Design of PSTN - VoIP Gateway for rural environments

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Outline

1. Introduction
2. Approaches for rural connectivity
3. Timbaktu Case-study
4. Survey of Hardware and Software
5. Affordable Gateway PBX
6. LDAP authentication in Asterisk PBX
7. Conclusion and Future work

Introduction

- Around 70% of India's population lives in villages.
- Typical village consist of around 250 households.
- Problem of Last mile rural connectivity.
- Traditional coverage proves too expensive.
- ARPU is too low to recover infrastructure and service costs.
- Several solutions exist for last-mile connectivity.
- DoT through VPT(Village Public Telephone)

Rural environment constraints

- Income levels for rural India are lower than national average (INR2500 approx).
- Lack of power supply.
- Lack of knowledge on technology.

An acceptable solution for rural connectivity would be:

- easy to deploy and maintain,
- low on operational expenditure, and
- low power consumption

Approach 1: Using off-the-self components

Use of off-the-self components to build intra-connectivity in the village

Approach 2: Design VoIP Gateway PBX

Design a VoIP gateway PBX to minimize the cost of the entire system for rural deployment

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Timbaktu Collective

- is a remote location and mountainous area,
- lack of cellular coverage, and
- no A/C power supply.

Problem in Communication

- its connectivity is through a single PSTN line,
- each time a user needs to walk to the central phone to make and receive a call, and
- solar panels(DC power) are installed to meet power requirements.

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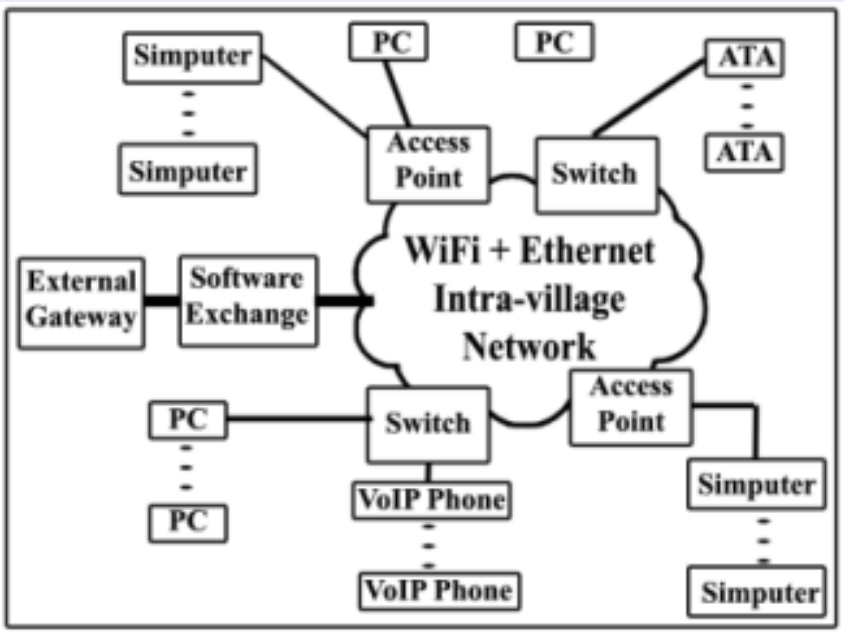
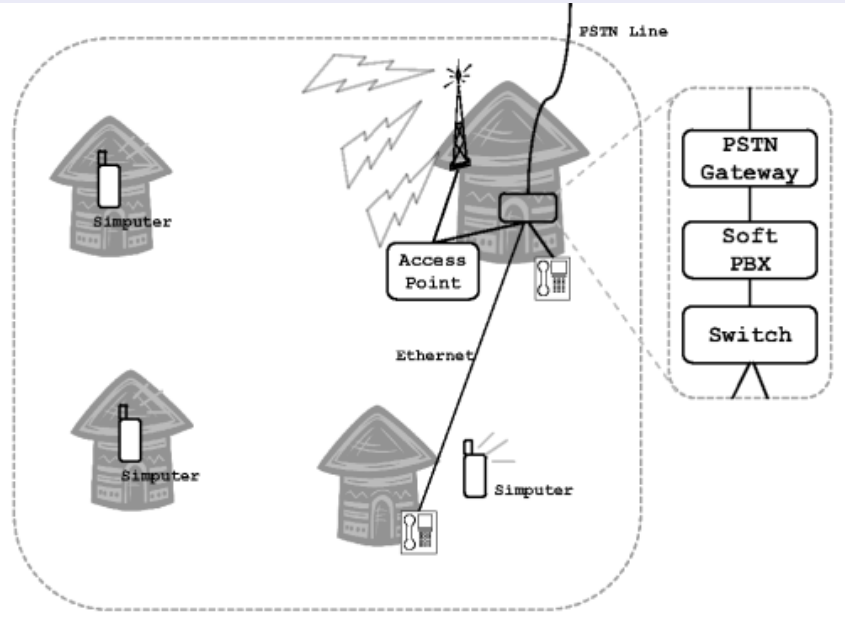
Proposed Architecture

