ReactOS

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ReactOS is a free and open-source operating system for x86/x64 personal computers intended to be binary-compatible with computer programs and device drivers made for Windows Server 2003.[5]

Development began in 1996, as a Windows 95 clone project, and was continued as *ReactOS* in 1998, with the incremental addition of features of later Windows versions. ReactOS has been noted as a potential open-source drop-in replacement for Windows[6][7][8] and for its information on undocumented Windows APIs.[9] As stated on the official website,

> The main goal of the ReactOS project is to provide an operating system which is binary compatible with Windows ... such that people accustomed to the familiar user interface of Windows would find using ReactOS straightforward. The ultimate goal of ReactOS is to allow you to remove Windows and install ReactOS without the end user noticing the change."[10]

As of September 2017, ReactOS is considered alpha software, feature-incomplete but with many Windows applications already working (e.g. Adobe Reader 6.0, OpenOffice, etc.[11]),[12] and therefore recommended by the developers only for evaluation and testing purposes.[13][14]

ReactOS is primarily written in C, with some elements, such as ReactOS File Explorer, written in C++. The project partially implements Windows API functionality and has been ported to the AMD64 processor architecture.[15] ReactOS, as part of the FOSS ecosystem, re-uses and collaborates with many other FOSS projects,[16][17] most notably the Wine project which develops a Windows compatibility layer for Unix-like operating systems.

ReactOS

ReactOS 0.4.4 Desktop

Developer	ReactOS Foundation
Written in	C, C++[1][2]
OS family	Windows-like
Working state	Alpha
Source model	Open source
Initial release	1998
Latest release	0.4.6 / September 1, 2017[3]
Latest preview	0.4.6 RC1 / July 30, 2017
Marketing target	Personal computing
Update method	CD-ROM ISO image, QEMU image, VirtualBox image, VMware image, or source code[4]
Platforms	IA-32, x86-64, ARM
Kernel type	Hybrid (designed to be compatible with Windows NT and beyond)
Default user interface	Graphical (ReactOS Explorer)
License	GNU GPL v2+ with parts under LGPL and BSD licenses
Official website	www.reactos.org (https://www.reactos.org)

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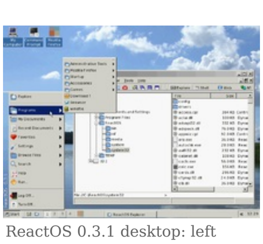
History

Early development

ReactOS 0.3 running the Firefox web browser

Around 1996, a group of free and open-source software developers started a project called *FreeWin95* to implement a clone of Windows 95. The project stalled in discussions of the design of the system.

While FreeWin95 had started out with high expectations, there still had not been any builds released to the public by the end of 1997. As a result, the project members, led by coordinator Jason Filby, joined together to revive the project. The revived project sought to duplicate the functionality of Windows NT.[18] In creating the new project, a new name, *ReactOS*, was chosen. The project began development in February 1998 by creating the basis for a new NT kernel and basic drivers.[19] The name ReactOS was coined during an IRC chat. While the term "OS" stood for operating system, the term "react" referred to the group's dissatisfaction with – and reaction to – Microsoft's monopolistic position.[7]



ReactOS 0.3.1 desktop: left Start Menu and right ReactOS's own File explorer

Ekush OS fork

In 2004, a copyright / license violation of ReactOS GPL'ed code (and other FOSS code) was found when someone distributed a ReactOS fork under the name *Ekush OS*.[20][21][22] The webpage later went offline.

Internal audit

New shell in ReactOS (v0.4.0 and newer)

In order to avoid copyright prosecution, ReactOS must be expressively completely distinct and non-derivative from Windows, a goal which needs very careful work.[23] A claim was made on 17 January 2006, by now former developer Hartmut Birr on the ReactOS developers mailing list (ros-dev) that ReactOS contained code derived from disassembling Microsoft Windows.[24] The code that Birr disputed involved the function BadStack in syscall.S.[25] as well as other unspecified items.[26] Comparing this function to disassembled binaries from Windows XP, Birr argued that the BadStack function was simply copy-pasted from Windows XP, given that they were identical. Alex Ionescu, the author of the code, asserted that while the Windows XP binary in question was indeed disassembled and studied, the code was not merely copy-pasted, but reimplemented; the reason why the functions were identical, Ionescu claimed, was because there was only one possible way to implement the function.[27]

On 27 January 2006, the developers responsible for maintaining the ReactOS code repository disabled access after a meeting was held to discuss the allegations. When approached by NewsForge, Microsoft declined to comment about the incident. Since ReactOS is a free and open-source software development project, the claim triggered a negative reaction by the free software community; in particular, Wine barred several inactive developers from providing contributions[28] and formal high level cooperation between the two projects remained difficult as of 2006.[29] Contributions from several active ReactOS developers have been accepted post-audit, and low level cooperation for bug fixes still occurs.

