File Encryption

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Why Encrypt Files?

- Theft of files
- Theft of media
- Theft of computer
- Cloud storage? == Someone else's computer

Issues with File Encryption

- Suppose we want to use crypto to protect files. Now what?
- What to encrypt?
- Where should keys be stored?
- What is the tradeoff between availability and confidentiality?

Bad Reasons and Good

- – Is there a flaw in the operating system's protection mechanisms? Why can't the OS keep bad guys from the file?
- – You don't trust the system administrator? Can the sysadmin steal the decryption key?
- ✓ The files are on a laptop, which might be stolen
- ✓ The files are on removable media (CD, flash drive, etc.)
- ✓ Avoid concerns when discarding drives
- ✓ Cloud-based file system?

Limitations of File or Disk Encryption

- Doesn't protect against on-machine threats, including malware
- How are keys stored or entered?
- What happens if you lose the key?

How Do You Enter a Key?

- Type it in to a window?
  - Malware can sniff the keystrokes
- External keypad
  - Where would you put one on a laptop?
  - Not much room on a flash disk…
  - Can or will users type long-enough keys?
- Your host's key store?
  - What if your host is compromised or seized?
- External smart card or equivalent? TPM?

Lost Keys

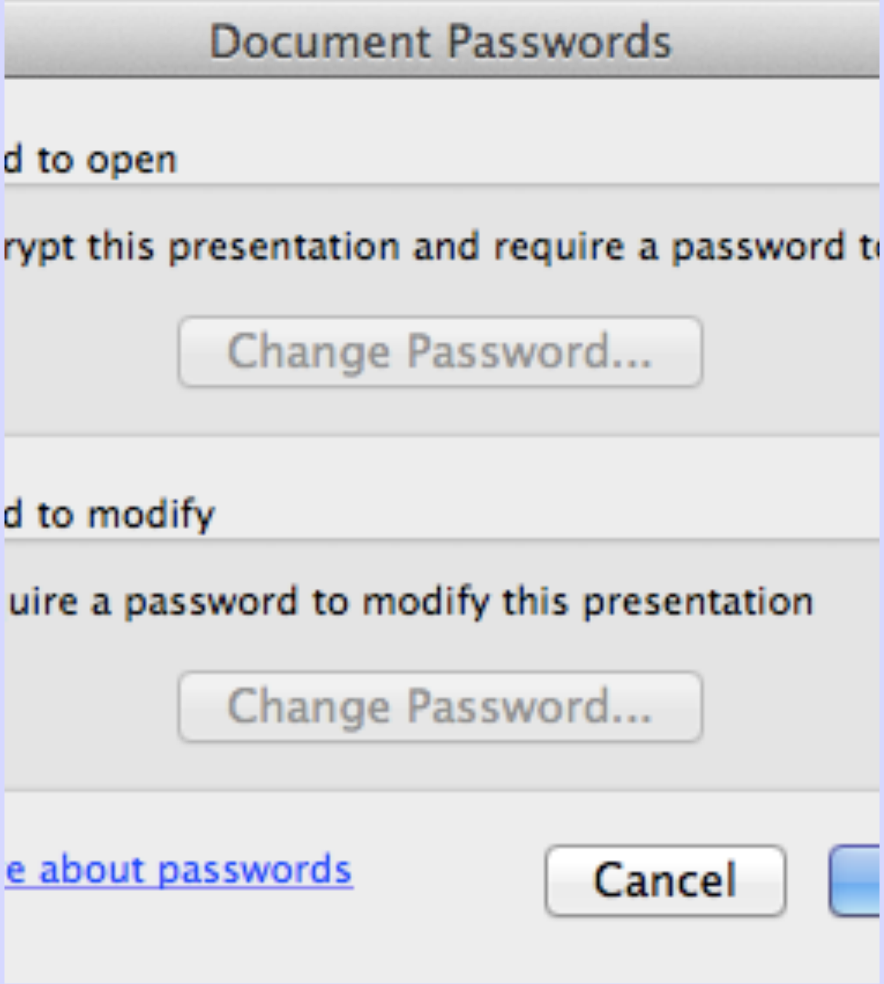
- If you lose the key (i.e., forget the passphrase), you lose access to the encrypted files
- For communication encryption, you can restart the session
- This is “data at rest” (also known as “object encryption”); there’s no negotiation of a key, and no way to restart
- You *must* have some form of key backup or key recovery
  - For corporate use, there is often an administrator key

