# *The Future Is Bright*

*www. The Future Is Bright .net*

# Orion

Author: Joseph Kilcullen

Version: 1.0 (A4)

Date: 1 August 2006

# Executive Summary

The objective of the Orion project is to replace Video Recorders, Games Consoles (Playstation and XBox), DVD/Hard Disk Recorders, Stereo/Music systems and DVD Players with one PC based system, while still delivering all the functionality of a conventional PC.

The requirements for the system are discussed together with their impact on the industry as a whole. Finally an economics based strategy is discussed which will, over time, erode the existing Games Console and Hard Disk Recorder (HDR) markets, replacing them with one PC based Home Entertainment System market (HES).

In particular the requirement for Graphical Terminals is discussed, their impact on the industry, the many approaches to their design and the transformation they will bring about in the overall IT industry.

# Contents

# Figures



# Tables

# Introduction

Of all the requirements described in this document one stands out for having a major impact on every aspect of the IT industry. Delivery of conventional PC functionality while locating a PC system box under a television requires a Graphical Terminal. Once Graphical Terminal technology is introduced into the industry the technology will adopt a life of its own.

Part I of this document discusses Graphical Terminals and associated issues in detail. Part II takes a first principles approach to the overall system design and objectives. Finally Part III discusses an economics based strategy to achieve success in the marketplace.

# I. Graphical Terminals

UNIX operating systems have had graphical terminals called X Terminals for over 10 years. This section describes the arguments in favour of the creation of such graphical terminals for Microsoft Windows and Apple computers.

## 1 What is a Graphical Terminal?

Imagine that your PC is located under your television in a system box shaped like a video recorder. You use it to record television programs, play computer games etc. but you cannot use it like a conventional computer because of its location. If you move it away from the television then you cannot easily record television programs or play computer games. You cannot have your cake and eat it, or can you?

A Graphical Terminal consists of a conventional computer monitor, keyboard, mouse and stereo speakers. All plugged into a box that connects them to a computer system box located some distance away. The connection can be wireless or wired. It is still a Graphical Terminal.

Hence 'Home Entertainment Systems' (HES) will consist of:

**Under your television:**
A system box shaped and sized like a video recorder.

**And a Graphical Terminal which can be:**

**A:**
A Graphical Terminal box with conventional monitor, keyboard, mouse and speakers. This can be located anywhere in your house e.g. on a desk in a 'home office'.

**Or B:**
A 'tablet' Graphical Terminal i.e. a device similar to tablet PCs except it consists of a flat panel touch sensitive display, speaker(s), a stylus and wireless connection to the system box under the television. Suitable for use while sitting watching television.

## 2 Terminals in the Home

### *2.1 A Compelling Reason to Buy*

There is an inevitable convergence approaching for home entertainment technologies. Games consoles already have a specification that is more than capable for 99% of users. Investment in higher spec. consoles is unwarranted because visible improvement in quality cannot be seen. DVD players are so cheap that they are likely to be built into other devices as a bonus.

Similarly TV Tuner cards are cheap and the large volume of hard disk space needed for Hard Disk Recorders is continually dropping in price.

Clearly PCs are capable of performing all of these tasks and more. Once systems are available that deliver the functionality of:

- Games Consoles
- Hard Disk Recorders
- DVD Player / DVD Recorder
- Media Centre i.e. Music, Video and Photos.
- AND all the functionality/capability of existing PCs!

then consumers will feel compelled to adopt these systems in preference to buying several older systems.

Without a Graphical Terminal our system cannot deliver the functionality of a conventional PC. Hence Graphical Terminals facilitate the delivery of conventional PC functionality while delivering added functionality associated with locating the PC under your television. Effectively presenting the sales pitch as 'buy a computer and get a Games Console, Hard Disk Recorder for free' – a compelling reason to buy!

## *2.2 Additional Benefits*

*Low Maintenance*

Terminals located throughout the house would be low maintenance because 100% of their functionality would come from the System Box located under the Television located in the living room.

If terminals are designed and built by hardware companies, rather than software companies, then they can be Operating System independent. A basic configuration, in the terminal, could allow it to automatically detect available servers.

*Reduced Costs*

While CPU, Operating Systems, RAM and other System Box located technologies are continuously advancing, monitors, mice, keyboards etc. are not. As such consumers can save money by keeping their old monitors, keyboards etc. In fact old computers could be converted into Graphical Terminals. Ironically this approach could result in greater sales of such components as computer literacy levels would increase resulting in an increased demand for computers.

Universities and schools would also welcome a reduction in upgrade costs.

*Centralised Control*

Parents will be able to control Terminals located in their children's bedrooms. This is particularly useful for control of Internet access, installation of software, playing of games[1] and hours or duration that any given Terminal can be active for, in a day, weekend etc.

[1] Terminals are not intended for heavy graphical use. Playing of DVDs/MPEGs may be possible as the data can be buffered in the terminal in advance of display.

A project titled 'Fabel – Fact Based Labelling' from Kilcullen Research addresses control over access to adult content, on the Internet. This paper is available for download at www.TheFutureIsBright.net

# 3 Terminals in School and Industry

## *3.1 Terminals for Educational Purposes*

The costs associated with providing a PC for every student in every class are prohibitively high. Maintenance for such a large number of computers would require full time professionals in most schools, adding to the costs. Even then additional software is needed to network educational LANs.

However, twenty terminals connected to one central multiprocessor computer would reduce costs by allowing that one central computer to be maintained and upgraded as necessary. Systems could even be developed for new processors to be added to existing computers to allow for a modular approach to computer purchases. Effectively LANs of Graphical Terminals would convert PCs into Mainframes i.e. centralised computers with terminals.

