

Embedded Asterisk

A Crazy Man's Approach to VoIP

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1

The Master Plan

- Embedded... are you insane?
- My kinda shopping
- In search of... simplicity
- Network administration
- A step-by-step guide to insanity
- Future lunacy

Embedded... are you insane?

- Cost
 - Verizon's plan still costs too much
- Single Line Replacement
 - Local dialing for relatives
 - Voicemail w/SMS notification
- Trixbox is overkill
 - Full-blown PBX replacement solution
- High geek factor



Dial Tone Line	\$ 5.92
Non-Published Number	\$ 1.89
Local Calls	\$ 0.50
MD Fee	\$ 0.20
MD Gross Receipts Tax	\$ 0.31
Montgomery County Local	\$ 2.00
MD 911 Fee	\$ 1.00
MD Federal Universal Service	\$ 0.70
Federal Tax	\$ 0.50
Federal Subscriber Line	\$ 5.99
Total Bill	\$19.01

My Verizon Phone Bill

This is a typical monthly phone bill for me as part of their “cheapest” available plan known as “Tone Economy Message Service.” You must ask for it by name.

trixbox - Admin Mode - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://192.168.0.201/maint/?configEdit

Gmail Calendar DealDetectives GotApex Newegg Investments Blimp Entries Blimp Comments Get Real Real Estate ... Vanguard AstLinux Admin

Admin Mode [switch]

username *****
login OR register

Home Forum Packages Asterisk System Settings

extensions_additional.conf

[/etc/asterisk](#) [/var/www/html/panel](#) [/etc](#) [/ftpboot](#) [Re-Read Configs](#)

extensions_additional.conf

Header

globals

app-userlogonoff

app-pickup

app-zapbarga

app-chanspy

ext-test

ext-did

ext-did-direct

ext-local

outbound-allroutes

outrt-001-9_outside

outrt-002-john

app-blackhole

from-internal-additional

Edit: extensions_additional.conf

```
; do not edit this file, this is an auto-generated file by freepbx
; all modifications must be done from the web gui

[globals]
#include globals_custom.conf
CALLFILENAME = ""
DIAL_OPTIONS = tr
TRUNK_OPTIONS =
DIAL_OUT = 9
FAX =
FAX_RX = system
FAX_RX_EMAIL = fax@mydomain.com
FAX_RX_FROM = freepbx@gmail.com
INCOMING = group-all
NULL = ""
OPERATOR =
OPERATOR_XTN =
PARKNOTIFY = SIP/200
RECORDEXTEN = ""
RINGTIMER = 15
DIRECTORY = last
AFTER_INCOMING =
IN_OVERRIDE = forcerehours
```

Done

MrAfee SiteAdvisor

trixbox - Admin Mode - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://192.168.0.201/maint/?configEdit

Gmail Calendar DealDetectives GotApex Newegg Investments Blimp Entries Blimp Comments Get Real Real Estate ... Vanguard AstLinux Admin

from-internal-trixbox
custom-meetme
custom-wakeupext
custom-fastagi

Edit: extensions_trixbox.conf

```
[from-internal-trixbox]

exten => *61,1,Answer
exten => *61,2,AGI(weather.agi)
exten => *61,3,Hangup

exten => *62,1,Answer
exten => *62,2,AGI(wakeup.php)
exten => *62,3,Hangup

exten => 611,1,Answer
exten => 611,2,Wait(1)
exten => 611,3,DigitTimeout(7)
exten => 611,4,ResponseTimeout(10)
exten => 611,5,Flite("At the beep enter the three character airport code for the weather report yo
exten => 611,6,Read(&PCODE,beep,3)
exten => 611,7,Flite("Please hold a moment while we contact the National Weather Service for your
exten => 611,8,AGI(nv-weather.php|${&PCODE})
exten => 611,9,NoOp(Wave file: ${TMPWAVE})
exten => 611,10,Playback(${TMPWAVE})
exten => 611,11,Hangup

; CallingCard application
;add an incoimf route for the DID to Custom App: (un-comment next line)
;custom-callingcard,s,1

; un-comment the 6 lines below to work on incoming DIDs
;[custom-callingcard]
;exten => s,1,Answer
;exten => s,2,Wait,2
```

Update

Done McAfee SiteAdvisor

My kinda shopping

- Soekris net4826
 - 233 MHz AMD Geode SC1100
 - 64 MB SDRAM
 - 64 MB on-board Compact Flash
 - 10/100 Ethernet Port
 - Serial Port
 - 2 Mini-PCI Type III Sockets
- Cost: \$195

My kinda shopping

- USB Card Reader
- SD Card
- VMware Server Software
- Wireless LAN
- Cost: ???

