

User's Guide



PartitionExpert 2003

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Introduction

What is Acronis PartitionExpert

Acronis PartitionExpert is a hard disk **partition manager**, enabling you to:

- Create hard disk partitions,
- Resize and move them without data loss and destruction,
- Convert partitions to other file systems without data loss,
- Copy (move) partition contents,
- Delete partitions,
- Format, label, assign letters, hide and unhide partitions, set active partitions and perform rarely used operations.



Some terms of this Guide might seem unfamiliar. Appendix A «Hard Disk And Operating System» and Appendix B «Glossary» provide descriptions of some hard disk data storage components and used terms.

The purpose of Acronis PartitionExpert

Current hard disks feature 100 GB and higher capacity. To better organize application files, images, video files, etc. – it makes sense to keep them on separate partitions.

Disk space should be **controlled**. Acronis PartitionExpert enables you to re-configure hard disk partitions any time to **use the disk space most efficiently**.

By partitioning your hard disk, you get the following **advantages**:

1. More effective hard disk space usage.

The cluster is a minimal data storage unit in Windows FAT16, FAT32 and NTFS file systems. High-capacity disks usually feature 32 KB clusters. Keeping numerous small files on a disk, wastes much of the disk space. Having partitioned it, you can significantly reduce space losses. (For details see A.9.2 «FAT16» — Table 3.)

2. Different partitions for operating system(s), applications and data.

If the system partition (where the OS is installed) is destroyed by a virus, for example, it will not affect your data partitions.

3. The opportunity to install several operating systems on different partitions.

Installing several operating systems enables you to master new OS versions, or work with older, but useful applications.

4. Simpler and faster disk maintenance. Bad sector and OS error check, defragmentation of a 6–8 GB partition is significantly faster than that of 100 GB hard disk.

Guide contents or how to find the information you need

Acronis PartitionExpert User's Guide contains:

- Chapter 1 «Installation And Running» — general information about software installation, running, error recovery, removal, and user interface essentials.
- Chapter 2 «Beginning The Work» — information about the main window of Acronis PartitionExpert, logical software organization, main features, methods of calling and executing partition operations.
- Chapter 3 «Automatic Partition Operations» — **beginner** information about disk partition operations, performed through Wizards.
- Chapter 4 «Manual Partition» — **experienced user** information about manually performed disk partition operations.
- Appendix A «Hard Disk And Operating System» — supplemental information about hard disks, partitions, and file systems.
- Appendix B «Glossary» — technical term glossary to help you understand this Guide.

Software use conditions

The conditions of Acronis PartitionExpert use are listed in the supplied «License Agreement». To be able to prove that you legally purchased and use Acronis PartitionExpert, you receive a registration card along with the package. Each registration card also has its own unique number.

Based on current legislation the «License Agreement» is considered as a contract between user and software vendor. The contract has the legal effect; its violation may lead to a trial.

Illegal use or distribution of software is a violation of the law and will be prosecuted.

Technical support

Users that have legally purchased and registered their copy of Acronis PartitionExpert receive free technical support from Acronis. If you have problems installing or using the system that you cannot be resolve with the help of this Guide and `readme` file, please e-mail technical support. You will also need to provide the registration number of your Acronis PartitionExpert copy supplied with this package.

Support URL: <http://www.acronis.com/support/>

E-mail: support@acronis.com

Chapter 1. Installation And Running

1.1 What's Included

Acronis PartitionExpert package includes:

- Installation CD-ROM,
- This Guide,
- License Agreement,
- Registration card,
- Advertising information.

1.2 System Requirements

To take full advantage of Acronis PartitionExpert you should have:

- A PC-compatible computer with a Pentium CPU or similar,
- 32 MB RAM,
- A floppy or a CD-RW drive,
- VGA monitor,
- A mouse (recommended).

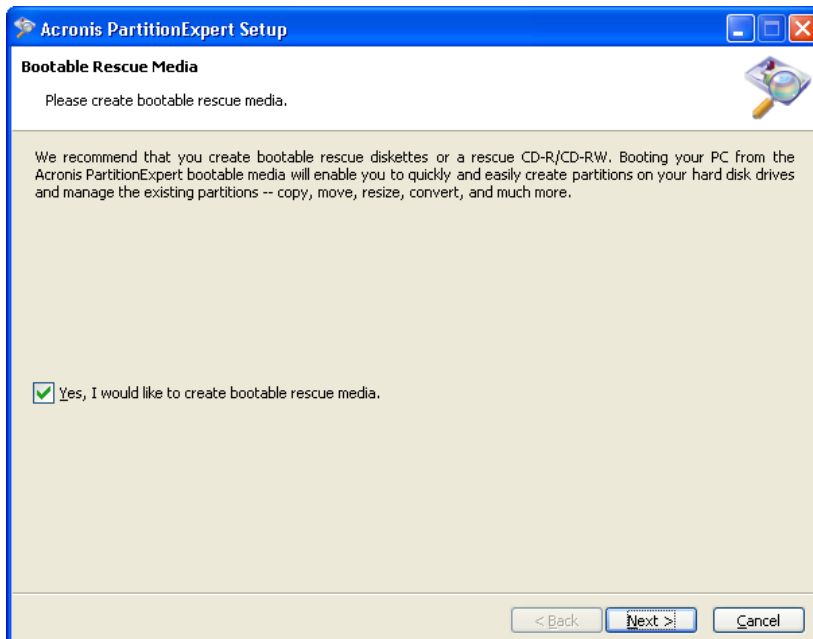
1.3 Installation Process

To install Acronis PartitionExpert:

1. Insert the CD into the CD-ROM drive and run the installer.
2. Thoroughly follow all instructions.
3. Having answered all installer questions, Acronis PartitionExpert files will be copied to the hard disk, and you'll be prompted to create Acronis PartitionExpert **bootable diskettes or a CD** (pass this step if you purchased PartitionExpert on a bootable CD).

You might have to run the software from bootable diskettes or CD in two situations:

- (1) After a serious Windows failure, forcing you to reinstall it and re-configure partitions,
- (2) For working with Acronis PartitionExpert on a non-Windows, for example Linux-based, PC.



Having installed Acronis PartitionExpert, reboot your PC.

1.4 Upgrading Acronis PartitionExpert

If Acronis PartitionExpert was damaged during installation or execution, run its installation program again. The software will determine that Acronis PartitionExpert has already been installed to your PC and ask if you want to recover (update) or completely remove it from the disk.

In the installation wizard window select **Recover/Update Acronis PartitionExpert** and click . All Acronis PartitionExpert files will be copied to your hard disk again to restore the software.



Software upgrades (with certain bug fixes) may be downloaded freely from Acronis website: <http://www.acronis.com/support/updates/>.

1.5 Removing Software

To remove the software select **Acronis → PartitionExpert → Remove Acronis PartitionExpert** from the Programs menu. You will see the dialog box to confirm removal of the software from your PC hard disk.

To confirm removal click . Acronis PartitionExpert will be completely removed from the PC hard disk.

1.6 User Interface

Acronis PartitionExpert software is installed in OS Windows, has graphical user interface and is controlled by the mouse or by `Tab`, `Shift+Tab`, `Left`, `Right`, `Up`, `Down`, `Space`, `Enter` and `Escape` keys.



If you regularly work with Windows or X Window applications, you should not encounter any problems with the Acronis PartitionExpert interface.

While working with Acronis PartitionExpert software, a user deals with a sequence of **dialogs**, in which he/she selects one further action, of several possible, by setting switches to the necessary position or choosing a value from a list, or marking the necessary partitions or disks for work.

1.7 Before You Run Acronis PartitionExpert

PLEASE NOTE: Operations on system, application or data partitions must be done very carefully to avoid potential hard disk booting or data storage problems.



Acronis PartitionExpert is thoroughly tested for working with numerous hard disks, so any potential problems are not caused by the software, but only from improper use.

A power loss, PC power cut, or pressed **Reset** might result in partition damage and data loss.

Please take all necessary precautions and following these **simple rules**:

1. Create a full backup of the disk that partitions are to be reconfigured. It will assure you that your data will not be lost under any circumstances.

Almost all current PCs feature CD-R/W drives. Having a hard disk or the most important data CD backup will enable you to work on partitions with full confidence.



Acronis offers extremely effective hard disk and partition backup software — Acronis **TrueImage** (visit <http://www.acronis.com/products/trueimage/>). Acronis TrueImage creates a hard disk and partition backup, stored in a compressed archive file, whose contents can be restored any time.

2. Test your disk to make sure it's fully functional and does not contain bad sectors or file system errors.



You can invoke system hard disk checking tools directly from Acronis PartitionExpert by selecting **Disk → Check** or clicking **Check the selected partition for errors** toolbar button.

3. Do not perform any partition operations while running other software that has low-level disk access, for example anti-virus or backup tools. Close such programs before running Acronis PartitionExpert.

Following these simple rules, you will protect yourself against data loss.

1.8 Running Acronis PartitionExpert

Running under Windows

Under Windows Acronis PartitionExpert can be run by selecting **Start → Programs → Acronis → PartitionExpert → Acronis PartitionExpert**.



Having been run under Windows, Acronis PartitionExpert can perform operations on any partitions, including primary, logical, system, or data without rebooting your PC.

Running Acronis PartitionExpert for the first time

Having run Acronis PartitionExpert for the first time, you will be prompted to choose if you want to work in the **Automatic Mode** or in the **Manual Mode**.

Automatic Mode provides enough functionality to create almost any partition configuration on your PC hard disks.

If you need a detailed partition structure representation with a complete set of partition operations and controls, choose the **Manual Mode**.

Working with Acronis PartitionExpert, you can switch between modes any time (see 2.1.3 «Switching modes»).

Running from bootable diskettes or CD

Previously we have explained how to create bootable diskettes or a CD (see 1.3 «Installation Process» #3.). While working with Acronis PartitionExpert you may need to use the disks/disc: (1) after a serious Windows failure or (2) to work on a Linux-based PC.

Your PC BIOS must be set correctly to boot and run the software from bootable diskettes or CD.



Bootable diskettes or CD can be created during Acronis PartitionExpert installation (see 1.3 «Installation Process»). If you need to do this after installation, select **Start → Program → Acronis → PartitionExpert → Bootable Rescue Media Builder**. If you purchased Acronis PartitionExpert on a CD-ROM, you do not have to create bootable media, as the CD-ROM itself is bootable.

Chapter 2. Beginning The Work

2.1 Acronis PartitionExpert Logical Organization

Acronis PartitionExpert provides **two operation modes** (see 1.8 «Running Acronis PartitionExpert» — «Running Acronis PartitionExpert»):

- **«Automatic partition operations»** mode is designed for **the most frequent operations** suitable for most users.
- **«Manual partition operations»** mode for **any partition operations**. This mode is intended for experienced users with some knowledge of disk data storage organization and provides full operation control.

2.1.1 Automatic partition operations

In the «Automatic partition operations» mode all actions are performed through Acronis PartitionExpert wizards. There are three of them available:

- **Create partition wizard** — enables you to create a partition of unallocated disk space or other partitions;
- **Increase free space wizard** — enables you to enlarge a partition at the expense of unallocated disk space or other partitions;
- **Copy partition wizard** — enables you to copy a partition.

Through these wizards even an inexperienced user will be able to perform step-by-step operations in this mode.

2.1.2 Manual partition operations

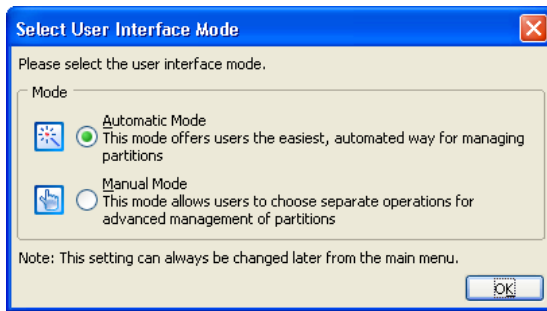
In the «Manual partition operations» mode experienced users have access to all Acronis PartitionExpert features.

Partition operations are performed through entering necessary parameters into dialog boxes.

The main difference between the automatic and manual modes is that wizards perform **operation series** in the former case, and **only single** disk/partition operation in the latter.

2.1.3 Switching modes

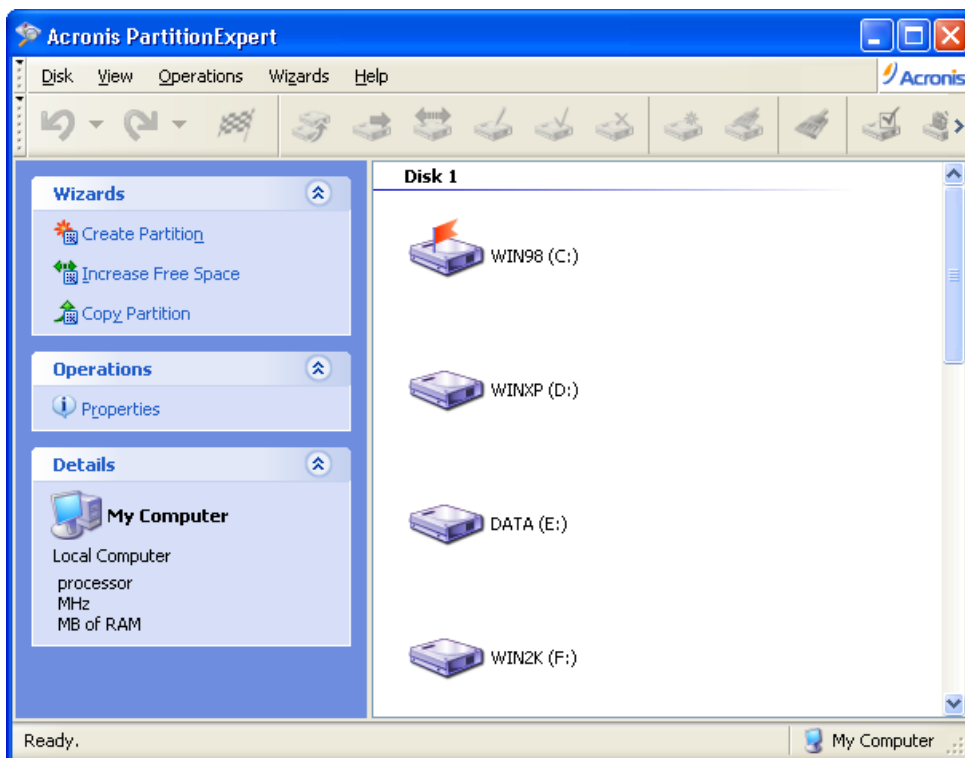
Having selected Acronis PartitionExpert operation mode during the installation (see 1.3 «Installation Process» #3.), you can switch to another mode any time. Select **View → Automatic Mode** for the automatic mode or **View → Manual Mode** for the manual.



2.2 Acronis PartitionExpert Main Window

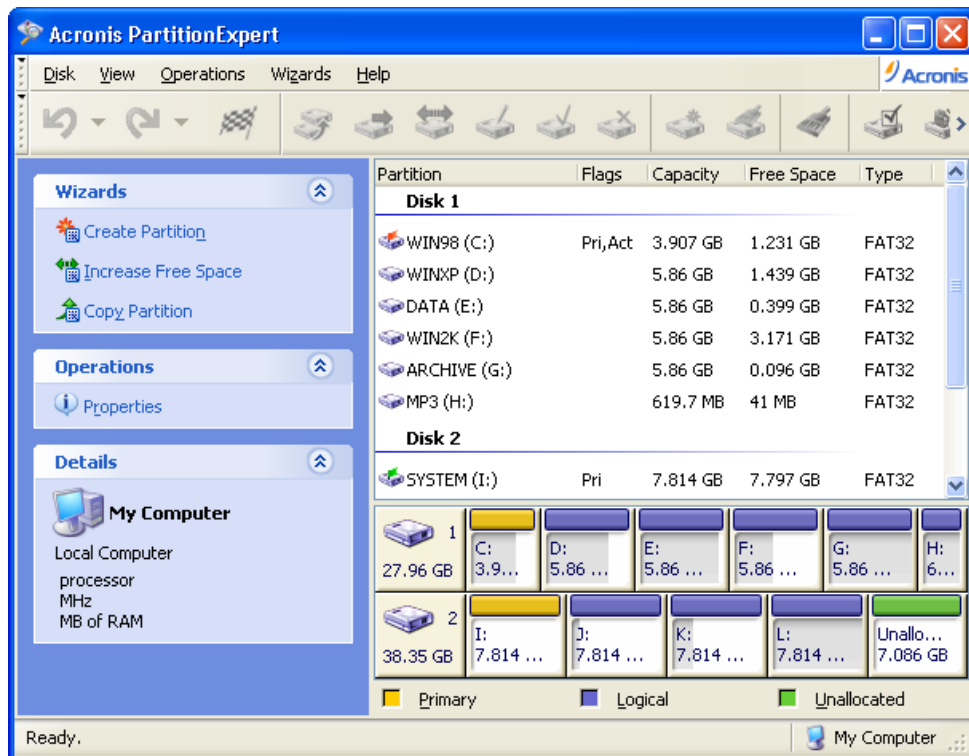
Acronis PartitionExpert is controlled through the main window. It includes the menu, toolbar, disk and partition tree (shown/hidden through the **View** menu), and represents the computer **disk and partition list**.

The main window appearance differs depending on the selected operation mode (see 2.1 «Acronis PartitionExpert Logical Organization»). The difference applies to the available operation list in the main menu, partition context menus, side- and toolbar, and the amount of partition structure details represented.