In a statement on its website, ReactOS cited differing legal definitions of what constitutes clean-room reverse engineering as a cause for the conflict.[30] Some countries, including the United States, require that a reimplementation based on disassembled code must be written by someone other than the person having disassembled and examined the original code,[31][32] whereas other countries allow both tasks to be performed by the same individual. Consequently, ReactOS clarified that its Intellectual Property Policy Statement requirements on clean room reverse engineering conform to US law. An internal source code audit was conducted to ensure that only clean room reverse engineering was used, and all developers were made to sign an agreement committing them to comply with the project's policies on reverse engineering.[29] Contributors to its development were not affected by these events, and all access to the software development tools was restored shortly afterward. In September 2007, with the audit nearing completion, the audit status was removed from the ReactOS homepage. Though the audit was completed, specific details were not made public as it was only an internal effort to ensure compliance with the project's own policies.[33]

Much of the assembly code that was allegedly copied has also been replaced as a natural progression in ReactOS development, with developers having reimplemented the functionality in C for portability reasons.

Also, the 2004 leaked Windows source code[34] was not seen as legal risk for ReactOS, as the trade secret was considered indefensible in court due to broad spread.[35]

Google Summer of Code participation

Starting in 2006[36] the ReactOS project participated in several Google Summers of Code. For example, in the GSoC 2011[37] ReactOS mentored a student project which integrated lwIP into the network stack.[38] ReactOS has to date participated four times in GSoC: 2006, 2011, 2016, and 2017.

Public demonstration

ReactOS project coordinator Aleksey Bragin (left) showing ReactOS to Viktor Alksnis

Demonstrations of the operating system have been given, mainly to Russian political figures. Viktor Alksnis met with project coordinator Aleksey Bragin, who gave a presentation and demonstration of the project, showing ReactOS running with Total Commander and Mozilla Firefox in 2007.[39] Dmitry Medvedev was also given a demonstration during a visit as President of Russia to a high school in Verhnerusskoe, Stavropol, attended by one of the development team members in 2011.[40]

On 31 July 2012, Vladimir Putin was also given a demonstration during his visit as President of Russia to Seliger Youth Forum, attended by Marat Karatov, one of the development team members.[41]

Funding campaigns

The Prime Minister of Russia Dmitry Medvedev (left) being given a demonstration of ReactOS

On 1 May 2012 a 30,000 euro funding campaign was started to finance additional development projects.[42][43] On the end of the year approximately 50% of the funding goal was achieved and it was decided to continue the funding campaign without deadlines.[44] The money went to *ReactOS Deutschland e. V.*. As the tax law in Germany for this form of a registered voluntary association (*Eingetragener Verein*) makes it problematic to pay developers directly,[45] indirect possibilities like stipends were evaluated.

Thorium Core Cloud Desktop project

When ReactOS was awarded as Project of the Month on SourceForge on June 2013, a crowdfunding campaign on Kickstarter was announced in an interview with the project's coordinator, Aleksey Bragin.[46] On 23 December 2013 the announced project was revealed as a Kickstarter campaign with the goal of US$120,000 was started.[47][48] The *Thorium Core Cloud Desktop* dubbed cloud computing service would use ReactOS as core and could allow the use of Windows compatible applications from mobile devices (like smartphones, tablets), workstations, or any other connected device. On 21 February 2014, fundraising ended short of the target amount, with $48,965 of $120,000 raised, resulting in no transferred money.[49]

ReactOS Community Edition

In April 2014, the ReactOS project announced an Indiegogo campaign to launch ReactOS Community Edition, a version of ReactOS based on the 0.4 release. The flexible funding campaign had a goal of US$50,000 with additional stretch goals beyond that.[50] Development of ReactOS Community Edition would be community-centric, with ReactOS users voting and funding to decide which software and hardware drivers the project will aim to support.[51][52] On 1 June 2014, the flexible crowdfunding campaign on Indiegogo was finished with raising $25,141 for the development of the community edition,[53][54] and the voting process to support hardware and software was started shortly after.[55]

ReactOS Hackfest 2015

The ReactOS project organized a Hackfest from 7 to 12 August 2015, in the German city of Aachen.[56][57][58] The Hackfest was declared a success, as it added many features to ReactOS.