As new computers are purchased the existing terminals would be used with the new Mainframe i.e. costs are reduced by keeping the terminals and replacing or upgrading the Mainframe.

Additional software to facilitate educational requirements would be minimal as the terminals are already networked.

Costs associated with breakage would be minimised as monitors could be housed in the desks and basic keyboards are already low-priced.

Universities would adopt this technology for many of the same reasons. Terminals could be configured to list available Mainframes on the University network and prompt the user to select one, to log onto. This is a more flexible arrangement that would deliver installed software to anywhere on the University campus, including student accommodation terminals.

## *3.2 Industrial Applications*

Industry is always looking for ways to reduce costs. As such this technology is likely to be adopted in industry. Many companies already recycle their monitors, keyboards etc.

# 4 Terminals Driving Evolution in the Computer Industry

While computerising people's homes would be welcomed by the industry, Graphical Terminals, as a technology, would have a life of their own. Like it or not, Graphical Terminals will transform the entire industry.

## *4.1 Fractal Computers i.e. A Computer inside my Computer!*

A Graphical Terminal is simply another computer that is permanently setup to run Microsoft's Remote Desktop i.e. a Graphical Terminal is a computer within your computer.

Each time you zoom in on a Fractal you see an image that contains patterns that existed in your previous zoom. In the same way the Internet can be viewed as 'a computer'. Our web browser acts like a terminal. Through our browser we take advantage of multiple processors, distributed computing, file sharing, worldwide file and data server's etc.

Another example, broadcasting digital TV is a productivity gaining exercise i.e. one computer compresses the TV signal and many computers receive the benefit of that work i.e. a productivity gain associated with the 'computer within a computer analogy'.

## *4.2 Return of the Mainframe*

By creating hardware Remote Desktops, Graphical Terminals, we will be destroying the PC. We will be replacing networked PCs with Mainframes that have Graphical Terminals.

Mainframes were among the earliest successes in the computer world. However an inability to deliver on graphical user interfaces saw them surpassed by LANs of PCs. The Internet and PC networking were there in the form of the Mainframe. The Mainframe delivered a computer network as standard. Email, file transfer etc. were easy.

No doubt IBM, HP etc. will adopt this new (yet very old) paradigm and attempt to assert their dominance in the mainframe markets, selling to Universities, Governments etc.

## *4.3 Strategy – is Your Company Positioned for the New Paradigm?*

The problem for Intel, AMD and other companies based in the PC world, is that a sudden shift to this new paradigm may upset their business model.

It is unlikely that this idea can be patented as Graphical Terminals are simply low powered PCs running Microsoft's Remote Desktop. It would be like putting a new name on sliced bread and patenting it.

Clearly presenting home users with "a free games console and Hard Disk Recorder" with their new PC will be so compelling as to wipe out games consoles, as we know them, and grab the emerging Hard Disk Recorder industry for the PC industry. Hence, it is difficult to see this idea failing. As such do we accept this change and try to figure out the impact of this new technology in Industry and Education?

For Intel & AMD the challenge is to adapt to a world where PCs do not exist. Yes some PCs will still be sold, but, for the most part, they will be Mini-Mainframes. The challenge is to be the company that makes essential components for these new products. Again the problem that 'Graphical Terminals are simply low power PCs' arises i.e. there is nothing essential that the existing market cannot quickly deliver on. Especially for mainframe companies who need only develop a basic box that will run existing X Terminal software.

For a company to best position itself it must focus on the new characteristics of these systems and try to patent sufficient technologies to get a competitive edge. That edge must then be leveraged to beat their competitors in the market place. Also advance warning of the paradigm shift will allow them to grab whatever market share is available in the early days. Maximising the market penetration of the new system will further aid the leading company. Hence excellent market research, design and delivery of the new system will aid customer's attempts to adapt the technology and aid the market leading companies to pay off their initial investment early, before moving to a more competitive stance to discourage further entry into the market.

New characteristics of this system include:

- Wireless and Wired Graphical Terminal Boxes
- Bus and other chipsets to facilitate multiple Graphical Terminals on one computer i.e. new Specialisation Chipsets.
- Facilitate easy upgrading of computer hardware.

*Wireless and Wired Graphical Terminal Boxes*
Replacing a full computer system box running Microsoft Remote Desktop with a small, preferable cheap, networking device will require new chipsets at the sending/broadcasting (System Box/Mini-Mainframe) end and at the receiving end (terminal).

*New Specialisation Chipsets.*
Modern video cards perform tasks previously performed in the CPU. This is necessary because the vast quantity of these calculations/tasks being performed demanded specialisation i.e. a dedicated chip to perform the task. No doubt Graphical Terminals could be created entirely in software by making the CPU perform all required tasks. However the computer is likely to become slow as the CPU is performing so many tasks required for the Terminals. Hence specialisation chips may be needed to perform these tasks. These chips may involve networking, graphics, sound, buffering etc.

The complex task of designing such systems will illuminate the problem areas and facilitate the development of solutions i.e. the specialisation chipsets required will become apparent once we see the failure/weaknesses of software systems.

It is preferable that there be some surprise in the chipsets required. A surprise implies something that your competitors can only find out through time and effort. Both expended while you sell your wares. However the fact that Graphical Terminals are simply low power PCs makes this unlikely.

*Facilitate Easy Upgrading of Computer Hardware.*
Imagine a home user wants a new terminal for their existing computer. They purchase a new terminal and a new CPU processor. The processor's housing is such that it can be inserted into an expansion slot in the existing computer. Note the lack of expertise or knowledge required to perform this upgrade.