Acronis PartitionExpert main window, Automatic Mode

In the manual partition operations mode the main window also includes all unallocated disk space, while only partitions are shown in the automatic mode. Partition creation, free space, and copy wizards **automatically** recognize unallocated disk space.



Acronis PartitionExpert main window, Manual Mode

2.2.1 Disk and partition information

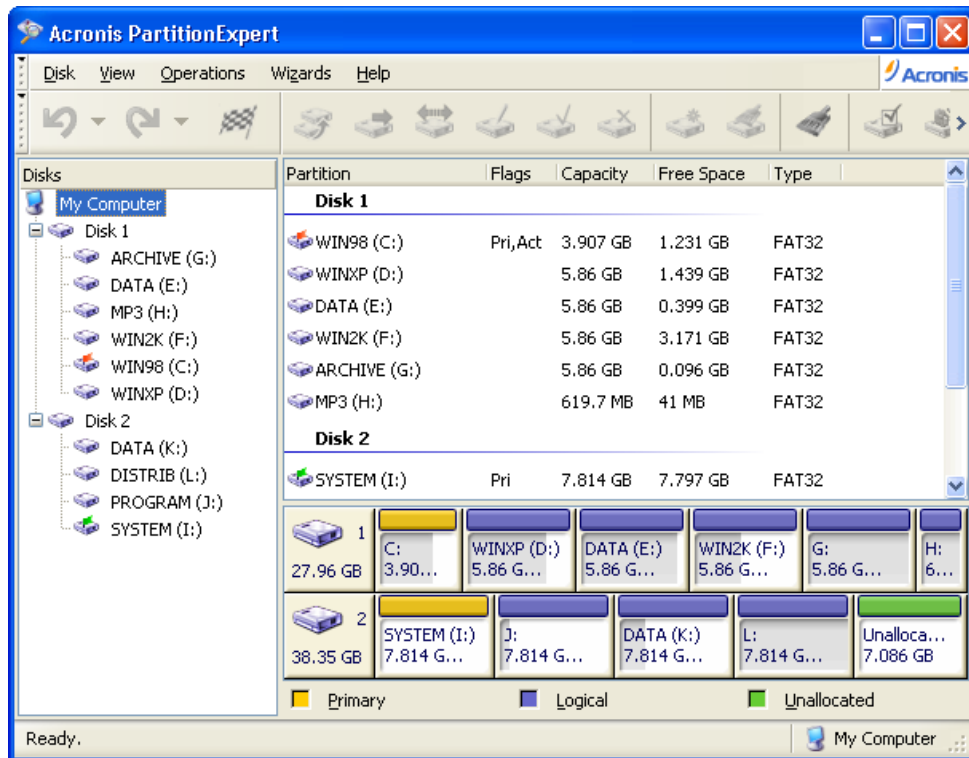
The main window shows the partition's disk number, assigned letter, label, type, status, size, free space size, and file system.

Disk and partition information is also provided in the partition and disk tree.

The bottom part of the main window **graphically** indicates the selected disk and its partitions as rectangles with basic data on them (label, letter, size, type, file system).

2.2.2 Customizing the main window appearance

You can customize the main window appearance as you would like using the **View** menu — in particular to show or hide window elements like sidebar, partition and disk tree, toolbars, etc.



The partition and disk tree in the main window

2.3 Calling Partition Operations

All partition operations in both modes are called and executed similarly.

2.3.1 Calling the main operations

Any partition operations can be called:

- By selecting from the **Disk** submenu,
- From customizable toolbars,
- From partition context menu (both in the main window, and the graphical panel),
- From **Operations** and **Advanced** sidebar lists.



Note that the list of **available** operations in the **Disk** submenu and the **Operations** sidebar list depend on the selected partition type. This holds true for unallocated space as well.

2.3.2 Additional operations

Additional hard disk partition operations are:

- **Convert** — convert FAT16 partition file system to FAT32, Ext2 to Ext3, and vice versa,
- **Hide/Unhide** — hide/unhide a partition,
- **Set Active** — set active partition,
- **Resize Root** — resize FAT16 partition root,
- **Change Bytes per INODE** — resize INODE table (Linux Ext2/Ext3),
- **Change Cluster Size** — change FAT16/FAT32 partition cluster size,
- **Change Type** — change partition type.

Additional partition operations are called from the **Advanced** sidebar list, same partition context menu item or toolbar button.



Note that the additional operations list of the partition context menu or toolbar depends on the selection of a partition type. For example, the FAT16 partition menu contains **Advanced** → **Resize Root**; this is absent in the FAT32 partition menu. Unlike FAT16, Linux Ext2/Ext3 partition context menu contains **Advanced** → **Change Bytes per INODE**.

2.3.3 Invoking Acronis PartitionExpert wizards

Acronis PartitionExpert wizards are invoked from the **Wizards** submenu and the same sidebar list. For example, select **Wizards** → **Create Partition** for the partition creation wizard.

2.4 Partition Operation Properties

2.4.1 Displaying operation results

Results of performing any disk partition operation are immediately displayed in Acronis PartitionExpert main window.

If you create a new partition, it will be immediately shown in the hard disk partition list in the main window, as well as in the graphical form on the bottom of the main windows.

Any existing partition changes, including resizing, relocating, labeling, etc., are also immediately displayed in the main window.

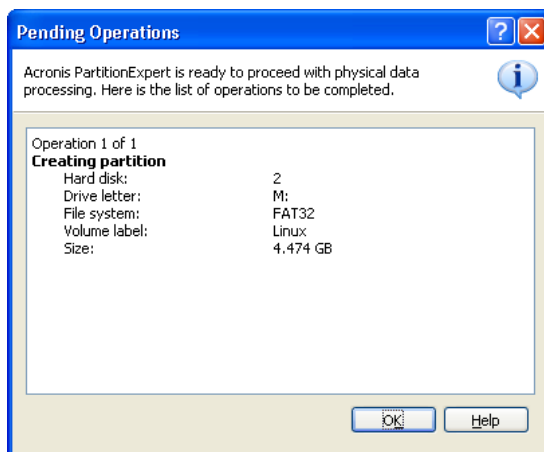
2.4.2 Pending operations

All Acronis PartitionExpert operations are **pending**, that is they are performed later, when you are completely sure they are necessary. Until then Acronis PartitionExpert will only show the new partition structure that is provided by operations to be performed.

Therefore, you can view the graphical representation of the new partition structure first, and then decide to perform or cancel chosen operations.

2.4.3 Viewing delayed operations

All Acronis PartitionExpert pending operations are added to the pending operations list. You can view it in the **Pending Operations** window, by clicking **Operations → Show:**




Pending operations list

This organization enables you to control all planned operations, double check your intended work, and undo them fully or partially if needed.

2.4.4 Performing pending operations

To actually perform planned hard disk operations, one has to do one of the following:

- Select **Operations → Commit** in the main menu,
- Click  **Commit Pending Operations** toolbar button.

This performs **all pending operations**. You will not be able to undo any actions or operations after you commit the operation.

2.4.5 Modifying pending operations

All your actions result in the creation of pending operations. For example, you can create a new partition, provided its type, file system, size, loca-

tion, and label. You can easily view the Acronis PartitionExpert pending operation for the partition you are working on (see 2.4.3 «Viewing delayed operations»).

You can always change any operation parameter, including type, files system, size, location, etc. before performing the operation. Using **Change type**, **Convert**, **Move**, **Resize**, etc. operations, you will also see that your actions do not result in creating new pending operations, as you might have expected. These actions will only change the existing pending operation parameters.

If you decide to change the label of **another** (existing) partition, Acronis PartitionExpert will immediately create a **new** pending operation. So, the same actions sometimes result in the creation of a new pending operation, or modification of existing operations.

2.4.6 Undoing user actions


Calling wizards or dialog boxes for planning disk partition operations are **user actions**. User entries are necessary operation parameters on the wizard or dialog box pages.

One user action in Acronis PartitionExpert enables you to plan a whole list of partition operations. For example, **calling a wizard** for partition creation or resizing. (You can easily verify your actions by looking at the **Pending Operations when** the wizard finishes its work.)


You can also create a partition by selecting **Disk → Create Partition**, that requires a list of actions to be performed (enter a label, select partition type, file system, size, and location), resulting in the creation of a single partition create operation only.

The difference between user actions and partition operations should be kept in mind, if you wish to **undo user actions**.

Any user action in Acronis PartitionExpert can be undone or redone before committing the operation. To undo a user action:

- Select **Operations → Undo** from the main menu (or press **Ctrl+Z**),
- Click  **Undo Last Action** toolbar button.

To redo a user action:

- Select **Operations → Redo** from the main menu (or press **Ctrl+Y**),
- Click  **Redo Last Action** toolbar button.

As user actions result in pending partition operations, as mentioned above, undoing them results in canceling one or several partition operations.

And vice versa, redoing a user action results in the addition of one or several pending operations.

Depending on your situation, undoing an action may cancel a pending operation or undo changes of an existing operation (see 2.4.5 «Modifying pending operations»).

Similar, redoing an action might add a pending operation to the list again or redo a change of a pending operation parameter.



You can undo user actions **one at a time or all at once** by selecting **Operations → Undo All**. Similarly, you can redo user actions (along with the corresponding graphical representation of partition reconfiguration) one-by-one or all at once by selecting **Operations → Redo All**.

2.4.7 Wizard operations

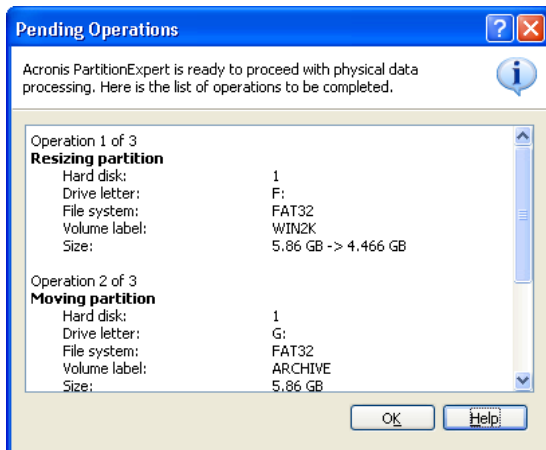
Pending partition operations, created by Acronis PartitionExpert wizards, differ in that a user must provide a list of operation **parameters** to perform it. Each parameter is entered on a separate wizard page.

Entering operation parameters, you change wizard pages using **Back** and **Next** buttons until you reach the **Preview** page with the **Finish** button.


In the **Preview** wizard page you can click **Back** to return and change any operation parameters.

After clicking **Finish** on the last wizard page:

- New partition structure is graphically represented in Acronis PartitionExpert main window,
- Wizard creates a list of pending operations; you can see it by selecting **Operations → Show**.



Remember that **no** actions are performed on your disks when the wizard finishes working! If you are sure that the new structure is suitable, select **Operations** → **Commit** or click **Commit Pending operations**, wizard-created pending operations will then be **actually** performed.

Before you select **Operations** → **Commit** or click **Commit Pending operations**, you can undo your actions (calling a wizard) and wizard-created pending operations in the usual way (selecting **Operations** → **Undo** or pressing **Ctrl+Z**) or clicking  **Undo Last Action**.



Acronis PartitionExpert shows the wizard and its results as a user action by creating **the list of operations**. Any pending actions can be **fully** undone by any of mentioned methods, i.e. pressing **Undo Last Action** will undo a user action and **all operations**, planned by the wizard.

2.5 Protecting Acronis PartitionExpert With A Password

When using Acronis PartitionExpert on a PC you should always be aware of possible unauthorized access to your data. To protect your hard disk, partition, applications and data, Acronis PartitionExpert provides password protection.

If you need to protect Acronis PartitionExpert with a password

1. Select **Disk → Set Password**,
2. Enter a password in the **New Password** and **Confirm New Password** fields in the **Set Password** window,



3. Click **OK** to enable password protection.

After you run the program, you'll be prompted to enter a password in the **Password Protected** window:



If you enter a wrong password, you'll be asked to re-enter it. Clicking **Cancel** will close the program.

If you need to change password:

1. Select **Disk → Set Password**,
2. Enter the old password in the Old Password field and the new password in the **New Password** and **Confirm New Password** fields in the **Set Password** window,
3. Click **OK** to enable password protection.



Please Note: If you protected Acronis PartitionExpert with a password and forgot it, you will have to uninstall PartitionExpert by selecting **Programs → Acronis → PartitionExpert → Uninstall Acronis PartitionExpert**, and install it again!

Chapter 3. Automatic Partition Operations

In the «Automatic partition operations» mode Acronis PartitionExpert enables you to perform the following typical partition operations:

- Create a new partition,
- Increase partition free space,
- Copy a partition.

These operations are performed with wizards, enabling to enter operation parameters step-by-step and return to any step as needed. Each parameter is provided with detailed instructions.


3.1 Creating A New Partition

You might need a new hard disk partition to:

- Store several **same-type files** — for example, MP3 collection, video files, etc. on a partition;
- Store **backups** (images) of other partitions/disks on a partition;
- Install a new **operating system** (or swap file) on a partition.

Create partition wizard lets you create a partition of any type (**Active, Primary** or **Logical**), select a file system, label, assign a letter, etc.

If you need to create a new partition:

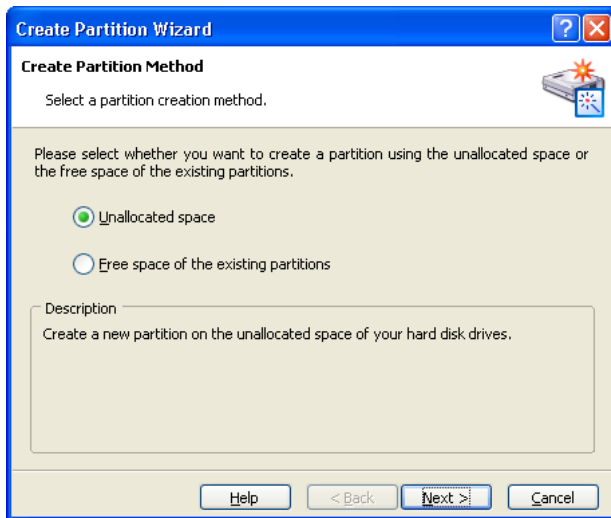
1. Run the create partition wizard by selecting **Wizards** → **Create partition** or similar **Wizards** list item on the sidebar, or by clicking  **Create a new partition** on the toolbar.
2. The wizard will analyze computer disks and partitions. **If the wizard finds unallocated space**, you will see the **Action Selection** wizard page.

It will ask you to select how to create a new partition:

- (1) using disk **unallocated space**,
- (2) using existing partitions **free space**.



Unallocated space is the space not used by any existing partitions. In contrast to this, partition free space is the space free from any data.



Partition creation method selection window

The partition creation wizard provides the following operations:


3. If you want to create a partition using unallocated disk space:

3.1 Set the switch to **Unallocated space**.

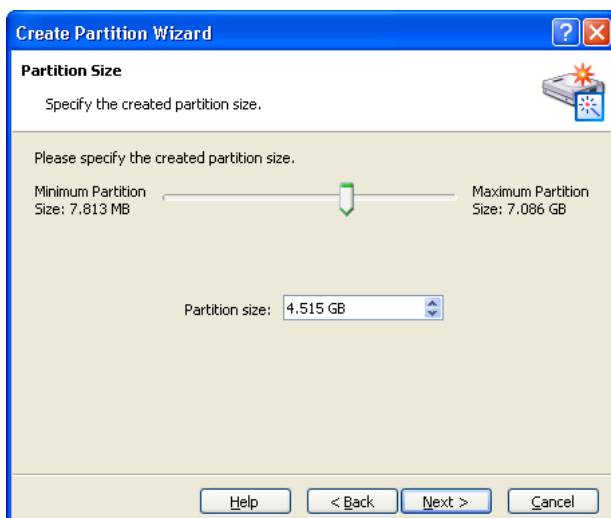
3.2 The wizard will offer to create a partition on the **largest** unallocated area.

For example, if you have 5.0 GB and 12.0 GB unallocated areas, the wizard will offer to create a partition on 12.0 GB area.



If you want to create a partition on 5.0 GB unallocated space, you will have to reject wizard's offer and simply select this area and click  **Create a new partition**. You can do this in the «Manual partition operations» mode.

On the **Partition Size** wizard page set the partition size.



New partition size window

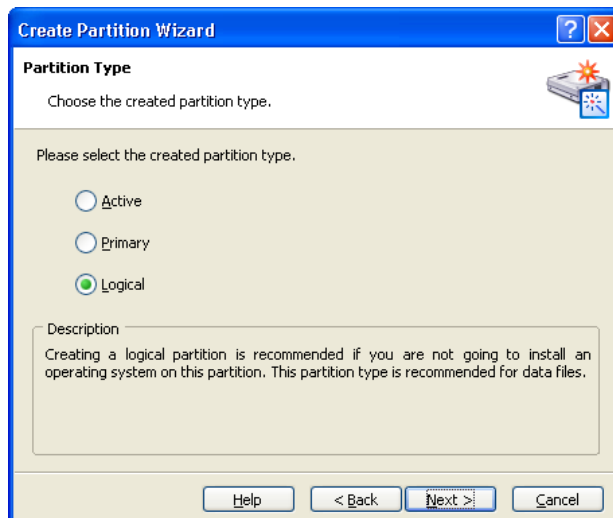
- 3.3 On the next wizard page select partition type — **Active** (Active Primary), **Primary** or **Logical**.

Typically **Primary** is selected to install an operating system to a partition. If the partition is for data storage, select **Logical**.

Select **Active**, if you want to install an operating system on this partition to boot at startup.



Note that if you enter over 2 GB size, you will not be able to use the FAT16 file system on this partition. It will be disabled in the **File System** wizard page.



