What Is MythTV?

chapter 1

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MythTV is an extensible third-party software package (see the sidebar titled "The Linux Package") that converts a mild-mannered Linux desktop into a full-fledged personal entertainment system. Its capabilities include graphics and photo display, music management and playback, DVD playback, and, of course, TV capture and playback. The package may get its name from its television capabilities, but there's a lot more to it than that. It offers a built-in Digital Video Recorder (DVR) and integrates a customizable user-driven interface and underlying audio and video decoding and encoding capabilities with device support necessary to work with sound, images, movies, and TV programs. In fact, DVR boxes (including a suitably equipped PC running MythTV) can take analog or digital inputs and store or manipulate such data streams before sending them out to other components via numerous outputs: RCA, S-Video, Component video, Composite video, S/PDIF (the Sony-Philips digital interface format often used for handling multi-channel sound), and so forth.

The MythTV framework provides an alternative to manufactured Personal Video Recorders (PVRs) — and perhaps more directly, to Windows Media Center PCs — solutions currently available for sale in today's home entertainment marketplace. Not only does MythTV deliver much of the same capabilities, it also picks up where such pre-fabricated packages often leave off. Much of the motivation behind MythTV is to help users build an ultimate entertainment convergence box — a device that handles all the functions of several common though usually discrete communications or playback devices.

MythTV can do numerous things, including (but not limited to) the following: Store live television feeds directly to the disk volumes of your choosing, and burn captures in real time straight to DVD using compatible DVD-ROM burners. It can help you browse the Internet, peruse RSS news feeds, and obtain local program guide listings and detailed weather information from online sources. You can use it to provide background sound as an MP3 jukebox, to proffer itself as an Xmame arcade emulator, or display vivid eye candy in a slide show of digital images. You can use its Voice over IP (VoIP) phone and videophone modules to integrate Internet telephony devices and services. You can also combine multiple capture cards on multiple computers, and create varied client/server arrangements by setting up a MythTV master computer with multiple MythTV slave backends (making more entertainment available to multiple users and displays than you might have thought a PC-based environment could handle).

The Linux Package

In Linux, a software package is generally little more than a single archive containing one or more files and the necessary rules for installing the package contents on the target computer. The most commonly used utility for packages on the Linux platform is called the *Red Hat Package Manager,* and such files end in an `.rpm` extension. Unlike shrink-wrapped or downloaded software packages for the Windows platform, sometimes Linux packages are incomplete — that is, they rely on third-party dependencies developed independently from the software package contents. This is easily resolved through a comprehensive package management utility such as Yellow Dog Updater, Modified (YUM) in Fedora Core, or Yet Another Set-up Tool (YaST) under the SUSE distribution.

Given even a modest bill of materials, a well-designed MythTV PC can easily best the capabilities of most commercial Personal Video Recorder (PVR) gear, but the strongest lure to using the MythTV framework is the freedom of personal choice it offers: You are the one who gets to decide what does and doesn't go into your project build.

Let's be very clear about what MythTV definitely *is not*: MythTV is not intended as a fast and cost-effective replacement for TiVo, ReplayTV, or similar video recording units. MythTV only offers the software foundation upon which a DVR is built; the hardware elements are entirely up to you, the system architect and designer. After all is said and done, the bottom line on building a MythTV box from scratch will lose to commercial, turnkey white box options purely on a cost basis (although such devices usually require for-a-fee monthly subscriptions).

Commercial applications such as Windows Media Center Edition may claim advantages primarily in the areas of initial cost and ease of use, owing to volume of production and corporate sponsorship for research and development. That said, MythTV's open-source origins and licensing explains why it dominates the categories of flexibility, capability, and extensibility. MythTV is also the nexus for a broad and varied community of developers around the world. Plus — for those of you concerned about such things — there's no need to worry about voiding any warranties by tinkering under MythTV's hood (short of messing with system components and their individual warranties).

This chapter takes you through the fundamental concepts and components that define a digital video recorder, explaining how MythTV fits that definition and why it outshines all other forms of video cataloging and playback software and hardware products.

A Few Essential Terms

In the Linux world, jargon is an essential element of communication. Thus, understanding the significance of this potentially valuable appendix depends on decoding the jargon that makes up its very title:

- **Distro** is an abbreviation for *distribution*, or, more properly, *Linux distribution* or *code distribution* — namely, the collection of elements necessary to install, configure, and make Linux or related software run. Some distributions are binary (and thus target specific processor architectures); others are source code, and require access to the proper compiler or other code generators needed to create binary code; and still others include a mix of binary and source code elements. The distribution typically represents the kernel for the version of Linux you intend to install and run, and thus establishes the foundation for whatever type of system you wish to build. For this book, though other distributions are indeed feasible for use with MythTV, we concentrate on two specific Linux distributions: Fedora Core 5 and KnoppMyth, a specially tailored version of Knoppix.
- **Download** is the term normally used for a file, or collection of files, that you grab from a Web site or FTP server. Ultimately, all noncommercial Linux distributions may be obtained by grabbing their associated downloads (commercial versions usually require users to possess a valid account and password to download such for-a-fee software). The same thing is true for all other kinds of MythTV components, including the primary MythTV core, MythTV Plug-ins, and MythTV Themes, among numerous other elements you will copy to your machine in the process of installing, configuring, and, ultimately, extending MythTV on your system.
- **Docs** is short for documentation, but covers a multitude of vehicles typical in the Linux world. This includes the ubiquitous and often informative Q&A documents known as FAQs (lists of *Frequently Asked Questions*), plus another genre of technical advice and information known as the HOW-TO. It also includes a lot of manuals (*man pages* in Linux), references, guides, tutorials, and other kinds of information and advice to help turn novices into more experienced (and self-sufficient) Linuxheads.

Understanding DVRs

Before delving further into what defines MythTV, it is important to understand what a Digital Video Recorder does, for those not already "in the know." Often mistakenly used interchangeably with the term Personal Video Recorder (PVR), a Digital Video Recorder (DVR) describes a class of devices capable of recording from virtually any format and storing it digitally. DVRs represent a natural progression away from antiquated VCRs that were once key elements in a typical array of home theater equipment. PVRs share many of the same characteristics of a DVR: Most (but not necessarily all) of them make digital recordings, and many provide all kinds of program selection, scheduling, and playback functions as well. We prefer the term DVR because we look at it as a component of a larger-scale multimedia playback, capture, and management system, rather than focusing purely on the video (or TV) component of a multifaceted set of media types.

Some of the advantages of a DVR over a VCR are immediate and clear: freedom of component selection (and from being tied to vendor-specific products and services); larger storage potential; the capability to capture from a wide variety of input sources; and the capability to write using a variety of formats and multiple types of media. Many of the remaining advantages are not so obvious, and reveal themselves only in how you leverage this technology and apply your knowledge.

The MythTV initiative is largely designed by and for the do-it-yourself community, and its freely modifiable open-source development grants creative license to anyone with enough know-how and drive for such an undertaking. The rewards come from the completion of a custom-tailored media center that rivals commercial offerings in terms of features and functionality — where it doesn't outright surpass them. In fact, roll-your-own motivation inspired MythTV's author, Isaac Richards, to begin the monumental task of developing the framework in April of 2002. If DIY is a staple acronym of your verbal diet, MythTV is definitely for you.

MythTV is essentially a suite of applications to aid you in designing and implementing a fully customized entertainment and communications center. Consider it enabling software for building the ultimate Home Theater Personal Computer (HTPC) — or, in the apt words of MythTV's author, a "mythical [home] convergence box." Video capture and playback is only part of what MythTV is about — and does not adequately define MythTV or address its full capabilities.

Convergence technology speaks to a tendency to merge consumer commodities that approach one another in feature sets or functionality to perform similar tasks inside a single system or framework. As an example, consider your cable service provider's communications infrastructure, whereby services are often rolled into a single so-called *triple-play package* that combines television, Internet, and telephony in a single offering. MythTV converges nicely by providing the building blocks necessary to engineer a perfectly capable communications center that can browse the Internet, check e-mail, play games, obtain current weather information, display digital telephone caller identification on screen, handle radio, movies, music, and TV programs, and much more. This enables users to harness common communications devices and find synergies that increase their usability.

The "myth" in MythTV reminds you of unfulfilled promises from key industry players to deliver uncompromised home entertainment convergence. Each vendor inevitably attempts to tie end users into its own proprietary platforms and services, often limiting how much freedom and flexibility users may exercise to enhance or personalize them. With MythTV, nearly everything is designed to be personalized, from themed interfaces to the modular plug-in framework used for optional features such as MythWeather and MythNews (RSS news feeds).

MythTV can perform many of the same duties as garden-variety commercial offerings, and some tasks that such products cannot, including the following:

- Pause, fast-forward, and rewind real-time television programs.
- Watch recordings at variable rates to adjust audio pitch.
- Analyze recorded shows and eliminate them from playback.
- Transcode live television feed into various formats.
- Remotely service content to multiple clients from a central server.
- Centralize programs to provide a common view to all clients.

- Administer system functions via a Web-enabled interface.
- Utilize multiple capture cards to perform multiple parallel recordings.
- Obtain free program guide information directly over the Internet.
- Provide optional functionality via an extensible plug-in framework.
- Remotely control the box using infrared and/or radio frequency.
- Display a fully customizable interface with a themed menu system.
- Provide Picture-in-Picture support for multiple tuner cards.
- Encode and decode various audio and video formats.
- Categorize and visualize various audio formats.
- Create a slide show from a gallery of pictures.
- Enable phone and videophone capability (SIP).