- External gateway interfaces with the software exchange.
- Software exchange is connected to user devices through Intra-village network.
- Software exchange includes VoIP gateway and soft-PBX.
- VoIP gateway interfaces a PoP with an IP network.
- Soft-PBX allow VoIP user to make and receive calls.
- Intra-village network is hybrid network, (Ethernet+WiFi)
- Connecting nearby places with ethernet.
- Connecting far places with WiFi.

Intra-village connectivity



Case-study setup

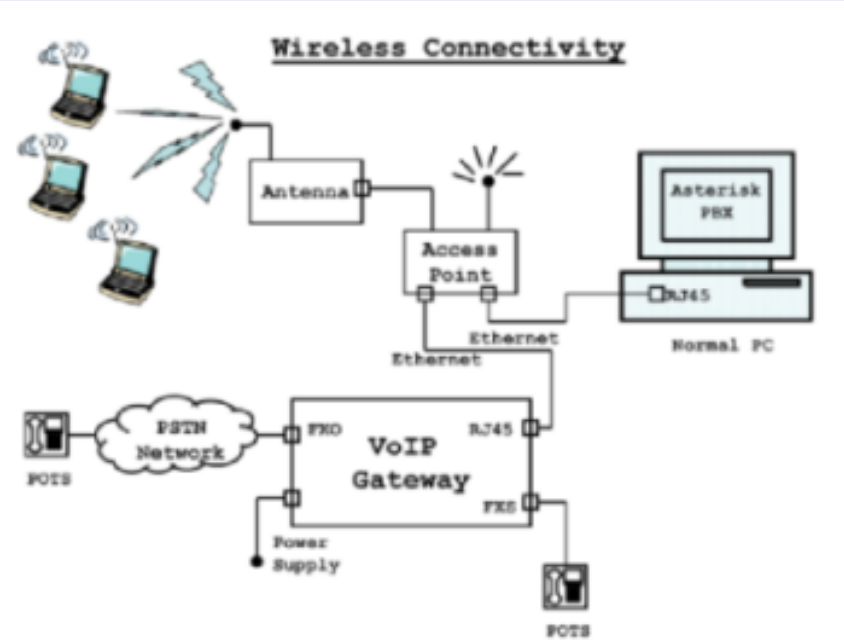


Case-study results

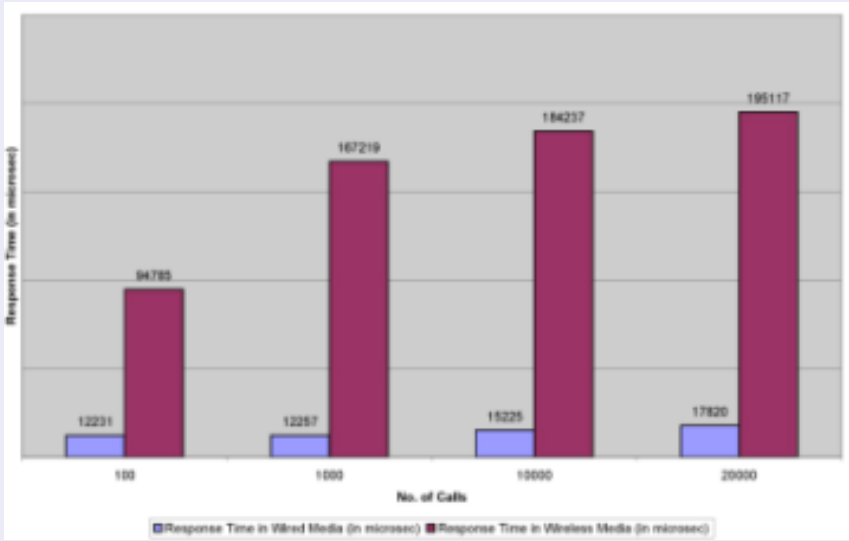
- We proposed an architecture for rural scenario.
- We performed VoIP tests with different clients.
- Quality of the calls were very good except with the Simputer.
- Simputer have processing delays and codec problems.

Device(Fr/To)	*PC*	*Simputer*	*Phone*	*Landline*
PC	Very good	Poor	Good	Very good
Simputer	Average	Poor	Poor	Average
Phone	Good	Average	Good	Very good
Landline	Very good	Average	Very good	-

Wireless architecture for Asterisk testing



Asterisk Response Times in wired and wireless media



Motivation

