You da M.A.N.
Voice, over IP, over stuff

Outline

- Network design & provisioning
- Network topology & hardware
- Network applications
- Security
- VoIP & Asterisk
- Future work & possibilities
- Live demonstration
Design

- Initial design came quickly
- Request For Heckles (RFH)
  - Define the standards that allow the network to inter-operate
- RFH 1, 2 & 3
  - 1 - WNIC proposed common numbering scheme
  - 2 - Proposed services for routing and services network
  - 3 - Telephony systems layout
- Implementation took much longer than planned

Network topology

Comprised of:
- FreeBSD 5.3 routers
- Mixed end hosts
  - FreeBSD, Mac OS X, Windows, cisco IP phones
- Link layer
  - 802.11g
  - Switched ethernet
  - ADSL
Network topology (Simplified)

Law & Shell

Home network

Trem

Gateway

Wazz & Mon

SWIN

INTERNET

Network topology (Swinnet)

SWINNET
(vlan 49)
(DHCP: 136.186.49.x)

Swin Cisco VPN
counterator
(136.186.13.6)

INTERNET
Network topology (Swinnet)

- 10.254.1.6/24
- 136.186.49.77
- 136.186.49.47
- 10.254.1.3/24

Swinnet (vlan 49)
(DHCP: 136.186.49.x)

Swin Cisco VPN concentrator
(136.186.13.6)

Network topology Law & Shell

- 802.11g AP
- fxp0 10.254.7.1/25
- Law & Shell
  - fxp1 10.254.7.129/25
  - ath0 10.254.1.7/24

SWINNET (vlan 49)
Network topology Law & Shell

Network Topology (Daniel)

SWINNET (vlan 49)

Trem

fxf0 10.254.5.10/24

ath0 10.254.1.5/24

10.254.5.10/24
So what does it look like when it's all on the same page?
Hardware List

- 4 x D-Link DWL-G520 (Hardware Version: B2) PCI Wireless card
- 1 x D-Link DWL-2100AP 108/54 Mbps Wireless Access Point
- 1 x D-Link DWL-G810 108/54 Mbps Wireless Bridge
- 1 x PCI to PCMCIA Cradle
- 1 x 802.11b PCMCIA Wireless Network Card
- 4 x 10/00 Ethernet Switches
- 6 x Intel 10/100 Pro/100 S NICs
- 5 x FreeBSD 5.3 Routers (Mix machine types)
- 1 x Dell Inspiron 600m laptop
- 2 x Cisco 7910 VoIP Phones
- 2 x Generic X100P FXO Cards
- 10+ x End Hosts
- ...

Network Applications

- VoIP
- SAMBA file sharing
- Mail
- http proxy (Caching & peered with swin)
- DNS
- NTP
- ...
Security

- **IPSEC (IETF RFC2401)**
  - Secures links between boarder routers and gateway
  - Uses ESP for IP encryption and raccoon for automated key exchange
  - Used to create and secure an IP over UDP tunnel from Wazz & Mon to gateway
VoIP

Voice over Internet Protocol

VoIP using Asterisk

- Asterisk (http://www.asterisk.org/)
  - Platforms
    - Linux, FreeBSD, Mac OS X...
  - Features
    - Trunking between asterisk servers
    - Hardware compatibility
      - Digital: SIP & SKINNY Phones, ISDN line cards, T1/E1 line cards, GSM bridge
      - Analog: Multi port FXO & FXS cards
    - Call waiting, transfer, on hold (mp3s)...
  - There are many more!...
Asterisk feature list

Asterisk™ Features

- ADI On-Screen Menu System
- Alarm Receiver
- Append Message
- Authentication
- Automated Attendant
- Blocklist
- Blind Transfer
- Call Detail Records
- Call Forward on Busy
- Call Forward on No Answer
- Call Forward Variable
- Call Monitoring
- Call Parking
- Call Queuing
- Call Recording
- Call Retrieval
- Call Routing (DID & ANI)
- Call Snooping
- Call Transfer
- Call Waiting
- Caller ID
- Caller ID Blocking
- Caller ID on Call Waiting
- Calling Cards
- Conference Bridging
- Database Store / Retrieve
- Database Integration
- Dial by Name
- Distinctive Ring
- Direct Inward System Access
- Do Not Disturb
- DUNDI™
- ENUM