As of this writing, the current version of MythTV supports the following plug-ins:

- **MythBrowser** — A small browser window module
- **MythDVD** — A DVD-management module
- **MythGame** — A frontend for the Xmame arcade emulator
- **MythGallery** — An image gallery management module
- **MythMusic** — A music player collection management module
- **MythNews** — An RSS news feed reader module
- **MythPhone** — A SIP phone and video phone module
- **MythVideo** — A video management module
- **MythWeather** — A local weather forecast module
- **MythWeb** — A Web interface module for MythTV

This book aims to bring MythTV to a much broader audience of do-it-yourself hobbyists and weekend project warriors, based largely upon information available from the online MythTV community and the personal experiences and insights of the contributing authors. Particularly useful resources that make this book what it is come from the MythTV project Web site and the documented experiences of Jarod Wilson, maintainer of perhaps the most comprehensive MythTV HOW-TO coverage to date, and the keen insight of HTPCnews.com moderator Matt Wright. You may want to peruse the online copy of Wilson's Fedora-centric MythTV installation guide (the same one that serves as a basis for this book). Point your favorite browser to `http://wilsonet.com/mythtv/fcmyth.php` for details.

How MythTV Compares to Other PC-TV Systems

When put under the microscope, innumerable differences between MythTV and alternative PVR solutions pop up. Only the most distinctive differences are covered here, to help you differentiate among available DVR offerings.

Apples and oranges are the currency of distinction for a side-by-side comparison of MythTV and the many similar (though entirely different) alternative media center implementations. In the case of MythTV, this means only the third-party add-on software; that is, neither operating system nor hardware are included. Barring any obvious architectural differences (such as the well-defined client/server architecture underlying the MythTV framework), MythTV is similar to Windows Media Center Edition in that it provides additional support for multimedia playback to an existing platform (such as Linux or Windows). Openly available on the market are complete solutions such as TiVo or ReplayTV, although their continued operation requires periodic subscription fees. A handful of these units are detailed in the paragraphs that follow.

First and foremost, commercial solutions such as TiVo and ReplayTV generally involve a one-time cost to purchase the relevant PVR or DVR hardware. Next follows a subscription service fee for the duration of account ownership (either an annual fee or monthly billing). Overall costs must be calculated on the basis of initial hardware costs, plus service charges over its useful lifetime. Remember too that you're explicitly tied to the hardware choices that the vendor makes, and that any DIY upgrades are likely to void warranty coverage.

However, a prefab unit offers tremendous savings in time and expense over the careful research, system assembly, and software configuration necessary to implement a working MythTV system. By reading this book you express interest in this fast-growing home entertainment sector, but you may not be inherently disposed to devote free time to building your own system.

In addition, you must recognize that in and of itself, MythTV is an incomplete solution. It's merely a framework for building a multimedia home entertainment system, and lacks any of the hardware you'll need to finish the job. Like Windows XP Media Center Edition (MCE), MythTV provides a viable basis for personal entertainment systems. As such, it can't compare directly to more focused products such as the TiVo and ReplayTV units.

Windows MCE can't begin to compare to MythTV on many levels. First, MythTV is free to anybody who wants to download, own, or redistribute it, for any number of installations. Second, MythTV is merely a third-party extension to an existing Linux desktop environment. Windows MCE is an entire operating system (Windows XP, to be exact) with various multimedia underpinnings and a graphical user interface overlay. Third, end-users are at liberty to modify, compile, and redistribute MythTV — as with KnoppMyth, a Knoppix CD-ROM based distribution.

On the upside, a self-made MythTV DVR system is more rewarding beyond anything a TiVo, ReplayTV, or other commercial unit can offer. The enriching experience of learning a new operating system, playing with new hardware, and using existing technology in creative new ways is a reward all by itself. The satisfaction of building something truly useful and beneficial for your entertainment center is another.

There is no restriction on hardware: You have the freedom to build massive storage volumes of virtually any kind (internal and external), a choice of networking equipment (wireless or wired), and the freedom to pick and choose precisely what components go into your system build. Because it's your show, you get to call the shots.

Again, the downside is made crystal clear in regard to time spent on research, building the system, and working out bugs or problems before your MythTV system is ready to be put to work.

HACKmyth represents one of few ready-made solutions for MythTV, and further expands upon the notion of convergence technology by incorporating a variety of wireless home automation features as an essential ingredient. At present, HACKmyth Version 3 is out of production and into the mainstream market as a solution to home automation control. The HACKmyth product line features many mainstream products, including a handful of plug-in appliance modules, and is one of only a few outlets for prefab MythTV systems.

Potential customers are directed to the vendor Web site (`www.hackmyth.com`) for additional information.

Freevo is one of few products that compares directly to MythTV in that it too is a third-party extension to the Linux working environment. Though the project appears quite mature, a quick browse through the features list indicates that the complexity of the Freevo code base leaves MythTV unequalled. For instance, there currently appears to be no means to configure multiple recording units as used in MythTV's master and slave backend systems (although it does support multiple cards).

Curious readers are directed to the Freevo vendor Web site at `http://freevo.sourceforge.net`.

Some MythTV System Terminology

- **Frontend Systems** — The MythTV frontend system delivers content and control to the user (see Figure 1-1). It's the colorful interface that provides a window to access all configurable aspects of MythTV appearance, behavior, and control. This is usually referred to as the On-Screen Display (OSD) or simply the menu system.

  Configuration settings are accessed through a hierarchy of entries categorized by similar functionality. This lends MythTV a more-or-less universally accepted interface that makes transitioning to MythTV from similar video recording solutions relatively simple. The frontend application also serves as a launch pad for MythTV plug-ins, and provides a modular and adaptive framework for customizers.

- **Backend Systems** — Single capture card configurations are their own master backend and are simply called backend systems. When multiple tuner cards are involved, a master/slave relationship is established in an abstracted layer that operates between the MythTV frontend (user interface) and the actual video codecs. (Codec, a combination of the words coder and decoder, describes an application capable of encoding a stream or signal-based communications.)

  The backend system is responsible for the timely scheduling of recording tasks, obtaining and cataloging DataDirect or XMLTV program guides, and handling the complex interaction between user interface and hardware.

FIGURE 1-1: The MythTV frontend

- **Master Backend Systems** — A Master Backend System (MBE) coordinates the collective scheduling and interoperation of backend systems using multiple tuner cards. It may reside on a single machine with multiple cards or exist as one machine on a network with other tuner cards. Behind the scenes, a scheduler on the MBE maintains a running track record of idle states throughout the entire MythTV network of Slave Backends (SBEs). The MBE then delegates recording tasks among the available SBE systems.

  This lends scalability to MythTV capture systems whereby multiple tuner cards work together to record multiple sources following varying schedules. This also enables SBE systems to be awakened or put to sleep at the MBE's sole discretion. Using MythTV in a multiple capture system topology requires Network Interface Cards (NICs) with Wake-on-LAN (WoL) capability to enable remote initialization and shutdown, so plan in advance.

  This unique configuration is especially beneficial to consumers of multiple video feed types, such as satellite and cable television, VCR and DVD players, and the like.

  The MythTV Master backend architecture is detailed in the following wiki: `http://wiki.cs.uiuc.edu/cs427/MythTV+Architecture+Styles+and+Patterns`

- **Slave Backend Systems** — Slave Backend (SBE) systems are units designated to batch recording jobs in keeping with the MBE master schedule. These units can hibernate to conserve energy and heat output by exploiting lapses in activity until the MBE wakes a subservient SBE for its scheduled recording duty.

  As stated, NICs with WoL functionality are required for multiple capture system configurations.

  The MythTV Slave backend architecture is detailed in the following wiki: `http://wiki.cs.uiuc.edu/cs427/MythTV+Architecture+Styles+and+Patterns`

Basic MythTV Requirements

Proper research is vital to ensuring timely and efficient MythTV construction. Poor planning and inadequate product information will certainly lead to unnecessary delays and hang-ups. To ensure a relatively trouble-free experience, make sure that all components are chosen on the basis of possessing workable Linux driver software and documented reliability.

As stated on the MythTV Web site (`http://mythtv.org`), the absolute bare-minimum requirements to get a functional base system up and running are as follows:

- **500 MHz or better CPU** (low-cost AMD Sempron, XP, and Duron processors are suitable)
- **TV tuner or capture card that supports Video4Linux (V4L)** — The Hauppauge line of PVR cards has a great reputation for working well with Linux, and comes highly recommended as the tuner of choice. As a basic model, the Hauppauge PVR-150MCE Original Equipment Manufacturer (OEM) edition offers great value at minimal cost by ditching retail packaging, the remote control, and cables. OEM products generally pass savings onto you, the consumer, by skimping on the accessories or packaging, which makes a great alternative to paying full price for extra features you neither want nor need.

  Video4Linux supplies the software interface between the operating system and the encoder card under Linux. Online lists detail the currently supported hardware for V4L use, but you must establish a mailing list account to view this information. Join the `www.redhat.com` Video4Linux Mailing List at `https://listman.redhat.com/mailman/listinfo/video4linux-list`. After you sign up, you can read the (private) Red Hat Video4Linux Mailing List at `www.redhat.com/mailman/private/video4linux-list/`.

