

Windows RE

Windows Recovery Environment (Microsoft Corporation)

What is Windows RE?

Windows Recovery Environment (Windows RE) is an extensible recovery platform based on Windows Preinstallation Environment (Windows PE). When the computer fails to start, Windows automatically fails over into this environment, and the Startup Repair tool in Windows RE automates the diagnosis and repair of an unbootable Windows Vista® installation. Furthermore, Windows RE is a starting point for various tools for manual system recovery. The primary audience of this technology includes original equipment manufacturers (OEMs), original device manufacturers (ODMs), and corporate IT professionals.

This topic includes:

- Benefits of Windows RE
- Common scenarios
- Image-based recovery from Windows RE
- Security considerations
- Technologies related to Windows RE

Benefits of Windows RE

Windows RE provides the following benefits:

- Can help reduce support costs by up to 80 percent through automatic repair of common root causes of unbootable operating system installations.
- Can add customized recovery tools to Windows RE.
- Can be used as the platform for image recovery.
- Supports mass-storage drivers and language packs through Windows PE tools.
- Can run automatically or manually.
- Provides diagnostic and repair logs.

Common Scenarios

End-user Scenario

A home user installs a video card driver from Fabrikam and restarts his computer. While Windows Vista restarts, the computer stops unexpectedly and an error message appears on a blue screen because of the driver. The computer automatically restarts. The user then sees a message that the computer failed to start and that Windows will attempt to repair it. Once in Windows RE, the Startup Repair wizard actively diagnoses the computer and determines that System Restore must repair the problematic video card driver. The user chooses to repair the video card driver, and the computer restarts after the repair. Now the computer successfully restarts, and the user sees the logon screen for Windows.

System Administrator Scenario

A system administrator for an enterprise is attempting to fix a client computer that cannot start. The administrator presses F8 during startup and selects the Recovery Environment entry, which boots the computer into Windows RE. He logs on by using a local administrator account, and selects the full-volume restore application from the list of available tools. Once the restore has completed, the administrator clicks the Reset button in Windows RE, and the computer restarts.

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Unsupported Scenario

A user attempts to log on to their Windows user account by typing their password. However, the computer encounters a problem and crashes, triggering a restart. The computer restarts to Windows Vista without failing over into Windows RE. The user is back at the logon screen, and the error in Windows Vista is not repaired automatically.

Image-based Recovery from Windows RE

In the event that the Windows installation cannot be repaired with Startup Repair or other manual repair steps, Windows RE can be used to launch an image-based recovery tool.

User-created Recovery Image

Windows Vista provides end users with the ability to create a backup image of their entire operating system. End users can do this by using the Backup tool. The system image can be stored on an external hard disk, on a hard disk partition other than those imaged, or on a DVD. To restore the computer by using this system image, users must launch the restore interface from the list of Windows RE manual tools.

Factory-created Recovery Image

To facilitate restoring a computer to its factory state, a recovery image can be placed on the Windows RE partition. This eliminates the need for a separate recovery media in most cases.

If the Windows image format is used in the manufacturing process, the same operating system image can be used for recovery as well. A computer manufacturer can develop an application by using the Imaging APIs for Windows and the Windows image to restore the operating system volume. This application can be launched from the Windows RE user interface (UI) by using customizations provided by the ODM.

Security Considerations

When working with Windows RE, keep in mind the following security considerations:

- When launching Windows RE from hard disk by using the F8 advanced boot options screen, users are required to use a local user name and password for authentication. To gain access to the Command Prompt window, the built-in administrator account must be used. Any local user can gain access to tools such as System Restore and the customized recovery application from the list of manual tools.
- By default, networking is turned off in Windows RE. Applications can turn on networking dynamically if needed but are advised to disable it when network connectivity is no longer needed.
- Because Windows RE does not include the security infrastructure present in the Windows Vista operating system, manufacturers and system administrators should not install Windows RE on hard disks of high-security risk computers, such as public kiosk computers running Windows Vista.

Technologies Related to Windows RE

Windows RE is related to the following technologies:

Windows Preinstallation Environment (Windows PE)

Windows Preinstallation Environment (Windows PE) is a minimal Win32 operating system with limited services. Windows RE is built from Windows PE.