The reason why I'm suggesting this type of upgrade is that these new systems will have unpredicted effects. A thorough design process is required so customers and

companies will know in advance the capabilities and limitations of the system e.g. early Graphical Terminals may not be able to display MPEG or DVD Video.

# 5 Terminal Operating System (TOS)

Existing UNIX X Terminals have a significant software component. As such Graphical Terminals for Windows and Apple operating systems may also have a software component. To break the link to individual operating systems a number of different approaches can be taken:

- Firmware: like printers that understand postscript, create a language that will instruct the terminal. Basically this is a Terminal Operating System (TOS) created by an independent company.

- Create an abstraction layer in each operating system i.e. have functions that normally draw to the screen linked to a different library that calls the appropriate Graphical Terminal function instead. This approach may involve a TOS from an independent company or from the same company that provided the main computer's operating system e.g. Microsoft.

- Take a free market approach where the terminal will download firmware from the server once a server is selected i.e. Microsoft, Apple etc. will write their own software. In this case the TOS is part of the PC's operating system. The terminal will download that software at boot time.

The Firmware idea sounds great because a terminal could display software applications from a number of servers at once e.g. a user could run Windows, Apple and UNIX applications at the same time on the one terminal.

Operating System vendors, Microsoft in particular, will dislike this because it undermines their product. Allowing applications from different operating systems to be displayed side by side removes dependence on any one operating system. New software applications could be purchased for any server on a network. This would increase the availability of software on Non-Microsoft operating systems undermining their dominance in the market place.

Yes this issue will arise again as windowing systems are being developed for delivery over the Internet. However a strong link between terminals and their server will be sought by operating system vendors to protect their product. (Internet Based Windowing Technologies - Microsoft are promoting XAML in response to the Free Software Community's XUL technology.)

The following table uses Microsoft Windows XP as an example of an Operating System and 'TOS Inc.' as a factitious company that created a Terminal Operating System.

| | PC Operating System | TOS Supplied by: |
|---|---|---|
| Firmware | XP | TOS Inc. |
| Abstraction Layer | XP and Abstraction Layer from TOS Inc. | TOS Inc. |
| Free Market | XP | XP |

*Table 12.1 – Provider of Terminal Software for Various Configurations*

Clearly the Free Market approach will be favoured by Microsoft, Apple etc., if only to keep the terminals under their control. In this case hardware companies need only develop a cut down PC. There is no need for persistent storage and minimal CPU power is required.

## *5.1 Mini Graphical Terminals*

While facilitating Operating System vendors by allowing them to control the TOS is a sound approach the Firmware idea is still compelling. As such the idea deserves further consideration.

Consider a Radio-Alarm Clock type device. It contains a 4-5 inch display, 4-8 buttons located around the edges of that display and a connection to a PC located elsewhere. A basic Firmware would allow the PC to control the image displayed and drive menus that could be navigated with the buttons.


*Figure 12.1 – A Mini-Graphical Terminal Configured as a Clock-Radio*

# II. HES System Requirements & Design

Here we identify the requirements needed based on the systems that we will be replacing e.g. Games Consoles & HDR.

## 6 Conventional PC Functionality

Basically the challenge is to modify Windows based PCs and Apple iMac computers so that they will assimilate the markets of these other products. Specifically the challenge is to deliver the added functionality while not loosing any of the existing capabilities of PCs.

Here the primary conflict of requirements is between:

A. Our need to locate the System Box under a television so it can be used with that television and
B. Our need to access the PC in a conventional manner in a Home Office type environment.

Here we introduce our first requirement:

**1st)** *Provide a Graphical Terminal*

## 7 VCR, DVD±R(W) & HDR

These systems are grouped together because they are different implementations of the same set of requirements. For clarification purposes:

- VCR Video Cassette Recorder
- DVD±RW Digital Versatile Disk - 'Read' and optionally 'Write'[2]
- HDR Hard Disk Recording

We cannot identify these requirements until we have identified the television transmission technologies being used.

### *7.1 Television Standards & Systems*

In this context there is no need to discuss all of these systems in detail. Suffice it to say that the following major categories of system exist:

- Analogue Television
- MPEG-2 based Digital Television e.g. DVB (Europe) and ATSC (USA)

[2] The term 'WORM Disk' is a better description of the 'R' i.e. WORM, Write Once Read Many.

- MPEG-4 based Digital Television i.e. High-Definition Television (HDTV)

## *7.2 Requirement by Television System*

The following table briefly describes the requirements for watching and recording television with each category of technology.

| Category | Watching | Recording |
|---|---|---|
| Analogue | Pass through i.e. do nothing the television will display the image without any pre-processing. | A chip is needed to compress the signal in real time. This is expensive. Also there are other hardware requirements to ensure good quality. |
| MPEG-2 | The data must be decompressed in order to display it. However MPEG-2 decompression chips are inexpensive. | The signal is already compressed. As such recording involves streaming the data to a hard disk. |
| MPEG-4 | The data must be decompressed in order to display it. This is more expensive than MPEG-2 decompression though costs will come down over time.[3] | Same as MPEG-2 except the volume of data is larger.[4] |

*Table 2.1 – Recording and Watching Requirements by TV Transmission Type*

Personally I believe the easiest way forward is to ignore Analogue. Reasons include:

- Analogue television systems are, one by one, being turned off. Both the UK and Ireland plan to have terrestrial analogue television turned off by 2012.
- By the time this product gets to market only a few years of Analogue TV will remain. This will discourage customers from buying systems for analogue TV. This will reduce the time window for us to pay off our initial investment and get a return on investment i.e. profit.
- Real time compression of television is expensive. Simply channelling already compressed television to a hard disk is cheep i.e. streaming Digital TV to a hard disk!