  The following wiki provides information about V4L and compatible hardware under its Supported Hardware heading: `www.linuxtv.org/v4lwiki/index.php/Main_Page`
- **Compatible video card with TV-out**
- **XMLTV for obtaining program information** (`http://membled.com/work/apps/xmltv/`)

- **MySQL for storing program information** (`www.mysql.com/`) — MySQL is a reliable, fast database that supports a symbolic query language. It's designed to store all kinds of information, and enjoys good market share across various multiple platforms (especially Linux, but versions for many other operating systems are also available). MySQL is integral to MythTV's operation — for storing program guide listings, among other information — but its ease of installation makes setup a snap. Consult your chosen Linux distribution documentation about package management, and for instructions on adding MySQL to your system's runtime environment.
- **FreeType for rendering on-screen fonts** (`www.freetype.org/`)
- **Qt** (`www.trolltech.com/`) The Qt class library is a cross-platform collection of functions and definitions for developing graphical user interfaces on both Linux and Windows platforms. Qt is required for building many applications that tie into the MythTV framework.
- **LAME (libmp3lame) for compressing audio streams** (`http://lame.sourceforge.net`)

Using MythMusic on a MythTV system also requires the following libraries and applications:

- MAD MP3 decoder and ID3 library (`www.mp3dev.org/mp3/`)
- Ogg Vorbis high-quality MP3 alternative format (`www.vorbis.com/`)
- FLAC lossless encoding of audio streams (`http://flac.sourceforge.net/`)
- libcdaudio for obtaining FreeDB information (`http://libcdaudio.sourceforge.net/`)
- cdparanoia for ripping CD information (`www.xiph.org/paranoia/`)

Not listed on the MythTV Web site, but absolutely required for a working MythTV installation, are the following:

- **Current version of a Linux distribution** (kernel version 2.6.x or better) — See the section "Suggested Linux Distributions" later in this chapter for more information on selecting a distribution.
- **Linux Infra-Red Remote Control Daemon** — If you want to use a remote control with your MythTV system, you'll also need the Linux Infra-Red Remote Control Daemon (LIRC). LIRC supplies the Linux interface to IrDA technology found in electronic component remote controls. Visit the Linux Infra-Red Remote Control Daemon Web site at `www.lirc.org/`.
- **IVTV or BTTV driver support (card-specific)** — See the following sections for more information on IVTV and BTTV.

IVTV MPEG-2 CODEC

The IVTV project goal, as stated in the IVTV FAQ, is to "provide a 'clean room' Linux Open Source driver implementation for video capture cards based on the iCompression iTVC15 or Conexant CX23415/CX23416 MPEG Codec." In short, IVTV drivers rank among the best and most widely used MPEG-2 codecs for Linux. A lot of the better capture-card products on the market bundle and use the IVTV driver software as part of their product offerings. See the following sites for more information:

- IVTV Vendor Web Site — `http://ivtv.sourceforge.net`
- IVTV Product Support Page — `http://ivtvdriver.org/index.php/Supported_hardware`
- IVTV TV-Out How-To — `http://ivtv.writeme.ch/tiki-index.php?page=TvOutHowto`

BTTV MPEG-2 CODEC

Another popular driver solution caters to the BrookTree Technologies BT848 and BT878 chipsets, both of which are known to work fairly well under Linux. Driver support appears in the 2.2.0 kernel version of Linux and continues to show up in the latest 2.6.x versions. Many popular vendor cards use this chipset; consult online resources for compatibility listings according to exact make and model.

The following list shows cards known to be compatible with the BTTV driver:

- Euresys Picolo Tetra
- Spirit TV Tuner
- AVerMedia AVerTV DVB-T 771
- AVerMedia AVerTV DVB-T 761
- MATRIX Vision Sigma-SQ
- MATRIX Vision Sigma-SLC
- APAC Viewcomp 878(AMAX)
- DVICO FusionHDTV DVB-T Lite
- V-Gear MyVCD
- Super TV Tuner
- Tibet Systems "Progress DVR" CS16
- Kodicom 4400R (master)
- Kodicom 4400R (slave)

To learn about new hardware that may have been added recently, please check the following BTTV-supported cards list: `www.linuxtv.org/v4lwiki/index.php/CardlistPre.BTTV`.

For additional information on BTTV, try the following sites:

- BTTV Web Site — `http://linux.bytesex.org/v4l2/bttv.html`
- BTTV Wiki — `www.linuxtv.org/v4lwiki/index.php/Bttv_devices_%28bt848%2C_bt878%29`
- Enabling support for your Bt8×8 hardware in Linux — `www.linux.com/howtos/BTTV/hw.shtml`
- Linux BTTV Video How-To — `www.faqs.org/docs/Linux-mini/BTTV.html#ss4.5`
- Linux BTTV Audio How-To — `www.linuxtv.org/v4lwiki/index.php/Btaudio`

MythTV Packages

MythTV is bundled in a myriad of package schemes, primarily as a base set of packages (`mythplugins`, `myththeme`s, and the `mythtv` itself) to be installed on an existing Linux distribution, though specialty distributions roll a functional operating system with MythTV specifically tailored to Linux video capture. Because this book explicitly deals with MythTV as a package system, with a walkthrough for specific Linux operating system setup and operation, alternative options are mentioned only in passing.

And You May Also Want . . .

The following elements are not required, but are highly recommended additions:

- **Xmame, Xmess, and Arcade Emulation** — Both Xmame and Xmess are applications adapted from an original pair of arcade game emulation programs, the Multiple Arcade Machine Emulator (MAME) and Multi Emulator Super System (MESS). Xmame and Xmess are born of the long-lost arcade game nostalgia and nurture the inner child within every geek. Using the MythGames plug-in, Xmame functionality provides endless hours of low-resolution entertainment. The Xmame and Xmess Web site is `http://x.mame.net/`.
- **MythTV Upcoming CGI Script** — The MythTV Upcoming CGI Script details current recordings scheduled under MythTV without requiring connection to the `mythbackend` daemon process. Queries are made directly to the MySQL database kept by MythTV. Though not essential to the operation of MythTV, this script does merit one-time mention as a useful potential addition to any MythTV system. The MythTV Upcoming CGI Script Web site is `www.webdez.net/hacks/mythtv-upcoming`.

Hardware Considerations

A typical DVR system need not be a formidable powerhouse in terms of performance. For example, in certain TiVo boxes the power plant is nothing more than a relatively paltry 50 to 250 MHz PowerPC processor with a measly 16 to 32 MB of on-board memory. The key concept here is the continental divide between a desktop computer and a DVR solution; a DVR uses a subset of typical desktop hardware resources. Depending upon desired quality of capture and playback, a core clock speed of 500 MHz is adequate, but 1 GHz or better is preferable. Thus, it's entirely feasible to cobble a MythTV system together from remnants of yesteryear's technology.

As a general rule, buying the latest in advanced hardware ingredients when working with Linux does not sit high on the list of priorities. That's because the driver development cycle for the open-source community faces a different set of challenges than does the Windows community. Some hardware vendors closely guard the ingredients to their secret sauces, and the very nature of open source violates their rights to such secrecy. Occasionally, though, a vendor does show support either directly or by indirect participation (providing closed-source binary-only drivers), or driver support is simply reverse-engineered into existence (as is the case with `forcedeth` Ethernet drivers for Linux).

That said, many recent distributions of Linux support a surprising number of new technologies without major omissions, challenging this notion. However, just because support is there doesn't justify the costs that some of these items can involve. We recommend taking a cost-benefit trade-off approach in picking hardware components, spending most on what matters most to you, and cutting back on things that may not be as important (such as skimping a bit on hard disks to spend more on a more capable graphics card, for example).

MythTV boasts support for many PVR cards from various manufacturers, as well as support for High-Definition TV (HDTV) and Digital Video Broadcasting (DVB; European) capture cards (since release version 0.17). The tuner card should do most of the heavy lifting, so we recommend that you purchase a card that provides on-board MPEG-2 decoding. This way, the CPU is better utilized for auxiliary system tasks that are less subject to interruptions from the video encoding and decoding processes.

Do Your Hardware Homework

It's always smart to research hardware specifications thoroughly before you make any purchases. That's the best way to ensure minimal fuss and downtime during the construction phase. One of the most important component choices you'll face is your TV tuner card (or cards, if you also decide to build in over-the-air HDTV capability); among other choices you must consider are regional dependencies that relate to broadcast technologies and signals (such as NTSC in North America versus PAL/SECAM throughout much of the rest of the world). Network cards, though non-essential, contain chipsets that may not be identified or even supported under Linux — especially where 802.11 b and g wireless gear is concerned. That's why a short but important list of resources devoted to this subject appears at the end of this chapter.

Several online resources such as the PVR Hardware Database provide short listings of MythTV-compatible hardware builds from various users. Google is a huge treasure trove of MythTV user experiences, so this is but one of many resources you might wish to consult: `http://pvrhw.goldfish.org/tiki-pvrhwdb.php`.

Well-informed research, conducted well in advance of any purchase, is vital to successful construction of a MythTV system. Newcomers to Linux will soon discover the tremendous learning curve involved in configuring, building, and maintaining a functional system, but those who persevere will also discover the rewards of a fully customizable operating system. Recent distributions cater to the curious Windows user base by streamlining and simplifying the installation process and creating graphical interfaces for virtually every task. However, actual administration of a Linux box differs vastly from Windows.

Keep your general design scheme in mind and observe how that influences the hardware choices you make. While horizontal cases fit nicely amid entertainment center gear, they can prevent using oversized components or those that require extra room. For example, try cramming a passively cooled GeForce 6600 card with overarching heat pipes such as the Gigabyte GV-N66256DP into a slim profile case such as the Silverstone LC04 and you'll immediately understand what we're getting at when you realize you can't fit the cover over the heat pipes. Plenty of add-in cards come in Low-Profile (LP) formats that work well within horizontal cases, or where space may be at a premium for one reason or another. For example, Hauppauge offers the PVR-150-MCE LP in a tiny form factor.

Make your most essential hardware purchases to meet compatibility and consumption requirements. When you find yourself weighing certain options, determine the most essential capability you seek from your own personally tailored MythTV system. Which is more relevant to your needs: extreme processing capability or expansive storage? Do you want to record one or more programs while watching another program (which requires multiple tuner cards, or a dual tuner card such as the Hauppauge PVR-500MCE), or is a single tuner in your system enough to meet your needs?

In addition, consider carefully any features you may not need but for which you may still pay extra. As an example, the Hauppauge PVR-150MCE card doubles as an FM radio tuner in addition to on-board MPEG-2 decoding. Don't need FM radio? Get the new Hauppauge model that comes without it, and save $18 or more. Tuner cards arrive in a variety of configurations at distributors and retail outlets; some have multiple tuners per card, others lack integrated audio encoding. Know what you want, and what you're buying.