Encryption Options

- File at a time, perhaps manually
- A file system tree
- A disk or disk image
- Disk hardware

File at a Time

- Very fine-grained encryption: protect only what needs protecting
- Easy to use different keys for different data
- But…
  - Must *remember* to encrypt the files
  - Not all applications have built-in support
  - Easy to forget your key



Document Passwords

d to open

rypt this presentation and require a password t

d to modify

uire a password to modify this presentation

Encrypted Directory

- Encrypt any subtree
  - Best choice on Linux
- File sizes show through; length of file names show, also
  - The equivalent of traffic analysis?
- Advantages
  - Easy to do fine-grained keying
  - Doesn't waste space in disk images

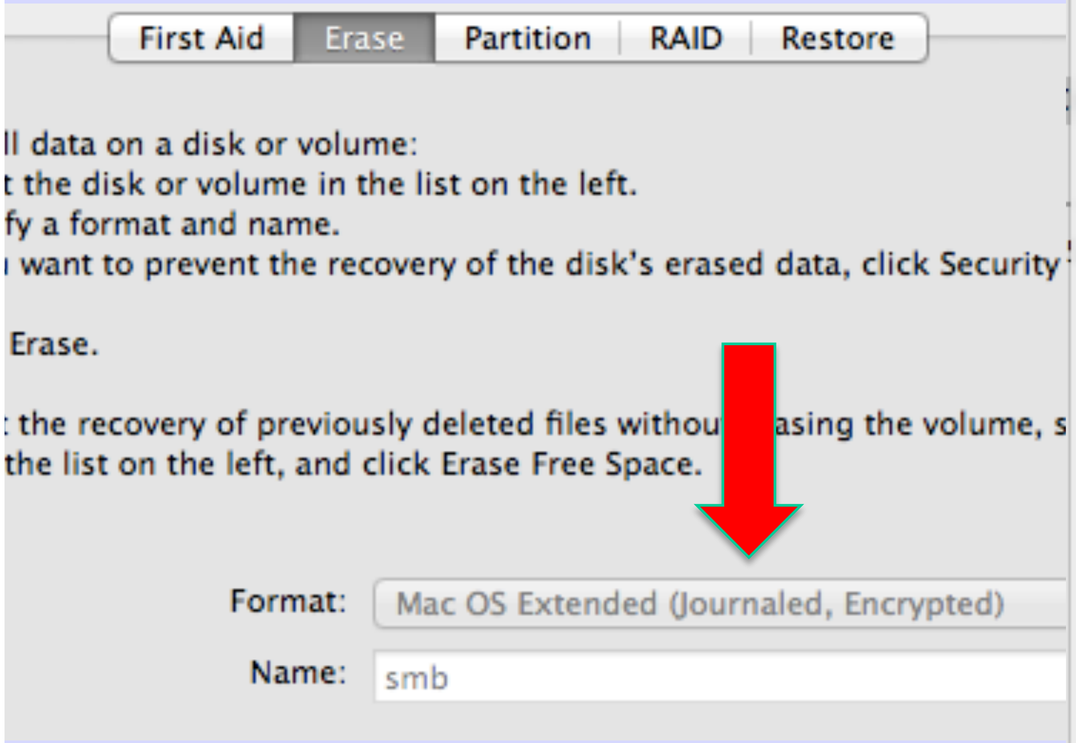
Encrypted Disk or Disk Image

- The most popular today
- No need for encryption options in every program
- No need for the user to remember to encrypt
- Hides file sizes and other metadata
- But: only one key per partition; all users share that key

