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Version of Microsoft Office released in 2013 Microsoft Office 2013Microsoft Office 2013 applications from top left to bottom right: Word, Excel, PowerPoint and Outlook which collectively make up the Home & Business edition.Developer(s)MicrosoftInitial releaseJanuary 29, 2013; 12 years ago (2013-01-29)[1]Stable releaseService Pack 1 (15.0.5603.1000) / November 7, 2023; 18 months ago (2023-11-07)[2] Operating systemWindows 7 or laterWindows Server 2008 R2 or later[3]PlatformIA-32, x64, ARMPredecessorMicrosoft Office 2010 (2010)SuccessorMicrosoft Office 2016 (2016)Available in40 languages[4]List of languagesEnglish, Arabic, Bulgarian, Chinese (Simplified), Chinese, Croatian, Czech, Danish, Dutch, Estonian, Finnish, French, German, Greek, Hebrew, Hindi, Hungarian, Indonesian, Italian, Japanese, Kazakh, Korean, Latvian, Lithuanian, Malay, Norwegian (Bokmål), Polish, Portuguese (Brazil), Portuguese (Portugal), Romanian, Russian, Serbian (Latin), Slovak, Slovenian, Spanish, Swedish, Thai, Turkish, Ukrainian, VietnameseTypeOffice suiteLicenseTrialware[5]OneNote: Freemium since 2014)Websiteproducts.office.com/microsoft-office-2013 Microsoft Office 2013 (codenamed Office 15[6]) is a version of Microsoft Office, a productivity suite for Microsoft Windows. Unlike with Office 2010, no macOS equivalent was released. Microsoft Office 2013 includes extended file format support, user interface updates and support for touch among its new features and is suitable for IA-32 and x64 systems.[7] Office 2013 is compatible with Windows 7 and Windows Server 2008 R2 through Windows 10 v21H1 and Windows Server 2019.[8][9][10][11][8] A version of Office 2013 comes included on RT devices.[12][3] It is the last version of Microsoft Office to support Windows 7 RTM and Windows Server 2008 R2 RTM. Development on this version of Microsoft Office was started in 2010 and ended on October 11, 2012, when Microsoft Office 2013 was released to manufacturing.[13] Microsoft released Office 2013 to general availability on January 29, 2013.[1] This version includes new features such as integration support for online services (including OneDrive, Outlook.com, Skype, Viva Engage and Flickr), improved format support for Office Open XML (OOXML), OpenDocument (ODF) and Portable Document Format (PDF) and support for multi-touch interfaces. Microsoft Office 2013 comes in twelve different editions, including three editions for retail outlets, two editions for volume licensing channel, five subscription-based editions available through Microsoft Office 365 program, the web application edition known as Office Web Apps and the Office RT edition made for tablets and mobile devices. Office Web Apps are available free of charge on the web although enterprises may obtain on-premises installations for a price. Microsoft Office applications may be obtained individually; this includes Microsoft Visio, Microsoft Project and Microsoft SharePoint Designer which are not included in any of the twelve editions. Service Pack 1 (SP1) was released on February 25, 2014.[14] Support for the original release (RTM) ended on April 14, 2015, and Service Pack 1 is required for receiving updates and support. Support for Office 2013 ended on April 11, 2023.[15] On June 9, 2018, Microsoft announced that its forums would no longer include Office 2013 or other products in extended support among its products for discussions involving support.[16] On August 27, 2021, Microsoft announced that Microsoft Office 2013 SP1 with all subsequent updates will be required to connect to Microsoft 365 Exchange servers by November 1, 2021; Outlook 2013 without SP1 will no longer be supported.[17][18][additional citation(s) needed][inconsistent] Office 2013 removed support for processors without PAE, SSE2 and NX and is also the final version of Microsoft Office that supports processors without PrefetchW, LAHF and SAHF. Its successor, Office 2016, requires a processor with PrefetchW, LAHF and SAHF in any supported architecture. It is also the final version of Microsoft Office to receive a Service Pack from Microsoft. Despite the end of support for Office 2013 in April, Microsoft is still rolling out monthly security patches for the Office suite programs as of November 2023.[19][20] Development started in 2010 while Microsoft was finishing work on Office 14, released as Microsoft Office 2010. On January 30, 2012, Microsoft released a technical preview of Office 15, build 3612.1010, to a selected group of testers bound by non-disclosure agreements.[21] On July 16, 2012, Microsoft held a press conference to showcase Office 2013 and to release the Consumer Preview.[22] The Office 2013 Consumer Preview is a free, fully functional version but will expire 60 days after the final product's release.[23][24] An update was issued for the Office 2013 Customer Preview suite on October 5.[25] Office 2013 was released to manufacturing on October 11, 2012.[13] It was made available to TechNet and MSDN subscribers on October 24, 2012.[26] On November 15, 2012, 60-days trial versions of Microsoft Office 2013 Professional Plus, Project Professional 2013 and Visio Professional 2013 were made available to the public over the Internet.[5][27] Microsoft has released Office 2013 for general availability on January 29, 2013.[1] Microsoft released the service pack 1 update on February 25, 2014.[28] Office 2013 introduces Click-To-Run 2.0 installation technology for all editions based on Microsoft App-V Version 5.[29] Previously, only certain editions of Office 2010 were available with Click-To-Run 1.0 installation technology, which was based on App-V 4.x, where a separate Q drive was created and installed files of Office were isolated from the rest of the system, causing many Office add-ins to not be compatible.[30] With the newer Click-To-Run technology, Office 2013 installs files just like Windows Installer (MSI) to the Program Files directory. Retail versions of Office 2013 use the Click-To-Run installer. Volume-licensed versions use Windows Installer (MSI) technology.[31] Some editions like Professional Plus are available in both retail (C2R) and volume (MSI) channels. Office 2013 is more cloud-based than previous versions: a domain login, Office 365 account, or Microsoft account can now be used to sync Office application settings (including recent documents) between devices, and users can also save documents directly to their OneDrive account.[32] Microsoft Office 2013 includes updated support for ISO/IEC 29500, the International Standard version of Office Open XML (OOXML) file format: in particular it supports saving in the "Strict" profile of ISO/IEC 29500 (Office Open XML Strict).[33] It also supports OASIS version 1.2 of ISO/IEC 26300:2006, Open Document Format,[33] which Office 2013 can read and write.[34] Additionally, Office 2013 provides full read, write, and edit support for ISO 32000 (PDF). New features include a new read mode in Microsoft Word, a presentation mode in Microsoft PowerPoint and improved touch and inking in all of the Office programs. Microsoft Word can also insert video and audio from online sources as well as the capability to broadcast documents on the Web.[35] Word and PowerPoint also have bookmark-like features which sync the position of the document between different computers. The Office Web Apps suite was also updated for Office 2013, introducing additional editing features and interface changes.[36] Other features of Office 2013 include: PDF Import feature in Microsoft Word Improved text wrapping and improved Track Changes feature in Microsoft Word Flash Fill in Microsoft Excel Office Remote/Microsoft PowerPoint Remote app and Office add-in to control presentations from a Windows Phone or Android phone. Automatic slide resizing/refit in Microsoft PowerPoint New Office Open XML-based format, VSDX for Microsoft Visio Flatter look of the Ribbon interface and subtle animations when typing or selecting (Word and Excel) Band in application color at bottom of each screen A new visualization for scheduled tasks in Microsoft Outlook Remodeled start screen[37] New graphical options in Word[38] Objects such as images can be freely moved; they snap to boundaries such as paragraph edges, document margin and or column boundaries Supports embedding of Online picture support with content from Office.com, Bing.com and Flickr (by default, only images in public domain) to in replacement to the cliparts gallery from previous office versions Ability to return to the last viewed or edited location in Word and PowerPoint New slide designs, animations and transitions in PowerPoint 2013 Support for Outlook.com and Hotmail.com in Outlook Support for integration with Skype, Yammer and SkyDrive[39] IMAP special folders support[40] Starting with Office 2013, proofing tools are separately and freely downloadable without being bundled in Multilingual User Interface (MUI)/Multilanguage packs, Language Interface Packs (LIPs) or Single Language Packs (SLP).