ReactOS printing for the first time

Release history

System version	Release date	Release information
0.2.0	January 25, 2004	First release with working GUI
0.2.1	2004-03-03	Bug fixes only
0.2.2	2004-04-27	Bug fixes only
0.2.3	2004-06-26	New LiveCD image, improved stability in the kernel and win32k, networking improvements and improved shell, command prompt and hardware drivers
0.2.4	2004-09-13	Code synced with Wine, compiler fixes and cleaned up file headers
0.2.5	2005-01-02	Imported Notepad from WINE, added Date/Time application
0.2.6	2005-04-09	NVIDIA OpenGL hardware acceleration works, NCITool created for generating system call database files
0.2.7	2005-08-21	New Command Prompt, My Computer and ReactOS logo icons, improved first-stage installer appearance
0.2.8	2005-10-29	VMWare detection, CSRSS rewrite
0.2.9	2005-12-22	Bug fixes only
0.3.0	2006-08-27	First version to officially support networking
0.3.1	2007-03-10	Program manager included, start of kernel rewrite
0.3.2	*skipped*	Branch created but never released
0.3.3	2007-09-12	Kernel and win32k improvements
0.3.4	2008-01-22	Registry support rewrite, remote desktop client and Plug and Play
0.3.5	2008-06-30	Bug fixes only
0.3.6	2008-08-06	RTL support
0.3.7	2008-11-04	Improved x86-64; MSVC, new stacks
0.3.8	2009-02-04	Introduced PSEH and multi-partition HDD support in LiveCD
0.3.9	2009-04-26	24 MB minimum RAM, faster hyperspace mapping, initial sound support
0.3.10	2009-07-05	Initial SATA support, USB keyboard/mouse support, Paint clone, initial MSVC.[59][60]
0.3.11	2009-12-16	Kdcom rewrite; Chinese/Korean fonts; compatibility updates; sound system improvements
0.3.12	2010-10-20	Trap handler rewrite; timer and message handling rewrite; NMI support; SxS support; partial EMS support[61]
0.3.13	2011-03-22	Heap manager rewrite, improved SATA support, fixed graphics issues[62]
0.3.14	2012-02-07	ACPI enabled by default, WiFi support (unencrypted and WEP), theme support, new TCP/IP driver (LwIP), MSVC compatibility, Scatter/Gather DMA operations supported, shell32 rewrite[63]
0.3.15	2013-05-30	USB support for mice, keyboard, and storage devices; rewritten session management; AHCI support with updated UniATA driver; alternate ReactOS Memory Management Module has taken over all memory management responsibilities except for sections; preliminary support for debugging ReactOS components using windbg; improvements based on results from the AutoHotKey application functionality test suite; Bugfixes based on running Driver Verifier on several bundled drivers[64]
0.3.16	2014-02-06	CSRSS rewrite; theme support improved; network card driver for the RTL8139, allowing ReactOS to support newer versions of QEMU out of the box[65]
0.3.17	2014-11-05	Inclusion of an NTVDM; font improvements;[66][67] bug fixes[68]
0.4.0	2016-02-16[69]	Improved USB support, new file explorer shell and theming, improved VirtualBox and Virtual PC support, ext2 read/write support, NTFS read support and improved networking support
0.4.1	2016-05-17[70]	Improved Activation Context, Btrfs support, improved Shell, USB bug fixes, support for Virtual Machine Shared Folders
0.4.2	2016-08-16[71]	Improved Btrfs and extended file system support, ReiserFS and UFS/FFS, introduced .NET Framework 2.0 and 4.0 support, Shell fixes and improvements
0.4.3	2016-11-16[72]	New Winsock library, initial sections support, usual bug fixes
0.4.4	2017-02-16[73]	Initial print stack support, minor font fixes, usual improvements and bug fixes
0.4.5	2017-05-18[74]	Improved rendering of fonts and font metrics, major fixes in kernel and drivers, Microsoft Office 2010 tested as functioning
0.4.6	2017-09-01[75]	Several fixes in dual-boot issues, improved theming support, NFS driver added, several kernel and filesystem fixes

