SCRAMDISK V2.02H USER MANUAL

FREE HARD DRIVE ENCRYPTION
FOR WINDOWS 95 & 98

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Contents

Disclaimer:

> "*No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks.*"
> -- Article 12 Universal Declaration of Human Rights

This program employs disk volume scrambling methods to prevent unauthorised access of stored data, which may be interpreted by some as being 'encryption', and therefore the use of this program may be restricted or forbidden in some countries.

It is not intended for use of storage of data illegal in your country, and such use is not the purpose of the program writers, in providing this utility software.

The program writers (who wish to remain anonymous) cannot be responsible for loss of data, due to any incompatibility of the program, running on any particular hardware, and/or software configuration.

By using the program, the person installing it, acknowledges their ***own*** responsibility to back up their important data, and is here advised to do so, before the installation of this software.

It is a condition of use, that data loss owing to any bug, error or failure of this program is not the responsibility of the program writers. If in doubt, backup your data before installation of this software, and if possible satisfy yourself of its current operation on a system which doesn't contain irreplaceable data.

The program writers cannot be responsible, or render any assistance, in the event of loss of passphrase needed to access scrambled data.

Introduction

> "*Why should you care if you have nothing to hide?*"
> -- J. Edgar Hoover

ScramDisk is a program that provides a virtual encrypted disk on Windows 95 & 98 machines. Basically, a container is created on the hard disk that is then mounted by the ScramDisk software. This software creates a new logical drive letter through which the disk is accessed. The important thing is that any data written to the new logical drive is encrypted with the algorithm of your choice.

This document doesn't include an introduction into the way encryption works.

There are existing programs that already provide this functionality under Windows 95 & NT, but ScramDisk is currently unique for a number of reasons:

1. It is a fully functional virtual disk based encryption system that runs under both Windows 95 and Windows 98.

2. It is free to use with absolutely no restrictions.

3. The source code is available for peer-review and further program development with very few conditions (See the section License Details).

4. It has been developed in the UK and, for the time being at least, can be exported electronically from the UK. Even if the law changes in the future, it is hoped that ScramDisk will by then be widely disseminated.

5. It is impossible to prove that a large file held on a drive is a ScramDisk virtual disk container without knowing the pass-phrase. The ScramDisk container files do not have to have a standard file extension and contain no file headers that indicate the file is anything but random data. Use the program DieHard to test the 'randomness' of a ScramDisk virtual disk.

6. It can be seen as a work in progress. It is hoped that people with the correct skills will take the software and enhance the functionality by adding both new features and new encryption algorithms. The program includes an extensible architecture, which enables new algorithms to be added with minimal fuss.

7. The program executables are very small and can be carried on a 31/2" floppy disk.

8. The program allows you to hide a file-system in a WAV file. This is known as steganography.

9. It is far harder to mount a Dictionary or Brute Force attack against ScramDisk compared to any of the competitors.

10. "Red Screen" for password entry that prevents the passwords from being sniffed by a program such as Skin98 or Back Orifice.

System Requirements

ScramDisk has very meagre system requirements in order to run:

- A PC capable of running Windows 95 or 98
- At least 1Mb of free disk space for the ScramDisk installation.
- Space to create the ScramDisk volume files. This could be either space on a FAT16 or FAT32 drive, a blank partition, or a large WAV file in the case of steganography.

Installing ScramDisk

ScramDisk is distributed as a ZIP file named SDisk.zip, which is downloadable from the ScramDisk homepage (http://www.scramdisk.clara.net/). Once the zip file has been downloaded you need to extract the file to a suitable directory (for example 'c:\scramdisk\').

Known Problem: Do not try to install ScramDisk into the same directory that it was extracted.

Now run the file 'installdir\sdinstal.exe' and follow the instructions. Once the installation is complete the system will restart. Once the system has restarted you will then be able use the ScramDisk program to create and access encrypted volumes.

In the very unlikely event of complete system failure immediately after installation do the following:

1. Boot to DOS using the appropriate function keys
2. Delete the file "C:\Windows\SYSTEM\IOSUBSYS\SD.VXD"
3. Restart windows. The scramdisk won't work however as the driver will have been removed.

The path above assumes your windows directory to be "C:\Windows\", if it isn't then use the correct windows directory.

Removing ScramDisk

Load the ScramDisk application and choose the menu option 'File | Uninstall ScramDisk…'. You will be asked if you really wish to remove the ScramDisk program and the program will then restart the computer.

Using ScramDisk

This part of the documentation provides step-by-step guides to using the major features of ScramDisk.

Where there is more than one way to do something, the guide will give you each of the possible courses and the appropriate actions for each.

To get the most from this guide, it is worth spending a moment familiarising yourself with the conventions employed, as explained in the next paragraph.

Conventions

Items in **bold** refer to screen items; they may be a menu title, a menu entry or just an option in a dialogue box. When you encounter a **bold** entry, look at the ScramDisk screen and you should see the item there.

Items in [brackets] are usually the titles of sections within dialogue boxes, they will also be in **bold** because they are items that are present on the screen.

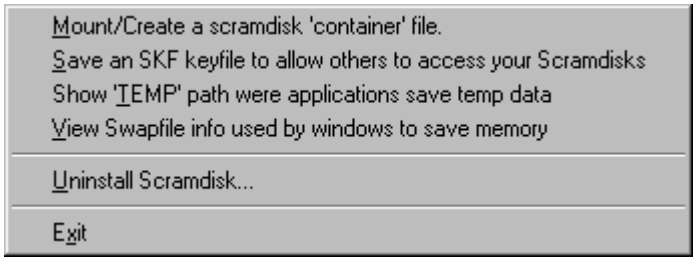
Items in `monospaced font` are command line entries, they are text that is typed directly at a DOS-box prompt.

Alternative courses of action are nested within the description of the parent process. Thus a course of action which can be performed in several ways will have –OR- as a separator between the different possibilities. This carries down so that further options are nested within the main possibilities. Look for different levels of indentation as a guide to this.

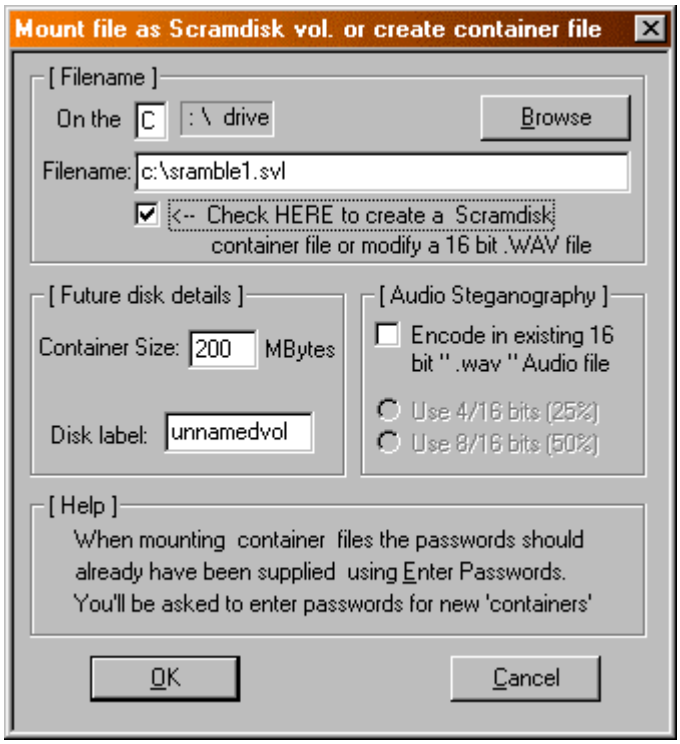
Creating an Encrypted Volume

At the main screen:

From the **File** menu, choose **Mount/Create a ScramDisk 'container' file**.



Fill in the resulting dialogue box according to the following instructions:



In the **[Filename]** section:

Tick the "**Click HERE to create a ScramDisk container file or modify a 16bit .WAV file**" checkbox.

> Enter the path for the encrypted volume as a combination of Drive and Filename (Filename may include directory path as well).
>
> -OR-
>
> If you wish to use Audio Steganography, enter the path to a suitable wave file or click the **Browse** button to locate it.

In the **[Future disk details]** section:

> Enter the size for the new volume (in Megabytes).

Give the volume a label, exactly as you would an ordinary logical drive.

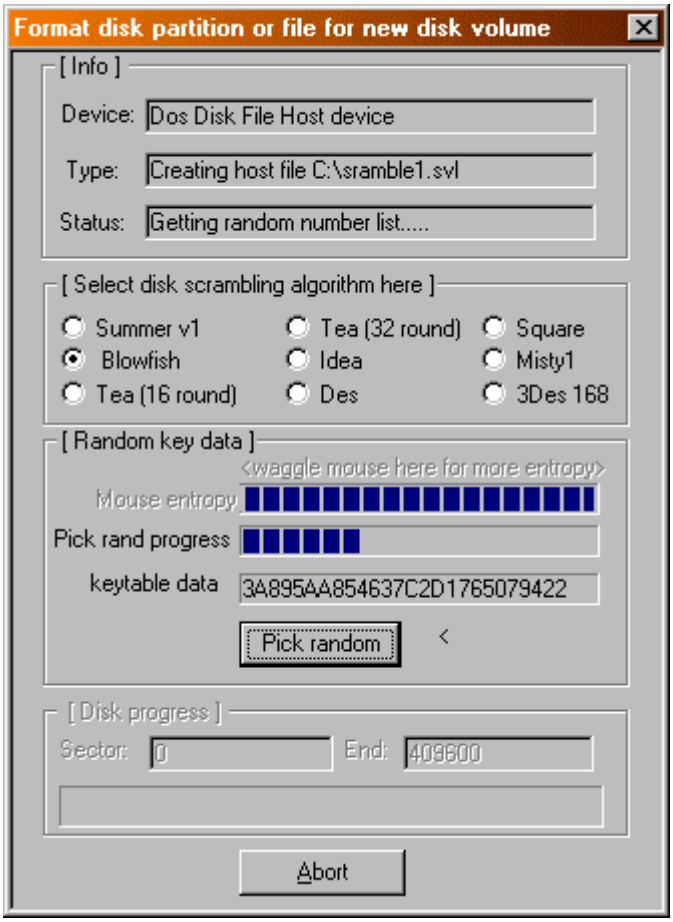
-OR-

In the **[Audio Steganography]** section:

Check the **Encode in existing 16bit** box.

Choose either to use either the least 4 or 8 bits of the file for the encrypted volume. This will give you an Encrypted Volume with a size equal to 25% or 50% of that of the Wave file, respectively.

Click the "**OK**" button to move to the Format screen.



In the section **[Select disk scrambling algorithm here]**:

Choose the algorithm you wish to be used in the encryption of the volume.

In the section **[Random Key data]**:

Move the mouse until a good portion, or preferable all, of the **Mouse entropy** gauge is filled.

Click the **Pick random** button until the **Pick rand progress** gauge is full.

-OR-

Click the **Pick random** button once, to pass the focus to it, then press the space bar until the **Pick rand progress** gauge is full.

In the Password screen:

Enter the passphrase be used by the algorithm.

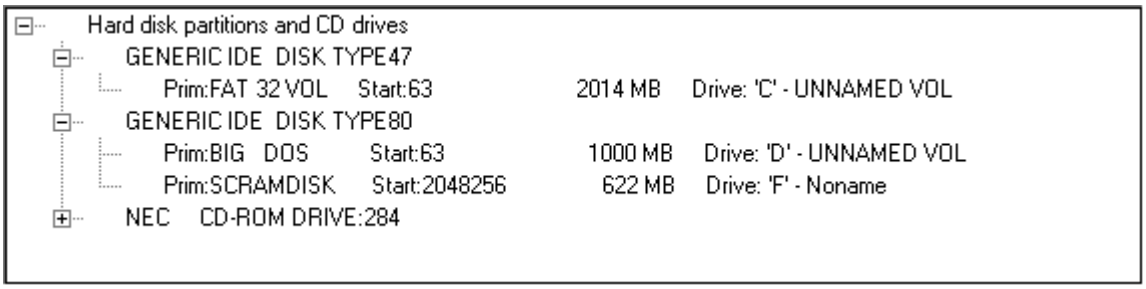
You will then be required to re-enter the passphrase to confirm it.

N.B. This phrase will be required to access the encrypted volume in future, so make sure you remember it and the positions in which you entered it!

The volume will now be created by ScramDisk. This may take some time, depending upon the size of the volume.

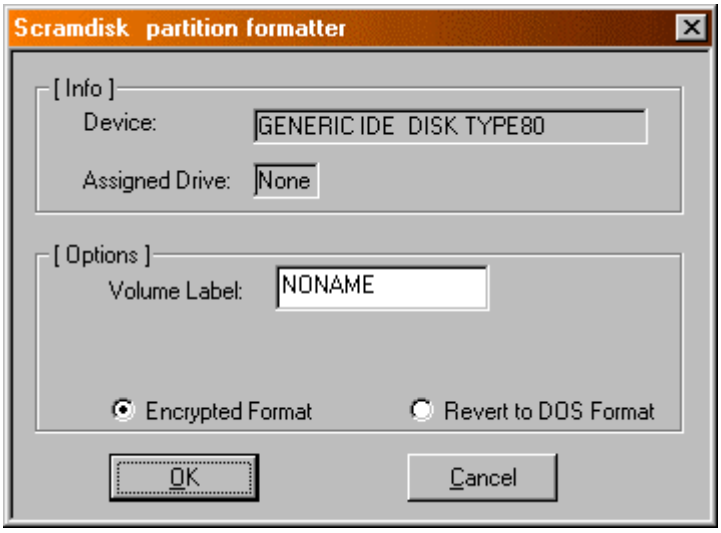
Creating an Encrypted Partition

In the centre portion of the main screen (see Screen descriptions further on in this guide) there is displayed a list of the devices attached to the system.

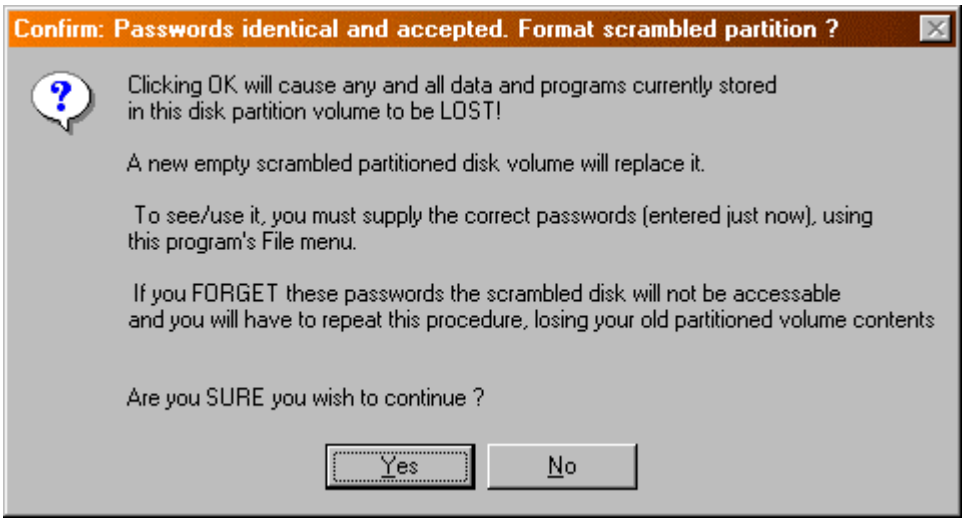


Double-click on the partition you wish to format with ScramDisk and a dialogue box will appear.