[41] Excel 2013 supports new limit models, as follows:[42] Quantifiable limits in objects Object Upper limit Characters in a table or column name 100 characters Number of tables in a model 2,147,483,647 bytes (2 GB minus 1 byte) Number of columns and calculated columns in a table 2,147,483,647 bytes (2 GB minus 1 byte) Memory limit, checked when saving a workbook 4,294,967,296 bytes (4 GB) Concurrent requests per workbook 6 Number of connections 5 Number of distinct values in a column 1,999,999,997 Number of rows in a table 1,999,999,997 String length 536,870,912 bytes (512 MB) Restrictions in objects Category Details Reserved characters that cannot be used in a Name1 . , ; ' ` : / \ * | ? " & % $ ! + = ( ) [ ] { } < > Remarks 1 "Name", in this context, is a form of variable in Microsoft Excel.[43] The following features were removed from Microsoft Office 2013. Removed from the entire suite[44] Microsoft SharePoint Workspace Microsoft Clip Organizer Microsoft Office Picture Manager Office 2007 and Office 2010 chart styles Ability to insert a 3D cone, pyramid, or cylinder chart (It is still possible to insert a 3D rectangle chart and change the shape after insertion.[44]) Only basic version of help files available while offline. There is no longer an option to install local help files during installation.[45] Features removed from Microsoft Word Custom XML markup has been removed for legal reasons Older WordArt objects are now converted to new WordArt objects Word 2013 no longer uses ClearType[46] Features removed from Microsoft Excel Simultaneous open files via Multiple Document Interface (MDI), along with requisite changes to VBA code to no longer support MDI; Excel is now Single Document Interface (SDI) only[47] Features removed from Microsoft Access Access Data Projects (ADP) Support for Jet 3.x IISAM Access OWC control dBASE support suite[44] Features removed from Microsoft Outlook Download Headers Only mode for IMAP[48] Outlook Exchange Classic offline Microsoft Exchange Server 2003 support[49] Public Folder Free/Busy feature (Cleanfreebusy startup switch)[44][further explanation needed] Ability to import from or export to any formats other than Personal Storage Table (PST) or comma-separated values (CSV) Notes and Journal customization Outlook Activities tab Outlook Mobile Service (OMS) Outlook Search through Windows Shell[44] Features removed from Microsoft PowerPoint Support for Visio Drawing Unlike past versions of Office, retail copies of Office 2013 on DVD are only offered in select regions, such as those Microsoft classifies as emerging markets, as well as Australia, at the discretion of retailers. In all other regions, retail copies of Office 2013 and Office 365 subscriptions only contain a product key, and direct users to the Office website to redeem their license and download the software.[50][51] The original license agreement for retail editions of Microsoft Office 2013 was different from the license agreements of retail editions of previous versions of Microsoft Office in two significant ways.[52] The first of these was that the software could no longer be transferred to another computer. In previous versions of Office, this restriction also applied only to OEM editions; retail Office license agreements allowed uninstalling from one computer to install on another computer.[52] Digitally downloaded copies of Office were also said to be permanently locked to that PC's hardware, preventing it from being transferred to any other computing device. Should the buyer have wished to use Office 2013 on a different computer, or if they later became unable to use the computing device that the original license was downloaded to (e.g. hardware became inoperable due to malfunction) then a completely new, full-priced copy of Office 2013 would have to have been purchased to replace the prior one.[52] Microsoft stated that this change was related to the software piracy that has been rampant for years, worldwide.[53] However, many commentators saw this change as an effort to forcibly move its customers towards the subscription-based business model used by the Office 365 service.[54][55][56] The legality of this move, particularly in Europe, has been questioned.[57] However, on March 6, 2013, Microsoft announced that equivalent transfer rights to those in the Office 2010 retail license agreements are applicable to retail Office 2013 copies effective immediately. Transfer of license from one computer to another owned by the same user is now allowed every 90 days, except in the case of hardware failure, in which the license may be moved sooner. The first user of the product is now also allowed to transfer it to another user.[58][59] The second difference, which remains in the updated licensing agreement, is that the software can be installed on only one computer. In previous versions of Office, retail Office license agreements allowed installing the product on two or three computers, depending on the edition.[52] Microsoft requires an account in order to activate the new version of Microsoft Office 2013 icons, from left to right: Word, Excel, PowerPoint, Outlook, Access, OneNote, Publisher, Lync and InfoPath As with previous versions, Office 2013 is made available in several distinct editions aimed towards different markets. All traditional editions of Microsoft Office 2013 contain at least Word, PowerPoint and OneNote and are licensed for use on one computer. Five traditional editions of Office 2013 were released: Home & Student: This retail suite includes the core applications Word, Excel, PowerPoint, and OneNote.[60] Home & Business: This retail suite includes the core applications Word, Excel, PowerPoint, and OneNote plus Outlook.[60] Standard: This suite, only available through volume licensing channels, includes the core applications Word, Excel, PowerPoint, and OneNote plus Outlook and Publisher.[61] Professional: This retail suite includes the core applications Word, Excel, PowerPoint, and OneNote plus Outlook, Publisher and Lync.[61] Word Excel PowerPoint OneNote Outlook Publisher Access InfoPath Lync Home & Student + + + + Standard + + + + + Professional Plus + + + + + + + + Main article: Microsoft Office 365 The Office 365 subscription services, which were previously aimed towards business and enterprise users, were expanded for Office 2013 to include new plans aimed at home use. The subscriptions allow use of the Office 2013 applications by multiple users using a software as a service model. Different plans are available for Office 365, some of which also include value-added services, such as 20 GB of OneDrive storage (later increased to 1 TB) and 60 Skype minutes per month on the new Home Premium plan.[62] These new subscription offerings were positioned as a new option for consumers wanting a cost-effective way to purchase and use Office on multiple computers in their household.[63] A special version of Office 2013, initially known as Office 2013 Home & Student RT, is shipped with all Windows RT devices. It initially consisted of Word, Excel, PowerPoint and OneNote. In Windows RT 8.1, the suite was renamed Office 2013 RT and Outlook was added. The edition, whilst visually indistinguishable from normal versions of Office 2013, contains special optimizations for ARM-based devices, such as reduced power consumption (including, for example, freezing the animation of the blinking cursor for text editing during periods of inactivity), enabling touch mode by default to improve usability on tablets, and using the graphics portion of a device's SoC for hardware acceleration.