Occasionally, a given tuner card is sold in OEM form. This means you pay only for the bare essentials; none of the mark-up for retail packaging, accessory parts, and sometimes cabling (where applicable). Again as an example, the aforementioned PVR-150MCE from Hauppauge ships in OEM form, minus the remote, cables, and adapter found in the more expensive retail version. The price difference may be negligible, as you'll have to buy another remote control, but that's a plus if you think the stock Hauppauge remote is too restrictive for your needs (indeed, we did, and opted for SnapStream's Firefly and Logitech's Harmony 680 remotes instead).

For ambitious system builders operating on less restrictive budgets, options that offer comprehensive airflow management, functional case design and construction, and acoustic noise reducing materials are plentiful. Conversely, you can choose a case that doesn't integrate much

acoustic dampening, and add in such materials as you build your system. For example, Antec carries a line of NoiseKiller products — thin silicon rubber screw gaskets and shims molded to fit specific fan diameters (80 and 120 mm), or standard ATX power supplies that, when installed properly between component and case, provide superb sound deadening.

Likewise, various types of sound-dampening foam pads are available to help limit noise from your MythTV PC. Acousti Products offers various noise-dampening products, including a dense, adhesive-backed foam sheeting called AcoustiPack that comes in various kits, some designed for the end-user to cut to fit a PC case, others pre-cut to fit specific case makes and models. The company also offers ultra-quiet fans, fan mounting kits, and even cases with AcoustiPack dampening already installed. Visit them at `www.acoustiproducts.com`.

Visit Mike Chin's outstanding Silent PC Review Web site (`www.silentpcreview.com`) for more information about quiet PC components and good noise-dampening products and techniques.

Component Recommendations

In the sections that follow, we walk through the key components you'll want to consider — and ultimately, select — for your MythTV PC. Though we may mention specific vendors with whom we've had good experiences, don't be bashful about doing your own research to come up with other options. You'll find sites such as HTPCnews.com, PCAlchemy.com, Quietpcusa.com, EndPCNoise.com, Subzeropcs.com, and Siliconacoustics.com all to be of great value in helping you narrow down your options because all cater to the home theater and/or quiet PC buyer.

Computer Cases

Many contributing factors distinguish a good case design from a bad one, and these factors are unique to your MythTV build. Motherboard form factors such as ATX and mini-ITX require entirely different chassis with completely incompatible dimensions, for example. It might make more sense to consider specialty components such as slim-line optical drives and low-profile memory where mini-ITX dimensions are concerned, but the premium for these specialized components may not appeal to budget-oriented consumers. Therefore, the more standard ATX form factor makes the most sense from an economic standpoint, accommodates more types and quantities of hardware, and yields the most abundant off-the-shelf equipment for timely, cost-effective system builds.

Antec (`www.antec.com`) is a leading manufacturer and innovative producer of computer-related hardware, encompassing everything from consumer-grade to enterprise-level enclosures, power supplies, and an increasing variety of silencing accessories. We've had great results using the Antec P-180 as a workstation, and it would make a formidable master-backend server for multi-client environments. The P-180 has removable drive trays for 3.5" magnetic drives and bolt-on slide rails for 5.25" opticals and accessory panels, enabling quick and easy access for maintenance and parts replacement.

Ahanix (www.ahanix.com/), maker of high-end High Definition TVs (HDTVs), offers several sleek and attractive cases for home theater and media center components. The Ahanix products run in the medium to high price range. Its D.Vine 5 case — what a great name! — features all aluminum construction and comes with a Vacuum Fluorescent Display (VFD), 300-watt ATX power supply, and two silent case fans.

SilverStone (www.silverstonetek.com), a major Taiwanese specialty case manufacturer, has product lines offering many entertainment-center-related aluminum case designs that natively provide excellent noise management while maintaining fair thermal properties. Their design characteristics also include mid- to low-profile heights, black and silver aluminum colors, and optional VFD read-outs, ideal for placement within an arena of shelf-kept entertainment equipment.

Also noteworthy is the thoughtful planning and careful consideration evident in the layout of SilverStone's LASCALA (LC) series lay-flat structures, which encompass a wide variety of designs. This particular line is well-suited to HTPC builds with low height requirements.

Although they are ideal cases for inclusion with any HTPC build, the SilverStone line carries quite a premium price tag. Base models sporting the bare minimum of features can easily go for $200 and up.

Table 1-1 provides a summary of case manufacturers.

Origen AE Technology (www.origenae.com), formerly Uneed International, is a leading manufacturer of high-end aluminum cases, specializing in HTPC enclosures encompassing a variety of designs and features. Most notable is the x15e all-aluminum case with touch-screen Vacuum Fluorescent Display (VFD) panel. The only downside to some of these units is that they are subject to inadequate ventilation issues, and all run at least $200 and up for basic models (the x15e costs $600 and up).

Fremont, California-based Casetronic (www.casetronic.com) designs and produces a variety of passive electronic components and specialty enclosures. Particularly worthy of mention is the Travla line of small form factor hobbyist enclosures fabricated entirely from aluminum. A unit such as the Travla C137 maintains the professional finish of a modern entertainment device, making it right at home on your television stand or bookshelf.

Table 1-1 Brief Summary of Case Manufacturers

Low-End	*Mid-Range*	*High-End*
Antec	Ahanix	Ahanix
Casetronic	Antec	SilverStone
	SilverStone	Origen

Motherboards

In terms of compatibility, Linux is mainly concerned with chipsets. Support relies on vendor cooperation so that Linux driver developers may properly implement hardware chipset support in the mainstream distribution channels. Motherboard chipsets are generally very well supported, so expect to find few if any obstacles in the path to a clean operating system installation. A few instances where problems may arise might occur when older Linux distributions are used on newer motherboards, or on motherboards using chipsets too new to find driver support in stable Linux releases.

The most significant decision is likely to be that of size: how big should the motherboard be? This should be a recurring consideration when picking and choosing MythTV components. Motherboard dimensions are governed by the overall space that the form factor makes available, or that the case chosen dictates. Those opting for small form factor components will find the most challenging experience when researching and pricing relevant parts as compared to builders who choose standard desktop PC components.

Advanced Technology Extended (ATX)

The most ubiquitous of all is the time-tested, industry standard Advanced Technology eXtended (ATX) form factor. As the oldest of all current motherboard types, the ATX design has experienced a rich history of evolution and enhancement. ATX is the de facto standard in motherboard design for the do-it-yourself consumer, and offers the most options in terms of on-board features and functions.

Setups requiring multiple tuner cards will most likely demand the use of this large layout. Lack of adequate airflow or sandwiching two tuner cards together is a quick shortcut to a system meltdown, however, so ventilation is an important concern when designing and building such a system. Optimal airflow may be achieved by placing cards in every other slot and introducing proper ventilation into the case design.

MicroATX (µATX)

Considered a smaller sibling to the original ATX form factor, microATX is popular among high-volume and low-volume desktop vendors alike owing to its smaller size (9.6" × 9.6") and relatively low cost. A smaller size enables the µATX to be shoehorned into a variety of small and mid-tower cases, some no bigger than VCR units or 8-bit Nintendo entertainment systems.

To achieve its mildly conservative dimensions, the µATX layout skimps on the number of socket types it provides (usually omitting on-board headers and extension cables for extended port availability). Small dimensions also leaves room only for a smaller number of PCI slots (commonly three instead of five) or cutting the number of Universal Serial Bus (USB) ports in half. This can pose design challenges for configurations that require multiple tuner cards along with add-in sound cards and other peripherals.

Specialty power supplies with smaller dimensions than typical ATX units are marketed solely for the µATX segment. These units generally maintain the same peak power output as the larger PSUs.

Mini-ITX

Among the newest of PC form factors, the mini-ITX layout is by far the smallest, measuring only 170 mm by 170 mm (approximately the width of ordinary printer paper). This form factor addresses a variety of needs for targeting embedded applications, most notably in the areas of low power consumption, low noise output, and minimal thermal signature (in fact, several early models lacked active CPU cooling up to the 1 GHz mark).

Developed by VIA technologies, the mini-ITX form factor has seen tremendous success in the hobbyist sector, primarily for home entertainment designs. Those tiny dimensions promise amazing potential in terms of the features thoughtfully included in such limited space, and in terms of creative case design and use. VIA markets a wide array of functionality neatly tucked into each ITX board, and some even sport on-board video processing with several types of video output ports provided.

Popular and creative cases for the mini-ITX board include gutted humidors, RC cars, vintage toasters, and even mock-ups of R2D2 (of Star Wars fame) and Bender the Robot (of Futurama sitcom fame). And this illustrates only a small part of the potential for new and clever uses for mini-ITX components.

A variety of low-profile components suited to the cramped environments of mini-ITX builds are available on the market. Everything from low-profile memory and processor heatsink/fan combinations to add-in cards and storage drives provide every means necessary to construct a functional mini-ITX DVR.

Processors

Standard-definition units emphasize lower demand on subsystem components, and therefore require less expensive parts to build and maintain. An AMD 3200+ or Intel P4 3.2 GHz core is pure overkill for anything but a high-definition build, so consider reallocating some of that expense toward a better tuner card or a PCI-based sound card. Higher clock speeds can contribute to higher bit rates for encoding audio or video, or enable higher-resolution capture and display, however, so buying cheap does have trade-offs.

