
Future Product Options

A Software Perspective

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Introduction

Objective

Future Product Options: A Software Perspective is intended to provide an overview of a number of feasible short-term and long-term options for future system hardware and software products.

Philosophy

The underlying philosophy of this overview is:

- Users purchase and use computer systems for one or more applications. Examples of such applications include action games, word processing, and video editing and production.
- The suitability of a computer system to an application is determined by the availability of hardware and/or software products for the application.
- The role of system hardware and software is to provide an effective platform for application hardware and software.

From this philosophy derives the goal of producing system hardware and software that most effectively satisfies this role, while minimizing cost and risk. This is consistent with the single, overriding goal of the Company, which is to earn a profit.

Market Segments

The market segments in which Commodore has historically been most successful are:

- Entertainment
- Desktop video
- Multimedia
- Education
- Hobby ("hacker")

Future systems should maintain or improve Commodore's position in these market segments.

The technology, skills, and position that have produced success in these market segments may be readily adapted to penetrate other closely-related current or potential market segments, such as:

- Home education ("edutainment"/"infotainment")
- Home productivity
- Interactive television
- Home automation

Architectures

Currently available, or under development, processor architectures are:

- MotorolaXE "Motorola"§ MC680x0XE "MC680x0 (Motorola)"§
- Hewlett-PackardXE "Hewlett-Packard"§ PA-RISCXE "PA-RISC (Hewlett-Packard)"§

and graphics architectures are:

- Advanced Graphics ArchitectureXE "Advanced Graphics Architecture" \t "see AGA"§ (AGA)XE "AGA (chipset)"§ chipset
- AAAXE "AAA (chipset)"§ chipset
- 3D Graphics EngineXE "3D Graphics Engine"§

All of these architectures are flexible and can be adapted to the needs of various market segments by system hardware and software configuration.

In addition, a number of graphics boards are available from or under development by third parties. Availability of and support for such products can contribute to Commodore's position in a number of specialized market segments, such as high-end graphic arts.

Recommendations

The following recommendations are made to achieve the goals of:

- Maintenance or improvement of Commodore's position in existing markets
- Penetration of new markets through the application of existing technology, skills, and position
- Minimum cost
- Minimum risk

Short-Term Recommendations

Recommendations for short-term development strategy are:

- Develop CD³²-compatible CD-ROM peripherals, tentatively designated CD1200 and CD4000, for the A1200 and A4000, respectively, to improve the competitiveness of these systems with Multimedia PC (MPC)XE "Multimedia PC (MPC)"§ systems and expand the market for CD-ROM applications by adopting CD-ROM technology throughout the product line. Both of these products are already under development.
- Develop an A1200-compatible computer module for the CD³² system to provide an upgrade path to full computer functionality. This differentiates the CD³² from competing home entertainment consoles, such as the NintendoXE "Nintendo"§ *Super Nintendo Entertainment System* (SNES)XE "Super Nintendo Entertainment System (SNES) (Nintendo)"§

and Sega GenesisXE "Genesis (Sega)"§ and MegaCDXE "MegaCD (Sega)"§ systems. However, this upgrade path should not be over-emphasized, to prevent potential damage to the position of the CD³² due to "computer-phobia."

- Develop cost-reduced versions of the CD³² and A1200 systems to improve the price competitiveness of these systems in the entertainment, edutainment, and home productivity markets.
- Develop an MPEG peripheral for the CD³², tentatively designated CD^{MPEG}, to provide the CD³² system with high-quality full-screen full-motion video and audio capabilities.
- Develop an evolutionary improvement of the CD³², tentatively designated CD³² PlusXE "CD32 Plus"§, with built-in MPEG capabilities, expanded nonvolatile storage, and other improvements, with a critical emphasis on maximizing compatibility with CD³² applications, for release in late-1994 if a safe evolution of the existing platform is necessary to maintain competitiveness with other home entertainment consoles.
- Develop a multimedia information retrieval engine, tentatively designated MemeXE "Meme"§, to support home education ("edutainment"/"infotainment") applications for the CD³² system.
- Develop a basic front-end graphical user interface for program access, tentatively designated EssenceXE "Essence"§, to provide easy-to-use direct access to programs in multi-application packages (such as game anthologies), demos and for non-computer-oriented users.
- Develop a variety of after-market products for the CD³² system, such as input devices, virtual reality headsetsXE "virtual reality headset"§, and I/O boardsXE "CDI/O"§ to improve the position of this product in a number of market segments and earn relatively high margins with low to moderate development costs. OEM or VAR arrangements may be appropriate for many of these products.
- The interactive television and home automation market segments should be investigated and, if sufficient demand is identified, efforts should be undertaken to enter these segments.
- Consider re-pricing the CD³² system unit at or near cost and increasing the application licensing fee. This pricing structure may lower the buy-in price, expanding the market for applications, from which additional revenue could be earned through application licensing fees.