[64][65][66] Windows RT devices on launch were shipped with a "preview" version of Office Home & Student 2013 RT. The release date for the final version varied depending on the user's language, and was distributed through Windows Update.[66] On June 5, 2013, Microsoft announced that Windows RT 8.1 would add Outlook to the suite in response to public demand.[67] Office RT modifies or excludes other various features for compatibility reasons or resource reduction. To save disk space; templates, clip art, and language packs are downloaded online rather than stored locally. Other excluded features include the removal of support for third-party code such as macros/VBA/ActiveX controls, the removal of support for older media formats and narration in PowerPoint, editing of equations generated with the legacy Equation Editor, data models in Excel (PivotCharts, PivotTables, and QueryTables are unaffected), searching embedded media files in OneNote, along with data loss prevention, Group Policy support, and creating e-mails with information rights management in Outlook.[67][68] As the version of Office RT included on Windows RT devices is based on the Home & Student version, it cannot be used for "commercial, nonprofit, or revenue-generating activities" unless the organization has a volume license for Office 2013 already, or the user has an Office 365 subscription with commercial use rights.[69] Alongside Office RT, free versions of OneNote and the Lync client were made available as Windows Store apps.[70] The OneNote app, originally known as OneNote MX, contains a limited feature set in comparison to its desktop version, but is also optimized for use on tablets.[71] The OneNote app has since received several major updates, including camera integration, printing abilities, and multiple inking options. Universal Microsoft Word, Excel, and PowerPoint apps were released in 2015.[72][needs update] Further information: Microsoft Office Mobile Windows Phone 8 ships with an updated version of the Office Mobile suite, consisting of mobile versions of Word, Excel, PowerPoint, and OneNote. In comparison to their Windows Phone 7 versions, the new versions add an improved Office Hub interface that can sync recently opened and modified documents (including changes to documents stored via Office 365 and SkyDrive),[73] a separated OneNote app with additional features (such as voice notes and integration with the new "Rooms" functionality of the OS), and improved document editing and viewing functionality.[74] In June 2013, Microsoft released a version of Office Mobile for iPhone; it is similar to the Windows Phone version, although it requires an Office 365 subscription to use.[75] A version for Android smartphones was released in July 2013; it, too, originally needed Office 365 for use.[76] Apps for iPad and Android tablet computers were released in 2014 and January 2015, respectively.[77][78] These, along with their smartphone equivalents, have been made free for personal use, though certain premium features have been paywalled and require Office 365, which includes licensing of the apps for business use. Windows 10 Mobile that was released in December 2015 included new Office apps, more in line with their iPhone and Android equivalent, and making use of the "universal app" platform pioneered.[79][80] Comparison of Office 2013 suites  As anindividualproduct Traditional editions[60][61][81] Office 365 subscriptions[60][82] Office RT Home & Student Home & Business Standard Professional Home Personal[83] Home University[84] Small Business Premium ProPlus Enterprise Availability Varies Windows RT Retail, OEM Retail, OEM Volume licensing Retail, OEM Retail, Volume licensing Software plus services Software plus services Software plus services Software plus services Maximum users 1 1 1 1 As licensed 1 As licensed 1 all users in one household[85] 1 10 25[86] Unlimited Devices per user 1 1 1 1 As licensed 1 computer and 1 mobile 5 shared among all users[85] 2 computers and 2 mobiles 5 5[86] 5 Commercial use allowed? Yes Separate2 No Yes Yes Yes No No[d7] No Yes Yes Yes Yes Yes Yes Yes Yes Yes Word Yes Yes1 Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Excel Yes Yes1 Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes PowerPoint Yes Yes1 Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes OneNote Yes1 Yes1 Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Outlook Yes1 No1 Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Access No No No No Yes Yes No No No No Yes Yes Yes Yes Publisher Yes No No No Yes Yes No No No No Yes Yes Yes Yes InfoPath No No No No No No No No No No No Yes Yes Yes Lync No No No No No No No No No No No No Yes Yes SharePoint Designer Yes No No No No No No No No No No No No No ProjectHas multiple editions Yes No No No No No No No No No No No No No VisioHas multiple editions Yes No Viewer Viewer Viewer Viewer Viewer Viewer Viewer Viewer Viewer Viewer Remarks 1 The Windows RT versions do not include all of the functionality provided by other versions of Office. 2 Commercial use of Office RT is allowed through volume licensing procurement for business subscriptions to Office 365.[69] 3 Windows Store versions are also available. 4 InfoPath was initially part of Office 365 Small Business Premium.[88][89] However, it's currently unavailable though subscription.[90] 5 Professional Plus edition on the retail channel is/was available with MSDN subscription or via Home Use Program.[91] Each Microsoft Office 2013 application has the following requirements, although there may be app-specific requirements.[92] Item Requirement CPU 1 GHz clock speed, IA-32 or x64 architecture with SSE2 support RAM IA-32 edition: 1 GBx64 edition: 2 GB Hard disk drive 3.0 GB free disk space Operating system Windows 7, Windows Server 2008 R2 or later Software .NET Framework 3.5 or later In addition to these, graphics hardware acceleration requires a screen resolution of 1024×576 pixels or larger and a DirectX 10-compliant GPU with at least 64 MB of video memory (in case of absence of the required hardware, however, Office 2013 applications can still run without graphics acceleration.)[92] List of office suites ^ a b c Page, Carly (January 28, 2013). 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You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Earlier this week, Microsoft released the version of Microsoft Office 2013 to MSDN and TechNet subscribers. By now many of you might have installed Office 2013 RTM on your Windows 7 and Windows 8 machines. Unlike Office 2010, Office 2013 setup doesn't ask you enter the product key during the installation. So, once you complete the installation, you need to enter the key and activate your product. Office 2013 is compatible with only Windows 7 and Windows 8 operating systems. Vista and XP users need to upgrade to Windows 7 or Windows 8 to experience the newest version of Microsoft Office. After completing the Office 2013 setup, just follow the given below steps to activate your Office 2013 copy: Step 1: Once installed, run Office Word, Excel or any other program. You will immediately see Activate Office dialog. Step 2: Click Enter a product key instead option, enter the 25-character product key and then click Install button to activate your copy of Office 2013. Step 3: Click File menu and then click Account to see your Office 2013 activation message on the right-hand side. Updated: January 17, 2024 By Melissa Eggleston You may need to reset your computer, or just want a reinstall your Office 2013 application, or move it to a different computer. But unfortunately, before doing this, you may find that you forget or lost the product key. How to find back Office 2013 lost Product key? Here are two methods to retrieve your Office 2013 activation key after installing on PC device. Guide Steps Find your Office 2013 Product Key with Office Account page Retrieve your Office 2013 activation key in registry Find your Office 2013 Product Key from Office Account page 1. Get into your Office account page login. Log into your Microsoft account used to install or activate Office 2013. 