



# The Design and Implementation of an Audio Recording Service in Push-to-Talk (PTT) Systems

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# 1 功能及架構

# Push-to-talk(一按通服務)

早期的無線電對講機功能類似

同一時間僅能有一人發話，以確保關鍵任務時的通話效率

以網路協定完成通話

## \*Multicast Push-to-talk

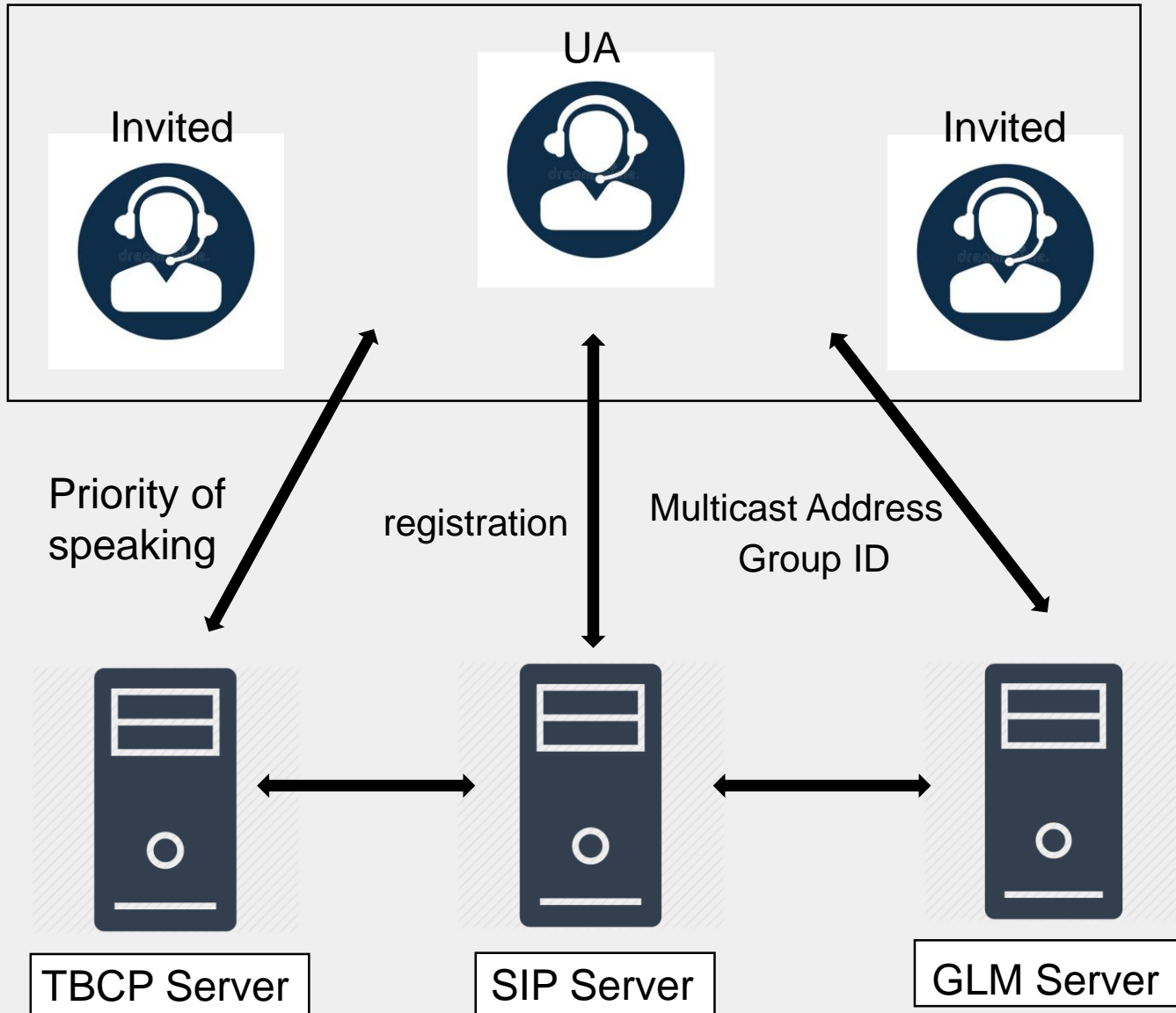
以往的Push-to-talk系統皆是由server收送封包  
(server 收到封包後複製發送給其他UA)

