

The EZ Box:

Wireless Television Solution

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The EZ Box: Wireless Television Solution

Abstract

This project examines the feasibility of replacing existing wired television home networks with an 802.11g 2.4GHz wireless implementation. This solution will be constructed with a centralized server and multiple wireless transceivers, either inside or outside the home. The novel network will carry television along with media files and music which will be obtainable from any of the various wireless transceivers. The new system offers a cost effective alternative for both the company and client by eliminating wired installation and maintenance costs while providing improved service. Research, design, and implementation are all assessed in this economic business solution.

Introduction

The motivation behind this project is convenience for consumers and the television service providers. It is very expensive to wire a house for cable television as well as repair the existing system in addition to labor costs. A wireless system would remove the labor cost all together provided that the user could simply plug in the device. It would also remove the cost of wiring the house for both the company and the client. The system would be implemented with a server and wireless transceivers (EZ Box). The television service provider would provide all the cable channels to the server. The EZ Box can be used to select and receive one of the channels for the user to view from the server. The server and EZ Box are designed with a plug-in-play feature to be user friendly. The user just needs to turn on the EZ Box and it will automatically synchronize with the server making the whole set up very simple for the customer. Television service providers would be able to check the status of the servers and EZ Boxes remotely which would eliminate the need for repairmen.

Background

For existing satellite TV systems, television channels are transmitted via satellite and received by a dish located on the customer's property. A wire is then run from the dish into the house. Coaxial cables must be installed and wired to each room that the customer desires to place a television set. The wire is then connected to a converter box, which descrambles the channel and sends it to the television. Similarly, cable service providers also run a wire into the house and coaxial cables are wired to every room with a television set. The coaxial cable is then connected to the cable box, which descrambles the channel for the television. The required bandwidth for Standard Definition Television is approximately 4 to 7 Mbps and for High Definition Television is approximately 20 Mbps.

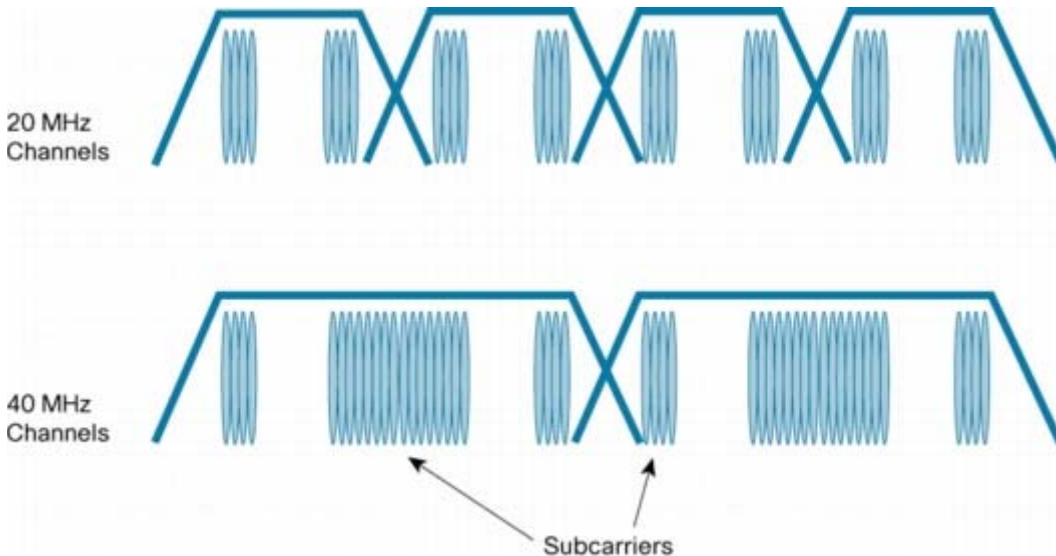
WinTV is the official application that is distributed with Hauppauge TV Tuners. It is only compatible with Windows XP and Windows Vista. Features include watching and recording live television. Record shows are encoded in MPEG-2.

SageTV is a commercial digital video recording program for Mac OS X, Windows, and Linux. Recorded television shows are encoded in MPEG-2. Features

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include watching and recording live television shows, integrated programming guide, and video and music file management. SageTV can also be used over the internet with high speed connection.

