

Asterisk - The Basics

APRICOT2007 VoIP Workshop

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What is Asterisk

- Asterisk, *The Open Source PBX*. www.asterisk.org
- A complete PBX in software
- Runs on virtually any OS
- Support for most VoIP protocols
- Most full-featured PBX features already built in
 - MOH, conferencing, queues, voicemail, IVR...
- Supports many different hardware telephony cards

Asterisk Documentation

- There's lots of info all over the place, some of it contrary though
- www.voip-info.org
 - Lots of really good information, lots of plain wrong information too!
 - Defacto documentation store at this stage
- www.asterisk.org
- www.digium.org - hardware cards
- Asterisk CLI !

Useful Reading

- Asterisk, The Future of Telephony. By Jared Smith, Jim Van Meggelen, Leif Madsen. ISBN: 0-596-00962-3
 - Published under Creative Commons license
 - Can download, or buy a real book from O'Reilly
 - <http://www.asteriskdocs.org/modules/tinycontent/index.php?id=11>

Asterisk Versions

- Three versions currently in popular use:
 - 1.0 - becoming obsolete rapidly, but it's good and stable
 - 1.2 - the current release of choice for most, stable
 - We'll be dealing with v1.2
 - 1.4 - all the new features in here, still a few bugs

Installing Asterisk

- Asterisk uses three main packages:
 - asterisk
 - zaptel
 - libpri
- Compile Requirements:
 - GCC (version 3.x or later)
 - Kernel source
 - Kernel headers
 - bison
 - openssl, openssl-dev, libssl-dev
 - libnewt

Download Source

```
# cd /usr/src/  
# wget --passive-ftp ftp.digium.com/pub/asterisk/asterisk-1.*.tar.gz  
# wget --passive-ftp ftp.digium.com/pub/asterisk/asterisk-sounds-*.tar.gz  
# wget --passive-ftp ftp.digium.com/pub/zaptel/zaptel-*.tar.gz  
# wget --passive-ftp ftp.digium.com/pub/libpri/libpri-*.tar.gz
```

```
# tar zxvf zaptel-*.tar.gz  
# tar zxvf libpri-*.tar.gz  
# tar zxvf asterisk-*.tar.gz  
# tar zxvf asterisk-sounds*.tar.gz
```

*** If using Linux kernel 2.4 a symbolic link named linux-2.4 is required pointing to your kernel source:**

```
#ln -s /usr/src/`uname -r` /usr/src/linux-2.4
```

Compile Zaptel

- Several features in Asterisk require an accurate timing source, e.g. conferencing
- Digium PCI hardware provides this 1kHz timing clock
- If you aren't using PCI hardware the *ztdummy* driver can be used
 - Kernels 2.4.5 and greater use the UHCI USB controller for this (so you need the *usb-uhci* module loaded)
 - The 2.6 kernel provides a 1kHz so a USB controller is not needed
- Need to uncomment out 'ztdummy' in Makefile

```
MODULES=zaptel tor2 torisa wcusb wcfxo wctdm \  
        ztdynamic ztd-eth wctlxxp wct4xxp wctellxp # ztdummy
```


Compile Zaptel

```
# cd /usr/src/zaptel-version
# make clean
# make
# make install
# make config
```

- Also installs some tools:
 - *ztcfg* - reads config in */etc/zaptel.conf* to configure hardware
 - *zttool* - for monitoring installed hardware
 - *ztmonitor* - for monitoring active channels
- *zconfig.h* contains many zaptel compile-time options - echo cancellation options, RAS options, etc.

Compile Libpri

```
# cd /usr/src/libpri-version  
# make clean  
# make  
# make install
```

- Used by many manufacturers of PCI TDM cards
 - Safe to compile even if a card is not installed/used

Compile Asterisk

```
# cd /usr/src/asterisk-version  
# make clean  
# make  
# make install  
# make samples
```

Package Install

- Much easier to use pre-compiled binary packages!
 - RPM packages for redhat
 - DEB packages for Debian
 - Asterisk.pkg for MacOSX <http://www.astmasters.net>
- We'll be using Debian .deb packages
 - Debain testing
 - Asterisk version 1.2

Debian Install

```
apt-get install asterisk
apt-get install asterisk-sounds-extra
apt-get install zaptel
apt-get install zaptel-source
apt-get build-dep asterisk
```