Partition type selection window

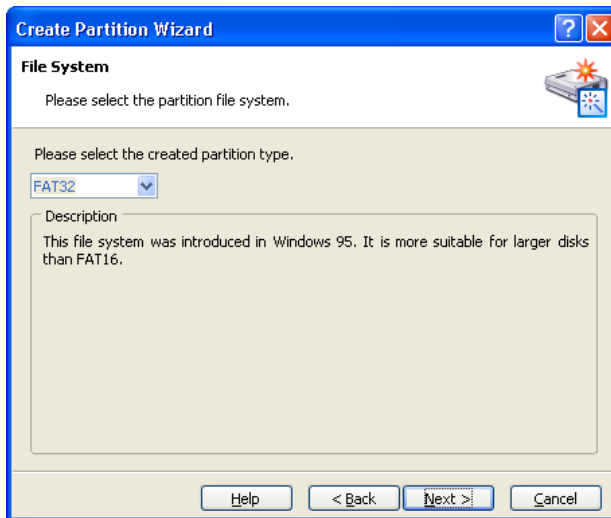


A hard disk can contain up to 4 primary partitions. If they already exist, Active and Primary options will be disabled, and you will be able to select only Logical partition type.

- 3.4 On the next **File System** wizard page select a file system. The wizard will offer you one of Windows file systems — **FAT16**, **FAT32**, **NTFS**, or **Linux** file systems — **EXT2**, **EXT3**, **ReiserFS**, **Swap**, or to leave the partition **Unformatted**.



More details about the properties of main file systems, the operating systems, and disks are provided in the A.9 «File System Main Specifications» appendix.

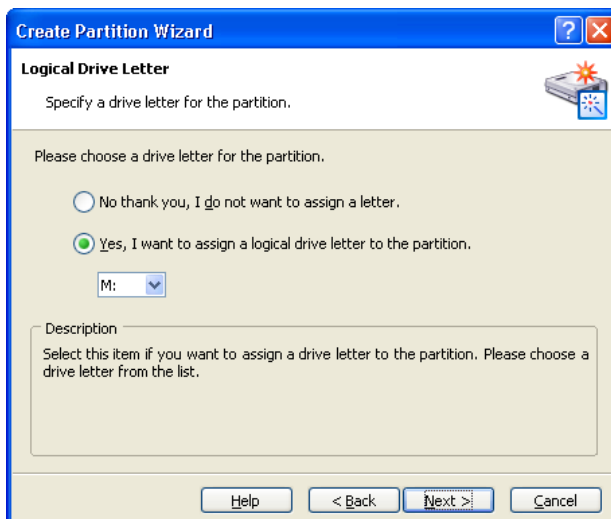


Partition file system selection window



Selecting a partition file system results in partition formatting, i.e. creating partition **data storage structures** – boot record, file allocation table, etc.

3.5 On the next wizard page, you will be asked to select a partition letter.



Partition Logical Drive Letter selection window

At startup, an operating system assigns letters (C:, D:,...) to partitions. These letters are used by applications and the operating system to locate files on partitions. For example, C:\Program Files\Acronis\Partition Expert\PartitionExpert.exe. See also Appendix B «Glossary» — «Letter (of a drive, partition)».



Hard disk partitions are not only assigned letters, but are also enumerated. That means some operating systems partitions are assigned letters and numbers, in others – only numbers.

Create, delete, move partition operations, as well as hiding/unhiding a partition and direct letter change may result in problems running applications, opening files (as some shortcuts become unusable) or booting an operating system.

Therefore performing partition operations, you must be careful and remember that each operating system works differently with partition letters. Each OS has its own partition letter assignment rules.

Windows 95/95OSR2/98/Me

Windows 95 (original) assigns partition letters **automatically** in the fixed order, according to these rules:

- **Partition** letters start from C: and continue until Z:. C: partition is considered system, i.e. used for OS startup.



Note that this OS cannot recognize all partitions, but only 1 (FAT12), 4, 6 (FAT16) **types**. File system type is determined not by partition type, but by its contents. Partitions of other types are passed (no letters are assigned to them).

- The first **primary active** partition found on the 1st hard disk is assigned C:. If there's no such partition, C: is assigned to the first suitable primary partition.
- Similar and consecutively, one of **primary** partitions from other hard disks are considered. They are assigned D:, E:, etc. (If there is no suitable partition found on the first disk, then C:, D:, etc. are assigned.)
- Next, all suitable **logical** partitions are considered in the sequence order on the first, second, third, etc. hard disks. They are assigned E:, F:, G:, etc., for example.
- Finally, in order letters are assigned to **all remaining** suitable **primary partitions** of the first, second, third, etc. disks.

Windows 95OSR2/98/ME partition letter assignment order is almost the same as in original Windows 95, with the following exceptions:

- Additional **type** 11 (FAT32), 12 (FAT32 LBA) and 13 (FAT16 LBA) partitions are considered. This is tied to FAT32 and high-capacity hard disk support.

Partition operations in the mentioned operating systems may result in problems running applications, opening files, etc., if letter assignment change.

Windows NT/2000/XP

Windows NT/2000/XP operating systems **initial letter assignment** is done **automatically**: in Windows NT 3.x it's similar to Windows 95, and in Windows NT 4.0, and Windows 2000/XP — similar to Windows 95OSR/98. Windows NT 4.0 does not support FAT32, but assigns letters to such partitions.



Please note that letter order in these operating systems can differ depending on the number of hard disks and other disk drives recognized by BIOS.

All these operating systems enable you to **change** initially assigned **letters**. Partition create, delete, and move operations do not affect letters assigned to other partitions. Assigning a partition a new letter or hiding it will prevent only its applications and files from running or opening. Other partitions will not be affected by these operations.

OS startup problems may appear if you directly change the letter assigned to the system partition or a partition with PAGEFILE.SYS swap file.



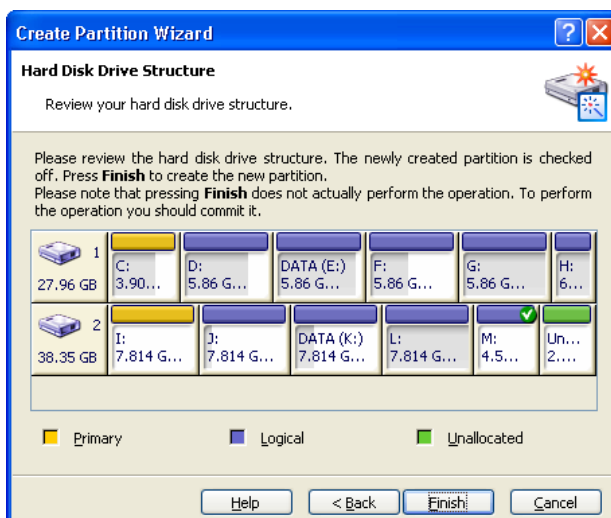
The given discussion of hard disk partition letter assignment in various operating systems is further explained in all Guide chapters, where the partition operations might affect PC operation or booting.

- 3.6 On the next page you can enter an optional partition label, that will enable you to distinguish a created partition from another.



In Windows a partition label is shown in the Explorer disk and folder tree, for example, WIN98(C:), WINXP(D:), DATA(E:), etc. WIN98, WINXP, DATA are partition labels. See also Appendix B «Glossary» — «Label».

- 3.7 The last wizard page **graphically** shows you the new disk partition structure, including those just created.



Created partition in the disk partition structure

Clicking **Finish** on this page to make Acronis PartitionExpert create a pending **operation** for new partition creation, (your actions may only modify an existing operation as well. See 2.4.5 «Modifying pending operations»).

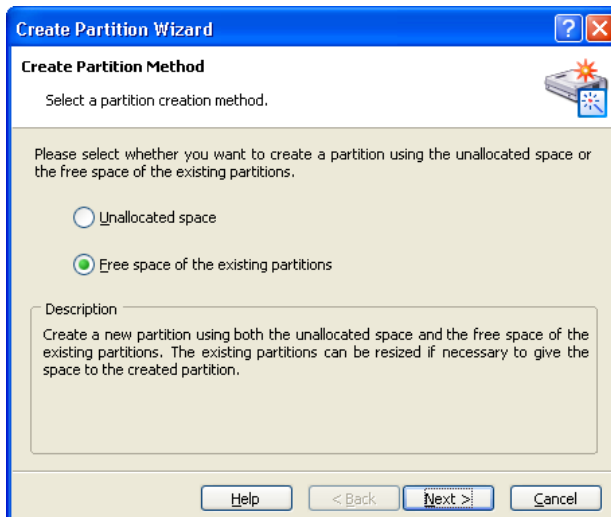
The new partition structure will be graphically represented in Acronis PartitionExpert main window.



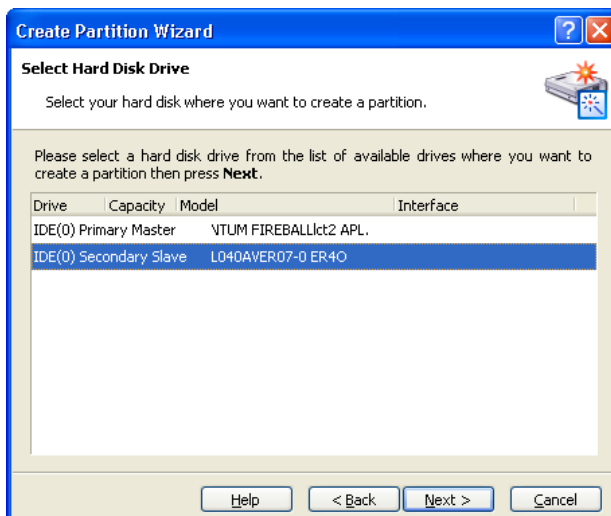
More details about **Finish** command results are provided in 2.4.7. «Wizard operations».

4. If you want to create a new partition using other partition free space:

4.1 On the **Action Selection** wizard page set the switch to **Free space of the existing partitions**.



4.2 On the **Select Hard Disk Drive** wizard page select a **disk** to create a partition on.



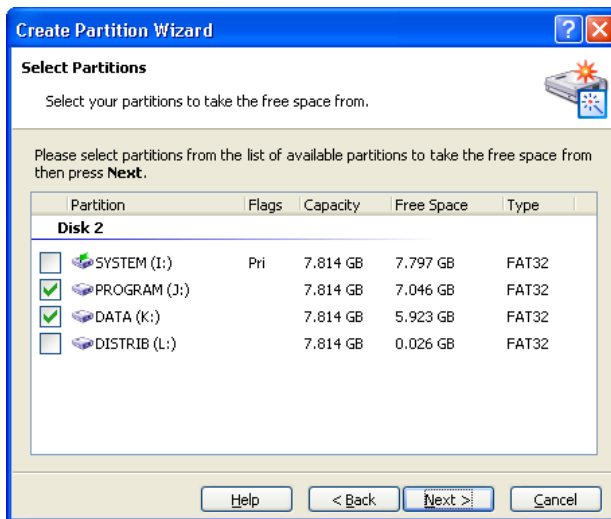
Partition disk selection page



Note that this wizard page represents **physical** disks actually connected to your PC. The next page shows **logical** disks (or partitions) on the selected physical disk. See also Appendix B «Glossary» — «Physical disk», «Logical disk».

- 4.3 On the next **Select Partitions** wizard page select the disk partition(s) **who's space you want to use** to create a new partition.

This means that if these partitions have free space, their size can be reduced. As a result, the freed space will be automatically considered as unallocated (not used by any partitions). A new partition can be created in this space.



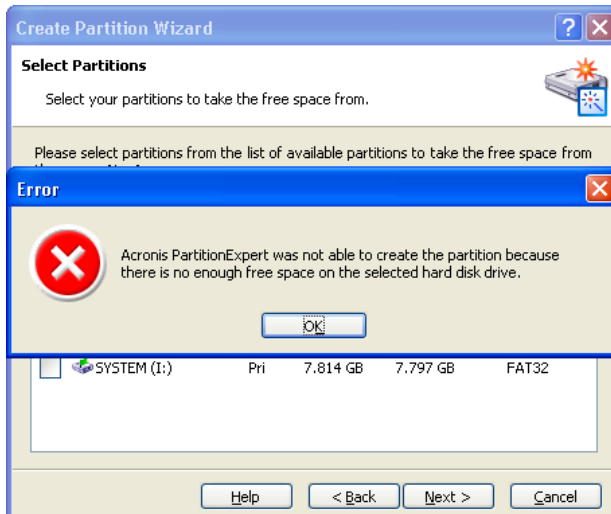
The window of existing partition selection to create a new partition



By creating a partition using the free space of other partitions, Acronis PartitionExpert can collect it in such a way so the final partition size is not smaller than 110% of data-occupied space.

If creating a partition with the switch set to **Free space of the existing partitions** you provide a small partition size. If it is possible to create it using unallocated disk space, it will be created this way. In other words, the existing partitions will not be resized. If a partition cannot be created using unallocated space only, then the deficient space will be taken from existing partitions.

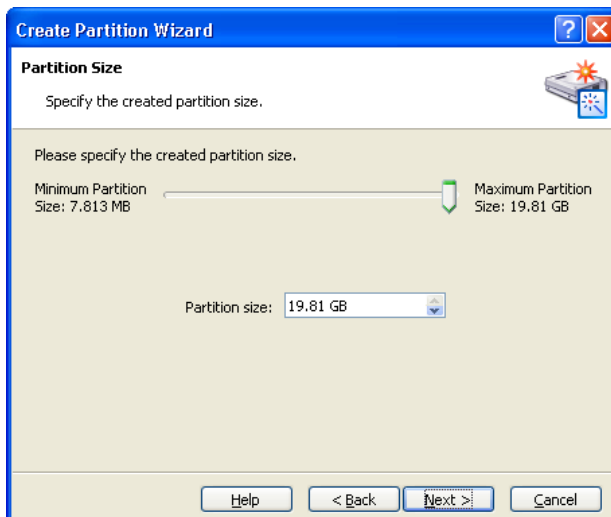
If you do not select a partition to take space from on the **Select Partitions** wizard page and there is no unallocated disk space, you will see an error message:



Error message of deficient disk space for partition creation

In this case you will have to return to the previous wizard page and select a partition to take the necessary space from.

- 4.4 On the **Partition Size** wizard page enter the size of the created partition (the wizard automatically determines minimal and maximum partition sizes).



Created partition size window


- 4.5 The next wizard pages provide partition type, file system, letter (if you work in Windows NT/2000/XP), and optional labeling.

Further actions for partition creation are the same as described in #3.3–3.7 of 3.1 «Creating A New Partition».

Clicking **Finish** on the last wizard page allows Acronis PartitionExpert to create a **pending operation list** for new partition creation (these actions may only modify an existing operation as well. See 2.4.5 «Modifying pending operations»).

The list will include not only the operation of partition creation itself, but also operations of partition resize for creating a new partition.

5. If you want to create a new partition and there is no free space on disks:

Run the create partition wizard, by clicking  **Create a new partition.**

You will immediately see the **Select Hard Disk Drive** wizard page, passing the **Action Selection** page.

Further actions for partition creation are the same as described in #4.2–4.5 of 3.1 «Creating A New Partition».

Clicking **Finish** on the last wizard page to allow Acronis PartitionExpert to create a **pending operation list** for new partition creation (these actions may only modify an existing operation as well. See 2.4.5 «Modifying pending operations»).


3.2 Increasing Partition Free Space

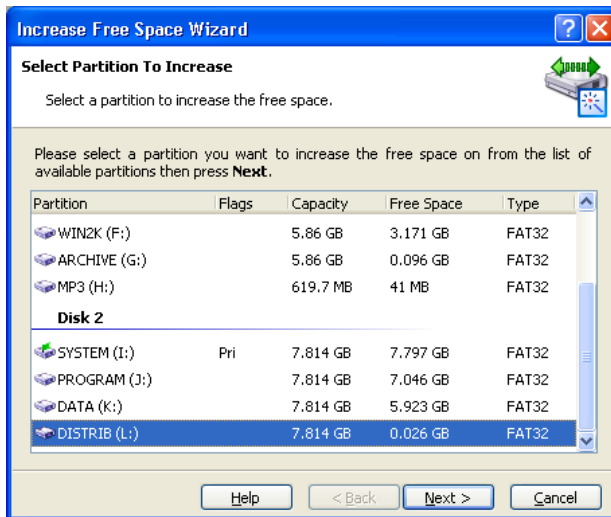
You may need to increase partition free space in some cases:

- There is no free space to install new applications or store data,
- Some programs, like defragmenters, may stop working correctly if partition free space is smaller than a certain value,
- Reducing system partition free space below a certain value might cause operating system problems.

Increase free space wizard will enable you to enlarge a partition using other partitions free space. If there is not enough free space in other partitions, it can use unallocated disk space.

