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Building an embedded VoIP network for video intercom systems

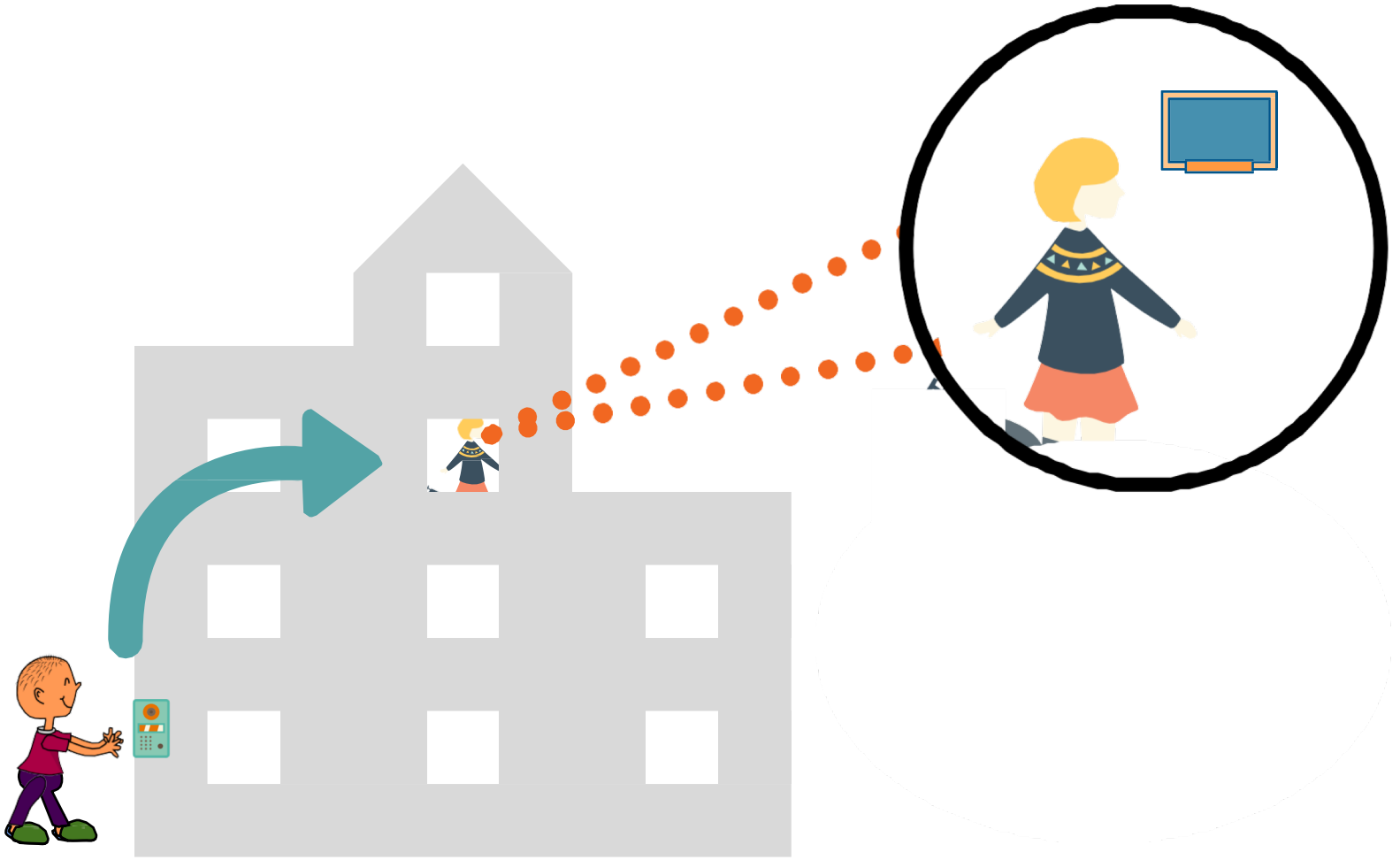
FOSDEM - 2 février 2020

Speaker presentation

Speaker name: Jehan Monnier
Function: Software engineer since 1999
Involved in Linphone's development since 2010.

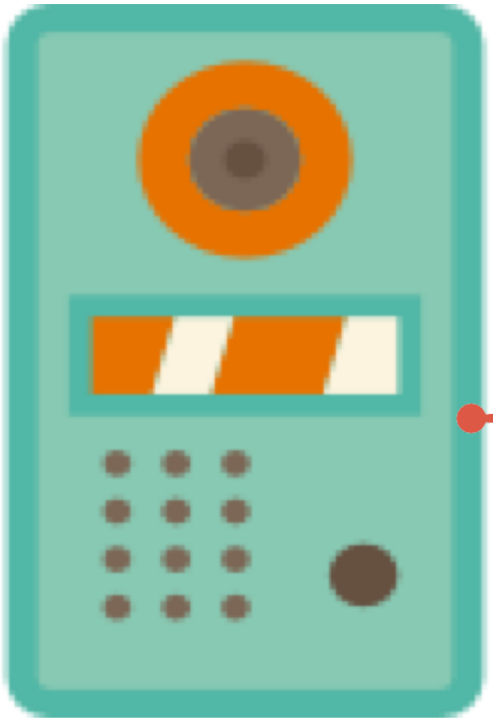
Agenda

- Video intercom uses cases.
- Introduction to SIP VoIP technologies.
- Building a VoIP network on Raspberry pi using Linphone's softwares.
- What's next.