Hardware Options

- Some flash drives and hard drives do encryption in hardware
  - Even for desktops, eliminates need to erase disk before discarding
- Check your vendor carefully; some have done it wrong: http://www.zdnet.com/blog/hardware/encryption-busted-on-nist-certified-kingston-sandisk-and-verbatim-usb-flash-drives/6655
- Actual disk key is usually randomly generated; user-supplied pass phrase is used to encrypt the key

Encrypted Disks: Mac OS



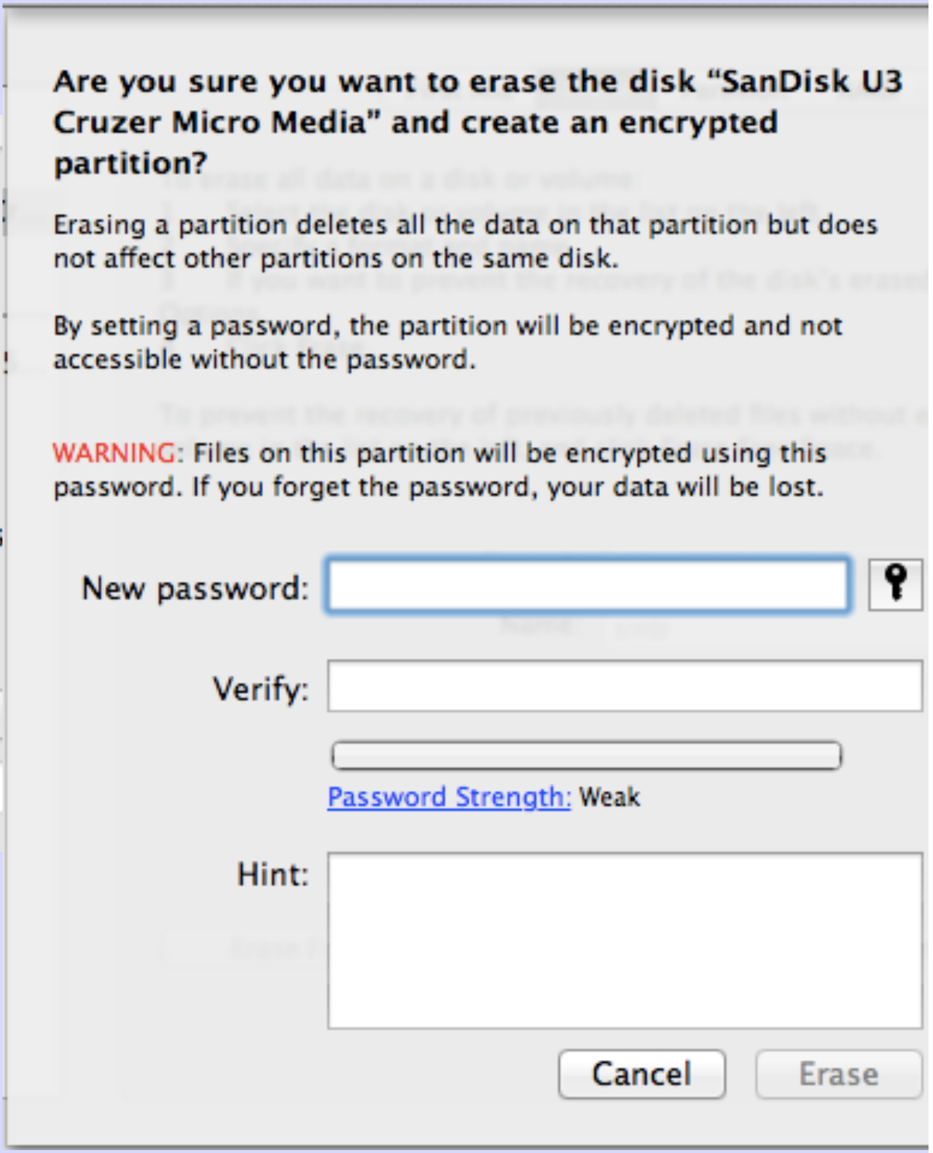
ll data on a disk or volume:
t the disk or volume in the list on the left.
fy a format and name.
want to prevent the recovery of the disk's erased data, click Security

Erase.

the recovery of previously deleted files withou asing the volume, s
the list on the left, and click Erase Free Space.

