

Build your own TiVo

A researched approach to building a personal video recorder with Linux and MythTV

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Abstract

MythTV[1] is software that provides personal video recording in a variety of operating systems, most notably in Linux. It provides an extremely customizable package to create anything from a system similar to TiVo[2] to a full-fledged media center PC.

1 INTRODUCTION

I first discovered MythTV through a colleague at Novell. I had researched much of what the process would entail during the course of several months to plan out exactly what would be the easiest and most rewarding solution for the MythTV system. But as there was little in the form of installation and configuration guides on the Internet, I decided to create one with recommendations and guidelines for building a MythTV PVR from scratch. This covers the hardware and software needed to install MythTV as well as some important configurations for optimal performance as well as some solutions to problems that I ran into. I did not cover how to install from a specific MythTV distribution, but explained the possibilities of them. I also do not delve into the many MythTV plugins available.

1.1 Author's background/qualifications

I have some background with home entertainment systems. I have been a Dish Network installer in Southern California. But more importantly, I had the confidence with Linux that is necessary as I wanted to avoid headaches with the installation and configuration of the system. I have several Linux certifications, including the Novell CLP 10 and CLE 10 as well as my Red Hat RHCT 5 and RCHE 5. In retrospect I think that it ironic that I chose to use Ubuntu 7.10 server considering these certifications. Nevertheless, most of the same principles apply from one distribution of Linux to the next.

1.2 Assumptions

For this document, I assume that you are using the defaults for much of the Linux installation and MythTV. I assume that you are using the MySQL database to run MythTV. You can use several others, but MythTV defaults to

MySQL. I do not discriminate on the specific Linux distribution that you are using, although I assume that you are using a member of one of the major families of Debian [3] (Ubuntu, Knoppix, Debian), Red Hat [4] (Cent OS, Fedora Core, RHEL), or Novell [5] (SLES, openSuSE) based systems.

1.3 Time

If you are starting the install without Linux installed, it should take around two hours for the installation and at least another three hours for configuration. Any issues will require additional time for searching for solutions or reading documentation.

2 HARDWARE

The system should be a mid to high range computer. As anything else goes, the faster the better. As you can get MythTV to run on lower system requirements, it may cause high utilization issues and may cause the system hangs. Here are some suggested system requirements:

2.1 Hard Drive

The minimal disk space for installing MythTV is at least 2 GBs for the OS and 10 for recordings, figuring around 1 GB per hour recording. Of course, I would suggest much more. On my box I have three drives in a software RAID totaling 320 GBs. This in turn is partitioned in an LVM volume so that I can add additional space if 300+ hours of TV is not enough or I decide to upgrade to HDTV, which takes up more space and requires a HD tuner. MythTV allows you to preserve a certain amount of space on the hard drive partition, thus it will not totally fill up the partition that you store the recordings on. On my particular box, I reserved 27 GBs for free space, thus the result is the following:

```
root@mythtv-mars:~# df -h
Filesystem      Size  Used Avail Use%
Mounted on
/dev/mapper/mythtvvg-slashlv
                335G 309G  27G  93% /
/dev/sda1
177M  37M 131M  22% /boot
```

2.2 TV capture card

Whether you are grabbing your television over the air (bunny ears), through cable (CableOne, Comcast) or through satellite (DirectTV, Dish Network), you will need a TV capture card to record and possibly encode your shows. I

would highly recommend doing some research before you buy performance in a noticeable fashion. I would recommend at least 128 MB of RAM on the video card. If you are going to watch the recordings on a TV, I would suggest having a video card with either RCA or S-Video out. On the ATI X300, it has a S-Video out which I plug into the TV's input for video output.