Legend: Old version **Latest version** Latest preview version Future release

Development

ReactOS core development

ReactOS is primarily written in C, with some elements, such as ReactOS Explorer and the sound stack, written in C++. The project compiles using both MinGW and Microsoft Visual Studio, and contributes to the development of the build systems used through the submission of patches to its components.[76]

The developers aim to make the kernel and usermode APIs more compatible with Windows NT version 5.2 (Windows Server 2003) and to add support for more applications and hardware with plans to target newer versions of Windows as development matures.[77] DirectX support is undertaken through ReactX, an in-house implementation. 2D hardware-accelerated rendering is done natively, while other drawing functionality is redirected to OpenGL as a stopgap solution.[15]

The development progress is influenced by the size of the development team and the level of experience among them. As an estimate of the effort required to implement Windows 7, Microsoft employed 1,000 or so developers, organized into 25 teams, with each team averaging 40 developers.[78] As of 2 September 2011, in the ReactOS entry in Ohloh, the page followed through the "Very large, active development team" link lists 33 developers who have contributed over a 12-month period and a cumulative total of 104 present and former users who have contributed code to the project via Subversion since its inception.[79] In his presentation at Hackmeeting 2009 in Milan, ReactOS developer Michele C. noted that most of the developers learn about Windows architecture while working on ReactOS and have no prior knowledge.[80]

While ReactOS targets currently mainly the x86/AMD64 PC platform,[81] an effort to port to the ARM architecture was at one point "under way",[15] while it didn't produce much functionality and was abandoned.[82] Support for the Xbox, a variant IA-32 architecture, was added through the use of an architecture-specific HAL,[80] although this, along with a port to PowerPC, are no longer actively maintained.[13]

Collaboration and reuse

While ReactOS has the aim to build a Windows-compatible kernel as open-source software, much of the surrounding required functionality to create a complete OS is already available in the greater open-source ecosystem. When available and possible, ReactOS therefore builds on and collaborates with already existing open-source projects.[16] Conversely, projects like Wine,[17] former Captive NTFS,[83] and Longene re-use the open-source ReactOS code-base as well.[84]

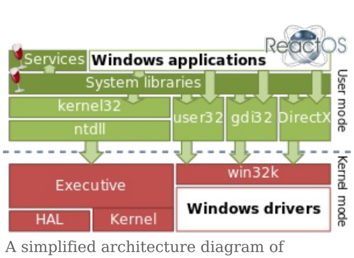
Hardware driver stack

On the hardware driver side, for instance the UniATA project provides Serial ATA drivers for ReactOS.[14][85] The project has also experimented with using the FullFAT library in its rewrite of its FAT Installable File System.[86] ReactOS makes use of the USB stack from Haiku both as a reference and as a foundation for its USB support.[87][88] Mesa 3D provides OpenGL rendering.[14][76]

Networking

ReactOS's network stack is built on the TCP portion of OSKit's port of the network stack in FreeBSD, along with an internally developed implementation for packet-oriented protocols like IP.[89] Later, lwIP was integrated into the ReactOS's network stack.[38] Windows network services like LSASS, SAM, NETLOGON, and print spooling are already available as open-source alternative by the Samba/Samba TNG project. A fork of rdesktop is used as an implementation of a client software for Microsoft's proprietary Remote Desktop Protocol.

Wine cooperation



A simplified architecture diagram of ReactOS, with Wine dependencies indicated with the Wine logo. White boxes denote third party binary software. Green boxes are "userland" components, red are kernel components.

