

ENSC 833-3: NETWORK PROTOCOLS AND PERFORMANCE

Final Project Presentation
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Implement Session Initiation Protocol (SIP) User Agent Prototype

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Agenda

- SIP Introduction
- Project Scope
- High Level Design
- Limitations
- Future Work
- Reference
- Q&A

SIP Introduction (1/2)

- IETF Signaling protocol (RFC 2543) for establishing real-time calls and conferences over IP
- Work began in 1995
- Authors: Henning G. Schulzrinne, Jonathan D. Rosenberg
- Lightweight - six basic messages

SIP Introduction (2/2)

- Text-based internet protocol resembles HTTP and SMTP
- Uses Session Description Protocol (SDP) for media description
- Transport independent (UDP, TCP, SCTP)
- Client-server protocol
- Not intended to replace H.323

SIP Messages (1/3)

- Invite - invites a user to join a call
- Bye - terminates the call
- Options - requests information on the capabilities of a server
- Ack - confirms that a client has received a final response to an INVITE
- Register - map for address resolution and location lookup
- Cancel - ends pending request

SIP Messages (2/3)

Example: SIP Request

```
INVITE sip:UserB@there.com SIP/2.0
Via: SIP/2.0/UDP here.com:5060
From: BigGuy <sip:UserA@here.com>
To: LittleGuy <sip:UserB@there.com>
Call-ID: 12345601@here.com
CSeq: 1 INVITE
Contact: BigGuy <sip:UserA@here.com>
Content-Type: application/sdp
Content-Length: ...

v=0
o=UserA 2890844526 2890844526 IN IP4 client.here.com
s=Session SDP
c=IN IP4 100.101.102.103
t=3034423619 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000
```

SIP Messages (3/3)

Example: SIP Response

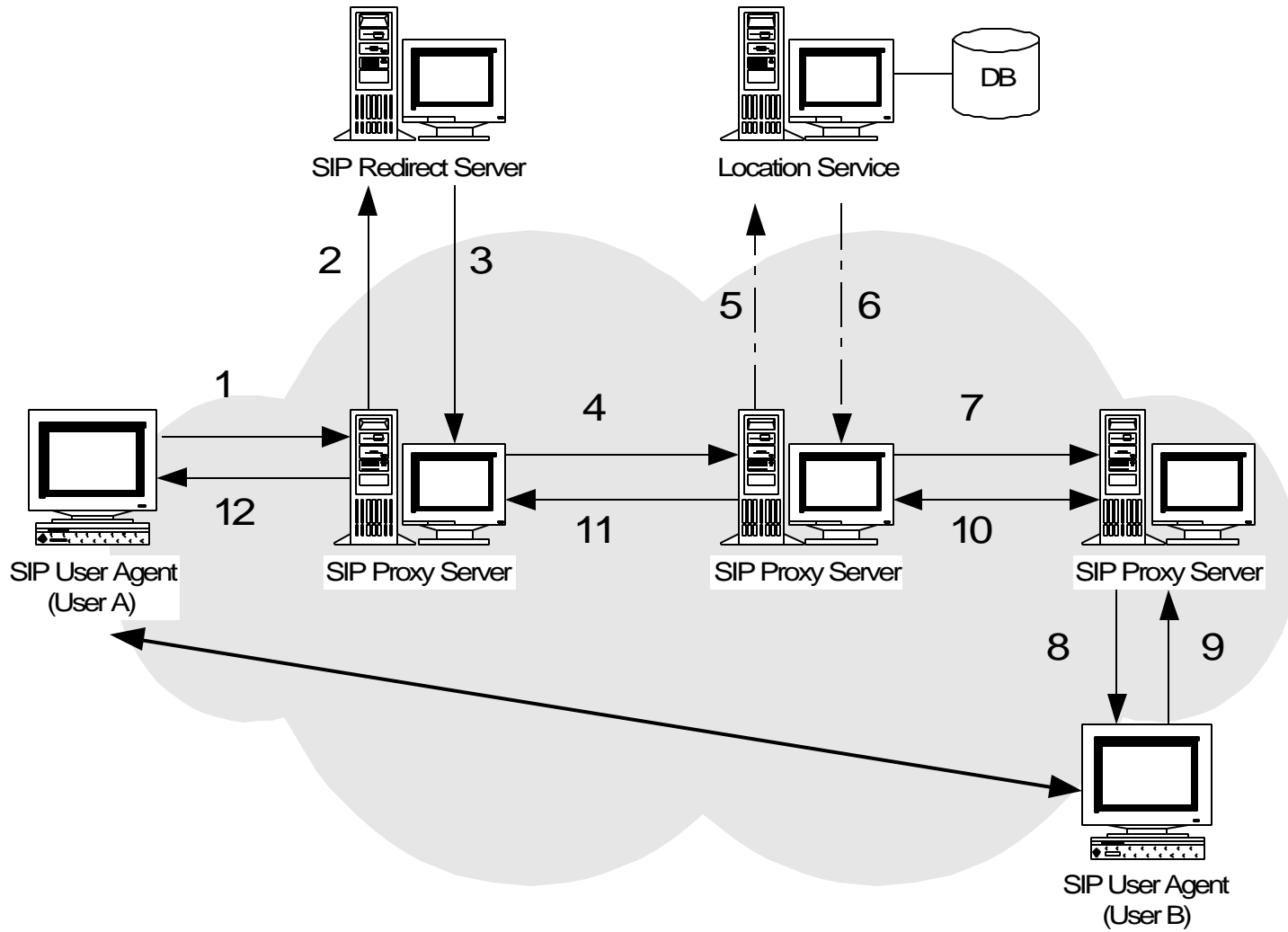
```
SIP/2.0 200 OK
Via: SIP/2.0/UDP here.com:5060
Record-Route: <sip:UserB@there.com;maddr=ss1.wcom.com>
From: BigGuy <sip:UserA@here.com>
To: LittleGuy <sip:UserB@there.com>;tag=314159
Call-ID: 12345601@here.com
CSeq: 1 INVITE
Contact: LittleGuy <sip:UserB@there.com>
Content-Type: application/sdp
Content-Length: ...

v=0
o=UserB 2890844527 2890844527 IN IP4 client.there.com
s=Session SDP
c=IN IP4 110.111.112.113
t=3034423619 0 m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000
```