Here are some key points of reference regarding CPUs in MythTV systems (taken from the MythTV Hardware page):

- A PIII/733 MHz system can encode one video stream using the MPEG-4 codec using 480 × 480 capture resolution. This does not permit watching live TV, but it does permit encoding video during capture, and then watching it later.
- One developer states that his AMD Athlon XP 1800+ system can *almost* encode two MPEG-4 video streams and watch one program simultaneously.
- A PIII/800 MHz system with 512 MB of RAM can encode one video stream using the RTjpeg codec with 480 × 480 capture resolution and play it back simultaneously, thereby permitting viewing of live TV.
- A dual Celeron/450 MHz can view a 480 × 480 MPEG-4/3300 Kbps file created on a different system with 30 percent CPU usage.
- A P4 2.4 GHz machine can encode two 3300 Kbps 480 × 480 MPEG-4 files and simultaneously serve content to a remote frontend.

AMD Semprons in their various socket types (Socket A/462, Socket 754) make an excellent economical choice for a basic MythTV box. They're inexpensive, provide high clock speeds, and are widely available. Selecting a Socket A/462-based motherboard is highly cost-effective. While the chipsets that accompany these boards are well supported under Linux, you should also expect fewer features and less power than motherboards with newer socket types would deliver. Socket 754 boards offer fairly recent technologies and newer features than socket 462 models, but they're old enough now that you should only expect them to deliver fair to mid-range capabilities.

The latest classes of chipsets and features are clearly present in Socket 939 motherboards for AMD processors, and LGA 775 for high-end Intel Pentium processors. All the latest development happens here, where bleeding-edge home entertainment features keep creeping into mainstream product lines offered by top-tier manufacturers. The top-of-the-line AMD and Intel processors that conform to sockets 939 and LGA 775, respectively, offer the highest clock cycles, best utilized in high-definition multi-user environments on MythTV systems.

While 64-bit computing offers little (if no) benefit to a DVR box, the nice thing about going with Linux and 64-bit processors is the freedom to compile kernel and system utility support in 32- or 64-bit modes. The performance advantage is only gained in applications specifically designed to take advantage of 64-bit registers and enhancements, which are few and far between on the desktop front. There is little evidence supporting the notion that 64-bit × 86 computing is inherently faster than 32-bit equivalents where such programmatic consideration is not involved. However, this problem will soon be academic, validating the forward-thinking choice of buying 64-bit now.

Memory

Installing copious onboard RAM will not necessarily benefit every individual MythTV build. For many applications, standard-definition television leaves memory in excess of 1 GB mostly unused. While there is certainly no harm in having maximum headroom, the added expense for unused memory might be better spent elsewhere on other system components.

Evidence of system performance in which all memory resources are completely consumed might indicate problems outside the hardware realm. For example, this might point to incorrect configuration settings, incompatible hardware, or inefficient usage. In fact, as long as you follow our basic recommendations you should be okay for memory as long as Linux and MythTV software doesn't go through too many major revisions in the meantime.

Unless your build is going to handle high-definition TV, 512 MB is sufficient for standard-definition TV (SDTV) playback. Be sure to choose memory that's suited to the Front-Side Bus (FSB) on your motherboard and your processor. For example, VIA C3/Eden mainboards sporting VIA's own CLE/266 Northbridge requires PC-133 Synchronous Dynamic RAM (SDRAM), a much older technology (though, perversely, more expensive) than the PC-3200 Double Data Rate RAM (DDR) used by current AMD chipset designs, or the PC-3200 DDR2 that most modern Intel chipsets demand.

Standard-definition systems can be equipped with a wide range of memory options — from budget-oriented Semprons and Celerons to mid-range Athlon and Pentium 4 cores. Such processors generally use Double Data Rate (DDR) SDRAM, which offers better performance than the older SDRAM technology. This translates into better overall responsiveness. DDR is

available in a wide variety of capacities, from 256 MB up to 2 GB, with varying timing ratings, such as Column Address Select/Strobe (CAS) latency timing, that factor into part costs.

Memory timings determine how quickly memory cells may be loaded with fresh information, how quickly such information is refreshed and accessed, and how quickly the module can establish a ready state for the next operation. This impacts the rest of the input/output subsystem directly, much of which relies heavily on the current contents of main memory.

Standard memory timings for DDR modules usually sit somewhere around 3-5-5-8, a modest collection of values. High-performance DDR modules boast latency ratings of 2-3-2-6, and the absolute best is 2-2-2-5. DDR2 sports higher timing values, but the operation of DDR2 is entirely different from DDR. At any rate, low latency ratings for DDR2 are around 3-2-2-8, plus or minus a few points. DDR2 memory is currently used exclusively in recent Pentium 4 models, and does not affect systems with AMD processors.

While there's no rule that states low-latency parts will provide substantial performance gains, they are relevant for high-definition systems where high bandwidth, heavier encoding/decoding rates, and more data to handle puts more of a premium on system speeds. Your mileage will certainly vary.

TV/Capture Cards

Most of the underlying magic happens at the hardware level in the capture card (aka the *tuner card*, because of its ability to tune into specific channel frequencies). The capture card functions as a tuner to select among the different analog frequencies that make up television channels. A capture is then broken down from its native line-resolution format into a digital pixilated format that a modern computer can handle. To ensure best picture quality, this is one area where you shouldn't skimp on cost by buying bargain-bin hardware.

MythTV operates in two basic modes: software and hardware video encoding. Your choice of capture card influences this mode of operation directly, which may be classified according to what kind of encoding functionality the capture card can deliver. These two classes are called software encoding and hardware encoding.

Software encoding relies entirely on the CPU and underlying resources to process multimedia data. This offers the most cost-effective approach but also inflicts the heaviest performance penalty. Other system tasks will compete for available resources, all vying for slices of processor time to run alongside one another.

Software-based solutions usually occur on systems with motherboards that sport integrated video solutions or on video capture cards that lack vital Digital-to-Analog Converter (DAC) capabilities. For optimal performance, figure that one gigahertz in CPU clock speed (1 GHz) is required for each tuner or capture card that uses software MPEG-2 encoding.

Hardware-based solutions employ on-board processors to handle the heavy lifting for the analog conversion process instead of off-loading that burdensome task to the CPU itself. Spotty playback is indicative of an overtaxed processor, and is most apparent on systems that support multiple users or a multitude of system processes.

Therefore, our strongest recommendation is to make a proper video card selection. Better cards handle on-board MPEG-2 encoding and decoding (sometimes called *compression hardware*) functionality, freeing up system resources for the other tasks vital to regular system operation. Even TiVo and ReplayTV include hardware MPEG-2 encoders in their units; buying hardware with the right encoder chips is invariably worth the extra cost. A quality Hauppauge PVR-150 sells for around $70 or $80 in its retail packaging, and even less for the OEM version, which skimps on accessories and packaging. Likewise, the Hauppauge PVR-500 costs upwards of $150 online in its retail packaging. These are all excellent MPEG-2-based tuner cards, with software-based tuner cards starting around $40 for entry models.

Capture cards are available in a wide variety of designs. You choose from numerous internal and external models, from PCI add-in cards to USB and FireWire conversion units. But only a small number of these are known to work well both with Linux and MythTV itself. Several online resources name products that work well with MythTV. Thus, we urge you to consult the following resources to help you select a worthy tuner card:

- Red Hat Video4Linux Mailing List: `https://listman.redhat.com/mailman/listinfo/video4linux-list`
- Waikato Linux Users Group TV Tuner Cards: `www.wlug.org.nz/TvTunerCards`
- LinuxTV V4L Wiki survey of cards in use now: `www.linuxtv.org/v4lwiki/index.php/List_survey_of_cards_in_use_now`

Key Tuner and Capture Cards Considerations

Early TV tuner and capture cards had a miniscule 320 × 240 frame size, which offers relatively little picture element data. Contemporary cards can handle much higher resolutions — most commonly, 640 × 480 and 720 × 480. Regular coaxial television occurs at the highest resolution, 720 × 480, with higher-quality signals going well beyond. Modern capture cards should easily handle at least 720 × 480. Digital tuner cards receive a digitized signal in the form of binary MPEG-2 streams, obviating the need for on-board encoding, as the stream comes encoded right from the source.

However, not all cards truly support the 720 × 480 resolution size, and instead cheat by stretching a 640 × 480 image to match the larger size. Though largely historic, these less capable cards should be avoided, and the only real way to know whether you're getting a quality upscale or low-grade stretched image is to compare side-by-side captures of still frame high-definition video.

The following list shows known good capture cards compatible with V4L:

- Hauppauge Nova-T WinFast 2000 XP
- WinTV-PCI-FM model 619
- Plextor ConvertX PX-TV402U
- Hauppauge WinTV-DBX (model 401)
- LifeView FlyVideo 3000

- nVidia Ti4200
- pcHDTV HD-3000
- ADS Tech Instant TV PCI (PTV 350)

Direct Video Broadcast (DVB) Capture Cards

Cards adhering to a code of internationally accepted open standards for digital television are given the initials DVB — short for Direct Video Broadcasting. This set of standards is maintained by a well-represented consortium of industry representatives and is published by several European organizations. Variations of the specification are currently in use throughout Europe, Australia, Africa, South America, and several parts of Asia.

DVB is well supported under Linux and MythTV for those who may have the opportunity to work with European or other broadcasting equipment outside the United States at some point in their travels.

HDTV Tuner Card

Arguably the most commonly used interface for a high-definition picture is the Digital Video Interface (DVI) specification. This is because it enables the proper devices to realize the most enriching picture quality available. HDTV tuner cards are capable of resolution as high as 1920 × 1080i (the "i" represents interleave).

Modern tuner and graphics cards sport a few video ports on the backplane (commonly S-Video and DVI) and provide component and composite output to HDTV-ready and HDTV displays. In a concerted effort to reach an ever-widening array of video connector capability, many video card vendors offer several types of output connections in single blocky adapters that plug directly into the S-Video (or similar) socket.

Ensure that your HDTV tuner card and HDTV television are on the same page when it comes to wiring everything up.

Other Noteworthy TV Capture Cards

For high-definition setups, the pcHDTV HD-3000 offers the best available Linux experience. pcHDTV's founder and CEO, Jack Kelliher, is committed to the open-source initiative, particularly its role in the arena of television entertainment. Visit the vendor Web site at `www.pchdtv.com` for more information.