- Develop or license a limited number of applications, with an emphasis on minimal development cost and risk, minimal licensing cost, and targeting of market segments, for the CD³² system. This increases the software base of the system and generates significantly more per-unit revenue than licensing fees paid to Commodore by third parties.
- Develop system software components to provide basic out-of-the-box functionality in major application categories to Amiga systems. Approaches to this functionality include applets, found on other platforms, or an object-oriented computing environment, tentatively designated *Athena*, that provides out-of-the-box functionality and a number of other significant features for home productivity and multimedia applications.

These short-term recommendations have a strong emphasis on the CD³² system. This recognizes the significant development, manufacturing, marketing, sales, and distribution resources that Commodore has committed to this product and the resulting importance of this product to the short-term success of the Company.

Long-Term Recommendations

Recommendations for long-term development strategy are:

- Develop a new release of the Amiga Operating System, tentatively designated Amiga Operating System Release 4.0, that implements retargettable graphics (RTG) and other features necessary to remain competitive in existing market segments and improve Commodore's position in new market segments.

Implementation of RTG will provide Commodore and third-party developers a stable, supported mechanism for improving the graphics capabilities of existing open Amiga systems (such as the A4000) via high-resolution/high-color graphics boards, maintain compatibility with existing applications because the AGA chipset can continue to be accessed as before, and maintain or improve the competitiveness of these systems with other open platforms.

- Develop a new architecture based on the Hewlett-PackardXE "Hewlett-Packard"§ PA-RISCXE "PA-RISC (Hewlett-Packard)"§ and the 3D Graphics EngineXE "3D Graphics Engine"§ and systems based on this architecture on a fast-track schedule.

Options for systems based on this architecture include:

- CD^{3D} (low-end CD-ROM- or cartridge-based entertainment and home education console)
- RISC1000/3D (mid-end personal computer)

Initial development of this architecture is currently underway. For the console platform based on this architecture, the low buy-in cost/high licensing fee pricing structure discussed under Short-Term Recommendations should also be considered.

- Develop a new operating system for the PA-RISCXE "PA-RISC (Hewlett-Packard)"§/3D Graphics EngineXE "3D Graphics Engine"§ architecture on a fast-track schedule. The basic configuration should be a scalable, multitasking operating system designed for entertainment and edutainment applications. Optional components should provide additional features necessary for productivity, multimedia, and other higher-end applications.

Other Long-Term Considerations

- It is not apparent that the demand for systems based on the MC680x0/AAA architecture is sufficient to justify the development time and cost of this architecture. However, if a sufficiently large market need is identified, systems based on this architecture, tentatively designated A1400 and A5000, should be developed. Retargettable graphics drivers and other operating system support should be implemented as necessary to support this new architecture.
- It is particularly important that a AAA-based home entertainment console, similar to the CD³², not be developed or publicly discussed. Such a system would be incompatible with existing CD³² applications and thus lack the software base that is a major factor in the sales of any home entertainment console. In addition, such a system would kill sales of the existing CD³² system, because it would be, most likely correctly, perceived in the marketplace as a replacement and customers do not wish to pursue an obsolete system.
- An option to provide some return on the current investment in the AAA chipset, while protecting existing products and minimizing the impact on development resources, is to produce a MC680x0/AAA-based system targeted solely toward VAR markets, such as a next-generation NewTek *Video Toaster* system. Such a system would require very minimal operating system support and, if limited to the VAR market, would not compete with or obsolete existing Amiga and Amiga CD systems.