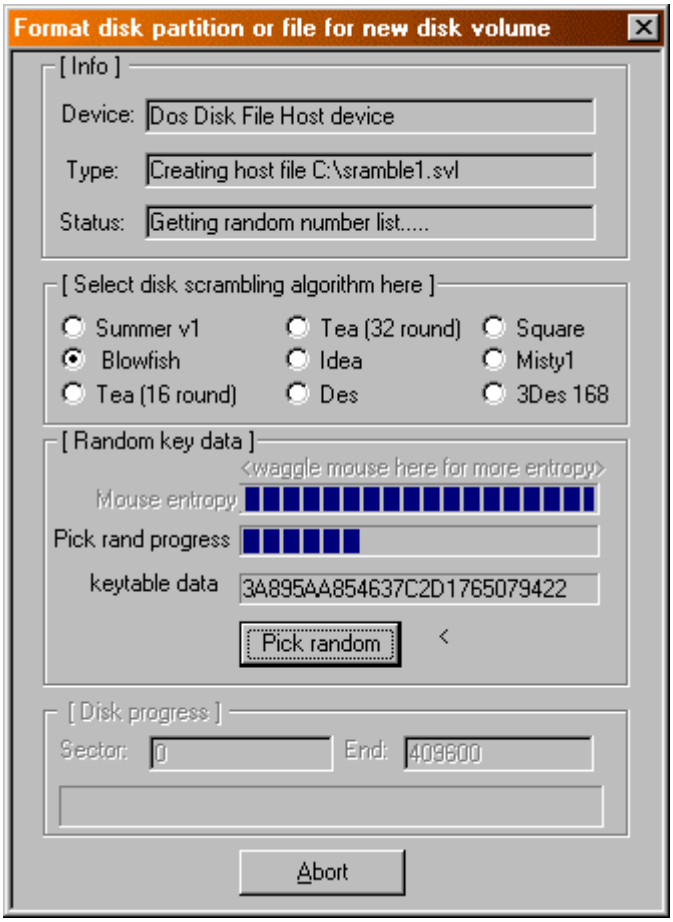
NOTE: You **must not** select a partition greater than 2Gb or the system **will** behave unreliably.



Choosing **Encrypted Format** and clicking OK will bring up a confirmation box.



Clicking **Yes** in this box will take you to a Dialogue box which is common to all the methods of creating encrypted volumes.



In the section **[Select disk scrambling algorithm here]**:

Choose the algorithm you wish to be used in the encryption of the partition.

In the section **[Random Key data]**:

Move the mouse until a good portion, or preferable all, of the **Mouse entropy** gauge is filled.

Click the **Pick random** button until the **Pick rand progress** gauge is full.

-OR-

Click the **Pick random** button once, to pass the focus to it, then press the space bar until the **Pick rand progress** gauge is full.

In the **Password** screen:

Enter the passphrase be used by the algorithm.

You will then be required to re-enter the passphrase to confirm it.

N.B. This phrase will be required to access the encrypted partition in future, so make sure you remember it and the positions in which you entered it!

The partition will now be formatted by ScramDisk. This may take some time, depending upon the size of the partition and the algorithm chosen.

Mounting an Encrypted Volume

At the main screen:

From the **Passwords** menu, choose **Enter ciphered disk volume passwords**

Enter the passphrase that you chose when you created the encrypted volume, in the same lines that you first entered it.

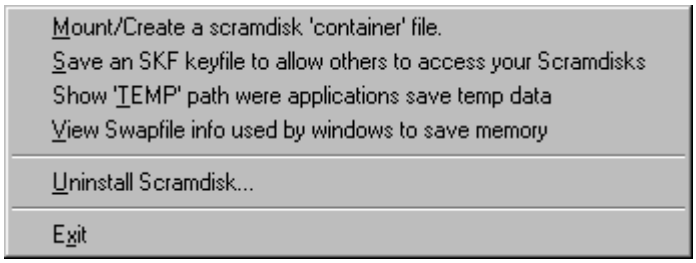
If you have associated the .SVL extension with ScramDisk (see How To… Associate extensions), double-click the filename in an Explorer / Open window.

-OR-

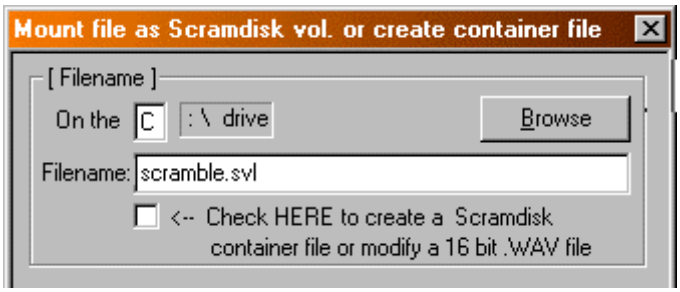
Drag the Encrypted Volume file from an Explorer / Open window and drop it on an empty slot.

-OR-

From the **File** menu, choose **Mount/Create a ScramDisk 'container' file**



Fill in the resulting dialogue box according to the following instructions:



In the **[Filename]** section:

Enter the path for the encrypted volume as a combination of Drive and Filename (Filename may include directory path as well, but not drive letter).

-OR-

Click the **Browse** button to locate it.

Make sure that the "**Click HERE to create a ScramDisk container file or modify a 16bit .WAV file**" checkbox is not ticked, then click the **OK** button to finish mounting the volume.

The mounted volume will now appear in the first free slot in the Main Screen.

N.B. See the instructions for setting volume preferences to alter the way the volume is presented.

Mounting an Encrypted Partition

Enter the passphrase for the partition by choosing "**Enter ciphered disk volume passwords** " from the **Passwords** menu.

If you have left the "**Don t scan HD partitions after entering passwords**" option un-checked in the **Timeout and Other Settings** dialogue box, then ScramDisk will mount any partition that the passwords have been entered for automatically.

If not, you must choose **Remount/Refresh** from the **SDPartitions** menu to make ScramDisk mount the partition.

Accessing an Encrypted Volume

Run ScramDisk and follow the instructions for mounting a volume.

The volume can now be accessed in a number of ways:

> From the Main Screen click on the mounted volume icon (see Main Screen description for further details).
>
> -OR-
>
> From Explorer / File Manager in the same way that any drive is accessed.
>
> -OR-
>
> From any file dialogue box, e.g. The **Start** menu **Run** command, the **File Open** dialogue box in any Microsoft Office application etc.
>
> -OR-
>
> From an MS-DOS box use the drive letter of the volume exactly as you would a local hard drive.

Operation of the encrypted volume is transparent to the user and application, save for a small performance drop, the magnitude of which is dependant upon the algorithm used and computational power of the PC.

Encrypted Volumes remain accessible until Windows is next shutdown. Since the VxD component is always loaded, you do not need to keep the ScramDisk utility running once the Encrypted Volumes have been mounted.

Dismounting Encrypted Volumes

At the main screen:

From the **Dismount** menu,

Choose **Dismount All**, to dismount all the currently Mounted Volumes.

-OR-

Choose **Dismount Brutal**, to brutally dismount all the mounted volumes. This will cause all volumes to be dismounted regardless of any open files or windows. ScramDisk will wait until 2 seconds have elapsed since the last I/O operation on the Volume, to allow for pending writes etc.

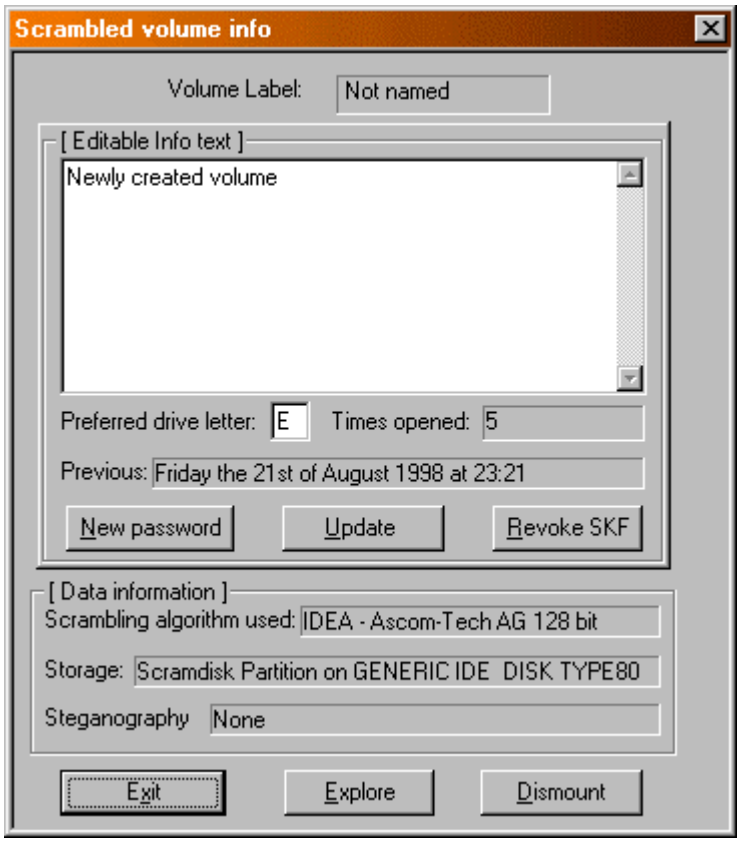
-OR-

If you wish to dismount a particular volume but leave the others mounted, right-click the Volume's icon in the main screen and click the **Dismount** button in the **Volume info** dialogue box.

Setting Preferences for an Encrypted Volume

At the main screen:

Right-Click on the slot with the mounted volume you wish to set preferences for to bring up the "**Scrambled Volume info**" dialogue box.



In the **[Editable Info Text]** section:

Add comments to describe the volume (optional).

Enter a drive letter that you would prefer the volume to mounted as. If none is entered then the volume is assigned the first available letter at the time it is mounted.

Click the **New Password** button to change the passphrase for the Volume.

Click the **Revoke SKF** button to revoke the rights any previously created SKF files have to access the Volume.

Click the **Update** button to save your preferences for the volume.

N.B. If you are going to run an application from within the volume, that has registry entries associated with it, then you should make sure the same letter is always assigned and available. A good way to do this is to choose a drive letter well into the alphabet (E.G. X:) to prevent a clash with your CD-ROM or other volumes.

This section also gives information on when the volume was last successfully mounted and how many times it has been successfully mounted so far.

The **[Data information]** section summarises the Encryption Algorithm, Encrypted Volume Storage name and the Steganography used (if any).

You can also explore or dismount the volume from this screen by clicking the **Explore** or **Dismount** buttons.

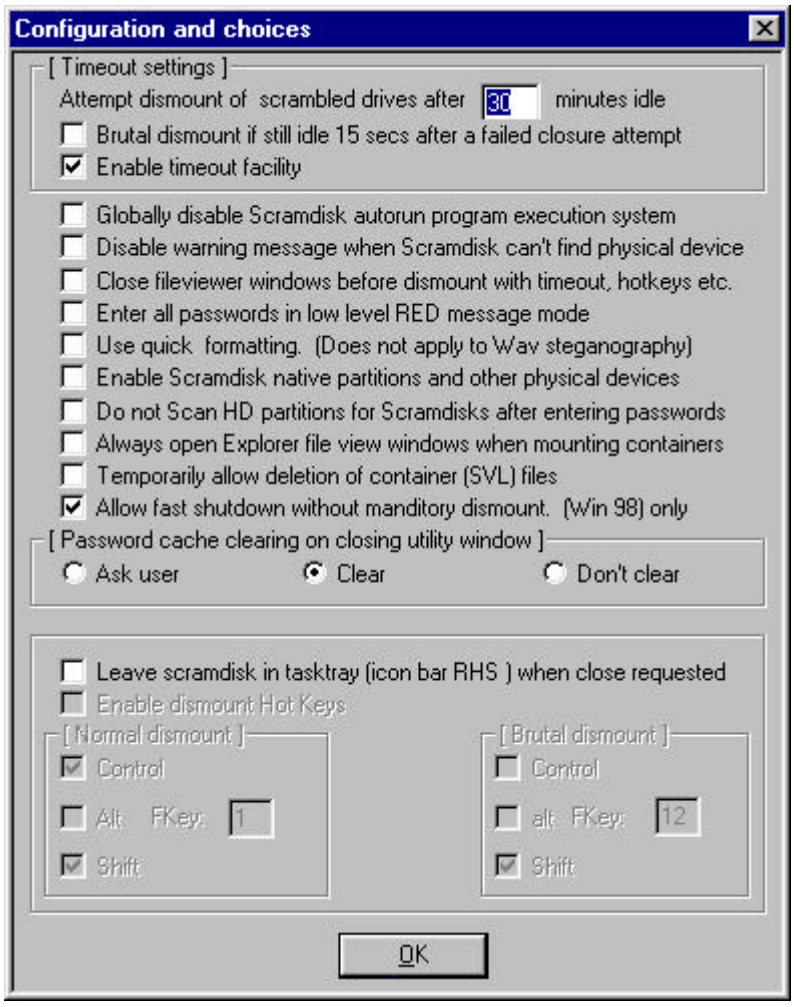
N.B. If you have changed the preferred drive letter for the volume, you must dismount and remount it for the change to be effected.

Using the Timeout Feature

At the main screen:

From the **Configure** menu, choose **Configure Scramdisk**

In the resulting dialogue box,



Check the "**Enable timeout facility**" box to activate this feature.

In the **[Timeout settings]** section:

> Enter the period of idle time (in minutes) that you want ScramDisk to wait before it attempts to dismount all mounted volumes. This may fail if there are open files from or windows on the Encrypted volume(s).
>
> Check the "**Brutal dismount if still idle 15 secs after a failed closure attempt**" checkbox if you want ScramDisk to forcibly dismount the volumes. This will happen 15 seconds after the first attempt if ScramDisk failed on that occasion.

Other settings that affect the timeout functionality of ScramDisk are:

"**Close fileviewer windows before dismount with timeout, hotkeys etc.**".

> Check this if you want ScramDisk to close any Explorer type windows that are open on encrypted volumes when it attempts to dismount them.
> Choosing this option makes it more likely that ScramDisk will dismount Volumes gently and hence successfully.

"**Enable dismount Hot Keys**"

> Check this box if you want to able to cause ScramDisk to dismount all Encrypted Volumes at the press of a key.
>
> For this to work you must check the "**Leave ScramDisk in tasktray…**" box which is also in this dialogue box.
>
> Once "**Enable dismount Hot keys**" has been selected you may use the options in the "**Normal dismount**" and "**Brutal dismount**" sections to choose key combinations for the Hot Keys.

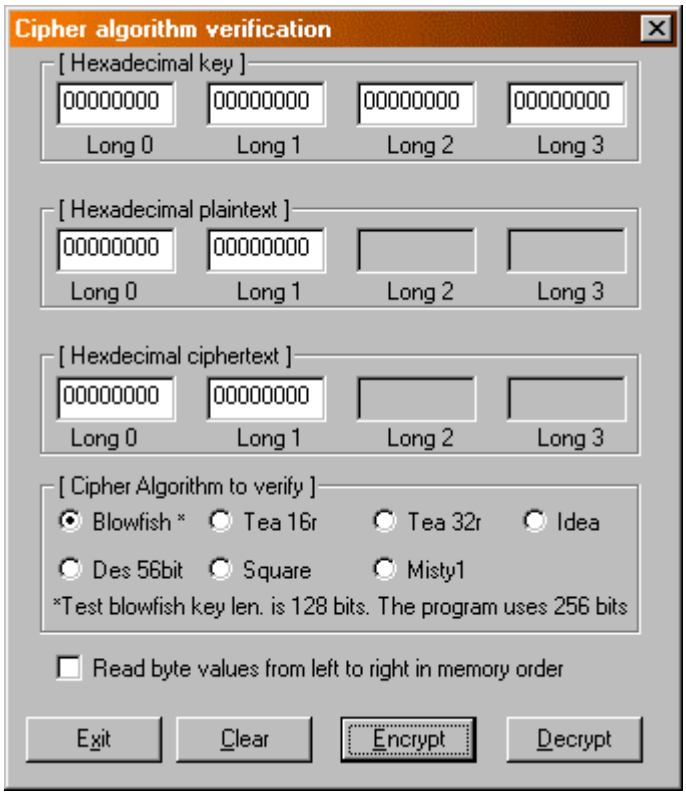
Other Settings in this dialogue box are explained elsewhere in this guide.

Verifying the Algorithms Used

Obtain a reliable set of plaintext, key and ciphertext for the algorithm you wish to verify.

At the main screen:

From the **About** menu, choose **Cipher verifier**. This will bring up the verifier utility.



In the **[Hexadecimal key]** section:

> Enter your 'known good' key.

In the **[Hexadecimal plaintext]** section:

> Enter your 'known good' plaintext.