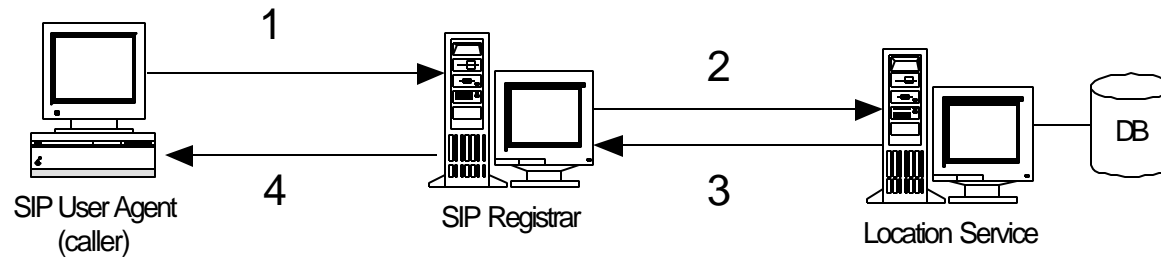
Protocol Components

- User Agent - end system that acts on behalf of someone who wants to participate in calls
 - User Agent Client (UAC)
 - User Agent Server (UAS)
 - peer-to-peer operation
- Network Servers: proxy, redirect
- Registrar