- We can use off-the-self approach to solve connectivity problem in rural environment.
- This approach is still expensive for rural scenario, approximately Rs. 42,000.

Problem Statement

We have focused on solving the following problems:

- We have to design a single integrated DC-powered device that combines the Gateway and the Soft PBX.
- Setup Asterisk to authenticate users using OpenLDAP.

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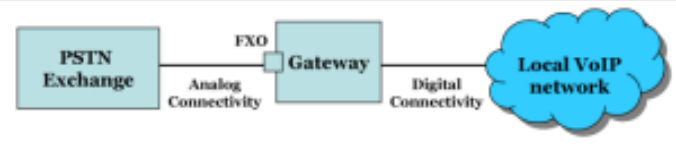
FXO interface

points to the Telcom office



FXS interface

points to the subscriber

Hardware

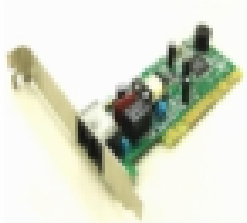

Sipura SPA 3000


Linksys SPA 3102


Linksys ATA


VIA motherboard


X100P


V.92 Modem


IDE flash

FXO interface

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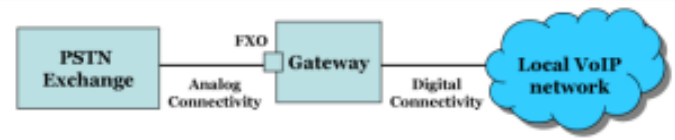

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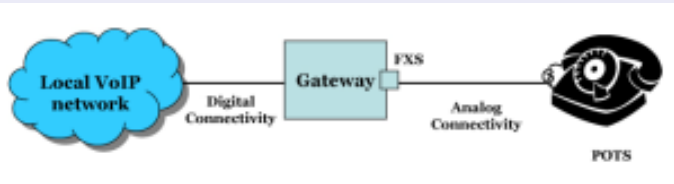

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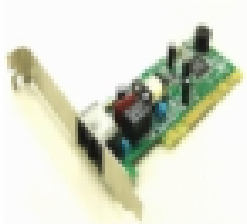
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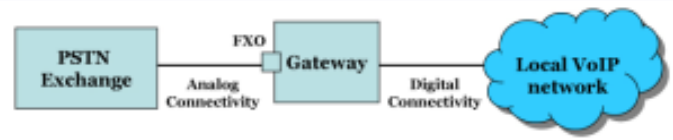