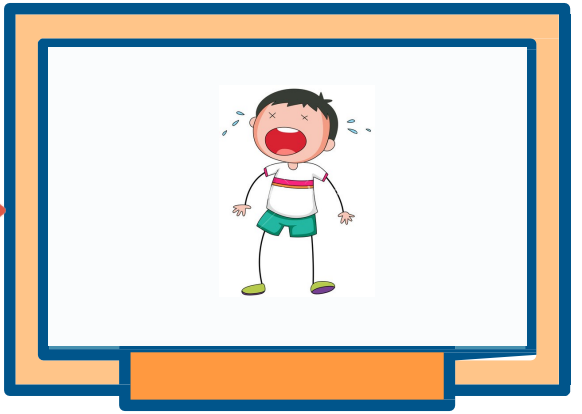


Simple use case

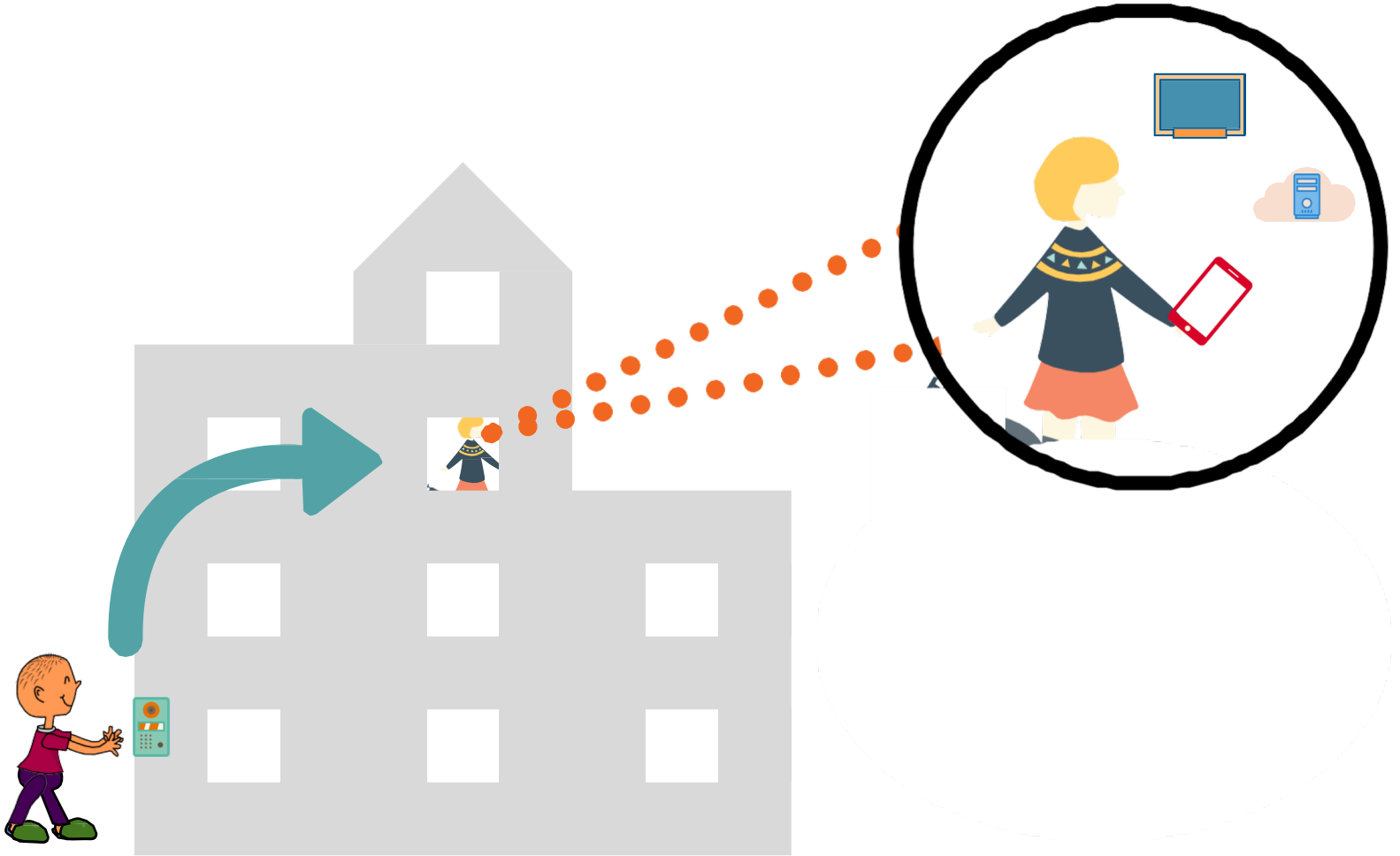
Door entry camera



Home screen



Simple analog solution



Multiple displays use case

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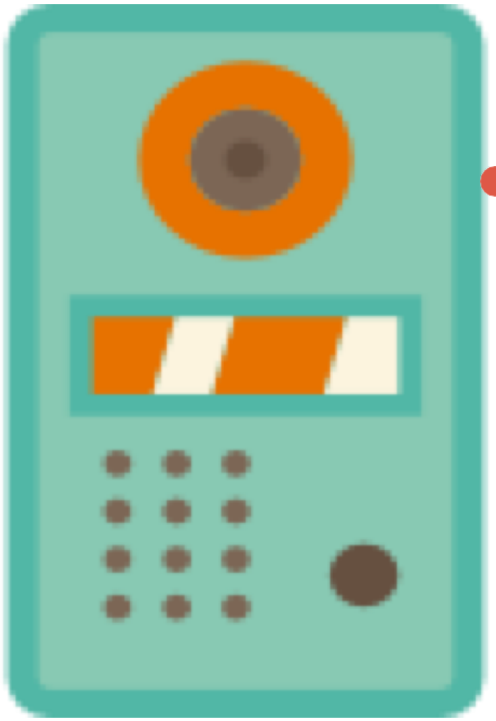
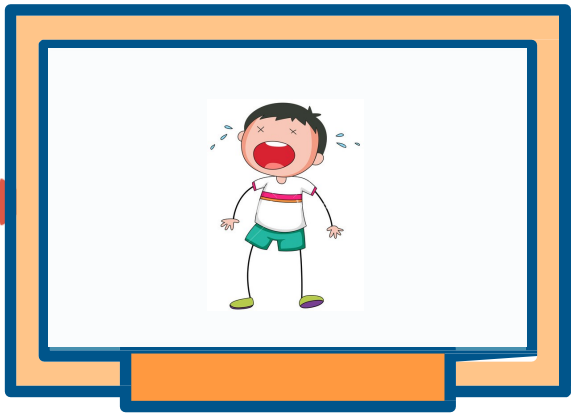
Door entry camera