- The scope of hardware and software development work (if any) for systems based on the MC680x0 (Motorola) should be limited to that necessary to meet the specific needs of the targeted markets. This minimizes the impact of such work on the limited resources available to pursue the PA-RISC (Hewlett-Packard) 3D Graphics Engine architecture, which is likely to be significantly more important to the long-term success of the Company.

This strategy emphasizes extending the life of existing Amiga systems, such as the CD32 and A4000, while concentrating engineering resources on developing the PA-RISC/3D Graphics Engine architecture that can be the basis for Commodore's long-term product strategy.

System Software

Overview

In the short-term, a number of system software projects could play a role in maintaining or improving the position of the Amiga and CD³² product line in a number of market segments:

- *Meme*: multimedia information retrieval engine
- *Essence*: basic front-end graphical user interface for program access

Long-term operating system projects discussed include:

- Amiga Operating System Release 4.0
- RISC/3D Operating System Release 1.0

In addition

- *Athena*: object-oriented computing environment
- Applets: simple applications providing basic functionality in major application categories

may be integrated into the system software with either Amiga Operating System Release 4.0 or RISC/3D Operating System Release 1.0.

Operating system support for

- Interactive television

based on the three hardware architectures currently available or under development is also discussed.

Meme

The primary market for the CD³² system is home entertainment. However, a secondary market exists for home education/entertainment (known as "edutainment" or "infotainment") applications. To stimulate the development of such applications, a system-standard multimedia information engine, tentatively designated *Meme*¹, may be developed.

The role of *Meme* is similar to that of the Microsoft *Multimedia Viewer* used for MPC applications or the Xiphias search engine used for CDTV applications. *Meme* would provide the user interface, hypermedia, and information retrieval engine components of an edutainment application. This allows the application developer to concentrate fully on providing the information (text, graphics, audio, video, etc.) that is the focus of the edutainment product.

Essence

The CD³² and A1200 systems, which are Commodore's most significant products, are targeted at the home entertainment, education, and productivity market segments. Because Commodore has historically been most successful in these market segments, this is likely to continue to be the case for future products.

A basic graphical user interface shell, tentatively designated *Essence*, would provide a simple mechanism to select applications and documents. *Essence* is similar in concept to the *At Ease* shell used on the Apple Macintosh Performa line or the shell used on the Tandy Sensation system. Such a shell would be more appropriate for users in these market segments, who typically have minimal experience with personal computers and are unlikely to work through any significant learning curve, than the existing Workbench shell, which is more powerful, but also more complex due to the hierarchical system of volumes and drawers and other characteristics.

¹ The term *meme* is used in information sciences and refers to an atomic unit of knowledge, such as an idea or concept.

In addition to serving as a general-purpose shell for beginning users, *Essence* could also serve as the front-end to demo discs and software collections.

Athena

An object-oriented computing environment, tentatively designated *Athena*, could provide a powerful and natural environment for home productivity and multimedia applications. This concept is discussed extensively in the *Athena* design documentation that is currently being prepared, but is overviewed here as an introduction.

Current computer systems are based on distinct applications and files. As an example, a typical document may contain a large amount of text, a number of bit-mapped images, and a chart. The text is created in a word processor, such as Microsoft *Word*. The bit-mapped images are created in a paint program, such as the *Paintbrush* applet. The chart is created in a business graphics application, such as SPC's *Harvard Graphics*, using data created in a spreadsheet application, such as Microsoft *Excel*.

In the *Athena* environment, based on concepts from the Go *PenPoint* and Taligent *Pink* operating systems and other leading-edge software technology, this paradigm of applications and files is replaced by a paradigm of documents. Documents are containers for one or more objects, each of a particular class (such as text, bit-mapped graphics, or a table). For example, the document discussed above would contain an underlying text object, a number of bit-mapped image objects, and a chart object. All of the objects would be created edited in context, with the interface automatically adjusting to the current editing context. For example, when the user selected the paint object, the menus, tool palette, and other interface features would adjust to present paint functionality.

Out-of-the Box Functionality

Currently, Amiga systems have no out-of-the-box functionality. Using the system for any application at any level requires obtaining third-party software.