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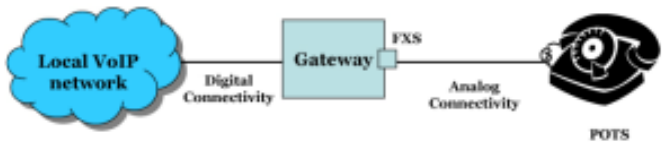

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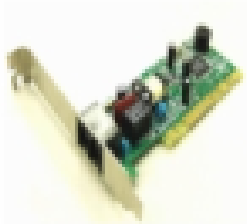
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IDE flash

Asterisk PBX

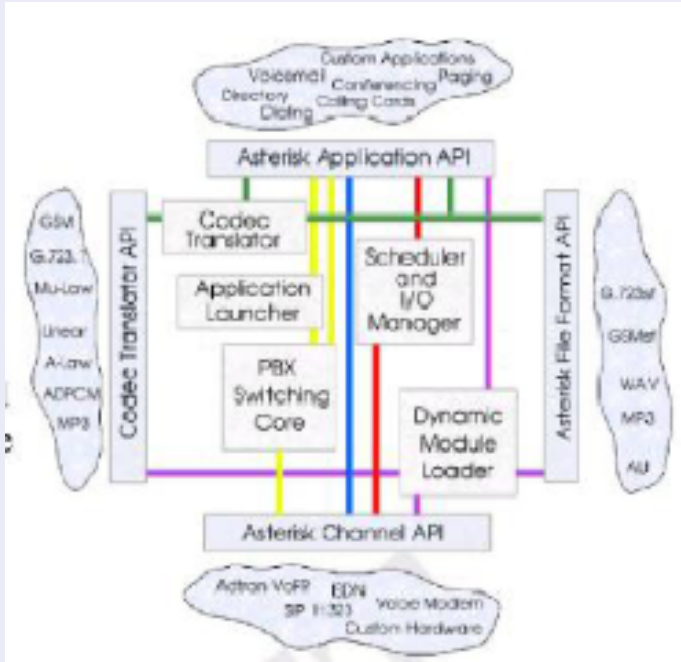
- Open source Soft PBX.
- Supports many protocols.
- Needs no hardware for VoIP.

AstLinux

- Linux distribution of Asterisk
- Occupies around 40MB
- Runs on flash memory

Softphone

- Making calls over Internet



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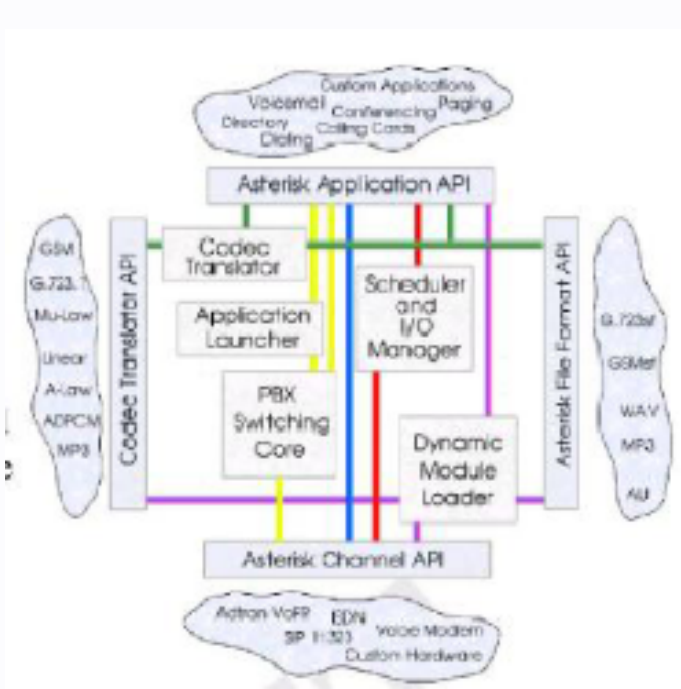