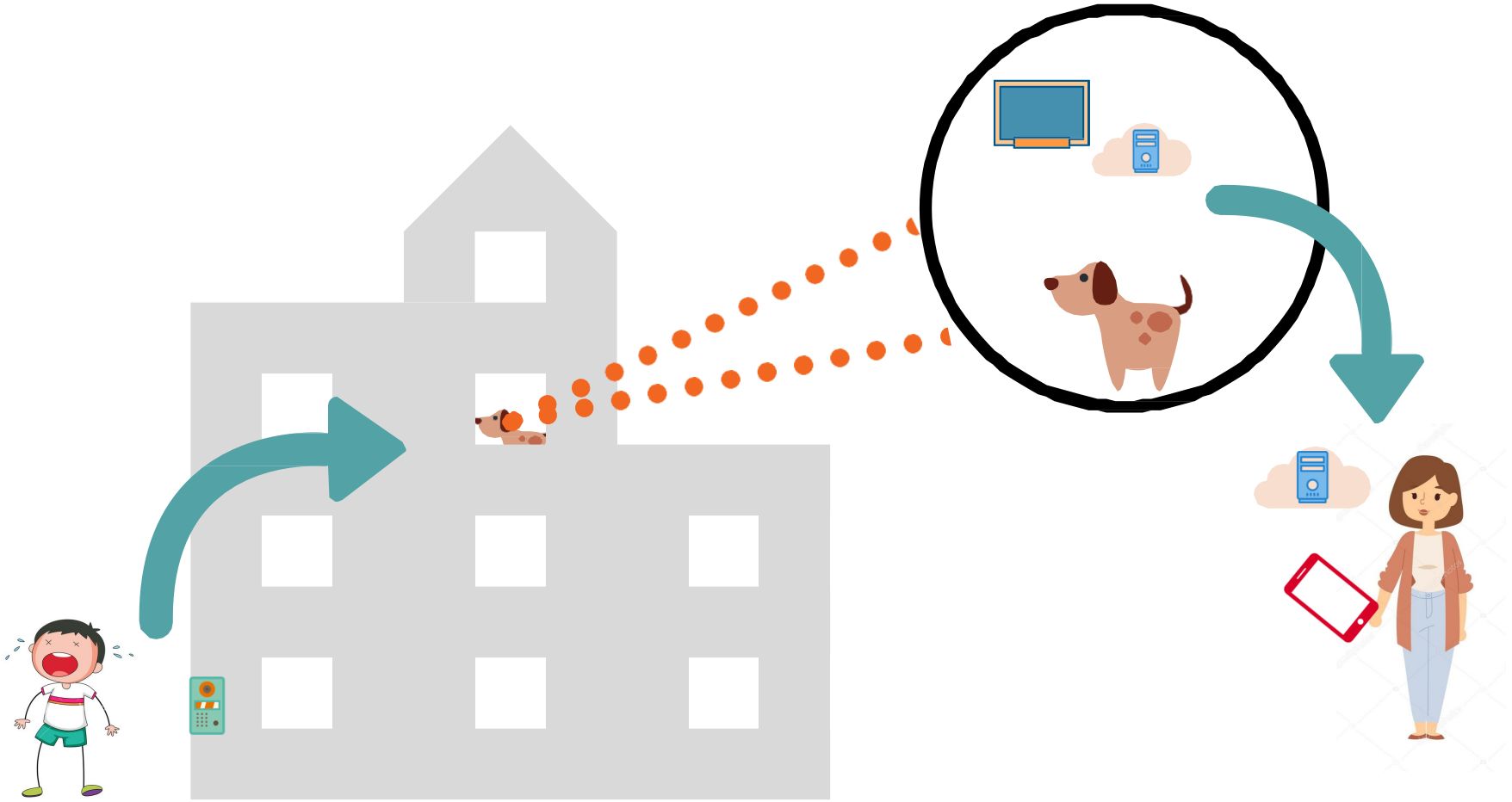


Home screen



???

Simple analog solution no longer works



Display everywhere

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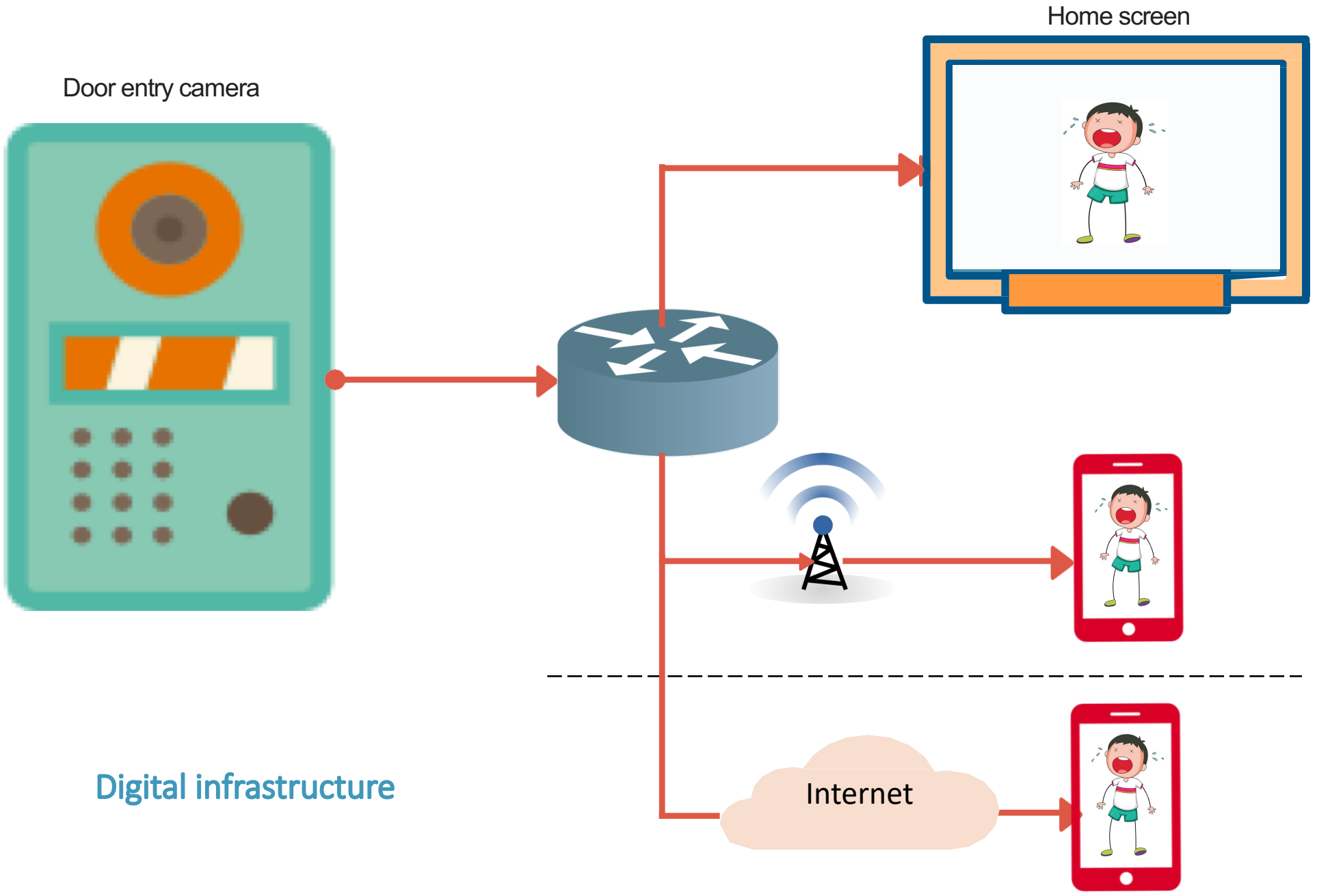