In search of... simplicity

- Asterisk Distributions:
 - [AsteriskNOW™](#)
 - [Trixbox](#)
 - [AdminsParadise VoIP & Fax System](#)
 - [Evolution PBX](#)
 - [Elastix PBX](#)
- Common Problems
 - Bloatware!

In search of... simplicity

- AstLinux
 - Asterisk
 - Linux kernel 2.6
 - busybox
 - bash
 - mini_httpd
 - OpenSSH & OpenSSL
 - iptables
 - and much more useful stuff

Network Administration

- Embedded development system
 - Virtual machine running Ubuntu
 - Servers
 - DHCP
 - PXE boot needs IP and kernel image location
 - TFTP
 - Provides the kernel image to load
 - NFS
 - Provides a networked file system and access to the AstLinux installation

Step-by-Step Guide to Insanity

- The Ubuntu Nitty-Gritty
 - Server version of Ubuntu 6.06 LTS
 - Update system
 - `sudo apt-get update`
 - `sudo apt-get upgrade`
 - Install servers
 - `sudo apt-get install dhcp3-server`
 - `sudo apt-get install tftpd-hpa`
 - `sudo apt-get install nfs-common`
 - `sudo apt-get install nfs-kernel-server`

Step-by-Step Guide to Insanity

/etc/dhcp/dhcpd.conf

```
ddns-update-style none;
default-lease-time 600;
max-lease-time 7200;
subnet 192.168.0.0 netmask 255.255.255.0 {
    host soekris {
        hardware ethernet 00:00:24:c5:56:04;
        fixed-address 192.168.0.50;
        option subnet-mask 255.255.255.0;
        option routers 192.168.0.1;
        option domain-name-servers 192.168.0.1;
        server-name "192.168.0.105";
        filename "pxelinux.0";
    }
}
```

Step-by-Step Guide to Insanity

`/etc/exports`

`/astlinux 192.168.0.50(rw,no_root_squash,sync)`



Step-by-Step Guide to Insanity

- Let's fire it up!
 - `sudo /etc/init.d/dhcp3-server start`
 - `sudo /etc/init.d/tftpd-hpa start`
 - `sudo /etc/init.d/nfs-common start`
 - `sudo /etc/init.d/nfs-kernel-server start`

```
p0x - Hyper Terminal
File Edit View Call Transfer Help
[Icons]
comBIOS ver. 1.28 20050529 Copyright (C) 2000-2005 Soekris Engineering
net4801
0064 Mbyte Memory CPU Geode 233 Mhz
Pri Mas 64MB ATA Flash Disk LBA 977-4-32 62 Mbyte
Slot Vend Dev ClassRev Cmd Stat CL LT HT Base1 Base2 Int
-----
0:00:0 1078 0001 06000000 0107 0280 00 00 00 00000000 00000000
0:06:0 100B 0020 02000000 0107 0290 00 3F 00 0000E101 A0000000 10
0:14:0 168C 0013 02000001 0116 0290 08 3C 00 A0010000 00000000 11
0:15:0 168C 0013 02000001 0116 0290 08 3C 00 A0020000 00000000 05
0:18:2 100B 0502 01018001 0005 0280 00 00 00 00000000 00000000
0:19:0 0E11 A0F8 0C031008 0117 0280 08 38 00 A0030000 00000000 09

2 Seconds to automatic boot. Press Ctrl-P for entering Monitor.
comBIOS Monitor. Press ? for help.
> boot f0_
```

Soekris Booting Over Network

Typical Soekris output from the console.


```
pxe - Hyper Terminal
File Edit View Call Transfer Help
[Icons]
0:06:0 100B 0020 02000000 0107 0290 00 3F 00 0000E101 A0000000 10
0:14:0 168C 0013 02000001 0116 0290 08 3C 00 A0010000 00000000 11
0:15:0 168C 0013 02000001 0116 0290 08 3C 00 A0020000 00000000 05
0:18:2 100B 0502 01018001 0005 0280 00 00 00 00000000 00000000
0:19:0 0E11 A0F8 0C031008 0117 0280 08 38 00 A0030000 00000000 09

 4 Seconds to automatic boot. Press Ctrl-P for entering Monitor.
comBIOS Monitor. Press ? for help.

> boot f0

NSC DP83815/DP83816 Fast Ethernet UNDI, v1.03
Copyright (C) 2002, 2003 National Semiconductor Corporation
All rights reserved.

Pre-boot eXecution Environment PXE-2.0 (build 082)
Copyright (C) 1997-2000 Intel Corporation

CLIENT MAC ADDR: 00 00 24 C5 56 04
CLIENT IP: 192.168.0.50 MASK: 255.255.255.0 DHCP IP: 192.168.0.105
GATEWAY IP: 192.168.0.1
TFTP.
```