Providing basic out-of-the-box functionality in major application categories would:

- Increase the customer's initial satisfaction with the system.
- Serve as a potential selling point.
- Serve as a point-of-sale demonstration.

- Improve the quality of third-party applications by setting a minimum standard of functionality and user interface for the application categories.

Two approaches to providing this out-of-the-box functionality are possible:

- Design and implement a set of applets, which are simple applications included with the operating system that provide this basic level of functionality. Examples of applets include *Notepad*, *Write*, *Paintbrush*, and *Solitaire* under the Microsoft *Windows* operating system.
- A basic level of application functionality could be implemented in the built-in classes of the *Athena* object-oriented computing environment. This environment is discussed more extensively above and in the *Athena* design documentation that is currently being prepared.

Potential applets include: notepad (basic text editor), calendar, calculator, clock, word processor, spreadsheet, free-form database, video titler, telecommunications, and games (such as Solitaire or Reversi). Some of these programs (such as Calculator and Clock) are already included with the Amiga Operating System. However, they may be improved to provide more functionality and/or an improved user interface.

Amiga OS Release 4.0

Two options are available for Amiga Operating System Release 4.0 (internally known as V42):

- Implementation of RTG and support for these features in related areas of the OS (such as Intuition and some Preferences editors).
- Implementation of RTG drivers for the AAA chipset in addition to implementation of the underlying RTG support discussed above.

The former is recommended. This allows graphics boards produced by third parties (such the *Picasso* board) or Commodore (such as the *Motivator* board) to maintain or improve the competitiveness of the Amiga system's graphics capabilities without the more extensive effort necessary to develop the AAA chipset and the associated operating system support. In addition, full compatibility with ECS/AGA-specific applications would be maintained in existing Amiga systems equipped with add-on graphics board by using the built-in AGA chipset to run such applications.

An additional benefit of de-coupling retargetable graphics from support for the AAA chipset is that an early release of an Amiga OS with RTG will encourage the development of RTG-ready applications. These applications will provide an immediately-available software base for all graphics subsystems, including the AAA architecture, if and when systems based on this architecture are released.

RISC/3D Release 1.0

Suggested major features of an operating system for the RISC/3D architecture include:

- Scalability
- Modularity
- Preemptive multitasking
- Interprocess communication
- Interprocess synchronization
- Retargetable 2D and 3D graphics
- Graphical user interface
- Low processor and storage load

The following additional features are suggested for mid- to high-end personal computer versions of this operating system:

- Object-oriented computing environment, tentatively designated *Athena*
- Outline font engine
- Workgroup connectivity
- Device-independent 2D and 3D graphics

Interactive Television

The system software requirements for interactive television systems will be defined by the cable television or telecommunications network provider with which Commodore enters into a partnership.

Application Software

Overview

Commodore earns only a relatively small licensing fee from the sale of application software for the CD³² system by third-party vendors. Software revenue can be significantly increased by effectively applying available resources in licensing and/or development of application software, from which Commodore will earn a significantly larger full profit.

The application software options discussed in this section were selected based on the following criteria:

- Minimum development cost
- Minimum development risk
- Minimum licensing cost
- Market targeting

These criteria, and the resulting options, are consistent with the market-oriented philosophy of this overview and the position and goals of Commodore.

Arcade Classics Series

The *Arcade Classics* Series would consist of a number of volumes of Amiga implementations of classic arcade games from the late 1970s and early 1980s such as *Asteroids*, *Missile Command*, *PacMan*, *Defender*, *Zaxxon*, *Tempest*, *Donkey Kong*, *Xevious*, *Joust*, and *Centipede*.

This series targets the 25- to 40-year old demographic group that may have purchased a CD³² or other Amiga system for their children as an entertainment system. This group is typically not attracted to the platform and fighting games popular with the younger demographic groups, but may be nostalgic for arcade games that they played in their youth.

Because of the age of these games, licensing fees should be minimal. However, it is important that an official license be obtained for name recognition and to legally allow the exact reproduction of the original game, including gameplay, graphics, and sound. Both of these would be major selling points.

Implementation of these games should require only minimal development resources. Although these games were state-of-the-art in their time, modern hardware and software technologies makes implementation a fairly simple task.