1. Price/value. Is this a generic, white box card that will fizzle after a few months of recording, or will it do the job magnificently? The range that you can expect for a good TV tuner card if you shop around can be from \$60 to \$200. Remember that the better the card, the more expensive it will be.
2. Single or dual tuner. This is important to consider as if you have a single tuner, you will not be able to watch TV while the capture card is recording. If you are only going to be watching recordings, this is not an issue. But if you are a hardcore TV viewer, you should go with a dual tuner to avoid conflicts. You will just need a cable splitter to fork the input into two inputs.
3. Compatibility. There are specific cards that supported with MythTV very well (usually through `ivtv` drivers) and some that have very little compatibility. In general, the Haupaugee[6] TV capture cards have great support and are probably the best bet for a new box. I went with a less expensive Haupaugee PVR-150. This is an entry level model with a single tuner without HD capabilities. From reading hundreds of forum posts and pieces of documentation about capture cards, it seems that the Haupaugee PVR-350 and PVR-500 are the most popular TV capture cards for MythTV installs. Several ATI and NVIDIA cards are also supported well, as well as other brands. The MythTV hardware wiki[7] is a great place to start your research for a capture card.
4. Hardware based or software based encoding. If you have a slower processor (e.g. slower than 2 Ghz) I recommend that you buy a video card with a hardware encoder. These are large modules built right on the video capture card that will encode the TV program from the video capture card instead of the CPU. This will free up the CPU for availability for other tasks, and will help you avoid playback quality issues as well as high utilization issues. If you have a faster processor, (e.g. faster than 2Ghz) you are probably safe with using a software-based encoder within the MythTV software.

2.3 Video card

If you have a newer box with PCI-express, then I highly recommend that you have a video card running on this speed. An AGP port is also sufficient. I have seen some issues with very old PCI-based cards, but as long as there is sufficient RAM on the card, you should be fine. I have an ATI X300 PCI-express card with 64 MB of RAM. There are occasional frame drops, but it does not affect overall

2.4 Sound Card

If you want features like Dolby Digital Surround sound and the like, you will need a sound card that has these features to output to the home theater system. On my ASUS motherboard, I have Dolby Digital 5.1 Surround Sound outputs directly on the motherboard. However, I am under utilizing them because I am simply plugging in a headphone-to-RCA converter cord and plugging them into the RCA ports on the TV. This combination of S-Video plus the RCA audio is sufficient for my needs, with volume control both on the TV set and through MythTV.

2.5 RAM

Linux is much more RAM intensive than processor intensive. My box only has 1 GB of physical RAM, which is in 100% utilization almost all of the time. This is normal for most RAM levels. But my box would benefit to upgrade to at least double the RAM. It still may be 100% utilized all of the time, but there would be noticeable performance gains. This is the weakest link in my computer system, and the next to be upgraded.

2.6 Processor

I have seen some people attempting a MythTV install with sub par processors, and although they can get it to work as a proof of concept, but the performance has not been incredible. I suggest that you have at least a 2Ghz processor. Generally speaking, you should also opt for high processor cache levels on the processor. Multiple core processors or HyperThreading technology will increase performance logarithmically.

2.7 What about my {fill in the blank} computer?

The best thing that I could suggest is that you try the install out and not performance bottlenecks and later upgrade. If you have a borderline system based upon these recommendations, I would only spend the money on new hardware if you experience quality issues post install.

2.8 My hardware configuration

My system was built three years ago, but still qualifies as a mid range computer as of the end of 2007. Here are the specifications:

ASUS motherboard
 Intel Pentium 4 3.2 Ghz processor with
 HyperThreading technology
 1GB RAM
 320 GB HDD space (80GB+80GB+200GB HDDs)
 DVD-ROM, CDRW
 ATI X300 video card
 Gigabyte Ethernet
 Hauppauge PVR150

```
root@mythtv-mars:~# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/mapper/mythtvvg-slashlv
                335G 309G  27G  93% /
/dev/sda1
 177M  37M 131M  22% /boot
```

3 SOFTWARE INSTALLATION

3.1 MythTV Distributions

There are three major MythTV distributions, in which they have a customized Linux distribution with MythTV ready and running. They are:

1. KnoppMyth[8], built off Knoppix, a Debian-based distribution.
2. Mythdora[9], built off of Fedora Core, from Red Hat.
3. Mythbuntu[10], built off of Ubuntu, from Canocial.