If you need to increase partition free space (size):

1. Run the increase free space wizard by selecting **Wizards** → **Increase free space** or a similar item in the **Wizards** sidebar list or by clicking  **Increase free space on a partition** on the toolbar,
2. On the **Select Partition To Increase** wizard page select a partition that you want to enlarge,

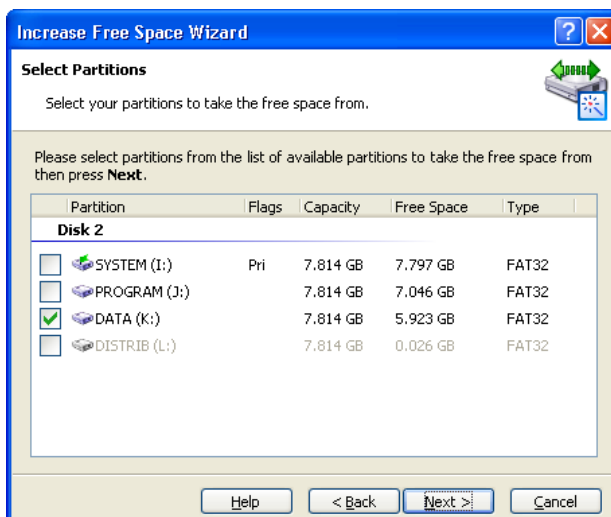


Selecting a partition to increase free space

3. On the **Select Partitions** wizard page select a disk partition, on which space will be used to increase the selected partition,

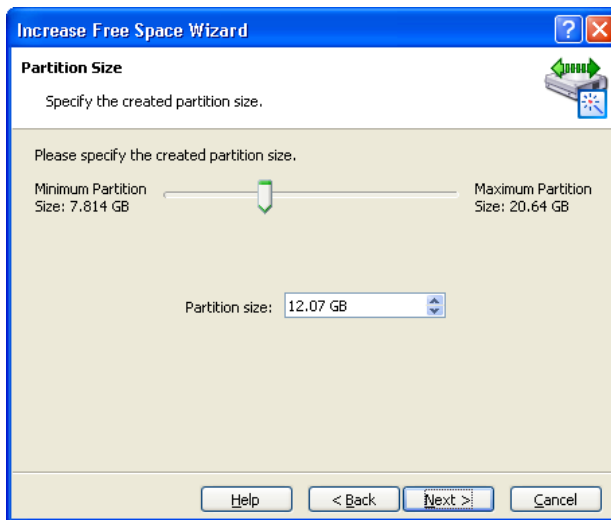


«Enlarging a partition at the expense of another partition» is described above: see #4.3 of 3.1 «Creating A New Partition».



Selecting a partition to use for free space increase

4. On the next wizard page you will see the maximum size available for the selected partition. You must select the size yourself.



Entering the size to increase partition free space



Note that although selected partition size is increased at the expense of other partition space, if there is unallocated space, it will also be used if needed. Unallocated space is automatically considered to be the maximum partition size.

5. In the last **Preview** wizard window you will see a **graphical** representation of the new partition structure, including the resized partition.

Clicking **Finish** on the last wizard page will allow Acronis PartitionExpert create the **pending operation list** for partition resizing (your actions may only modify an existing operation. See 2.4.5 «Modifying pending operations»).

The new partition structure will be graphically represented in the Acronis PartitionExpert main window.



Similar to creating a new partition (see 3.1 «Creating A New Partition»), Acronis PartitionExpert considers the results of partition free space increase as a single complex operation that can be undone only as a whole.

3.3 Copying Partitions

Having copied a partition, you get the duplicate of all its data. Partition copy can be used:


- As a partition backup (or rather a data backup),
- A system partition backup is advised if you want to upgrade the existing operating system,
- To quickly move all data from the old disk to the new.

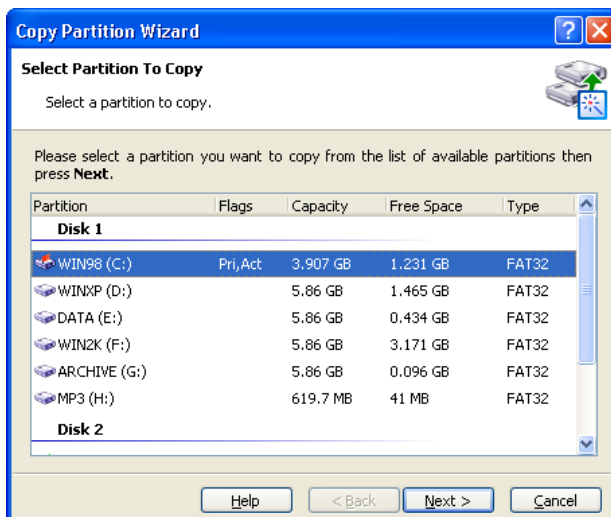


May we again recommend our backup solution — Acronis TrueImage. It enables you to create a backup (image) of a partition and/or entire hard disk in a compressed archive file, while allowing comments and password protection. See <http://www.acronis.com/products/trueimage/>).

The copy partition wizard will let you create a partition copy on the selected disk space. It can be created on unallocated disk space or at the expense of existing partition space, inserted between other partitions, resized after comparison with the original, change the type or file system, and assign a label or a letter if needed.

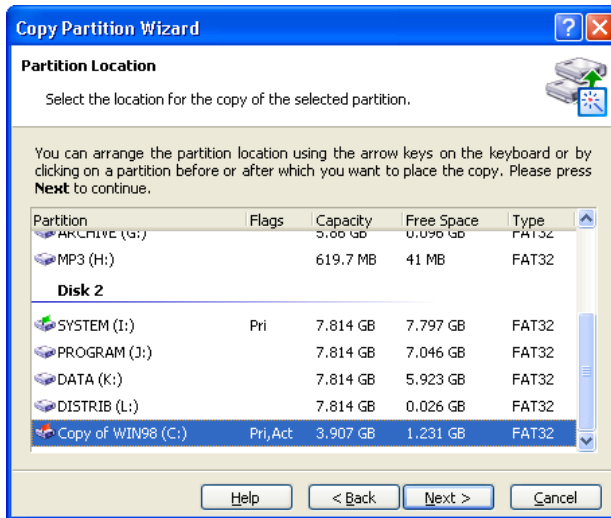
If you need to copy a partition:

1. Run the wizard by selecting **Wizards** → **Copy partition** or a similar item in the **Wizards** sidebar list, or by clicking  **Copy a partition** on the toolbar,
2. On the **Select Partition To Copy** wizard page select a partition to copy — Win98(C:) partition is selected on the figure below,



Selecting a partition to copy

- On the next **Partition Location** wizard page a **record** of copied partition parameters will be created (Copy of Win98(C:) on the figure below).



The page for selecting a disk location for partition copy

You will have to select a copy location on one of the disks, among existing partition. To make your selection click **before or after a partition**, before or after which you want to locate the copy.

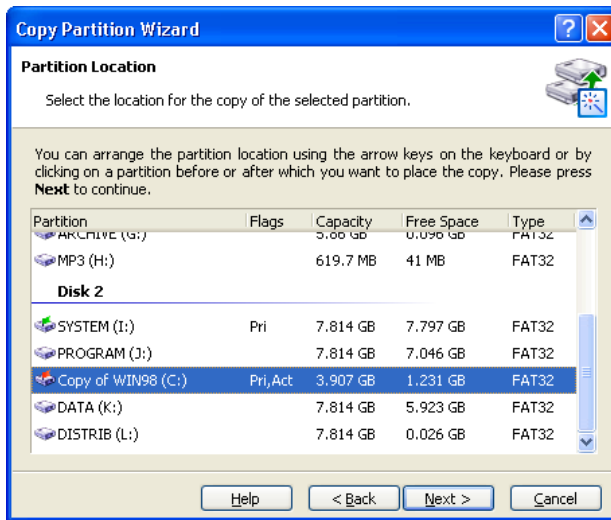
If you click before a partition, the copy will be located before it. In this example, the copy will be located **before** PROGRAM(J:) partition on the figure below.

Disk 2				
Partition	Flags	Capacity	Free Space	Type
SYSTEM (I:)	Pri	7.814 GB	7.797 GB	FAT32
PROGRAM (J:)		7.814 GB	7.046 GB	FAT32
DATA (K:)		7.814 GB	5.923 GB	FAT32

If you click after a partition, the copy will be located after it. The copy will be located **after** PROGRAM(J:) partition on the figure below.

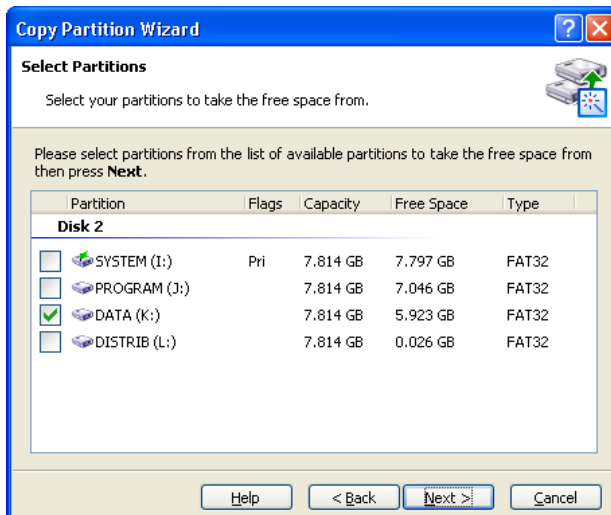
Disk 2				
Partition	Flags	Capacity	Free Space	Type
SYSTEM (I:)	Pri	7.814 GB	7.797 GB	FAT32
PROGRAM (J:)		7.814 GB	7.046 GB	FAT32
DATA (K:)		7.814 GB	5.923 GB	FAT32

The figure below shows the result of locating a partition copy after clicking **after** PROGRAM(J:) partition.



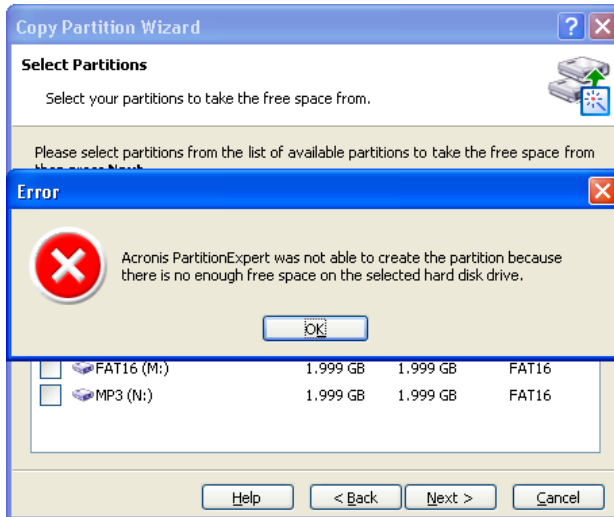
You can locate a copy anywhere on your disk(s). The copy partition wizard will automatically perform all necessary operations, even if it has to resize or move other partitions!

- The selected disk might lack space for a copy. Nevertheless you can copy a partition by selecting another partition, whose space will be partly used. This can be done in the **Select Partitions** window.



The page to select a partition, which will be partly used for a copy location

If you do not select a partition to be partly used as the copy location on the **Select Partitions** wizard page and there is no (or not enough) unallocated disk space, you will see an error message:

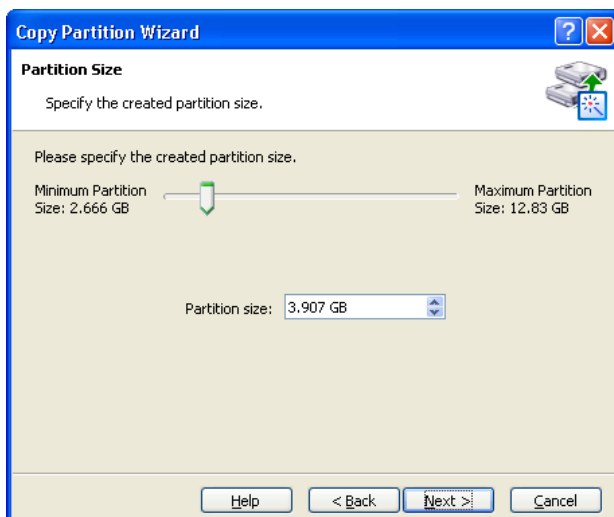


Error message showing not enough disk space for a partition copy

In this case the wizard will prompt you to select a partition to take some space from.

If there is not enough space, a partition will not be copied!

5. On the next **Partition Size** wizard page you can provide a desired partition size. The wizard will automatically determine the minimal and maximum copy size.



The page for partition copy size selection



The minimal copy size is determined by the data area size of a copied partition. The maximum size is determined by the available disk space. It includes the space taken from a partition and unallocated disk space.



By copying a partition at the expense of existing partition free space, Acronis PartitionExpert can take the partition space to make sure that partition size is not smaller than 110% of data-occupied space.

6. On the next **Partition Type** wizard page you can select partition copy type: **Active**, **Primary** and **Logical**.

As a rule, **Primary** is selected if a partition contains an operating system. If a partition is intended for data storage, you should select **Logical**.

Select **Active**, if you want to boot the partition's operating system at startup.



The selection of partition copy type and possible limitations are described in the comment to #3.3 of 3.1 «Creating A New Partition».

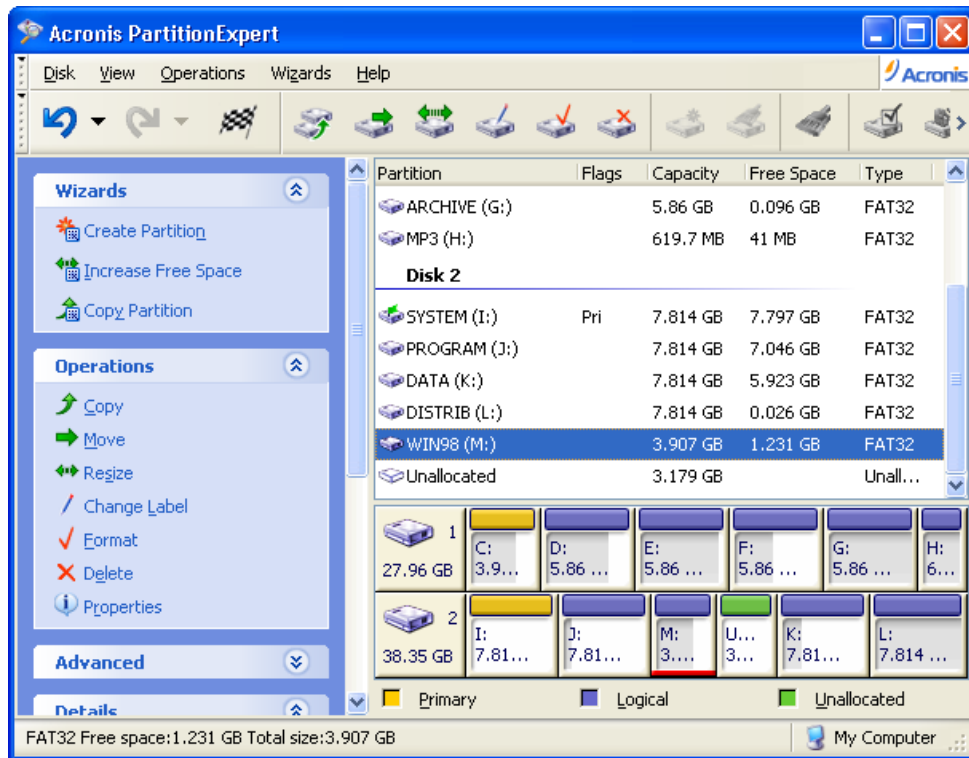
Further actions for copying a partition are the same as described in #3.4–3.7 of 3.1 «Creating A New Partition».



Copying a partition in Windows 95/98/Me and assigning it a letter can change the order of letters assigned to other partitions. As a result, some shortcuts might stop working. For a detailed discussion of partition letter assignment rules for various operating systems see 3.1 «Creating A New Partition».

Clicking on the last wizard page will allow Acronis PartitionExpert to create the **pending operation list** for copying a partition (your actions may only modify an existing operation as well. See 2.4.5 «Modifying pending operations»).


The new partition structure will be graphically represented in Acronis PartitionExpert main window.



Copied partition in Acronis PartitionExpert main window

Chapter 4. Manual Partition Operations

Unlike the «Automatic partition operations» mode (see 2.1) the «Manual partition operations» mode is intended for experienced users only, and offers much wider operation lists. Manual operation parameters are entered in the dialog boxes.

To execute a partition operation, you select **Operations** → **Commit** or click  (**Commit Pending Operations**).

4.1 Main Partition Operations

Main hard disk partition operations include the typical, **most frequently used** operations of partition creation (selecting a type, file system, formatting, etc.), assigning label and letter partition, resizing, relocating, clearing, deletion, etc.

4.1.1 Creating new partitions

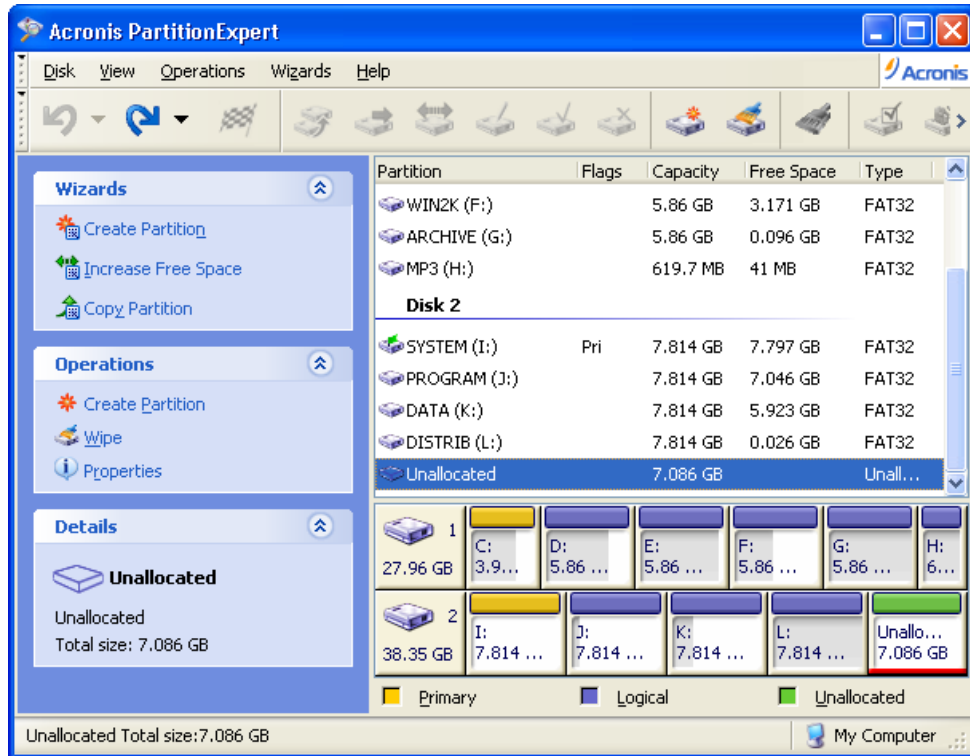
If there is unallocated space on a disk, you can create a new partition using manual disk operations.