Classic Games Series

The *Classic Games* series would consist of a number of volumes of earlier popular Amiga games such as:

- *Shadow of the Beast*^{XE} "*Shadow of the Beast (Psygnosis)*"§ series by Psygnosis^{XE} "Psygnosis"§
- *Menace*^{XE} "*Menace (Psygnosis)*"§ by Psygnosis^{XE} "Psygnosis"§
- *Marble Madness*^{XE} "*Marble Madness (Electronic Arts)*"§ by Electronic Arts^{XE} "Electronic Arts"§
- *Archon*^{XE} "*Archon (Electronic Arts)*"§ series by Electronic Arts^{XE} "Electronic Arts"§

The initial format would be CD³², although releases for other Amiga systems are an additional option.

This series targets new users of the Amiga and CD³² product lines who have had no previous exposure to these games. Although these games have exceeded the lifespans of their original release on Amiga computer systems, many are still competitive in graphics, sound, and gameplay with the games typically available on home entertainment consoles.

Full rights, including source code, would be licensed from the original producer. Because of these games have exceeded their lifespan, licensing costs should be minimal.

The games would, if necessary, be modified for compatibility with current Amiga systems. Minor upgrades, such as updating artwork for AGA graphics, would also be implemented as appropriate.

Original Games

Development of modern games is a major venture, requiring a variety of skills, such as production, graphics, animation, art, sound, music, programming, and testing. However, the potential revenue from successful games is very significant, and is an important factor in the profitability of competing companies, such as Nintendo. In addition, original games improve the market position of the hardware platforms. Commodore should investigate the possibility of undertaking the development of original games.

Personal Management System

The potential of personal computer systems to assist the user in common household tasks, such as household budgeting and checkbook reconciliation, is well-known. This potential is, in many cases, a significant factor in the purchase of a personal computer for the home and sales of personal finance applications, such as *Quicken* by Intuit, on the Microsoft MS-DOS and Windows and Apple Macintosh platforms, indicate that there is significant market interest in such capabilities.

The *Personal Management System* would provide an easy-to-use, integrated package for common household tasks, such as:

- Budgeting
- Bookkeeping
- Checkbook reconciliation
- Business correspondence (via templates)

System Hardware

Overview

The CD³² is the currently Commodore's most critical product. Commodore has committed significant development, manufacturing, marketing, sales, and distribution resources to this product and short-term success is largely dependent on this product. A number of hardware products could maintain or improve the competitive position of this system with low to moderate development effort and provide fairly high margins.

The consistency of Commodore's existing product line can be improved by:

- CD1200 (CD³²-compatible CD-ROM peripheral for A1200)
- CD33 (A1200-compatible computer module for CD32)
- CD4000 (CD³²-compatible CD-ROM peripheral for A4000)

All of these products require low to moderate development effort, may have relatively high margins, and meet the needs of various market segments.

If the short-term development of the market requires an evolutionary improvement on the CD³² system, feasible options with low development effort and minimum compatibility impact include:

- CD³² Cost-Reduced
- CD³² Modular

- CD³² Plus (CD³² with built-in MPEG capabilities, expanded nonvolatile storage, and other minor improvements)

The MC680x0 (Motorola) architecture, implemented in a number of system configurations, may be useful in maintaining or improving Commodore's position in current or future market segments.

A new architecture based on the Hewlett-Packard PA-RISC CPU and the 3D Graphics Engine is currently under development. Systems based on this architecture could address a variety of market segments in the long-term.

Emerging market segments, which may be realized in a short-, mid-, or long-term timeframe, are:

- Interactive television
- Home automation

A number of systems currently available or under development can be adapted to the needs of these markets with moderate development effort.

CD1200

A CD32-compatible CD-ROM drive peripheral for the A1200, tentatively designated CD1200, would provide A1200 users with the capability to run CD-ROM applications designed for the CD³² system. This product is currently under development.

The CD1200 would provide a broader base of entertainment and home education software for actual or potential A1200 users. These users may be more oriented toward home productivity, graphic arts, and other capabilities of a full computer system, but may also be interested in entertainment and home education applications. This improves the competitive position of the A1200 relative to Multimedia PC (MPC) systems based on the Intel 80x86 CPU and Microsoft MS-DOS/Windows operating system.