Digital infrastructure

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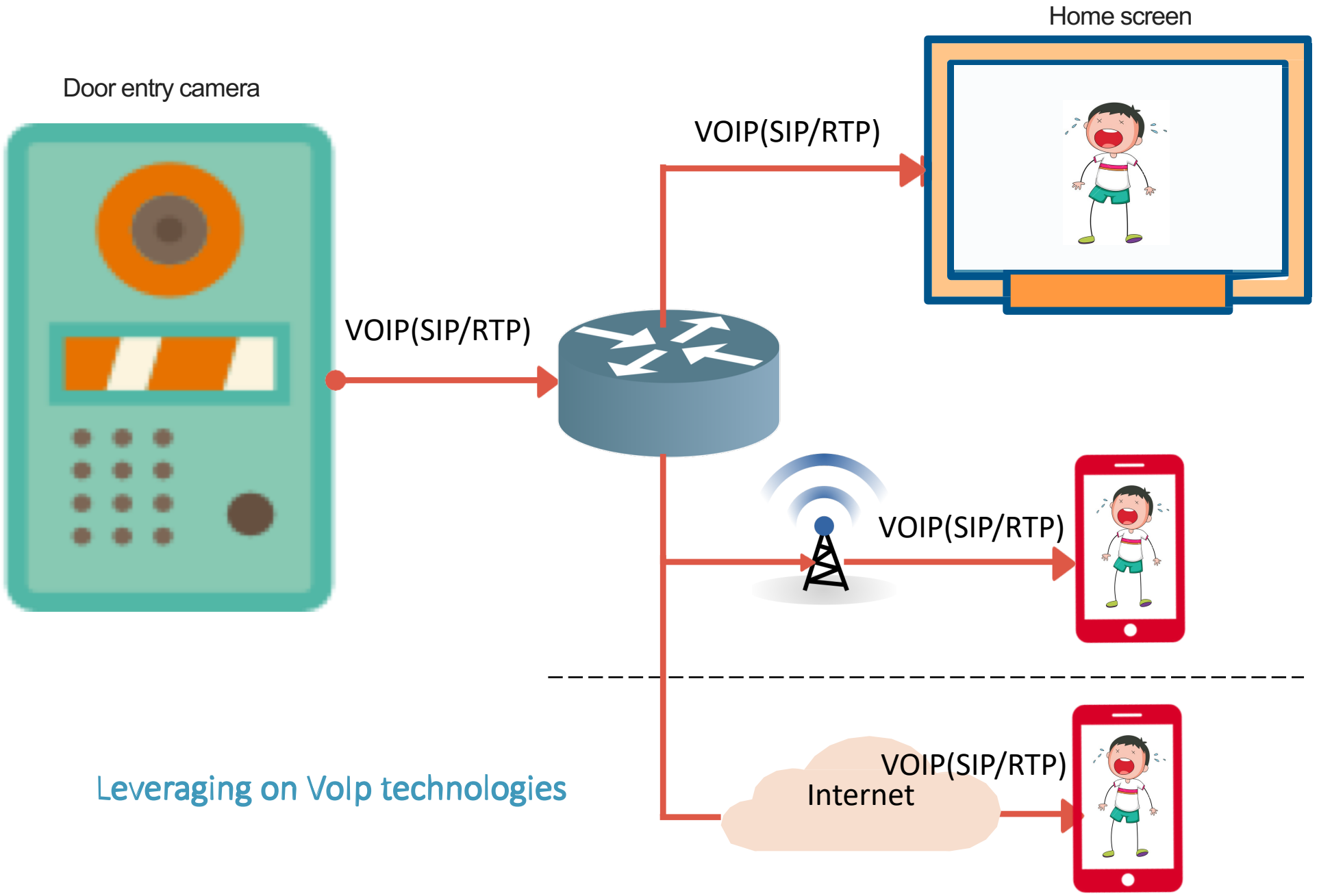


Leveraging on Volp technologies

VoIP technologies

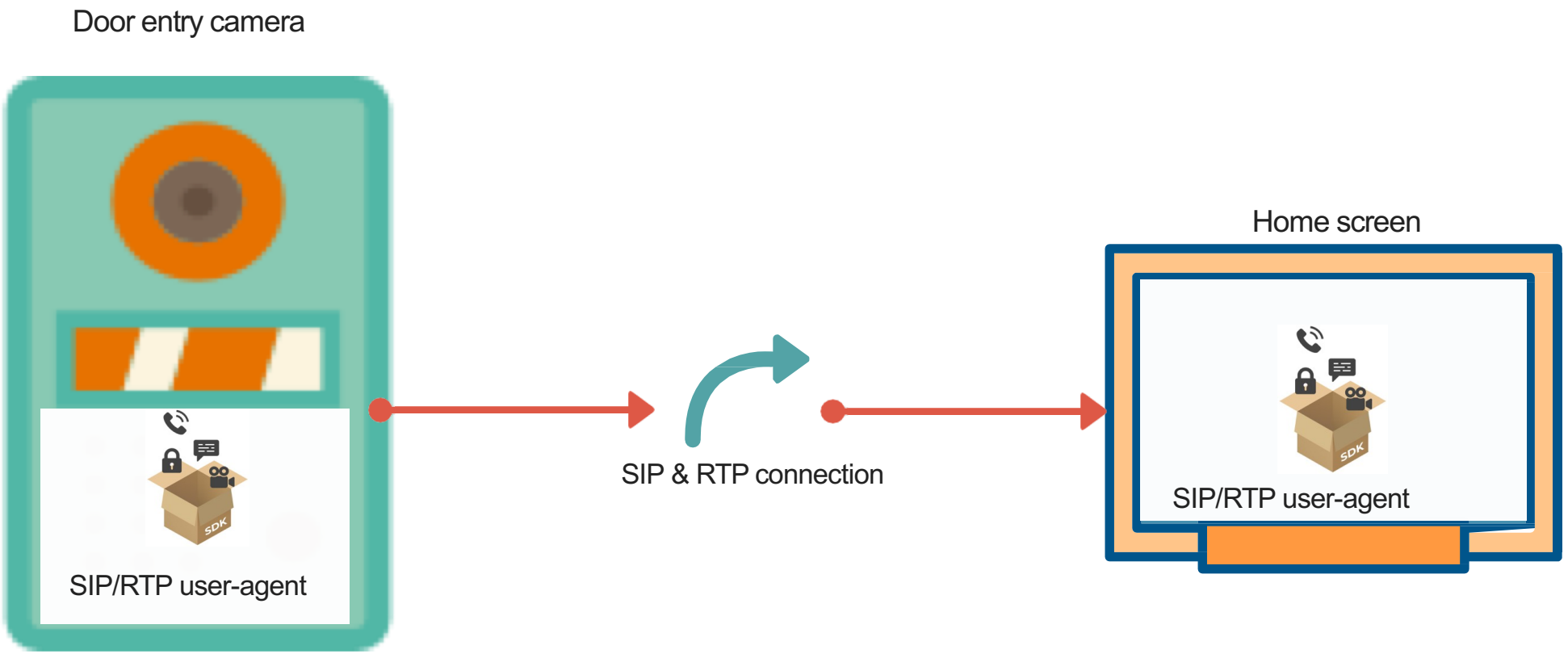
- Based on 2 main IETF standards
  - Session Initiation Protocol (RFC3261)
  - Real Time Transport (rfc3550)

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.