Note that the Create partition wizard mentioned above can create partition using both unallocated disk space and the space of existing partitions (see 3.1 «Creating A New Partition»). The create partition operation will enable you to create a partition on unallocated space only. If there is no such space, it should be provided by resizing and moving existing partitions.

If you need to create a new disk partition:

1. Select hard disk and unallocated space in Acronis PartitionExpert main window; **Create a new partition** button will become available on the toolbar, and **Create Partition** operation — on the sidebar and in the context menu;

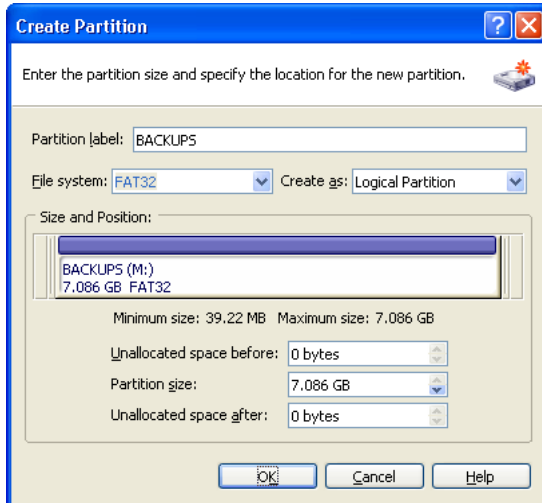


Selecting unallocated disk space

2. Execute operation of partition creation by selecting **Disk → Create partition** or a similar item in the **Operations** sidebar list, or by clicking  **Create a new partition** on the toolbar;

3. In the **Create Partition** window enter a partition label, select a file system and partition type (**Primary — Logical**) from the list; you can also enter partition size and location using mouse or by direct input to **Partition size**, **Unallocated space before** (and **Unallocated space after**) fields.

As a rule, **Primary** is selected if a partition is to contain an operating system. If a partition is meant for data storage, **Logical** should be selected.



Created partition parameters window

4. By clicking , you add the pending operation of new partition creation.

The new partition structure will be graphically represented in Acronis PartitionExpert main window.



Creating a partition in unallocated disk space in Windows 95/98/Me can change the order of letters, assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».

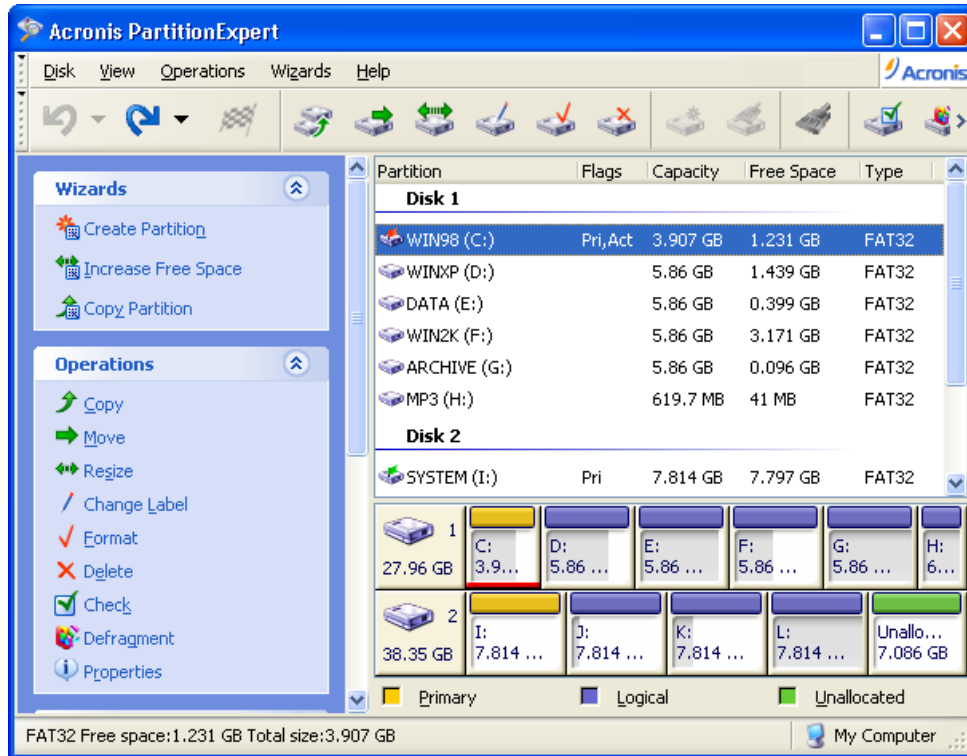
4.1.2 Copying a partition to unallocated disk space

The reasons for copying a partition were discussed above (see 3.3 «Copying Partitions»). Partition copy can be used:


- As a partition backup (or rather a data backup),
- As a system partition backup if you want to upgrade the existing operating system,
- To quickly move all data from the old disk to the new.

If you need to copy a partition:

1. Select a hard disk and a partition to copy. Data (K:) partition of the hard disk 2 is selected for copying on the figure below.

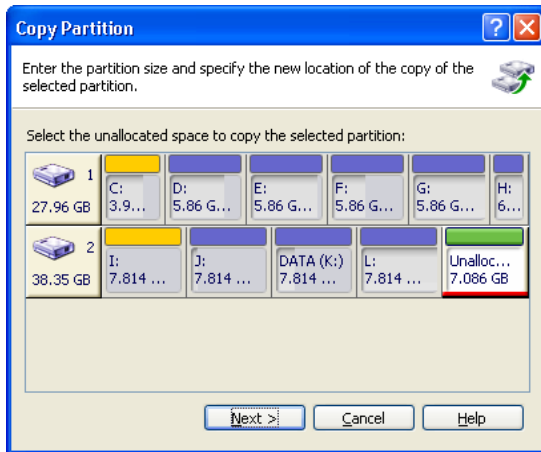


Selecting a partition to copy

2. Execute partition copy operation by selecting **Disk** → **Copy** or a similar item in the **Operations** sidebar list or by clicking  **Copy the selected partition to another free space** on the toolbar,

- Acronis PartitionExpert will automatically compare the size of a copied partition and disk free space as shown in the **Copy Partition** window.

Only the free space on disk 2 is available for copying.



Free space available for copying

Note that the unallocated space is smaller than copied partition size, but its data area is smaller than unallocated space. Therefore copying is possible.

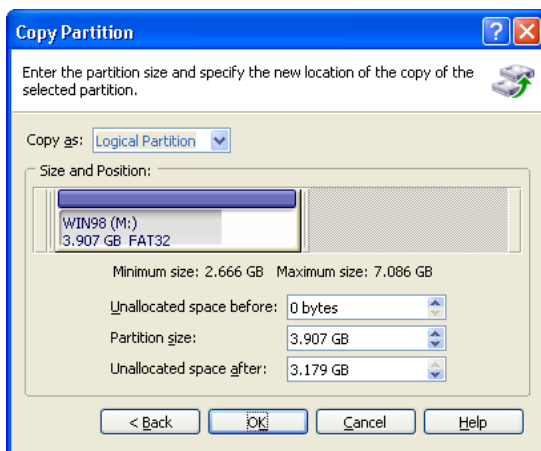


If there is not enough free space to copy a partition on a hard disk, no unallocated spaces will be available for selection.

- Select the unallocated disk space to copy a selected partition to it.
- In the next wizard page enter partition copy type (**Logical — Primary**), size, and location.



While copying a partition you might have to change its type. For example, you have to copy a primary partition, but there are already 4 primary partitions on the disk. You will be able to copy it only as a logical partition. If you need to restore the primary partition from a copy, you will be able to change its type again.



Entering partition copy parameters

The size and location of partition copy can be provided with a mouse or by entering data into the **Unallocated space before**, **Partition size** (and **Unallocated space after**) fields.

6. By clicking in the **Copy Partition** wizard, you add the pending operation of partition copying and location (your actions may only undo or modify already existing operation; see 2.4.5 «Modifying pending operations»).

The new partition structure will be graphically represented in Acronis PartitionExpert main window.



Copying a partition in Windows 95/98/Me and assigning it a letter can change the order of letters, assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».

4.1.3 Moving a partition to unallocated disk space

You might need to move a partition to:

- Change order of letters assigned by operating system;



For example, Windows 95/98/Me unlike Windows NT/2000/XP does not let users assign random letters to partitions. So you must move a partition to assign it the necessary letter.

- Work with some older OS (MS-DOS, Windows 95, Windows NT 4.0), that can boot only from binary partitions located in the beginning of the disk;
- Speed up partition operations;

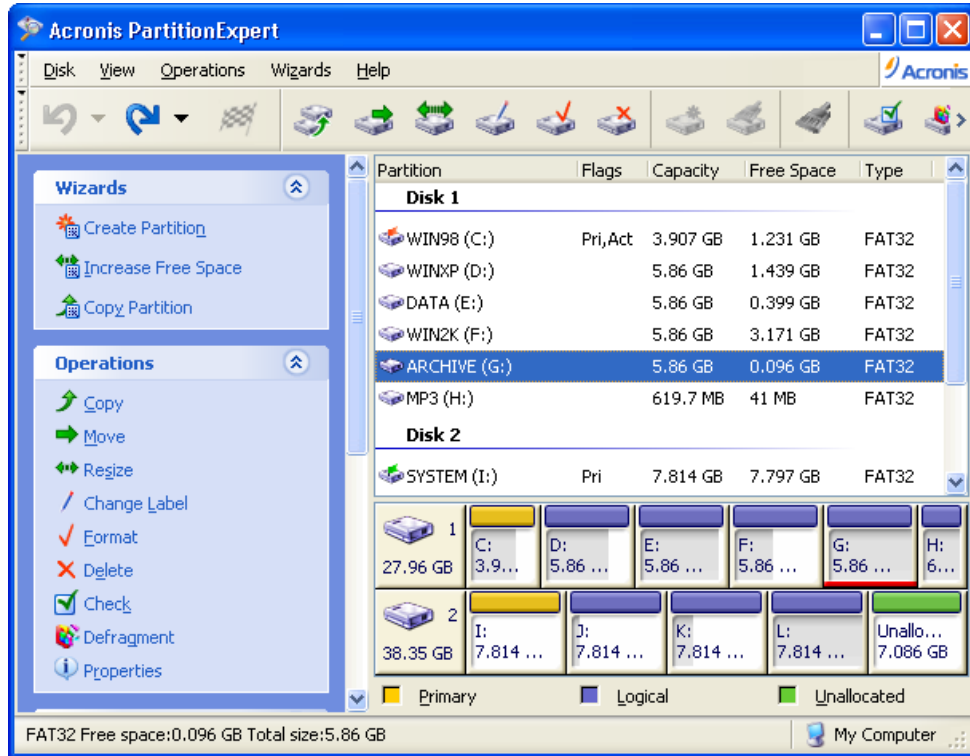


For example, you might have a special partition for a swap file. If you move this partition closer to the beginning of a disk OS might work much faster with it.


- Change partition configuration.

If you need to move a partition to unallocated disk space:

1. Select hard disk and **partition** to move. Data (K:) partition of hard disk 2 is selected for moving on the figure below.

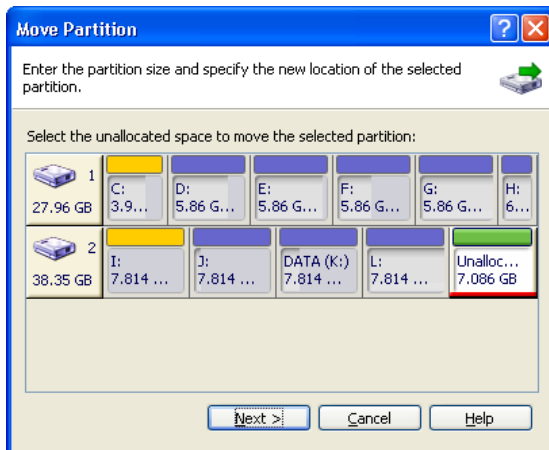


Selecting a partition to move

2. Execute operation of partition moving by selecting **Disk** → **Move** or a similar item in the **Operations** sidebar list or by clicking  **Move the selected partition to another free space** on the toolbar.

- Acronis PartitionExpert will automatically compare moved partition size and available free space, indicating it in the **Move Partition** window.

Only hard disk 2 unallocated space is available for partition moving on the figure below.



Unallocated space available for partition moving

Note that the unallocated space is smaller than moved partition size, but its data area is smaller than unallocated space. Therefore moving is possible.

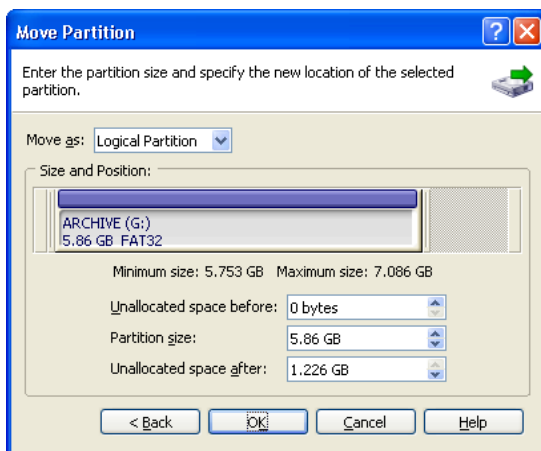


If there is not enough free space to copy a partition on a hard disk, no unallocated spaces will be available for selection.

- Select free space to move the selected partition to.
- On the next wizard page select the type of **moved** partition (**Logical — Primary**), size, and location.




Changing partition type is not as necessary here as partition copying (see 4.1.2 «Copying a partition to unallocated disk space»). Nevertheless, Acronis PartitionExpert gives you this added flexibility.



Entering moved partition parameters

The size and location of partition copy can be provided with a mouse click or by entering data into the **Unallocated space before, Partition size** (and **Unallocated space after**) fields.

6. By clicking  in the **Move partition** window, you add a pending operation to partition moving (your actions may only undo or modify already existing operation; see 2.4.5 «Modifying pending operations»).

The new partition structure will be graphically represented in Acronis PartitionExpert main window.



Moving a partition to unallocated disk space in Windows 95/98/Me can change the order of letters assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».




Take special care when moving an **operating system partition** and its boot code location. The OS might stop booting. For example, Windows NT 4.0 and earlier versions limit boot code location to 2016 MB.

4.1.4 Resizing and/or moving a partition

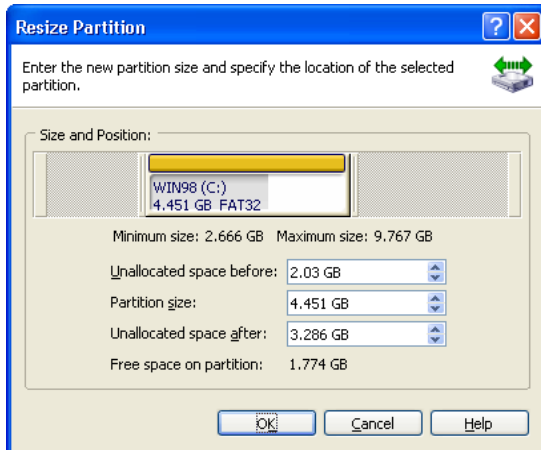
You may find that there is not enough free space on a certain partition. For example, it is almost filled with MP3 files. Acronis PartitionExpert lets you easily enlarge a partition.

Reasons of moving a partition were discussed above (see 4.1.3 «Moving a partition to unallocated disk space»).

If you need to resize and/or move a partition:

1. Select hard disk and a partition to be resized,
2. Execute operation of partition resizing by selecting **Disk → Resize** or a similar item in the **Operations** sidebar list, or by clicking  **Resize/move the selected partition** on the toolbar,

3. Resize the partition in the **Resize Partition** window:
 - (1) Hold mouse button and drag a corresponding partition rectangle side until you get the necessary size in the **Partition size** field,
 - (2) Specify the partition size in the **Partition size** field,



Resize partition window

4. Relocate a partition on a disk by one of the following methods:
 - (1) Holding mouse button and dragging corresponding partition rectangle left side to resize free space before the partition;
 - (2) Having pointed to the rectangle, hold the left mouse button and move a partition as a whole until you get the necessary MB or GB amount in the **Unallocated space before** field;
 - (3) Specifying the necessary value in the **Unallocated space before** field.



Acronis PartitionExpert automatically considers the limitations of file systems and parameters provided. In particular, it won't let you enlarge FAT16 partition over the maximum 4 GB (2 GB for Windows 95OSR2/98/Me) value.

5. By clicking in the **Resize Partition** window, you create a pending operation for partition resizing and moving (your actions may only undo or modify an existing operation; see 2.4.5 «Modifying pending operations»). The new partition structure will be graphically represented in the Acronis PartitionExpert main window.



Acronis PartitionExpert features a wizard for performing more complex partition resizing (see 3.2 «Increasing Partition»). Simple partition resizing lets you increase partition size only if there is free (unallocated) space before or after a partition. The wizard lets you perform more complex operations such as increasing partition free space **at the expense of other partitions**.