These are good avenues to travel if you are new to Linux as they include all of the software packages needed for proper installation of a MythTV box. The disadvantage here is that these distributions are based off of older versions of the parent distribution, resulting in older code. For example, at the time of writing, Mythdora was based upon Fedora Core 6, whereas the most recent version was Fedora Core 8. I opted to install Ubuntu 7.10 server because of its ease of use, easy upgrades and large package manager.

3.2 Linux partitioning and installation

Installing using one of these MythTV distributions is beyond the scope of this text, but the general guidelines are the same. I used Ubuntu 7.10 and installed a minimalistic server with Gnome. I setup the partitioning of three disks in a software RAID 5, and then with LVM, logical volume manager to have an adjustable size of the final partition. I decided to separate my boot partition and my root partition, and I have read that many decide to put the MythTV recordings on a separate partition. The most flexible solution if you are using an LVM volume is to partition as described. The boot partition cannot be included in an LVM volume. If you are not using LVM, you can put everything in a single partition to cut down on slack space within individual partitions. This is how the partitioning panned out:

One of the other important steps to consider is what file system to format these partitions as. There are a wide range of options for partitioning, and here is what some popular file systems do well with:

Small files-Reiserfs, FAT, ext2
 Medium sized files-ext3, JFS, FAT32, NTFS
 Large files-XFS

MythTV stores all of its recordings in a subdirectory on the root file system. You can configure this to be whatever you desire. I have decided to allow it to be on the same partition as my root partition. If you have the boot or the root partitions separate from the mythtv partition, I would suggest formatting both as either Reiserfs or ext3. Then I highly recommend that you use XFS for the mythtv partition. XFS does great with large files, and with recordings averaging between 1-5 GBs, it will shine here. If you only have one partition for everything, including the mythtv recordings, then I still suggest that you format it as XFS for increased performance.

3.3 Swap Space

Swap space is a cache that Linux uses for memory segments that are old. It resides on the hard drive, and is much slower than physical RAM. You can specify this at install time during the partitioning portion of install. I have heard many different recommendations with regards to how much swap space one should dedicate to the system. They have went from 1/2 to 2 times the amount of physical RAM. I tend to lean on the latter for a memory-intensive application for the system. Because I had 320 GB at my disposal, I decided to partition 4GB as swap space. Under normal operation, it is around 10-15% utilized, but at times, it can be around 50% utilized. Note that I only have 1 GB of physical memory installed. If you are running with an HD tuner, you should partition even more.

3.4 Software packages

Once the system has been partitioned, be sure to select a windows environment (Gnome, KDE, XFCE, Fluxbox) and install the Linux system. If available, select the

MythTV, MySQL and any media encoder/decoder packages. This entire process should take between an hour and two hours for the entire process of installation.

3.5 MythTV installation

Once the system has been installed, update if possible. Here are the commands to do this, depending on the specific distribution that you are using:

Debian based systems (Ubuntu, Knoppix, Debian)

```
$sudo apt-get update && sudo apt-get upgrade
```

Red Hat based systems (Cent OS, Fedora Core, RHEL)

```
#yum -t -y update
```

Novell based systems (SLES, openSuSE)

```
#yast --update
```

Once the system has been updated, you should select the MythTV, MySQL and any encoder/decoder packages. A search for mythtv* should resolve any necessary packages and will resolve any dependencies. Generally speaking, these packages should be in the distribution's repositories, if not, you will have to install third party repositories.

3.6 Configuration

MythTV will require at least three hours for proper configuration. This can go up quickly if you want to test different configurations or you run into problems. MythTV consists of several programs that work in tandem. It is important to understand how they work in tandem.

Mythtv-setup. This is where the majority of the configuration of MythTV goes on. Run this program first before starting any mythbackend or mythfrontend processes. I will speak about some important configurations later on. It will then run the program mythfilldatabase to commit the changes to the database.

Mythbackend. This is the workhorse of MythTV. It connects to a database backend (defaults to MySQL, but you can use other databases) and performs other tasks like recoding, commercial detection/deletion and tuner management. It also manages recordings, deleting, encoding, archiving and scheduling them, all based upon your preferences.