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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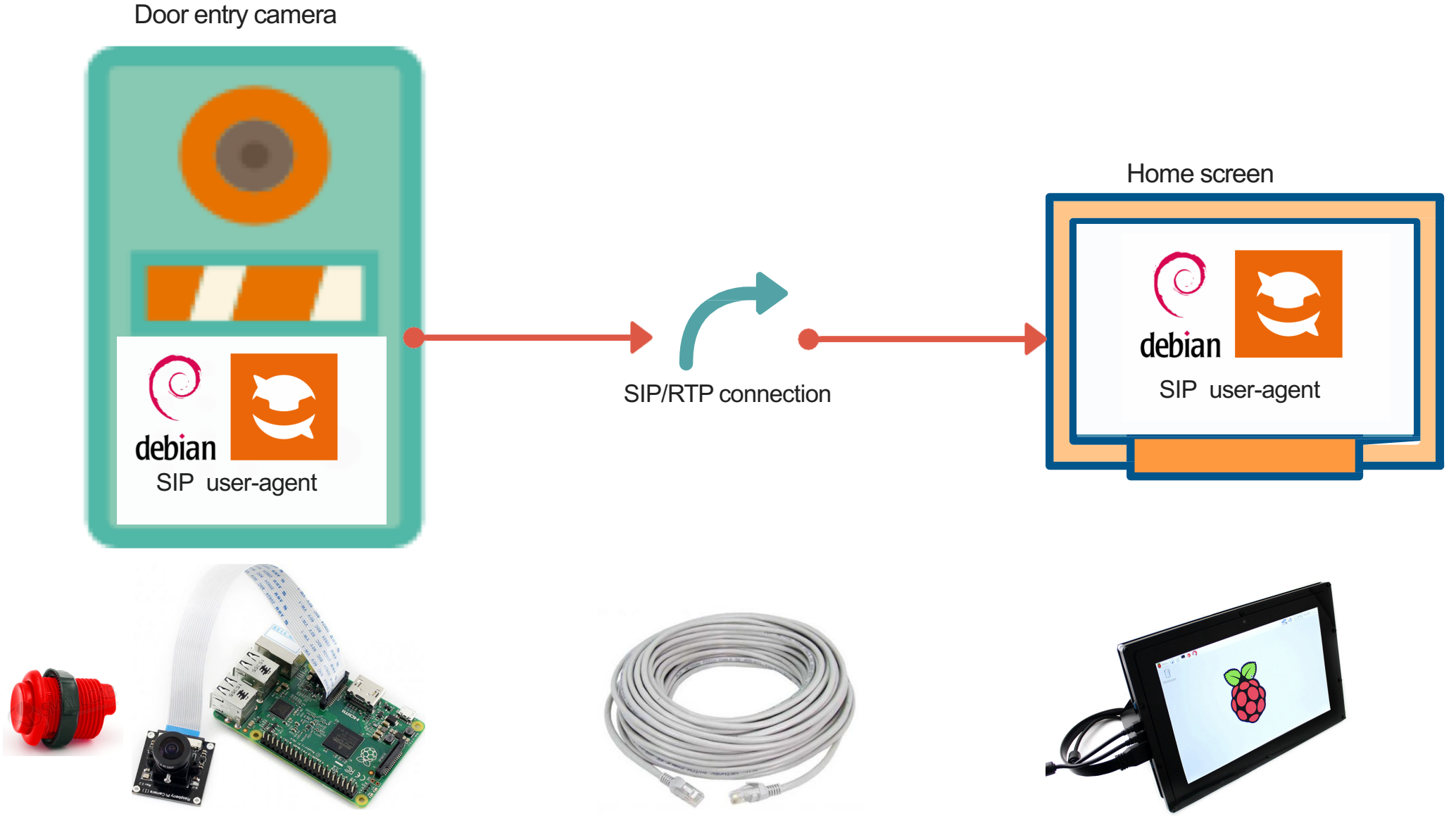
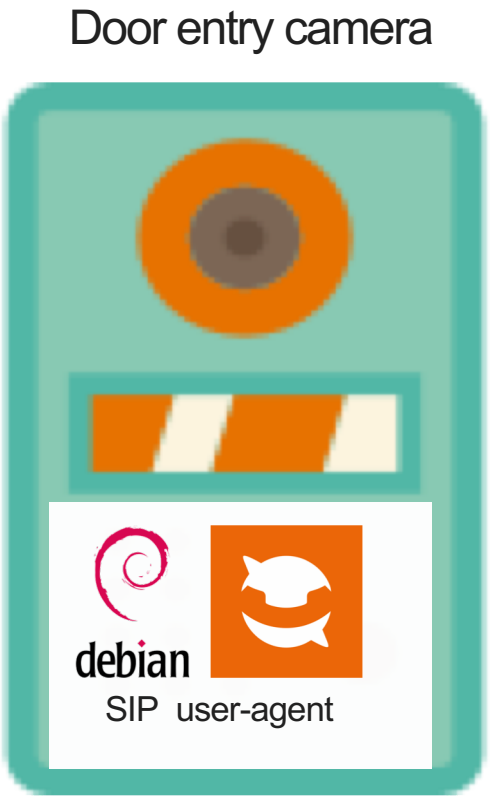


Typical software/hardware architecture



- Command line front end controlled by a Unix pipe with ***Early Media*** *Feature*.
- Command example:

call sip:homescreen@myhouse

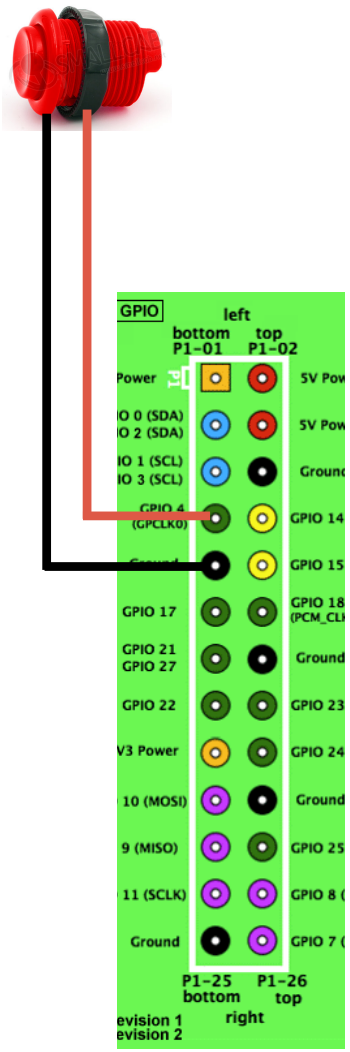
Linphone-deamon in the door entry camera