IEEE 802.11 is a set of standards for wireless local area networks. The most widely used are 802.11g and 802.11n. 802.11g operates at the 2.4 GHz frequency while 802.11n operates at either 2.4 GHz or 5GHz. 802.11g has a rated bandwidth of 54 Mbps and 802.11n has a rated speed of 300 Mbps. 802.11n uses the MIMO technology (Multiple In Multiple Out), the use of multiple antennas at both the transmitter and receiver to improve performance. The modulating scheme used for 802.11 is Orthogonal frequency-division multiplexing (OFDM), a multi-carrier modulation method. The number of sub carriers is 52 and the sub carrier modulation scheme can be Binary Phase Shift Keying, Quadrature Phase Shift Keying, Quadrature Amplitude Modulation. Both have 11 public channels in the US, 1-11, where channels 1, 6, and 11 are no overlapping. 2.4-2.4835GHz band is divided up into 13 channels of 22 MHz width and 5 MHz apart. The 802.11n uses both 20 MHz and 40 MHz channels.



With the 40 MHz channel, the top and bottom of the channel does not need to be reserved to avoid interference like the 20 MHz channel. This allows the ability to carry more information while the 20 MHz channel will be used to separate the adjacent channels from interference. When using the 40 MHz channel, the 802.11n increases the number of subcarriers to 108, which improves the data rate. For one transmitter, the max data rate is 135 Mbps up to 540 Mbps with four transmitters.

A MIMO (multiple input multiple output) radio sends multiple radio signals at the same time takes advantage of multi-path. Each signal will have its own antenna and uses its own transmitter. Since there is space between the antennas, each signal has its own path. The receiver also has multiple antennas in addition to a radio. Each receive radio can independently decode the signals and combine them together with some complex math calculations. This results in achieving a better signal than with a single antenna.

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This feature dramatically improves the signal to noise ratio and better flexibility. MIMO systems are described by how many transmitters and receivers in the system. For example, a 2x2 means there are 2 transmitters and 2 receivers. Each added transmitter or receiver will dramatically increase the SNR. This leads to the second benefit of MIMO, which is the ability to use spatial stream to carry its own information therefore providing a dramatic increase in data rates.

Ubuntu is one of the most popular operating systems based on GNU/Linux and is composed of multiple software packages distributed under free software/open source licenses. It includes packages APT and Synaptic, which includes the most popular software and drivers. The current version is 8.10 also known as Intrepid Ibex. New versions are released every 6 months. Ubuntu has a “sudo” tool, which is used for administrative tasks. Recommended hardware requirements are 700 MHz processor, 384 MB ram, and 8 GB hard drive.

MythTV is a free Linux application that acts as a digital video recorder and home media server. Development began in 2002 and since then many plugins and other features have been added to make MythTV an all inclusive system. Features include watching and recording live television shows, commercial detection, interfacing with television listing sources such as XMLTV or PSIP. Additional plugins include MythVideo, MythMusic, MythDVD, MythGallery, MythNews, MythWeather, MythBrowser, MythGame, MythWeb, MythPhone, MythFlix, MythArchive, MythStreamTV. These additional plugins provide features such as video file player, music player/manager, DVD ripper/burner, photo manager, weather forecast, web browser, RSS feeds, and games.

MythWeb is the backend plugin that allows users to access the MySQL database that stores all the information about the MythTV backend server. MythWeb generates a website with features such as scheduling and management of scheduled recordings, downloading music and video to the local computer, and retrieving weather reports.

Body

The project was solely based on the software called MythTV using the Linux operating system, Ubuntu. This program allows the user to watch live television, recorded shows, and shared media files such as AVI and MPEG-2. All of the installation process was done through the Terminal by commands such as `sudo apt-get install`. Before booting up the desktop PC, the Hauppauge HVR-1600 was installed to the desktop via removing the side panel and inserting it into the PCI slot and replacing the side panel to the original position. After the computer boots up to the desktop screen, the driver needed for Ubuntu to recognize the Hauppauge TV tuner was called CX-18. The



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command downloads the CX-18 firmware and copies it to the Linux kernel. At this point, the computer was rebooted and it will load the proper firmware to use the TV tuner.