Moving a partition to unallocated disk space in Windows 95/98/Me can change the order of letters, assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».



Take special care when moving an **operating system partition** and its boot code location. The OS might stop booting. For example, Windows NT 4.0 and earlier versions limit boot code location to 2016 MB.


4.1.5 Changing partition labels

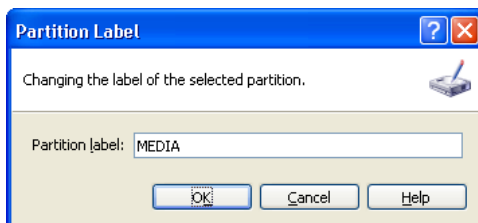
Partition label is an optional attribute. It's a **name, assigned to a partition** for easier recognition of your partitions. For example, one could be called **System** — a partition with an operating system, **Program** — an application partition, **Data** — a data partition, etc.




In Windows partition labels are shown in the Explorer disk and folder tree: WIN98(C:), WINXP(D:), DATA(E:), etc. WIN98, WINXP, DATA are partition labels. A partition label is shown in all application dialog boxes for opening and saving files. (See Appendix B «Glossary» — «Label».)

If you need to change a partition label:

1. Execute operation of partition label changing by selecting **Disk** → **Change Label** or a similar item in the **Operations** sidebar list, or by clicking  **Change the selected partition label** on the toolbar,
2. Enter a new label in the **Partition label** window.



Partition label window


3. By clicking  in the **Partition Label** window, you add the pending operation of partition label changing (your actions may only undo or modify an existing operation; see 2.4.5 «Modifying pending operations»).

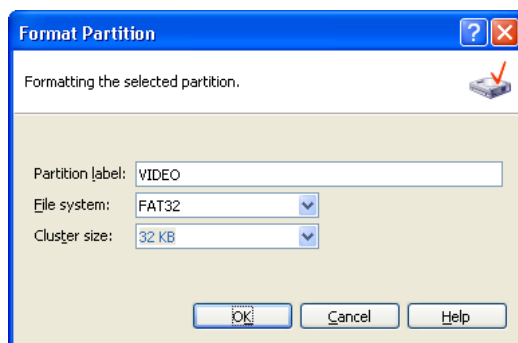
The new partition label will be graphically represented in Acronis PartitionExpert main window.

4.1.6 Formatting a partition

Acronis PartitionExpert lets you **logically format** a partition. It includes organizing a file system that supports files and folder data storage.

If you need to format an existing partition:

1. Select a disk and a partition,
2. Run partition formatting by selecting **Disk → Format** or a similar item in the **Operations** sidebar list, or by clicking  **Format the selected partition** on the toolbar,
3. Enter partition label in the **Format Partition** window.



Format Partition window

4. Select a file system to be created on a partition after formatting.


Acronis PartitionExpert supports the following file systems (see A.9 «File System Main Specifications»):

- **FAT16/FAT32, NTFS** — Windows file systems,
- **Linux EXT2, Ext3, ReiserFS, Swap** — Linux file systems.

5. Select cluster size (Auto, 512 bytes, 1, 2, 4... 64 KB).

Note that:


- (1) the smaller the cluster size, the less disk space will be lost (see A.9.2 «FAT16» — Table 3),
- (2) the smaller the cluster size, the bigger file allocation table (FAT) is. The bigger the FAT, the slower the operating system works with the disk,
- (3) having selected Auto, you allow PartitionExpert to automatically determine the cluster size depending on selected file system and partition size.

6. By clicking  in the **Format Partition** window you add the pending operation of partition formatting (your actions may only modify an existing operation. See 2.4.5 «Modifying pending operations»).



Attention! Partition formatting destroys all its data, including files and folders! Take special care when performing this operation.




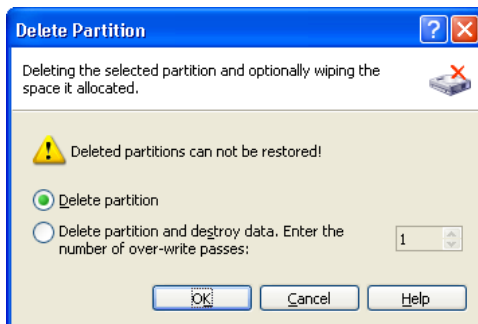
Remember that each operation described must be executed by selecting **Operations** → **Commit** or clicking  **Commit Pending Operations** (see 2.4.4 «Performing pending operations»).

4.1.7 Deleting a partition

After a partition is deleted its space is added to unallocated disk space. It can be used for a new partition or to resize an existing partition.

If you need to delete a partition:

1. Select a hard disk and a partition to be deleted,
2. Execute partition deletion by selecting **Disk** → **Delete** or a similar item in the **Operations** sidebar list, or by clicking  **Delete the selected partition** on the toolbar,
3. Select the deleting method in the **Delete Partition** window; you can:
 - (1) just **delete a hard disk partition** (without wiping disk sectors) — set the switch to **Delete partition**,
 - (2) **delete a hard disk partition** and fully **wipe partition sectors** — set the switch to **Delete partition and destroy data**.



Delete Partition window

Having set the switch to **Delete partition and destroy data**, enter a **number of passes** for wiping.



Wiping unallocated disk space means multiple writing of special data to hard disk sectors. Acronis PartitionExpert features a rather simple wiping algorithm. During each pass a symbol sequence or logical zeroes (0x00) or ones (0xFF) are written to unallocated space sectors. Only logical zeroes are written during the last pass. **The more passes** performed, the safer the wiping will be.



Acronis offers extremely powerful hard disk/partition wiping software — **Acronis DriveCleanser**, featuring strict algorithms for **guaranteed confidential information wiping and destruction** (see <http://www.acronis.com/products/drivecleanser/>).

4. Confirm partition deletion by clicking **OK** in the **Delete Partition** window;
5. By clicking **OK** in the **Delete Partition** window, you add the pending operation of partition deletion (your actions may only undo an existing operation depending on the situation selected see 2.4.5 «Modifying pending operations»).

The new partition structure will be graphically represented in the Acronis PartitionExpert main window.



Attention! Deleting a partition destroys all its data, including files and folders! Deleting a system partition will make a PC inoperable. Take special care when performing this operation.




Deleting a partition Windows 95/98/Me can change the order of letters assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».

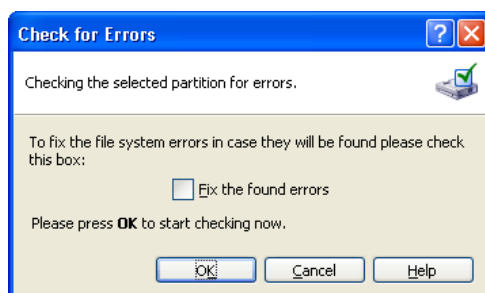
4.1.8 Checking hard disk partitions for errors

Acronis PartitionExpert enables you to check hard disk partitions for file system errors.

Hard disk partitions should be checked before any partition operations (see 1.7 «Before You Run Acronis PartitionExpert»).

If you need to check a hard disk partition:

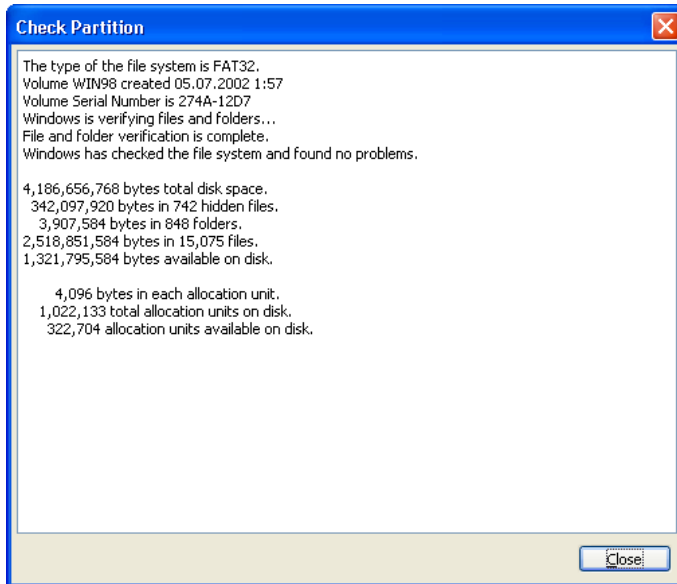
1. Select hard disk and partition in Acronis PartitionExpert main window,
2. Execute operation of partition error checking by selecting **Disk** → **Check** or a similar item in the **Operations** sidebar list, or by clicking  **Check the selected partition for errors** on the toolbar,
3. If you want to fix found errors check the **Fix the found errors** box in the **Check for errors** window,



Check for Errors window

4. By clicking **OK**, you run partition error checking,

5. Check results are shown in the **Check Partition** window.



Partition check results window

4.1.9 Defragmenting a partition

Defragmentation is reorganizing file storage on a hard disk partition to locate file data in the consequent clusters.

Defragmentation is the process of eliminating file fragmentation, causing files to be spread across the disk after disk operations.

File fragmentation significantly reduces PC or server performance, especially at considerable amount of I/O operations. Vice versa, file defragmentation can increase performance, as the read head has to move less across the disk to read all file parts.

Acronis PartitionExpert enables you to defragment a hard disk partition.

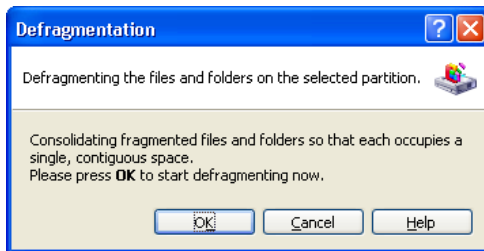
If you need to defragment a hard disk partition:

1. Select hard disk and partition to defragment in Acronis PartitionExpert main window,
2. Execute operation of partition defragmentation by selecting **Disk → Defragment** or a similar item in the **Operations** sidebar list, or by clicking



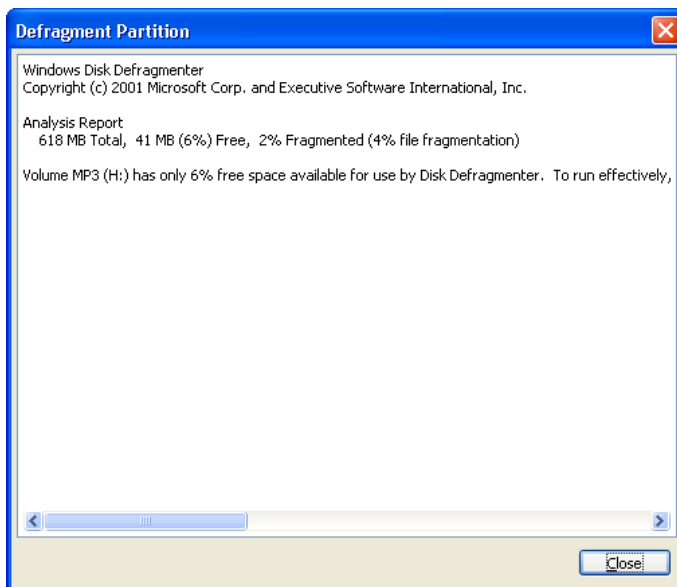
Defragment the selected partition on the toolbar,

- By clicking **OK** in the **Defragmentation** window, you run partition defragmentation,



Run partition defragmentation window

- Defragmentation results are shown in the **Defragment Partition** window.




Partition defragmentation results window

4.1.10 Wiping unallocated hard disk space

PC hard disks can contain a substantial amount of confidential information. Often users forget that private information should not only be kept safe, but also be completely destroyed to avoid unauthorized access to it.

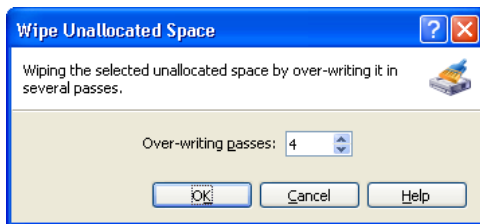
Windows tools do not **guaranteed** data destruction. Deleted files can be restored. Formatting and even deleting a partition leaves **hard disk sector contents** the same. Acronis PartitionExpert offers a simple but reliable algorithm for wiping hard disk unallocated space.

If you need to wipe unallocated disk space:


1. Select hard disk and unallocated space in Acronis PartitionExpert main window — **Wipe unallocated space** becomes available on the toolbar,
2. Execute operation of free space clearing by selecting **Disk → Wipe** or a similar item in the **Operations** sidebar list, or by clicking  **Wipe the selected unallocated space** on the toolbar,
3. In the **Wipe Unallocated Space** window enter a number of disk passes (up to 99),



For information about Acronis PartitionExpert data wiping algorithm see the comment for 4.1.7 «Deleting a partition».




Hard disk passes number window

4. By clicking , you add a pending operation of unallocated disk space wiping.

4.1.11 Clearing a hard disk

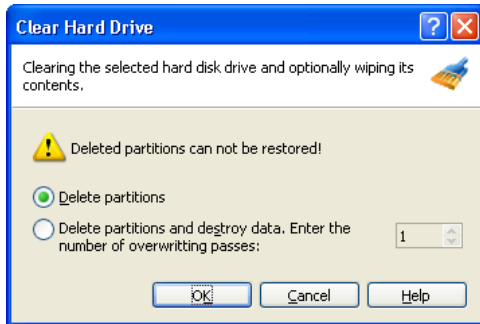
Acronis PartitionExpert lets you clear not only unallocated disk space, but entire disk as well.

If you need to clear the entire hard disk:

1. Select hard disk on the **Tree View** panel of Acronis PartitionExpert — **Clear the current hard disk drive** button becomes available on the toolbar (if there is no **Tree View** panel in the main window, show it by selecting **View → Tree View**),
2. Execute operation of hard disk space clearing by selecting **Disk → Clear** or a similar item in the **Operations** sidebar list, or by clicking  **Clear the current hard disk drive** on the toolbar,

3. Select the clearing method in the **Clear Hard Drive** window; you can:
 - (1) just **delete hard disk partitions** (without wiping disk sectors) — set the switch to **Delete partitions**,
 - (2) **delete hard disk partitions** and fully **clear hard disk sectors** — set the switch to **Delete partitions and destroy data**.

Having set the switch to **Delete partitions and destroy data**, enter the **number of passes** for wiping.



Hard disk clearing parameters window

4. By clicking **OK**, you add a pending operation of hard disk clearing.



Deleting a hard disk partitions does not destroy disk sector contents. It can be restored by special means if needed. Therefore if you need to destroy confidential information, set the switch to **Delete partitions and destroy data!**



For information about Acronis PartitionExpert data wiping algorithm see the comment for 4.1.7 «Deleting a partition».



Deleting a partition in Windows 95/98/Me can change the order of letters, assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».

4.2 Additional Partition Operations


Additional hard disk partition operations include some rarely used but useful operations of converting partition file system, hiding and unhiding partitions, setting active partitions, changing root size, and changing partition cluster size.

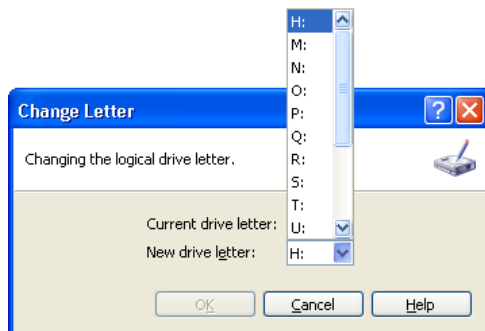
4.2.1 Changing partition letter

Some operating systems assign letters (C:, D:,...) to hard disk partitions at startup. They are used by applications and operating systems for locating files on partitions.


Connecting an additional disk or creating (deleting) a partition on existing disks might change your system configuration. As a result, some applications might stop working or user files might not be opened. To prevent this, you can change letters assigned by an operating system.

If you need to change letter assigned to a partition by an operating system:

1. Select hard disk and partition on it,
2. Execute operation of partition letter changing by selecting **Disk → Advanced → Change Letter** or a similar item in the **Advanced** sidebar list, or by clicking  **Change the logical drive letter** on the toolbar,
3. Select a new letter in the **Change letter** window,



Change letter window

4. By clicking  in the **Change letter** window, you add a pending operation to partition letter assignment (your actions may only undo or modify already existing operation; see 2.4.5 «Modifying pending operations»).

The new partition structure will be graphically represented in Acronis PartitionExpert main window.



Only Windows NT/2000/XP lets you change letters assigned to partitions. Windows 95/98/Me assigns letters to partitions automatically.



Directly changing a partition letter might affect shortcuts to existing partitions. Changing a partition letter in Windows NT/2000/XP might result in problems running applications and opening files on the partition. If it is a system or swap file partition, it might cause OS boot problems. The detailed discussion of partition letter assignment rules for various operating systems are provided in 3.1 «Creating A New Partition».

4.2.2 Converting a file system

FAT16

The main disadvantages of FAT16 are:

- Inability to support partitions larger than 2 GB,
- Inability to work with files larger than 2 GB,
- Inability to work with hard disks larger than 8 GB,
- Limited root size — up to 512 elements,
- Filenames containing up to 8 name symbols, a dot, and 3 extension symbols (Windows 95OSR2 and Windows NT do not have this limitation already).

FAT32

FAT32 file system appeared in Windows 95 OSR2 and is supported by Windows 98/ME and Windows 2000/XP.

Its main purpose was to remove FAT16 limitation. FAT32 is the evolution of FAT16.


The main difference between FAT32 and FAT16 is the support of higher-capacity folders, files, and disks, more flexible root organization that features unlimited size and long filenames support. (For more details see A.9 «File System Main Specifications».)