Format: Mac OS Extended (Journaled, Encrypted)

Name: smb



Are you sure you want to erase the disk "SanDisk U3 Cruzer Micro Media" and create an encrypted partition?

Erasing a partition deletes all the data on that partition but does not affect other partitions on the same disk.

By setting a password, the partition will be encrypted and not accessible without the password.

WARNING: Files on this partition will be encrypted using this password. If you forget the password, your data will be lost.

New password:

Verify:

Password Strength: Weak

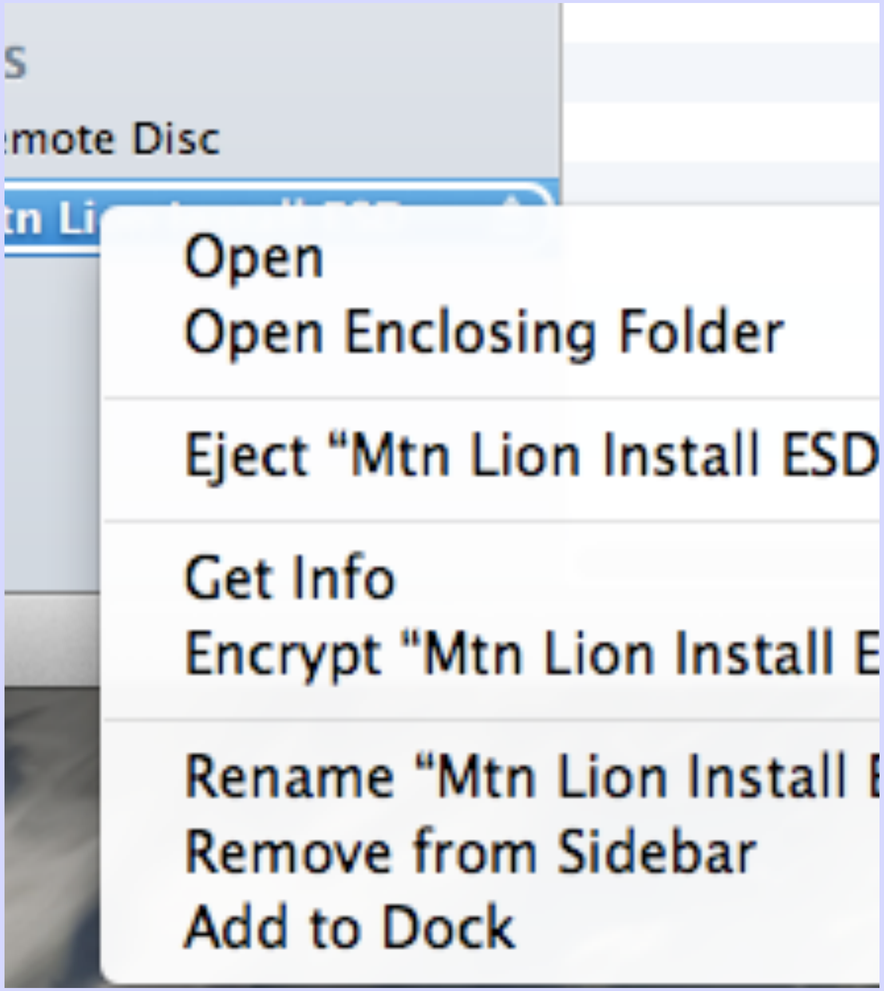
Hint:

Encrypting a Disk on Existing Mac OS

When you erase the drive, select "Encrypted"