效率較差

Multicast Push-to-talk 會先將要通話的UA邀請至同一群組內，再由IPv6 Multicast 方式一次發送封包

伺服器負擔小

# 簡易流程圖



## User Agent

- Receive Call
- Register itself to server
- Audio Recording



Talk Burst Control Protocol

Group List Management

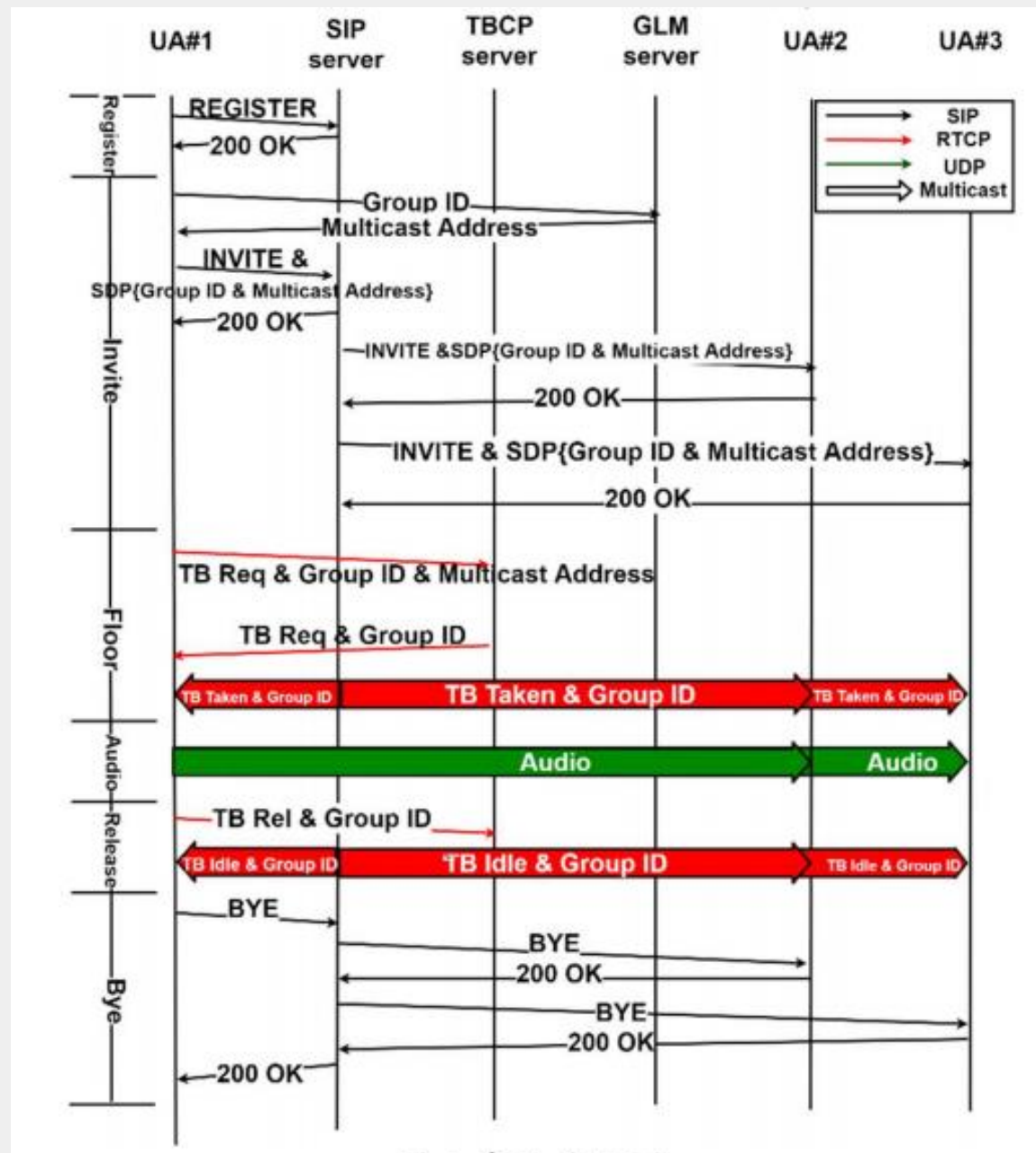
## 詳細流程圖

UA 會先向SIP Server註冊帳號

再由GLM Server 配給 Group ID 和 Address

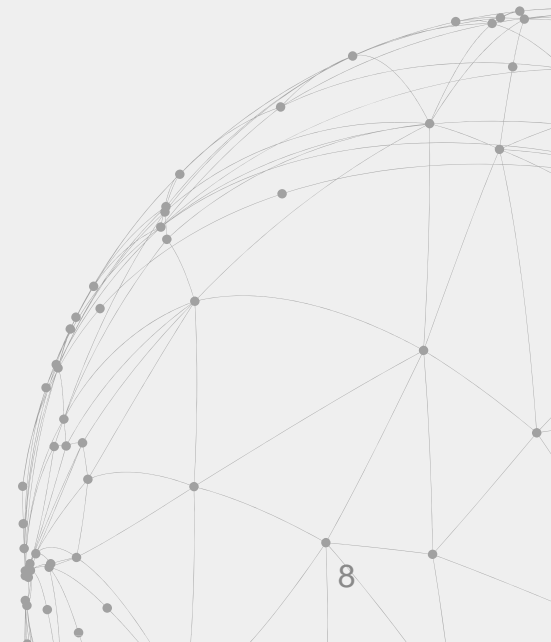
便可邀請已註冊在SIP Server 上的其他UA

群組通話建立後，TBCP Server 會控制發話優先權



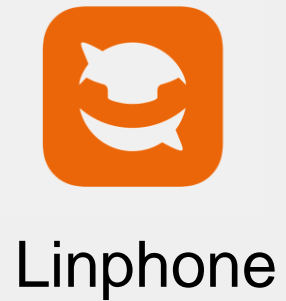
# Protocols in SIP(Session Initiation Protocol) Phone

- Application Layer : SIP SDP(Session Description Protocol)
- Transport Layer : UDP(User Datagram Protocol)  
TCP(Transmission Control Protocol)  
RTP(Real-Time Protocol)
- Network Layer : IPv4 or IPv6