Now that Ubuntu recognizes Hauppauge HVR-1600 TV tuner, the foundation of the EZ Box can be implemented with the MythTV Backend Server. This allows streaming of live television, recording of shows, and sharing of media files. A wireless-g router was set up to create a network between a laptop, which was used to emulate the EZ



Box, and the server. During the installation of MythTV, MySQL was also installed which loaded databases such as the available cable channels. All of the available cable channels were scanned by the backend server through the analog source utilizing the MPEG-2 Encoder and saved in the database.

The client side, MythTV Frontend, was installed to access the server from another computer wirelessly. The Frontend and Backend were then synchronized. Once the correct set of

data was inputted, the frontend seamlessly accessed the database where it was able to watch live television as well as recorded videos. Two additional plug-ins, Myth Video and NFS, were needed in order to watch shared media files. NFS allows Ubuntu to share folders from one computer to another. The backend has the NFS Server configured while the frontend needed only the NFS client configuration. On the backend side, the export file was edited so that the shared folder can be seen by other networked computers. On the frontend, the fstab file was edited to automatically mount the folder at startup. The file was then manually mounted through the terminal and displayed on the desktop screen. Through Myth Frontend, the general video settings were accessed to enter the mounted video folder. The videos were organized in a manner such that the watch media section of the frontend main menu can detect the videos. To watch the shared media files, the watch media section was accessed. They were viewed using the internal media player of Myth TV called mplayer.

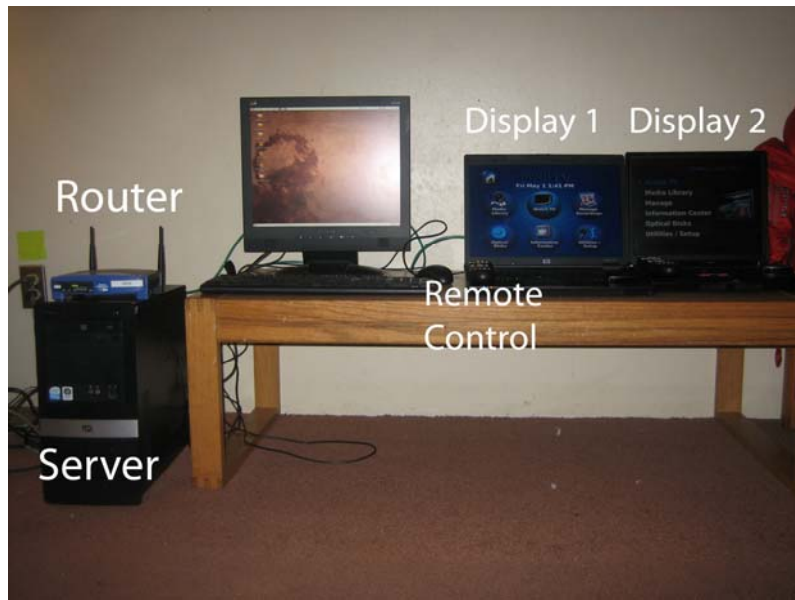
The last setup that needed to be done was programming the remote control and linking it to MythTV. The lirc program and its corresponding modules were installed; mythbuntu-lirc-generator, lirc, gnome-lirc-properties, liblircclient0, lirc-x, lirc-modules-source. The lirc hardware file was modified so the proper modules load during boot up. Next, the lirc lircd file was changed so that Ubuntu recognizes the remote control keys when pressed. Also, the lircrc which calls the lircd file was created so that it can work with MythTV according to the default keyboard commands. The remote control was tested through the terminal then with MythTV.

The installation of MythWeb was used to try to help with the understanding of building a website to control the whole EZ Box system. This plugin required knowledge of Apache, PHP, and MySQL. Each component was installed correctly with the proper modules enabled, however MythWeb didn't run properly. Many tests were run to verify the installation and configuration of the different applications. Apache was able to host

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normal html websites. PHP was able to run the command `<?php phpinfo() ?>`. A simple test script allowed access into the MySQL database. All the MythWeb configuration files were checked to verify that they were correct. In the end, the installation of MythWeb was unsuccessful.