Astute readers will note that our favorite TV capture card, the Hauppauge WinTV-150MCE, is missing from the foregoing list. Despite its absence from that list, we've had no trouble with that card and the VL4 drivers (and have several such systems running right now, in fact). Visit the vendor Web site at `www.hauppauge.com` for more information about this and other Hauppauge TV capture cards available (the WinTV-500MCE has two built-in tuners, which some system builders may find attractive).

In addition to the thorough treatment given to MythTV on Fedora Core documented on Jarod Wilson's Web site (`http://wilsonet.com/mythtv/`), there is a collaborative write-up detailing the shared experiences MythTV users have with successful HDTV configuration. Happily, we have both Wilson and Matt Wright (of HTPCnews.com fame) aboard to walk us through the HDTV experience in later portions of this book.

HDTV is further explored in Chapters 3, 15, and 17.

FireWire and USB Capture Devices

Many MythTV users have reported success working with various FireWire- and USB-based capture card solutions. No coverage is provided here about the specific configurations and applications of such devices, but readers should be aware that these units can work.

Plextor's ConvertX PVR model PX-TV402U provides hardware capture and encoding for MPEG-1, MPEG-2, and MPEG-4 formats from real-time satellite, cable, or broadcast TV signals in an external USB 2.0 solution. ConvertX PVR device driver support under Linux is provided by Plextor via a special Linux Software Development Kit made available at `www.plextor.com/english/support/LinuxSDK.htm`.

Hauppauge's ever-popular WinTV-PVR-USB2 external capture device is reported to work well under Linux using the collaborative reverse-engineered driver support made available by Mike Isely. Along with the relevant driver code, Isley provides detailed information to get you up and running with the WinTV-PVR-USB2 (not to be confused with the WinTV-USB2, a less capable device), and found at `www.isely.net/pvrusb2.html`.

According to current information available on the MythTV.org Web site, the following devices have been proven problematic or otherwise unworkable under Linux:

- Hauppauge WinTV-D or -HD (no driver)
- Hauppauge WinTV-USB series
- Hauppauge WinTV-PVR-USB (model 602), or WinTV-PVR-PCI (model 880) cards (no driver — this is not the PVR-250/350 series of cards supported by the IvyTV driver)
- ATI All-in-Wonder series

Miscellaneous Graphics Processors

In a concerted effort to pack budget-oriented added value into low-cost motherboard solutions, manufacturers integrate video functionality directly into their feature sets. Owing to the poor performance integrated graphics typically deliver, we recommend that you use a dedicated hardware MPEG-2 encoder instead. Many leading vendors — including Intel (Intel Graphics Port, IGP), Silicon Integrated Systems (SiS), and ATI — presently develop discrete on-board video solutions for the consumer market.

VIA Technology, a leader in embedded technology hardware, produces the most desirable of all on-board processing solutions with its C3 Eden Core product line. Select models sport S-Video, Composite, and Component output ports right on the backplane along with onboard analog encoding capabilities. Such units are designed for use in set-top boxes and entertainment devices, and thus also work well with MythTV.

Audio Cards

When it comes to internal audio components, your options are clear-cut: on-board audio (integrated audio solutions) or off-board audio (in the form of PCI). Each has its strengths and weaknesses for a given application, but what matters most is your perception of ideal audio playback. The following sections lend insight into the underlying principles that might otherwise escape casual notice.

On-Board Discrete Audio Chips

Circuit board layout is as much art as it is science, and it merits special attention for audio purposes. Integrated sound solutions are generally based on the AC'97 codec (considered the industry standard) and are at the whim of the electronic pathways (called *traces*) that interconnect mainboard components. These traces emit varying ranges of electronic noise that can affect sound quality for poor circuit board layouts. Granted, only the most critical audiophiles will consciously notice the difference; most users will get by fine on standard fidelity output. Should you experience feedback during audio playback in the form of electronic hissing and popping, this would be the first possible cause.

On the upside, when going with on-board audio solutions, Creative Labs offers their Home Theater Connect DTS-610, a standalone bridge set inline between a PC and home entertainment system. This impressive little unit is capable of sampling audio streams with DTS quality compression, delivering a respectable 5.1 channel surround sound. This solution neatly sidesteps any potential conflict both with on-board circuit traces and substandard driver support under Linux.

PCI-Based Audio

For cheap and easy sound solutions, electronics manufacturer Chaintech provides fair quality sound at an affordable price with its AV-710 series PCI sound card. The AV-710 delivers 24-bit audio resolution with sampling rates up to 192 KHz and can output in digital optical (via SPDIF or tos-link).

The Chaintech USA daughter site is located at `http://chaintechusa.com/`.

Middle and high-fidelity audio solutions are provided by a relatively new line of PCI-based audio equipment by Creative Labs called Xi-Fi that targets the professional recorder and extreme gamer demographics.

Another Noteworthy Audio Card

DFI redefines the notion of integrating on-board audio by separating the audio chipset from the noisy circuitry in the form of an add-in card. This card, called the *Karajan module,* can deliver crisp 8-channel sound using the on-board Realtek ALC850 audio codec.

Users of the Realtek audio solutions have reported mixed results using the requisite Linux drivers, and recommend using the nVidia-based sound codec instead. Your mileage may vary.

Disk Drives

Storage is an important consideration in the design of any HTPC. Dealing with this subject matter means deciding how much capacity is needed, which file system to use, and understanding how stored files — particularly media files — will be accessed. You may know that a drive labeled "media-ready" has a spindle speed (rotational platter) of 7,200 RPM. It earns the media-ready designation because the drive's performance is adequate for the fairly low-latency requirements of high-resolution, real-time playback of multimedia data. Most modern 3.5" desktop drive offerings on the retail market are available only with 7,200 RPM spindles (suffice it to say, it's the most common rotational speed), but occasionally OEM versions are available at lower rotational speeds. The choice is clear: choose nothing less than 7,200 RPM, which is typical for most retail drives, and avoid the potential for undesirable artifacts in subsequent playback.

With that decision made, there's also the question of size: Standard MPEG-2, the de facto encoding format for distribution-quality streaming analog encoding and playback, can weigh in anywhere from 800 MB to 3 GB per hour, depending on the levels of compression elected. TV-quality content operates at a data rate of 1 Mb per second, which isn't asking much, but pushing higher resolutions places greater demand on the storage subsystem. This is most evident in terms of storage space requirements. You'd be surprised to know exactly how easy it is to fully saturate a seemingly gargantuan 300 GB drive using DVD data alone, without including additional image, audio, or TV recording files.

Size matters, but bigger drives also cost disproportionately more than smaller ones. While you can purchase 500 GB drives nowadays, you may be better off buying three 250 GB drives instead (which will cost less than a single 500 GB drive) even if you must also purchase a $40–$60 external USB 2.0 drive enclosure as well to accommodate the third drive. With storage densities increasing all the time, and storage needs growing even faster, we recommend building systems with no less than 300 GB of disk storage. We also assume you'll use one or more USB or FireWire attached drive enclosures to bump up storage for your MythTV system even further.

Motion pictures may not be the only content archived on those drive platters. As is commonly the case, picture files and audio files also consume substantial amounts of storage space. Assume that MP3 compressed audio requires about 1 MB per minute of playback time — a fair assessment — and that your music collection includes 200 CDs and another 200 individual songs. At 74 minutes per CD and 7 minutes per song, that's a total of 16,200 minutes, or 15.8 GB of space for your music. For smaller music collections, that's not bad; for larger music collections, only one 250 or 300 GB drive may not be big enough.

Table 1-2 provides estimated file format sizes according to an hour-long sampling for each type listed. This information should serve as a basis for your consumption needs when calculating the cost and capacity of storage drives.

Table 1-2 Estimated File Format Sizes per Hour of Footage

Quality	*Per Hour*	*10 Files*	*100 Files*	*1000 Files*
VCR/MPEG-4	700 MB	7 GB	70 GB	700 GB
RTJPEG	2 GB	20 GB	200 GB	2000 GB!
DVD/MPEG-2	2.5–5 GB	25–50 GB	250–500 GB	2500–5000 GB!
ATSC HDTV	7 GB	700 GB	7000 GB!	70000 GB!

These unusually large file sizes directly impact the overall performance of DVR units, so special attention is needed for those parts that bear the brunt of this burden. Drive storage is a primary component, as Direct Memory Access (DMA) leverages a straight line of communication with memory to quickly transfer data, without requiring processor intervention (until such time as said data needs to be interpreted or used in some fashion). DMA must be used to avoid jittery and choppy video playback. Because not all distributions enable DMA at boot time, ensure that both the BIOS and boot configuration settings explicitly enable DMA capability.

MythTV operates on any given number of files, the sizes of which vary, but any of which easily involves several gigabytes of information at a time. Most of this kind of material exceeds 4 GB, so particular attention must be paid to your choice of file system based on read/write/remove performance and maximum storage capacity.

According to the best available information, two specific file system formats are the best candidates when it comes to maintaining large data sets efficiently. Both are especially useful for DVR storage, as both provide a reliable, high-performance, fault-tolerant, and expandable framework for maintaining large data files. Characteristics related to the deletion or manipulation of large data sets are especially important.

- **Journaled File System (JFS)** — A mature, fault-tolerant design first implemented by IBM in early AIX versions that has seen over a decade of enterprise-level storage experience and expansion. According to benchmark information, JFS shows the best performance when deleting large files.
- **Extended File System (XFS)** — This also shares a rich and storied history in the enterprise storage arena and shows exceptional response when handling large data files. Not to be confused with the Linux native Extended File Systems (ext, ext2, ext3), XFS is a framework of its own, and provides online expansion (the file system dynamically grows), online defragmentation, and a real-time Input/Output (I/O) API for streaming time-sensitive hardware-based and software-based applications.