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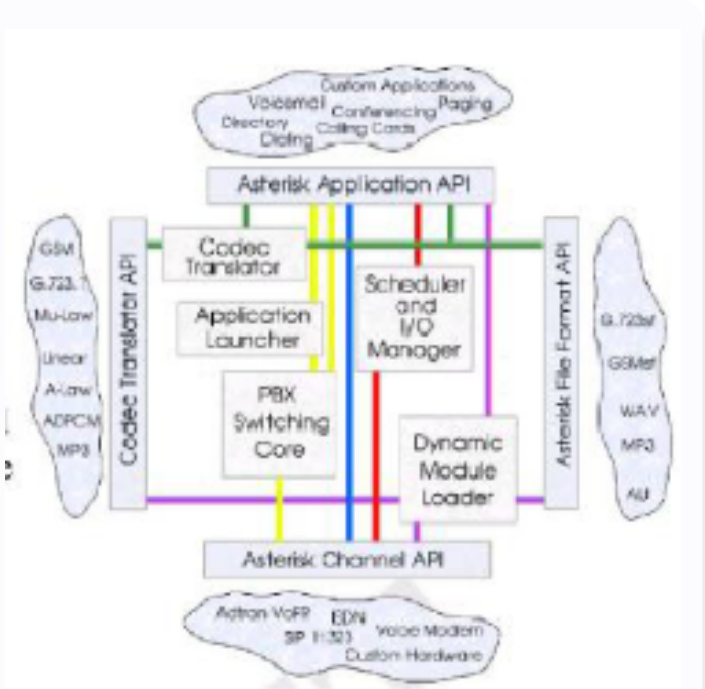

Softphone

- Making calls over Internet

Experiments 1: Sipura SPA3000 with Normal PC

Advantages:

- This setup is easy to install.
- Sipura provides a nice web interface for its configuration.
- SPA3000 provides us the facility for fine tuning the system.

Disadvantages:

- This setup is the most expensive in terms of cost and power consumption.
- Asterisk server is installed on a computer system, causing wastage of computing resources.

Experiments 2: Sipura SPA3000 with VIA Motherboard

Advantages:

- Power and cost reduction from last experiment.
- VIA motherboard takes less DC power, 12VDC.
- In this setup we have made efficient usage of computational resources.
- The cost of the system is reduced by using Via motherboard.

Disadvantages:

- Still gateway cost is high.
- SPA-3000 takes additional power.

Experiments 3: Digium X100P with VIA Motherboard

Advantages:

- Cost reduction from last experiment.
- X100P is cheaper than SPA-3000.
- X100P is a PCI card, it won't take extra power.

Disadvantages:

- No fine tuning is possible for the system.
- The power consumption of the system is still high because of hard disk.

Experiments 4: V.92 data MODEM with VIA Motherboard

Advantages:

- Power and cost reduction from last experiment.
- MODEM is much more cheaper than X100P.
- Using normal data MODEM, entire gateway cost is reduced.
- Replaced hard disk with IDE flash, so entire system become more compact.
- Efficient usage power resources.

Disadvantages:

- Code modification is needed.
- System life is reduced because of flash memory.