*** if you need ztdummy:**

```
m-a prepare
m-a build zaptel
```

```
dpkg -i zaptel-modules-xxxxxx.deb
```

```
depmod
modprobe zaptel
modprobe wctellxp    # if using TE110P single span T1/E1 card
modprobe wcfxo       # if using single port FXO card
modprobe ztdummy     # if using ztdummy
```

```
ztcfg
zttool
```

```
nano /etc/default/asterisk
```

*** To get ztdummy, modify Makefile to uncomment 'ztdummy'**
*** On Debian, add 'ztdummy' to /etc/module to get ztdummy to load at boot**
*** set RUNASTERISK=yes in /etc/default/asterisk**

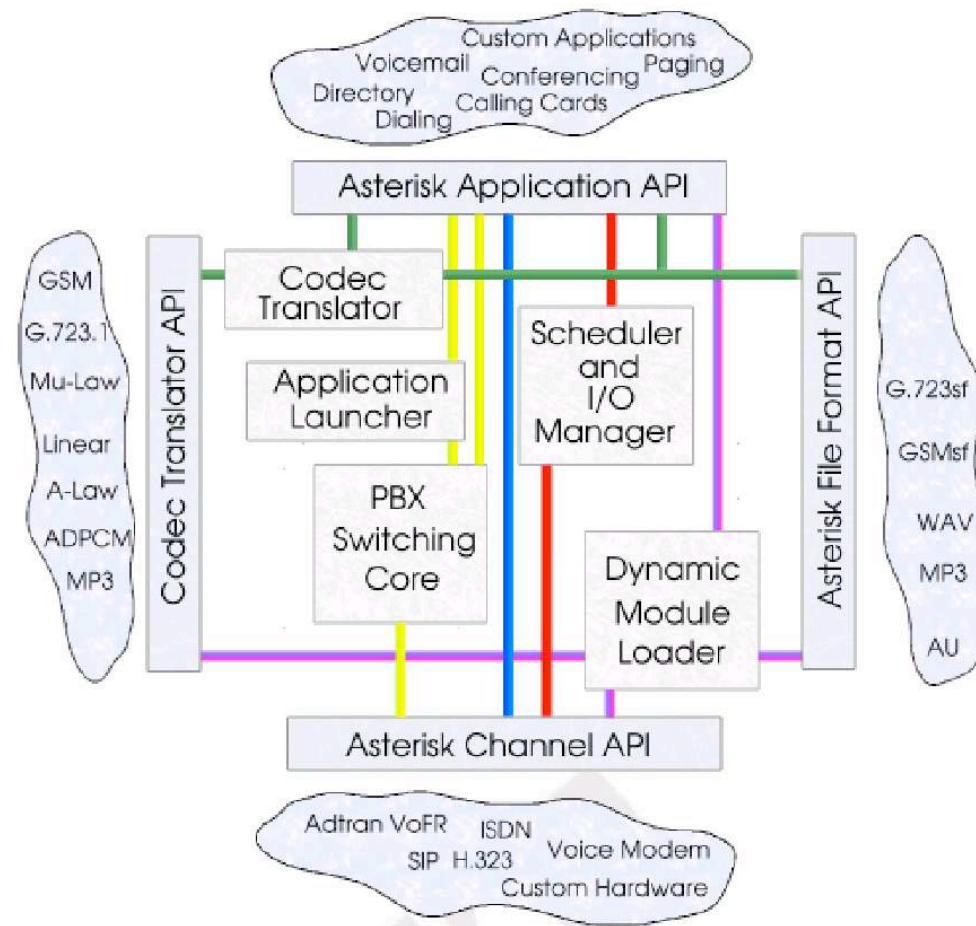
Asterisk File Locations (debian)

- `/etc/asterisk/` - Asterisk configuration files
- `/var/lib/asterisk/` - contains the astdb, firmware and keys
- `/usr/share/asterisk/sounds` - in built asterisk sound prompts
- `/var/spool/asterisk/` - temporary files and voicemail files
- `/var/log/asterisk/` - Asterisk log files
- `/var/log/asterisk/cdr-csv/` - Asterisk call detail records

How Asterisk Works, in one slide or less!