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
- Yocto packaging https://wiki.linphone.org/xwiki/wiki/public/view/Linphone/Building%20Linphone%20with%20Yocto/



pi@door-entry>linphone-daemon --pipe doorbell –C &

Linphone-daemon controlled by a Python script

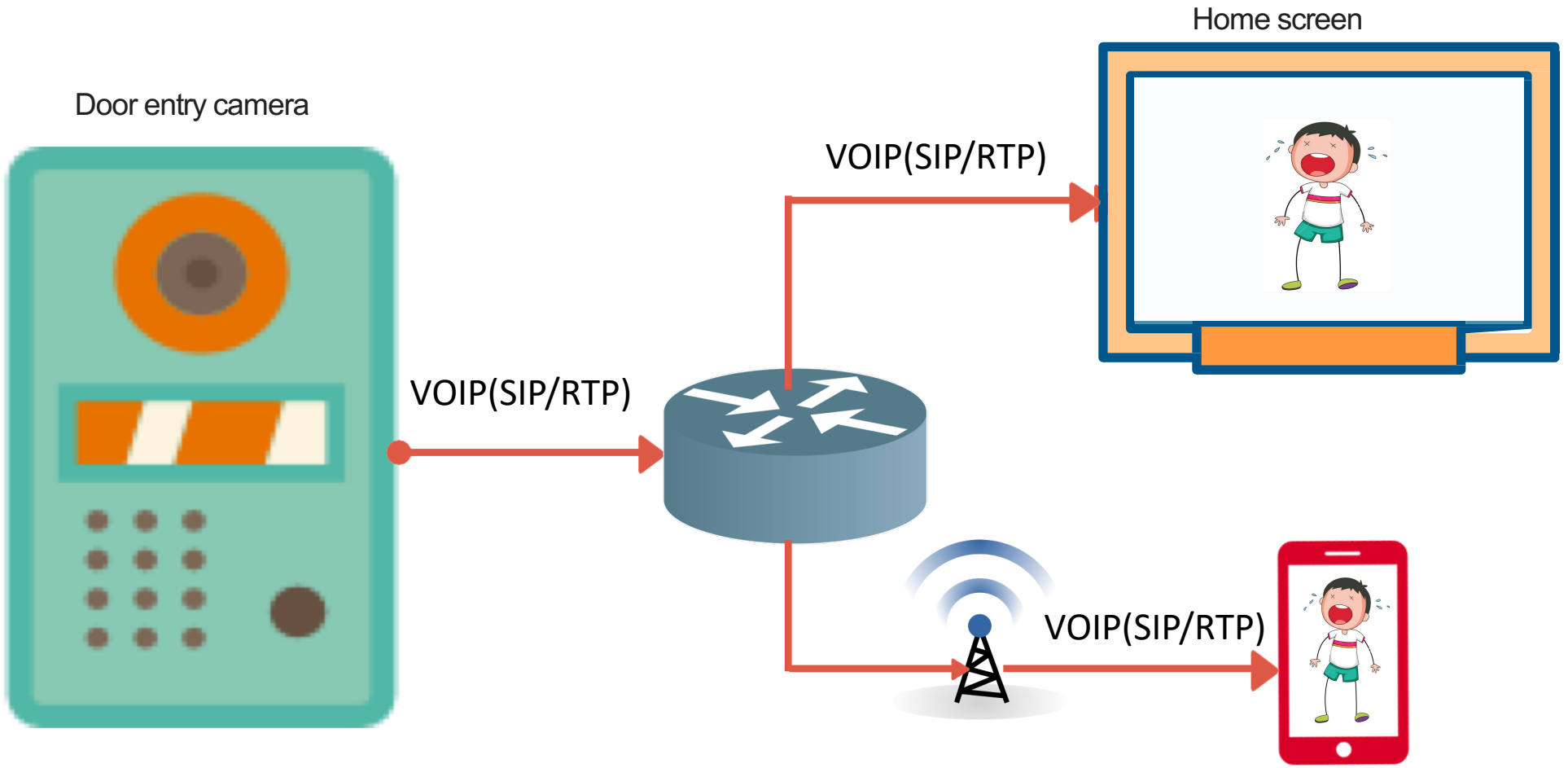
```
#!/usr/bin/python
import socket
import time
from gpiozero import Button

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

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

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

Home screen

- Display on + auto-answer.

Linphone-deamon in the home screen



Multiple displays use case