2. Select the tap of Office 2013, and view the product key by this way: choose Install from a disc > I have a disc > View your product key. If the Office 2013 application was installed on your computer and have activated, the product key will be showed below. Identify the product key that was used on your computer If you are not sure whether the product key is associated with your PC, you can check the last five characters through Command Prompt, and then match it up to the full 25-character product key. To check your PC, open Command Prompt. 2. Type the appropriate script to Command Prompt, and press Enter to run it. Scripts to find Office 2013 product key on your computer: For 32-bit Office and 32-bit Windows: cscript "C:\Program Files\Microsoft Office\Office15\OSPP.VBS" /dstatus For 32-bit Office and 64-bit Windows: cscript "C:\Program Files (x86)\Microsoft Office\Office15\OSPP.VBS" /dstatus For 64-bit Office and 64-bit Windows: cscript "C:\Program Files\Microsoft Office\Office15\OSPP.VBS" /dstatus After running the command, the last five characters of your Office 2013 product key will be showed for you. Match it up with the product key you find from your Office account page, then you won't make it wrong. Reference: Retrieve your Office 2013 activation key in registry If you didn't associate your Office product key with your Microsoft account, you may not be able to find it from registry.HKEY_LOCAL_MACHINE\Software\Microsoft\CurrentVersion\DigitalProductID. In fact, you can't read the product key directly from registry, because it is in the binary format. But you can read it with a Product key tool. To retrieve your Office 2013 product key from registry: 1. Get the Cocosenor Product Key Tuner and install it on your computer. 2. On the Product key tool list, click the Product Key Tuner to run. 3. On the Product Key tool list, click on Start Recovery button and begin to recover your Office 2013 product key. 4. The product keys for all the software installed on your computer are showed here for you. And you can find your Office 2013 product key from the list easily. Yes, it is so easy, just have a try. Related Articles 616 of the x86 architecture "Intel 64" redirects here. For the Intel 64-bit architecture in Itanium chips, see IA-64. "x64" redirects here. For the New York City bus route, see X64 (New York City bus). AMD Opteron, the first CPU to introduce the x86-64 extensions in April 2003 The five-volume set of Intel 64 and IA-32 Architectures Software Developer's Manuals, as published and distributed by AMD in 2002 x86-64 (also known as x64, x86_64, AMD64, and Intel 64)[note 1] is a 64-bit extension of the x86 instruction set. It was announced in 1999 and first available in the AMD Opteron family in 2003. It introduces two new operating modes: 64-bit mode and compatibility mode, along with a new four-level paging mechanism. With 64-bit mode and the new paging mode, it supports vastly larger amounts of virtual memory and physical memory than was possible on its 32-bit predecessors, allowing programs to store larger amounts of data in memory. x86-64 also expands general-purpose registers to 64-bit, and expands the number of them from 8 (some of which had limited or fixed functionality, e.g. for stack management) to 16 (fully general), and provides numerous other enhancements. Floating-point arithmetic is supported via mandatory SSE2-like instructions in x86-64 mode, and x87/MMX style registers are generally not used (but still available even in 64-bit mode); instead, a set of 16 vector registers, each 128 bits wide, is used. (Each vector register can store one or two double-precision floating-point numbers, up to four single-precision floating-point numbers, or various integer formats. In 64-bit mode, instructions are modified to support 64-bit operands and 64-bit addressing mode. The x86-64 architecture defines a compatibility mode that allows 16-bit and 32-bit user applications to run unmodified alongside 64-bit applications, provided the 64-bit operating system supports them.[11][note 2] Since the full x86-32 instruction sets remain implemented in hardware without the need for emulation, these older executables can run with little or no performance penalty,[13] while newer or modified applications can take advantage of new features of the processor design to achieve performance improvements. Also, processors supporting x86-64 still implement backward compatibility with the original 8086 processor, as has been the case with x86 processors since the introduction of protected mode with the 80286. The original specification, created by AMD and released in 2000, has been implemented by AMD, Intel, and VIA. The AMD K8 microarchitecture, in the Opteron and Athlon 64 processors, was the first to implement it. This was the first significant addition to the x86 architecture designed by a company other than Intel. Intel was forced to follow suit and introduced a modified NetBurst family which was software-compatible with AMD's specification. VIA Technologies introduced x86-64 in their VIA Isaiah architecture, with the VIA Nano. The x86-64 architecture was quickly adopted for desktop and laptop personal computers and servers which were commonly configured for 16 GiB (gibibytes) of memory or more. It has effectively replaced the discontinued Intel Itanium architecture (formerly IA-64), which was originally intended to replace the x86 architecture. x86-64 and Itanium are not compatible on the native instruction set level, and operating systems and applications compiled for one architecture cannot be run on the other natively. AMD64 logo AMD64 (also variously referred to by AMD in their literature and documentation as "AMD 64-bit Technology" and "AMD x86-64 Architecture") was created as an alternative to the radically different IA-64 architecture designed by Intel and Hewlett-Packard, which was backward-incompatible with IA-32, the 32-bit version of the x86 architecture. AMD originally announced AMD64 in 1999[14] with a full specification available in August 2000.[15] As AMD was never invited to be a contributing party for the IA-64 architecture and any kind of licensing seemed unlikely, the AMD64 architecture was positioned by AMD from the beginning as an evolutionary way to add 64-bit computing capabilities to the existing x86 architecture while supporting legacy 32-bit x86 code, as opposed to Intel's approach of creating an entirely new, completely x86-incompatible 64-bit architecture with IA-64. The first AMD64-based processor, the Opteron, was released in April 2003. AMD's processors implementing the AMD64 architecture include Opteron, Athlon 64, Athlon 64 X2, Athlon 64 FX, Athlon II (followed by "X2", "X3", or "X4" to indicate the number of cores), Turion 64, Turion 64 X2, Sempron ("Palermo" E6 stepping and all "Manila" models), Phenom (followed by "X3" or "X4" to indicate the number of cores), Phenom II (followed by "X2", "X3", "X4" or "X6" to indicate the number of cores), FX, Fusion/APU and Ryzen/Epyc. The primary defining characteristic of AMD64 is the availability of 64-bit general-purpose processor registers (for example, rax and rbx), 64-bit integer arithmetic and logical operations, and 64-bit virtual addresses.[16] The designers took the opportunity to make other improvements as well. Notable changes in the 64-bit extensions include: 64-bit integer capability All general-purpose registers (GPRs) are expanded from 32 bits to 64 bits, and all arithmetic and logical operations, memory-to-register and register-to-memory operations, etc., can operate directly on 64-bit integers. Pushes and pops on the stack default to 8-byte strides, and pointers are 8 bytes wide. Additional registers In addition to increasing the size of the general-purpose registers, the number of named general-purpose registers is increased from eight (i.e. eax, ebx, ecx, edx, esi, edi, ebp, esp) in x86-32 to 16 (i.e. rax, rbx, rcx, rdx, rsi, rdi, rbp, rsp, r8, r9, r10, r11, r12, r13, r14, r15). It is therefore possible to keep more local variables in registers rather than on the stack, and to let registers hold frequently accessed constants; arguments for small and fast subroutines may also be passed in registers to a greater degree. AMD64 still has fewer registers than many RISC instruction sets (e.g. PA-RISC, Power ISA, and MIPS have 32 each; the IA-64 (which has 128) or CISC sets such as the IBM System/360 through z/Architecture (which have 16 general-purpose registers), however, an AMD64 implementation may have far more internal registers than the number of architectural registers exposed by the instruction set (see register renaming). (For example, AMD Zen cores have 168 64-bit integer and 160 128-bit vector floating-point physical internal registers.) Additional XMM (SSE) registers Similarly, the number of 128-bit XMM registers (used for Streaming SIMD instructions) is also increased from 8 to 16. The traditional x87 FPU register stack is not included in the register file size extension in 64-bit mode, compared with the XMM registers used by SSE2, which did get extended. The x87 register stack is not a simple register file although it does allow direct access to individual registers by low cost exchange operations. Larger virtual address space The AMD64 architecture defines a 64-bit virtual address format, of which the low-order 48 bits are used in current implementations.