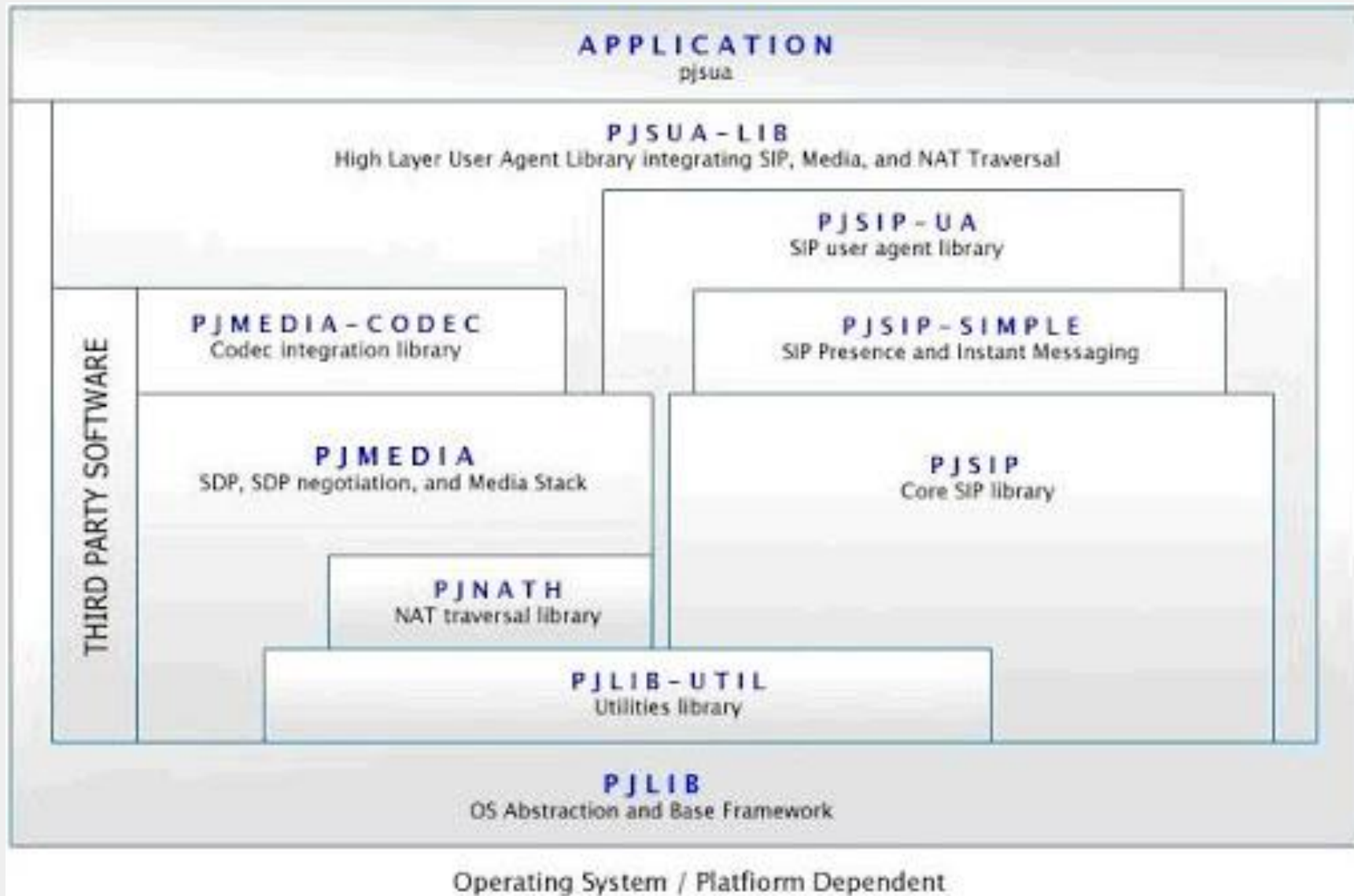


# Environment and tools





# PJSIP 架構



# 錄音功能分析

## Approach I

<pcap.h>

Sniff packets from network interface card

Set filter (packets , host , port)

<pjsua.h>

Save packets into pcap file

Convert pcap file into wav file or other types of audio file

# 錄音功能分析

## Approach II

<pjsua.h>

Get sound device info from local endpoint (microphone)