The ReactOS and the Wine projects share the goal to run binary Windows software natively and can share therefore many dependencies and development.[17][90] ReactOS uses portions of the Wine project so that it can benefit from Wine's progress in implementing the Win32 API.[90] While Wine's NTDLL, USER32, KERNEL32, GDI32, and ADVAPI32 components cannot be used directly by ReactOS due to architectural differences, code snippets of them and other parts can be shared between both projects. The kernel is developed by ReactOS separately as Wine relies here on existing Unix-like kernels.[76][80]

Separately, the experimental *Arwinss* branch was created as an alternative means to improve USER32 and GDI32 support through an alternative implementation of the Win32 API. Whereas ReactOS's original Win32 subsystem was closely modeled after its equivalent in Windows, Arwinss combines the architecture of that subsystem with the corresponding implementation in Wine. To this end, Arwinss uses Wine's GDI32 and USER32 libraries with few changes to take fuller advantage of Wine's existing software compatibility. Arwinss also allows the user to optionally use a remote X server instead of a local display.[91]

Other

The Tango Desktop Project initiative provides open-source design guidelines and resources (as icons) for applications on desktop environments. FreeType is an open-source software development library, used to render text on to bitmaps and provides support for other font-related operations.[14] The *KernelEx* project is an Windows-API extension and compatibility layer project, which provides open-source implementations of some Windows-APIs.[92] Other contributing projects are MinGW, SYSLINUX, adns, ICU, GraphApp, Ext2, GNU FreeFont, DejaVu fonts, and Liberation fonts.[93][94][95]

Forks

Forks based on ReactOS are occasionally created:

- Ekush OS (2004)[20][21][22]
- ReactOS Server Edition[96]
- ReactOS Server[97]
- OpenROS (2013)[98]
- FusionOS (2013)[99]
- ReactOS NG (2015) – aiming for compatibility with Windows 8[100]
- Greentea OS (2016) – aiming for accelerated and simplified development[101]

Reception

Various people have acknowledged ReactOS and the implications of having a viable open-source drop-in replacement for Windows.[7] A 2004 article and interview of the German weekly magazine *Der Spiegel* describes ReactOS as directed at Windows users who want to renounce use of proprietary commercial software without having to switch to Linux.[7] DistroWatch, a Linux distribution's monitoring website, lists also ReactOS and describes it as "*a free and open-source operating system based on the best design principles found in the Windows NT architecture.*".[102]

In his column for Free Software Magazine, David Sugar noted in 2006 that ReactOS would allow the use of applications depending on older versions of Windows whose APIs have been deprecated. He also recognized its potential to expand the total deployed base of free software, and as a resource for developers wanting to know undocumented Windows APIs in the course of writing portable applications.[9] PC Magazine columnist John C. Dvorak remarked in 2008 that the Windows NT architecture had remained largely unchanged, making it an ideal candidate for cloning, and believed that ReactOS could be "a bigger threat than Linux to Microsoft's dominance".[8] In response to Dvorak's column, ZDNet technology journalist Dana Blankenhorn noted in 2008 that a lack of corporate sponsors and partners had rendered the project harmless to Microsoft.[103][104] Echoing this, Thom Holwerda of OSNews in 2009 categorized ReactOS under a family of hobby operating systems maintained only by small groups of developers working in their spare time, lacking the financial support of more mainstream operating systems and the legacy of formerly mainstream ones such as RISC OS.[105]

In October 2015, a Network World review of ReactOS v0.3.17 noted impressed "*It's just like running Windows 2000*" and praised the extension by an application package manager, a feature the original Windows is missing.[106]

Awards

The ReactOS Project won on the annual Seliger Youth Forum "The Best Presentation" award with 100,000 Russian rubles (≈US$2700) in 2011, attended by Alexander Rechitskiy, one of the development team members.[107]

ReactOS was a featured project on SourceForge for the week beginning 27 February 2012, and 25 April 2013[108] along with several others. It was Project of the Month on Sourceforge for June 2013.[109]

In 2015, ReactOS was named by the Russian Ministry of Communications as support-worthy "client operating system / Server Operating System" alternative,[110][111] for its potential in reducing Russia's dependency from proprietary software imports.[6][112]

See also

- Binary code compatibility
- coLinux, a project allowing Microsoft Windows and the Linux kernel to run simultaneously in parallel on the same machine
- FreeDOS, a clone of MS-DOS
- Longene, a hybrid operating system kernel intended to be binary-compatible with both the Microsoft Windows and Linux ecosystem
- NDISwrapper, a recreation of Windows NT kernel parts inside the Linux Kernel to allow the use of Windows drivers in Linux
- Wine, compatibility layer which runs Microsoft Windows applications on Unix-like operating systems

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External links

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- Official website (https://www.reactos.org/)
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