Soekris Acquiring IP and Kernel Image

The Ubuntu DVD contains a directory (/install/netboot/ubuntu-installer/i386) which has pxelinux.0, linux kernel and initrd.gz image as well as a corresponding default configuration file for networking boot with a serial console.

```
pbx - HyperTerminal
File Edit View Call Transfer Help
XXX

BusyBox v1.1.3 (Debian 1:1.1.3-2ubuntu3) Built-in shell (ash)
Enter 'help' for a list of built-in commands.

~ # cd /
~ # ls
bin      etc      init     lib      proc     sbin     tmp      var
dev      floppy  initrd   mnt      root     sys      usr
~ # df -h
Filesystem      Size      Used Available Use% Mounted on
tmpfs           29.9M     32.0k    29.9M    0% /dev
tmpfs           29.9M     32.0k    29.9M    0% /.dev
tmpfs           29.9M     216.0k   29.7M    1% /lib/modules/2.6.17-10-3
86/volatile
~ # mount /dev/hda1 /mnt
~ # ls /mnt
bin      etc      lost+found  proc     stat     tmp
boot     home    mnt         root     sys      usr
dev      lib     opt        sbin     tftpboot var
~ # _

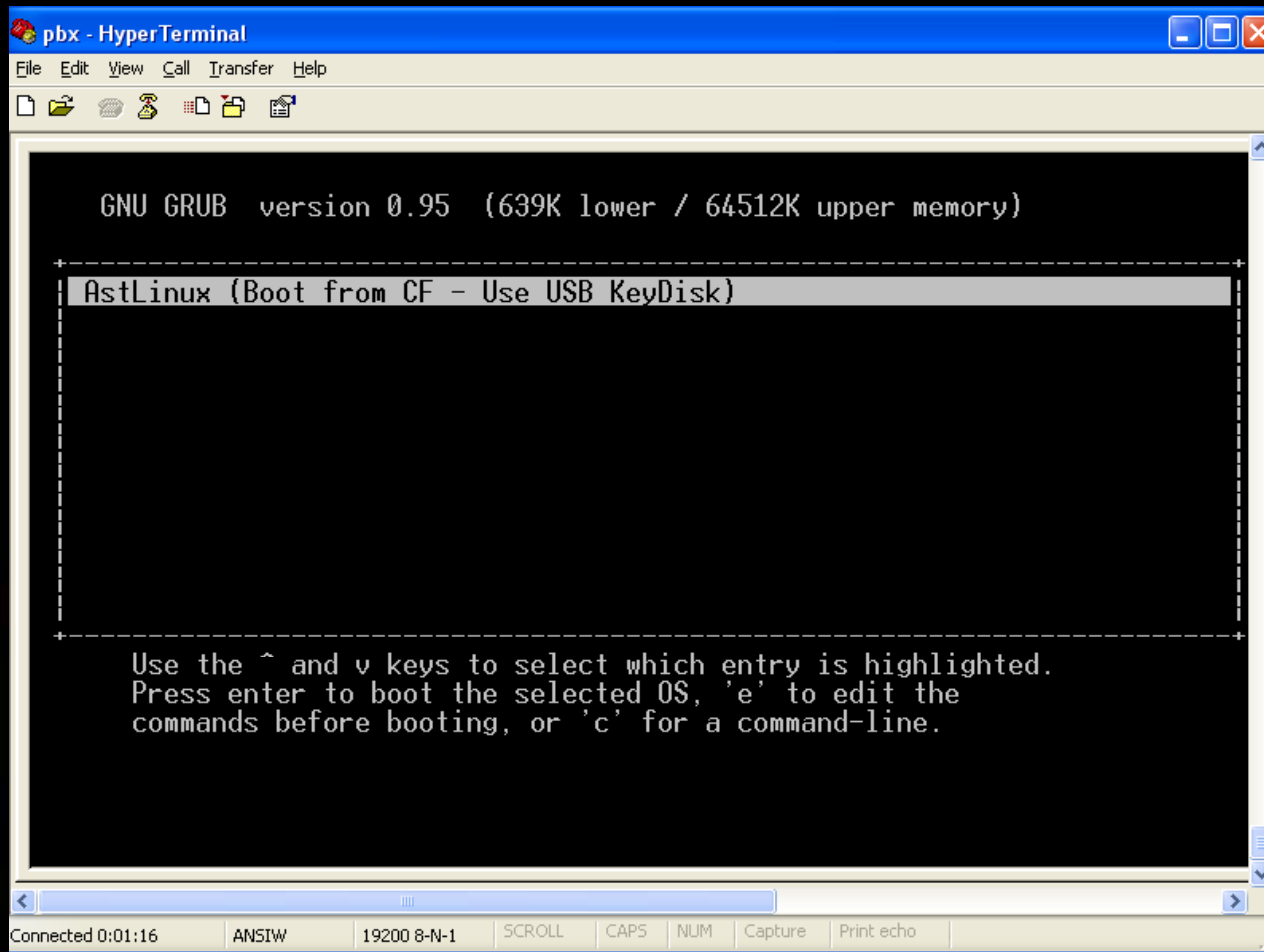
connected 0:31:07  ANSIV  9600 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

Ubuntu & BusyBox

Use the Ubuntu “expert” installation option. Proceed through all the menus and configurations up to and including “Partition Disks.” Once the partition is complete, drop to a shell.

Step-by-Step Guide to Insanity

- Booting the Soekris
 - AstLinux uses a 19200 baud rate on the console
 - Ctrl-P to stop boot
 - set ConSpeed=19200
 - Change your terminal settings as well