To deliver functionality for Digital TV while ignoring Analogue presents the problem that customers will not feel compelled to buy until Digital TV arrives. We can resolve this issue by developing 'Transition' systems, as described in section 12.2 below.

Assuming our system's primary function will be for Digital TV then the following requirements should be added to our list:

**2nd)** *A Digital TV receiver and sufficient dedicated bandwidth to stream the data to a hard disk, continuously i.e. delivery of quality recordings.*

[3] It is possible that High-Definition televisions have decompression chips already as such a 'pass through' option may also be available.
[4] HDTV actually takes up as much bandwidth as a regular analogue channel, with no possibility of further compression. Downloading that program may be an alternative.

**3rd)** *Ability to decode software based video Codecs to the television display. At least MPEG-2 though MPEG-4, DivX and others will be needed for forward compatibility reasons.*

An issue with digital TV systems is the need for multiple tuners i.e. recording requires a tuner. Hence you cannot watch a different channel while recording. While HDTV's may have tuners built in conventional televisions do not. Hence systems should have two or more tuners and be configurable so as to deliver the maximum benefit to customers. Possibilities include:

- One tuner streaming a signal to a hard disk i.e. recording. While a second sends its signal to a conventional television.
- Two tuners streaming television to two separate Graphical Terminals.
- A HDTV decodes and displays one television channel while an unused tuner in the PC sends its signal to the television for display as a 'picture in picture'

Hence

**4th)** *Two tuners will be needed to allow recording and watching, of Digital TV, to occur simultaneously.*

Finally customers will want to burn recorded programs to disk:

**5th)** *Provide a DVD burner. A new formatting standard that does not need to be finalised may also help.*

# 8 Games Console Requirements

In order for a PC based system to operate as a Games Console, that console must be located under a television rather than being connected to a conventional monitor, keyboard etc. This is also a requirement for use as a Hard Disk Recorder (HDR).

**6th)** *The System Box should be shaped and sized like a Video Recorder for easy installation into existing furniture.*

**7th)** *Suitable connectors for television output should be provided e.g. a SCART connection. Also connectors that will allow easy integration with other television technologies/systems.*

Given the fact that this is a PC, users may use the television for activities other than watching television and gaming. Yes Graphical Terminals will be available for Internet surfing, email etc. However it will still be necessary to connect various devices to the System Box, including:

- Keyboards & Mice
- Game Controllers – Console and Joystick type controllers.
- Remote Control i.e. to control the Digital Television, recording and playing movies etc.

- Wireless headsets for VoIP, gaming etc.

This last item is different because it requires two way communications. Hence I will include it as a separate requirement.

**8th)** *Provide a unidirectional wireless hub for controller type devices. Infrared or radio.*

**9th)** *If necessary provide a bidirectional hub for devices that require bidirectional communications.*

By publishing a standard for these hubs the Free Market will provide an inexpensive selection of devices that connect to the system. Alternatively an existing standard could be used e.g. Bluetooth.

Since this is a PC a number of software applications may wish to provide an interface through the remote control. While generic remotes exist it is unreasonable to request users to reprogram these remotes for every software application that offers remote control. As such a generic remote like the following may be appropriate.

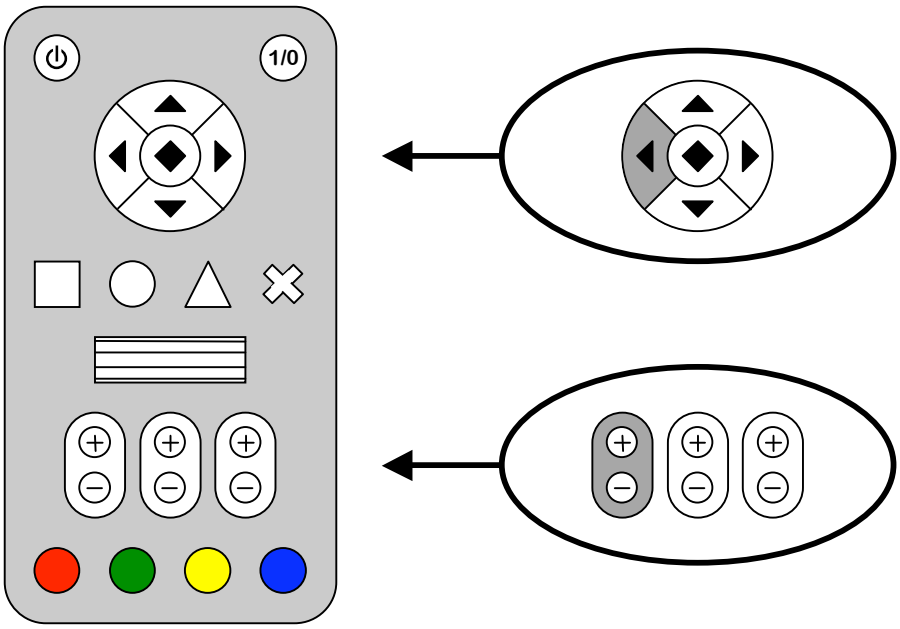


*Figure 3.1 – A Generic Remote Control with Schematics Indicating Use*

Through menus this remote can control all the functionality required for Digital Television and other application. On the right are schematics that could be displayed, on screen, with their function/use.[5]

The intention is to allow applications to be selected with this remote and control then passes to that application, just like keyboard focus on a PC.