The first attempt in creating the wireless cable television was done through Windows XP utilizing the Hauppauge HVR-1600 software called WinTV. This program enables Windows to watch streaming cable channels and recording of shows from the desktop. This program was selected because it came with the TV Tuner. There was no feature of sharing the cable source to other computers besides itself. So the first trial was networking the 8MB buffer file located in the WinTV folder. It can only be played for about 12 seconds since it does not update the file consistently to continuously watch live television. This was a big issue because there was no way of concatenating the file to update itself as it plays. The only way to watch videos continuously was recording the show and networking it to other computers. But this hinders the ability to change to other channels and is not user friendly. Also, a different video player must be used to watch the media file called VLC player. There was no consistent user interface in both the server and client which makes it unattractive and troublesome. In conclusion, this attempt failed in all aspects the project has required.



Results

Our final EZ Box system consists of a desktop, an 802.11g router, and three laptops. The desktop acts as a server, where the TV tuner is installed on, which wirelessly provides television capabilities and media files to the three laptops. The functions and features of the system include viewing live television, recording television shows, viewing personal video files stored on the server, and playing music. While watching live television, the show can be paused and rewound. Television shows can be recorded manually by pressing the record button and preset using scheduled recordings.



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The set schedules can be viewed and edited from an upcoming recordings menu. In addition to television shows, common media files such as AVI, MPEG-2 as well as music files can be viewed. Since there is only one TV tuner installed on the server, only one laptop can watch live television at a time, however previously recorded shows and other media files can be accessed by multiple laptops at the same time. Although most media files are hosted on the server, files from the laptops can also be shared to the other laptops. However, sharing from the laptops wouldn't be the best way, since the user wouldn't always keep the laptop on and would power it down when it is not in use. The



laptops are controlled by a universal remote, which can access the available menus, control the volume, and change channels.

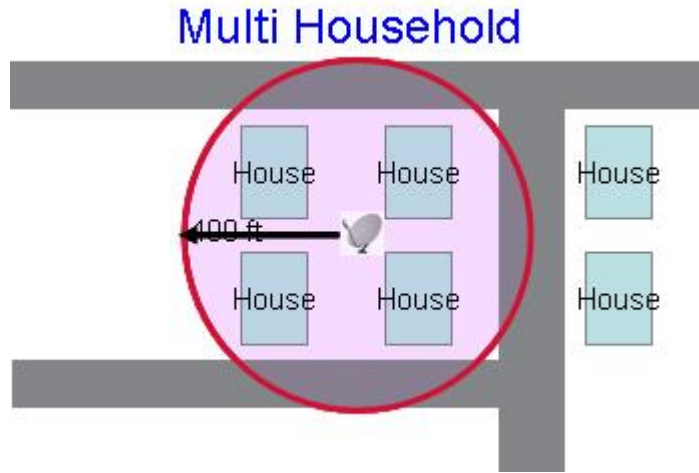
The wireless capabilities of the system were also tested using an 802.11g wireless router. Our maximum number of clients that can be served at one time is four with the bandwidth that is available on 802.11g. The maximum distance that the laptop display could be carried away from the router was approximately 30 yards with interference from

cement walls in Rutgers Suites Residence Halls. The performance of this particular Linksys router that was being used was actually rather poor, so with a more reliable 802.11g router results would be even better. Possibilities for serving extra clients would be to find solutions to decrease bandwidth use for clients watching the same files.

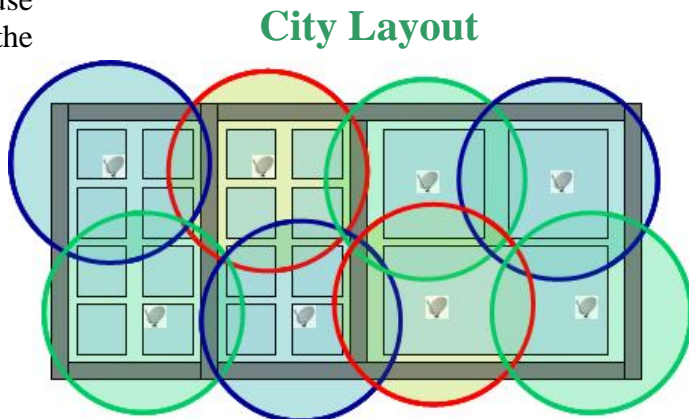
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Applications

