The Modern Commodore 64
Payton Byrd

Forward

The Commodore 64 is one of the most iconic computers in history. Even today there is a large and thriving community of users, goods and services for the C64. Getting the most out of the Commodore 64 can be daunting considering the depth and breadth of products and services available. This book is intended to give both new and experienced Commodore 64 collectors the insight and knowledge to get the most out of this wonderful platform.

Introduction and History of the Commodore 64

The Commodore 64 personal computer is still the best selling model of personal computer of all times. Introduced in January 1982, the Commodore 64 was the successor to Commodore Business Machine's wildly popular VIC-20. The Commodore 64 built on the architecture of the VIC-20, but was not backwards compatible beyond simple BASIC games that did not utilize any hardware-specific features of either computer.

In 1982, the world had never seen anything like the Commodore 64 at anywhere near the Commodore 64's price. The closest thing to a competitor for the Commodore 64 was the Atari 800 which was significantly more expensive and lacked the incredible sound capabilities of the Commodore 64. The heart of that sound prowess of the Commodore 64 is the 6581 SID chip, which to this day makes the Commodore 64 a sought-after machine by the Electronic music crowd as well as modern sceners who create incredible arrangements using a single SID chip. You should really listen to this You Tube video (https://www.youtube.com/watch?v=azgZ5Qw8ass) to get a sense of what sceners are accomplishing on the SID and C64 today.

What can you do with a Commodore 64?

The Commodore 64 is a very versatile computer. Over 10,000 software titles have been released for the Commodore 64 since its release in 1984. Those titles range from simple and complex games to word processors and financial planning software to utilities for managing and maintaining software libraries to popular programming languages such as BASIC, Assembly, C, PASCAL and FORTH.

Games

There are many great resources for finding classic games and information about those games on the Internet. At the time of this writing, the Commodore 64 is seeing a

Figure 1 - Jar's Revenge, Bomberland, and Cosmic Ark

revitalization of the game-writing scene. A significant driver of this increase in new game development is the advent of the annual 16K Cartridge Game contest hosted by RGCD (need citation). Some of the recent games released during this competition over the last few years include remakes of games like Yar's Revenge and Cosmic Ark. Other new games include Commodore 64 adaptations of

games like Canabalt (C64abalt) and Bomberman (Bomberland).

(todo: Comprehensive list of games released by RGCD)

Applications

One of the things that made the Commodore 64 a great personal computer was the depth and breadth of not only games available, but productivity applications as well. Word processing, drawing apps, accounting and even spreadsheets were all widely sold and accepted in the market. At the forefront of

Figure 2 - geoLink IRC - http://lyonlabs.org/commodore/geoLink/geoLink.html

Applications for the Commodore 64 were the applications designed for GEOS (Graphical Environment Operating System) which provided a modern 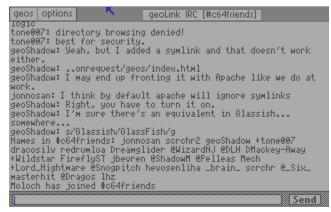point-and-click operating system for the Commodore 64. Many Commodore 64 computers were sold with GEOS, but it was also sold as a stand-alone package.

GEOS included two key applications: geoWrite (a word processor) and geoPaint (a drawing program). Other popular applications available for GEOS included geoCalc (spreadsheet) and geoPublish (desktop publishing).

Although time has passed the user interface of GEOS by, the operating system isn't quite dead yet. There are still a small, but noisy, contingent of users who still perform their daily tasks such as writing letters and papers in GEOS. Not all GEOS applications are so focused on tasks such as word processing. In recent years GEOS has gained an IRC (Internet Relay Chat) client written by Glen Holmer, who happens to also maintain an excellent website devoted to GEOS (todo: cite ShadowM's website).

Although the Windows PC has become the main platform for performing tasks like programming and creating graphics for the Commodore 64, there are still tasks that are best performed on the real hardware such as creation of SID tunes (SID is the name of the sound chip in the Commodore 64). There are several actively developed projects for screen editors, SID tune editors (called Trackers), and creating demos.