Create and connect sound device port and write-in port

Connect caller's port and recorder

音訊的傳輸皆可透過PJSIP的會議橋進行

# 會議橋

以下音訊流皆有自己專屬的 port 可以與相應的功能做連結，也就是建立一個溝通的橋樑。

響鈴

麥克風

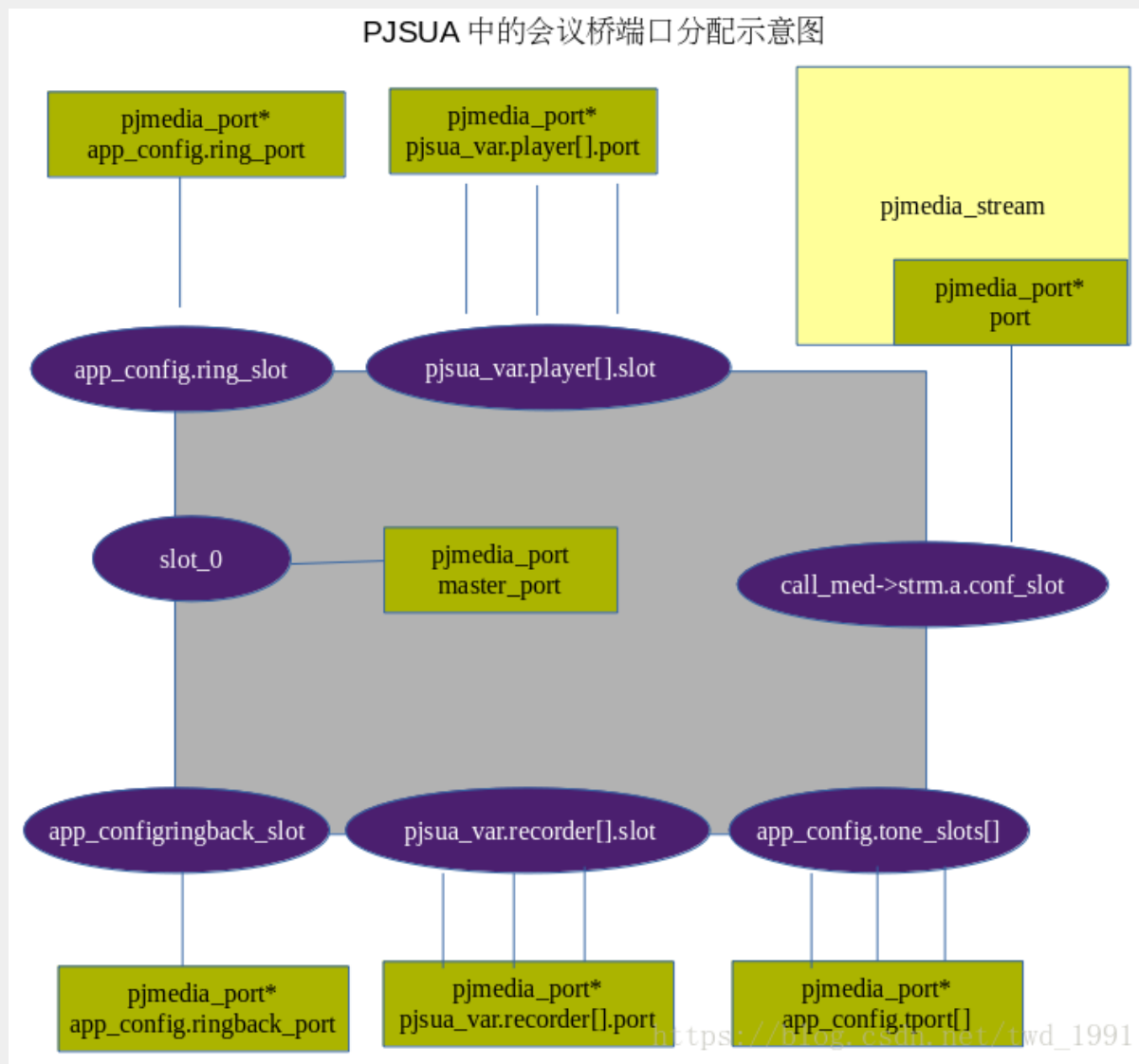
撥放器

錄音機

通話道

撥號

例如將通話道與錄音機連結，便可開始錄音

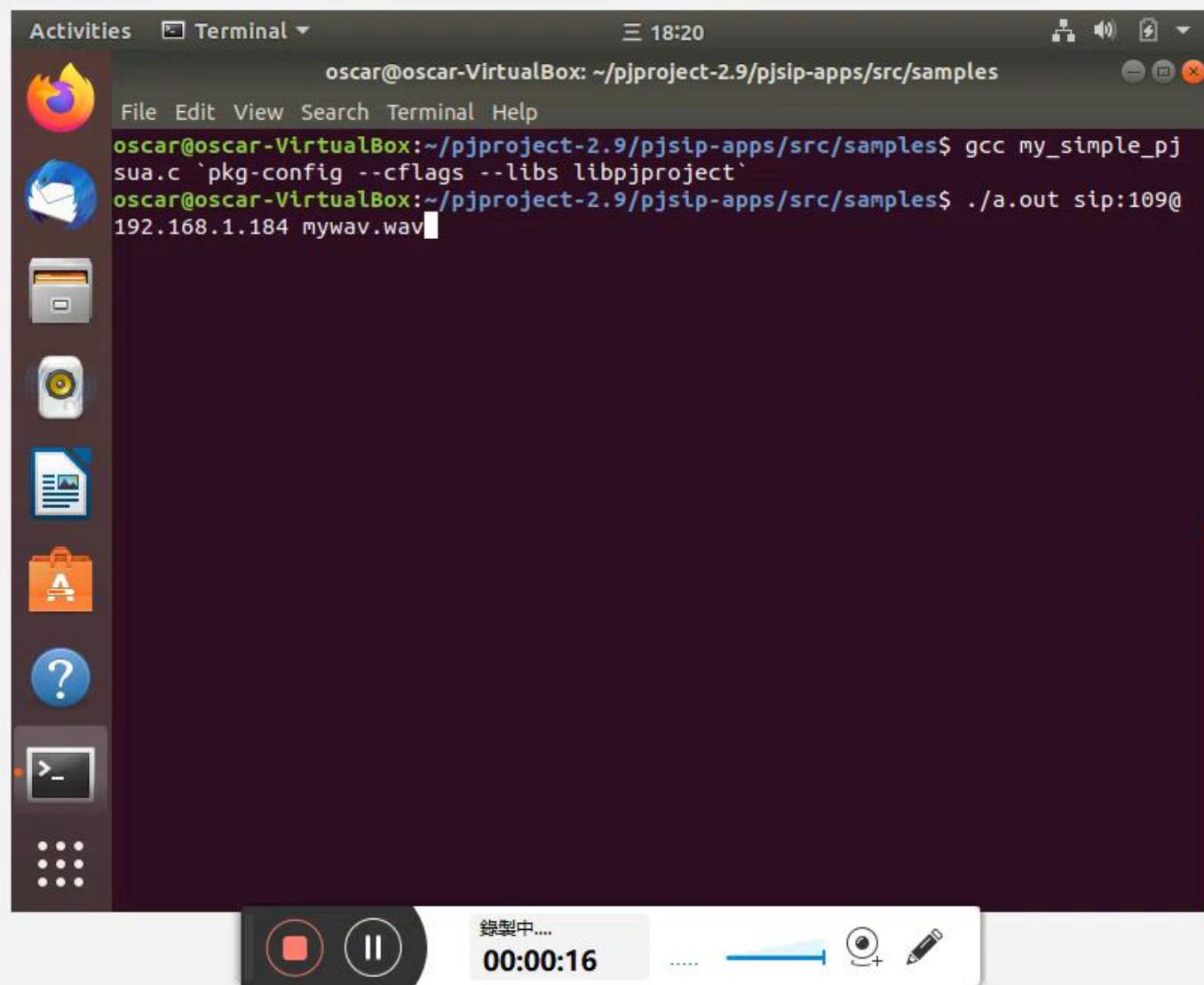


Demo

# Phone to PC

以Linphone作為手機的用戶(已註冊在SIP server)與 PC端的 UA程式互通網路電話，可以在命名想要儲存的wav檔名稱，若沒有命名則以按下錄音的時刻作為檔名儲存<Time.h>





```
oscar@oscar-VirtualBox: ~/pjproject-2.9/pjsip-apps/src/samples
File Edit View Search Terminal Help
oscar@oscar-VirtualBox:~/pjproject-2.9/pjsip-apps/src/samples$ gcc my_simple_pj
sua.c `pkg-config --cflags --libs libpjproject`
oscar@oscar-VirtualBox:~/pjproject-2.9/pjsip-apps/src/samples$ ./a.out sip:109@
192.168.1.184 mywav.wav
```