The EZ Box system is most valuable to television service providers such as Comcast and Direct TV. A single user home system could be implemented multiple ways. The server location could either be in the user's home or outside. The outside scenario is more practical since the television service providers would never need to enter the user's house to physically examine and install the server. The single user would then purchase an EZ Box and connect it to their television through composite, HDMI or coaxial cables. Once powered on, the EZ Box automatically synchronizes with the server; the EZ Box will display the default channel to the television.



A single home could also use multiple televisions networked to the same server. The user would then purchase and connect one EZ Box for each additional television at home. These would also automatically connect to the server. This system can be monitored remotely from the television service provider through the outdoor server connected to their network.



Depending on the wireless technologies available, multiple homes could use the same outdoor server. Thus, even though two adjacent residents would independently purchase an EZ Box for their home, the two boxes would connect to the same external server. This saves the television service providers by allowing them to reuse existing equipment with new customers. This is especially valuable in apartment situations where tenants subscribe for a short period of time, and then relocate, leaving the television service provider hardware behind.

The method previously described can be adapted to a satellite television setup. A sole satellite dish can be mounted on one user's house while all of the adjacent houses can wirelessly connect to it. Multiple servers can be connected to create a larger mesh network which would allow for faster service and better coverage.

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The system also integrates with the user's existing media appliances by becoming a centralized media source. From any television with an EZ Box on the network, the user would be able to listen to music, watch television, and wirelessly stream media files. In addition, by connecting a laptop to the system the user would be able to watch home videos or DVDs. This is practical especially when there is a video in the computer and the user wants to watch it on the large screen television.

Future experiments

There are a few features to the system that have not yet been developed or integrated. Accessing this secure system remotely is first on the list by means of an internet source such as a web page. This web page could be accessed with a mobile device such as a cell phone or laptop and would be able to control certain aspects of the system. This web interface could branch out to the whole household. The user would then be able to control any television in the house in addition to being able to open garage doors, turning on and off the oven, and locking doors. Wireless 802.11n is also something of high priority. With more bandwidth and range, the system would be able to span multiple houses or cover entire apartment buildings. There would be less hardware and thus less maintenance required. Mesh network feasibility is also an issue that was considered but should be reassessed once wireless 802.11n is finalized. Another issue that hasn't been looked into was compatibility with existing home wireless networks. Users would be able to combine existing systems with the new EZ Box system; yet if they choose to keep it separate, interference between the two systems becomes a pressing issue. One last option is to integrate internet capabilities within the system which would make it possible to view online media as well.



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Appendix I: Code

MythWeb Setup

Installation done on server side of the system

1. Install MythWeb
~\$ sudo apt-get install mythweb
2. Install Apache2 with mod_rewrite and mod_env enabled.
./configure --enable-so --enable-rewrite --enable-env
make
make install
3. Install PHP5
./configure --with-apxs2=/usr/local/apache2/bin/apxs --with-mysql
make
make install
4. Setup PHP
cp php.ini-dist /usr/local/lib/php.ini
5. Setup Apache to parse certain extensions as PHP
<FilesMatch \.php\$>
 SetHandler application/x-httpd-php
</FilesMatch>
<FilesMatch "\.ph(p[2-6]?|tml)\$">
 SetHandler application/x-httpd-php
</FilesMatch>
<FilesMatch "\.phps\$">
 SetHandler application/x-httpd-php-source
</FilesMatch>
6. Configure MythWeb MySQL Login
Setenv db_server "localhost"
Setenv db_name "mythconverg"
Setenv db_login "mythtv"
Setenv db_password
7. Access MythWeb