In the **[Cipher Algorithm to verify]** section:

> Choose the algorithm to be tested by clicking the radio button beside it.

Press the **Encrypt button**.

Check the values in the **[Hexadecimal ciphertext]** section against your 'known good' ciphertext.

N.B. The reverse may also be tested by entering "known good" ciphertext and using the **Decrypt** button to produce the plaintext for comparison

See the section "Appendix A – Algorithm Test Vectors" on page 74 for details of published test vectors.

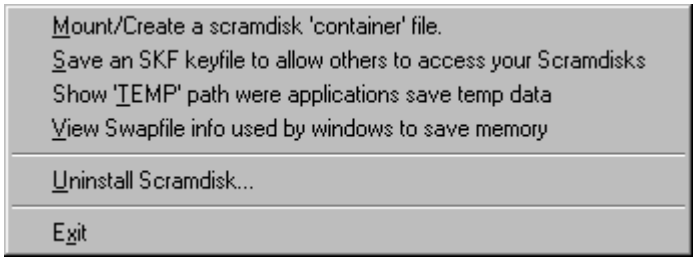
2nd User Access - Saving a Keyfile

Mount all the Encrypted Volumes that you wish the second user to able to access. Instructions for doing this are under "**How To Mounting an Encrypted Volume**".

Enter the passphrase for the keyfile. This is the only passphrase the 2nd user will need or see.

At the main screen:

From the **File** menu, choose **Save an SKF keyfile to allow others to access your Scramdisks**.



Give the Keyfile a name and save it to any location you wish.

The Keyfile is portable, but applies only to the system it was saved from and then only to the volumes that were mounted when it was saved.

A Keyfile's purpose is to allow others access to an Encrypted Volume without needing to let them know the passphrase for the volume itself.

N.B. Keyfile access to a volume can be revoked at a later date from the Volume information dialogue box.

Access via a Keyfile does not allow the user to access to the volume properties dialogue box, the volumes must be mounted with their own passphrase(s) for this to be accessible. Exceptions to this are Summer encrypted volumes whose Keyfiles still allow access to the Properties Dialogue box.

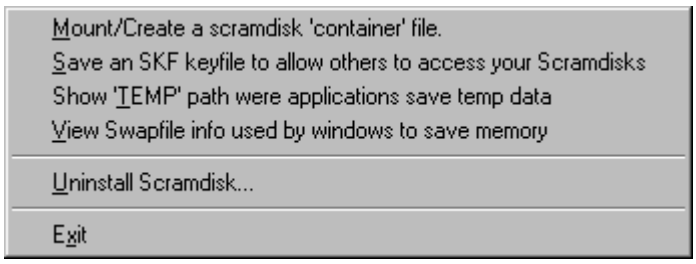
2nd User Access - Mounting Encrypted Volumes

At the main screen:

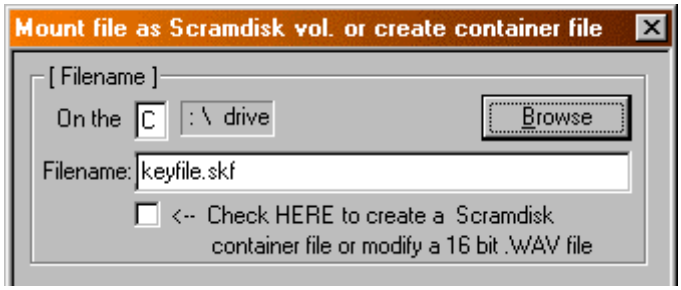
From the **Passwords** menu, choose **Enter Keyfile password [SKF access files],** this will bring up the password entry screen.

Enter the passphrase that you chose when you created the Keyfile volume, on the same lines that you originally entered it.

From the **File** menu, choose **Mount/Create a ScramDisk 'container' file.**



Fill in the resulting dialogue box according to the following instructions:



In the **[Filename]** section:

Enter the path for the Keyfile as a combination of Drive and Filename (Filename may include directory path as well, but not drive letter).

-OR-

Click the **Browse** button to locate it.

Make sure that the " **Click HERE to create a ScramDisk container file or modify a 16bit .WAV file** " checkbox is not ticked, then click the **OK** button.

The mounted volume(s) will now appear in the slot(s) in the Main Screen.

N.B. Keyfiles created with an earlier version of Scramdisk cannot be opened by V2.02. You should first revoke them (See How To… Setting preferences for an encrypted volume) and then recreate them using V2.02.

Associate Container and Keyfiles with ScramDisk

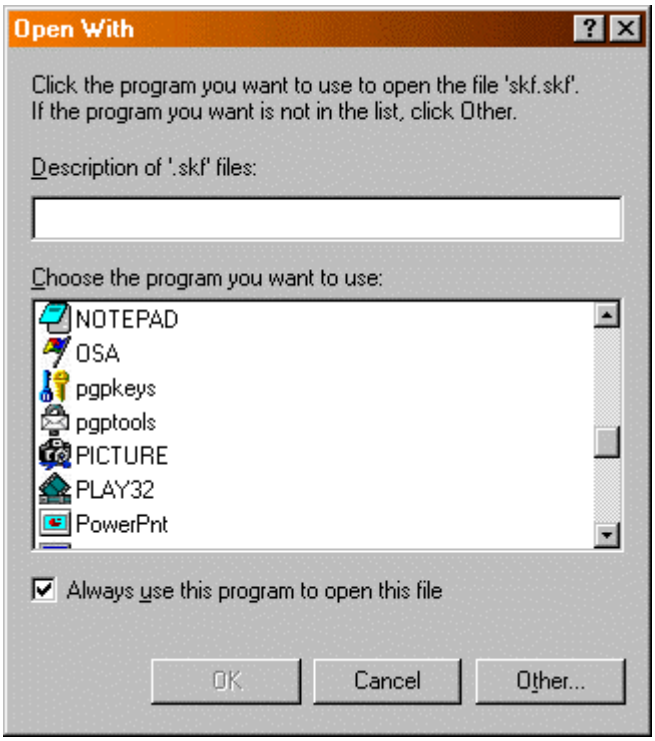
Open **Explorer** or **My Computer** and browse to an Keyfile (.skf) or a container file (.svl) file.

Left-click the file to select it (the name will then be in inverse text).

Hold down Shift and right-click the file icon.

Choose **Open With** from the menu that pops up.

A dialogue box will open:



Click the **Other** button and browse to the location of the ScramDisk.exe file (If you don't know where it is then use **Find** on the **Start** menu to locate it).

Select the ScramDisk.exe file and **OK** it.

Make sure that **Always use this program to open this file** is checked and ScramDisk is selected in the **Choose the program you want to use section**.

OK the choices.

When you next click on a Keyfile or container file, ScramDisk will open and request a passphrase (if it is not already cached).

Mounting Encrypted volume(s) or partition(s) at start-up

There are two different mechanisms for mounting volumes at start-up, which one you use will depend on the number and type of volumes you wish to mount.

For either method to work you must have first associated the file type with the ScramDisk executable. To find out how to do this read the section entitled "How To… Associate Container and Keyfiles with ScramDisk"

Use the table below to decide method is appropriate to you.

Encrypted Volume(s)	Method
Single, file container (.svl) type Volume	1 - Shortcut to file name
Multiple file container (.svl) volumes	2 - Shortcut to SKF file
Steganographic (.wav) volume(s)	2 - Shortcut to SKF file
Encrypted partition(s)	2 - Shortcut to SKF file

METHOD 1 SHORTCUT TO FILE NAME:

Open the **Start Menu** by right-clicking the **Start** button.

Browse to the **StartUp** folder (it's inside **Programs**).

Right-click on a blank space in the folder.

Choose **New** and then choose **Shortcut** from the menu that pops up.

Enter the path to your container (.svl) file in the **Command Line** box and **OK** it.

Give the shortcut a name and **OK** it.

Next time you start Windows, ScramDisk will open and request the passphrase for your container file.

Once entered, your Encrypted Volume will be accessible.

METHOD 2 SHORTCUT TO SKF FILE:

First mount all the container files and partitions that you wish to mount at start-up.

Save an SKF file according to the instructions in the "How To… 2nd User Access - Saving a Keyfile" section.

Follow **Method 1** but enter the path to your Keyfile instead of the path to a container file.

When you next start Windows ScramDisk will open and request the Passphrase for the Keyfile.

Once entered, your Encrypted Volume(s) will be accessible.

Autorun feature

ScramDisk v2.02h onwards contains a feature to allow a program or associated document to be executed whenever specific containers are mounted.

Create a shortcut inside a ScramDisk root directory ('f:\' for example) to something you want to be run or started (as if you'd double clicked on the shortcut) whenever the particular container is mounted.

Rename the shortcut to 'ScramDisk'

That's it! Every time the ScramDisk container is mounted, the application or data file pointed to by the shortcut is executed.

This feature is provided in response to people who moaned that applications could not be started in the Start "Startup" menu, if they were stored on ScramDisk. Now they can, if ScramDisk is started by the Start "Startup" menu, and the containers opened. ScramDisk will start the applications as set up.

It is possible to disable this feature from the Configuration dialog.

Command Line Access

ScramDisk supports the passing of parameters via the command line for the following actions:

Action	Parameter	Example
Mount[1]	Path to volume	`SCRAMDISK.EXE C:\myvolume.svl`
Mount [1a]	Path to file	`SCRAMDISK.EXE C:\mykeyfile.skf`
Normal Dismount	/DN	`SCRAMDISK.EXE /DN`
Brutal Dismount[2]	/DB	`SCRAMDISK.EXE /DB`

[1] ScramDisk will attempt to mount the specified volume with currently cached passwords. If the password(s) are not valid or none are cached, then the Password Screen will appear.

[1a] ScramDisk will open all volumes that the Keyfile was made for. You only get one chance to enter the password, if you get it wrong you must run the command again.

[2] Brutal Dismount will not dismount the volume(s) until there have been 2 seconds since the last I/O operation.

N.B. The parameters can be used with a shortcut to the ScramDisk executable (ScramDisk.EXE), but you must include the path to a volume in double quotes if it has spaces in it.

Screen and Menu Descriptions

This part of the documentation provides descriptions of the most frequently used screens and all the Main Screen menus.

The most frequently used screens are represented by a screen shot and accompanying text which explains the elements found in the screen.

All the menus from the Main Screen are represented by a screen shot and a description of the actions of each of it's items.

Conventions (Menu descriptions)

Bold items refer to menu options themselves.

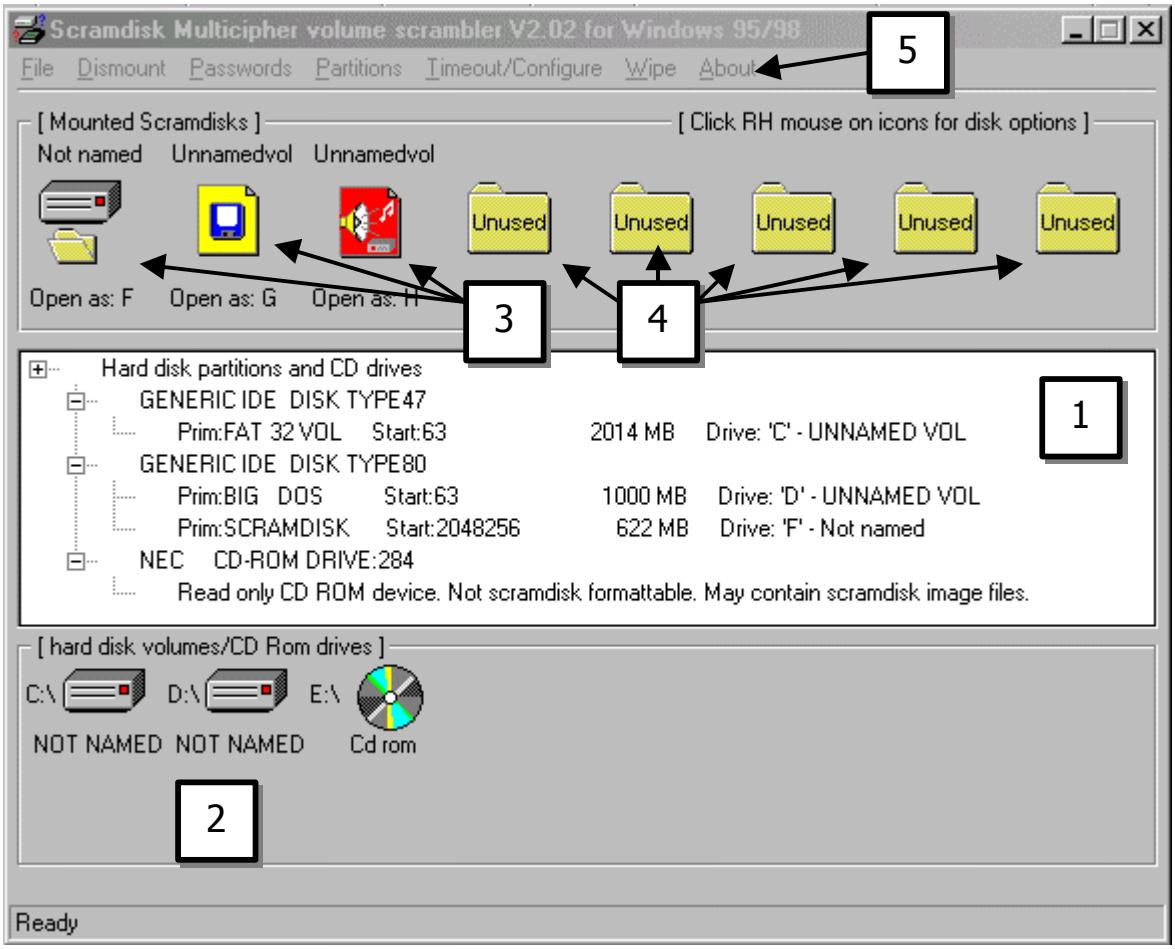
The text for each item is set as an indented paragraph.

Thus the overall style is:

MENU ITEM (bold, SMALL CAPS)

Description of item. (indented)

The Main Screen



Key to Figure:

1 This area displays the devices attached to the system. To format a partition as a ScramDisk partition simply double click on it. Warning! This will destroy all existing data on the partition! From v2.02g onwards, this area is, by default, hidden. Show this area by selecting the option in the Configuration dialog box).

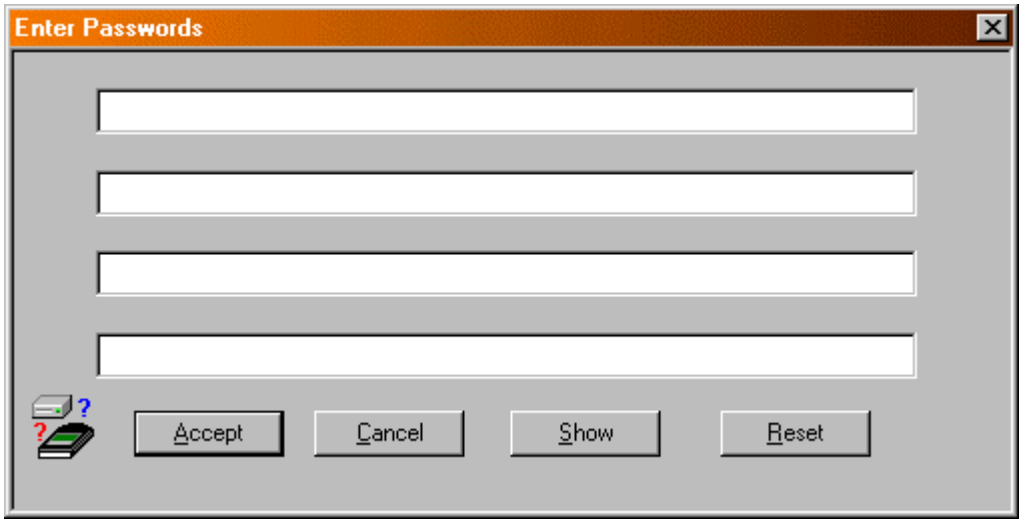
2 This area displays the first 16 Hard Disk volumes and CD ROMs attached to the system.
Left-Clicking an icon opens that volume.
Right-Clicking an icon opens that volume in an Explorer window.