[5] The long rectangle is a 'roller' i.e. for navigating through menus. Just like the wheel on a mouse it rolls and can be pressed to select a menu item.

# 9 Music System Requirements

A number of possibilities exist here:

- Playing music through the television e.g. with iTunes.
- Playing music through the television with the sound directed to a legacy sound system i.e. feed sound to a wired or wireless device that connects to a stereo system.
- Playing music on one or more Graphical Terminals i.e. playing music in other locations in the house.
- Clock Radio type Mini Graphical Terminal idea – create mini graphical terminals that are Firmware driven. See section 5.1 above.

Mostly these systems require bandwidth and CPU power to facilitate additional Graphical Terminals. However an additional requirement for the main system box is:

**10th)** *Provide standard outputs for sound systems. Possibly including the ability to connect wirelessly to a legacy stereo system.*

# 10 DVD Player Requirements

Though delivering DVD Player functionality may appear straightforward the reality is that our new Home Entertainment System is so sophisticated that basic functionality like this needs to be assessed thoroughly.

Watching Digital TV involves decoding of MPEG-2 or MPEG-4 video streams, similar to the decoding of DVD data. Simultaneously watching Digital TV, a DVD or a recorded television program while other PC functions are being carried out may prove taxing for the computer.

Since poor quality playback will taint the overall quality of the system we must design our system to consistently deliver good quality playback in spite of any other activities being carried out on the PC.

If possible a dedicated chip could be used for output of MPEG data streams to the television. It would not be used while computer games are being played or for other PC type functionality, though it would be used for:

- Decoding of Digital TV
- Decoding of previously recorded television programs i.e. MPEG 2 or 4
- Decoding of DVD data while playing DVDs.

By dedicating a chip to this task we are ensuring good quality television and playback of recorded TV. See chapter 11 for further discussion of this problem.

**11th)** *Provide dedicated hardware for critical tasks like playing DVDs.*

Locating this chip in the video card makes sense though upgrading from MPEG-2 to MPEG-4 would require changing the video card and tuners i.e. upgrading to HDTV. Manufacturers should consider the various options and make their systems forwardly compatible. Not taking this into consideration may result in customers delaying a purchase and, in the process, helping other products to keep their existing market share.

# 11 Quality, Capacity Utilisation & Critical Tasks

If a television could not display a TV channel continuously we would return it as a defective product. Similarly DVD players and Personal Video Recorders (PVR i.e. HDR or VCR) are expected to deliver quality recordings and playback. However computers are often slow and unresponsive as disks spin up or excessive demand on RAM or processor time pushes data into slow disk swap space.

Though analogue technologies are reliable, users require the improved quality and instant access of digital systems. Also transmitting compressed television channels saves bandwidth, allowing more channels to be broadcast.

The challenge in designing this system is to consistently deliver a quality product in a number of key areas. These include:

- Playback of compressed video e.g. MPEG-2, MPEG-4, DivX and other software based video codecs.
- Delivery of quality television recordings.[6]

Failure to deliver a quality product in these key areas will taint the public's perception of the product. Simply giving these critical quality tasks priority will not work. This is because computers are designed with a different philosophy to dedicated hardware systems. Such systems perform one, and only one, task. As such the concept of competition for resources does not exist. Giving key tasks priority, in the operating system, does not guarantee good quality it simply increases the probability of a 'good quality' outcome.

Addressing these issues presents a challenge that potentially undermines the entire concept of Home Entertainment Systems. Rather than assuming that I can present all the answers I will address this problem by outlining the types of design analysis needed to deliver this system and then discuss probable solutions. For actual solutions these analysis and any others, of merit, should also be carried out.

Two types of analysis to be discussed here are:

- Capacity Utilisation
- Impact Load

Where these, or other, analysis are deemed to be unsatisfactory or deemed to have failed then other analysis methods should be utilised.

[6] Gaming quality is also important. The capacity utilisation analysis should address these issues.

## *11.1 Capacity Utilisation*

Despite the term PC, Personal Computer, this system is actually a multi-user system. It must simultaneously deliver conventional computer applications and media applications to a number of users. With demands placed on the computer by one user impacting the resources available to other users, a deterioration of quality may be experienced. Should a key task experience a drop in quality then the overall product will be viewed as being of poor quality.

We cannot control how the system will be used. We cannot dictate the number of software applications that can be run simultaneously. We cannot dictate the number of simultaneous users on the system. All we can do is inform the customer, at the time of purchase, of the capacity constraints of the system they are buying. If a customer's needs exceed the design capacity of the system then they can purchase a new system or upgrade their existing one.

A thorough analysis and design will create lists of hardware utilised by each task. Then conflicts can be identified by assessing the levels of capacity utilisation. The following table is an example of the kind of analysis needed. Each box contains a 1-10 measure of capacity utilisation i.e. 0 (blank) indicates no use and 10 indicates 100% usage.

| | Tuner | Data Bus | Hard Disk | CPU | DVD Drive |
|---|---|---|---|---|---|
| Recording | 10 | 6 | 7 | 3 | |
| Watching Digital TV | 10 | 2 | | 3 | |
| Playback of Recordings | | 4 | 7 | 1 | |
| Gaming | | 6 | 7 | 8 | 10 |
| Basic OS Functionality | | | | 1 | |
| DVD Playback | | 4 | | 1 | 10 |

*Table 7.1 – Capacity Utilisation Chart, Hardware v. Tasks*

As 'off the shelf' hardware is assessed for this system we can build up a table with actual utilisation figures rather than the estimates used here.[7] Starting with a conventional hardware configuration we can identify (using a spreadsheet) where bottlenecks will occur.