<http://localhost/mythweb/>

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/etc/lirc/hardware.conf

```
# /etc/lirc/hardware.conf
#
# Arguments which will be used when launching lircd
LIRCD_ARGS=""

#Don't start lircmd even if there seems to be a good config file
#START_LIRCMD=false

#Try to load appropriate kernel modules
LOAD_MODULES=true

# Run "lircd --driver=help" for a list of supported drivers.
DRIVER=""
# If DEVICE is set to /dev/lirc and devfs is in use /dev/lirc/0 will be
# automatically used instead
DEVICE=""
MODULES="lirc_mceusb2"

# Default configuration files for your hardware if any
LIRCD_CONF=""
LIRCMD_CONF=""

# Remote settings required by gnome-lirc-properties
#REMOTE_MODEL="45 buttons Snowboard Shape Silver over Black"
#REMOTE_VENDOR="Hauppauge"

# Receiver settings required by gnome-lirc-properties
#RECEIVER_MODEL="AT Translated Set 2 keyboard"
#RECEIVER_VENDOR="Linux Input Device"
```

/etc/lirc/lircd.conf

```
#####
#####
# lircd.conf file for the new Microsoft Media Center remote using a new
# Microsoft Media Center receiver.
#####
#####
begin remote

    name mceusb2
    bits          16
    flags RC6|CONST_LENGTH
    eps           30
    aeps          100

    header        2667   889
    one           444    444
    zero          444    444
    pre_data_bits 21
    pre_data      0x37FF0
    gap           105000
    toggle_bit    22
    rc6_mask      0x100000000
```

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```
begin codes

# starts at A1
KEY_BLUE          0x00007BA1
KEY_YELLOW        0x00007BA2
KEY_GREEN         0x00007BA3
KEY_RED           0x00007BA4
KEY_TELETEXT     0x00007BA5
KEY_RADIO         0x00007BAF
KEY_PRINT         0x00007BB1
KEY_VIDEO         0x00007BB5 # VIDEOS button
KEY_IMAGE        0x00007BB6 # PICTURES button
KEY_PVR          0x00007BB7 # RECORDED TV button
KEY_AUDIO        0x00007BB8 # MUSIC button
KEY_TV           0x00007BB9

# no BA - D8
KEY_GUIDE        0x00007BD9
KEY_TV           0x00007BDA # LIVE TV button
KEY_DVD          0x00007BDB
KEY_BACK         0x00007BDC
KEY_OK           0x00007BDD
KEY_RIGHT        0x00007BDE
KEY_LEFT         0x00007BDF
KEY_DOWN         0x00007BE0
KEY_UP           0x00007BE1
STAR             0x00007BE2
HASH             0x00007BE3
KEY_PREVIOUS     0x00007BE4 # REPLAY button
KEY_NEXT         0x00007BE5 # SKIP button
KEY_STOP         0x00007BE6
KEY_PAUSE        0x00007BE7
KEY_RECORD       0x00007BE8
KEY_PLAY         0x00007BE9
KEY_REWIND       0x00007BEA
KEY_FORWARD      0x00007BEB
KEY_CHANNELDOWN  0x00007BEC
KEY_CHANNELUP    0x00007BED
KEY_VOLUMEDOWN  0x00007BEE
KEY_VOLUMEUP     0x00007BEF
KEY_INFO         0x00007BF0 # MORE (i) button
KEY_MUTE         0x00007BF1
KEY_MENU         0x00007BF2 # START (Windows) button
KEY_POWER        0x00007BF3
KEY_ENTER        0x00007BF4
KEY_CLEAR        0x00007BF5
KEY_9            0x00007BF6
KEY_8            0x00007BF7
KEY_7            0x00007BF8
KEY_6            0x00007BF9
KEY_5            0x00007BFA
KEY_4            0x00007BFB
KEY_3            0x00007BFC
KEY_2            0x00007BFD
KEY_1            0x00007BFE
KEY_0            0x00007BFF
```

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```
end codes  
  
end remote
```