[11]:120 This allows up to 256 TiB (248 bytes) of virtual address space. The architecture definition allows this limit to be raised in future implementations to the full 64 bits,[11]:2:3:13:117:120 extending the virtual address space to 16 EiB (264 bytes). [7] This is compared to just 4 GiB (232 bytes) for the x86.[18] This means that very large files can be operated on by mapping the entire file into the process's address space (which is often much faster than working with file reads and writes), rather than having to map regions of the file in and out of the address space. Larger physical address space The original implementation of the AMD64 architecture implemented 40-bit physical addresses and so could address up to 1 TiB (240 bytes) of RAM.[11]:24 Current implementations of the AMD64 architecture (starting from AMD 10h microarchitecture) extend this to 48-bit physical addresses[19] and therefore can address up to 256 TiB (248 bytes) of RAM. The architecture permits extending this to 52 bits in the future[11]:24[20] (limited by the page table entry format);[11]:131 this would allow addressing of up to 4 PiB of RAM. For comparison, 32-bit x86 processors are limited to 64 GiB of RAM in Physical Address Extension (PAE) mode,[21] or 4 GiB of RAM without PAE mode.[11]:4 Larger physical address space in legacy mode When operating in legacy mode the AMD64 architecture supports Physical Address Extension (PAE) mode, as do most current x86 processors, but AMD64 extends PAE from 36 bits to an architectural limit of 52 bits of physical address. Any implementation, therefore, allows the same physical address limit as under long mode.[11]:24 Instruction pointer relative data access Instructions can now reference data relative to the instruction pointer (RIP register). This makes position-independent code, as is often used in shared libraries and code loaded at run time, more efficient. SSE instructions The original AMD64 architecture adopted Intel's SSE and SSE2 as core instructions. These instruction sets provide a vector supplement to the scalar x87 FPU, for the single-precision and double-precision data types. SSE2 also offers integer vector operations, for data types ranging from 8-bit to 64-bit precision. This makes the vector capabilities of the architecture on par with those of the most advanced x86 processors of its time. These instructions can also be used in 32-bit mode. The proliferation of 64-bit processors has made these vector capabilities ubiquitous in home computers, allowing the improvement of the standards of 32-bit applications. The 32-bit edition of Windows 8, for example, requires the presence of SSE2 instructions.[22] SSE3 instructions and later Streaming SIMD Extensions instruction sets are not standard features of the architecture. No-Execute bit The No-Execute bit or NX bit (bit 63 of the page table entry) allows the operating system to specify which pages of virtual address space can contain executable code and which cannot. An attempt to execute code from a page tagged "no execute" will result in a memory access violation, similar to an attempt to write to a read-only page. This should make it more difficult for malicious code to take control of the system via a "buffer overrun" or "unchecked buffer" attack. A similar feature has been available on x86 processors since the 80286 as an attribute of segment descriptors; however, this works only on an entire segment at a time. Segmented addressing has long been considered an obsolete mode of operation, and all current PC operating systems in effect bypass it, setting all segments to a base address of zero and (in their 32-bit implementation) a size of 4 GiB. AMD was the first x86-family vendor to implement no-execute in linear addressing mode. The feature is also available in legacy mode on AMD64 processors, and recent Intel x86 processors, when PAE is used. Removal of older features A few "system programming" or "legacy" features of the x86 architecture were either dropped or disabled in 64-bit mode. These included segmented addressing (although the FS and GS segments are retained in vestigial form for use as extra-base pointers to operating system structures),[11]:70 the task state switch mechanism, and virtual 8086 mode. These features remain fully implemented in "legacy mode", allowing these processors to run 32-bit and 16-bit operating systems without modifications. Some instructions that proved to be rarely useful are not supported in 64-bit mode, including saving/restoring of segment registers on the stack, saving/restoring of all registers (PUSHA/POPA), decimal arithmetic, BOUND and INTO instructions, and "far" jumps and calls with immediate operands. Canonical address space Instructions that reference memory operands (diagrams not to scale)Current 48-bit implementation57-bit implementationAlthough virtual addresses are 64 bits wide in 64-bit mode, current implementations (and all chips that are known to be in the planning stages) do not allow the entire virtual address space of 264 bytes (16 EiB) to be used. This would be approximately four billion times the size of the virtual address space on 32-bit machines. Most operating systems and applications will not need such a large address space for the foreseeable future, so implementing such wide virtual addresses would simply increase the complexity and cost of address translation with no real benefit. AMD, therefore, decided that, in the first implementations of the architecture, only the least significant 48 bits of a virtual address would actually be used in address translation (page table lookup).[11]:120 In addition, the AMD specification requires that the most significant 16 bits of any virtual address, bits 48 through 63, must be copies of bit 47 (in a manner akin to sign extension). If this requirement is not met, the processor will raise an exception.[11]:131 Addresses complying with this rule are referred to as "canonical form."[11]:130 Canonical form addresses run from 0 through 00007FFF'FFFFFFFF, and from

FFFF8000'00000000 through FFFFFFFF'FFFFFFFF, for a total of 256 TiB of usable virtual address space. This is still 65,536 times larger than the virtual 4 GiB address space of 32-bit machines. This feature eases later scalability to true 64-bit addressing. Many operating systems (including, but not limited to, the Windows NT family) take the higher-addressed half of the address space (named kernel space) for themselves and leave the lower-addressed half (user space) for application code, user mode stacks, heaps, and other data regions.[23] The "canonical form" design ensures that every AMD64 compliant implementation has, in effect, two memory halves: the lower half starts at 00000000'00000000 and "grows upwards" as more virtual address bits become available, while the higher half is "docked" to the top of the address space and grows downwards. Also, enforcing the "canonical form" of addresses by checking the unused address bits prevents their use by the operating system in tagged pointers as flags, privilege markers, etc., as such use could become problematic when the architecture is extended to implement more virtual address bits. The first versions of Windows for x64 did not even use the full 256 TiB; they were restricted to just 8 TiB of user space and 8 TiB of kernel space.[23] Windows did not support the entire 48-bit address space until Windows 8.1, which was released in October 2013.