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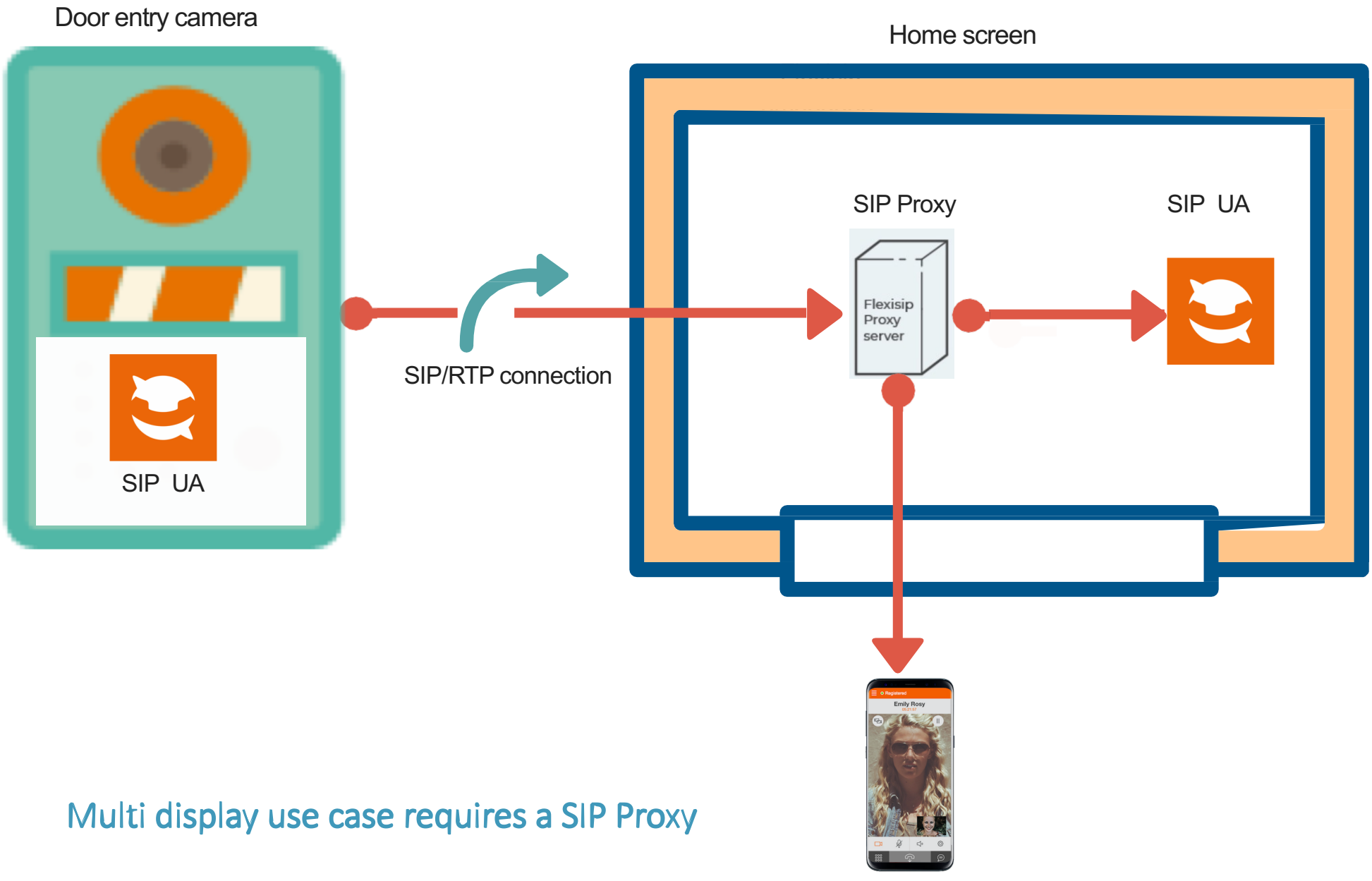


Multi display use case requires a SIP Proxy

Flexisip SIP Proxy with Early Media Call Forking.

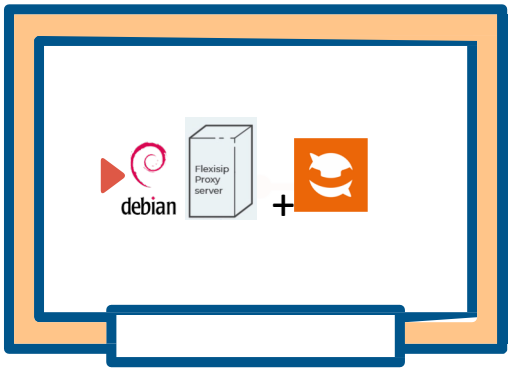
- Source code:

https://gitlab.linphone.org/BC/public/flexisip

- Documentation:
  http://www.linphone.org/technical-corner/flexisip
- Yocto packaging
  https://wiki.linphone.org/xwiki/wiki/public/view/Linphone/Building%20Linphone%20with%20Yocto/

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*:

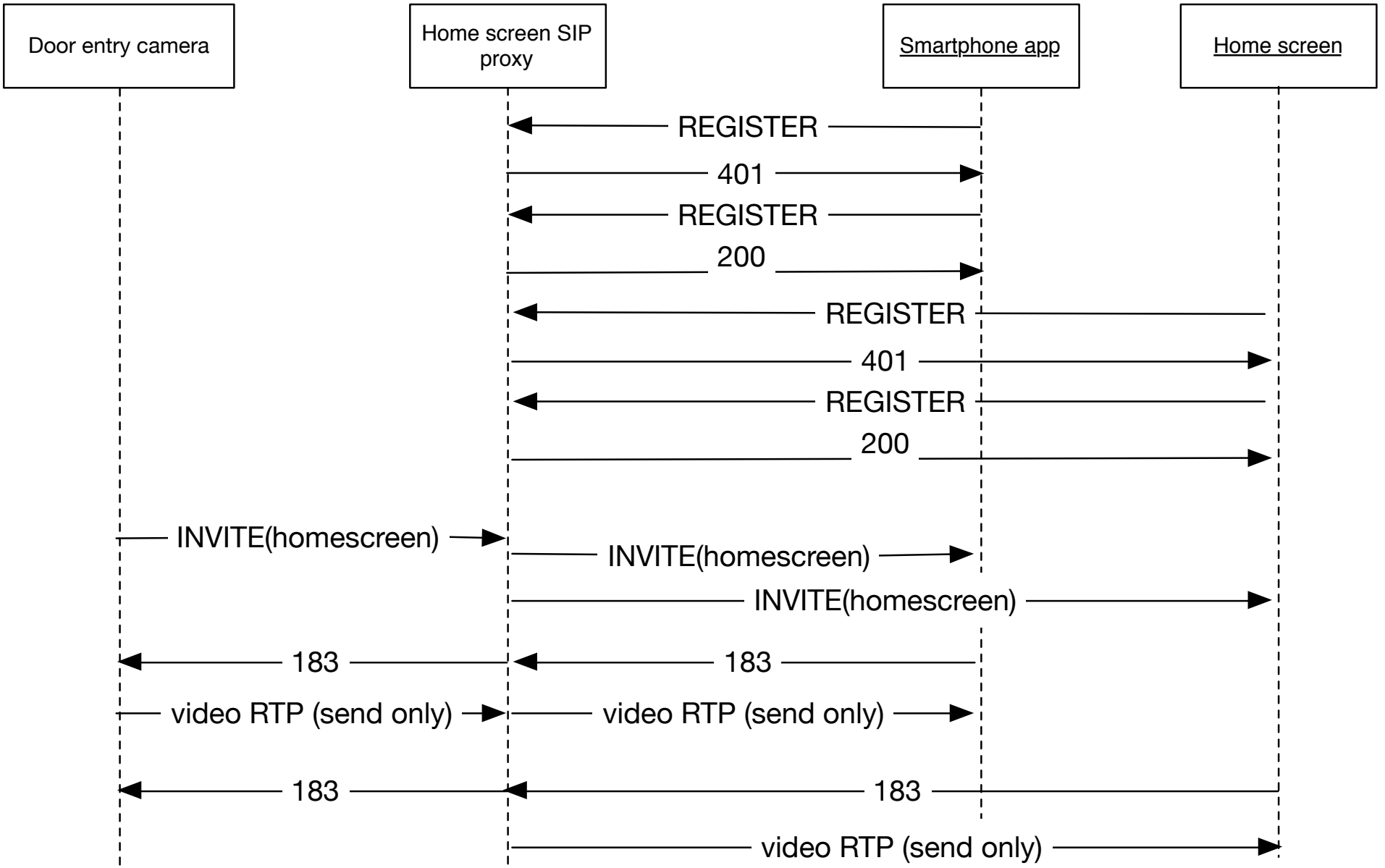
  [module::Authentication]
  enabled=true
  auth-domains=myhouse
  db-implementation=file
  datasource=/etc/flexisip/passwd
- Enabling SIP registrar for domain myhouse