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ImageX

ImageX is a command-line tool that enables the capture, the modification, and the application of file-based Windows images for rapid deployment. Windows RE is a customized Windows PE image (.wim) file that can be modified only by using ImageX. Windows RE scripts also rely on ImageX to install Windows RE images.

How Windows RE Works

This topic describes how Windows RE works, specifically the automatic failover behavior, manual diagnosis and repair process and how Startup Repair tool works.

Automatic Failover

A computer running Windows Vista can automatically fail over into the on-disk Windows RE only if a boot failure is detected. At startup, the Windows loader sets a status flag to indicate that the boot process has started, and this flag is typically cleared before the Windows logon screen is displayed. If the boot attempt fails, the flag is not cleared. The next time the computer starts, the loader detects the flag and assumes that a boot failure occurred. When this happens, the loader launches Windows RE instead of Windows Vista.

NOTE: The detection of boot failure relies on boot completion and not on whether an error occurred in Windows Vista. One example of a false-positive is when power is lost during the boot process, and Windows RE is launched even though the Windows installation is bootable.

Because the failover mechanism relies on the Windows boot manager and Windows boot loader, some failures will render Windows RE inaccessible. In the following scenarios, the user must use bootable Windows RE media to recover the computer:

- Disk metadata corruption in the master boot record (MBR), partition table, or boot sector of Windows RE partition.
- Missing or corrupt boot manager.
- Missing or corrupt boot configuration data.

Sometimes the boot status flag cannot be read or written to by the boot loader, in which case Windows will not automatically fail over into Windows RE. However, the user can still manually launch into the on-disk Windows RE through the F8 menu.

Manual Diagnosis and Repair

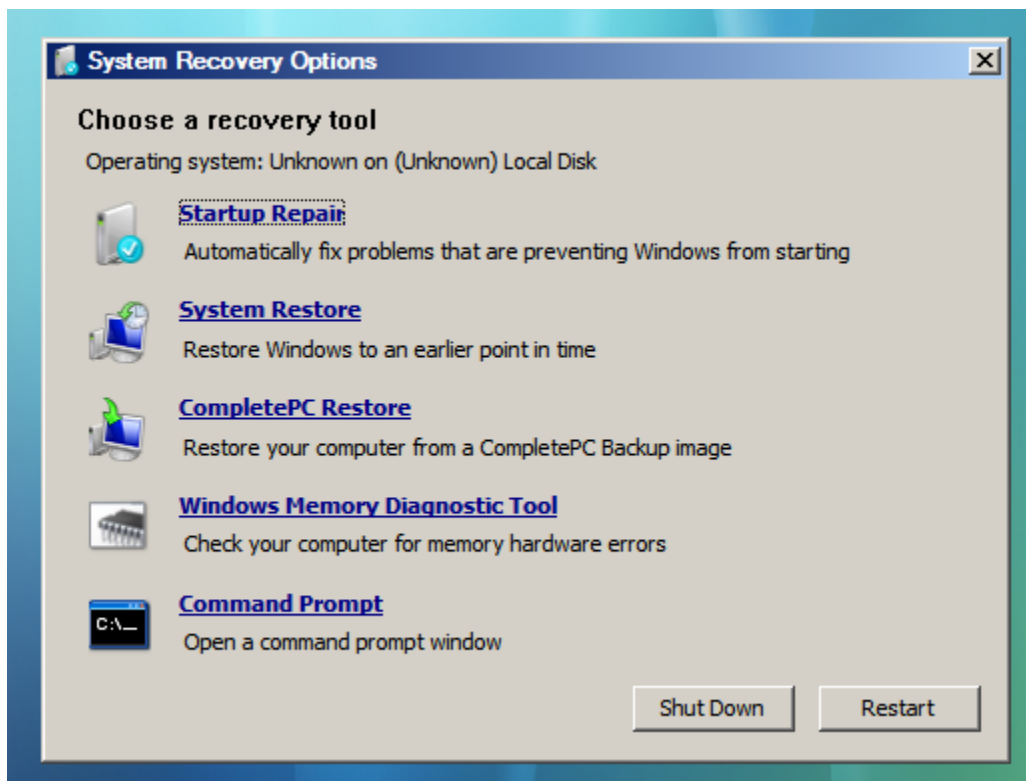
When starting from a Windows RE CD/DVD or using the F8 advanced boot option menu to launch the on-disk Windows RE, the user can manually launch various system recovery tools:

- Startup Repair (when not launched automatically)
- System Restore (on rollback, by using existing restore points)
- Windows Backup Disaster Recovery (to restore from a volume backup image)
- Command prompt, from which all standard Windows PE console tools, such as Regedit and Chkdsk, are available

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- Custom OEM support/recovery tool



Startup Repair

Startup Repair is a tool that automates common diagnostic and repair tasks of unbootable Windows Vista installations. If the computer fails over into Windows RE because of a detected boot failure, Startup Repair launches automatically. If automatic failover to an on-disk Windows RE is not available, Startup Repair can also be launched as a manual recovery tool from a Windows RE CD/DVD.

Startup Repair Process

Startup Repair will try to repair computers that are unbootable because of the following reasons:

- Registry corruption
- Missing or damaged system and driver files
- Disk metadata corruption (MBR, partition table, and boot sector)
- File system metadata corruption
- Installation of problematic or incompatible drivers
- Installation of incompatible Windows service packs and patches
- Corrupt boot configuration data
- Bad memory and hard disk hardware (detection only)

Startup Repair will not repair unbootable systems caused by the following issues:

- Malfunctioning firmware and other hardware components

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- Problems with clean Windows installations or Windows upgrades (for example, from Windows XP to Windows Vista)
- Windows logon errors
- Viruses and malicious software

Startup Repair Log

After Startup Repair has run, a text log with diagnostic information and repair results is generated. This log file is located at %WINDIR%\System32\LogFiles\Srt\SrtTrail.txt.

The log file begins with information about the diagnostic and repair session, such as in the following example.

```
Session Summary:  
System Disk = \Device\Harddisk0  
WinDir = C:\windows  
AutoChk Run = 0  
Root causes = 1
```

The following table describes these fields.

Field	Description
System Disk	Device path of the disk on which the Windows installation is located.
WinDir	Full path of the Windows installation to be repaired.
AutoChk Run	A non-zero value indicates that AutoChk was run during Windows PE boot.
Root causes	Number of root causes found during diagnostics.

The next section of the log file contains diagnostic tasks performed. For example,

```
Test Performed:  
-----  
Name: Software installation log diagnosis  
Result: Completed successfully. Error code = 0x0  
Time taken = 125 ms  
  
Test Performed:  
-----  
Name: ACL test  
Result: Completed successfully. Error code = 0x0  
Time taken = 18200 ms
```

The following table describes these fields.

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Field	Description
Name	Name of the diagnostic task performed.
Result	Textual description of whether the test completed successfully.
Error code	Win32 return code of the diagnostic procedure. A value of 0x0 indicates that the specified test ran successfully.
Time taken	The amount of time, in milliseconds, spent on the diagnostic step.

The following table describes the diagnostic tasks performed by Startup Repair.

Diagnostic task	Description
Disk metadata test	Verifies the integrity of the MBR, partition table, and boot sector.
Determine target OS	Extracts the location of the Windows installation from the Boot Configuration Data (BCD).
Registry hives test	Verifies the integrity of the registry hives.
Quick volume metadata test	Verifies that the Windows directory exists.
Event log diagnosis	Checks the Event Log for recent changes to Windows.
Boot status test	Verifies that Windows did not start successfully
Setup state check	Checks whether the failure occurred during Windows installation.
Bugcheck analysis	Analyzes available crash dumps created during the failed startup attempt.
Software installation log diagnosis	Checks whether Windows updates have recently been installed.
Disk failure diagnosis	Checks the Self-Monitoring, Analysis, and Reporting Technology (SMART) status on the hard disk hardware.
Chkdsk	Runs Chkdsk to identify file system metadata problems.
Binary file integrity test	Verifies the integrity of system files required for startup.
ACL test	Verifies that system files required for boot have the correct access control list (ACL).