- Asterisk is a hybrid TDM and packet voice PBX
- Interfaces any piece of telephony hardware or software to any application
- Prime components: channels and extensions.conf - the Asterisk dial plan
- Channels can be many different technologies - SIP, IAX, H323, skinny, Zaptel, and others as they are created
- extensions.conf is basically a programming language controlling the flow of calls
- Applications do the work - answer a channel, ring a channel, voicemail, etc.

Asterisk Architecture



TrixBox

- www.trixbox.org
- Asterisk PBX up and running in one hour
- The PBX formally known as Asterisk@Home
- Latest version = 2.0, based on Asterisk 1.2
- Full featured PBX system including all the regulars:
 - Voicemail, conferencing, call forwarding, extensions
- Provides web based interface, which in turn drives Asterisk configuration files
- We'll be looking at this later in the workshop

Asterisk Configuration Details

- Text based configuration files
 - sip.conf
 - extensions.conf
 - voicemail.conf
 - agents.conf
 - queues.conf

sip.conf

/etc/asterisk/sip.conf

```
[general]
context=default           ; Default context for incoming calls
port=5060                 ; UDP Port to bind to (SIP standard port is 5060)
bindaddr=0.0.0.0          ; IP address to bind to (0.0.0.0 binds to all)
srvlookup=yes             ; Enable DNS SRV lookups on outbound calls

[2000]
type=friend                ; both send and receive calls from this peer
host=dynamic              ; this peer will register with us
username=2000
secret=j3nny
canreinvite=no            ; don't send SIP re-invites (ie. terminate rtp stream)
nat=yes                   ; always assume peer is behind a NAT
context=phones            ; send calls to 'phones' context
dtmfmode=rfc2833          ; set dtmf relay mode
allow=all                  ; allow all codecs

[pstn-gateway]
type=friend
disallow=all
allow=alaw
context=from-pstn-gateway
host=pstn-gateway.jonnynet.net
canreinvite=no
dtmfmode=rfc2833
allow=all
```

extensions.conf

/etc/asterisk/extensions.conf

```
[general]
static=yes           ; default values for changes to this file
writeprotect=no      ; by the Asterisk CLI

[globals]
; variables go here

[default]
; default context

[phones]
; context for our phones
exten => 2000,1,Dial(SIP/2000)
exten => 2000,2,VoiceMail(u2000)

exten => 500,1,Answer()
exten => 500,2,Playback(demo-echotest)      ; Let them know what's going on
exten => 500,3,Echo                        ; Do the echo test
exten => 500,4,Playback(demo-echodone)      ; Let them know it's over
exten => 500,5,Hangup

exten => _1.,1,Dial(SIP/${EXTEN:1}@pstn-gateway) ; match anything and send to wlg-gateway
exten => _1.,2,Hangup

[from-pstn-gateway]
; context for calls coming from wlg-gateway
exten => 4989560,1,GoTo(phones,2000,1)
exten => _.,1,Congestion()                ; everyone else gets congestion
```

Dial Plan - Contexts

- extensions.conf split into sections called contexts
- [context-name]
- contexts isolated from one another - can have the same extension in multiple contexts
- Calls from a channel land in the context specified by that channel,
- Calls land in default context if nothing is specified
- Be careful with what is in the default context - it is easy to give access to more than is intended

Dial Plan - Extensions

- One or more extensions in each context
- An extension is followed by an incoming call or digits dialled on a channel
 - `exten => name,priority,application()`
 - `exten => 2000,1,Dial(SIP/2000)`
- Priorities are numbered and followed sequentially from '1'
 - Asterisk will stop processing an extension if you skip a priority
- Each priority executes one specific application

Dial Plan - Applications

- Applications 'do things' in the Asterisk dial plan
 - play a sound
 - answer a call
 - interact with a database
- Can take zero or more arguments
 - Answer()
 - Dial(SIP/2001)
 - AnApplicationWithThreeArguments(arg1,arg2,arg3)
- Arguments can be separated with a pipe (|) or a comma.

Dial Plan - 'n' priority

- Asterisk 1.2 onwards understands the 'n' priority

`exten => 2000,1,FirstApplication()`

`exten => 2000,n,NextApplication()`

`exten => 2000,n(priority_label),AnotherApplication()`

- Saves renumbering your extensions if you add or remove a priority
- Labels can make dial plan more readable, particularly when branching using gotos.