Converting FAT16 to FAT32

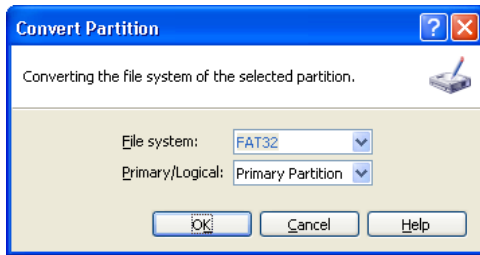
You would convert a FAT16 partition to FAT32 in the following cases:

1. If you need a partition larger than 2 GB;
2. If you replace a small-capacity hard disk with a high-capacity hard disk.

If you need to convert a FAT16 partition to FAT32:

1. Select the disk and FAT16 partition to convert to FAT32 from the list in Acronis PartitionExpert main window,
2. Execute operation of partition converting by selecting **Disk → Advanced → Convert** or a similar item in the **Advanced** sidebar list, or by clicking  **Convert the file system on the selected partition** on the toolbar (or selecting it from partition or the graphical representation context menu),

3. Enter partition type (**Logical — Primary**) in the **Convert Partition** window,



Convert partition window

4. By clicking **OK**, you add a pending operation of FAT16 partition converting to FAT32 partition (your actions may only undo or modify an existing operation as well. See 2.4.5 «Modifying pending operations»).

The new partition file system will be graphically represented in Acronis PartitionExpert main window.





Attention! Converting FAT16 partition to FAT32 might cause the installed operating system to stop «understanding» the file system and/or the allocation table. For more information about compatibility of file and operating systems see A.9 «File System Main Specifications».

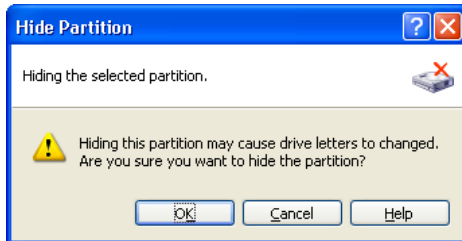
4.2.3 Hiding a partition

Acronis PartitionExpert allows you to hide a partition. It can be useful for protecting important information from unauthorized or casual access. Unlike other software Acronis PartitionExpert can hide any partitions independent of their types, primary or logical.

If you need to hide a partition:

1. Select disk and a partition to hide in the list of Acronis PartitionExpert main window,
2. Execute operation of partition hiding by selecting **Disk → Advanced → Hide** or a similar item in the **Advanced** sidebar list, or by clicking  **Hide the selected partition** on the toolbar (or selecting it from partition or the graphical representation context menu),

3. By clicking  in the **Hide Partition** window, you add a pending operation to partition hiding (your actions may only undo or modify an existing operation as well. See 2.4.5 «Modifying pending operations»).



Hide Partition window

A hidden partition is labeled **Hid** in the **Flags** field of partition list in the main window.



Attention! Hiding a system partition will prevent your PC from booting. Hiding a swap file partition in Windows NT/2000/XP will produce a similar result. If you have several primary partitions with different operating systems, hiding an active system partition will automatically make another partition active.



Note that **Advanced** → **Hide** sidebar item is changed to **Advanced** → **Unhide** after you select a hidden partition from the list. Partition context menu changes the same.





Hiding a partition in Windows 95/98/Me can change the order of letters, assigned to other partitions. As a result, some shortcuts might stop working. In Windows NT/2000/XP hiding a partition does not affect letters assigned to other partitions. As a result only hidden partition shortcuts will stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».

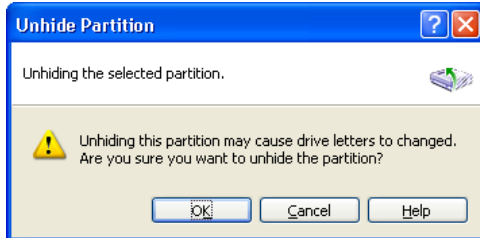
4.2.4 Unhiding a partition

Unhiding a partition is performed so an operating system can "see" the partition, assign it a letter, and provide access to partition files.

If you need to unhide a partition:

1. Select disk and partition to unhide from the list in Acronis PartitionExpert main window,
2. Execute operation of partition unhide by selecting **Disk** → **Advanced** → **Unhide** or a similar item in the **Advanced** sidebar list, or by clicking  **Unhide the selected partition** on the toolbar (or selecting it from partition or the graphical representation context menu),

- By clicking  in the **Unhide Partition** window, you add the pending operation to partition un hiding (your actions may only undo or modify an existing operation, See 2.4.5 «Modifying pending operations»).



Unhide partition window

The partition **Hid** label will disappear from the **Flags** field.



Note that **Advanced** → **Unhide** sidebar item is changed to **Advanced** → **Hide** after you select a hidden partition from the list. Partition context menu changes the same.



If you unhidden the only primary partition on a disk, it will be set active.




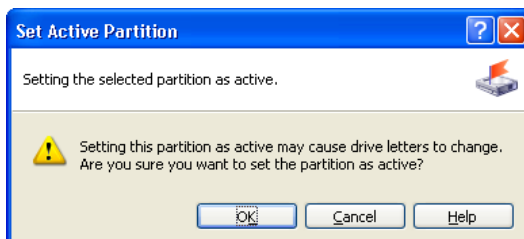
Hiding a partition in Windows 95/98/Me can change the order of letters assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».

4.2.5 Setting active partition


If you have several primary partitions, you must specify one to boot from. For this you can set a partition active. A disk can have only one active partition.

If you need to set an active partition:

- Select **primary** partition to set active from the list in Acronis PartitionExpert main window,
- Execute operation of setting active partition by selecting **Disk** → **Advanced** → **Set Active** or a similar item in the **Advanced** sidebar list, or by clicking  **Set the selected partition as active** on the toolbar (or selecting it from partition or the graphical representation context menu),



Set Active Partition

3. By clicking  in the **Set Active Partition** window, you add the pending operation of setting active partition (your actions may only undo or modify an existing operation. See 2.4.5 «Modifying pending operations»).

The new partition structure will be graphically represented in Acronis PartitionExpert main window.

Partition will be marked **Act** in the **Flags** field. Primary partition is also marked **Pri**, so the **Flags** field will contain **Pri, Act**.



Before you set a partition active you must make sure it is formatted and contains an operating system. Otherwise your PC will not boot from this partition!



If you set a partition active and there was another active partition on a disk, it will be unset **automatically**. This might also prevent your PC from booting.




Setting active partition in Windows 95/98/Me can change the order of letters assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».

4.2.6 Resizing root

Unlike all others, FAT16 root is located in a special place and has a limited size (512 elements after standard formatting). Acronis PartitionExpert lets you change the root size of existing partitions.

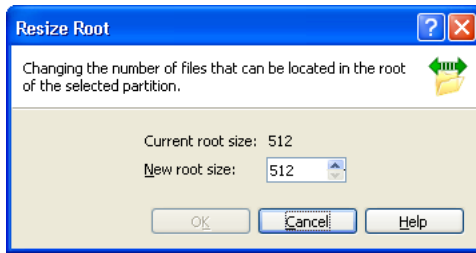
If you need to resize FAT16 partition root:

1. Select disk and FAT16 partition from the list in Acronis PartitionExpert main window,
2. Execute operation of FAT16 partition root resizing by selecting **Disk → Advanced → Resize Root** or a similar item in the **Advanced** sidebar list, or by clicking  **Change the number of files that can be located in the root of the selected partition** on the toolbar (or selecting it from partition or the graphical representation context menu),



If you select a partition with another file system, mentioned sidebar and context menu items will not be available.

3. Enter the new root size (a number of elements) in the **Resize Root** window,



Resize FAT16 root window



FAT16 can contain a maximum of 65520 elements.

4. By clicking , you add the pending operation of FAT16 partition root resizing (your actions may only undo or modify an existing operation. See 2.4.5 «Modifying pending operations»).


4.2.7 Changing cluster size

Smaller clusters (see Appendix B «Glossary» — «Cluster») might significantly reduce disk space losses, related to the fact that any file occupies at least one cluster/block.

Disk space losses depending on cluster size are shown in Appendix A (see A.9.2 «FAT16» — Table 3).

However reducing FAT32 partition cluster size might increase the space, occupied by file allocation table (FAT) and slowdown file access.

If you need to change cluster size:

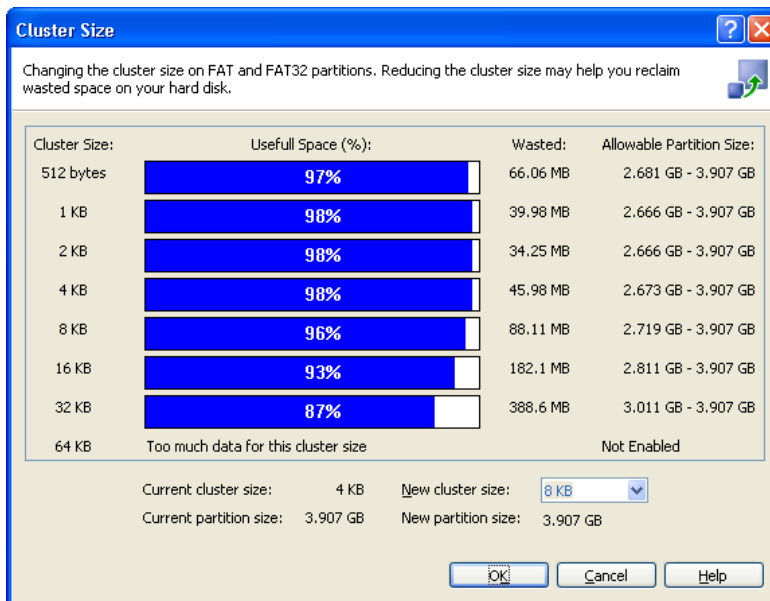
1. Select disk and partition from the list in Acronis PartitionExpert main window,
2. Execute operation of cluster resizing by selecting **Disk → Advanced → Change cluster size** or a similar item in the **Advanced** sidebar list, or by clicking  **Change the cluster size of the selected partition** on the toolbar (or selecting it from partition or the graphical representation context menu),

3. In the **Cluster Size** window you can:
 - (1) see the current cluster size of selected partition,
 - (2) see average statistics of disk space losses for the selected partition and different cluster size,



Some cluster sizes might become unavailable for a partition because there will not be enough clusters to store actual partition data on.

- (3) set new cluster size in the **New cluster size** field,



Cluster Size window

4. Having entered new cluster size and clicking **OK** in the **Cluster Size** window, you add the pending operation of cluster resizing (your actions may only undo or modify an existing operation, See 2.4.5 «Modifying pending operations»).

4.2.8 Changing partition type


Each partition record includes the «partition type field». It is a hexadecimal value, that defines the file and operating system suitable for a partition.

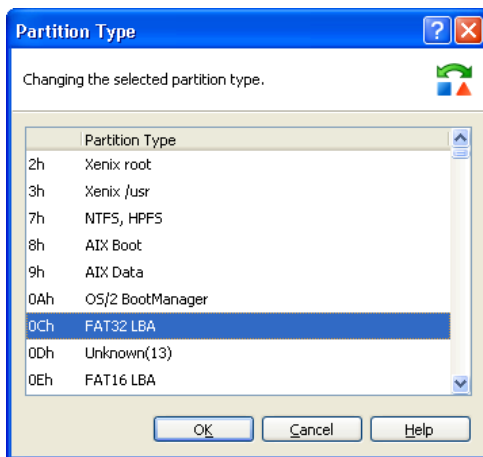


This hexadecimal value is optional, as some operating systems use it and some do not. In particular, Windows 95/98/Me strictly use the «partition type» field when determining if it can support a partition.


Usually partition type is set during its creation **depending on file system** to be used. However you may need to select the type manually. For example, if a partition is created without a file system or if a partition is meant for use with a specific OS, it must be assigned a corresponding type.

If you need to change partition type:

1. Select disk and partition to change type of from the list in Acronis PartitionExpert main window,
2. Execute operation of partition type changing by selecting **Disk** → **Advanced** → **Change type** or a similar item in the **Advanced** sidebar list, or by clicking  **Change the type of the selected partition** on the toolbar (or selecting it from partition or the graphical representation context menu),
3. Select the necessary partition type in the **Partition type** window,



Partition type window

3. By clicking  in the **Partition type** window, you add the pending operation of partition type changing (your actions may only undo or modify an existing operation, See 2.4.5 «Modifying pending operations»).



Attention! Changing partition type might prevent some operating systems from working with it, even if it is a compatible file system!



Changing partition type in Windows 95/98/Me can hide a partition and change the order of letters assigned to other partitions. As a result, some shortcuts might stop working. The detailed discussion of partition letter assignment rules for various operating systems are described in 3.1 «Creating A New Partition».

4.2.9 Resizing INODE table in Linux Ext2/Ext3

In Linux Ext2/Ext3, the INODE index descriptor is the main data structure describing files.


Each descriptor contains a file description, including file type, size, data block pointers, etc. Data block addresses, reserved for a file, are stored in its index descriptor.

The space for all INODEs must be allocated in advance (at formatting). So in Ext2/Ext3 file systems the maximum number of files is set at formatting.

The «bytes per a single INODE» value indicates the average partition file size. If there are many small files, there must be many descriptors, each of which occupies some space. Large files require fewer descriptors.

Acronis PartitionExpert enables you to resize INODE tables of existing partitions to change the maximum file amount on it.

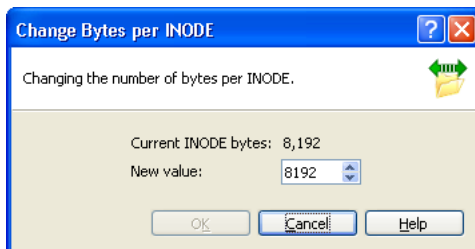
If you need to resize INODE table of an existing Linux Ext2/Ext3 partition:

1. Select disk and Linux Ext2/Ext3 partition from the list in Acronis PartitionExpert main window,
2. Execute operation of INODE resizing by selecting **Disk → Advanced → Change Bytes per INODE** or a similar item in the **Advanced** sidebar list, or by clicking  **Change the number of bytes per INODE** on the toolbar (or selecting it from partition or the graphical representation context menu),




If you select a partition with another file system, mentioned sidebar and context menu items will be unavailable.

3. Enter the new amount of bytes per descriptor (INODE) in the **Change bytes per INODE** window,



Resize INODE window

4. By clicking  in the **Change bytes per INODE** window, you add the pending operation of Linux Ext2/Ext3 partition INODE resizing (your actions may only undo or modify an existing operation, See 2.4.5 «Modifying pending operations»).

Appendix A. Hard Disk And Operating System

Provided Appendices contain additional information about hard disk construction and data storage, partitions, file systems and interaction of operating system with hard disk.

A.1 Hard Disk Organization

All hard disks, or hard disk drives, have basically the same structure, however diverse they are. Inside the case there are several disks with magnetic coating set on a single axis (spindle). A special motor provides the necessary rotation speed to the spindle, e.g. 5400 rpm, 7200 rpm, or 10000 rpm.

Information on disks resides on concentric **tracks**. Each track has its number. The outermost track is number 0, and the numbers grow inwards.

Each of the tracks is divided into **sectors** that contain minimal information blocks that can be written to disk or read from it. Sectors also have numbers. On every disk there is a marker that indicates the beginning of sector enumeration. The sector that is the closest to this marker is number 1.

At the beginning of a sector there is a header (prefix portion) that marks the beginning of the sector and its number. At the end of a sector in the suffix portion there is the checksum that is used to check data integrity. Data area between the prefix and suffix portions is 512 bytes large.

Both upper and lower sides of each disk on the spindle are used to store data. All tracks that have the same number on all the surfaces of all disks comprise a **cylinder**. For each work surface of a disk in the drive there is a **head** that enables reading and writing data from/ to the disk. Heads are assembled into a block and are enumerated, starting with 0.

To perform an elementary read or write operation the head block should be positioned at the necessary cylinder. When the necessary sector (with the necessary number in the service area) of the rotating disks approaches the head, data is exchanged between the head and the electronic board of the drive.

Sector structure of a hard disk is created via **low-level formatting** during which each of the tracks of the disk is marked up.

Modern disk drives usually contain relatively few magnetic disks (1–2) to make the head block lighter and speed up access to sectors (a drive like this has 2–4 heads respectively).

There can be up to several tens of thousands of cylinders per disk. The higher the write density on the disk, the more cylinders can be created on it and the larger the capacity of the disk.

This design has a lot of technical implementation peculiarities, but we are not discussing them here.

A.2 Hard Disk Partition

After low-level formatting creates disk sectors, partitions must be created on it as well.

A **Partition** is an area on a hard disk that can be used to install an operating system and/or used as data storage. Creating disk partitions is called **partitioning**. Each disk partition does not depend on another. In particular, each partition can contain its own operating system.

Different operating systems use **different data storage means — file systems**. The process of creating a partition file system is called **formatting**. Each partition can have its own file system.

Preparing a disk for working includes two stages: partitioning and formatting.

Partitioning is useful and often necessary because:

1. Different partitions can have different operating systems.
For example, Windows 2000, XP, and Linux.
2. Partitioning provides more effective disk space usage.
3. Partitioning enables you to separate system files from user data, making personal information storage safer.
4. Partitioning provides more effective hard disk maintenance. In particular, more effective data integrity control, file defragmentation, and data backup.

A.3 Partition Types

There are three main partition types:

- Primary,
- Extended,
- Logical.