A Logical Volume Manager (LVM) offers greater flexibility in allocating and maintaining mass storage devices than conventional hard disk partitioning utilities provide. An LVM can concentrate separate partitions into a single expansive virtual partition that can be resized and moved. However, an LVM by itself is meaningless without a supportive file system format such as JFS or XFS.

While not every distribution will offer all (or even any) of the options during installation, Linux installations everywhere can still benefit from packaged-based additions after the disk drive is populated with viable system data. We suggest you use either JFS or XFS for your MythTV media files.

Parallel ATA Magnetic Disk Drives

Parallel ATA (PATA) is a geriatric standard in terms of technology, and has seen widespread use at both consumer- and enterprise-grade storage levels. PATA is by far the most common disk storage interface specification in use today, is available in a wide range of capacities, and works with most modern computer equipment.

The most distinctive aspect of PATA drives is the 40-conductor, 80-wire flat-ribbon cable used to connect the drive interface to the host controller. Use in small form factor systems makes ribbon cabling clearly impractical, where specialty rounded cables that provide better internal airflow management are normally used instead.

Perhaps the most important point about PATA drives is their impact on overall system performance. For each drive pair chained onto a single cable, the available bandwidth is effectively halved. PATA signaling is unidirectional, in pulses, and only a single drive may signal at any given time. These undesirable effects may be felt when storing a stream of high-definition data to a hard drive that's attached to the same cable as a DVD drive burning an image.

Serial ATA Magnetic Disk Drives

Serial ATA (SATA) signaling, conversely, provides a much cleaner method for dealing with bandwidth-intensive processing. SATA drives plug directly into a SATA port on the motherboard host controller, either directly linked to the Southbridge as part of a discrete chip solution, or as part of the Southbridge controller itself, as in the case of nForce4 and Intel Controller Hub 6/7 (ICH6, ICH7) series chipsets. SATA signaling occurs in a bidirectional, switch-arbitrated fashion (where quality of service influences prioritization of time-sensitive processing such as streaming live video) and offers a more efficient component interface.

While SATA disk drives show varying performance increases over PATA versions, a valid argument stands that SATA optical drives are not necessarily faster than their PATA counterparts. The choice in going with SATA is clear; raw performance is not the essential ingredient, but instead the more efficient utilization of system resources and better performance potential for fully loaded DVRs. Ostensibly, a pair of SATA optical drives will operate independently and create less interruption to other running tasks on the same machine, unlike mated parallel drives, which share a common (divided) resource. For MythTV units that will serve as on-demand back-up stations, SATA drives make the best choice.

Another unique feature about SATA drives is that true SATA drives (those not using parallel-to-serial bridge interfaces) support Native Command Queuing (NCQ), a shortest-path algorithm for multiple outstanding requests for data. Essentially, NCQ dynamically reorders pending requests for information in the most efficient sequence, so that the drive arm describes a single concentric circle around the disk platters, instead of randomly jumping from one location to another. Such jumping places excess strain on particularly active drives (such as with DVR boxes), so NCQ helps prolong the life span of a given drive by reducing normal wear and tear.

NCQ is a feature implemented in the drive and recognized by on-board chipsets that support the SATA 2.0 (SATA II) and SATA 2.5 specifications. Early adopters Seagate (Barracuda Series 7 and later) and Maxtor (Diamond Max 10 and later) drives implemented NCQ well before the SATA II specification was finalized. These particular drives also happen to be among the quietest on the market, with Seagate setting the trend for Fluid Dynamic Bearing drive acoustic dampening technology. Ensure smooth, reliable, near-silent operation by choosing a drive marked as having Fluid Dynamic Bearing, or FDB, on the retail packaging.

Optical Drives

Relatively little has changed in consumer-grade optical drive technology to the extent that Linux may give you significant problems when trying to establish a working relationship with the drive. Depending on which versions of kernel and supporting packages are used at the time of build, support may or may not be present for the latest drives. Such is the case with SATA DVD drives — not all distributions support SATA-based optical drives during the installation process, which is a compelling reason to keep a spare PATA DVD drive handy. PATA drive technologies have long been supported under Linux, and just about any parallel optical drive will work under Linux.

CD-ROM Optical Disc Drives

Compact Disc ROM (CD-ROM) technology hasn't changed much in the past few years, with minor incremental revisions to the core ATAPI specification and rotational spindle speeds. Overall, the underlying technology has remained consistent in its ability to read and write a variety of data to the optical CD-ROM media, and with fairly lasting results. However, CD-ROM inclusion within a DVR build seems a bit short-sighted and unnecessary because DVD-ROM drives are fully capable of reading and writing to both CDs and DVDs.

The ATAPI specification is well understood and widely supported under Linux. Very few exceptions arise with regard to drive compatibility, short of manufacturer-specific implementations that clearly limit compatibility by their very use (overburn technologies, for example, that allow for writing more data to disc than is apparently available). Any functional CD-ROM drive should work fine and be properly identified under Linux.

DVD-ROM Optical Disc Drives

Current Digital Video Disc (DVD) drives offer a wealth of options in the areas of aesthetics, features, and media compatibility. Dual-Layer (DL) DVD burners are becoming more apparent in the marketplace, alongside the readily available single-layer DVD plus/minus R/W drives.

Most DVD offerings are available as PATA drives, while a few vendors offer select models with SATA support (such as Plextor's 712-A PATA and 712-SA SATA optical drives). Table 1-3 lists DVD disc media types and their estimated on-disc sizes for the most common formats.

When searching the marketplace for a suitable optical drive, seek out those products with the most suitable acoustic and vibration characteristics. Unnecessary noise during drive spin-up and unsteady disc rotation are the hallmarks of cheap drives. With decent and fairly quiet drives available for between $70 and $100 (SATA) or $40 and $60 (PATA), there's no reason to use cheaper but noisier drives. Savings of $20 or $30 won't make up for the added noise.

Table 1-3 DVD Disc Media Types and Features

Format	*Sides*	*Layers*	*Capacity*
DVD-5	Single	Single	4.7 GB
DVD-9	Single	Double	8.5 GB
DVD-10	Double	Single	9.4 GB
DVD-14	Double	Double	13.3 GB
DVD-18	Double	Double	17.1 GB

Apart from slot-load versus tray-load mechanisms, the major distinction among optical drive technologies is form factor. Common dimensions measure anywhere from 146 × 41.2 × 177.5 mm and up for a modern desktop optical drive. Unusual and creative uses come from the laptop world, where slim-line drives reign supreme and stand a mere 12 mm (not quite half of an inch) high and easily adapt to most desktops with the appropriate backplane converter (44 pin to 40 pin IDE). However, these drives carry a premium for their small size.

For completeness, some unconventional methods, requiring expertise to set up and operate, are noted in the following sidebar.

Power Supply Units

The system Power Supply Unit (PSU) is perhaps the most casually overlooked and easily underestimated component consideration made during common consumer decisions. We pay special attention to the PSU for several key reasons, including efficient thermal design, economy of sound, and optimal airflow management. PSUs are manufactured to a variety of specifications, the most common of which are the ATX and micro-ATX form factors.

We can make some general approximations about the power consumption requirements for a given component based on its power ratings listed on the product label. On an optical drive, this appears topside, where the required FCC (in the United States) compliance tested seal of approval appears. A Mitsumi CD-ROM optical drive manufactured in August of 2000 states VDC ratings of 0.8 Amps at 5 Volts and 2.0 A at 12 V. By multiplying amps and volts and then adding the respective values of both the 5 and 12 V rails, we can determine the maximum power consumption by this device (in watts), which is 28 — about average for an optical device.

Consider this an operational consumption requirement — that is, the power drawn necessarily under load. There is also a peak efficiency rating on most PSUs that determines the maximal amount of current that can be overdrawn by several components at once during the initial power-up phase. When a computer boots up, each spindle-based device promptly fires up its engines and begins a ready state to be interrogated by the BIOS and subsequent operating system components. During this period, a device will use twice its rated power consumption when initializing the rotational pieces.

Depending upon CPU clock speed and core features, the hottest running component in a DVR box will draw anywhere from 65 to 130 watts at most. Add-in cards on the PCI bus draw on the steady 3.3 to 5 volt signaling, and the tuner cards mostly target this connection interface. In addition, expect the tuner cards to run quite hot, as they rely on mostly passively cooled aluminum shield designs enclosing the encoder chip.

Ideally, for economy of sound and power, the power supply should be a "smart" consumer by selectively throttling its main fan and auxiliary fan as load increases. Leading PSU manufacturers such as Seasonic, Antec, and OCZ design thermally sound, highly efficient units that adapt well to the ever-changing demands of a dynamic environment.

For suggestions, see the SilentPC Power Supply Fundamentals and Recommendations at `www.silentpcreview.com/article28-page1.html`.

Storage Solutions for the Intrepid

RAID Technology

Redundant Array of Independent Disks (RAID) provides certain optional features that can improve performance for high-demand audio and video processing. RAID functionality is provided either as an add-in card or as an optional integrated motherboard feature. Only specifically marked motherboard packages are capable of RAID, and these packages usually carry a premium. The intrepid builder who places the utmost emphasis on pure performance should consider RAID performance benefits for inclusion in his or her build.

RAID comes in a variety of levels and configurations, most of which are beyond the scope of this book. Only the applicable variations earn mention herein:

- RAID-0 (striping) — Requires at minimum two drives; splits data in half (parts A and B), and stores one half (A) on one drive, and the other half (B) on the second drive. Once accessed, the data is effectively pulled from two drives in shorter time than a single drive. This offers the best performance for high-density storage applications and is commonly used in industrial-grade digital video production rigs to store and maintain raw footage.
- RAID-1 (mirroring) — Requires at minimum two drives; copies data twice, to two or more drives, offering the best reliability at the cost of performance. This method is of little use to most users, finding purpose only for prolonged and verified archival reasons.
- RAID-10 (mirror/stripe) — Often also interchanged with RAID-10, RAID-0+1, or RAID-1+0, though each is implemented differently; basically, the reliability of mirroring with the blazing fast access times of striping.

