Building an embedded VoIP network for video intercom systems
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Speaker presentation

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Building an embedded VoIP network for video intercom systems

Agenda

- Video intercom uses cases.
- Introduction to SIP VoIP technologies.
- Building a VoIP network on Raspberry pi using Linphone’s softwares.
- What’s next.
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Simple use case
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Door entry camera

Simple analog solution
Building an embedded VoIP network for video intercom systems

Multiple displays use case
Building an embedded VoIP network for video intercom systems

Simple analog solution no longer works
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Display everywhere
Building an embedded VoIP network for video intercom systems

Door entry camera

Digital infrastructure

Internet

Home screen

linphone open source VOIP project
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Door entry camera

VOIP(SIP/RTP)

Home screen

Leveraging on VoIP technologies

Internet
VoIP technologies

- Based on 2 main IETF standards
  - Session Initiation Protocol (RFC3261)
  - Real Time Transport (rfc3550)
SIP RFC3261 in short

• Transaction based text protocol standardized in early 2000 inspired by HTTP.
• Main components are:
  • SIP user agents for client part initiating or receiving calls.
  • SIP proxies for message routing.
RTP RFC3550 in short
• UDP based protocol to exchange media stream in a packetized way.
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Typical software architecture
Hardware Requirements

- Door entry camera should be able to capture video and capture/playback audio.
- Home screen should be able to display video and capture/playback audio.
Software requirements

- Door entry camera running Linphone SIP/RTP User Agent on Gnu/Linux.
- Home screen running Linphone SIP/RTP user agent on Gnu/Linux,
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Door entry camera

SIP/RTP connection

Home screen

SIP user-agent

debian

Typical software/hardware architecture
• Command line front end controlled by a Unix pipe with *Early Media Feature*.
• Command example:

```plaintext
call sip:homescreen@myhouse
```
Early Media ???

• For a regular call, audio/video only start after caller has accepted the call.
• Early media is way to start audio and video exchange before caller call pick up.
• Early Media is used to send **half way** video preview from door entry camera to an home screen.
Linphone-daemon:

- Source code: https://gitlab.linphone.org/BC/public/linphone-sdk
Linphone-daemon controlled by a Python script

```python
#!/usr/bin/python
import socket
import time
from gpiozero import Button

def call_out():
    s = socket.socket(socket.AF_UNIX)
    s.connect("/tmp/doorbell")
    s.send("call sip:homescreeen@myhouse")
    print(s.recv(8192))
    s.close()

button = Button(4)
button.when_pressed = call_out
while True:
    time.sleep(1)
```

Linphone-daemon control
pi@home-screen> linphone-daemon -D --auto-answer &

• Display on + auto-answer.

Linphone-deamon in the home screen
Multiple displays use case
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Door entry camera

![Diagram](attachment:image.png)

Home screen

Multi display use case requires a SIP Proxy

Linphone based app
Flexisip SIP Proxy with Early Media Call Forking.

- Source code: https://gitlab.linphone.org/BC/public/flexisip
- Documentation: http://www.linphone.org/technical-corner/flexisip
- Yocto packaging
Early media call forking???

- Early Media is used to send video preview from door entry camera to the home screen.
- Video previous should be delivered to all ringing devices (I.E home screen and smartphone app)
- Early media call forking is about sending video previous packets from call initiator to all ringing devices.
Flexisip configuration

- A text base configuration file /etc/flexisip/flexisip.conf
- Enable authentication for sip domain *myhouse*:
  
  ```
  [module::Authentication]
  enabled=true
  auth-domains=myhouse
  db-implementation=file
data-source=/etc/flexisip/passwd
  ```

- Enabling SIP registrar for domain myhouse
  
  ```
  [module::Registrar]
  reg-domains=myhouse
  ```

- Password file /etc/flexisip/passwd
  
  ```
  version:1
  homescreen@myhouse clrtxt:secret ;
alice@myhouse clrtxt:secret ;
  ```

- pi@home-screen> flexisip -c /etc/flexisip/flexisip.conf

Flexisip SIP proxy in the home screen
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SIP call flow with early media call forking

- Door entry camera
- Home screen SIP proxy
- Smartphone app
- Home screen

INVITE(homescreen) → INVITE(homescreen) → INVITE(homescreen)

183 → 183 → 183

video RTP (send only) → video RTP (send only) → video RTP (send only)

REGISTER 401 → REGISTER 200

REGISTER 401 → REGISTER 200

REGISTER 401 → REGISTER 200

REGISTER 401 → REGISTER 200
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Door entry camera

SIP user-agent

SIP/RTCP connection

SIP Proxy

SIP UA

Mobile app connected to public Internet

Linphone based app
Flexisip SIP Proxy with Early Media Call Forking and Static Route.

- Definition of a broadcast sip uri
  
  `sip:sip:everyone@myhouse` targeting `sip:homescreen@myhouse` and `sip:bob@sip.linphone.org`

- Definition of static route in `/etc/flexisip/flexisip.conf`

```yaml
[module::Registrar]
  reg-domains=myhouse
  static-records-file=/etc/flexisip/routes.conf
```

- File `=/etc/flexisip/routes.conf`
  
  `<sip:everyone@myhouse> <sip:homescreen@myhouse>, <sip:bob@sip.linphone.org>`
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SIP call flow with multiple proxies
Security Considerations

- Use SIP TLS/SRTP everywhere.
- Store Flexisip users password in an hashed form.
What else?

- Calling the door entry camera from a smartphone.
  - Possible, but strong security requirements.
- Opening the door from a smartphone
  - Can be done using SIP messages or just DTMF.
- Using mdns to discover homescreen
- Push notification to reach mobile apps
  - Flexisip SIP proxy does support both Apple and Android push notification.
- Interworking with existing door entry camera.
  - Many entry door camera providers do support SIP.
- For better control, develop your own application on top of liblinphone instead of Linphone-daemon
Thank you!