In addition, the CD1200 may expand the market for CD³² applications. This is beneficial to CD³² application developers and may contribute to attracting additional application development to the platform and thus improve the competitiveness of this system.

CD4000

A CD32-compatible CD-ROM drive peripheral for the A4000XE "A4000"§, tentatively designated CD4000XE "CD4000"§, would provide A4000 users with the capability to run CD-ROM applications designed for the CD³² system, as well as potential A4000-specific CD-ROM applications oriented toward higher-end applications, such as multimedia authoring. This product is currently in the early stages of development.

The CD4000 peripheral could be supplemented by a SCSI-based version of cd.deviceXE "cd.device"§ supporting a variety of SCSI controllers and CD-ROM drives. This software-only solution could be released to SCSI controller and/or CD-ROM drive vendors for redistribution with hardware provided by the vendor and is already under development and near completion.

The CD4000 and other third-party CD-ROM systems would provide a broader base of entertainment and home education software for actual or potential A4000 users. These users may be more oriented toward desktop video, multimedia, graphic arts, and other capabilities of a high-end computer system, but may also be interested in entertainment and education applications. This improves the competitive position of the A4000 relative to Multimedia PC (MPC)XE "Multimedia PC (MPC)"§ systems based on the IntelXE "Intel"§ 80x86XE "80x86 (Intel)"§ CPU and MicrosoftXE "Microsoft"§ *MS-DOS*XE "*MS-DOS (Microsoft)*"§/*Windows*XE "*Windows (Microsoft)*"§ operating system.

In addition, the CD4000 may marginally expand the market for CD³² applications. This is beneficial to CD³² application developers and may contribute to attracting additional application development to the platform and thus improve the competitiveness of this system.

CD33

An A1200XE "A1200"§-equivalent and -compatible computer module for the CD³², tentatively designated CD33XE "CD33"§, would provide an upgrade path to full personal computer functionality for CD³² users.

This may provide a competitive advantage over other home entertainment consoles, such as the Nintendo[®] SNES[®] "Super Nintendo Entertainment System (SNES) (Nintendo)"[®] and Sega[®] Genesis[®] "Genesis (Sega)"[®] and MegaCD[®] "MegaCD (Sega)"[®] systems. However, this capability should not be over-emphasized to avoid inducing "computer-phobia" that may damage the position of the CD³².

CD³² Cost-Reduced

Development is underway, in cooperation with Motorola, to produce a VLSI device that integrates a Motorola MC68020-class CPU and the Advanced Graphics Architecture (AGA) chipset in a single package. This package could form the basis for very substantial cost reduction.

The most appropriate candidate for cost reduction based on this chip is the CD³², Commodore's most strategically important product. Some estimates indicate that a re-design of the CD³² using this single-chip design would reduce end-user price by approximately US\$100.

An additional cost reduction option is to develop a cartridge-based version of the CD³², with a CD-ROM drive available as an optional peripheral. This would reduce the buy-in cost, creating greater sales volume and a larger market for applications (from which the Company earns licensing fees).

A number of other cost-reduction options may also be available.

Input Devices

A significant after-market exists for alternate input devices on the Nintendo[®] SNES[®] "Super Nintendo Entertainment System (SNES) (Nintendo)"[®] and Sega[®] Genesis[®] "Genesis (Sega)"[®] and MegaCD[®] "MegaCD (Sega)"[®] system. Commodore may pursue a similar after-market for the CD³² system with input devices such as:

- Enhanced game controller
- Light gun
- Light bazooka
- Input glove

As an alternative to in-house development and manufacturing, Commodore may pursue an OEM arrangement for these products.

CD³² Plus

If an evolutionary development of the CD³² is required to maintain the competitive position of this product line in the entertainment and home education markets, a new system, tentatively designated CD³² PlusXE "CD32 Plus"§, may be an appropriate option.

Features of such a system may include:

- Built-in MPEG capabilities
- Expanded nonvolatile storage
- Enhanced game controller
- Restyled casework

and other minor improvements.