Dial Plan - Variables

- Three types of variables available in the dial plan
- Global
 - Set in the [globals] section of extensions.conf
- Channel
 - Variables set automatically, and using the set command on a per channel basis
- A number of pre-defined channel variables - e.g. \${EXTEN}

Dial Plan - Variables

- Some of the common pre-defined channel variables:

`${CALLERID}`
`${CALLERIDNAME}`
`${CALLERIDNUM}`
`${CHANNEL}`
`${CONTEXT}`
`${EXTEN}`
`${SIPUSERAGENT}`

Dial Plan - Extension Matching

- `exten => _04NXXXXXX,1,SomeApplication()`
- `exten => _.,1,SomeApplication()`
 - `_` denotes a pattern matching extension
 - `N` matches any number from 2 through 9
 - `X` matches any single digit
 - `.` matches one or more of any digit
 - `[2-6]` matches any of 2,3,4,5,6

Dial Plan - Extension Matching

- Examples

- `_02[1579].`

- matches NZ mobiles, i.e. numbers starting in 021, 025, 027, or 029

- `_027NXXXXXX`

- matches numbers starting in 027 and exactly 10 digits long, where the fourth digit is from 2 - 9

Starting Asterisk

- On Debian systems:
 - `/etc/init.d/asterisk start`
- Or, `/usr/sbin/asterisk`
 - `asterisk -c` if you want asterisk to load straight into a console
- To connect to a running instance of Asterisk:
 - `asterisk -r`

Running Asterisk

```
jonny@collins:~# asterisk -h
Asterisk 1.0.7-BRIstuffed-0.2.0-RC7k, Copyright (C) 2000-2004, Digium.
Usage: asterisk [OPTIONS]
Valid Options:
  -V                Display version number and exit
  -C <configfile>   Use an alternate configuration file
  -G <group>         Run as a group other than the caller
  -U <user>          Run as a user other than the caller
  -c                Provide console CLI
  -d                Enable extra debugging
  -f                Do not fork
  -g                Dump core in case of a crash
  -h                This help screen
  -i                Initialize crypto keys at startup
  -n                Disable console colorization
  -p                Run as pseudo-realtime thread
  -q                Quiet mode (suppress output)
  -r                Connect to Asterisk on this machine
  -R                Connect to Asterisk, and attempt to reconnect if disconnected
  -t                Record soundfiles in /var/tmp and move them where they belong after they are done.
  -v                Increase verbosity (multiple v's = more verbose)
  -x <cmd>          Execute command <cmd> (only valid with -r)

jonny@collins:~# asterisk -r
Asterisk 1.0.7-BRIstuffed-0.2.0-RC7k, Copyright (C) 1999-2004 Digium.
Written by Mark Spencer <markster@digium.com>
=====
Connected to Asterisk 1.0.7-BRIstuffed-0.2.0-RC7k currently running on collins (pid = 10763)
collins*CLI>
```

Asterisk CLI

- Similar to IOS:
 - sip show peers
 - reload
 - ? for help, tab for command autocomplete
 - sip show ?
- Restart commands
 - restart gracefully: Restart Asterisk gracefully
 - restart now: Restart Asterisk immediately
 - restart when convenient: Restart Asterisk at empty call volume
 - reload: Reload configuration
- stop gracefully: Gracefully shut down Asterisk
- stop now: Shut down Asterisk immediately
- stop when convenient: Shut down Asterisk at empty call volume

Asterisk CLI

- sip debug: Enable SIP debugging
- sip no debug: Disable SIP debugging
- sip reload: Reload sip.conf
- SIP Show commands
 - sip show channels: Show active SIP channels
 - sip show channel: Show detailed SIP channel info
 - sip show inuse: List all inuse/limit
 - sip show peers: Show defined SIP peers (clients that register to your Asterisk server)
 - sip show registry: Show SIP registration status (when Asterisk registers as a client to a SIP Proxy)
 - sip show users: Show defined SIP users