In this example recording and gaming require 110% of the CPU's capacity. Hence this architecture will not facilitate simultaneous recording and gaming. Also a second digital TV tuner is needed to simultaneously watch and record digital TV.

We can also use this approach to assess the quality of key tasks e.g. will quality suffer while simultaneously playing a DVD and recording television? The chart indicates 100% usage of the Data Bus. With no spare capacity one or both tasks may suffer intermittent disruptions/drop in quality.

Clearly a full analysis of requirements and hardware will be needed. Duel core processors, buffering etc. should all be represented. Some tasks may have varying

[7] An actual analysis will use units for each capacity requirement, not a percentage like this example.

capacity utilisation e.g. application 'Start-Up' may temporarily require higher capacity of the hard disk.

The possibility of 'Start-Up' requirements being greater indicates the need for another type of analysis i.e. Impact Load analysis.

### *11.2 Impact Load*

Image you are watching your favourite TV show that you recorded a few days ago. At a key point in the show the recording quality is poor and replaying it does nothing to improve it. The explanation is that a software application was started up while the program was being recorded.

'Impact Load' analysis simply means identifying what tasks have a significantly varying capacity utilisation figure, over their run lifetime.

Many software applications have a much higher use of the hard disk at Start-Up. The intention of Impact Load analysis is not to design systems that can take high impact loads and regular loads simultaneously. Rather it is to provide an input into the design process.

## 12 Design

The inputs to the design are the outputs of the various requirements analysis carried out. Some requirements can be satisfied by systems that deserve their own analysis and design e.g. Graphical Terminals. Others require the capacity utilisation figures and impact load data to be assessed and key design approaches to be identified, assessed and finally adopted.

This document is not intended to be an exhaustive design or requirements analysis. Merely an introduction that will help assess the overall work involved in this project. As such the following are examples of the work required, not a thorough design. Even these examples are not exhaustive e.g. the following discussion does not assess the possibility of conventional TV resolution being broadcast as MPEG-4 or the earlier stated need for more than one TV tuner.

Section 12.2 below addresses a design requirement from a Marketing analysis i.e. address customer's unwillingness to buy when digital TV is not yet available.

### *12.1 Hardware for Recording of Digital TV*

Since digital TV is already compressed there is no need for significant CPU usage while recording. Given the multi-user nature of the system, CPU time required by recording might not be available. Hence reducing the CPU time needed to zero will help maintain the quality of recordings.

Effectively we are saying that data should flow directly from the TV tuner through a data bus and into a hard disk. If everyone on the design team accepts this assertion then hardware components can be chosen, or designed, to satisfy this design criteria.

However hard disks are used by other applications. Hence the impact load analysis indicates a possible drop in quality during application start-up.

On identifying a problem the following steps should be followed (add others if you think they are needed):

- Identify a number of possible solutions
- Assess each solutions for effectiveness in a number of areas e.g. response of competitors.
- Choose a solution. Then update all capacity utilisation charts etc.

Here are some examples of solutions to capacity utilisation conflicts for hard disks.

*Create a Priority Bus*
Basically this is the same as a regular SATA bus except it accepts data from a number of input sources and prioritises the data sent from some of those sources.

Data from a digital TV tuner card (data to record) would be prioritised. Data reads or writes from software applications would have to wait.

The main problem with this solution is that software applications would become significantly slower unless sufficient bandwidth was provided. This may simply result in slow start up.

A benefit of this approach is that existing hard disks can be used and competition in the existing hard disk market will carry over.

*Modify Hard Disks to Accommodate Recording*
If one side of a disk platter is dedicated to recording then a special input can be provided for input of recording data. The disk can then manage it's RAM buffer and head positioning to facilitate steady flow of data.

A disadvantage is that recording time will be limited to the capacity of half a disk platter. After recording for this length that data must be copied to the regular disk area. Alternatively this option could be presented within the operating system as a device i.e. disk space on that half platter would not appear as disk space within the operating system. Rather it could appear as either a buffer for recording into or dedicated persistent storage for recordings.

Even though the final design has not been arrived at here I will specify design criteria based on the above discussion:

**12th)** *Recording of Digital Television should not utilise hardware or bandwidth that is available to other computer applications/functions i.e. the data stream should flow from the tuner card directly to the hard disk.*

Also:

**13th)** *If necessary add a second hard disk or a second input into the main hard disk to ensure no competition for resources between TV recording and other computer applications.*

## *12.2 Transition System – Recording Analogue and Digital TV*

Transition Systems refers to systems that cater for Analogue and Digital television. Basically they are digital systems that have an analogue tuner added to them. Once digital systems have been rolled out the system will seamlessly adjust to the new technology.

Clearly all of the issues and problems associated with analogue television will be present. Yet analogue television is going to be turned off. Hence they are temporary problems and the system is a transition system to allow purchases to be made now rather than waiting.

Analogue television must be compressed, in real time, and streamed to a hard disk. Any bottle neck in the system will result in dropped frames i.e. poor quality recording. It is possible that hardware installed for digital TV will help e.g. a RAM buffer in the hard disk. Another example is the use of any MPEG playback chip as a coprocessor to assist compression i.e. the chip that would be used to display digital TV. Needless to say the system will not be able to do anything else while recording analogue television as this is both a critical task and a computationally intensive task.

Historically capturing television with analogue tuner cards was difficult for a number of reasons. Among these reasons is the Recalibration of hard disk heads.