A very popular type of application for the Commodore 64 has always been the BBS (Bulletin Board System). Thanks to improved hardware, software and the Internet, there is a resurgence of BBS activity around the world. One BBS even travels with its operator around the world while being available 24 hours a day, seven days a week. Several hardware solutions exist for connecting your Commodore 64 to the Internet which has allowed a boom in applications dedicated to talking to BBS's, IRC, Twitter and even the World Wide Web (yes, the Commodore 64 has a web browser). Development of the BBS genre goes on even today with new BBS packages such as Millenium BBS and BridgeBBS being actively developed at the time of this writing. (todo: cite Millenium BBS and BridgeBBS websites)

(TODO: List of recent applications and their CSDb entry links)

Utilities

One of the most popular genres of software for the Commodore 64 has always been utilities. In the early days, utilities for performing tasks like file management, formatting disks, and even copying a program from one disk to another were handled in large applications with clunky user interfaces. These applications grew to include disk copiers, software protection crackers, game cheaters, note writers, file archival and more.

Figure 3 - CBM-Command V2.3 - http://cbmcommand.codeplex.com

In the early 1990's Norton Commander was released on the PC and the world changed forever; at least on newer computers. Norton Commander is an Orthodox File Manager (todo: Cite Wikipedia) where views of two storage

devices are displayed side-by-side or top-and-bottom. Amazingly, this type of application was not developed for the Commodore 64 until the author of this book created CBM-Command. (todo: cite CBM-Command website)

(TODO: List of recent utilities and their CSDb entry links)

Programming & Demos

When the Commodore 64 was released, there was very little software available for all computers, and most of what was available that was platform-agnostic was written in BASIC. Wisely, Commodore chose to purchase Microsoft BASIC during the development of the Commodore PET with a perpetual license that allowed Commodore to distribute an unlimited number of computers with the BASIC built in. Commodore then released three computer families utilizing that version of BASIC (2.0): The Commodore PET, Commodore VIC-20 and Commodore 64. Subsequent 8-bit Commodore computers would utilize enhanced versions of Commodore BASIC.

Programming for the Commodore 64 did not begin and end with BASIC. 6502 Machine Language is the core of any Commodore 64 program and a class of compiler called an Assembler is commonly used to write new software that extracts maximum performance from the Commodore 64. Most games, and many applications and utilities, are written in Assembler. Today, Assembly programmers are endowed with a wealth of tools to perform this type of development. Most of these tools run on PCs with Windows, GNU/Linux, or Mac OS X, but one native assembler called Turbo Macro Assembler stands out as the greatest assembler ever written for the Commodore 64 and is actively maintained and distributed even today.

Other programming options available today include the cc65 C compiler which produces 6502 machine code programs from software written in the ANSI (mostly) C programming language. C based programs are typically written to be platform independent and as such many applications, such as CBM-Command, are able to be run on several different platforms.

Some classic programming platforms for the Commodore 64 included HES FORTH, Abacus C, and many more.

(TODO: cite programming languages and platforms and links to resources)

What hardware is available for the Commodore 64?

Essential Upgrades

JiffyDOS

JiffyDOS is practically a requirement for using the Commodore 64 in modern times. The original software built into the Commodore 64 used a very safe, but slow protocol for communicating with disk drives and printers over the IEC port. JiffyDOS was introduced by Creative Micro Designs as a replacement for the Commodore 64's stock routines that added new functionality as well as a vastly superior protocol for communicating over the IEC port. To get the most out of JiffyDOS, the disk drives you are using must support the JiffyDOS protocol. Period devices such as the 1541 floppy drive can be upgraded with a JiffyDOS ROM chip that replaces the software that the drive normally runs so that the drive understands the JiffyDOS protocol. JiffyDOS is still a commercially sold product and can be bought at the Retro Innovations web store.

(todo: cite Retro Innovations)

Storage

Probably the area where modern electronics has benefitted the Commodore 64 the most is storage. There is a wide variety of storage devices available from simple SD-Card readers, to complex IDE interfaces to Flash-based devices that can store huge applications. Here is a list of the major options available.