To encrypt an existing disk (Mountain Lion), go to finder

For Lion, use "diskutil"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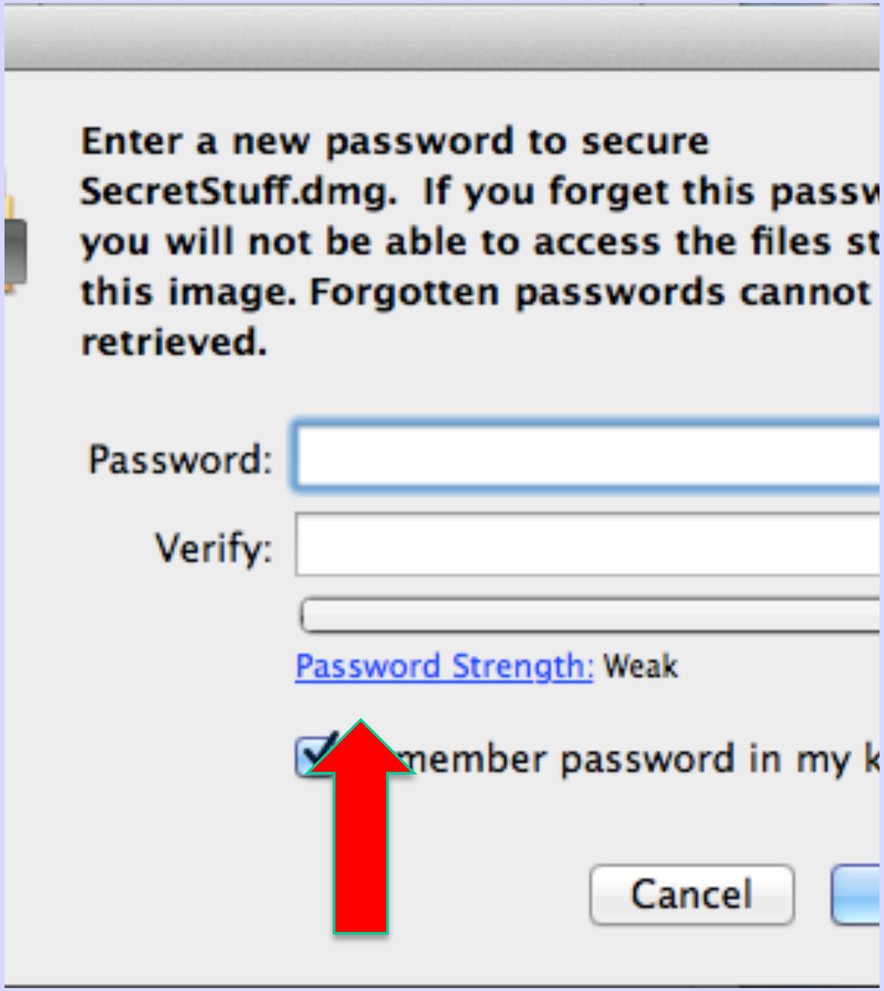
mote Disc
tn Li
Open
Open Enclosing Folder
Eject "Mtn Lion Install ESD
Get Info
Encrypt "Mtn Lion Install E
Rename "Mtn Lion Install E
Remove from Sidebar
Add to Dock

Encrypting a Mac Disk Image

- You can encrypt disk images, too
- Note the option to store the newly-created key in your keychain
- What is your threat model? This is a good choice for cloud-resident images



Enter a new password to secure SecretStuff.dmg. If you forget this passw you will not be able to access the files st this image. Forgotten passwords cannot retrieved.

Password:

Verify:

Password Strength: Weak

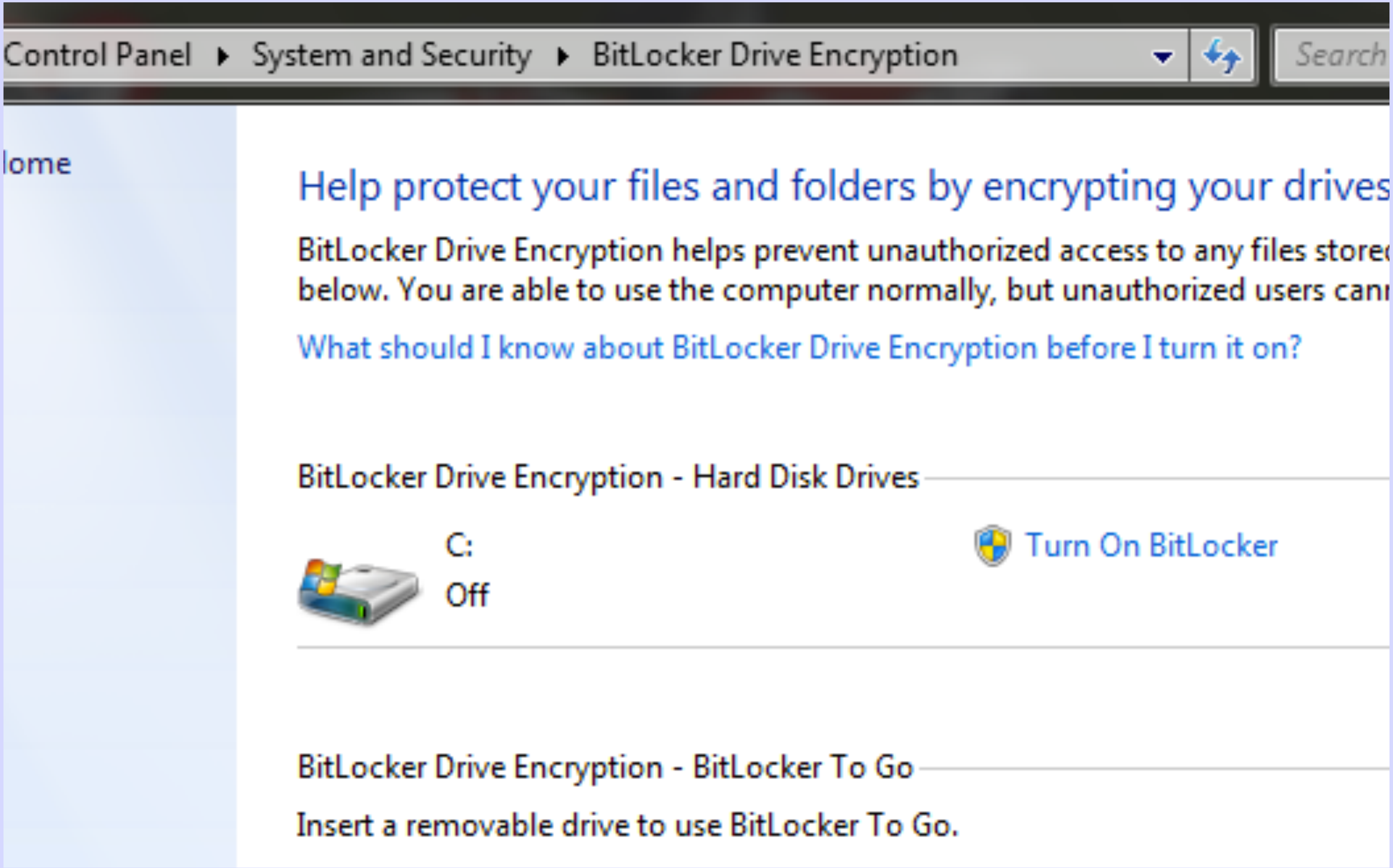
☑ member password in my k

Encrypted Disk Images on Linux

```
# Installation
$ sudo apt-get install encfs fuse-utils
$ sudo modprobe fuse

# Add yourself to the group
$ sudo adduser <your username> fuse

# Create the directories
$ mkdir ~/ciphertext ~/plaintext

# Create it or mount it
$ encfs ~/ciphertext ~/plaintext

# To unmount
$ fusermount -u ~/plaintext
```

Bitlocker on Windows

You need TPM to encrypt your boot drive



Control Panel ▸ System and Security ▸ BitLocker Drive Encryption
Search
lome

Help protect your files and folders by encrypting your drives

BitLocker Drive Encryption helps prevent unauthorized access to any files store
below. You are able to use the computer normally, but unauthorized users cann

What should I know about BitLocker Drive Encryption before I turn it on?

BitLocker Drive Encryption - Hard Disk Drives

C:
Off

Turn On BitLocker

BitLocker Drive Encryption - BitLocker To Go

Insert a removable drive to use BitLocker To Go.