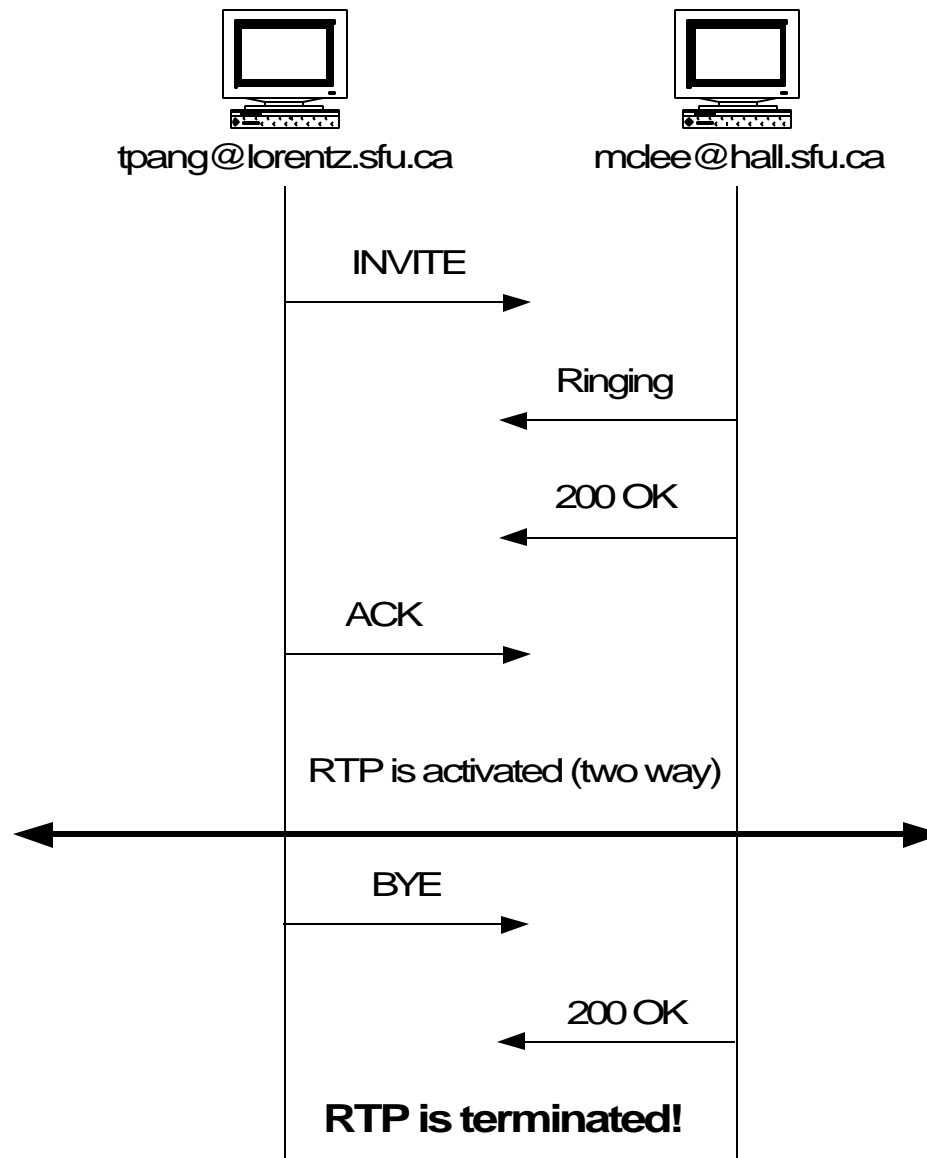
SIP Architecture (1/2)



SIP Architecture (2/2)



Basic Call Message Flow



Project Scope (1/2)

- SIP User Agent (both server and client)
- Supported methods: INVITE, BYE, ACK
- Supported response messages: 200 OK, 180 Ringing, 486 Busy, 400 Bad Request
- Data terminal to data terminal
- One session at a time
- Media type: SDP

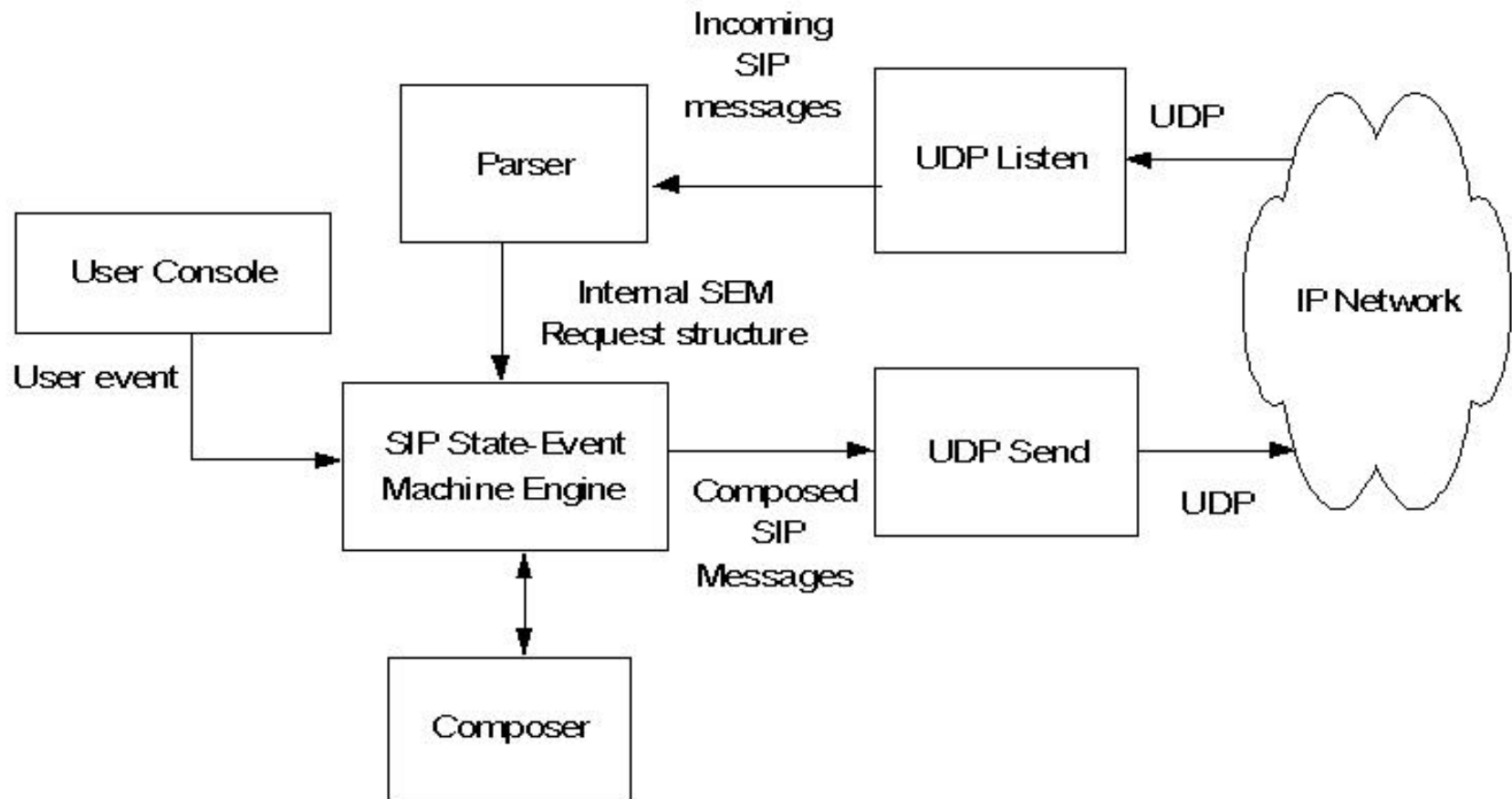
Project Scope (2/2)