Cost comparison

System	*Cost*
SPA + PC	Rs. 41,350
SPA + VIA	Rs. 26,350
X100P + VIA	Rs. 21,850
V.92 + VIA	Rs. 19,850

Conclusion of Gateway PBX

Our proposed solution to Gateway PBX is V.92 data MODEM with VIA motherboard using IDE flash memory

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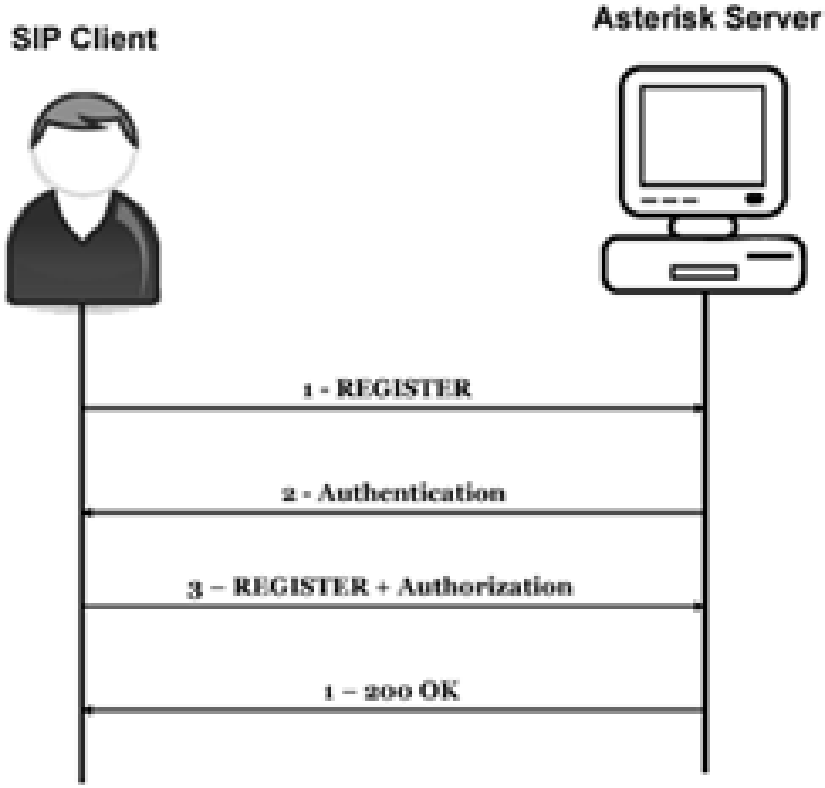
- Asterisk has its own authentication, details stored in sip.conf.
- Large organizations maintain some external authentication mechanism.
- Many of organizations provide VoIP telephony.
- For unique authentication, need to provide an external authentication in Asterisk.

sip.conf

```
[username]
type=friend
context=from-sip
secret=secret
host=dynamic
```

Simple Registration



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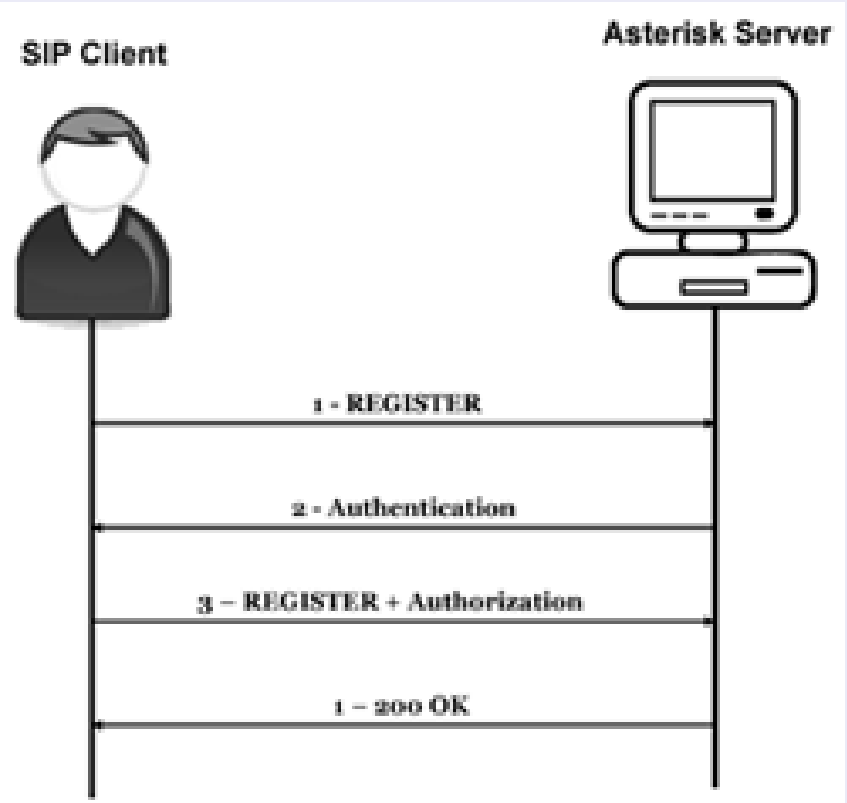