  [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



SIP call flow with early media call forking

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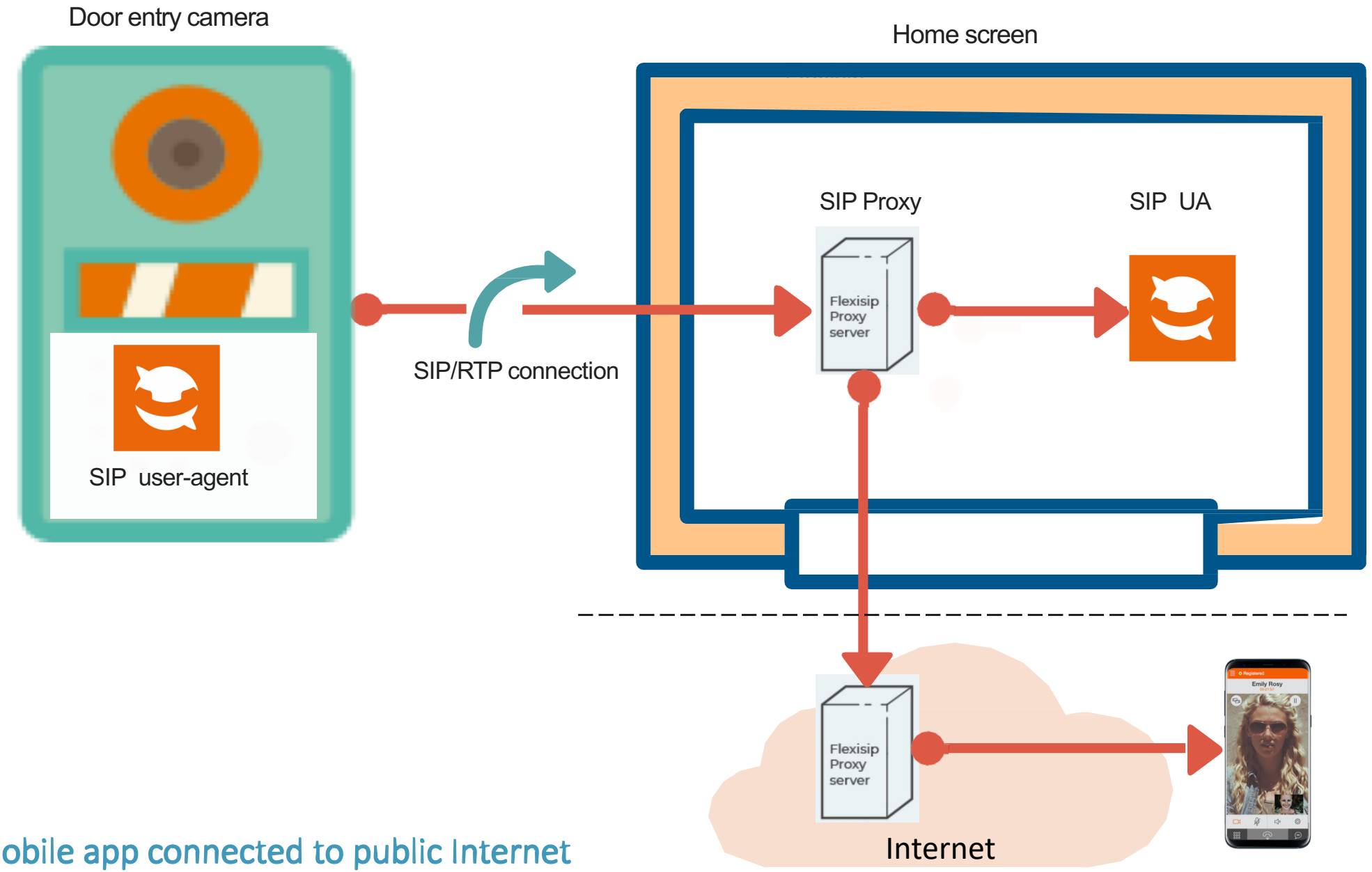

Mobile app connected to public Internet

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

[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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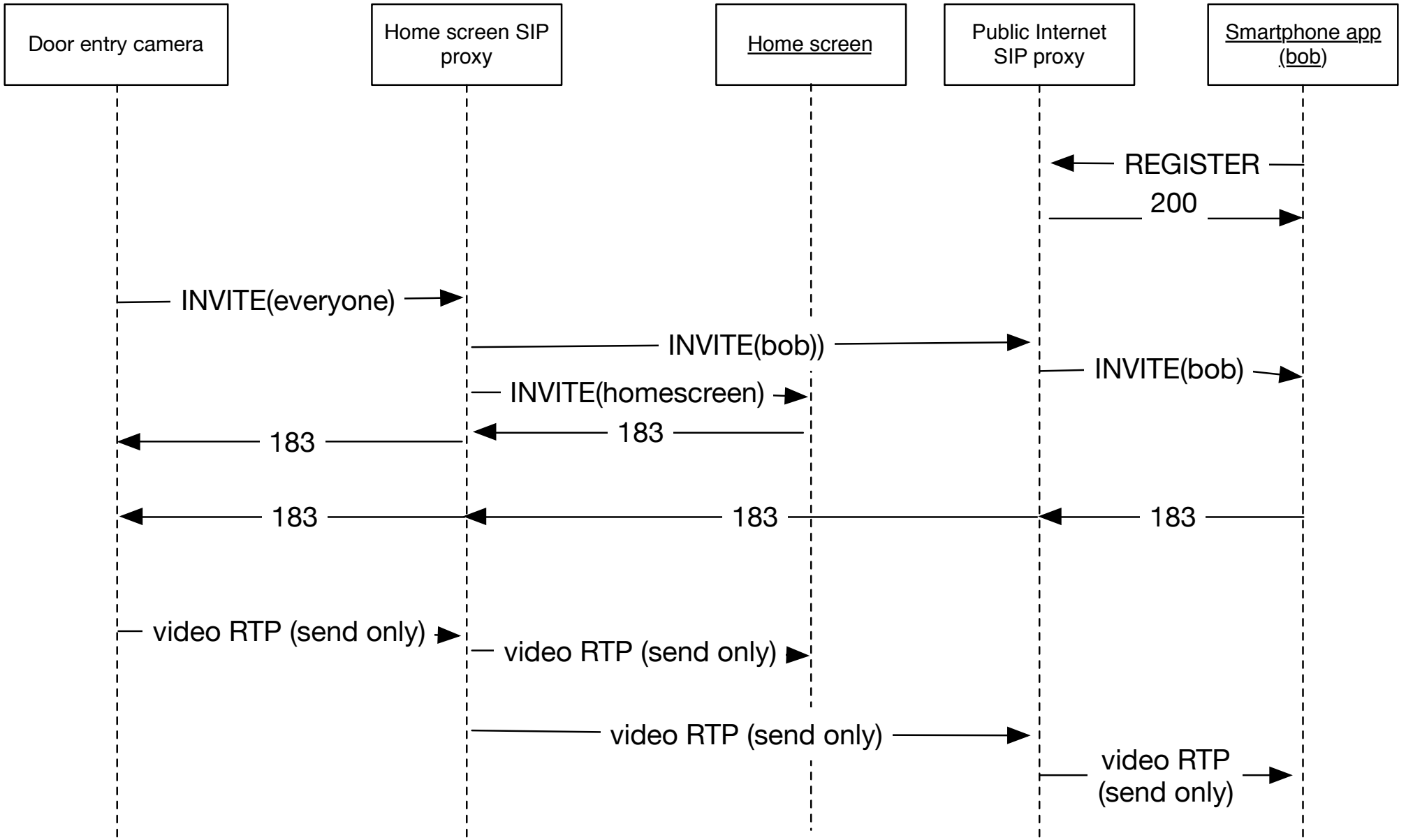

SIP call flow with multiple proxies

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
  - https://www.linphone.org/news/sip-network-deployment-made-easy-thanks-mdns
- 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 !