~/mytv/lircrc

```
# LIRCRC Auto Generated by Mythbuntu Lirc Generator  
# Author(s): Mario Limonciello, Nick Fox  
# Created for use with Mythbuntu  
  
#Custom lircrc generated via mythbuntu-lirc-generator  
#All application specific lircrc files are within ~/.lirc  
  
#include ~/.lirc/mythtv  
#include ~/.lirc/mplayer  
#include ~/.lirc/xine  
#include ~/.lirc/vlc  
#include ~/.lirc/xmame  
#include ~/.lirc/xmess  
#include ~/.lirc/totem  
#include ~/.lirc/elisa  
  
#  
# lircrc config file for the Microsoft Media Center Edition Remote,  
model 1039  
#  
# @url          $URL$  
# @date         03/10/2008  
# @version      0.2  
# @author       callmeajs  
#  
# This file is intended to complement the lircd.conf.mceusb file  
included with  
# lirc 0.8 and above.  
#  
# Save this file in ~/  
#  
# You will also need to make a few changes to the MythTV key bindings  
and #jump  
# points as follows.  
#  
# Jump Points:  
#  
#   TV Recording Playback:           Alt+R  
#   Program Guide:                   Alt+G  
#   Live TV:                          Alt+P  
#   MythVideo -> The MythVideo default view: Alt+V  
#   Main Menu:                        Alt+Home  
#   Play music:                       Alt+M  
#   MythGallery:                      Alt+I  
#   Status Screen:                    Alt+S  
#   Play DVD                           Alt+D  
  
# Key Bindings:  
#  
#   TV Playback -> CHANNELDOWN:      PgDown
```


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```
# TV Playback -> CHANNELUP:      PgUp
# TV Playback -> JUMPPFFWD:      Up
# TV Playback -> JUMPRWND:       Down
# TV Playback -> SEEKFFWD:       Z
# TV Playback -> SEEKRWND:       Q
# TV Playback -> SKIPCOMMBACK:   Left
# TV Playback -> SKIPCOMMERCIAL: Right

#
# Execute Start MythTV Frontend Script
#

#begin
#remote = mceusb2
#button = KEY_POWER
#prog = irexec
#repeat = 0
#config = sudo /usr/sbin/hibernate-ram
#end

begin
    prog = irexec
    button = KEY_POWER
    repeat = 3
    config = /usr/local/bin/mythpowerbutton.sh
    #config = Key Alt-Escape CurrentWindow
end

#begin
#    prog = irexec
#    button = KEY_POWER
#    repeat = 3
#    config = /usr/local/bin/mythtpvpower.sh
#end

begin
    remote = mceusb2
    prog = irexec
    button = KEY_GREEN
    config = /usr/local/bin/mce_green_button.sh
end

#
# Send Sleep Signal to Monitor
#

#
# MPlayer Program Navigation
#

begin
    remote = mceusb2
    prog = mplayer
    button = Music
    config =
end
```

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```
begin
    remote = mceusb2
    prog   = mplayer
    button = Pictures
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_MENU
    config = q
end

begin
    remote = mceusb2
    prog   = mplayer
    button = RecTV
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = Guide
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = LiveTV
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = DVD
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = Videos
    config =
end

#
# Menu Navigation
#

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_CLEAR
```

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```
    config = Esc
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_OK
    config = Space
end

begin
    remote = mceusb2
    prog   = mplayer
    button = More
    config = OSD
end

begin
    remote = mceusb2
    prog   = mplayer
    button = Left
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = Right
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = Up
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = Down
    config =
end

#
# TV Control
#

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_VOLUMEDOWN
    repeat = 3
    delay  = 5
    config = volume -1
end
```

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```
begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_VOLUMEUP
    repeat = 3
    delay  = 5
    config = volume 1
end
```

```
begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_MUTE
    config = M
end
```

```
begin
    remote = mceusb2
    prog   = mplayer
    button = ChanDown
    config =
end
```

```
begin
    remote = mceusb2
    prog   = mplayer
    button = ChanUp
    config =
end
```

```
#
# Video Navigation
#
```

```
begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_PLAY
    config = P
end
```

```
begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_PAUSE
    config = P
end
```

```
begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_STOP
    config = P
end
```

```
begin
```

