have thousands of pages of documents, and material for many articles already. There are also bound to be problems with the machine—some serious—of which we are unaware (more articles).

However, the Apple IIGS is a worthy successor in the Apple II line, and with its Mac-like capabilities, could well become one of the most widely used small computers of the latter part of this decade. Its introduction, though 2 years late, should give a much needed shot in the arm to the entire hardware industry and also to user groups and magazines. Would you believe over 1.5 million units (new and upgrades) in the first year? A dozen or so of those will be for me—though it may be January 1987 before I can buy in quantity—and it may be as well, for new applications will likely take time to appear.

In the meantime, most of the old ones will run fine, and there's lots of new stuff for all the hackers and hobbyists to play with. Indeed, once the IIGS Programmer's Workshop is complete, it could be one of the premiere development environments on any machine, and it will certainly be a major selling point both for the H&H group and also for educators.

A sure thing—the "GS" really means "Good Stuff."