[23] The 64-bit addressing mode ("long mode") is a superset of Physical Address Extensions (PAE); because of this, page sizes may be 4 KiB (2¹² bytes) or 2 MiB (2²¹ bytes).[11][23] Long mode also supports page sizes of 1 GiB (2³⁰ bytes).[11];1 [1] Rather than the three-level page table scheme used by systems in PAE mode, systems running in long mode use four levels of page table: PAE's Page-Directory Pointer Table is extended from 4 entries to 512, and an additional Page-Map Level 4 (PML4) Table is added, containing 512 entries in 48-bit implementations.[11];1 [1] A full mapping hierarchy of 4 KiB pages for the whole 48-bit space would take a bit more than 512 GiB of memory (about 0.195% of the 256 TiB virtual space). 64 bit page table entries: 63 62 ... 52 51 ... 32 Content: NX reserved Bit 51...32 of base address Bits: 31 ... 12 11 ... 9 8 7 6 5 4 3 2 1 0 Content: Bit 31...12 of base address ign. G PAT D A PCD PWT U/S R/W P Intel has implemented a scheme with a 5-level page table, which allows Intel 64 processors to support 57-bit addresses, and in turn, a 128 PiB virtual address space.[24] Further operating system and physical memory with 12-bit page table descriptors and 16- or 21-bit memory offsets for each 64-bit address space and physical memory with 12-bit page table descriptors and 16- or 21-bit memory offsets for each KiB and 2 MiB page allocation sizes; the page table entry would be expanded to 128 bits to support additional hardware flags for page size and virtual address space size.[25] The operating system can also limit the virtual address space. The "Operating system compatibility and characteristics" section. Current AMD64 processors support a physical address space of up to 248 bytes of RAM, or 256 TiB.[19] However, as of 2020[update], there were no known x86-64 motherboards that support 256 TiB of RAM.[26][27][28][29] [failed verification] The operating system may place additional limits on the amount of RAM that is usable or addressable. On this point are given in the "Operating system compatibility and characteristics" section of this article. The architecture has two primary modes of operation: long mode and legacy mode. Operating Operating system Sub-mode Default address or register Type of code being run Size (in bits) No. of general-purpose registers Mode Sub-mode Addresses Operands (default in italics) Long mode 64-bit mode 64-bit 16, 32 8 16 Compatibility mode Bootloader or 64-bit OS 32-bit 32 8, 16, 32 8 16 Legacy mode Protected mode Bootloader, 32-bit OS, 32-bit UEFI firmware, or the latter two interacting via the firmware's UEFI interface 64-bit 64 8, 16, 32, 64 16 Compatibility mode Bootloader or 64-bit OS 32-bit 32 8, 16, 32 8 16 Legacy mode Protected mode Bootloader, 32-bit OS, 32-bit UEFI firmware, or the latter two interacting via the firmware's UEFI interface 32-bit 32 8, 16, 32 8 16-bit protected mode 16-bit protected mode 16 8, 16, 32[in 1] 8 Virtual 8086 mode 16-bit protected mode or 32-bit OS subset of real mode 16 8, 16, 32[in 1] 8 Unreal mode Bootloader or real mode 32-bit OS 8, 16, 32[in 1] 8 Real mode Bootloader, 32-bit OS

^ a b "Product Matrix". MiTEC International Corporation. Archived from the original on June 21, 2010. ^ "Tyan Product Matrix". MiTEC International Corporation. Archived from the original on June 21, 2010. ^ a b From the AMI Archives: AMIBIOS 8 and the Transition to EFIT. American Megatrends. September 8, 2017. Archived from the original on October 25, 2021. Retrieved June 5, 2022. ^ "Craig Barrett confirms 64 bit addressing decision for Xeon. And Prescott". The Inquirer. February 17, 2004. Archived from the original on January 12, 2013. Retrieved August 20, 2017. ^ "A Roundup of 64-Bit Computing". Free internetnews.com". Archived from the original on September 25, 2012. Retrieved September 18, 2006. ^ Lapedus, Mark (February 6, 2004). "Intel to demo 'CT' 64-bit processor line at IDF". EDN. AspenCore Media. Archived from the original on May 25, 2021. Retrieved May 25, 2021. ^ "Intel 64 Architecture". internetnews.com". Archived from the original on September 25, 2012. Retrieved September 18, 2006. ^ Lapedus, Mark (February 6, 2004). "Intel to demo 'CT' 64-bit processor line at IDF". EDN. AspenCore Media. Archived from the original on May 25, 2021. Retrieved May 25, 2021. ^ "Intel Publishes "X86-S" Specification For 64-bit Only Architecture". www.phoronix.com. ^ "Envisioning a Simplified Intel Architecture for the Future". Intel. ^ Paul Alcorn (December 19, 2024). "Intel terminates x86S initiative — unilateral quest to de-bloat x86 instruction set comes to an end". Tom's Hardware. Retrieved December 20, 2024. ^ "VIA to launch new processor architecture in IQ08" (subscription required). DigiTimes. July 25, 2007. Archived from the original on December 3, 2008. Retrieved July 8, 2008.

1983 Elxsi launches the Elxsi 6400 parallel minisupercomputer. The Elxsi architecture has 64-bit data registers but a 32-bit address space. 1989 Intel introduces the Intel i860 reduced instruction set computer (RISC) processor. Marketed as a "64-Bit Microprocessor", it had essentially a 32-bit architecture, enhanced with a 3D graphics unit capable of 64-bit integer operations.[8] 1993 Atari introduces the Atari Jaguar video game console, which includes some 64-bit wide data paths in its architecture.[9] 1991 MIPS Computer Systems produces the first 64-bit microprocessor, the R4000, which implements the MIPS III architecture, the third revision of its MIPS architecture.[10] The CPU is used in SGI graphics workstations starting with the IRIS Crimson. Kendall Square Research deliver their first KSR1 supercomputer, based on a proprietary 64-bit RISC processor architecture running OSF/1. 1992 Digital Equipment Corporation (DEC) introduces the pure 64-bit Alpha architecture which was born from the PRISM project.[11] 1994 Intel announces plans for the 64-bit IA-64 architecture (jointly developed with Hewlett-Packard) as a successor to its 32-bit IA-32 processors. A 1998 to 1999 launch date was targeted. 1995 Sun launches a 64-bit SPARC processor, the UltraSPARC.[12] Fujitsu-owned HAL Computer Systems launches workstations based on a 64-bit CPU, HAL's independently designed first-generation SPARC64. IBM releases the A10 and A30 microprocessors, the 64-bit POWER3 chips. IBM releases a 64-bit AS/400 system upgrade, which can convert the operating system, database and applications. 1996 Nintendo introduces the Nintendo 64 video game console, built around a low-cost variant of the MIPS R4000. HP releases the first implementation of its 64-bit PA-RISC 2.0 architecture, the PA-8000.[14] 1998 IBM releases the POWER3 line of full-64-bit PowerPC/POWER processors.[15] 1999 Intel releases the instruction set for the IA-64 architecture. AMD publicly discloses its set of 64-bit extensions to IA-32, called x86-64 (later branded AMD64). 2000 IBM ships its first 64-bit z/Architecture mainframe, the zSeries z900. z/Architecture is a 64-bit version of the 32-bit ESA/390 architecture, a descendant of the 32-bit System/360 architecture. 2001 Intel ships its IA-64 processor line, after repeated delays in getting to market. Now branded Itanium and targeting high-end servers, sales fail to meet expectations. 2003 AMD introduces its Opteron and Athlon 64 processor lines, based on its AMD64 architecture which is the first x86-based 64-bit processor architecture. Apple also ships the 64-bit "G5" PowerPC 970 CPU produced by IBM. Intel maintains that its Itanium chips would remain its only 64-bit processors. 2004 Intel, reacting to the market success of AMD, admits it has been developing a clone of the AMD64 extensions named EM64T. Intel ships updated versions of its Xeon and Pentium 4 processor families supporting the new 64-bit instruction set. VIA Technologies announces the Isaiah 64-bit processor.[16] 2006 Sony, IBM, and Toshiba begin manufacturing the 64-bit Cell processor for use in the PlayStation 3, servers, workstations, and other appliances. Intel released Core 2 Duo as the first mainstream x86-64 processor for its mobile, desktop, and workstation line. Prior 64-bit extension processor lines were not widely available in the consumer retail market (most of 64-bit Pentium 4/D were OEM), 64-bit Pentium 4, Pentium D, and Celeron were not into mass production until late 2006 due to poor yield issue (most of good yield wafers were targeted at server and mainframe while mainstream still remain 130 nm 32-bit processor line until 2006) and soon became low end after Core 2 debuted. AMD released their first 64-bit mobile processor and manufactured in 90 nm. 2011 ARM Holdings announces ARMv8-A, the first 64-bit version of the ARM architecture family.