*Recalibration and Seek Errors*

During hard disk use the error in head positioning increases over time, eventually causing Seek Errors. By returning the disk heads to their home position the accumulated positioning error disappears. This is called Recalibration.

The problem is that no disk writes can take place during this process. This can result in captured frames being dropped as the system cannot cope with any build up of data.

Modern hard disks are faster and often contain a RAM buffer. As such this might not be a problem with modern systems.

**14th)** *Digital systems may have analogue tuners added to facilitate sales into markets where digital technologies have not been rolled out yet.*

# III. A Strategy as a Solution

## 13 Strategic Overview

***Strategy a long-term plan for success, such as in politics or business.***

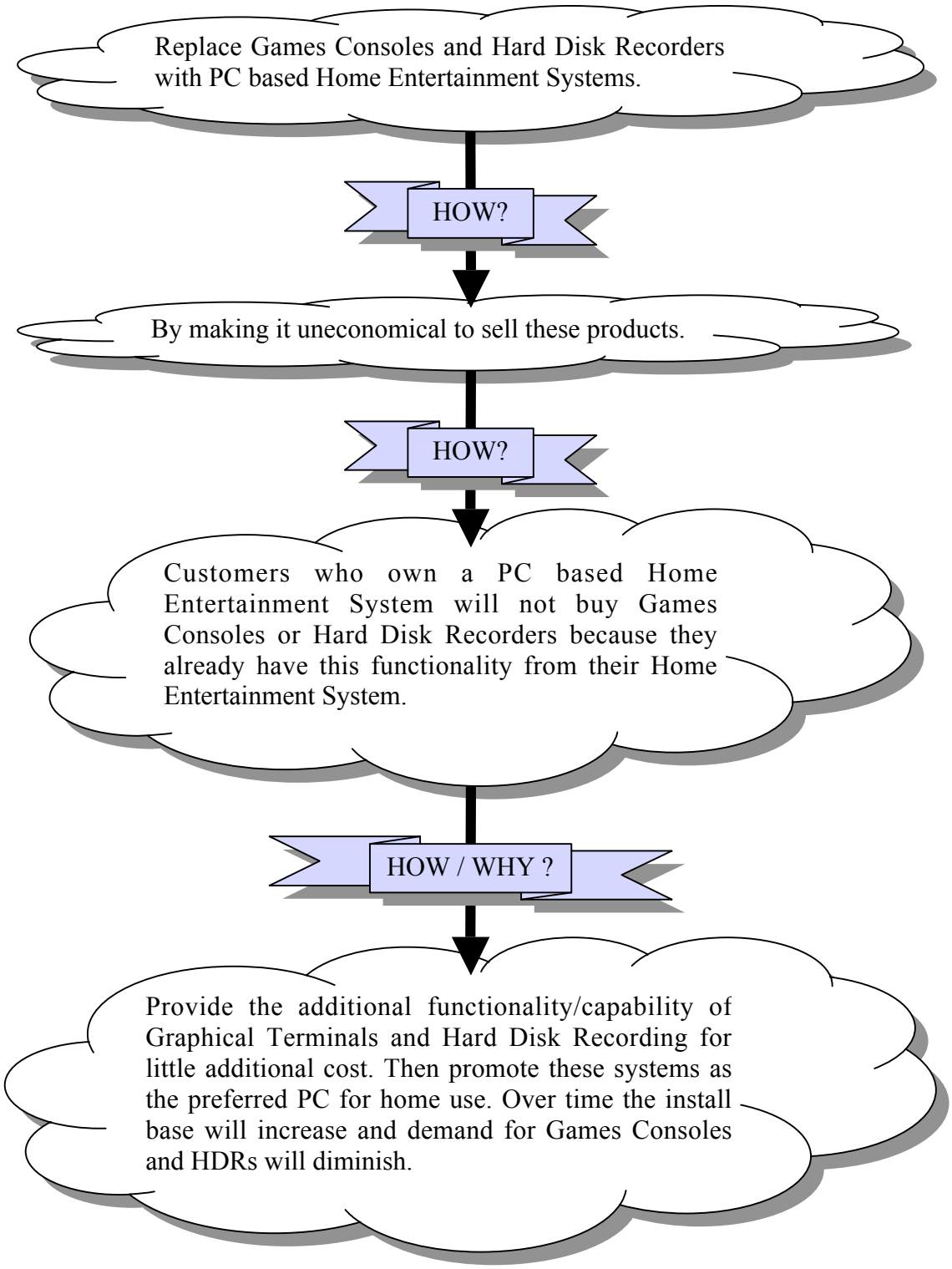


*Figure 13.1 – The Organic Acquisition of Games Console and HDR Markets.*

In the early days of the Games Console industry it was so difficult to develop games that games were only available for individual consoles. Today developers use tools to manage 3D geometries and graphics. These tools facilitate development for multiple platforms. Imagine if software applications could be installed on any computer with any operating system. Microsoft operating systems would suddenly have a lot of competition. This is precisely the problem games consoles are facing. Games console sales can no longer be protected by a strong link between console and what games are available for that console. Sony and Microsoft know this hence they only develop games for their own consoles. The advantage for us is that many games are now also developed for PCs i.e. our system. Customers are no longer restricted to games consoles for a good selection of games.

The Home Entertainment Systems described above should be presented as the standard PC for home users. Its installation as Graphical Terminal and System Box connected to a television should be straight forward so as to facilitate its use as a games console/HDR.