```
GNU GRUB  version 0.95  (639K lower / 64512K upper memory)

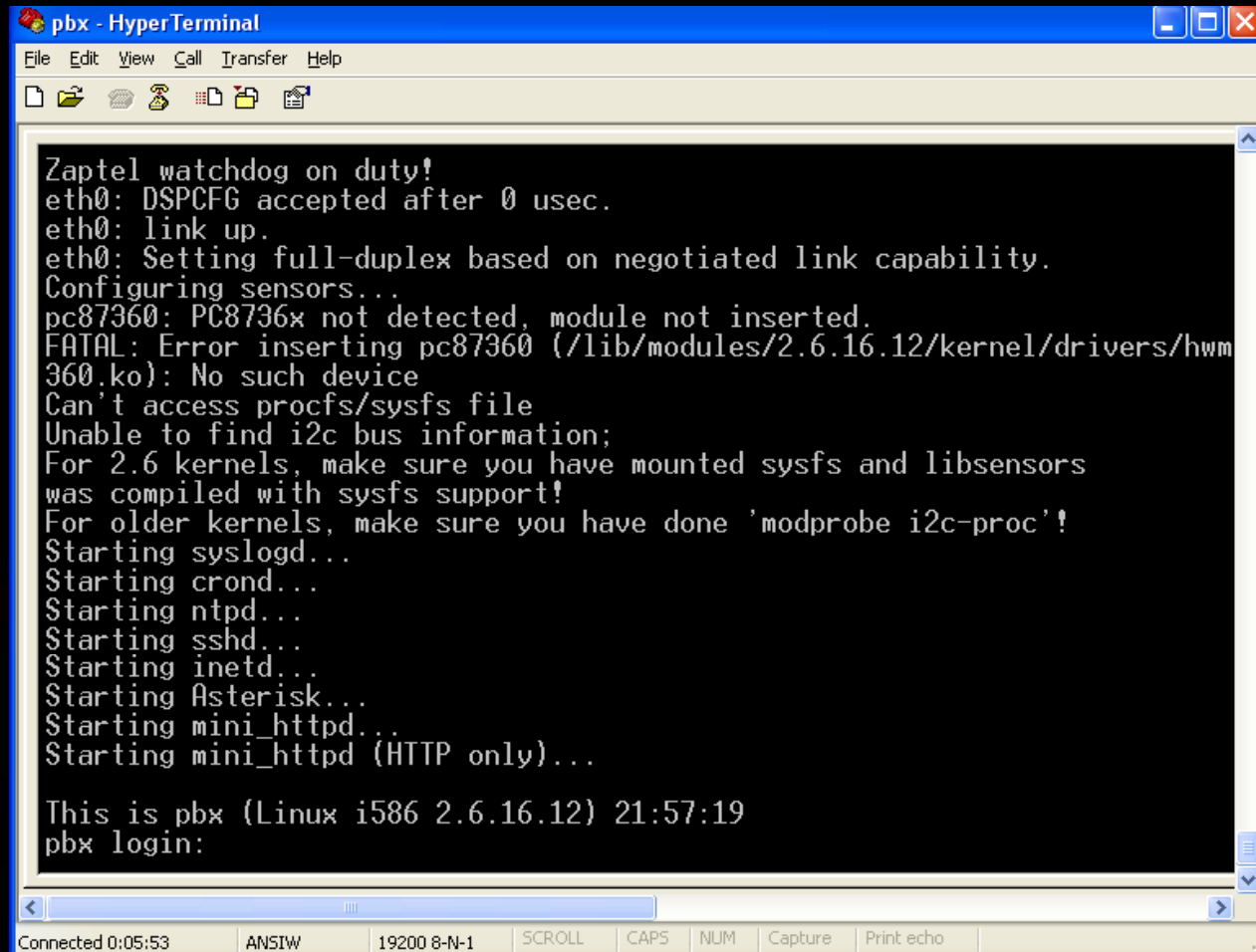
+-----+
| AstLinux (Boot from CF - Use USB KeyDisk) |
+-----+