[17] 2012 ARM Holdings announced their Cortex-A53 and Cortex-A57 cores, their first cores based on their 64-bit architecture, on 30 October 2012.[18][19] 2013 Tegra K1 chip. 2015 Apple announces the iPod Touch (6th generation), the first iPod Touch to use the 64-bit processor All ARMv8-A based system-on-a-chip alongside the iPad Air and iPad Mini 2 which are the world's first 64-bit processor in an Apple TV (4th generation) which is the world's first 64-bit processor in an Apple TV. 2018 Apple announces the Apple Watch Series 4, the first Apple Watch to use the 64-bit processor S4 ARMv8-A-based system-on-a-chip. 2020 Synopsis announce the ARCv3 ISA, the first 64-bit version of the ARC ISA.[21] 1985 Cray releases UNICOS, the first 64-bit implementation of the Unix operating system.[22] 1993 DEC releases the 64-bit DEC OSF/1 AXP Unix-like operating system (later renamed Tru64 UNIX) for its systems based on the Alpha architecture. 1994 Support for the R8000 processor is added by Silicon Graphics to the IRIX operating system in release 6.0. 1995 DEC releases OpenVMS 7.0, the first full 64-bit version of OpenVMS for Alpha. First 64-bit Linux distribution for the Alpha architecture is released.[23] 1996 Support for the R4x00 processors in 64-bit mode is added by Silicon Graphics to the IRIX operating system in release 6.2. 1998 Sun releases Solaris 7, with full 64-bit UltraSPARC support. 2000 IBM releases z/OS, a 64-bit operating system descended from MVS, for the new zSeries 64-bit mainframes; 64-bit Linux on zSeries follows the CPU release almost immediately. 2001 Linux becomes the first OS kernel to fully support x86-64 (on a simulator, as no x86-64 processors had been released yet).[24] 2001 Microsoft releases Windows XP 64-Bit Edition for the Itanium's IA-64 architecture; it could run 32-bit applications through an execution layer.[citation needed] 2003 Apple releases its Mac OS X 10.3 "Panther" operating system which adds support for native 64-bit integer arithmetic on PowerPC 970 processors.[25] Several Linux distributions release with support for AMD64. FreeBSD releases with support for AMD64. 2005 On January 4, Microsoft discontinues Windows XP 64-Bit Edition, as no PCs with IA-64 processors had been available since the previous September, and announces that it is developing x86-64 versions of Windows to replace it.[26] On January 31, Sun releases Solaris 10 with support for AMD64 and EM64T processors. On April 29, Apple releases Mac OS X 10.4 "Tiger" which provides limited support for 64-bit command-line applications on machines with PowerPC 970 processors; later versions for Intel-based Macs supported 64-bit command-line applications on Macs with EM64T processors. On April 30, Microsoft releases Windows XP Professional x64 Edition and Windows Server 2003 x64 Edition for AMD64 and EM64T processors.[27]

titles. In 2009, 3D Realms, citing financial issues, laid off its development team and the majority of its staff, effectively ceasing operations. In March 2014, the company was acquired by SDN Invest, a Danish holding company and part-owner of Interceptor Entertainment, and relaunched later that year as 3D Realms Entertainment ApS, headquartered in Denmark. 3D Realms Entertainment has since served as a games publisher. Miller remained an advisor for the company until 2021, when he and Nagy acquired the Apogee brand and relaunched Apogee Software LLC as Apogee Entertainment, an independent games publisher. In August 2021, 3D Realms Entertainment was acquired by Embracer Group subsidiary Saber Interactive, which was spun off from Embracer in March 2024. In the early 1980s, Scott Miller often spent time in the computer lab of the high school he was attending, programming text adventures on the facility's Apple II and getting to know fellow student George Broussard.[1] Following graduation, both of them took jobs at local amusement arcade The Twilight Zone, allowing Miller to attend college and increase his interest in video games at the same time.[1] At that time, Miller found a special interest in the Turbo Pascal programming language and its easy integration in DOS games, publishing the 1996 Duke Nukem 3D under the name, with the other titles remained.[1] Following his sophomore year, Miller dropped out of the University of Dallas to focus entirely on video games, including participating in tournaments as well as programming his own games.[1] At that time, Miller found a special interest in the Turbo Pascal programming language and its easy integration in DOS games, publishing the 1996 Duke Nukem 3D under the name, with the other titles remained earn him more money than he made at The Twilight Zone, wherefore he, with assistance by Broussard, wrote a manual-style book on "how to beat video games".[1] The book fell into obscurity due to an oversaturated market but landed Miller a job as a video game critic for The Dallas Morning News and minor game-centric papers.[1] After four years of writing for the newspaper, he decided that he was capable of creating games that were better than those that had to review and quit his job.[1] Miller acquired a 16.5k modem, which he installed in his parents' house in Garland, Texas, and started operating as a full-time independent game developer.[1] The Apogee Software logo Most games developed by Miller at the time used extended ASCII characters as graphics.[1][3] The format appeared popular to him but ultimately proved unsuccessful when pitching them to publishers, adding to him not having a college degree or any professional experience in game development.[1] As such, he considered self-printing copies of his games, or distributing them freely through bulletin board systems (BBS), where the boards' users make voluntary donations, a model known as shareware distribution.[1] As the prior option seemed too expensive to Miller, he had to choose the latter, despite being urged not to by friends and colleagues.[1] Miller released Beyond the Titanic and Supernova as shareware games in 1986 and 1987, respectively, but income was low, at roughly US$10,000 donated in a year for both games combined.[1] Miller's next game, Kingdom of Kroz, was developed to include 60 levels, more than what he wanted to release to the public for no cost.[1] As such, he developed a new distribution model, dubbed the "Apogee model", in which only a fraction of the game would be made available to play for free on BBS, which, upon completion, would display Miller's mailing address to the player and ask them to contact him to buy the rest of the game.[1] He applied this model to Kingdom of Kroz by breaking it up into three parts, named episodes, and sharing the first one over BBS while retaining the other two for sale.[1][2] Released on November 26, 1987, Kingdom of Kroz was the first game to bear the name of Miller's one-man company, Apogee Software Productions.[2] The game proved successful, with checks sent to Miller amounting to roughly US$80,000–US$100,000 and him receiving between US$100 and US$500 every single day.[2] Broussard later joined Apogee, merging his own, lesser-known game company Micro-FX into it.[4] In 1994, Apogee decided to launch different brand names for each genre of games they published; it created 3D Realms for 3D games, publishing Terminal Velocity in 1995 and developing the 1996 Duke Nukem 3D under the name, with the other titles still under Apogee.[5] In late 1996, however, Apogee renamed the company itself to 3D Realms to associate their brand with newer, 3D titles, and stopped using the Apogee brand name.[6] The last game to be published under the Apogee name was Stargunner in 1996. Most of the proposed brands were never used, as 3D games like Duke Nukem became the company's focus. 3D Realms launched a brand for pinball games, Pinball Wizards, in February 1997, but only published Balls of Steel (1997) under the name.