3 This area shows mounted volumes and available slots.

4 Example 3 shows 3 mounted volumes (A partition, container file and stegonographic wave containner, respectively). Example 4 shows 5 empty slots.
Left-Clicking on an empty slot brings up the password entry screen, readying the slot for a volume to be mounted.
Left-Clicking on an occupied slot opens the volume.
Right-Clicking on an occupied slot displays the volume info dialogue box.

5 Menus.
See following pages for individual descriptions.

Password and Confirm Password Screens



[Disk volume passwords]:

This section contains 4 text boxes, for entering your passphrase, you may use as many or as few of the 4 lines as you need.

Use the **Tab** and **Shift-Tab** key(s) to move between the 4 text boxes.

Buttons:

Accept	Saves the passwords entered and closes the dialogue box.
Cancel	Closes the dialogue box with no action taken.
Show	Toggle between displaying passwords as asterisk placeholders or plain-text.
Hide	
Reset	Clears all the text boxes.

N.B. With the exception of the title-bar text, the Confirm Passwords Screen and keyfile Password Screen are identical to the Password Screen.

The Red Low Level Message Screen

This feature is designed to avoid the possibility of keyboard messages, between Windows and the application, being copied by another programme or process.

When enabled in the "**Configure**", this feature takes over from the normal windows password entry screens.

Instead you will be presented with a red screen, rather CGA like in appearance.

The screen serves exactly the same function as the windows password screens, with keys taking the place of buttons according to the following rubric:

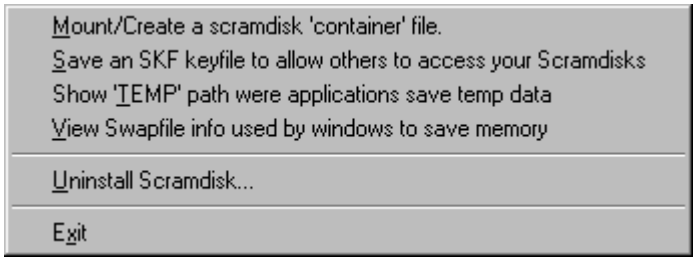
Key	Button
Enter	Accept
PageDown	Show
PageUp	Hide
Escape	Cancel
Home	Reset

In addition to the above keys, F1 enters a | (pipe) symbol and F2 enters a # (hash).

This feature should not be used when a keyboard other then a standard QWERTY type is used (e.g. a French keyboard).

Description of menu options

File



MOUNT/CREATE A SCRAMDISK 'CONTAINER' FILE:

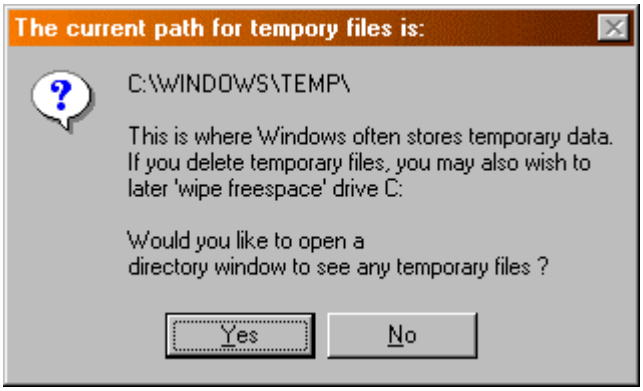
Used to create a new encrypted volume or to mount an already present one. See 'How To.. Mount an Encrypted Volume' for full usage.

SAVE AN SKF KEYFILE TO ALLOW OTHERS TO ACCESS YOUR SCRAMDISKS:

See the "How To... 2nd User Access" sections.

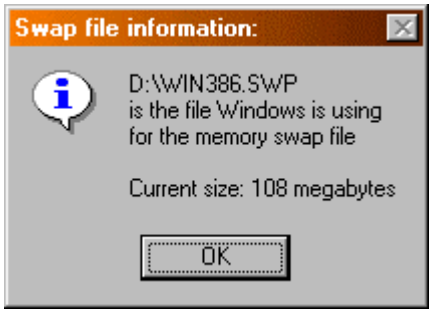
SHOW 'TEMP' PATH WHERE APPLICATIONS SAVE TEMP DATA:

Display the path to the directory where temporary data is saved by applications (the value of the TEMP environment variable), and allows you to explore that directory.



Data saved here is not encrypted and therefore represents a possible avenue for data theft.

VIEW SWAPFILE INFO USED BY WINDOWS TO SAVE MEMORY:



Windows 'pages' out data from memory that is not needed immediately to disk, as means of providing 'Virtual Memory'.

Data saved in this 'virtual memory' swapfile is not encrypted and therefore represents a possible avenue for data theft.

See also the **Wipe Menu** section for help on wiping the swap file slack.

UNINSTALL SCRAMDISK:

Completely removes the ScramDisk programme and driver from the system.

EXIT:

Exits ScramDisk, offering you the choice of whether to clear the password cache before doing so.

N.B. Your Encrypted volumes will still be accessible until you restart windows or use ScramDisk to dismount them.

Dismount

DISMOUNT ALL:

Dismounts all mounted volumes.

DISMOUNT BRUTAL:

Brutally dismounts all the mounted volumes.

See “How To… Dismounting Encrypted Volumes” for more information.

Passwords

ENTER CIPHERED DISK VOLUME PASSWORDS:

Brings up a dialogue box for entering your passphrase in preparation for mounting or creating an Encrypted Volume.

ENTER KEYFILE PASSWORD (SKF ACCESS FILES):

Brings up the Enter Passwords screen for you to input the passphrase you will use to restrict access to a Keyfile.

See the "**2nd User Access**" entries in the "**How To** " section, for usage instructions.

CLEAR ALL PASSWORDS CACHED IN DRIVER ETC:

Clears any passphrase held in memory by both the VxD component and the ScramDisk interface.

N.B. If the "**Enter all passwords in low level RED message mode**" setting is enabled then both the first two menu items will use this rather than the standard windows password screens.

Partitions

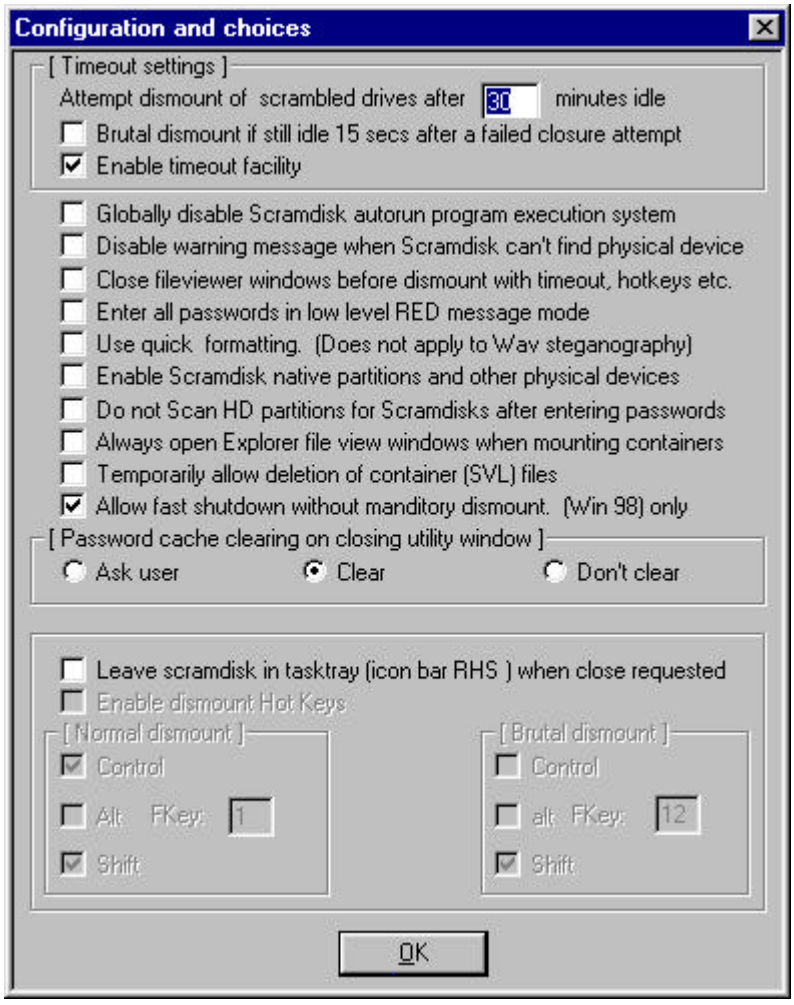
REMOUNT/REFRESH:

Updates the Device / Partition window and causes ScramDisk to attempt to mount any Encrypted Partitions for which it has a cached passphrase.

Configure

CONFIGURE SCRAMDISK:

Invokes the dialogue for configuring the timeout feature and other settings.



See the "**How To** " sections on:

"**Using the timeout feature**" for a description of the majority of these settings.

"**Creating an encrypted volume**" for the use of the "**Use quick formatting (Does not apply to Wav steganography)**" setting.

See the "**Screen Descriptions and Menus**" section on "**The RED Low Level Message Screen**" for an explanation of the effect of the "**Enter all passwords in low level RED message mode**" setting.

Globally disable ScramDisk autorun program execution system

Turns off the autorun feature present in v2.02h.

DISABLE WARNINGS WHEN SCRAMDISK CAN T FIND PHYSICAL DRIVE:

Usually ScramDisk warns you that the physical media type cannot be verified, which is not a problem if the disk resides on a normal, local, hard drive. If the ScramDisk volume being mounted resides on a network drive or on removable media then ScramDisk issues a warning. This option disables the warning and was added at the request of several users.

CLOSE FILEVIEWER WINDOWS BEFORE DISMOUNT WITH TIMEOUT, HOTKEYS ETC:

Select this option to automatically close all explorer windows viewing contents of encrypted volumes when drives are dismounted by timeout or hotkeys.

Use quick formatting:

Check this if you don't want ScramDisk to wipe the entire disk before allowing you to use it. This speeds up the formatting operation, but may not be as secure as existing files can potentially be recovered.

ENABLE SCRAMDISK NATIVE PARTITIONS AND OTHER PHYSICAL DEVICES:

Default off. Turn this setting on to view the physical partitions connected to the machine.

DO NOT SCAN HD PARTITIONS FOR SCRAMDISKS AFTER ENTERING PASSWORDS:

Tells ScramDisk not to perform a scan of hard disk partitions when you enter a new passphrase.

ALWAYS OPEN EXPLORER FILE VIEW WINDOWS WHEN MOUNTING CONTAINERS:

Sometimes Windows 95 or 98 opens an Explorer window (when a container is double clicked from an existing explorer window for example). This feature allows you to specify that ScramDisk behaves consistently regardless of the mechanism used to open the container.

TEMPORARILY ALLOW DELETION OF CONTAINER (SVL) FILES:

ScramDisk v2.02g onwards contains a feature preventing the accidental deletion of SVL files. If you do really need to delete a container file, then simply tick this option, delete the file, and then finally deselect this option.

ALLOW FAST SHUTDOWN WITHOUT MANDITORY DISMOUNT (WIN 98) ONLY:

This feature allows you to close a Windows 98 computer down without first having to dismount all ScramDisk volumes. This option has no use under Windows 95 as this system will not reliably close down with mounted volumes.

[PASSWORD CACHE CLEARING ON CLOSING UTILITY WINDOW]:

Allows you to specify whether ScramDisk clears passwords from its cache when the utility is closed.

LEAVE SCRAMDISK IN TASKTRAY (ICON BAR RHS) WHEN CLOSE/EXIT REQUESTED:

Causes ScramDisk to remain as an icon in the Systray after it has been closed. This option is necessary to enable dismount hotkey functionality.

Wipe

FREE SPACE:

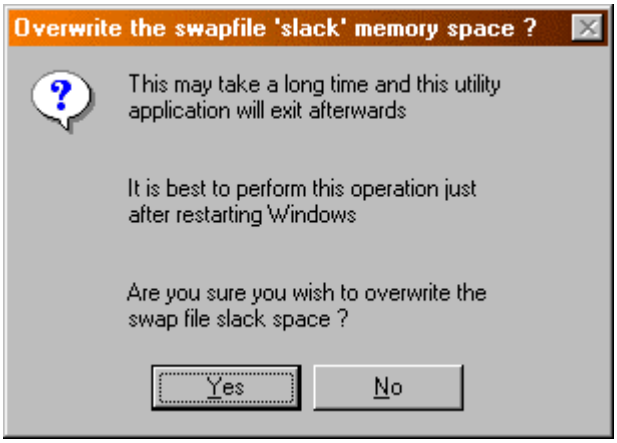
Causes ScramDisk to write random data to all free space on the disk. This prevents the acquisition of data from the remains of deleted files.

You can specify the drive you want ScramDisk to wipe the free space on and the number of times it is to repeat the operation (i.e. passes).

Free space usually still holds the data that was there when the files it previously constituted were deleted.

Wiping free space securely erases previously deleted files such that they cannot be restored by Undelete or by a disk sector editor.

OVERWRITE SWAPFILE SLACK:



Any slack left when the swapfile contracts may contain data, overwriting the slack securely clears any data in it.

About

ABOUT:

Credits and Version information.

REVIEW LICENCE:

An opportunity to look over and re-confirm or refuse the licence you agreed to by using this software.

CIPHER VERIFIER:

Invokes a utility that allows you to verify that the algorithms used by ScramDisk produce the same ciphertext as 'known good' implementations published elsewhere.

See the 'How To... Verify the algorithms used' section for usage.

Theoretical Attacks against ScramDisk

Introduction

There are two types of attacks that can be applied to most modern cryptosystems:

i) A Dictionary Attack. This involves trying every item in a dictionary against the container. If the password is in the dictionary then the attacker "gets lucky".

ii) A Brute Force Attack. This involves trying every possible password against a ScramDisk container. This is a **very** long shot, as will be described later.

This section of the document attempts to describe how feasible such attack is against ScramDisk.

Q: Is weaker than PGPDisk / BestCrypt etc?

A: No. In fact this has reaffirmed our suspicion that SD is *stronger* against a brute force attack than these packages. Each password attempt in ScramDisk takes approximately .5 seconds (on a P166) – this is a terrible rate for a Brute Force attack.

Q: Why do you state that these attacks are "hard" against SD?

A: The unencrypted ScramDisk volumes do not contain an indicator to which cipher was used to encipher the disk. Every time you try to dismount a disk, the following occurs (at a minimum):

a) 1x SHA-1 of the passphrase
b) And for each of the ciphers (there are currently 9):
    i) 1x Blockcipher initialise
    ii) 2x Blockcipher decrypt

For some block ciphers (e.g. BlowFish) the cost of an initialise is very large.

In most disk encryption programs, the enciphered volume contains an indicator as to which cipher is used – thus brute force attacks are aided.

Q: How (in)feasible are these attacks?

A: Depends how daft you've been with you're passwords ☺ If you have used a reasonable password (see the next question!) then this attack has absolutely no chance of working. Some simple example attacks follow[1]:

Dictionary attack:

100,000 words against 1 single password line = 1 second
100,000 words against 2 password lines = 1 day
100,000 words against 3 password lines = 300 years
100,000 words against the 4 password lines = 3 Million years

Brute Force attack (against a single line):

7 characters (the minimum password length) with a..z alphabet = 22 hours
7 characters (the minimum password length) with a full alphabet = 7 years
11 characters with a full alphabet = 3 Million years

It should be fairly obvious that, even with unrealistic hardware, an attack against a well-chosen password is infeasible.

[1] Example figures assume 10,000x PII 450Mhz chips running in parallel and assume that a single chip can do 100 tests per second (which is very optimistic – a P166 can only do 2 per second!).

Q: What type of passwords will these attacks find?

A: Short passphrases, passphrases containing just words in the dictionary & passphrases constructed from a small alphabet. See the section "Q: What makes a good passphrase?" in the FAQ section for details of how to select a "good" passphrase.

Q: Surely any system could be made to resist a Brute Force or Dictionary attack?

A: It is possible to clarify information security into two groups:

i) Security provided through cryptographic mechanisms.
ii) Security provided through obscurity.