Use the ^ and v keys to select which entry is highlighted.
Press enter to boot the selected OS, 'e' to edit the
commands before booting, or 'c' for a command-line.
```

Connected 0:01:16 ANSIW 19200 8-N-1 SCROLL CAPS NUM Capture Print echo

Successful Embedded AstLinux Installation

As a first time user, you will be given the opportunity to save all your config files, ssh keys and other necessary files to an external device. I used an SD card. It also stores my voicemails as well.



```
pbx - HyperTerminal
File Edit View Call Transfer Help
Zaptel watchdog on duty!
eth0: DSPCFG accepted after 0 usec.
eth0: link up.
eth0: Setting full-duplex based on negotiated link capability.
Configuring sensors...
pc87360: PC8736x not detected, module not inserted.
FATAL: Error inserting pc87360 (/lib/modules/2.6.16.12/kernel/drivers/hwm
360.ko): No such device
Can't access procfs/sysfs file
Unable to find i2c bus information;
For 2.6 kernels, make sure you have mounted sysfs and libsensors
was compiled with sysfs support!
For older kernels, make sure you have done 'modprobe i2c-proc'!
Starting syslogd...
Starting crond...
Starting ntpd...
Starting sshd...
Starting inetd...
Starting Asterisk...
Starting mini_httpd...
Starting mini_httpd (HTTP only)...

This is pbx (Linux i586 2.6.16.12) 21:57:19
pbx login:
```

Connected 0:05:53 ANSIW 19200 8-N-1 SCROLL CAPS NUM Capture Print echo

Successful Embedded AstLinux Running

At this point we can kill the serial console and administer AstLinux from a web browser.

astlinux

Filesystem: **Read Only**

Asterisk:
[Config](#)
[Shell](#)
[Log](#)

Boot:
[TFTP](#)
[FTP](#)

General:
[About](#)
[Credits](#)
[Status](#)
[Network](#)
[Shell](#)
[Setup](#)

Welcome to the AstLinux **VERY** Basic Web Interface.

Server uptime
3 mins 33 secs

Server load
 1 min avg 5 min avg 15 min avg
 0.20 0.27 0.12

Service status

Service	Status	Process Count
Asterisk	UP	13
HTTP Daemon	UP	4
SSH Daemon	UP	1
NTP Daemon	UP	2
DNSMasq Daemon	DOWN	0
Inet Daemon	UP	1
Syslog Daemon	UP	1

Stopped 192.168.0.204 McAfee SiteAdvisor

AstLinux Administration

The default user is “admin” while the default password is “astlinux.”
 The server uses SSL, so you will be prompted to accept an unverified SSL certificate since it was self-generated.

The screenshot shows a Mozilla Firefox browser window titled "AstLinux Web Admin - Mozilla Firefox". The address bar displays "https://192.168.0.204/admin/dir.php?dir=/etc/asterisk/". The page content shows a directory listing for the path "/etc/asterisk/". On the left, there are navigation links under "Asterisk:", "Boot:", and "General:". The main content is a table of files with columns for "File", "Size", and "Modified".

File	Size	Modified
> .. (parent)		
ads_i.conf	140 B	11/01/06
adtranvofr.conf	840 B	11/01/06
agents.conf	2.09 KB	11/01/06
alarmreceiver.conf	2.17 KB	11/01/06
alsa.conf	748 B	11/01/06
asterisk.ads_i	3.18 KB	11/01/06
asterisk.conf	412 B	11/01/06
cdr.conf	2.14 KB	11/01/06
cdr_custom.conf	388 B	11/01/06
cdr_manager.conf	59 B	11/01/06
cdr_odbc.conf	221 B	11/01/06
cdr_pgsql.conf	204 B	11/01/06
cdr_tds.conf	159 B	11/01/06
codecs.conf	1.62 KB	11/01/06
dnsmgr.conf	190 B	11/01/06
dundi.conf	7.56 KB	11/01/06
enum.conf	585 B	11/01/06
extconfig.conf	1.25 KB	11/01/06
extensions.ael	1.06 KB	11/01/06
extensions.conf	982 B	04/23/07
extensions.conf.sample	16.76 KB	03/04/07
features.conf	1.62 KB	11/01/06
festival.conf	929 B	11/01/06

Configuration hell


The list of config files seems endless! But through trial and error, and sometimes luck, I found that you only need to modify two files to get a working box: sip.conf & extensions.conf.

sip.conf Configuration