SD2IEC

SD2IEC stands for Secure Digital to IDE. Not really a product, it's a reference design of hardware and software that can be productized to create simple and elegant mass storage devices. The most common device to use the SD2IEC platform is the uIEC (pronounced "Micro IEC") by Retro Innovations. This small device isn't much bigger than a standard SD-Card, which is what it uses for storage. These are great for embedding into a Commodore 64 so your storage device is always with you.

The SD2IEC firmware (software) allows you to use disk images such as D64 and D81 files directly from a SD-Card. Disk images that do not have any copy protection can be used just like they were written to a floppy drive. Speaking of disk images and floppy drives, CBM-Command allows a user to create disk images and save them to mass storage, or write a disk image to a standard floppy drive such as a 1541 or 1581.

Figure 4 - uIEC/SD with Daughter Card - http://store.go4retro.com/uiec-sd/

What the SD2IEC solution lacks is a 6502 processor to run custom drive routines such as those found in custom fast-loaders and game protection schemes. To alleviate this shortcoming, the creator of SD2IEC, Ingo Korb, has implemented drive-side support for several fast loaders including JiffyDOS, Mach 5, and Super Snapshot.

Finally, the SD2IEC firmware supports using unprotected disk-images of GEOS, which has made the SD2IEC a must have for any serious GEOS user.

(todo: cite Retro Innovations)
(todo: cite SD2IEC website)

IDE64

What a bargain! For 99 Euros (as of the time of this writing), you can purchase a device that allows you to use standard IDE devices such as hard drives, CD-ROM drives and Compact Flash cards (did you know that CF cards are IDE devices?). Additionally, the IDE64 has a clock port which allows you to attach other interesting hardware such as a RR-Net Ethernet adapter. Not only do you get the IDE64 hardware, but you also get a full suite of utilities to help you manage all of that space.

Figure 5 - IDE64 V4.1 - http://www.ide64.org

(todo: cite IDE64 website)

1541 Ultimate

The 1541 Ultimate (now at version 2) is probably the most thoroughly developed and supported mass storage device for the Commodore 64. The 1541 Ultimate is a cartridge that plugs into the Commodore 64 and provides a built-in menu for navigating an attached SD-Card (or in the case of version 2, a USB drive), allowing the selection of disk images on the fly. Those disk images can be simple D64 files, or the more advanced G64 files which contain the low-level GCR data of the disk, allowing for even the toughest copy protections to be faithfully recreated.

Figure 6 - 1541 Ultimate 2 - www.1541Ultimate.net

The 1541 Ultimate is designed around an Altera FPGA (Fully Programmable Gate Array) that contains a simulated 6502 processor, 6520 CIA chips, and the ROM of the 1541 drive. The FPGA's emulation of a real 1541 is spot-on and allows even the most heavily protected software to be played from an SD-Card.

Other features of the 1541 Ultimate include the ability to provide an REU (RAM Expansion Unit) of up to 16 MB in size, using freezer cartridges such as the Retro-Replay or even using an EasyFlash cartridge image. The 1541 Ultimate is truly an awesome device, even if you never use the built in 1541 emulation.

(todo: Cite the 1541U website)

EasyFlash

During the early days of the Commodore 64 the primary means for distributing games was on cartridges. Hundreds of games were released on cartridges. Although all of these games have been dumped from ROM to a binary file, playing those games without the original cartridge requires finding a cracked version that's been converted for playing from a disk. Until the EasyFlash came along, that is.

The EasyFlash is a FPGA device that comes in the format of a cartridge that also contains 2 GB of Flash RAM that is used to store cartridge binary files and allow them to be played just like the originals. One of the cool things about the EasyFlash is that several scene groups have started converting old disk-based games into EasyFlash cartridges that breathe new life into classic games such as Mail Order Monsters, Caveman Ugh-Lympics and Test Drive 2.

The newest iteration of EasyFlash, the EasyFlash 3, has a new trick up its sleeve: The ability to replace the Commodore 64 Kernal with a binary ROM file such as JiffyDOS without having to open your Commodore 64 you just bought on eBay. This is a pretty big deal as it used to be that replacing the Commodore 64 Kernal often meant unsoldering the Kernal ROM and soldering in a socket to accept the new Kernal on a ROM chip.