LDAP Client: PAM

- we used *pam* as a LDAP client
- PAM allows integration of various authentication technologies such as standard UNIX and LDAP etc.
- patched Asterisk with *pam_ldap*

New *sip.conf*

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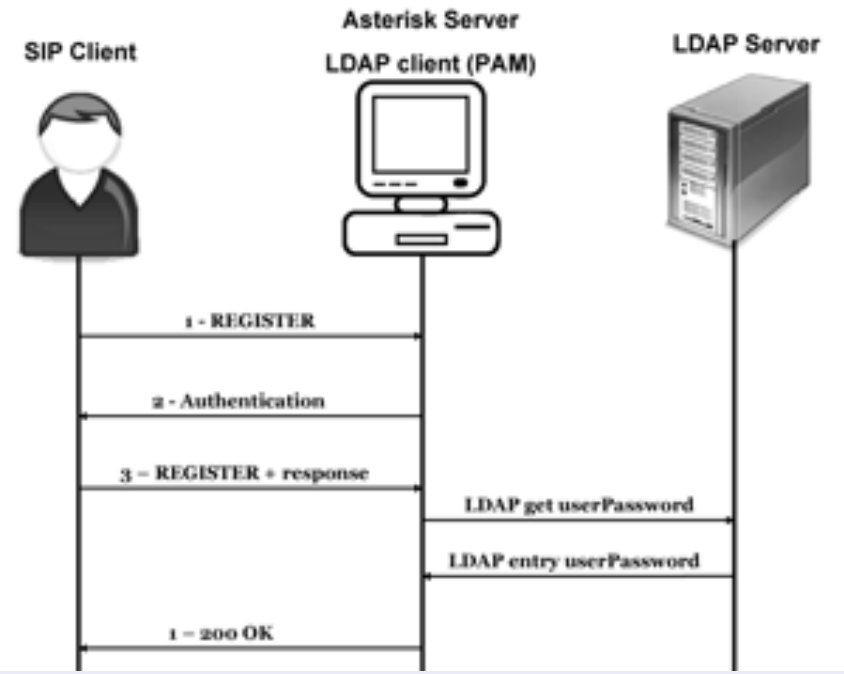
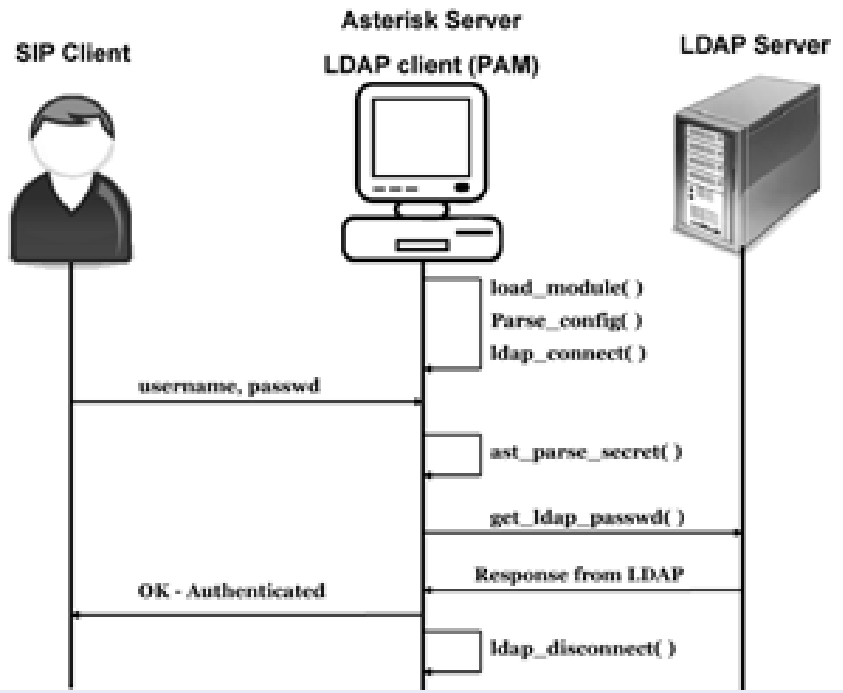
Registration with LDAP server