```
[general]
register => <username>:<password>@inbound1.vitelity.net:5060
context=default
bindport=5060
bindaddr=0.0.0.0
disallow=all
allow=ulaw
```

```
[300]
type=friend
secret=300
qualify=yes
dtmfmode=rfc2833
nat=yes
host=dynamic
context=voip
mailbox=1@default
```


sip.conf Configuration



```
[vitel-inbound]
type=friend
host=inbound1.vitelity.net
context=voip
username=<username>
secret=<password>
insecure=very
canreinvite=no
```

```
[vitel-outbound]
type=friend
host=outbound1.vitelity.net
context=voip
username=<username>
fromuser=<username>
trustpid=yes
sendrpid=yes
secret=<password>
canreinvite=no
```

extensions.conf Configuration



```
[general]
static=yes
writeprotect=no
autofallthrough=yes
clearglobalvars=no
priorityjumping=no

[voip]
include => inbound
include => outgoing
include => internal
include => voicemail

;[iax2trunk]
;include => john
;include => internal

[voicemail]
exten => 500,1,VoiceMailMain()
```

extensions.conf Configuration

[inbound]

exten => 2402383197,1,Dial(SIP/300,15)

exten => 2402383197,n,VoiceMail(1@default,u)

exten => 2402383197,n,Hangup()

exten => 9376883158,1,Dial(SIP/300,15)

exten => 9376883158,n,VoiceMail(1@default,u)

exten => 9376883158,n,Hangup()

exten => 5676234548,1,Dial(SIP/300,15)

exten => 5676234548,n,VoiceMail(1@default,u)

exten => 5676234548,n,Hangup()

exten => a,1,VoiceMailMain()

exten => a,n,Hangup()

extensions.conf Configuration

```
[outgoing]
exten => _NXXNXXXXXX,1,SetCallerId,2402383197
exten => _NXXNXXXXXX,n,Dial(SIP/${EXTEN}@vitel-outbound)
```

```
[internal]
exten => 300,1,Dial(SIP/300)
exten => 350,1,Dial(SIP/350)
;exten => 205,1,Dial(IAX2/205)
```

```
:[john]
;exten => 301,1,Dial(SIP/301)
;exten => 301,n,Hangup()
```

voicemail.conf Configuration

```
[general]
format=wav49|gsm|wav
serveremail=asterisk
attach=no
skipms=3000
maxsilence=10
silencethreshold=128
maxlogins=3
emaildateformat=%A, %B %d, %Y at %r
mailcmd=/usr/sbin/msmtp -C /tmp/etc/msmtp -t
sendvoicemail=yes
```

```
[default]
1 => <password>,Terry,,<mycellnumber>@vtext.com,attach=no|saycid=no|envelope=no|delete=no
```

msmtplib is an SMTP client.

In the default mode, it transmits a mail to an SMTP server (for example at a free mail provider) which does the delivery.

To use this program with your mail user agent (MUA), create a configuration file with your mail account(s) and tell your MUA to call msmtplib instead of /usr/sbin/sendmail.

Features include:

- Sendmail compatible interface (command line options and exit codes).
- Authentication methods PLAIN, LOGIN, CRAM-MD5, DIGEST-MD5, GSSAPI, and NTLM.
- TLS/SSL both in SMTP-over-SSL mode and in STARTTLS mode. Full certificate trust checks can be performed. A client certificate can be sent.
- Fast SMTP implementation using command pipelining.
- Support for Internationalized Domain Names (IDN).
- DSN (Delivery Status Notification) support.
- RMQS (Remote Message Queue Starting) support (ETRN keyword).
- IPv6 support.

Mini-smtp Client

Sendmail is way too big and complex for the embedded device. msmtplib is the perfect solution. It's simply a client that passes the email to the real smtp server I use: Verizon.

/etc/rc.conf Configuration

<snip>

```
##This is the SMTP server that all mail from cron, etc. on this  
##system will be sent through. This includes Asterisk VM notifications.
```