# 14 Key Strategic Objectives

The details of this strategy should originate in the various success criteria e.g. the system box should be shaped and sized like a video recorder for easy installation into existing household furniture, a design criteria that Games Consoles and HDRs already adhere to.

The primary success criteria for this project are:

- Delivery of Graphical Terminals for little additional cost i.e. the additional cost should not deter the customer from buying the system.
- Delivery of HDR capabilities as economically as possibly.
- Completing the package with other features that complement the system's primary functions.

Costs can be contained by:

- Proper use of Cooperation and Competition.
- Utilisation of Existing Assets

## *14.1 Cooperation and Competition*

Competition keeps costs down by making rival companies cut margins in order to gain market share. Cooperation keeps costs down by taking a division of labour approach e.g. let Microsoft and Apple write the software and Intel/AMD can make the chips. This is more economical than one company developing all the system components.

Clearly Microsoft and Apple should be brought on board as partners who will extend their own operating systems to function with/on Graphical Terminals. This will

deliver software for Graphical Terminals. Also competition between Microsoft and Apple will keep operating system costs down.

A number of Games Companies should be brought on board or the operating system vendors can provide a mechanism within their operating systems for managing legacy games played on this new system e.g. a Games Menu.

*Games Menu*
A Games button could be provided on remote controls that would display a 'Games Menu' i.e. a list of all games installed on the computer. The operating system could then start games selected from this menu in full screen mode i.e. present the game in an appropriate manner for playing on a television/games console type device.

Other examples of competition being used to keep costs down include:

- Publishing a standard for connecting wireless control devices i.e. many companies will compete to supply this market, ensuring a plentiful supply of low-cost controllers.

- If modified hardware is necessary, to ensure quality television recordings, then engage with a number of hard disk manufacturers. They will then compete to win the market, keeping costs down.

- Similarly provide all PC manufacturers with the same design documents. Ideas like, placing a LCD type display on the front of the system box, like a video recorder, will be adopted by all manufacturers out of fear that this feature may gain/loose the competitive edge in the marketplace.

## *14.2 Utilisation of Existing Assets*

Given the nature of Graphical Terminals the software companies are likely to sell software to convert old computers into terminals. Apple may even develop software to convert PCs into Apple Terminals. The problem, for Intel/AMD, is that this will reduce the terminal's hardware to that of a low power PC. Hence Intel/AMD will have competition as other companies piece together basic computers from existing commercially available components. This means there is little potential for return on investment from the development of new technologies.

The chip maker's response is likely to be Utilisation of Existing Assets e.g. piece together various chip designs that they already own to create a product. The investment required for this is minimal.

Other examples of Utilisation of Existing Assets include:

- Bundle a number of basic and old computer games with the system. As old computer games they have devalued. Yet supplying a number of games with the system, already listed on the Games Menu, will add value for the customers.

- If chipsets, that are being changed anyway, could have buffering etc. added to them rather than adding such buffering to hard disks then we are making

existing hard disks compatible with the new system. In this way existing competition in the hard disk sector will keep costs down i.e. utilise the existing competition in the hard disk market.

- Similarly if existing monitors, keyboards etc. can work with our new Graphical Terminals then competition in that market will also carry over.

- Companies like Intel and AMD already own CPU chip designs, Pentium etc. Where such chips can be utilised to deliver this system we will be using old depreciated assets to facilitate the creation of a new product. In the process enhancing the value of leading chip designs.

## *14.3 Entry Into The Marketplace*

An approach to this project that facilitates rapid entry into the market place will accelerate the return of initial investment into the project. Then a more competitive stance can be adopted to discourage further entry into the marketplace.

Where possible block entry into the market with Patents or other intellectual property.

Tactics to accelerate entry into the market include:

- Taking advantage of Digital TV technology rollouts, e.g. releasing this product when Digital TV and HDTV technologies are being rolled out.

- Attempt to assimilate various other technologies e.g. satellite receivers.[8]

- Forward and backward compatibility will encourage customers to buy now as their concerns about advances in technology will be eased.

This last statement needs further explanation. If a customer believes that an advance in technology will render their system useless then they will not buy. We need to provide customers with a number of choices, as regards navigating technological changes. Whatever choice the customer makes they need to know that they can upgrade their system to accommodate future technological changes. For example transition from Analogue to Digital TV.

[8] A simply 'home expansion slot' would facilitate easy hardware upgrades i.e. a slot that PCI devices could be inserted into without any expertise on the part of the installer. Satellite decoders etc. could be installed by home users without the assistance of a computer expert.

# Appendix I – Requirements

This list is not intended to be 'the be all and end all' of the design process. It is intended to be a ball park indication of the scale of the design process. Chapter 11 alone is likely to identify as many additional requirements as those listed here.

# Appendix II – Acronyms

| | | |
|---|---|---|
| ADD | - | AGP Digital Display (S-Video & Composite) |
| AGP | - | Advanced Graphics Port |
| ATSC | - | Advanced Television Systems Committee |
| CE | - | Consumer Electronics |
| Codec | - | Portmanteau of Coder Decoder i.e. for compressed video. |
| DBS | - | Direct Broadcast Satellite |
| DMR | - | Digital Media Recorder |
| DVB | - | Digital Video Broadcasting |
| DVR | - | Digital Video Recorder |
| HDR | - | Hard Disk Recording |
| HES | - | Home Entertainment System |
| IP-DSTB | - | Internet Protocol Digital Set Top Box |
| MPEG | - | Motion Picture Expert Group |
| PVR | - | Personal Video Recorder |
| STB | - | Set Top Box |
| VOD | - | Video On Demand |
| WORM | - | Write Once Read Many |