A common attempt to defeat a Dictionary or Brute Force attack is to put delay loops into the code that tests a password / passphrase. Replacing these machine code operations with NOPs easily circumvents this "security" - thus no real security is afforded by the inclusion of this loop.

Real security, as provided in SD, cannot be circumvented via this strategy: SD doesn't store the type of cipher that is used to encrypt the disk in the header (as does BestCrypt, a "competitor" to SD). So, basically, for every trial passphrase that you wish to try you have to undertake at least 1x SHA-1 operations, 1x block cipher initialise & 2x block cipher decryption's FOR EACH CIPHER (there are 10 ciphers).

Thus both of the previously mentioned attacks are FAR harder against SD compared to PGPDisk, BestCrypt et al. We conjecture that SD is more than 10 times harder to brute force than its competitors.

Technical Overview

The Encryption Process

The process of creating an encrypted disk is independent of the algorithm chosen. All disk containers are created in the following manner. When mounting a disk (assume one algorithm is only available) the procedure is:

1. The first 2048 bytes of the container are read into a buffer.

2. The user's password (up to 160 text bytes and assuming the correct one) is passed to SHA-1 for hashing to a digest value.

3. The chosen cipher algorithm is initialised with the key from the digest of SHA-1 obtained in (2)

4. The 2048 bytes in the buffer read in (1) are then decrypted with the chosen algorithm initialised with the digest value.

5. The MASTER KEY data (up to 256 bits) stored in the buffer+1024 is retrieved. This value has been decrypted in stage (4) along with the other data.

6. The chosen cipher algorithm is reinitialised with the correct length of bits as retrieved in (5) (256 for blowfish etc.....) This is the same key that is now used to decrypt the whole of the disk.

7. Two sectors which were filled with identical but random data (encrypted with the MASTER KEY at format time as are all data areas) are read, and decrypted with the master key, and IVs etc.

8. If these two sectors now produce identical data, the KEY/ IVs can be assumed to be correct, and windows is called to initialise the disk. Otherwise the driver returns without doing anything more.

9. If all is well Windows sees a new disk, all access which will go through the sd.VxD code via DCBs for the new device. The "Calldowns" in the DCBs call the correct code to decipher all the relevant sectors etc.

So, to summarise: Your passphrase is hashed with SHA-1 which unlocks 2 areas on the disk. An area containing the random values to be used for IV's and pre-whitening[2]. Another totally separate section that contains the key to be used for the encryption and decryption of the sectors on the disk. This key is then used as the key in the conventional encryption algorithm. The same key is used for all sectors on the disk, which doesn't matter as a different IV is used for each sector.

The two areas of random data are in no way related.

[2] As per pg 366 Applied Cryptography 2nd Ed

Supported Encryption Algorithms

> "*The irony of the Information Age is that it has given new respectability to uninformed opinion.*"
> --John Lawton

ScramDisk supports a number of algorithms in the first release. All Algorithms are used in CBC mode using a random value as the IV. Additionally, another random value is used to obfuscate the link between the plaintext and ciphertext (this process is called 'pre-whitening'). The algorithms are as follows:

- **3DES**. This is far better than DES; it uses 3 applications of the DES cipher in EDE (Encipher-Decipher-Encipher) mode with totally independent keys. Outer-CBC is used. This algorithm is thought to be very secure (major banks use it to protect very valuable transactions) but it is also very, very slow.

- **Blowfish**. This is a high security encryption algorithm designed by Bruce Schneier the author of Applied Cryptography and owner of the company Counterpane. This algorithm is very fast, is considered secure and is resistant to linear and differential analysis. This is my personal cipher of choice. NOTE: ScramDisk uses the bug free Blowfish code.

- **DES**. This is the Data Encryption Standard algorithm designed in the early 1970's by IBM (with input from the NSA). It is OK, but a single key can be broken in 3 days by a poorly funded organisation (the EFF!) ☹. This algorithm was provided for completeness, but it is quite slow and considered weak due to the key length.

- **IDEA**. This is a cipher produced by Xuejia Lai & James Massey. It is fairly fast and is considered secure. It is also resistant to both linear and differential analysis. To use this cipher in anything other than personal use you need to pay a royalty to Ascom. See the license details later in this document for information on royalties.

- **MISTY1**. This is an algorithm designed by M. Matsui of Mitsubishi. It is a reasonably fast cipher that is resistant to both linear and differential analysis. It is fairly new though, so use it with caution.

- **Square**. Square is a very fast and reasonably secure block cipher produced by John Daemen and Vincent Rijmen. It hasn't been subject to as much peer review as Blowfish, 3DES, IDEA etc. so may be succeptible to attacks.

- **Summer**. This is a proprietary stream cipher constructed by the author. It is designed for speed alone. It is supplied in the program for backward compatibility with version 1 of ScramDisk and is not recommended for use on newly created disks. Instead use TEA or Blowfish, which are both reasonably fast.

- **TEA**. Tiny Encryption Algorithm is a very fast and moderately secure cipher produced by David Wheeler and Roger Needham of Cambridge Computer Laboratory. There is a known weakness in the key schedule so it is not recommended if security is the prime consideration. TEA is provided in two forms, 16 & 32 rounds. 32-rounds are obviously more secure than 16, but also slower.

Algorithm Summary

The following table details the performance of the different algorithms:

Algorithm	Author	Implementation	Block Size (bits)	Key Size (bits)	Speed (m:s)
3DES (3-key, EDE)	Diffie & Hellman	Assembler	64	168	4:05
Blowfish	B.Schneier	C	64	256	0:55
DES	IBM & NSA	Assembler	64	56	1:42
IDEA	Xuejia Lai & J.Massey	Assembler	64	128	1:07
MISTY1	M.Matsui	C	64	128	2:50
Square	J.Daemon & V.Rijmen	Optimised C & ASM	128	128	0:39
Summer (Stream)	Aman	Assembler	N/A	128	0:31
TEA (16 Rounds)	D.Wheeler & R.Needham	Assembler	64	128	0:46
TEA (32 Rounds)	D.Wheeler & R.Needham	Assembler	64	128	1:03

The column 'Speed' gives performance figures for all of the ciphers. The times are based upon copying a 50Mb file from a normal disk to a ScramDisk disk on a Pentium 166mhz. Copying the same file from disk to disk (e.g. not to an enciphered volume but just disk to disk) took 28 seconds.

Frequently Asked Questions (FAQ)

Q: What can I store on my computer with ScramDisk?
A: Anything you can store on any other Windows disk, apart from ScramDisk file images. They cannot be recursively stored on other ScramDisk disks. Otherwise programs, data, anything.

Q: What does the license mean in plain English?
A: There has been several questions regarding the precise meaning of the license. The following should help to clarify. Individuals and companies can use ScramDisk to protect data within the following guidlines:

i) The software is not offered commercially by any business or individual to any business or individual.
ii) The software isn't used to encrypt commercial data offered on open sale to the public by way of retail, such as DVD, other video films, music, or computer programs or data.
iii) We take no responsibility for any loss of data, or other loss, however caused.
iv) IDEA needs licensing for commercial use.

Basically we don't want people making money out of our hard work, or the hard work of some of the cipher developers & implementers.

Q: How would someone know if ScramDisk is installed?
A: The following basic (and necessary) changes are made to the system:

- The file "C:\windows\system\ioSubSys\sd.vxd" is added. This is the driver software.
- The file "c:\windows\scramdisk.ini" is added. This is the file that holds the SD configuration.
- The file "*installpath*\scramdisk.exe" is added. This is the main executable.

Q: What cipher is best?
A: I don't know! In fact, nobody knows. Some ciphers are certainly known to be "weak" (e.g. they succumb to published attacks). Just because a cipher doesn't succumb to all known attacks doesn't mean that it is "proven" to be strong – just that it is relatively strong to "weak" ciphers. It is thought unlikely that a block ciphers strength will be proven anytime soon[3].

Saying that, I think it is appropriate to offer some guidance to users:

- 3DES is thought to be extremely strong, but may be too slow to use for all ciphered disks.
- IDEA and Blowfish are good choices – they are both thought to be secure against all know attacks.
- I personally like Blowfish because of its larger key size, very reasonable speed, lack of licensing issues and robustness against attack.
- IDEA needs licensing for commercial use. See section "IDEA Conditions of use and required notice:" on page 58 for details.
- Summer is weak.
- TEA, Square & MISTY1 are OK but are all relatively new.
- DES is certainly weak against a determined adversary (due to its small key size).

Q: What is that horrible "red screen" into which I have to type passwords?
A: This screen is a ***very*** low-level mechanism provided in Windows 95 that is usually used for critical error messages. By entering a password into this screen, rather than a conventional password dialog

[3] From the TwoFish paper: "any reasonable proof of general security for a block cipher would also prove P ≠ NP"

box, you prevent certain “sniffing” programs like Skin98 from being able to read the keystrokes that make up your passphrase.

Q: What kind of "disk" does Windows see on a ScramDisk disk?

A: Windows "sees" a standard FAT 16 disk in all cases. The data may actually be stored in a partition, or on a file on FAT32, or FAT16, in a CD FILE on CDFS, even at the other end of a network.

Q: If I create a virtual disk with ScramDisk, can I defrag it, and repair it like other FAT disks?

A: Defrag can be run on a "Scramdisk" disk just as it can be run on any standard disk. Scandisk can be run to repair any possible faulty DOS structure, just as a standard disk. Indeed the system doesn't know it isn't a standard disk!

Q: What about FAT32 support?

A: There is limited support for FAT32 in ScramDisk, it is possible to create a ScramDisk volume file on a FAT32 disk but it is not possible to create a FAT32 volume. All ScramDisk containers currently have to be formatted with the FAT16 file system – this restricts ScramDisk volumes to a maximum of 2Gb in size.

Q: Where are the passwords stored on the disk?

A: They are not. The disk is mounted statistically, not by comparing passwords. There are two sectors with the same (randomly derived data) having different sector keys. The data on these sectors with an incorrect password look different. Only when the correct password is supplied, creating the correct pair of keys (one for each sector) will the two sectors show the same data, and the passwords be assumed correct.

Q: Can anyone see the file names I've stored on the disk, when it is inaccessible?

A: No. The boot sector, directories, File Allocation Tables, and data are all scrambled using the algorithm of your choice.

Q: How do I back up my files, stored on ScramDisk disks?

A: Just as you usually would. However, if they are to remain secure, you will need to back them up on to a second ScramDisk drive. Just open both drives, and drag and drop the files, in windows from one to the other. Another option is to backup the entire encrypted volume.

Q: ScramDisk doesn’t work with x?

A: ScramDisk *should* work with all applications, but there are issues with some applications, for example JBN. 9 times out of 10, users who report problems with ScramDisk are actually doing something wrong, for example:

1. Trying to create to many files in the root directory of a drive.

2. Trying to do something with a read only file.

Obviously, these errors can occur on any type of disk. Please report any application issues to the author.

Q: Does ScramDisk work with DOS ?

A: ScramDisk is a Windows VxD driver system, with a Win32 utility application. It will work perfectly well within a DOS prompt under Windows, and allows the use of DOS utilities to access its disk in the normal way, but of course, it won't work unless Windows 95 is the underlying operating system. There is a DOS version of ScramDisk, but only one which will read ScramDisk partitions rather than file hosts.

Q: Do I have to have the "Scramdisk.exe" utility program running on the desktop when I am using my ScramDisk disks?

A: No. The VxD driver "SD.vxd" installed in the "..\system\iosubsys" directory does all the horsework. Unless you wish to close disks or open new ones, you can quit the utility program, when you have finished with it.

Q: Why doesn't it work on Windows NT?

A: Windows NT uses a completely different driver model, called the Kernel Mode Driver (KMD) which requires a different knowledge base to program. Windows 95/98 uses "VxDs" and the "IOS" for disk drivers. The two are completely different, and incompatible. Hopefully some kind soul will help the cause and help produce an NT version. The new Windows Driver Model that comes with NT v5 & Windows 98 will not help either, as this only covers display & multimedia drivers.

Q: What if I forget my passphrase?

A: Assume that you have lost your data! It would not be a very secure system if I could tell you how to get it back, would it?

Q: What makes a good passphrase?

A: Several pieces of advice can be given to users who have the task of choosing a passphrase:

1. Make the passphrase as long as possible. The passphrase can have 39 characters per line and there are 4 lines – so a passphrase can be up to 156 characters.

2. Try and make use of both upper and lower case letters.

3. Include both numbers and punctuation characters, such as ; : , . ! " £ etc

4. Try not to pick a single word or a well-known piece of literature – this will enable a dictionary attack on the system.

With ScramDisk, mounting a dictionary attack is a very time consuming task – for each password that is unsuccessfully tried the following is necessary: 1xSHA-1 followed by 1xinitialisation and 2xblock decipher **for each algorithm** – this is because the algorithm used to encipher the disk is not stored.

Q: Help! Parts of my passphrase appear in the enciphered volume!?

A: Statistically this is to be expected. For example, if you create a 100 Mb enciphered volume then it is expected that each 3 character combination (e.g. AAA, AAB, AAC etc) will appear approximately 16 times: $(100*1024*1024)/256^3$. Thus the users passphrase will most likely appear in the enciphered volume in 3 letter blocks.

This occurs because encrypted data looks like random numbers - it would be possible for ScramDisk to check and ensure that parts of the passphrase do not occur – but this would enable analysis. Since $(16*1024*1024)/256^3 = 1$, you would expect, on average, to see every possible 3 character combination in a 16Mb file.

Do be concerned if 5 letter chunks of your passphrase occur in the volume though – the chances of this happening accidentally are extremely small.

Q: How can every disk I create look different, even if I create the disk using the same password and algorithm and put the same data in it?

A: You will never generate the same master key table. The chances of doing so are astronomically remote. It is this master key table that is scrambled with your password and the unscrambled table which (un)scrambles the data on your disk. No two master key tables are alike -unless you copy a ScramDisk host file elsewhere.

Q: Is there anything I should not do?

A: Don't copy ScramDisk host files (ones which "contain" a ScramDisk disk) and then start to use them separately. For each new disk you wish to create, you should use the creation facilities/partition formatter provided in the utility program. This ensures greater security. If you did copy a host file and continue to use it then both drives would operate with the same IV's and pre-whitening values (because they have the same random data at the start of the disk), which could aid cryptanalysis.

Q: Why was the program produced?

A: Why was PGP produced? Why not? If we honestly believed that strong cryptography was going to cost lives or threaten national security, we would have been morally and ethically obliged not to develop or release the package. But the truth is, there has not been a convincing argument from any political or lawmaking group as to why strong cryptography shouldn't be produced, used, distributed and sold.

I personally like the 'keys' analogy. We don't have to give the Government copies of our home and work door keys, so why should we afford them the same privilege with the keys to our data? The police are welcome to access my data with a valid court order in the same way that they can enter my house with a valid search warrant.

I also like Phil Zimmerman's 'postcard' argument. When people send letters they use envelopes to ensure a level of security, they don't send letters without envelopes because they don't have to. Sending letters within an envelope is considered acceptable because everyone does it. Everyone should have the right to use strong crypto.

The real reason the American (and UK?) government are opposed to strong-crypto is that they are provided with far too much intelligence from monitoring communications to allow the proliferation of strong crypto, which would make there job necessarily harder. Read **Puzzle Palace** and **For the President s Eyes Only** if you don't believe us!

Both myself and the Author of the program are IT professionals without criminal records (not even driving endorsements!). We are neither "law breakers" nor "anarchists" - we just believe that privacy should be a right and that strong cryptography should be accessible to anybody who wants it.

We do not condone the use of ScramDisk for purposes illegal in the jurisdiction of use.

Q: What other similar software exists?

A: Jettico's Bestcrypt, and PGPs PGPDisk. They are of course incompatible with each other, and use different scrambling algorithms. BestCrypt uses Blowfish / GOST/ DES, PGPDisk uses CAST. ScramDisk (being free) is the cheapest. Jettico refuse to release the source code of BestCrypt.

Q: Are there "international" issues?

A: Just the one: the low-level Red Screen should be avoided if you are using anything other than a QWERTY keyboard.

This user manual is currently being converted to French & Russian.

Q: Why does an explorer window appear when I mount a ScramDisk volume? Can I disable this functionality?