[5] Beginning in 1997 3D Realms shifted from episodic MS-DOS titles to non-episodic console and personal computer games. In the process it abandoned the shareware model in favor of a traditional publishing model; it also largely ceased its activities as a developer that same year, releasing only Shadow Warrior (1997).[7] The sole exceptions were Prey (2006), which stayed in development until 2001 when it was transferred to Human Head Studios, and Duke Nukem Forever (2011), which famously stayed in development at 3D Realms as vaporware until 2009.[7][8] The "Apogee Software" name, library, and logo were licensed to Terry Nagy in 2008, who formed Apogee Software, LLC as a separate company that would handle distribution, remakes, and other developments related to older Apogee games. 3D Realms retained the corporate name of Apogee Software, Ltd. Apogee Software, LLC was renamed Apogee Entertainment in 2021.[6] After Prey was transferred away from 3D Realms in 2001, the only project under development at the company was Duke Nukem Forever, originally announced in 1997. The release date of the game was "when it's done."[9] 3D Realms continued some operations as a publisher as part of the Gathering of Developers publishing group, but otherwise served only as the publisher and licensee of Duke Nukem-related spinoffs and mobile games for the next few years. On May 6, 2009, the development of Duke Nukem Forever was initiated with the entire development team and most other employees laid off.[10][11] According to Miller, the development was using up much of the company's funds as they struggled to bring in new 3D rendering technology for the game, leading to the decision to cut their staff and sell the company.[12] On May 14, 2009, Take-Two, holders of the publishing rights of Duke Nukem Forever, filed a breach of contract suit against 3D Realms over failing to deliver the game.[13] Take-Two Interactive asked for a restraining order and a preliminary injunction, to make 3D Realms keep the Duke Nukem Forever assets intact during proceedings.[14][15] On May 18, 2009, 3D Realms key executives announced that "3D Realms has not closed and is not closing", but that due to lack of funds development operations were ceasing and the company would continue to "license and co-create games based upon the Duke Nukem franchise." They accused Take-Two of trying to acquire the Duke Nukem franchise in a "fire sale".[11] On September 3, 2010, Take-Two Interactive announced that development of Duke Nukem Forever had been shifted over to Gearbox Software, effectively ending 3D Realms' association with the game after 12 years of development. 3D Realms remained credited as a co-developer on Duke Nukem Forever, due to their involvement in developing most of the game. The rights and intellectual property were sold to Gearbox, however, who became the owners of the Duke Nukem franchise.[16] An external developer, Interceptor Entertainment, started work on a fan-project remake of Duke Nukem 3D in 2010. They received a limited authorization from Gearbox to proceed with the game, which was named Duke Nukem 3D: Reloaded. However, after Duke Nukem Forever's release and negative reception in 2011, Duke Nukem 3D: Reloaded was put on hold indefinitely. In an interview conducted with Scott Miller in April 2011, Miller specified that 3D Realms was involved with several projects: "we have several projects underway, all fairly small—not any big console games. Once [Duke Nukem Forever] comes out we'll be definitely looking to invest into other projects, and maybe other up-n-coming [sic] teams who are blazing new trails on smaller platforms, like smart phones and XBLA."[17] 3D Realms did not publish any released titles over the next few years, however. In June 2013, 3D Realms sued Gearbox for unpaid royalties as well as unpaid money for selling the Duke Nukem intellectual property.[18] The lawsuit was dropped in September 2013 with 3D Realms apologizing with an announcement that they had resolved any differences they had with Gearbox. In February 2014, Gearbox sued 3D Realms, Interceptor Entertainment and Apogee Software, LLC for developing a new game called Duke Nukem: Mass Destruction. Gearbox stated that it was still the rights holder of the Duke Nukem intellectual property and permission had not been granted by them to develop the game. 3D Realms soon after released a statement admitting its wrongdoing.[19] The lawsuit was settled in August 2015, with Gearbox stressing that it was still the lawful owner of the Duke Nukem intellectual property.[20] In March 2014, SDN Invest, the part-owner of Interceptor Entertainment, acquired 3D Realms for an undisclosed sum.[21] Mike Nielsen, the founder and chairman of SDN Invest, became the new chief executive officer of the company on May 16,[22] headquartered in Aalborg, Denmark and incorporated in 2015 as 3D Realms Entertainment ApS.[23][24] Miller remained with the company as a creative consultant,[25] while Apogee Software LLC retained the license to the Apogee brand and library.[26] On February 27, 3D Realms announced they were to publish Bombshell by Interceptor Entertainment,[27] and in October 2014 the company returned to distributing its own titles with a digital anthology collection.[28][29] Bombshell was released on January 29, 2016, as 3D Realms' first published title since 2005. On February 28, 2018, 3D Realms announced the game Ion Maiden, a prequel to Bombshell, developed by Voidpoint and using Ken Silverman's Build Engine. In May 2019, the company was hit with a $2 million trademark infringement lawsuit by heavy metal group Iron Maiden who claimed Ion Maiden was "nearly identical to the Iron Maiden trademark in appearance, sound and overall commercial impression" and was "attempting to trade off on Iron Maiden's notoriety."[30] In July 2019, 3D Realms and Voidpoint changed the name of Ion Maiden to Ion Fury to end to the lawsuit. Ion Fury was released on August 15, 2019. Since then, 3D Realms published Ghostrunner (2020) and announced several projects which have been under development for multiple years without further notice.[31] In April 2021, Miller and Nagy acquired the Apogee name from 3D Realms and relaunched Apogee Software LLC as Apogee Entertainment.[32] In 2022, Miller stated in a blog post that he was now uninvolved with 3D Realms and that "[the company] no longer has any link to the past, other than in name only" because he was no longer there to help design and fund games.[33] In August 2021, Embracer Group announced that they acquired the company through Saber Interactive, which will be the parent company.[34] 3D Realms published Cultic on October 13 (2022). In March 2023, 3D Realms announced that they hired Justin Burnham (formerly of Devolver Digital, Good Shepherd) to the position of CCO.[35] On September 30, 2023, 3D Realms held its 4th annual Realms Deep event showcasing the company's branding and announcing release dates for several previously-unreleased titles. Two days later on October 2, they published Ion Fury: Aftershock in collaboration with developer Voidpoint.[36] On October 24, 2023, 3D Realms published Ripout into early access in collaboration with developer Pet Project Games.[37] On November 16, 3D Realms published The Kindeman Remedy in collaboration with developer Troglobyte Games.

[38] On December 5, 2023, 3D Realms co-published (with Interplay) the Slipgate Ironworks-developed Kingpin Reloaded.[39] In mid-December, "at least half" of 3D Realms and Slipgate Ironworks was laid off as part of Embracer's restructuring.[40] Layoffs continued into January 2024.[41] On January 24, 2024, 3D Realms co-published (with Fulgrum Publishing) the Slipgate Ironworks-developed Graven out of early access.[42] On February 27, 3D Realms co-published (with Fulgrum Publishing) the Slipgate Ironworks and Killpixel Games-developed Wrath: Aeon of Ruin out of early access.[43] In March 2024, Saber Interactive was sold to Beacon Interactive, a new company from Saber co-founder Matthew Karch. Many of Saber's studios, including 3D Realms, were included in the sale.[44] Main article: List of 3D Realms games ^ a b c d e f g h i j k l m n Plante, Chris (October 26, 2017). "Apogee: Where Wolfenstein got its start". Polygon. Archived from the original on October 26, 2017. 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