- The following IP call scenarios will be simulated:
 - Normal call setup and release
 - Busy call
 - Call not answer
 - Call holding

Software Components

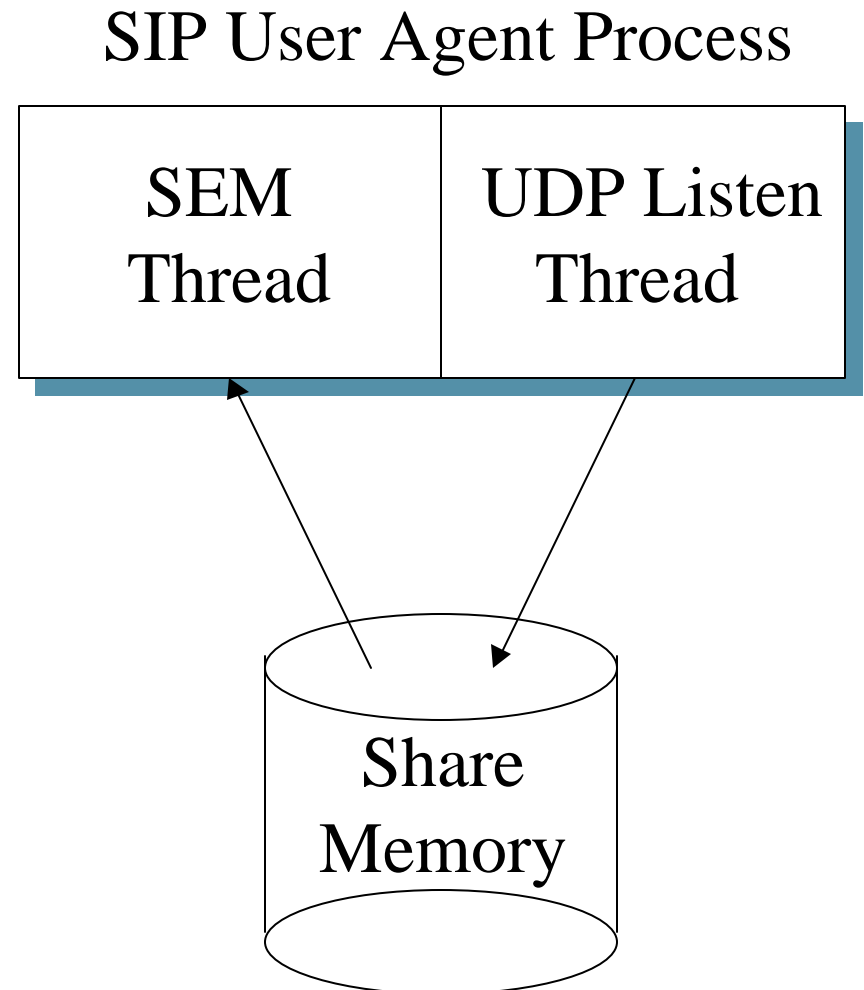
- State Event Machine
- UDP Listen
- UDP Send
- Parser
- Composer
- Share Memory Manager