Root Causes

When the root cause of the startup failure is found, the details and resulting actions are included in the log file. For example,

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Root cause found:

ACLs on file C:\windows\system32\user32.dll are not proper. Old value = 0xd015f

Repair action: ACLs fix

Result: Completed successfully. Error code = 0x0

The following table describes these fields.

Field	Description
Root cause found	Textual description of the problem.
Repair action	Name of the repair action taken.
Result	Textual description of the repair action's success or failure.
Error code	Win32 return code of the repair procedure. A value of 0x0 indicates that the specified repair completed successfully.

The following table lists the possible root causes for startup failures.

Root Cause	Description
Boot manager failed to find OS loader.	Winload.exe is missing or cannot be accessed.
Boot configuration is corrupt.	The boot configuration file is missing or it contains no valid operating system entry.
Boot critical file <filename> is missing.	The specified file required for startup is missing.
Boot critical file <filename> is corrupt.	The specified file required for startup is corrupt.
Several boot critical files are corrupt.	Multiple files required for startup are corrupt.
Registry is corrupt.	A registry hive fails to load.
Unknown bugcheck <code>. Parameters = <param1>, <param2>, <param3>, <param4>.	The system crashed during startup with the specified bugcheck error.
Driver <drivename> is preventing the system from starting.	The specified driver is missing or corrupt.
A recent driver installation or upgrade may be preventing the system from starting.	An incompatible driver was installed prior to the startup failure.

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A patch is preventing the system from starting.	An update to the operating system was installed prior to the startup failure.
ACLs on file <filename> are not proper. Old value = <value>	The specified file cannot be accessed due to an incorrect ACL.
The partition table does not have a valid System Partition.	The system partition listed in the partition table does not contain the required system files.
MBR is corrupt.	The MBR on the system disk is corrupt.
Partition table is corrupt on disk <drivenumber>.	The partition table on the specified disk does not contain any valid entries.
Boot sector for system disk partition is corrupt.	The boot sector information is not valid.
Boot sector code for system disk partition is corrupt.	The boot sector code does not match the default boot sector.
System volume on disk is corrupt.	The system volume cannot be accessed.
No OS files found on disk.	The Windows directory does not contain a valid Windows installation.
Boot manager is missing.	The boot manager cannot be found on the system partition.
A hard disk could not be found. If a hard disk is installed, it is not responding.	Cannot detect any installed hard disk. This is only available when running Windows RE from CD/DVD.
Security settings on this computer are preventing Windows from starting.	Windows is unable to audit the system.
System partition has an unknown file system type.	The system partition is formatted using a file system type that Windows does not recognize.
Boot status indicates that the OS booted successfully.	Windows started successfully. This is a common scenario if a user manually launches Windows RE and runs Startup Repair.
Failure while setup is in progress.	The computer does not start due to a failed Windows installation process.
The operating system version is incompatible with Startup Repair.	The version of Windows does not match that of Startup Repair. For example, trying to repair Windows XP using Startup Repair will trigger this root cause.

Repair Actions

The following table describes possible repair actions.

Repair action	Description
BCDMD	Repairs the MBR, partition table, or boot sector.

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Chkdsk	Runs Chkdsk in repair mode.
File Repair	Replaces the corrupt system file with a backup copy.
BootCfg	Reconstructs the BCD.
System Restore	Rolls back the system state by using System Restore.
ACLs fix	Sets the ACLs of the specified file to a default value.
Registry rollback	Replaces the corrupt registry hives with a backup copy.
Change Crash on Audit Failure setting	Disables Windows auditing. Only an administrator can log on to Windows.
Memory Diagnostics	Runs the Windows Memory Diagnostics tool.

The following table describes the descriptions of the possible diagnostic or repair results.

Result text	Description
Completed successfully. Error code = 0x0	Diagnostic and repair processes finished without error.
Failed. Error code = <errorcode>	Diagnostic and repair processes failed with the specified error.
Started but not completed	Either the diagnostic process or the repair process was cancelled by the user.

Customizing the Windows RE Experience

You can customize the user experience of Windows RE by creating an .xml file called WinREConfig.xml, which enables you to define custom support and diagnostic tools within Windows RE.