A: This "feature" is provided for two reasons:

1. Without calling an Explorer window showing the new drive, applications and other Explorer windows will not be updated to reflect the new drive – this is confusing for many users.

2. Windows 95/98 is inconsistent – even without calling the Explorer window, *sometimes* one is created automatically by the operating system. The author decided that it was best to make the operation consistent.

Currently, it is not possible to disable this functionality.

Q: Why does ScramDisk include so many ciphers?

A: When the program was first announced, several users criticised the program because it contains too many algorithms for three main reasons:

1. Having a large number of algorithms to choose from may confuse users.

2. It would be better to have a program that implements a few algorithms and works rather than implement loads of algorithms and is flakier.

3. No security is afforded by offering more than one algorithm.

Both the author and myself believe there are good arguments for having plenty of algorithms:

1. The default option of Blowfish is provided which is a fast and secure block cipher with no known attacks better than brute force despite having been subjected to fairly extensively cryptanalysis. If users don't know about all the different algorithms then this is a reasonable default choice.

2. All algorithms have been implemented using well-known code from the web, rather than being completely rewritten. It is highly unlikely that any of the code is defective, as all ciphers have been checked against the Test Vectors freely available on the web. Users can check Test Vectors for themselves using a mechanism built into the program.

3. Even if a defective algorithm were added to the program, it would only cause the program to act improperly when this algorithm is chosen. The security of the system as a whole will not be compromised, only disks created with the algorithm.

4. We believe that security is certainly added by including multiple ciphers. Nowhere on the virtual disk is a record of which algorithm is used to encrypt the disk. Thus someone who wishes to 'crack' an encrypted disk will have to first determine which algorithm is used. Generally, encrypted data looks like random numbers, so doing this is not a trivial task!

5. In response to point 3 above; if the program were to be supplied with one built in cipher and it was later discovered that this cipher was weak then all users of the program would have encrypted disks that are also weak. This would mean that the program would be useless until someone added another cipher! Users of ScramDisk can choose whichever algorithm they have most faith in. The author thought it improper to dictate to all users which algorithm they can use. At least now they have a reasonable choice. Really, the choice of algorithm can be seen as part of the key.

6. No algorithm is perfect for all situations; some data may just need 'low-security' encryption that is not noticeably slower than no encryption whereas some situations require a very high level of security. 3DES is arguably the most secure cipher, but is very slow, TEA however is the opposite; it is extremely fast, but may not be secure against a well-funded adversary.

7. If users have read the above, and still believe that they wish to have ScramDisk with one cipher, there is nothing to stop them from removing all the other ciphers and recompiling the program.

Q: What backdoors exist in ScramDisk?

A: To the best of our knowledge, none. We have no motivation to produce a defective program, so draw your own conclusions. Oh, and inspect the source code if you are so inclined!

ScramDisk is not totally secure (and nor is any security program!). There are a number of ways an attacker may try infiltrating your system:

1. Look for applications that leak data. A very well known word processor has an interesting bug that leaks the parts of the raw contents of the disk when saving an OLE Compound Document.

2. Look for data that isn't deleted securely. Ok, everyone knows that you can undelete a file easily. Did you know that even a file that has been 'wiped' can potentially be recovered by looking at the surface of the disk. Deleted files should be securely wiped using an appropriate program (PGP v6 contains a secure file-wiping program – users of PGP v5.x should be aware that the file wipe functionality is possibly insecure).

3. Look for data that has leaked in other ways. Temporary files and the swap file spring to mind. These both need to be securely erased too.

4. Using a "Tempest" type attack. Basically, electrical emissions from the monitor, hard drive and even keyboard can be detected and recorded from a distance away. This may allow an eavesdropper to see what is on your screen or detect your pass-phrase as you type it.

5. Brute Forcing. This can happen in a number of ways: they can try brute-forcing your pass-phrase or they can try to brute force the algorithm. To thwart the first attack it is important to use a large pass-phrase that isn't easily guessed, it helps to use both upper and lower case and numbers as well. This is hard work (and will take around 2^{127} operations with most of the ciphers included with ScramDisk - DES & Summer are exceptions).

6. Some of the ciphers included may be susceptible to attacks not known about in public. The NSA/GCHQ ***may*** have a mechanism faster than brute-force of attacking the algorithms. We have not included any weak algorithms in the original distribution (apart from Summer, which is included for backwards compatibility), but who can tell what the Intelligence Agencies can do with Blowfish, IDEA, 3DES et al?

7. Install an amended version of ScramDisk on your computer that secretly stores your pass-phrase so that a CIA agent can later read it. (Or use a program like SKIn98 to do it!) Far fetched? Possibly, but you should be aware that this kind of attack exists. There is no real way to defend this attack. Check the PGP Signatures of the ScramDisk files against the executables on your computer, but could your copy of PGP have also been amended?

8. Beating you until you spill your pass-phrase. Truth drugs also work, apparently.

The author has done as much as he can; giving you a program which offers ciphers that are believed to be strong, contains no key recovery mechanisms, is distributed with source code so you can independently verify the operation of the program and offers PGP Signature files so that you can check the authenticity and integrity of the package. The rest is up to you!

Q: How do I remove a ScramDisk container I no longer need?

A: The new version of ScramDisk contains container protection – it may protect you from simply deleting a container file. Instead you may have to unload the VxD (by deleting it for example) and then you can remove the physical file.

Q: What version of Blowfish is implemented?

A: The bug free version!

Q: Why can't I specify hotkeys?

A: You need to ensure that the "Leave ScramDisk in the systray" option is selected before you can specify the Hot Key information.

Q: Why don't you implement feature x?

A: As previously explained, ScramDisk is a work in progress. We are constantly being asked "Why don't you implement x". Time! A single person currently undertakes development so we can't add all of the features that all users want. See the list below of features we will certainly not be implementing:

Feature requested	Reason for not implementing
Disk compression	This is seriously hard work! It is either add this feature or work on an NT version… Also - hard drives are cheap!
Automatic disk size expansion	Again, this would be hard work. If you need the feature badly, start coding it yourself ☺
Adding cipher x	We have said that we would like to add well respected ciphers to ScramDisk. We do not, however, want to see "weak" ciphers added to ScramDisk. The cryptographic community decides what is "strong" and what is "weak". For example we won't be adding ROT-13 anytime soon! We also do not wish to add ciphers that are encumbered by patents – we believe that there are a sufficient number of strong, unpatented algorithms available.
Re-encipher disk	Potential problems if power is lost etc.

Program Rationale

This section aims to detail why ScramDisk works the way that it does.

Q: Why do you type the passwords in first?

A: So they can be used again and so any hard disk partitions that use them, will be opened. Once a password is entered, it can be used for all disks that were formatted with it, until you clear the password cache (in the application) or type more that 8 in. In that case it goes off the end of the password list.

Q: Why can't you double-click on a ScramDisk host file to start the mount the disk?

A: Any type of file can be used as a host file. This is deliberate; it makes ScramDisk volumes harder to spot.

It may be noticed that as little use of possible is made of the system registry and file types. This is deliberate. It is not necessary to register the software with the system, so it can be removed almost without trace if required. The win32app Scramdisk.exe can even be contained on a floppy disk drive if need be. The driver "sd.vxd" has to reside in system\iosubsys directory; there is no alternative. But that can be simply removed.

Certain possibilities have to be cast aside, if the use of the system registry is to be avoided. One of these is to be able to click on a cabinet file, and run the app. Future versions will allow you to set up the file extension and association yourselves. In the meantime, you'll have to be satisfied with BROWSE and "Drag and Drop" from the Scramdisk.exe application.

Q: Why don't you get an error, when your passwords are incorrect?

A: To give an error, would make it obvious the file was indeed a scrambled file (rather than a file full of junk, and in the case of WAV, an untouched music file). The fact that files are untyped, and all possible ciphers have to be "tried" against them, means that errors are meaningless. ScramDisk does not know the file isn't a valid file. It only knows when it has valid passwords, and other data, to convert bytes into their correct values, which then give us a win95 disk!

Q: Why can't you change your passwords?

A: From v2.02 onwards it **is** possible to change the password associated with a volume. This, unfortunately, still doesn't completely re-encipher the disk – it only re-enciphers the key area at the start of the disk. Totally re-enciphering the disk can be problematic in the event of power failures.

Q: Why does a key disk file not open new disks I format with the same password?

A: Key disks were designed to allow others to access ***particular*** disks, whilst keeping your passwords secret. The data in a key disk file, contains information to decode those absolutely unique disks that were mounted on ScramDisk, when the key disk was created. The data on the key disk file is enciphered "as if" the key disk password was used when the disk was formatted. Your own access password is never involved when a ScramDisk is opened with a key disk.

Future Developments

> "*Those who cannot remember the past are condemned to repeat it.*"
> -- George Santayana

ScramDisk is a work in progress. Version 2 is the first version to be released in the public domain. It is hoped that people from around the world will help to further develop ScramDisk. The author and myself have highlighted a number of areas for future development. They are listed in order of importance, with the most important item first:

1) Make the user interface easier to use. Possibly provide command line tools to mount / dismount drives etc, allow the program to associate itself with a file extension (.SVL?) if the user wishes.

2) Develop a version of ScramDisk for Windows NT and Linux.

3) Change the architecture so it is more standard and modular. The program ignores some C conventions, which I believe can be easily rectified. Also it needs to be altered so it is easier to add new ciphers and hash algorithms.

4) Add additional ciphers[4]. This program already has a fair number of well-respected ciphers, but we would like to see more added. Why? See the FAQ section for details… We are particularly keen to see the other very good-looking AES candidates added, namely Serpent, TwoFish & Rijndael. ScramDisk works best with algorithms with the following characteristics:

    i) Slow key-initialisation but fast encryption speed (in preference to quick initialisation and slow encryption speed).

    ii) A low amount of key-dependant data. This data has to be reserved in non-swappable kernel memory, so the smaller the better.

5) Add additional hash algorithms. Currently the system only supports SHA-1 which is OK, but should a major weakness be found, the whole program will be useless and all disks created with ScramDisk may be compromised. Either RIPEMD-160 or Tiger is probably the best choice.

6) Change the implementation of Blowfish, Misty1 & Square from straight C to assembly language or at least use an optimised C version.

7) Add the enhanced version of TEA (called TEAX) which solves the key schedule problem. This will probably need to be added alongside the existing implementation to provide backward compatibility.

If you are interested in further developing the program, either in one of the areas listed above or in another direction, please contact us. We are very keen to co-ordinate the development effort to ensure that each build is free from bugs and, as far as possible, is compatible with other versions. We would also like to keep a definitive version of the program on the web-site (along with any other release builds).

Maybe developing ScramDisk further would make an interesting under-graduate final year project?

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[4] We do not want to see patented algorithms added to ScramDisk. We believe that there are a sufficient number of strong, unencumbered algorithms available without worrying about licensing block cipher algorithms. We cannot support the addition of either the IBM AES entry or the Rivest AES entry while intellectual property issues exist.

Program Revisions

This section has two purposes; It outlines the various versions of ScramDisk that are in circulation and also lists some known problems that are to be / have been solved.

Program Versions

Version	Release Date	Details Of Release
V2.02h	1st Apr 99	Option to no longer ask if passwords are to be cleared. Added auto-execution facility. Allow fast automated shutdown under 98. Several intermittent bugs fixed.
V2.02g	17th Nov 98	Fixes several bugs: Dismount inaccessible container, shutdown problems, 100% CPU idling. New feature: Protect SVL from deletion.
V2.02e	10th Nov 98	Fixes several bugs: FindFast, no free drives, DieHard, 98 freezing under heavy load, Agent & JBN. ScramDisk now does not change the Last Modified date on WAV files. New features: Show physical device list & and option to not show explorer window.
V2.02c	20th Sept 98	Fixes several bugs: Quick Format under 98, recursive password box problem, "freeze" in Explorer problem. The documentation has been corrected in several areas and is also now available in Adobe Acrobat format.
V2.02	24th August 98	Solves the following bugs: BestCrypt, Window Fonts, Log off / log on bug, SKF bug, Intermittent freezing bug (caused by buffer misallocation). Enhancements include: • Can now have 8 mounted volumes rather than 4. • Very low level (Red) password entry screen that stops SKIN98 etc. snooping key-presses. • 16 (NORMAL) devices can be displayed rather than 8. • Shows last opened time & date of an enciphered volume. • Minor changes to Cipher Verification form. • Now allows forced dismount of drives. • Option to minimise to system tray. • Option to disable "No physical" warning message. (For Bear) • Hotkeys for dismount and brutal dismount. • Some command line options have been added. (To Mount container / dismount/ dismount brutal). • Can now change the passphrase used to access a disk (though this doesn't re-encipher the disk). • Now possible to revoke SKF access. • Completely rewritten User Manual. • Now comes with a small example app that demonstrates mounting disks programmatically. • Option to disable "No physical" warning message. (For "Bear").
V2.01	21st July 98	An interim build of ScramDisk that solved the BestCrypt bug. Not widely distributed.
V2.00	14th July 98	The first release given to the public. Contains the following ciphers: 3DES, Blowfish, DES, IDEA, Misty1, Square, Summer, TEA (16 & 32). SHA-1 is the sole hash algorithm and the program supports 8 & 4 bit WAV steganography. This version now works under '98.
V1.00	20th Nov 97	First release. Contains only the proprietary cipher 'Summer'. This was

not publicly released.

Bugs

The following 'bugs' have been found and will be fixed in due course. To report new bugs send an e-mail address to Sam Simpson at the address given in the 'Contacting the author' section.

Problem	Date first noticed	Resolved in version
ScramDisk causes CPU to cycle at 100% on some machines.	10th Nov 98	2.02g
Using ScanDisk or Defrag on a drive holding a ScramDisk container causes a Blue Screen Of Death. Both of these programs try to close RING0 files.	27th Oct 98	N/A
Sometimes locks up under heavy load (Windows 98 only).	19th Oct 98	V2.02e
Find Fast from Office 95 & Office 97 causes ScramDisk to hang when opening a ScramDisk volume.	13th Oct 98	V2.02e
Open containers become inaccessible when the drive it is hosted on has the scrandisk or defrag program run against it. You can't even dismount the container.	Oct 98	2.02g
Windows 95 OSR2 – Windows fails to send a Kernel32shutdown message, which causes ScramDisk to lock when shutting the system down. Recommended that users dismount all drivers before shutting the system down.	9th Oct 98	2.02g
Problems when JBN runs on a ScramDisk Volume	21st Aug 98	V2.02e
Problems when Agent runs on a ScramDisk Volume	16th Sept 98	V2.02e
ScramDisk fails DieHard tests because a 100 byte unused area of the disk is full of zeros. This does not affect the security of ScramDisk.	1st Oct 98	V2.02e
Quick format may not function correctly under Windows 98.	13th Sept 98	V2.02c
Intermittent freezing when clicking on Explorer windows.	5th Sept 98	V2.02c
Password dialog box keeps appearing, even when cancel pressed.	3rd Sept 98	V2.02c
When users log off then back on again (e.g. without shutting down) ScramDisk may refuse to load.	18th Aug 98	V2.02
Document rather than folder icon in main display window.	24th July 98	V2.02
Timeout doesn't work in some circumstances when the ScramDisk executable isn't loaded.	19th July 98	V2.02
Program locks computer totally when trying to mount a ScramDisk disk when there are no drive letters available. This can be caused by either using all available drive letters or having a "lastdrive=***x***" line in the config.sys	17th July 98	V2.02e
IE4 (and thus Windows 98) has some problems with redraws in Tree Views.	11th July 98	V2.02
BestCrypt and ScramDisk don't coexist perfectly. To do with BestCrypt creating lots of ports that ScramDisk thinks are real hard disks.	21st June 98	V2.02
Intermittent freezing bug – caused by buffer misallocation.	20th June 98	V2.02

The fonts under the drives don't appear properly when Large fonts are used.	20th June 98	V2.02
Failure to open WAV files, later in a windows session, means your machine cannot allocate the locked buffer needed. No error is given, just failure to access your WAV based disk. The buffer is only (permanently) allocated when a WAV file is first used. Mount the WAV early in the Windows session to avoid this. Future versions will give an error and/or have an option to claim the buffer at system start-up. Normal ScramDisk container files and partitions are not affected.	20th June 98	V2.02

License Details

> "*Legality? That particular aspect didn't enter into the discussions.*"
> -- Benson K Buffham, Deputy Director NSA

ScramDisk can only be used if you agree with the following terms and conditions:

1. You accept the creator of this software cannot be responsible for ***any*** loss of data however caused (including by any incorrect operation of this software program despite 'best efforts') and you agree to back up any files that you consider important before you use this software on your system.