Mythfrontend. This is MythTV's user interface. Most of the standard controls are located here. It is very similar to the user interface of TiVo. You can run as many

mythbackends and mythfrontends as you desire, although the standard setup is one mythbackend and one mythfrontend located on the same server. Another popular variation is a mythbackend on a console server and a mythfrontend on another, remote server with an window environment.

Other processes. MythTV also has processes for each plugin that is installed. Some examples are mytharchive, mythdvd, mythmusic, and mythweather.

4 INITIAL CONFIGURATION

4.1 TV tuner card

The first point of configuration should be the tuner card. Make sure that the TV card and the channels are picked up correctly and are labeled correctly. My Haupauge PVR-150 was picked up quickly and the channel scan picked up all of my available channels over local cable through CableOne.

4.2 Schedules

TV schedules used to be free, but with the popularity of MythTV, the servers that MythTV users were using to get their TV schedules became overloaded. A new open source project named Schedules Direct[11], which currently charges only \$20 per year for comprehensive TV schedules. This is only \$1.67 per month. As Schedules Direct is not-for profit, they provide a high quality service that comes at a minimal price. The only other viable solution is screen scraping. Results may vary.

5 TROUBLESHOOTING

5.1 Driver issues

One of the biggest frustrations I had with the configuration of MythTV was the problems that I had with the ATI X300 driver. The ATI and NVIDIA binary drivers will eventually be included in the upstream kernel, but for now there are several workarounds to get the ATI or NVIDIA video cards working without problems.

1. Generic drivers. Most of the time there are generic modules for ATI or NVIDIA drivers. They work most of the time but more advanced features like dual head or TV output have issues.
2. Installed distribution-specific kernel modules. These modules are included in the package repositories, but sometimes you will need to add additional third-party repositories to get the modules needed.
3. Graphic configuration programs. Sometimes you can get the system to automatically configure the graphics card for you. Here are the commands for

each distribution family:

Debian based systems (Ubuntu, Knoppix, Debian)

```
$sudo system-config-display-gtk
```

Red Hat based systems (Cent OS, Fedora Core, RHEL)

```
#system-config-display
```

Novell based systems (SLES, openSuSE)

```
#yast x11
```

4. The propriety package from the vendor's website. This can either be just the tarball file with the driver included, or a rpm or deb file. Usually you just unpack and run the installer program with the kernel-source package installed, and it will install the driver on the system. This was the solution that worked for me. I had to do quite a bit of hacking on my xorg.conf file before discovering this.

5.2 Picture quality issues

Sometimes you can get either a bad quality channel or the entire signal is bad. One of the first things that you should do in troubleshooting these issues is to see if they still exist without the MythTV box attached to your home entertainment system. For example, all of the recordings on the SciFi channel were wavy on my particular MythTV box. But in researching it, I found out that the channel itself was wavy coming straight from the cable connection. If this is the case, there are some tunings that can be done within the channel editor of mythtv-setup. You can change the frequency, tweak the hue, contrast or brightness and other quality settings. For example, the TNT channel was coming in quite dark compared to other channels. By tweaking the settings, I was able to adjust the brightness of darker shows like Law and Order, which showed up quite fine after the configuration changes within the channel editor.

5.3 Parser not found error

If you find the following line in the mythbackend logs, don't despair.

```
[mpeg @ 0xb748a8b0]Parser not found for  
Codec Id: 94210 !
```

If you are not experiencing issues with the playback and the encoding, it is a non fatal error. If it is causing errors, from my research, it is a fixed issue in upstream code releases, and may not be available in the repository's version of the package

yet.

5.4 Mythbackend not starting on bootup

You can use the runlevel configuration utilities in the control panel to make sure that the service is starting at boot time.