錄影中...  
00:00:16

# PC to PC

兩隻UA程式互相撥通，與Phone to PC 同理

```

oscar@oscar-VirtualBox: ~/pjproject-2.9/pjsip-apps/src/samples
File Edit View Search Terminal Help

oscar@oscar-VirtualBox:~/pjproject-2.9/pjsip-apps/src/samples$ cat my_simple_pjsua.c
/* $Id: simple_pjsua.c 3553 2011-05-05 06:14:19Z nanang $ */
/*
 * Copyright (C) 2008-2011 Teluu Inc. (http://www.teluu.com)
 * Copyright (C) 2003-2008 Benny Prijono <benny@prijono.org>
 *
 * This program is free software; you can redistribute it and/or modify
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 * the Free Software Foundation; either version 2 of the License, or
 * (at your option) any later version.
 *
 * This program is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with this program; if not, write to the Free Software
 * Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307 USA
 */

/**
 * simple_pjsua.c
 *
 * This is a very simple but fully featured SIP user agent, with the
 * following capabilities:
 * - SIP registration

```

```

oscar@oscar-VirtualBox: ~/pjproject-2.9/pjsip-apps/src/samples
File Edit View Search Terminal Help

oscar@oscar-VirtualBox:~/pjproject-2.9/pjsip-apps/src/samples$ cat simple_pjsua.c
/* $Id$ */
/*
 * Copyright (C) 2008-2011 Teluu Inc. (http://www.teluu.com)
 * Copyright (C) 2003-2008 Benny Prijono <benny@prijono.org>
 *
 * This program is free software; you can redistribute it and/or modify
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 *
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 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with this program; if not, write to the Free Software
 * Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307 USA
 */

/**
 * simple_pjsua.c
 *
 * This is a very simple but fully featured SIP user agent, with the
 * following capabilities:
 * - SIP registration

```

錄影中.... 00:00:00

# Wireshark 封包

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.137.121	192.168.1.184	SIP/SDP	1337	Status: 200 Ok
2	0.010134	192.168.1.184	192.168.137.121	SIP	736	Request: ACK sip:109@192.168.1.112:61449;transport=udp;ap...
3	0.012099	192.168.1.184	192.168.137.121	SIP/SDP	1227	Request: UPDATE sip:109@192.168.1.112:61449;transport=udp...
4	0.058202	192.168.137.121	192.168.1.184	STUN	62	Binding Request
5	0.058203	192.168.137.121	192.168.1.184	RTCP	62	7079 → 4001 Len=20
6	0.477440	192.168.1.184	192.168.137.121	SIP/SDP	1227	Request: UPDATE sip:109@192.168.1.112:61449;transport=udp...
7	0.510471	192.168.137.121	192.168.1.184	STUN	62	Binding Request
8	0.510471	192.168.137.121	192.168.1.184	RTCP	62	7079 → 4001 Len=20
9	0.517092	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=0, Time=3492746329
10	0.535925	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=1, Time=3492746649
11	0.555378	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=2, Time=3492746969
12	0.576384	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=3, Time=3492747289
13	0.595842	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=4, Time=3492747609
14	0.615906	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=5, Time=3492747929
15	0.635674	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=6, Time=3492748249
16	0.656101	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=7, Time=3492748569
17	0.676487	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=8, Time=3492748889
18	0.696661	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=9, Time=3492749209
19	0.718188	192.168.137.121	192.168.1.184	RTP	114	PT=speex, SSRC=0x5B47B68E, Seq=10, Time=3492749529

程式碼

code



# 2

問題與討論



# 參考資料及來源

# 參考文獻


Pjproject-2.9 compile : <https://blog.csdn.net/dreamInTheWorld/article/details/72049800>

Pjsip API 客戶端通話 : [https://blog.csdn.net/qq\\_27788177/article/details/104675061](https://blog.csdn.net/qq_27788177/article/details/104675061)

Audio file transmission using C : <https://stackoverflow.com/questions/9166998/transmission-of-audio-file-using-c-sockets>

PJSIP 架構圖 : <https://www.elinext.com/blog/using-pjsip-library-in-server-and-client-applications/>





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