2. You agree the creator of this program is anonymous, but wishes to retain copyright and commercial rights to this software.

3. You agree not to redistribute this software in any form other than that in which it was received by you, and will include all files exactly as present when it was so received, if you do distribute it.

4. You agree in the event of loss, or forgetting of passwords used by this software, no technical support can be given to assist in recovery such passwords. Forgetting any passwords, EQUATES to loss of your data when that data is stored on any disk partitions, or disk drive images created, and opened by the execution of this software. You accept no back doors exist, to gain access to scrambled data.

5. You agree that some of the ciphers used are the intellectual property of others, and may need a licence for commercial use, such as use on a business system. You acknowledge this is especially true in the case of the IDEA algorithm and will read the documents regarding the Ascom conditions of use of IDEA, which can be found at the bottom of this page.

6. You agree that if you obtain the publicly available source code, and amend it you will submit the amended program and new source code to the originators for publication, and understand that these amendments shall not violate compatibility with older versions of the software or reduce security levels in any way.

IDEA Conditions of use and required notice:

This Software/Hardware product contains the algorithm IDEA as described and claimed in US Patent No. 5,214,703, EPO Patent No. 0482154 and filed Japanese Patent Application No. 508119/1991 "Device for the conversion of a digital block and use of same" (hereinafter referred to as "Algorithm").

Any use of the Algorithm for Commercial Purposes is thus subject to a license from Ascom Systec Ltd. of CH-5506 Mägenwil (Switzerland), being the patentee and sole owner of all rights, including the term IDEA.

Commercial Purposes shall mean any revenue generating purpose including but not limited to:

i) using the Algorithm for company internal purposes (subject to a Site License).

ii) incorporating an application software containing the Algorithm into any hardware and/or software and distributing such hardware and/or software and/or providing services related thereto to others subject to a Product License).

iii) using a product containing an application software that uses the Algorithm (subject to an End-User License), except in case where such End-User has acquired an implied license by purchasing the said product from an authorised licensee or where the End-User has already signed up for a Site License.

All such commercial license agreements are available exclusively from Ascom Systec Ltd. and may be requested via the Internet World Wide Web at http://www.ascom.ch/systec or by sending an electronic mail to IDEA@ascom.ch. Any misuse will be prosecuted.

Use other than for Commercial Purposes is strictly limited to data transfer between private individuals and not serving Commercial Purposes. The use by government agencies, non-profit organisations etc. is considered as use for Commercial Purposes but may be subject to special conditions. Requests for waivers for non-commercial use (e.g. by software developers) are welcome.

Resources

See the ScramDisk web page for a link of Web links to interesting sites covering cryptography and information security. Anyway, I highly recommend the following books:

Cryptography and Information Security

Applied Cryptography - 2nd Edition, B.Schneier, 1996.
ISBN: 0-471-11709-9
Bible for crypto-wannabies and professionals alike. THE definitive piece, need I say more?

Handbook of Applied Cryptography, Menezes et al, 1996.
ISBN: 0-8493-8523-7
Heavy and comprehensive! A "*must buy*" book.

Cryptography - Theory and Practice, Douglas R Stinson, 1995.
ISBN: 0-8493-8521-0
Another great book.

A **Course in Number Theory**, Neal Koblitz, 1994.
ISBN: 0-387-94293-9
Mathematical aspects of crypto.

Decrypted Secrets, F.L.Bauer, 1997.
ISBN: 3-540-60418-9
Good discussion of older cryptanalysis.

Computers and Intractability, Michael Garey & David Johnson, 1997.
ISBN: 0-7167-1045-5
A guide to the theory of NP-completeness. Heavy but rewarding reading!

Computational Complexity, Christos Papdimitriou, 1994.
ISBN: 0-201-53082-1
A comprehensive review of algorithmic complexity.

Cryptography and Data Security, D.Denning, 1983.
ISBN: 0-201-10150-5
Sound cryptography introduction.

Security in Computing - 2nd Edition, C.Pfleeger, 1997.
ISBN: 0-13-185794-0
Covers both cryptography and the wider issues of information & computer systems.

Computer Security Handbook - 3rd Edition, Hutt, Bosworth & Hoyt, 1995.
ISBN: 0-471-11854-0
The Security Officers bible. A very serious tomb!

Cryptography and Secure Communication, M.Rhee, 1994.
ISBN: 0-07-112502-7
Nuts and bolts cryptography.

E-Mail Security with PGP and PEM, B.Schneier, 1995.
ISBN: 0-47-105318-x
The title says it all.

Wider Issues

Privacy on the Line - The Politics of Wiretapping and Encryption, W.Diffie & S.Landau, 1998.
ISBN: 0-262-04167-7
Excellent, balanced discussion of the national security/law enforcement vs. personal privacy debate.

Building in Big Brother, L.Hoffman, 1995.
ISBN: 0-387-94441-9
Excellent compilation of papers on cryptographic papers – if a little dated.

The Code-Breakers, D.Kahn, 1996.
ISBN: 0-684-83130-9
"The Comprehensive History of Secret Communications from Ancient Times to the Internet". It is!

The Puzzle Palace, J.Bamford, 1983.
ISBN: 0-14-006748-5
America's most secret agency revealed. Fascinating! Who only knows how much they have progressed in the 15 years proceeding this publication?

For the President's Eyes Only, C.Andrew, 1996.
ISBN: 0-06-092178-1
Not a book about Ms Lewinsky but rather "Secret Intelligence and the American Presidency from Washington to Bush". A great insight into intelligent agencies in the USA.

Marching Orders - The Untold Story of World War II, B.Lee, 1995.
ISBN: 0-517-57576-0
Discusses the use of ULTRA & MAGIC by the allies.

Inside CIA s private world, H.B.Westerfield, 1995.
ISBN: 0-300-07264-3
Recently declassified articles from the CIA's *Studies in intelligence*. Interesting!

Betrayal The Story Of Aldrich Ames An American Spy, Weiner, Johnston & Lewis, 1995.
ISBN: 1-86066-046-0
Who was more incompetent? Ames or the CIA?

A Century Of Spies Intelligence in the Twentieth Century, J.T.Richelson, 1995.
ISBN: 0-19-511390-x
ok, if a little light-weight.

The US Intelligence Community, J.T.Richelson, 1995.
ISBN: 0-8133-2376-2
"The authoritative survey of the American cloak-and-dagger establishment". Indeed!

Persuasion and Privacy in Cyberspace, L.Gurak, 1997.
ISBN: 0-300-06963-4
Haven't read it yet.

Technology and Privacy: The New Landscape, P.Agre & M.Rotenberg, 1997.
ISBN: 0-262-01162-x
Haven't read it yet.

Shamans, Software and Spleens, J.Boyle, 1996.
ISBN: 0-674-80522-4
Haven't read it yet.

The Art of Computer Programming Volume 2 Seminumerical Algorithms, D.Knuth, 1998.
ISBN: 0-201-89684-2
Loads of details on pseudo-random number generation, fast exponentiation etc.

The Right To Privacy, E.Alderman & C.Kennedy, 1995.
ISBN: 0-679-41986-1
Haven't read it yet.

Great Crypto & Info Security Quotes

"No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks."
-- Article 12 Universal Declaration of Human Rights

"The real aim of current policy is to ensure the continued effectiveness of US information warfare assets against individuals, businesses and governments in Europe and elsewhere"
-- Ross Anderson, posting to ukcrypto, 4th Dec 1998

"self-regulation is fine when the consumer's interests are at stake, but legislation is thought essential when the spooks consider their interests to be at stake."
-- Marc Rotenberg

"1984 - Orwell was only off by a decade or two."
-- Anon

"I am smug enough to say that NSA can't break RSA or discrete logs."
-- Bob Silverman posting to sci.crypt, January 5, 1996.

"RSA seems to me to be elegant in its simplicity (even I cannot forget it, though I try every time I leave the country) and ease of demonstration."
-- William Hugh Murray to talk.politics.crypto 7 Dec 1998

"An NSA-employed acquaintance, when asked whether the government can crack DES traffic, quipped that real systems are so insecure that they never need to bother. Unfortunately, there are no easy recipes for making a system secure, no substitute for careful design and critical, ongoing scrutiny."
-- Matt Blaze in AC2

(BS) "You cannot trust an encryption algorithm designed by someone who had not 'earned their bones' by first spending a lot of time cracking codes."
(PRZ) "...Practically no one in the commercial world of cryptography qualified under this criterion!"
(BS) "Yes, and that makes our job at the NSA so much easier"
-- Coversation between Philip Zimmermann and Brian Snow, a senior cryptographer with the NSA.

"Even the Four Horsemen of Kidporn, Dope Dealers, Mafia and Terrorists don't worry me as much as totalitarian governments. It's been a long century, and we've had enough of them."
-- Bruce Sterling

"You want us to put an ax in your hand and you're promising to hit us with only the flat side of it. But the Chinese don't see it that way; they're already licensing fax machines and they're gonna need a lot of new hardware to gear up for Tiananmen II"
-- Bruce Sterling

"I'd rather have him inside the tent pissing out than outside the tent pissing in"
-- Lyndon B Johnson on why he retained J. Edgar Hoover at the FBI, _Guardian Weekly_ 12/18/71.

"England has never enjoyed a genuine social revolution. Maybe that's what's wrong with that dear, tepid, vapid, insipid, stuffy, little country."
-- Edward Abbey

"The right of the people to be secure in their persons, houses, papers and effects, against unreasonable searches and seizures, shall not be violated..."
-- The Fourth Amendment to the U.S. Constitution

"Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the government for a redress of grievances."
-- The First Amendment to the U.S. Constitution

"No man's life, liberty, or property is safe while the legislature is in session."
-- Judge Gideon J. Tucker, 1866.

"The freedom of speech and of the press guaranteed by the Constitution embraces at the least the liberty to discuss publicly and truthfully all matters of public concern without previous restraint or fear of subsequent punishment."
-- Roth v. United States, 354 U.S. 476 (1957)

"...domestic intelligence activities [that] threaten to undermine our democratic society and fundamentally alter its nature"
-- Senate Church Committee report, 1976

"the debate over national cryptography policy can be carried out in a reasonable manner on an unclassified basis"
-- A Congress requested National Research Council report "Cryptography's role in securing the information society", 1996

"on balance, the advantages of more widespread use of cryptography outweigh the disadvantages"
-- ibid

"Escrowed encryption [encryption for which a third party holds a key] by design introduces a system weakness ... and so if the procedures that protect against improper use of that access somehow fail, information is left unprotected."
-- ibid

"I Really think we would do better to discuss this in executive session"
-- William E Colby, CIA Director, 1975

"Legality? That particular aspect didn't enter into the discussions."
-- Benson K Buffham, Deputy Director NSA when questioned by the Senate Church Committee about domestic monitoring

"The FBI, on the other hand, stretched the truth and distorted the fact. It seems fair to conclude that the government has not made its case regarding encryption."
-- Diffie in "Privacy on the line", 1998 - explaining how intelligence agencies (mis)use wiretap statistics.

"In total, therefore, the U.S. economy will lose between $35.16 and $95.92 billion over the next five years, as a consequence of current administration policy [on crypto]."
-- Economic Strategy Institute report "Finding the Key", 1998

"The right to be let alone is indeed the beginning of all freedom."
-- Supreme Court Justice William O. Douglas 1952, Public Utilities Commission v Pollak

"The right to be left alone - the most comprehensive of rights, and the right most valued by civilized men."
-- Supreme Court Justice Louis Brandeis

"There is no assurance, without scrutiny, that all keying material introduced during the chip programming is not already available to the NSA..... As long as the programming devices are controlled by the NSA, there is no way to prevent the NSA from routinely monitoring all SKIPJACK encrypted traffic. Moreover, compromise of the NSA keys, such as in the Walker case, could compromise the entire EES system."
-- NASA comments on EES, 1993. ok - branches of the government don't trust the NSA, but we should?

"In some countries, strong encryption has been banned or the keys have to be escrowed for government officials. With invisibility readily available to anyone with moderate programming skills, it is obvious that any such measures are ineffective. Restrictions on encryption cannot stop criminals from using, but may hurt law-abiding businesses and individuals who could greatly benefit from mass application of cryptographic techniques."
-- Counterintelligence News and Developments, National Counterintelligence Center, Volume 2 - June 1998

"Just because you're paranoid doesn't mean some one isn't out to get you..."
-- Unknown

"Any time that you're developing a new product, you will be working closely with the NSA"
-- Ira Rubenstein, Microsoft attorney

"All data is illegal - all you need is the appropriate one time pad"
-- AMAN, 25 September 1998

"The disk scrambler is of course like any other entity which can be put to good, or bad use (I could perhaps strangle someone with a stethoscope for example....)"
-- AMAN, 6 July 1998

"The law does not allow me to testify on any aspect of the National Security Agency, even to the Senate Intelligence Committee."
-- General Allen, Director of the NSA, 1975

"You don't want to buy a set of car keys from a guy who specializes in stealing cars"
-- Marc Rotenberg commenting on Clipper

"You bastards!"
-- guy@panix.com in response to the above General Allen quote :-)

"There can be no greater good than the quest for peace, and no finer purpose than the preservation of freedom."
-- U.S. President Ronald Reagan

"I know something about trust. I got my trust the old-fashioned way. I earned it."
--Bill Clinton, in Federal News Service, 28 October 1992. Hehehe.

"The strength of the Constitution lies entirely in the determination of each citizen to defend it. Only if every single citizen feels duty bound to do his share in this defense are the constitutional rights secure."
-- Albert Einstein

"At the very least, an effort should be made to develop minimal due process guarantees for individuals who are threatened with a secrecy order. The burden of proof should be on the gov't to show why a citizen's constitutional rights must be abridged in the interests of 'national security'."
-- pp 33 & 34 Werner Baum 1978 July [chaired an NSF committee on cryptography]

"Nearly all men can stand adversity, but if you want to test a man's character, give him power."
-- Abraham Lincoln

"It is dangerous to be right when the government is wrong."
-- Voltaire

"So far as we are concerned, there is no difference between an encrypted file and a locked suitcase"
-- UK Customs and Excise official, August 98. Apart from the fact you can force a locked suitcase open :-)

"If all the personal computers in the world - ~260 million computers - were put to work on a single PGP-encrypted message, it would still take an estimated 12 million times the age of the universe, on average, to break a single message."

-- William Crowell, Deputy Director of the National Security Agency, March 1997

"Without censorship, things can get terribly confused in the public mind."
-- U.S. General William Westmoreland

"I would rather be exposed to the inconveniences attending too much liberty than those attending too small a degree of it."
-- Thomas Jefferson

"The spirit of resistance to government is so valuable on certain occasions that I wish it to be always kept alive"
-- Thomas Jefferson

"My comment was that the FBI is either incompetent or lying, or both....."
-- Bruce Schneier on FBI claims that they don't have specialised machines that can break DES

"It is insufficient to protect ourselves with laws; we need to protect ourselves with mathematics."
-- Bruce Schneier

"Cryptography products may be declared illegal, but the information will never be"
-- Bruce Schneier

"But I'd also ask American business not to make a campaign out of just trying to bust through export controls as though somehow there was a God-given, inherent right to send the strongest encryption to anybody in the world, no matter who they are. I don't agree with that. I will never agree with that."
-- Deputy Secretary of Defense John J. Hamre, 21 July, 1998. But who said there is a god given right that the DoD can read my messages?