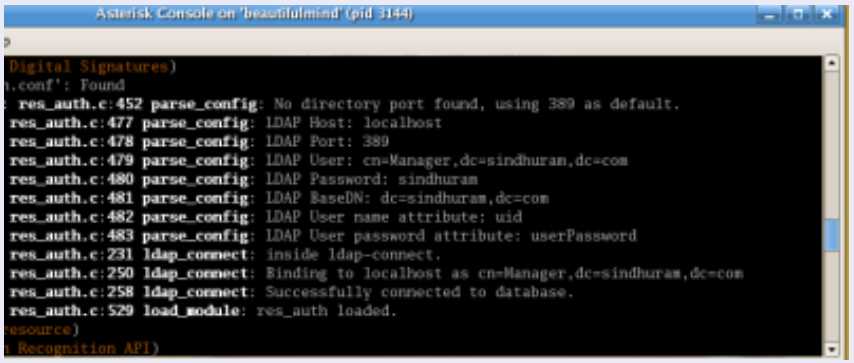
Sequence Diagram



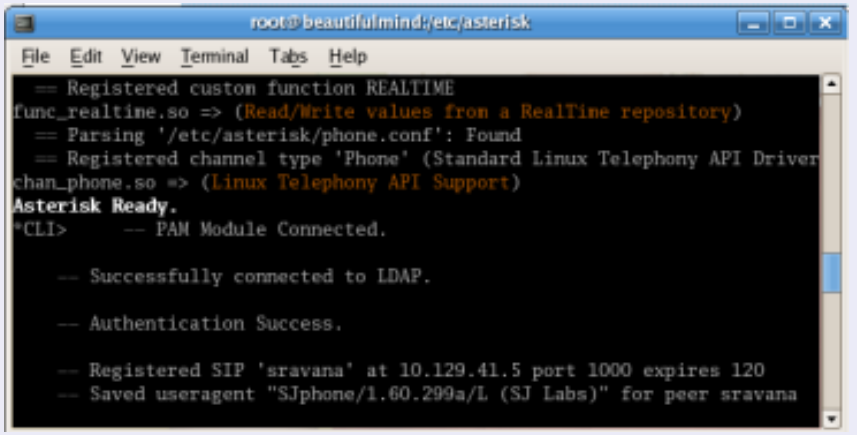
Implementation

- *load_module()*: loads *auth.conf*
- *parse_config()*: parse the *auth.conf*
- *ldap_connect()*: connects to LDAP server
- *ast_parse_secret()*: parse the secret string for Asterisk
- *get_ldap_password()*: finds the the LDAP password for the user
- *check_auth*: check the authentication with user information

Asterisk connects LDAP



User Registration with LDAP



Conclusion

- Proposed a affordable Gateway PBX with inexpensive devices.
- Configured Asterisk to authenticate with LDAP server.

Future work

- Need to do hardware implemention for Gateway PBX.

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Thank You