The EZ Box: Wireless Television Solution

```
remote = mceusb2
prog   = mplayer
button = KEY_FORWARD
config = seek 600
end

begin
remote = mceusb2
prog   = mplayer
button = KEY_REWIND
config = seek -600
end

begin
remote = mceusb2
prog   = mplayer
button = KEY_PREVIOUS
config = seek -10
end

begin
remote = mceusb2
prog   = mplayer
button = KEY_NEXT
config = seek 60
end

begin
remote = mceusb2
prog   = mplayer
button = KEY_RECORD
config =
end

#
# Miscellaneous
#

# M for Menu
begin
remote = mceusb2
prog   = mplayer
button = STAR
config = 0
end

begin
remote = mceusb2
prog   = mplayer
button = HASH
config = 0
end

begin
remote = mceusb2
prog   = mplayer
button = KEY_CLEAR
```

The EZ Box: Wireless Television Solution

```
    config = q
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_ENTER
    config =
end

begin
    remote = mceusb2
    prog   = mplayer
    button = Print
    config =
end

#
# Numbers
#

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_0
    config = 0
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_1
    config = 1
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_2
    config = 2
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_3
    config = 3
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_FOUR
    config = 4
end

begin
```


The EZ Box: Wireless Television Solution

```
    remote = mceusb2
    prog   = mplayer
    button = KEY_FIVE
    config = 5
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_6
    config = 6
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_7
    config = 7
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_8
    config = 8
end

begin
    remote = mceusb2
    prog   = mplayer
    button = KEY_9
    config = 9
end

#
# MythTV Program Navigation
#

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_AUDIO
    config = Alt+M
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_IMAGE
    config = Alt+I
end

begin
    remote = mceusb2
    prog   = mythtv
```

The EZ Box: Wireless Television Solution

```
    button = KEY_MENU
    config = Alt+Home
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_RECORD
    config = Alt+R
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_GUIDE
    config = Alt+G
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_TV
    config = Alt+P
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_DVD
    config = Alt+D
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_TV
    config = W
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_VIDEO
    config = Alt+V
end

#
# Menu Navigation
#

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_BACK
    config = Esc
end
```

The EZ Box: Wireless Television Solution

```
begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_OK
    config = Space
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_INFO
    config = I
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_LEFT
    config = Left
    repeat = 3
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_RIGHT
    config = Right
    repeat = 3
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_UP
    config = Up
    repeat = 3
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_DOWN
    config = Down
    repeat = 3
end

#
# TV Control
#

#change inputs on TV Tuner card
begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_RED
    config = C
end
```

The EZ Box: Wireless Television Solution

```
#cycle through zoom and fill modes: 4:3 aspect ratio, 16:9, 4:3 Zoom
(like Pan and Scan), 16:9 #Zoom, and 16:9 Stretch (eliminates black
sidebars in TV signal)
begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_YELLOW
    config = W
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_VOLUMEDOWN
    repeat = 3
    delay  = 5
    config = F10
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_VOLUMEUP
    repeat = 3
    delay  = 5
    config = F11
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_MUTE
    config = F9
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_CHANNELDOWN
    config = Down
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_CHANNELUP
    config = Up
end

#
# Video Navigation
#

begin
    remote = mceusb2
    prog   = mythtv
```

The EZ Box: Wireless Television Solution

```
    button = KEY_PLAY
    config = Ctrl+P
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_PAUSE
    config = P
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_STOP
    config = Esc
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_FORWARD
    config = >
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_REWIND
    config = <
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_PREVIOUS
    config = Q
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_NEXT
    config = Z
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_RECORD
    config = R
end

#
# Miscellaneous
#
```

The EZ Box: Wireless Television Solution

```
# M for Menu
begin
    remote = mceusb2
    prog   = mythtv
    button = STAR
    config = M
end

begin
    remote = mceusb2
    prog   = mythtv
    button = HASH
    config = M
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_CLEAR
    config = Backspace
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_ENTER
    config = Space
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_PRINT
    config = Alt+S
end

#
# Numbers
#

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_0
    config = 0
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_1
    config = 1
end

begin
    remote = mceusb2
    prog   = mythtv
```


The EZ Box: Wireless Television Solution

```
    button = KEY_2
    config = 2
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_3
    config = 3
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_4
    config = 4
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_5
    config = 5
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_6
    config = 6
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_7
    config = 7
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_8
    config = 8
end

begin
    remote = mceusb2
    prog   = mythtv
    button = KEY_9
    config = 9
end
```