Comet Flyer

The Comet Flyer is a difficult device to categorize. It serves as a file storage medium, but its primary function is internet connectivity which it provides through a secondary device channel that allows users to do all sorts of things such as acting as a TCP client or server, loading disk images from a web service and more. The Comet Flyer will be covered in more detail in the Networking section.

Networking

Comet64

Commodore Flyer

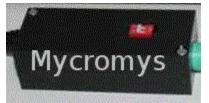**RR-Net/C64Nic**

Telecommunications

Comet BBS / Hayesduino

Human interface

Keyrah (V2)

http://icomp.de/products/keyrah_e.htm

Micromys

http://icomp.de/products/micromys_e.htm

C64JPX

http://www.64hdd.com/64jpx/64jpx.html

Where can I find information about the Commodore 64?

Forums

Lemon64 Forums

Melon64

Forum-64

CSDb Forum

WIKIs

C64-Wiki

Codebase 64

News Sites

C64 Portal

Commodore is Awesome

Custom and Project Sites

Lemon64

CSDb - Commodore Scene Database

CBM 8-Bit

Commodore Server

cc65

CBM-Command

Commodore BBS Outpost

What else should I know about the Commodore 64?

Emulators

VICE - Versatile Commodore Emulator

By most accounts, when you think of a
Commodore 64 Emulator, see a Commodore 64
Emulator, or hear about a Commodore 64
Emulator, you are referring to VICE. VICE comes
in many flavors, from the self-titled GNU/Linux and Mac OSX ports to WinVICE (Windows VICE),
C64 Forever (Windows), AnVice (Android) and more.

Not only is VICE pervasive, it's hands-down the single most important tool in the modern
Commodore 64 user's toolbox. VICE is used for playing games, watching demos, writing
software, running bulletin boards, and so much more. It's hard to imagine that the Commodore
64 scene of today would be possible without VICE.

VICE is an actively developed project and already has cycle-exact emulation of the Commodore
64. The package also includes emulators for practically all Commodore 8-bit computers
including the PET, VIC-20, 128, B128, Plus/4, etc.

http://vice-emu.sourceforge.net/

CCS64

CCS64 is by all accounts the second most used
C64 emulator, and many of its supporters claim
it is superior to VICE as an emulator. While the
author won't tackle that debate, what is
unbeatable is that CCS64 is a darn good
emulator. If you are evaluating emulators for your own needs, you must give CCS64 a try.
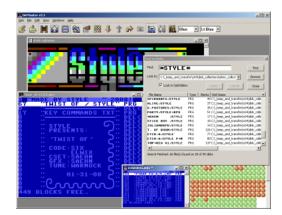
http://www.ccs64.com/

Frodo

Frodo was one of the first emulators of the Commodore 64, dating way back to the MS-DOS
days of the 1990s. Despite its early popularity, Frodo fell to the wayside as VICE took over as
the primary emulator of choice. For a while Frodo variants on Android and iOS were the only
mobile Commodore emulators and they pumped some life back into the old hobbit, but it may
be too late for the ring-bearer to become the standard-bearer again.

http://frodo.cebix.net/

Other Platform Tools

DirMaster/Style

DirMaster is *the* Swiss-army-knife disk utility for Microsoft Windows that allows users to manipulate most any kind of disk image and file archive. It also allows you to read Commodore Sequential Files (text files), read a disk image sector-by-sector and so much more, including mass import/export of files. No Commodore user should be without this awesome program.

http://style64.org/dirmaster

OpenCBM

It didn't take long for users of Commodore computers to look for options for connecting their disk drives to PCs for archival purposes. In the early days of the internet (we're talking pre-WWW), most people got their software from a box or a modem. The modem route was usually calling an illicit Bulletin Board System to download the latest warez (cracked software). Getting that software to and from a Commodore was a slow, tedious process. The design of the Commodore 64 is such that the RS232 port on the computer can only sustain 2400 baud while remaining a useful computer. Because of this, the telecommunications industry quickly passed the Commodore 64 by as 9600, 14400, 19200 and eventually 56k baud rates became standard. Many Commodore 64 owners began trading their warez on PC-based BBS systems and thus was born the need for quickly and reliably getting their disks and files onto a PC or off of a PC. Thus X-Cable was born to fill this need.