Primary and logical partitions are the main partition types. Physical hard disk can contain **up to 4 primary** partitions or **up to 3 primary and infinite logical**.

Partition information is stored in the special disk area – the 1st sector of 0 cylinder, 0 head, called **Partition Table**. This sector is called Master Boot Record, MBR.

The number of primary partitions on a disk is limited, because Partition Table contains four records itself.

Extended partition supports additional dividing into logical partitions. The amount of logical partitions is unlimited.

Special programs perform partitioning; usually they can:

- create a primary partition with a single logical disk;
- create an extended partition and divide it into logical partitions (disks);
- set **active partition** (a partition to boot an operating system from).

Typical hard disk partition structure can look like:

MBR
Primary partition 1-1. System logical disk C:.
Extended partition 1-2.
Logical partition 1-5 Logical disk D:.
Logical disk E:.
Logical disk F:.
.....

Usually, initial partitioning is made by means of an operating system. Different operating systems offer special programs for this.

After the installation of Windows XP, you can invoke the Control Panel, whose Disk Management tools will let you delete, create partitions (primary, extended, logical) using free (unallocated) disk space, or format a partition.

You cannot however change partition structure by means of the Windows operating system. To do this you will need software such as Acronis PartitionExpert. Acronis PartitionExpert lets you resize, move, hide partitions, set them active, copy, and perform other operations **without losing any data** or causing any OS and application workability problems.

A.4 Primary Partitions

Primary hard disk partition can contain operating system, applications and user data (files). Only one primary partition can be set active in the given PC session.

Most operating systems can boot from a primary partition only.

If you want to use several operating systems, you might have to create several primary partitions.

A.5 Extended Partitions

The extended hard disk partition was offered as a way to avoid the 4 primary partitions limit. Extended partition is used only for creating a desired number of **logical partitions**.

Extended partition may not contain any data directly.

A.6 Logical Partitions

Extended partition can be divided into any number of logical partitions that are similar to primary partitions. In particular, they can contain operating systems, applications, and user data.

Primary partitions should be used for booting operating systems and system files and folders.

Logical partitions may contain any other information, as they are accessible by most operating systems.

If you need several operating systems, you should use logical partitions for those which can boot from them, and leave primary partitions free.

A.7 Formatting Hard Disks

Within each of the partitions information has to be organized in a way understandable for the operating system that uses the partition. This organization is the **file system**.

As a rule, formatting program performs the following functions:

- It creates the boot record;
- It creates the file allocation table (FAT);
- It marks bad clusters so they are not ever used afterwards.

After formatting logical disks are organized as follows:

- Logical disks start with the boot sector;
- One or several copies of file allocation table (FAT) are placed after the boot sector;
- Next goes the root folder;
- Next goes the data area.

Each logical disk has to be formatted with FORMAT separately.

A.8 File Systems

The logical structure that has been created on the hard disk is supported by means of operating system. The file system itself presents the information on the disk as an ensemble of **files** and **folders**.

From the user's point of view a file is a unit of storage of logically connected information: texts, graphics, sound. As for data storage organization, a file is a chain of connected sectors or **clusters**. A cluster is a unit of several sectors. (Sectors are characteristic for file systems supported by various versions of Windows.)

Operating systems support file systems on hard disks (or disk partitions) by allowing to create, copy, and delete files and folders.

At present, the most widely spread file systems for PCs are the following two:

- **FAT16/FAT32** (File Allocation Table) for DOS, OS/2, Windows 95/98/Me/NT/2000/XP;
- **NTFS** (Windows NT File System) for Windows NT/2000/XP.

However, there are many more other file systems. Linux operating system, which is now gaining popularity, widely uses two file systems:

- **Ext2** is a file system for end-users' PCs;
- **Ext3** is the default file system used by Red Hat Linux;
- **ReiserFS** is a more secure (with respect to data integrity) file system that is used on data servers.

A.9 File System Main Specifications

Operating systems allow you to work with data by supporting a **file system** on a disk partition.

All file systems contain structures required for data storage and control. These structures usually consist of OS boot record, files and folders. A file system performs the following main functions:

1. Monitors used and free disk space (including bad sectors).
2. Maintains folders and filenames.
3. Monitors physical file location on a disk.

Different operating systems use different file systems. One operating system may support only one file system; others may support several.

A.9.1 File system specification summary

Below is a summary of the most popular file systems. Each system is briefly commented. This information can help you work with Acronis PartitionExpert.

Table 1. Windows file systems.

File system	FAT16	FAT32	NTFS
Operating systems	Almost all	Windows 95OSR2/98/Me, 2000/XP, Linux	Windows NT/2000/XP, Linux (for reading)
Max. partition size	4 GB (2 GB for Windows 95OSR2/98/Me)	2 TB	16 EB
Max. file size	Limited by partition size	4 GB	Limited by partition size
Max. filename length	255	255	32767
Restoration (logging)	No	No	Yes
Max. files in root	Set at formatting	Unlimited	Unlimited
Max. clusters/blocks	$\sim 2^{16}$	$\sim 2^{28}$	$\sim 2^{48}$
Cluster/block size	512 Bytes – 64 KB	512 bytes – 64 KB	512 bytes – 64 KB
File record table/I-node	No	No	Dynamic

Table 2. Linux file systems.

File system	Ext2	Ext3	ReiserFS
Operating systems	Linux	Linux	Linux
Max. partition size	16 TB	16 TB	16 TB
Max. file size	Limited by partition size	Limited by partition size	Limited by partition size
Max. filename length	255	255	255
Restoration (logging)	No	Yes	Yes
Max. files in root	Unlimited	Unlimited	Unlimited
Max. clusters/blocks	$\sim 2^{32}$	$\sim 2^{32}$	$\sim 2^{32}$
Cluster/block size	1–4 KB	1–4 KB	4 KB
File record table/I-node	Set at formatting	Set at formatting	Dynamic



In case you forgot computer engineering units: 1 Kbyte = 1024 Bytes, 1 Mbyte = 1024 Kbytes, 1 Gbyte = 1024 Mbytes, 1 Tbyte = 2^{10} Gbytes = 1024 Gbytes, 1 Pbyte = 2^{10} Tbytes = 1024 Tbytes, 1 Ebyte = 2^{10} Pbytes = 1024 Pbytes.

A.9.2 FAT16

FAT16 file system is widely used by DOS (DR-DOS, MS-DOS, PC-DOS, etc.), Windows 95/98/ME, Windows NT/2000/XP operating systems and is supported by most other systems.

Main features of FAT16 are the file allocation table (FAT) and clusters. FAT is the core of the file system. To increase data safety it is possible to have several instances of FAT (there are usually 2 of them). A cluster is a minimum data storage unit in FAT16 file system. One cluster contains a fixed number (some power of 2) of sectors. FAT stores information about what clusters are free, what clusters are bad, and also defines in what clusters files are stored.

Maximum size of a FAT16 file system is **4 Gigabytes**, and the maximum number of clusters is 65525, the largest cluster being 128 sectors. Usually cluster size is selected as minimum as possible so that the resulting number of clusters is less than 65526. The larger the partition size, the larger the cluster has to be. Most operating systems incorrectly perform with 128-sector clusters, thus reducing the maximum FAT16 partition size to **2 Gigabytes**.



Usually the larger the cluster size the more disk space is wasted.

Table 3. The following table gives the approximate dependence of these losses versus the cluster size:

Partition Size	Cluster Size	Wastes
<127 MB	2 KB	2%
128–255 MB	4 KB	4%
256–511 MB	8 KB	10%
512–1023 MB	16 KB	25%
1024–2047 MB	32 KB	40%
2048–4096 MB	64 KB	50%

Like many others, FAT16 file system has a root folder. Unlike others however, its root folder is stored in a special place and is limited in size (standard formatting produces a 512-item root folder).

Initially, FAT16 had limitations to file names that could only be 8 characters long, plus a dot, plus 3 characters of name extension. However, long name support in Windows 95 and Windows NT bypasses this limitation.

A.9.3 FAT32

FAT32 file system appeared in Windows 95 OSR2 and is also supported by Windows 98/ME and Windows 2000/XP. FAT32 grew out of FAT16. The main differences between FAT32 and FAT16 are 28-bit cluster numbers and more flexible root folder implementation, which is not limited in size. The reason for FAT32 is the necessity to support large (larger than 8 Gigabytes) hard disks and the inability to build any more complex file system into MS-DOS, which is still in the core of Windows 95/98/ME.

Maximum FAT32 file system size is **2 Terabytes**.

A.9.4 NTFS

NTFS file system is the main file system for Windows NT/2000/XP. Its structure is closed, so no other operating system fully supports. Main structure of NTFS is the MFT (Master File Table). NTFS stores a copy of the critical part of the MFT to reduce the possibility of data damage and loss. All other NTFS data structures are special files.

Like FAT, NTFS uses clusters to store files, but cluster size does not depend on partition size. NTFS is a 64-bit file system, it uses Unicode to store file names. It is also a journaling (failure-protected) file system, and supports compression and encryption.

Files in folders are indexed to speed up file search.

A.9.5 Linux Ext2

Ext2 is one of the main file systems for the Linux operating system. Ext2 is a 32-bit file system. Its maximum size is **16 Terabytes**. Main data structure that describes a file is an INODE. A place to store the table of all INODEs has to be allocated in advance (during formatting).

A.9.6 Linux Ext3

Officially introduced with their version 7.2 of the Linux operating system, Ext3 is the Red Hat Linux journaling file system. It is forward and backward compatible with Linux ext2. It has multiple journaling modes and broad cross-platform compatibility in both 32- and 64-bit architectures.

A.9.7 Linux ReiserFS

ReiserFS was officially introduced to Linux in 2001. ReiserFS frees many Ext2 disadvantages. It is a 64-bit journaling file system that dynamically allocates space for data substructures.

Appendix B. Glossary

Absolute sector. All the sectors of a hard disk can be numbered sequentially, starting with zero. Thus numbered sectors are called absolute.

Active partition. One of the primary partitions of a hard disk is usually active. Default MBR code tries to boot an operating system from the active partition of the first hard disk. Letter assignment in Microsoft operating systems depends on what partitions are active.

Bad cluster. A cluster that contains bad sectors. Such cluster cannot store useful information.

Bad sector. A sector that cannot store the information written, for instance due to defects or aging of the magnetic surface.

Boot is a procedure that is executed every time a computer is turned on or an operating system finishes its work or when the reset button is pressed. Booting consists of the following stages:

- Hardware diagnostics;
- Memory check;
- Built-in BIOS initialization;
- Initialization of additional hardware components and their BIOSes (video, SCSI etc.);
- Booting an operation system.

If a boot manager is installed on a computer, then it is booted instead of an operating system. Then the boot manager boots the user-chosen operating system itself.

Boot record. The initial part of a partition that contains code and data necessary for booting an operating system. May consist of one or several sectors. First sector of a boot record must end with the boot sector signature (0AA55h).

Boot sector is the first sector of a disk or a partition that contains the initial code for the operation system booting. Boot sector must end with 0AA55h signature.

Bootable disk is a disk from which an operating system may be booted. A bootable disk must contain a boot sector of an operating system and the necessary system and configuration files. The «Bootable disk» term usually refers to diskettes and CD-ROMs.

Bootable partition. A partition that can host an operating system. In the beginning of such a partition there should be a boot record.

Cluster. Information storage unit in such file systems as FAT and NTFS. Every file occupies a certain number of whole clusters, so the more the cluster size the higher the losses are that are due to file size adjustment, but the smaller the cluster the more place do the cluster distribution tables occupy.

Cylinder. A group of all the tracks on all the magnetic platters of a hard disk that can be accessed without moving the magnetic head. Access to the data inside one cylinder is much faster than moving the head from one cylinder to the other.

Disc. A non-magnetic storage media (compact disc, CD-RW, or DVD).

Disk. A magnetic storage media (floppy disk or hard disk).

Drive. A general word that can mean both a device for accessing information on a disk (floppy disk drive) and a partition that can be accessed from an operating system (logical drive).

File. A file is named information storage in the file system. In different file systems, files can be stored in different ways, with different file names and different ways to write the full path to the file in the folder tree.

File Allocation Table (FAT). The hard disk area, located after the boot sector, that describes physical files locations; a duplicate for higher data storage reliability follows FAT.

The File Allocation Table also contains the disk cluster list. FAT contains as many records, as there are clusters on a disk. If a FAT cell contains «0», the cluster is empty. The last file cluster, defective cluster and reserved clusters have their own special markings.

FAT describes each file by a chain of numbers — like serial numbers of file's disk clusters. The number of the first cluster of each file is stored in the folder. Writing, deleting, and modifying files and folders implies corresponding FAT changes.

File system. Data structure that is necessary to store and manage files. File system does the following functions: tracks free and occupied space, supports folders and file names, tracks the physical positions of files on the disk. Each partition may be formatted with its own file system.

Folder. A table in the file system that contains description of files and other folders. Such structure allows creating folder tree that begins with the root folder.

Formatting. The process of creating service structure on the disk. There are three levels of hard disk formatting: low-level (marking the magnetic surface

with tracks and sectors), partitioning and high-level (creation of file system on a partition).

Hard disk (hard drive). Fixed storage media along with integrated electronics that consists of several magnetic platters that rotate synchronously on one spindle. Hard disks have relatively high capacity and high read/write speed.

Hard disk geometry. A set of hard disk parameters that usually includes the number of cylinders, heads and sectors per track.

Head (magnetic head, read/write head). A hard disk consists of several magnetic platters, for each side of each platter there is a head that is used to read and write information on it.

Hidden partition. A partition that is somehow made invisible to the operating system. Usually partitions are hidden by changing their type.

Label. An optional name that can be assigned to a partition to simplify its identification. Usually has the same limitation as file names. For example, FAT partitions have labels up to 11 characters long, but may contain spaces.

Letter (of a drive, partition). All operating systems that are DOS-compatible use Latin letters to identify drives and partitions. Letters A: and B: are usually reserved for floppy drives. Starting with C: letters are assigned to hard disk partitions that can be recognized by the operating system. Separate letters may be assigned to CD-ROMs, DVDs, or other disk drives, and to network drives.

Logical disk is a partition whose file system is recognized by the operating system. Usually each logical disk is assigned with a letter that uniquely identifies it.

Logical partition. Partition information about which is located not in MBR, but in the extended partition table. The number of logical partitions on a disk is unlimited.

Master Boot Record (MBR) is a special place in the very first sector of the hard disk to store information about the hard disk partitioning and code to be loaded with BIOS. All the actions that follow depend on the contents of this code.

Operating system is a set of programs that usually includes kernel, drivers, shell and system programs that are used for centralized hardware management and hiding the details of hardware management from the user and applications.

Operating system booting is initiated by loading its boot sector to memory at 0:7C00h address and passing control to it. Since every operating system has its own boot sector, it is able to perform all the necessary actions to load and initialize system and configuration files.

Since a boot manager usually supports multiple operating systems on one computer and even one partition, it has to perform some preparatory actions (create the boot context) before booting an operating system.

Partition. An independent area on a hard disk where a file system can be located. A partition can be either primary or logical, depending on its position in the partition structure. One of the primary partitions of a hard disk may be active. A partition has the following attributes: type, beginning and size. Besides, some partition managing software and boot managers allow hiding partitions. Information about partitions is stored in the partition table.

Partitioning. The process of creating the logical structure on a hard disk. Partitioning is usually done with programs like FDISK. Disk Administrator completely replaces FDISK where functionality is concerned and allows performing many more useful operations.

Partition structure. All the partitions on a hard disk make a tree with the root in the MBR partition table. Many operating systems and programs assume that any partition table but MBR may contain not more than one partition entry and one table entry, and it simplifies the partition structure greatly – all the logical partitions form one chain.

Partition table. It is the table that contains the information about partitions and links to other partition tables. A partition table cannot have more than four entries. Main partition table is located in the hard disk MBR, and the other partition tables are called extended. Partition tables are usually stored in the first sector of a cylinder.

Physical disk. A disk that is physically a separate device. Thus, floppy disks, hard disks, CD-ROMs are physical disks.

Primary partition. The partition, information about which is contained in the MBR partition table. Majority of operating systems can be booted only from the primary partition of the first hard disk, but the number of primary partitions is limited.

Root folder. The folder where the folder tree of a file system begins. Starting from the root folder one can uniquely describe the file position on the folder tree by sequentially naming all the intermediate nested folders, e.g.: \WINDOWS\SYSTEM\VMM32.VXD. Here the WINDOWS folder is a subfolder of the root folder, SYSTEM folder – of the WINDOWS folder, and the VMM32.VXD file is located in the SYSTEM folder.

Sector. It is the minimal information unit on a disk that is transferred in single read or write operation. Usually a sector is 512 bytes in size. A sector on a disk can be addressed two ways: via the absolute number (see absolute sector) or via cylinder, head and sector number on a track.

System disk/partition is a disk/partition from which an operating system may be booted. Such disk usually contains the boot sector and system files of this operating system.

System file is a file that contains the code and constant data for an operating system. Each operating system has its own system file set.

System folder. Some operating systems keep most of their files in a special folder on a partition that may be different from the system one. For example for Windows 95/98/ME operating systems IO.SYS system file resides on the system partition, while other system files are located in the system folder which is usually called WINDOWS. Program Files folder can also be treated as system since it resides on the same partition as WINDOWS and also contains files that are relevant to the operating system.

Status. A flag that shows if a partition is active. This flag is stored in the partition table and has no meaning for logical partitions.

Track. Disks are divided into concentric circles called tracks. Information from one track can be accessed without moving the head.

User interface is a set of principles, concepts, and means by which programs interact with the user. For example in window interface all input and output is done in windows, the mouse is utilized quite often.