To customize the Windows RE experience

1. Create a tools subdirectory in your working Windows RE directory. For example,

```
\Sources\Recovery\Tools
```

2. Create an .xml file called WinREConfig.xml, with the following syntax.

```
<Recovery>
<Server/>
<RecoveryTools>
<RelativeFilePath> Tools.exe</RelativeFilePath>
</RecoveryTools>
<SupportTool AutoLaunch="Yes"/"No">
<RelativeFilePath> Tools.exe</RelativeFilePath>
</SupportTool>
<CustomFrontEnd>
```

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```

<RelativeFilePath> Tools.exe</RelativeFilePath>
</CustomFrontEnd>
<AlwaysAuthenticate/>
<NonAdminToolsOnly/>
<StartupRepair>
<NoNetworking/>
<NoAutoLaunchFromCD/>
</StartupRepair>
</Recovery>

```

3. Choose the customizations that you intend to enable and include the corresponding elements in your WinREConfig.xml file. The following table describes these XML elements.

Element	Description
Server	Sets Windows RE to run in server mode. When specified, client-specific Windows RE options are not displayed. This setting is required when installing Windows RE on a server system.
RecoveryTools	Link to the customized recovery application to be included in the System Recovery Options menu. Only one application can be specified. The icon shown is extracted from the first available icon in the application executable. The title and the description of the link are extracted from the "Product name" and "File description" attributes of the application executable file.
SupportTool	Denotes customized support or the diagnostic tool that can be launched from a link when Startup Repair is unable to repair the operating system. Only one tool can be specified.
AutoLaunch	Automatically launches the tool specified in SupportTool when the value is set equal to Yes . This setting does not apply to cases when no startup failure is detected or a hardware error is detected.
CustomFrontEnd	Specifies an application to be launched instead of the Windows RE default user interface (UI) unless one of the following is true. Windows RE is launched: <ul style="list-style-type: none"> ▪ From CD/DVD. ▪ Automatically. ▪ From the F8 menu. <p>This application must set the registry value HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\RecoveryEnvironment\Target OS to the path of the Windows directory of Windows Vista.</p> <p>This XML element is optional.</p>
RelativeFilePath	The relative path from the \Tools subfolder of the folder in which Recenv.exe resides. For example, if Recenv.exe is located in X:\WinRE\, the path designated in this field is relative to X:\WinRE\tools.
AlwaysAuthenticate	Authentication is enforced, regardless of the start location of Windows RE, including media. If the username/password database on the offline Windows operating system is corrupt or otherwise inaccessible, users will not be able to access the

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	recovery tools in Windows RE.
NonAdminToolsOnly	Only Startup Repair and the application specified in <RecoveryTools> (if present) is accessible through the Recovery menu. All other options are hidden.
StartupRepair	Contains a list of Startup Repair-specific settings.
NoNetworking	Disables the sending of diagnostic and repair data to Microsoft. Startup Repair will not turn on networking after a failed repair attempt.
NoAutoLaunchFromCD	Prevents Windows RE from launching Startup Repair automatically when it is booted from optical media and a boot failure in the offline operating system has been detected.

4. Save the file in your working Windows RE directory under \Sources\Recovery\Tools.

Windows RE Scripts

The Windows OPK and the Windows AIK include the following scripts and support files to help you build a Windows RE solution. All scripts are installed by default to the following location.

C:\Program Files\<version>\Recovery

Where <version> can be Windows OPK or Windows AIK.

The following table describes each script.

Filename	Description
Buildwinre.cmd	Sample script to create a Windows RE image from a given Windows PE image.
Configdiskwinre.cmd	Sample script to create Windows RE disk configuration.
Diskconfig-gpt.txt	Diskpart script to configure a GPT Partition. This file is used by Configdiskwinre.cmd.
Diskconfig-mbr.txt	Diskpart script to configure a MBR Partition. This file is used by Configdiskwinre.cmd.
Installwinre.cmd	Sample script to install Windows RE to a target path. This script requires ImageX.
Setautofailover.cmd	Sample script to configure the Boot Configuration Data (BCD) of Windows Vista and Windows RE to set automatic failover.