The features selected for such a system should meet the following criteria:

- Minimum development cost
- Minimum development risk
- Critical emphasis on complete compatibility with all CD³² applications

If a more significant technological improvement is necessary to remain competitive, features such as:

- MC68030 processor clocked at 25MHz
- 1 to 2MB fast RAM
- Digital signal processor (DSP)

should be considered. However, these features carry a risk of fragmenting the market and introducing incompatibility with existing CD³² applications.

CDVR

Virtual reality is becoming a fairly popular technology, with significant coverage in the mass media and exposure in arcade systems, such as the *Virtuality* system. Virtual reality headsets are available or under development for a number of competitors to the CD³², such as the SegaXE "Sega"§ GenesisXE "Genesis (Sega)"§ system.

A virtual reality headset for the CD³² system would improve the product's competitiveness by providing basic virtual reality capabilities, which are likely to be the next major technological movement in the home entertainment market. In addition, the development effort would provide an opportunity for engineering exploration of the technology, in preparation for the more advanced virtual reality products that will be possible on the RISC/3D architecture.

CDI/O

An I/O board for the CD³², tentatively designated CD^{I/OXE} "CDI/O"§, providing:

- RS-232C serial I/O
- Centronics parallel I/O

would improve the position of the CD³² system in the multimedia delivery market segment, particularly for distributed kiosk environments.

As an alternative to in-house manufacturing, marketing, sales, and distribution, Commodore may pursue a VAR arrangement for this board. In this arrangement, development would be performed in-house, while all other activities would be performed by the vendors of products using this board.

A1200-Cost Reduced

The cost of the A1200 system may be significantly reduced by applying the single-package Amiga chip (discussed in the section on the CD³²-Cost Reduced). A low-cost CD-ROM drive, providing compatibility with CD³² applications, should be considered for inclusion with the system and must be available as a peripheral.

Such a cost-reduced A1200 system, particularly in combination with bundled system and application software (such as *Essence*, *Athena*, etc.) specifically targeted to home entertainment and productivity, has the potential to gain a significant share of the home computing market, by simultaneously providing access to a broad base of high-quality entertainment software and effective productivity applications.

CD³² Modular

The integrated Amiga chip, discussed above, also presents the possibility of developing a low-cost, modular version of the CD³² system.

The conceptual base unit would consist of the motherboard, CD-ROM interface and drive, audio and video connectors, expansion bus, power supply connector, and external-plug-mounted power supply. The form factor of this unit would be similar to that of a Sony DiscMan portable CD player.

Options would include a battery power supply (for portability), grayscale and color liquid crystal display (LCD) display modules, a television tuner module, and an MPEG module.

Such a modular, portable system could address a number of markets, including interactive entertainment (games), audio and video CD playback, edutainment, personal digital assistant (PDA), and multimedia presentation, in both home and portable settings.

MC680x0/AAA Architecture

A new Amiga architecture, based on the Advanced Amiga Architecture (AAA) chipset and the Motorola MC680x0 CPU, is currently in development. Current plans for this architecture are to produce a high-end personal computer system, tentatively designated the A5000.

There are a number of significant issues related to this architecture that may indicate that it is not appropriate in view of Commodore's current position and overall strategy:

- The compatibility of AAA-based systems with existing software and hardware is expected to be very low. Basic applications that use operating system functions should, in theory, function. However, more sophisticated applications that directly access the Amiga hardware, such as the NewTek *Video Toaster*, *DeluxePaint IV-AGA* by Electronic Arts, and most entertainment applications will be incompatible. These applications, which will be incompatible with AAA, represent a significant portion of the market for Amiga systems. The installed base of AAA systems must be sufficiently large to justify the developers' effort to update existing products for compatibility and/or support for AAA or develop new products for this architecture. The likely result is a "Catch-22" in which AAA-aware applications are not developed because the

installed base is small and the installed base remains small because AAA-aware applications are not available.

- It is not apparent that the market segments that MC680x0/AAA systems are intended to address have been completely identified, nor does it appear that likely sales to these market segments will provide a significant return on the investment in this architecture.

Specifically, Commodore's most successful markets are home entertainment consoles (currently addressed by the CD³² system) and low-end personal computer systems (currently addressed by the A1200 system). Although AAA does provide improved graphics performance and sound capabilities, the time to market and impact on other longer-term projects may not be justifiable.