"You can torture me all you want, I don't know anything"
"torture you... that's a good idea"
-- Resevoir Dogs (Quentin Tarantino)

"The NSA response was, 'Well, that was interesting, but there aren't any ciphers like that.'"
-- Gus Simmons - "The History of Subliminal Channels"

"A secret between two is a secret of God; a secret among three is everybody's secret."
-- French proverb (about clipper / key-escrow systems? :-))

"Can you say 'cryptographic filesystem'? Can you say 'custom filesystem'?"
-- James MacDonald posting to sci.crypt, August 14, 1998. Sarcastic comment - made unwittingly to the author of ScramDisk :-)

"The obvious mathematical breakthrough would be development of an easy way to factor large prime numbers."
-- Bill Gates from The Road Ahead, p265

"Cryptography is like literacy in the Dark Ages. Infinitely potent, for good and ill... yet basically an intellectual construct, an idea, which by its nature will resist efforts to restrict it to bureaucrats and others who deem only themselves worthy of such Privilege."
-- A Thinking Man's Creed for Crypto

"There is a secret message embedded in the phosphor of this period."
-- David Honig [honig@sprynet.com] .sig

"It's the dungheap of History. If you look really, really closely at the tippy top, you can see Louis Freeh holding a Clipper chip."
-- Xcott Craver posting to sci.crypt 20 August 1998. Describing the 'pyramid thing' on the cover of AC2 :-)

"You shouldn't overestimate the I.Q. of crooks."

-- NYT: Stuart A. Baker, General Counsel for the NSA, explained why crooks and terrorists who are smart enough to use data encryption would be stupid enough to choose the U.S. Government's compromised data encryption standard.

"An essential element of freedom is the right to privacy, a right that cannot be expected to stand against an unremitting technological attack."
-- Whitfield Diffie, Distinguished Engineer at Sun Microsystems

"It must always be remembered that crime statistics are highly inflammatory---an explosive fuel that powers the nation's debate over a large number of important social issues---and that FBI Director Louis Freeh today is the leading official shoveling the fuel into the blazing firebox."
-- David Burnham

"Why should you care if you have nothing to hide?"
-- J. Edgar Hoover

"I love my country but fear my government"
-- Anonymous

"...Finally, face it; PGP, albeit useful for some niche applications, is a little pissant pimple on the body of cryptographic usage."
-- David Sternlight posting to comp.security.pgp.discuss, June 25, 1997. Click here for more :-)

"The irony of the Information Age is that it has given new respectability to uninformed opinion."
--John Lawton, as previously quoted in D.Sternlights .sig But was it written about him? :-)

"Where the hell is your great contribution to the field that I worked in?????"
-- Robert Gifford posting to comp.security.pgp.discuss, Aug 25, 1998 to David Sternlight :-).

"I have not got any father than just a few variables past one round. I tried to search for real info on the 3.5 rounds that some one reverseved engineered but could not find it."
-- The literate David A. Scott posting to sci.crypt , June 26, 1998. RE his analysis of IDEA :-)

"I have developed an encryption software package that I can best describe as a ONE-TIME-PAD GENERATOR."
-- Anthony Stephen Szopa posting to sci.crypt, August 8, 1997

"Is it time for another one of these already? Oh, bother."
-- Bruce Schneier posting to sci.crypt, August 8, 1997 - in response to the Szopa quote :-)

"Quis Custodiet Ipsos Custodes." -> "Who will watch the watchmen."
-- Juvenal, circa 128 AD

"Anyone who considers arithmetical methods of producing random digits is, of course, in a state of sin."
-- John Von Neumann, 1951

"Deception is a state of mind - and the mind of the state"
-- James Angleton, the late CIA superspy, quoted in the book, DECEPTION by Edward Jay Jones (1989)

"The limits of tyrants are prescribed by the endurance of those whom they oppress."
-- Frederick Douglass

"I swear to tell the truth, the whole truth, just the way the President did."
-- Timothy C. May .sig

"Random numbers should not be generated with a method chosen at random."
-- Donald Knuth, The Art of Computer Programming Volume 2 - Seminumerical Algorthms

"Key escrow to rule them all; key escrow to find them. Key escrow to bring them all and in the darkness bind them. In the land of surveillance where Big Brother lies."
-- Peter Gutmann

"When cryptography is outlawed, bayl bhgynjf jvyy unir cevinpl."
-- Kevin McCurleys Thought for the day, June 24, 1997

"The greatest calamity which could befall us would be submission to a government of unlimited powers."
--Thomas Jefferson, 1825

"I regret to say that we of the FBI are powerless to act in cases of oral-genital intimacy, unless it has in some way obstructed interstate commerce."
-- J. Edgar Hoover

"50 million potential S/Mime users can't be wrong.... But they can all be stupid!"
-- Sam Simpson, 4th December 98

"1 million PGP users can't be wrong.... But they can all be stupid! (But at least they ain't spied upon by Echelon)"
-- Sam Simpson, 7 Dec 98 (In response to Sternlights complaint about the previous quote)

"Mary had a little key (It's all she could export),
and all the email that she sent was opened at the Fort."
-- Ron Rivest

"Mary had a crypto key, she kept it in escrow,
and everything that Mary said, the Feds were sure to know."
-- Sam Simpson, July 9, 1998

"Mary had a scrambler prog, equipped with key recovery,
the snoops, her data, they did log, much to her shock discovery!"
-- AMAN, 22 September, 1998

"There is a group at Fort Meade
who fear that which they cannot read
so they fight with their friends
(God knows to what ends!)
In attempts to get more than they need."
-- Jim Bidzos, CEO of RSA Data Security

"Feistel and Coppersmith rule. Sixteen rounds and one hell of an avalanche."
-- Stephan Eisvogel in de.comp.security, Jan 1998

"The NSA regularly lies to people who ask it for advice on export control. They have no reason not to; accomplishing their goal by any legal means is fine by them. Lying by government employees is legal."
-- John Gilmore (gnu@toad.com)

"In God we trust. Everybody else we verify using PGP!"
-- Tim Newsome

"BTW, I learned a lovely new acronym today: "Law Enforcement Agency Key" - LEAK."
-- Charles H. Lindsey (chl@clw.cs.man.ac.uk)

"They that give up essential liberty to obtain a little temporary safety deserve neither liberty nor safety."
-- Benjamin Franklin

"[U]ncontrolled search & seizure is one of the first & more effective weapons in the arsenal of every arbitrary government."
-- Robert Jackson 1949 Brinegar v US 338 US 160, 180-181

"Wherever a man may be, he is entitled to know that he will remain free from unreasonable searches & seizures."
-- Supremes 1967 in Katz v US 389 US 347, 359

"When the President does it, that means that it's not illegal."
-- Richard M. Nixon in an interview with David Frost, 19th May, 1977

"Asking the Government to protect your Privacy is like asking a Peeping Tom to install your window blinds"
-- Founder of the EFF

"Whoever would overthrow the liberty of a nation must begin by subduing the freeness of speech."
-- Benjamin Franklin

"We must ensure that new technology does not mean new and sophisticated criminal and terrorist activity which leaves law enforcement outmatched -- we can't allow that to happen"
-- Al Gore - Sept. 16, 1998

"Civilization is the progress toward a society of privacy.The savage's whole existence is public, ruled by the laws of his tribe. Civilization is the process of setting man free from men"
-- Ayn Rand, The Fountainhead (1943)

"Individual rights are not subject to a public vote; a majority has no right to vote away the rights of a minority; the political function of rights is precisely to protect minorities from oppression by majorities (and the smallest minority on earth is the individual)"
--Ayn Rand

"Necessity is the plea for every infringement of human freedom. It is the argument of tyrants; it is the creed of slaves."
-- William Pitt, British Prime Minister, November 18, 1783

"There's no way to rule innocent men. The only power any government has is the power to crack down on criminals. Well, when there aren't enough criminals, one makes them. One declares so many things to be a crime that it becomes impossible to live without breaking laws."
-- Ayn Rand, "Atlas Shrugged"

"I apprehend no danger to our country from a foreign foe ... Our destruction, should it come at all, will be from another quarter. From the inattention of the people to the concerns of their government, from their carelessness and negligence, I must confess that I do apprehend some danger."
-- Daniel Webster, June 1, 1837

"This method, seemingly very clever, actually played into our hands! And so it often happens that an apparently ingenious idea is in fact a weakness which the scientific cryptographer seizes on for his solution."
-- Herbert Yardley, The American Black Chamber, p282, referring to a Japanese method of transposing the sections of a code message to hide the beginning and end.

"I applied ROT13 to this, but that didn't make it any more intelligible!"
-- Roger Schlafly posting to sci.crypt, 21st June 98 in response to a message posted in German :-)

"The Internet treats censorship as a malfunction and routes around it."
-- John Perry Barlow

"Liberty means responsibility. That is why most men dread it."
-- George Bernard Shaw

"The greatest trick the devil ever played was convincing everyone he didn't exist"
-- Verbal Kint. (Written about the NSA?)

"It is better to weep with wise men than to laugh with fools."
-- Spanish Proverb

"The best defense against logic is ignorance."
-- anon

"I think there's a world market for about five computers."
-- Watson, Thomas (Founder of IBM)

"Besides a mathematical inclination, an exceptionally good mastery of one's native tongue is the most vital asset of a competent programmer."
-- Edsger W.Dijkstra

"I know not with what weapons World War III will be fought, but World War IV will be fought with sticks and stones."
-- Albert Einstein

"Terrorism: deadly violence against humans and other living things, usually conducted by government against its own people."
-- Edward Abbey

"No poor bastard ever won a war by dying for his country. He won it by making other bastards die for their country."
-- George Smith Patton

"If I have seen further it is by standing on the shoulders of giants."
-- Sir Isaac Newton (1642-1727)

"Those who cannot remember the past are condemned to repeat it."
-- George Santayana (1863-1952)

"Furem fur cognoscit et lupum lupus. " -> "A thief recognises a thief and a wolf a wolf."
-- Anon

"In some ways, cryptography is like pharmaceuticals. Its integrity may be absolutely crucial. Bad penicillin looks the same as good penicillin. You can tell if you spread sheet is wrong, but how do you tell if your cryptography package is weak? The ciphertext produced by a weak encryption algorithm looks as good as ciphertext produced by a strong encryption algorithm. There's a lot of snake oil out there. A lot of quack cures. Unlike the patent medicine hucksters of old, these sofwtare implementors usually don't even know their stuff is snake oil. They may be good software engineers, but they usually haven't even read any of the academic literature in cryptography. But they think they can write good cryptographic software. And why not? After all, it seems intuitively easy to do so. And their software seems to work ok"
-- Philip Zimmermann

"Are there any users of cellular phones here? Because people are concerned (2-3 people finally clap) I knew it was a sophisticated group. Um, no. People are concerned about the privacy you know. Newt Gingrich, what happened to him. So a couple of months ago they set out to make these things a lot better so that you couldn't break in. Well. Put in a new code. Yesterday, a team of computer experts announced that they had already cracked the electronic code. And sadly, none of them knew how, still, to unhook a bra."
-- Politically Incorrect on ABC, 21 March 98

"First they came for the hackers.
But I never did anything illegal with my computer,
so I didn't speak up.
Then they came for the pornographers.
But I thought there was too much smut on the Internet anyway,
so I didn't speak up.
Then they came for the anonymous remailers.
But a lot of nasty stuff gets sent from anon.penet.fi,
so I didn't speak up.
Then they came for the encryption users.

But I could never figure out how to work PGP anyway,
so I didn't speak up.
Then they came for me.
And by that time there was no one left to speak up."
-- Unknown

"Buy four copies of the book, and mail one to each of the top four names on the list. Then add your name to the bottom of the list. In just a few short weeks you'll receive 2^56 copies of Applied Cryptography from all over the world...."
-- Bruce Schneier posting to sci.crypt, 19 October, 1998. Aren't pyramid schemes illegal? :-)

Contacting the author

The author of the program wishes to remain anonymous for personal reasons. If you wish to get a message to the author, please direct e-mail to the address below, preferably PGP encrypted. Alternatively, send a message to the account scramdisk@hotmail.com, which is read by both AMAN and myself.

Also, the author may be contacted by writing to the sci.crypt or alt.security.pgp newsgroups with the word 'Scramdisk' in the postings Subject heading. The author uses the pseudonym AMAN.

There are now four different PGP keys – one for the ScramDisk HotMail account (which is read by AMAN and myself), two for S.Simpson & one for A.Jeffries:

E-Mail Address	Key Type	Size (bits)	Created	Key ID
Scramdisk@hotmail.com	Diffie-Hellman/DSS	3072/1024	02/11/98	0xC0E0C17A
ssimpson@hertreg.ac.uk	Diffie-Hellman/DSS	3072/1024	24/07/97	0x433FDB4F
ssimpson@hertreg.ac.uk	RSA	2048	22/08/97	0x560D21A9
ajeffries@kwikrite.clara.net	Diffie-Hellman/DSS	4096/1024	11/12/98	0xF4B8DEE4

Updates to ScramDisk and details of development efforts can be found at the ScramDisk site http://www.scramdisk.clara.net/

Acknowledgements

> "*Is it time for another one of these already? Oh, bother.*"
> -- Bruce Schneier posting to sci.crypt, August 8, 1997

Firstly: absolutely no thanks to the UK government who seem determine to restrict its citizens crypto-rights (as well as right to privacy) with two new pieces of proposed legislation. Were the Conservatives right – "New Labour, new danger"? Labour blatantly lied in a pre-election pledge on crypto….

Just as Canada start to relax crypto controls, we start to increase them. Hhhmm.

We would like to thank dozens of people for helping the crypto cause, but I haven't got time to type a comprehensive list ☹ Obvious people are Phil Zimmerman, David Kahn, Professor's Bernstein & Junger, James Bamford, Charles (Softwar), Paul Leyland & Ross Anderson for expressing their views on cryptography so well. Then there are the crypto-kings, who develop, analyse and intelligently comment on cryptography, the likes of: Matt Blaze, Martin Hellman, Ross Anderson (AGAIN!), Bruce Schneier, John Savard, Don Coppersmith, Ron Rivest, Eli Biham, Ralph Merkle, David Wagner, Antoon Bosselaers, Bart Preneel, John Daemen, Vincent Rijmen, Sean Murphy, James Massey and far too many more to mention.

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Thanks to Ed Mortensen for providing a US mirror site for ScramDisk.

Thanks to everyone who has e-mailed us to show appreciation – people in France & Russia seem particularly grateful for programs like ScramDisk for some reason…

Oh, I should also mention the author of the program, for tirelessly producing and enhancing the program! I am assured that he will deservedly reach the (anonymous) status of net.sainthood, whatever that is!

Please do not hesitate to contact me with any comments, errors and omissions.

Appendix A – Algorithm Test Vectors

Cipher	Source	Reorder[5]	Key	Plaintext	Ciphertext
Blowfish	Counterpane web site	No	00000000 00000000	00000000 00000000	4EF99745 6198DD78
Blowfish	Counterpane web site	No	FFFFFFFF FFFFFFFF	FFFFFFFF FFFFFFFF	51866FD5 B85ECB8A
Blowfish	Counterpane web site	No	FFFFFFFF FFFFFFFF	00000000 00000000	F21E9A77 B71C49BC
DES	www.itl.nist.gov/div897/pubs/fip81.htm	Yes	01234567 89ABCDEF	4E6F7720 69732074	3FA40E8A 984D4815
DES	Applied Cryptography 2nd edition, p631	Yes	01234567 89ABCDEF	01234567 89ABCDEF	C9574425 6A5ED31D
IDEA	Cryptlib Source Code	Yes	00010002 00030004 00050006 00070008	00000001 00020003	11FBED2B 01986DE5
MISTY1	MISTY1 RFC	No	00112233 44556677 8899AABB CCDDEEFF	01234567 89ABCDEF	8B1DA5F5 6AB3D07C
Square	www.esat.kuleuven.ac.be/~rijmen/downloadable/square/vdata	Yes	80000000 00000000 00000000 00000000	00000000 00000000 00000000 00000000	05F8AAFD EFB4F5F9 C751E5B3 6C8A37D8
TEA32	Sci.crypt	No	00000000 00000000 00000000 00000000	00000000 00000000	41EA3A0A 94BAA940
TEA32	Sci.crypt	No	4C617073 616E675F 536F7563 686F6E67	4561726C 47726579	4B20E121 C32E8546

[5] This column indicates whether you need to tick the "Read byte values from left to right in memory order" check box in order to correctly verify the test vectors.