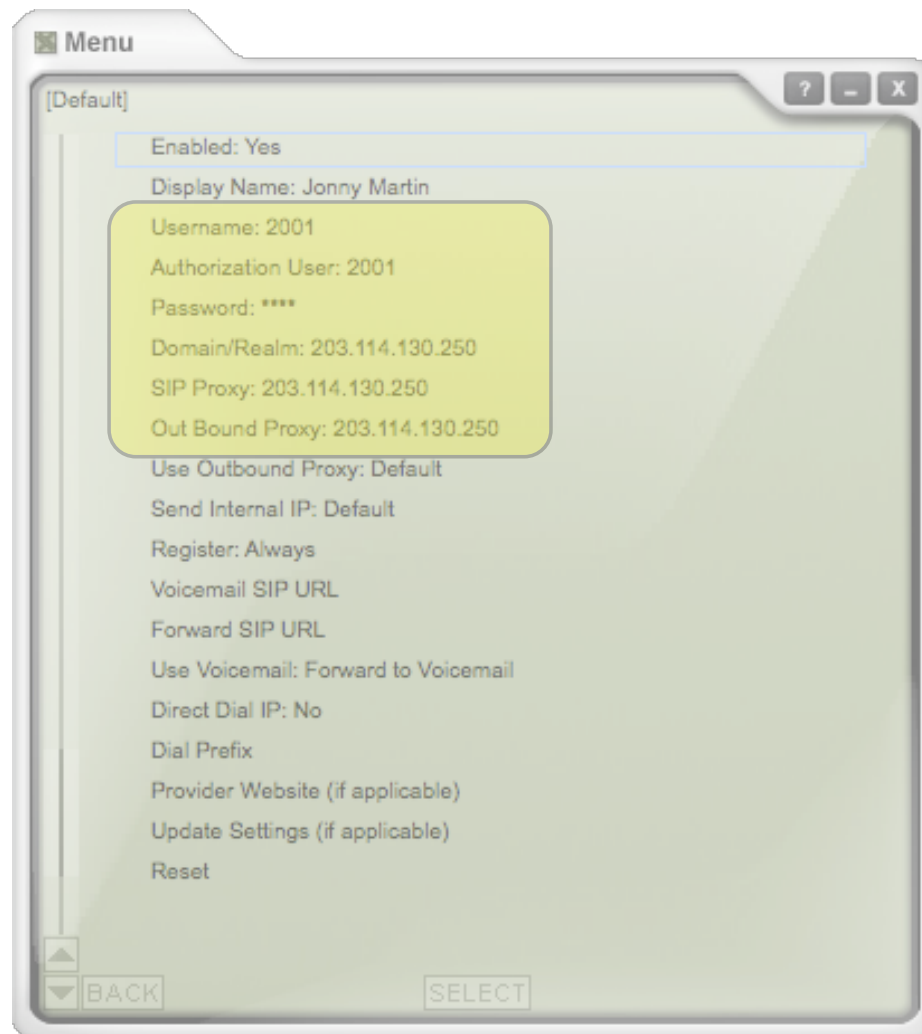
Soft Phone Client

- Any SIP client can be used for the lab
- We'll use the Xten Xlite client
 - Works on Win, Mac, Linux
 - <http://www.xten.com/index.php?menu=download>
- You can use a Wifi phone or similar if you have one with you

Xlite Softphone Setup

- Only need to set a few basic parameters
 - SIP username
 - SIP password
- This is done in
 - Main Menu > System Settings > SIP Proxy > Default

Xlite Softphone Setup



Lab 1: Initial Asterisk Install

Asterisk Variables

- Why use variables?

- Pattern match - how do we know what extensions was dialled?

exten => 2000,1,Dial(SIP/2000)

exten => 2001,1,Dial(SIP/2001)

exten => 2002,1,Dial(SIP/2002)

- OR

exten => _200X,1,Dial(SIP/\${EXTEN})

- \${some_variable} = the value of some_variable.

- some_variable = the variable itself

Asterisk Variables

- Set default variables

```
[globals]  
default_ring_time=10
```

```
[context]  
exten => 2000,1,Dial(SIP/2000,${default_ring_time})
```

- Now only one place in dial plan to update if it is changed
- Setting variables:
 -

Asterisk Variables

- Complete list of Asterisk variables

The 's' Start Extension

- The standard extension a call starts in without needed to specifically match an extension
- Often used with FXS/FXO cards due to lack of end to end signalling with analogue channels

```
[incoming]
exten => s,1,Answer()
exten => s,2,Background(enter-ext-of-person)

exten => 1,1,Playback(digits/1)
exten => 1,2,Goto(incoming,s,1)

exten => 2,1,Playback(digits/2)
exten => 2,2,Goto(incoming,s,1)

exten => 3,1,Hangup
```


The Standard Extensions

- i : Invalid
- s : Start
- h : Hangup
- t : Timeout
- T : AbsoluteTimeout
- o : Operator

Dial Command

- *Dial(**tech/username:password@hostname/extension,ring-timeout,flag**)*
- Can include complete information in the dial string, or reference a peer in sip.conf
 - exten => 2000,1,Dial(SIP/passwd:sipdevice@host.tld)
 - or
 - exten => 2000,1,Dial(SIP/sipdevice)

where there is a channel [sipdevice] defined in sip.conf containing at least definitions for username, password and host.