In the high-end personal computer market, the MC680x0/AAA architecture does provide performance and features equal or superior to those of other platforms at similar price points, such as Intel 80x86-based systems running Microsoft *MS-DOS* and *Windows*. However, such systems have a very significant advantage in software base and also benefit from major economies of scale, due to the very large installed base of systems, that allow rapid cost reduction. Because of these factors, and the long time to market of AAA-based systems, it is likely that high-end AAA-based Amiga systems will not be competitive when they are released.

- Development time and cost for the MC680x0/AAA architecture is very high. With current staff, it is estimated that minimal operating system support for the AAA architecture will require six months in the most optimistic possible scenario. More extensive support could require up to two years. This is particularly significant in view of the limited resources available, and the impact of such an allocation on other projects that have potentially greater short- or long-term benefit.

If sufficiently large market segments for the MC680x0/AAA architecture are identified, with full consideration of the compatibility issues and development time, such systems should be developed as near-term measure to maintain Commodore's product line. In any case, the scope of any such project should be limited to addressing identified market needs to minimize the impact of this project on longer-term efforts, such as the PA-RISC/3D Graphics Engine architecture.

An additional option for the MC680x0/AAA is to develop a system targeted solely for the VAR market, specifically a next-generation NewTek Video Toaster system based on this architecture. Such a system would require very minimal operating system support and, if limited to the VAR market, would not compete with or obsolete existing Amiga and Amiga CD systems.

PA-RISC/3D Graphics Engine Architecture

Early design work is currently underway for an architecture based on the Hewlett-Packard PA-RISC CPU and a custom 3D graphics engine. In view of Commodore's position, two desirable system options based on this architecture are:

- A low-end cartridge- or CD-ROM-based home entertainment and edutainment console, tentatively designated CD^{3D}.
- A low-end personal computer, targetted toward home entertainment, edutainment, and productivity applications, tentatively designated RISC/3D 1000.

If the cartridge-based design is pursued, a CD-ROM drive must be made available as a peripheral, preferably at product launch.

In addition, a high-end personal computer, tentatively designated RISC/3D 2000, could be developed from this architecture to address the productivity and multimedia market segments. However, in view of Commodore's historically limited success in these market segments, this should be considered only if a significant and recognizable advantage over competing systems is identified.

This architecture is particularly significant because the capabilities that this architecture provides and, more importantly the types of applications (such as detailed first-person arcade, adventure, and simulation games) that these capabilities allow, will be necessary to remain competitive in the home entertainment market segment, which is the most critical to Commodore. The 3DO and Atari Jaguar systems, which are currently available or near release, provide these capabilities, as will systems currently being developed by Nintendo and Sega. In view of this situation, the PA-RISC/3D Graphics Engine architecture is essential to the long-term competitiveness of Commodore.

Interactive Television

Interactive television, based on cable television (CATV) or fiber-optic telecommunications technology, is an emerging market segment. Hardware and software technology that is currently available or under development can be used in a strategic partnership with a major player in the cable television or telecommunications industries to penetrate this market segment.

All of the architectures currently available or under development are suitable for an interactive television console, also known as a "set-top" system. However, the higher performance of the MC680x0/AAA and PA-RISC/3D Graphics Engine architectures are likely to be necessary for competitiveness in the later generations of this market segment, which will demand more sophisticated applications, such as multi-player virtual reality entertainment services.

In addition to the basic configuration of a home entertainment/edutainment console, such as the CD³², interactive television has the following additional hardware requirements:

- Tuning
- Decoding
- Genlock

These components are likely to be provided by the CATV or telecommunications company that is Commodore's partner in such a venture.

Home Automation

The technology for home automation is evolving steadily, with several prototypes of "SmartHouse" systems already completed. The functions of a home automation system would include:

- Security
- Energy management
- Climate control
- Audio and video control, programming, and routing
- Lighting control and programming

These functions could be combined with personal management software, discussed previously, to provide an integrated system for common household tasks.

All of the architectures currently available or under development are suitable for a home automation system. To address this market, hardware and software interfaces and a control application would need to be developed.

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