The X-Cable gets its name from the monikers they were given based on the type of cable. The first cable was the X1541, which was a very simple cable that plugged into the parallel port of a PC running MS-DOS. Early software used for the X1541 cable included Star Commander, which is an Orthodox File Manager similar to Norton Commander that was used to transfer files between the Commodore 1541 disk drive and the PC. This worked quite well and it didn't take long for the combination to explode in popularity.

As the years went along, MS-DOS was replaced by Windows, GNU/Linux and Mac OSX, each of which were multitasking operating systems that could not provide the absolute control of the Parallel port on a PC that was needed to ensure that the simple X1541 cable could be used reliably. Variations for different platforms would arise to include the XE1541, XM1541, and finally the XA1541 which was the most compatible cable.

Not only was improved hardware needed for multitasking operating systems, but improved software as well. The first project to tackle this problem was dual-target cbm4win and

cbm4linux project. Because of user confusion, it was later named OpenCBM. OpenCBM supports any 32-bit or 64-bit version of Microsoft Windows, GNU/Linux and Apple Mac OSX.

OpenCBM is a very significant project. It is used by several archival programs as the back-end to talk to the disk drives connected via an X-cable. The project is headed up by Spiro Trikaliotis and Wolfgang Moser. If you ever run across them online or in person, give them a big thank you for creating such a fundamentally important piece of software for the Commodore community.

http://www.trikaliotis.net/opencbm

ZoomFloppy

ZoomFloppy is a USB device that allows users to plug any IEC port device such as a 1541 disk drive or IEEE device such as an SFD-1001 disk drive into a modern PC. ZoomFloppy (also known as XUM1541) is the evolution of years of development on the so called X-cables which allowed PC users to connect IEC devices to a PC through the parallel port. Since most modern PCs no longer have a parallel port, a USB solution as desired and the original XU1541 was created. The author was an original tester of the XU1541, and while it did work, it was very slow due to implementing the USB logic directly on the microcontroller instead of using a dedicated USB chip as the ZoomFloppy does. As with the X-Cables, users interact with the ZoomFloppy through OpenCBM.

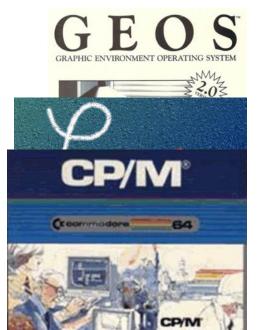http://www.go4retro.com/products/zoomfloppy/

The Commodore 128

Operating Systems

GEOS
http://cbmfiles.com/geos/index.php

LUNIX
http://hld.c64.org/poldi/lunix/lunix.html

ACE
http://www.csbruce.com/cbm/ace/

CP/M
http://www.z80.eu/c64.html

EasyCLI

https://easycli.codeplex.com/

Glossary

Index

About the Author

Payton Byrd has been using and writing software for the Commodore 8-bit line of computers since receiving a VIC-20 as a gift in 1983. Payton has owned and used a Commodore 64 or Commodore 128 non-stop since 1986. In the 1990's Payton created a BASIC pre-processor called Macro BASIC which was never officially released. In the 2000's Payton has continued his creation of software for the Commodore 64 to include utilities (CBM-Command), games (S-Blox), BBS servers (BridgeBBS) ,and even operating systems (EasyCLI). Payton writes many of the tools used to create these programs.

Today, Payton is the CTO of Tool Planners Inc., a small software company specializing in software for the tool and die industry. He is married to Rebecca Byrd and has three children: Mary, Robert and JT. Payton resides in Clarksville, TN, USA. Payton can be reached via email at payton@paytonbyrd.com or by visiting his website at http://www.paytonbyrd.com.