Gigabyte i-RAM: Solid-State DDR Storage

Solid-state storage devices such as Gigabyte's i-RAM PCI add-in card utilizes four DDR sockets capable of supporting up to 8 GB of 200 MHz RAM. Gigabyte's technology merges the speed of dynamic memory with the persistence of solid-state disk drives. What this means for the intrepid DVR builder is an ultimately silent playback unit with an ultra-responsive storage repository for the host operating system and the entirety of the MythTV code base and packages.

Other Useful Peripherals

Remote controls are bundled with some capture cards but not with others, as is the case with the OEM Hauppauge PVR-150, and one reason for its lower cost than the 350 and 500 series. However, these bundled remotes often skimp on features and provide only the functionality a manufacturer is willing to invest in, so you may want to purchase a remote control separately. The following sections provide you with need-to-know information regarding the operation of remote controls in the context of a MythTV DVR.

Remote Controls

Bundled remotes included with most capture card retail packages leave much to be desired. Most general users will get by fine with the rather lackluster features present on bundled remotes — they're not entirely useless, of course — but for the power user, they just won't have any appeal.

SnapStream's Firefly remote and paired USB receiver are entirely Radio Frequency (RF) based, meaning greater freedom of range and motion (note the occasionally necessary stretching of arms required for negotiating weakling Infrared Data Association, or IrDA, signals around solid objects). Everything from functionality to ergonomic design is well considered in the construction of the Firefly. It contains plenty of programmable buttons and integrates well with MythTV using the Linux IrDA Remote Control Daemon (lircd). Plus, the well-balanced design provides smooth handling and superior grip to conventional blocky shapes that disregard hand contour and formation.

The Firefly is very affordable and can be found for around $50. For more information, visit the SnapStream Firefly Product Page at `www.snapstream.com/products/firefly/`.

Logitech offers a pretty potent package in its Harmony 680 series of USB-based superior remote controls. The 680 is pretty advanced: It's a programmable remote control capable of downloading configuration settings for various AV components — all with a simple visit to the vendor Web page and quick setup of the applicable profile.

The Harmony 680 is encased in a durable dark-gray plastic enclosure sporting a backlit keypad and LCD read-out. As an ultimate example of following the convergent technology ideology, Logitech does an excellent job of freeing the hapless end-user from a multitude of mutually

independent remote controls. According to the manufacturer's suggested retail price, the Harmony 680 carries a hefty price tag of $199, but you may be able to find it for as little as $120.

For more information, visit the Logitech Harmony 680 product page: `www.logitech.com/index.cfm/products/detailsharmony/US/EN,CRID=2084,CONTENTID=9568`

Jarod Wilson, the very same maintainer of the ultimate MythTV How-To and a major contributor to this text, also offers useful pointers for remote control set-ups. Check out the following sites:

- Linux and LIRC:
  `http://wilsonet.com/mythtv/#lirc`
- Remote Controls and MythTV:
  `http://wilsonet.com/mythtv/remotes.php`

SIP Phones and Videophones

Users of phone and videophone equipment benefit from telecommunications integration via the standard SIP protocol courtesy of the MythPhone plug-in. MythPhone is a core component of the MythTV plug-ins package and thus requires minimal setup time. Interested readers are advised to consult the release documentation and distribution changelogs for information about the latest and greatest features supported. Find more info at the following sites:

- MythTV MythPhone plug-in home page:
  `www.zen13655.zen.co.uk/mythphone.html`
- MythTV MythPhone User Guide and How-To:
  `www.zen13655.zen.co.uk/mythphone-howto.html`

Suggested Linux Distributions

Throughout this book, the reader is treated to a comprehensive hands-on approach to building a Linux-based DVR from scratch, starting with a Fedora Core base installation and importing the appropriate packages and package dependencies. Fedora Core has been chosen for its general ease of installation and ease of use, and its reliable and consistent professional-grade quality. While initial portions of this book were written for Fedora Core 4, the techniques will translate to Fedora Core 5, but you should be aware of any subtleties regarding placement of utilities (such as the terminal application, which appears in System Tools on the taskbar in FC4, and Accessories in FC5).

While this book maintains strict adherence to the Fedora Core installation, configuration, and maintenance procedures, the reader is at liberty to choose among any of the readily available Linux distributions. Each distribution brings with it unique quirks and obstacles, so expect to see quite a bit of variance among other installation processes.

Table 1-4 is not meant to be exhaustive, merely a summary of distributions showing general popularity within the Linux PVR/DVR community.

Table 1-4 Suggested Linux Distributions for MythTV

Fedora Core Linux with MythTV Resources	
Fedora Core Linux Web Site	http://fedora.redhat.com
Fedora Myth(TV)ology	www.wilsonet.com/mythtv/
Gentoo Linux MythTV Resources	
Official Gentoo Linux Web site	www.gentoo.org
Official Gentoo MythTV Install Guide	http://dev.gentoo.org/~cardoe/mythtv/
Gentoo How-To Setup MythTV wiki	http://gentoo-wiki.com/HOWTO_Setup_MythTV
Mandrake Linux MythTV Resources	
Mandriva (formerly Mandrake) Linux Web Site	www.mandriva.com/
Maiku's Setting up MythTV under Mandrake 10.1 Guide	www.byopvr.com/Sections+index-req-viewarticle-artid-13-page-1.html
Thac's Mandrake 10.1 MythTV RPMs	www.mde.djura.org/10.1/RPMS/
SuSE Linux MythTV Resources	
Novell SuSE Linux Web Site	www.novell.com/linux/suse/
OpenSuSE 10.1 Distribution Site	www.opensuse.org/Welcome_to_openSUSE.org
MythTV Custom Builds	
KnoppMyth Web Site	www.mysettopbox.tv/knoppmyth.html
KnoppMyth Forums	www.mysettopbox.tv/phpBB2/

Getting Help from the MythTV Community

The MythTV community is a growing body consisting of tens of thousands of users from around the world, each contributing his or her own perspective and unique experiences. Parts of this community are represented by collaborative HOW-TOs, and other parts via online forums in which users can interact to resolve issues or explain specific configurations. The MythTV Forum at `www.mythtvtalk.com/forum/` is a main entry point for the MythTV community.

The following resources should provide a good jumping off point for the MythTV audience. Certainly no single resource has it all, so we provide several listings for the more popular areas of MythTV information.

Start with a Search Engine

Probably the best and first resort for quick problem resolution and troubleshooting methods is your preferred search engine. The Internet contains a wealth of cached user experiences detailing various symptomatic problems and resolutions encountered during individual MythTV builds. Many installation issues are commonly shared, and therefore abundantly documented. More obscure configuration or compilation problems may warrant further investigation by experienced forum moderators or the developers themselves, depending on the nature of the problem.

Before making a post in any forum, search for information specific to your condition. Include relevant portions of error messages produced either in consoles, message boxes, or log files. Google does an excellent job of ferreting out relevant information based on a precisely structured query with the appropriate descriptive terminology. Your search query results are likely to direct you to forums and message boards to pinpoint a post relevant to your scenario. The Linux community is generally very helpful, but your experience relies heavily on your approach; submitting obvious or known-and-resolved problems without first checking whether the fix has already been posted is frowned upon, and such requests for help have the potential to be met with rejection.

Mailing lists also provide a treasure trove of answers, which again depends on how well you structure your query. Searching directly within a specific page helps quickly locate key terms and makes more efficient use of time in weeding out helpful information from useless detail. Developer communications happen here, detailing the development process, occasionally information regarding fixes and workarounds to known and suspected problems.

User Resources

User resources are for the core audience — the user base of MythTV. Answers to common and popular questions are found here, as well as many pointers to resources further describing unique scenarios from MythTV users around the world. To obtain the most current and accurate information available regarding the configuration and operation of MythTV, check the following sites:

- MythTV Installation and Usage
  `www.mythtv.org/modules.php?name=MythInstall`
- MythTV User Mailing List
  `www.mythtv.org/mailman/listinfo/mythtv-users`
- MythTV User Mailing List Archive
  `www.gossamer-threads.com/lixsts/mythtv/users/`
- MythTV Home Page
  `www.mythtv.org/`

- MythTV HOW-TO Guide
  `http://wilsonet.com/mythtv/`
- Linux WiFi Compatibility List
  `www.linux-wlan.org/docs/wlan_adapters.html.gz`
- MythTV HOW-TO Guide
  `http://linux-wless.passys.nl/`

Resources for Developers

Developer resources are channels open to discussion regarding the programmatic aspect of MythTV. As such, these resources follow strict adherence to development-related subjects, and in some cases explicitly state that off-topic material will be promptly disregarded. The following links refer to points of interest regarding code-related inquiries:

MythTV Developer Mailing List
`http://mythtv.org/cgi-bin/mailman/listinfo/mythtv-dev`

IRC
`irc.freenode.net #mythtv, #mythtv-users`

Bug Tracking
`http://cvs.mythtv.org/trac`

Final Thoughts

MythTV truly is a departure from garden-variety video recording appliances that often represent only a small subset of the functionality present in the MythTV framework. Its robust client/server architecture, flexible configuration scheme, and extensive plug-in framework give you the ultimate freedom of choice. MythTV is unbeatable in terms of overall features, capability, and functionality, especially for the price — free. In the following chapters, we demonstrate how to obtain and install MythTV for existing Linux distributions (Chapter 2), walk you through setting up sound and picture (Chapter 3), and then, in subsequent chapters, show you how to configure a wide variety of software and hardware components to enhance your MythTV experience.