Voicemail

- Comedian Mail - a fully functional voicemail system included with Asterisk
 - Supports busy and unavailable messages
 - `exten => 2001,1,VoiceMail(b2001)`
 - `exten => 2001,1,VoiceMail(u2001)`
- Voicemail can be emailed out a .wav attachment to users
- Standard IVR voicemail access
 - `exten => 510,1,VoiceMailMain`

voicemail.conf

```
[general]
format=wav49|gsm|wav
serveremail=voicemail@jonny.net
mailcmd=/usr/sbin/sendmail -t
attach=yes
maxmsg=100
maxmessage=180
skipms=3000
maxsilence=10
silencethreshold=128
maxlogins=3

emailbody=Dear ${VM_NAME}:\n\n\tjust wanted to let you know you were just left a
\t${VM_DUR} long message (number ${VM_MSGNUM})\nin mailbox ${VM_MAILBOX} from ${V
M_CALLERID}, on ${VM_DATE}, so you might want to check it when you get a chance
. Thanks!\n\n\t\t\t\t\t--Asterisk\n
emaildateformat=%A, %B %d, %Y at %r

[default]
; all our mailboxes here
; mailbox number => pin,name,email
2000 => 1234,Jonny,jonny@jonny.net
```

Music on Hold

- Music on hold (MOH) played automatically when a channel is placed on hold

- Multiple classes of MOH defined

`exten => 100,1,Answer()`

`exten => 100,2,MusicOnHold(default) ; class = default, could be any other`

- Default file directory, Debian:

- `/usr/share/asterisk/mohmp3`

- RedHat, or if compiling from source

- `/var/lib/asterisk/mohmp3`

musiconhold.conf

```
[default]
;mode=quietmp3
mode=files
directory=/var/lib/asterisk/mohmp3

; valid mode options:
; quietmp3      -- default
; mp3           -- loud
; mp3nb        -- unbuffered
; quietmp3nb    -- quiet unbuffered
; custom        -- run a custom application
; files        -- read files from a directory in any Asterisk supported format
```

MeetMe Conferencing

- Powerful application built in to Asterisk
- Some use Asterisk purely for it's conferencing abilities
- Ad Hoc MeetMe conferencing, or individual conference rooms with PIN

```
/etc/asterisk/meetme.conf  
; Configuration file for MeetMe simple conference rooms  
;  
[rooms]  
; Usage is conf => confno[,pin]  
;  
conf => 101,1234  
conf => 102,2345
```

```
/etc/asterisk/extensions.conf  
exten => 5101,1,Meetme(101|M)  
exten => 5102,2,Meetme(102|M)
```

Interactive Voice Response

- Interactive Voice Response (IVR) is inherent to the Asterisk dialplan
- Simply a matter of playing prompts, waiting, accepting input in a channel, and moving around the dial plan
 - Useful applications:
 - Background(prompt-to-play-whilst-waiting-for-input)
 - Playback(prompt-to-play-whilst-NOT-accepting-input)
 - Goto(context,extension,priority)
 - Dial(SIP/2000)
 - Wait(seconds)

Sample IVR

```
[test-ivr]
exten => s,1,Answer()
exten => s,2,Background(enter-ext-of-person)

exten => 1,1,Playback(digits/1)
exten => 1,2,Goto(incoming,s,1)

exten => 2,1,Playback(digits/2)
exten => 2,2,Goto(incoming,s,1)

exten => i,1,Playback(pbx-invalid)
exten => i,2,Goto(incoming,s,1)

exten => t,1,Playback(vm-goodbye)
exten => t,2,Hangup()

[phones]
; allow our phones to dial into the IVR
exten => 2010,1,Goto(test-ivr,s,1)
```

Lab 2: Basic Asterisk Configuration