Call Features

- Fax Transmit and Receive (3rd Party OSS Package)
- Flexible Extension Logic
- Interactive Directory Listing
- Interactive Voice Response (IVR)
- Local and Remote Call Agents
- Macros
- Music On Hold
- Music On Transfer
- o Flexible Mg2-based System
- o Random or Linear Play
- o Volume Control
- o Predictive Dialer
- Privacy
- Open Settlement Protocol (OSP)
- Overseas Paging
- Protocol Conversion
- Remote Call Pickup
- Remote Office Support
- Roaming Extensions
- Route by Caller ID
- SMS Messaging
- Spell / Say
- Streaming Media Access
- Supervised Transfer
- Talk Detection
- Text-to-Speech (via Festival)
- Three-way Calling
- Time and Date
- Transcoding
- Trunking
- VoIP Gateways
- Voicemail
- o Visual Indicator for Message
- Waiting
- o Stutter Dialtone for Message
- o Voicemail to email
- o Voicemail Groups
- o Web Voicemail Interface
- Zapatera

Computer-Telephony Integration

- AGI (Asterisk Gateway Interface)
- * Graphical Call Manager
- * Outbound Call Spooling
- * Predictive Dialer
- * TCP/IP Management Interface

Scalability

- TDMoE: (Time Division Multiplex over Ethernet)
  - o Allows direct connection of Asterisk PBX
  - o Zero latency
  - o Uses commodity Ethernet hardware
- * Voice-over IP
- * o Allows for integration of physically
  - separate installations
- * o Uses commonly deployed data
  - connections
- * o Allows a unified dialplan across multiple
  - offices

Codes

- ADPCM
- G.711 (A-Law & µ-Law)
- G.723.1 (pass through)
- G.726
- G.729 (through purchase of commercial
  - license through Digikey)
- GSM
- iLBC
- Linear
- LPC-10
- Speex

Protocols

- IAX™ (Inter-Asterisk Exchange)
- * H.323
- * SIP (Session Initiation Protocol)
- * MGCP (Media Gateway Control Protocol)
- * SCCP (Cisco® Skinny®)

Traditional Telephony Interoperability

- E&M
- * E&M Wank
- * Feature Group D
- * FXS
- * FXO
- * GR-303
- * Loosetap
- * Groundstart
- * Kwistart
- * MF and DTMF support
- * Robbed-bit Signaling (RBS) Types

PRI Protocols

- 4ESS
- * BRI (ISDN4Linux)
- * DMS100
- * EuroISDN
- * Lucent 5E
- * National ISDN2
- * NFAS

- Asterisk config files

- Examples

  extensions.conf

  exten => 400,1,Dial(Skinny/400@MonWar,20)
  exten => 400,2,Voicemail(u400)

  exten => 401,1,Voicemail(u400)

  exten => 410,1,Dial(Sip/MonWarSip)
  exten => 410,2,Dial(Sip/test)

  sip.conf

  [cisco]
  type=friend
  username=cisco
  secret=blah
  nat=yes
Our implementation

- FXO
Our implementation

- FXO
CISCO IP phones

SIP Software Phones

Free download: http://xten.com/
Current capabilities

- POTS
  - “0” to get an outside line
  - Incoming call routing using menu
- Calls between hardware phones
- Calls between software SIP phones
- Calls between hardware and software SIP phones
- Voice mail
Future work

- Warren needs a static IP or dynamic DNS
  - To allow SIP calls from the wider Internet
- QoS
  - Strict priority queuing
- Expansion
- Peering with other SIP providers
  - Grenville has had success

Demonstration