```
SMTP_SERVER="66.174.3.30"
```

<snip>

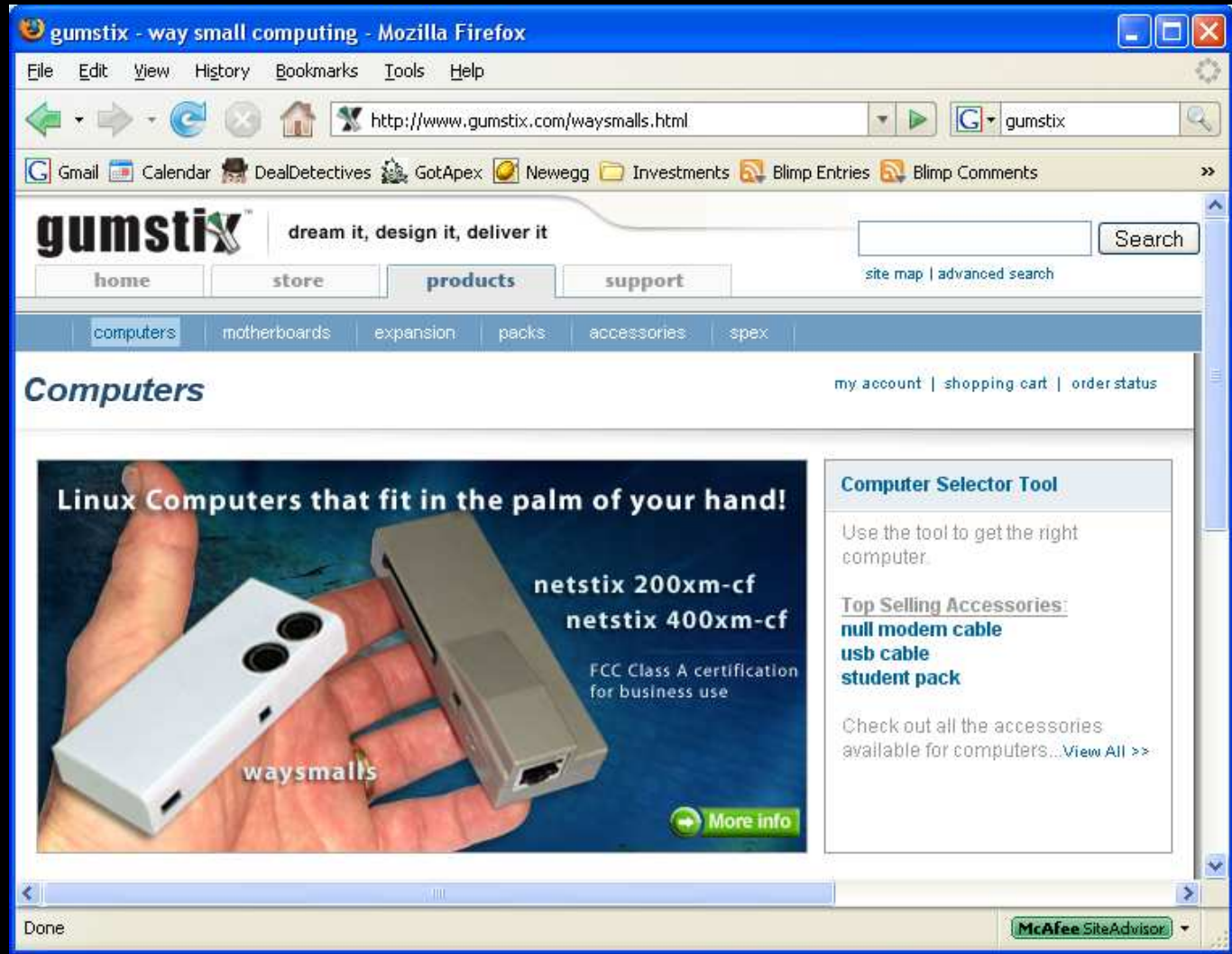


Future Lunacy

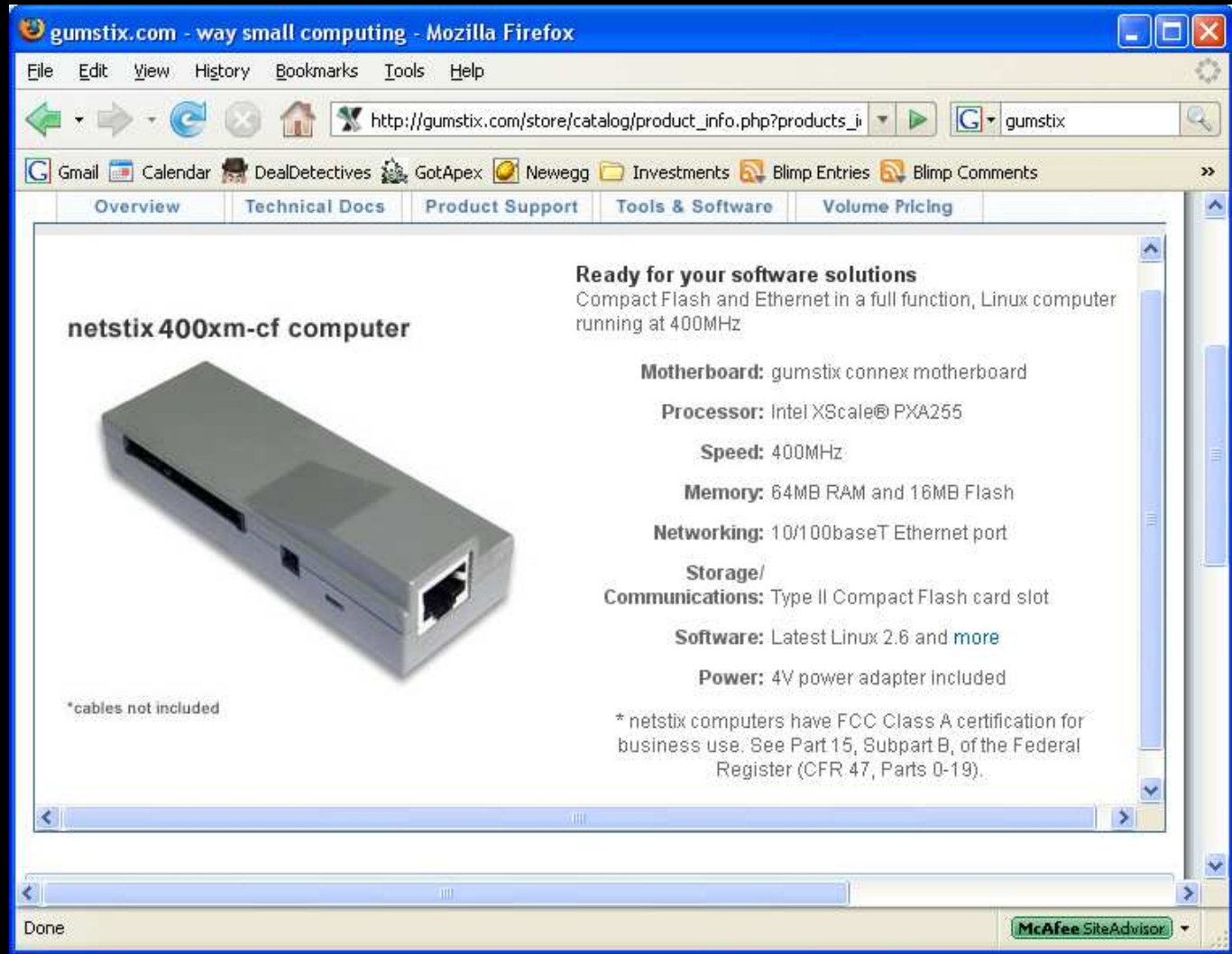
- 2.4 GHz Atheros 802.11b/g Card
 - Mini-PCI Type III Sockets
 - High Power 600mW



Future Lunacy



Future Lunacy



gumstix.com - way small computing - Mozilla Firefox


File Edit View History Bookmarks Tools Help

http://gumstix.com/store/catalog/product_info.php?products_i gumstix

Gmail Calendar DealDetectives GotApex Newegg Investments Blimp Entries Blimp Comments

Overview Technical Docs Product Support Tools & Software Volume Pricing

netstix 400xm-cf computer



*cables not included

Ready for your software solutions
Compact Flash and Ethernet in a full function, Linux computer running at 400MHz

- Motherboard:** gumstix connex motherboard
- Processor:** Intel XScale® PXA255
- Speed:** 400MHz
- Memory:** 64MB RAM and 16MB Flash
- Networking:** 10/100baseT Ethernet port
- Storage/Communications:** Type II Compact Flash card slot
- Software:** Latest Linux 2.6 and more
- Power:** 4V power adapter included

* netstix computers have FCC Class A certification for business use. See Part 15, Subpart B, of the Federal Register (CFR 47, Parts 0-19).

Done McAfee SiteAdvisor

Demo Time

Disclaimer: Past performance is not indicative of future results.



Contact Information

- www.terrydunlap.com
 - slides to be posted soon
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