Debian based systems (Ubuntu, Knoppix, Debian)

```
$sudo system-config-runlevel
```

Red Hat based systems (Cent OS, Fedora Core, RHEL)

```
#system-config-runlevel
```

Novell based systems (SLES, openSuSE)

```
#yast runlevel
```

You can also use the `insserv` program to enable it on startup on Red Hat and Novell based systems through the commands:

```
#insserv mythbackend  
#insserv mythfrontend
```

If these do not work, you will have to provide the full path to `mythbackend` or `mythfrontend` (eg. `#insserv /usr/bin/mythbackend`)

5.5 MythTV recording directory

When you define a non-existent directory or one that `mythtv` does not have read/write permissions to, it will echo the following errors:

```
/mythtv/recordings/nfslockfile.lock:  
Permission denied  
  
Unable to open lockfile!  
  
Be sure that '/mythtv/recordings' exists and  
that both  
  
the directory and that file are writeable by  
this user.
```

You can fix this by these commands:

Debian based systems (Ubuntu, Knoppix, Debian)

```
$sudo mkdir  
{/your/mythtv/recordings/directory}  
$sudo chown mythtv  
{/your/mythtv/recordings/directory}
```

Red Hat based systems (Cent OS, Fedora Core, RHEL) and Novell based systems (SLES, openSuSE)

```
#mkdir {/your/mythtv/recordings/directory}  
#chown mythtv  
{/your/mythtv/recordings/directory}
```

Then make sure that the {/your/mythtv/recordings/directory} is correct in the mythtv-setup program.

5.6 Callsigns not showing up on channel scans

It is very nice to have the channel's callsigns (e.g. ESPN) and channel icon show up in addition to the number. In my case neither showed up. The schedules would show up without an issue, but apart from editing all fifty channels manually, the callsigns would not show up. The icons still do not show up. I went all the way to submitting the question to the mythtv-users mailing list twice, but to no avail. So after losing patience with the issue, I spent some time manually editing the channel callsigns according to the listings on the Scheduling Direct website.

5.7 Database corruption

Rather often in my initial configuration, I would corrupt the mythconverg database. If that happens to you, here are some useful commands:

Repairing the database:

```
$mysqlcheck mythconverg -u root  
-pYourPassword --auto-repair
```

5.8 Backup the mythtv database to a file

I have a crontab that backs up the database periodically for disaster recovery purposes. Here is how to do this:

```
$mysqldump -u root -pYourPassword  
mythconverg > mythdatabasebackup.sql
```

5.9 Restore the mythtv database from a file

If you need to restore this database file from a backup, this is the command that you would use:

```
$mysql -u root -pYourPassword mythconverg  
< mythdatabasebackup.sql
```

5.10 Deleting channels

Sometimes you have a useless or undesired channel. If so, you can delete it from the database and it will not show up in the channel lineup anymore.

```
$ mysql -u root mythconverg  
  
mysql> select chanid from channel where  
channum=15;  
  
+-----+  
| chanid |  
+-----+  
| 1015 |  
+-----+  
  
1 row in set (0.00 sec)  
  
mysql> delete from channel where chanid =  
1015;
```

Note that the channum is the actual channel, and that to delete the channel, the second command is necessary.

6 CONCLUSION

MythTV is a versatile, extremely customizable personal video recording system that will give you years of commercial free, on demand television programming. It also includes many plugins that will allow you to make MythTV the center of your media, information and entertainment center.

7 REFERENCES

- [1] "MythTV," <http://www.mythtv.org/>
- [2] "TiVo," <http://www.tivo.com/>
- [3] "Debian—The Universal Operating System," <http://www.debian.org>
- [4] "Red Hat," <http://www.redhat.org>
- [5] "Novell," <http://www.novell.com>
- [6] "Hauppauge Computer Works," <http://www.hauppauge.com/>
- [7] "Main Page-MythTV," http://www.mythtv.org/wiki/index.php/Main_Page
- [8] "KnoppMyth," <http://mysettopbox.tv/knoppmyth.html>
- [9] "G-Ding.TV," <http://g-ding.tv/>
- [10] "Mythbuntu," <http://www.mythbuntu.org/>

[11] "Schedules Direct," <http://www.schedulesdirect.org/>