User Agent System Diagram



SIP User Agent Design

- Written in C under UNIX environment
- Single Process with 2 threads
 - State Event Machine
 - UDP Listen
- Both threads share the same database



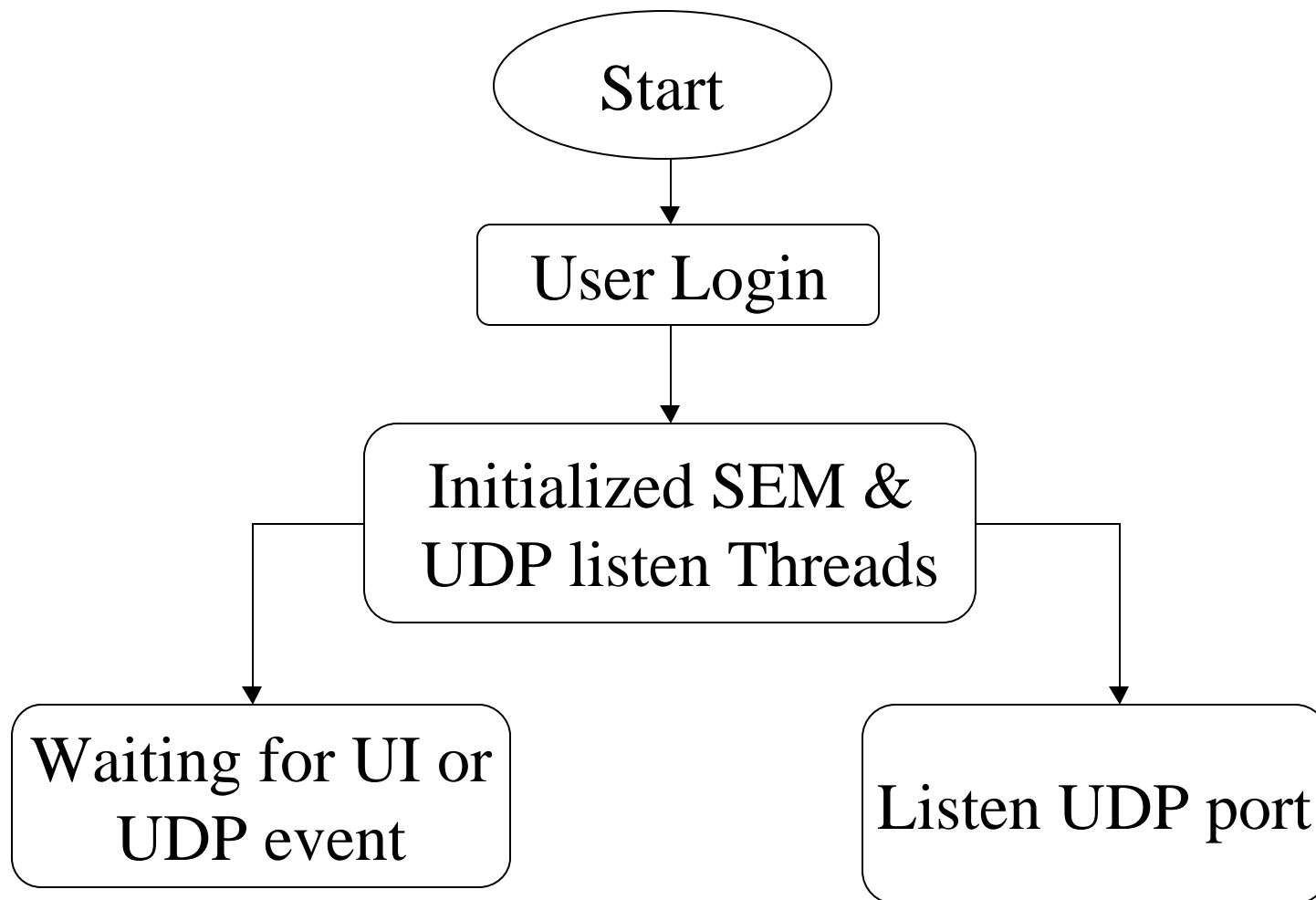
State Event Machine

- 2 different types of events
 - User Input event
 - UDP receive event
- 7 States
 - IDLE, WAITING, CONNECTED, HOLDING, PAUSE, RESUMING, DISCON

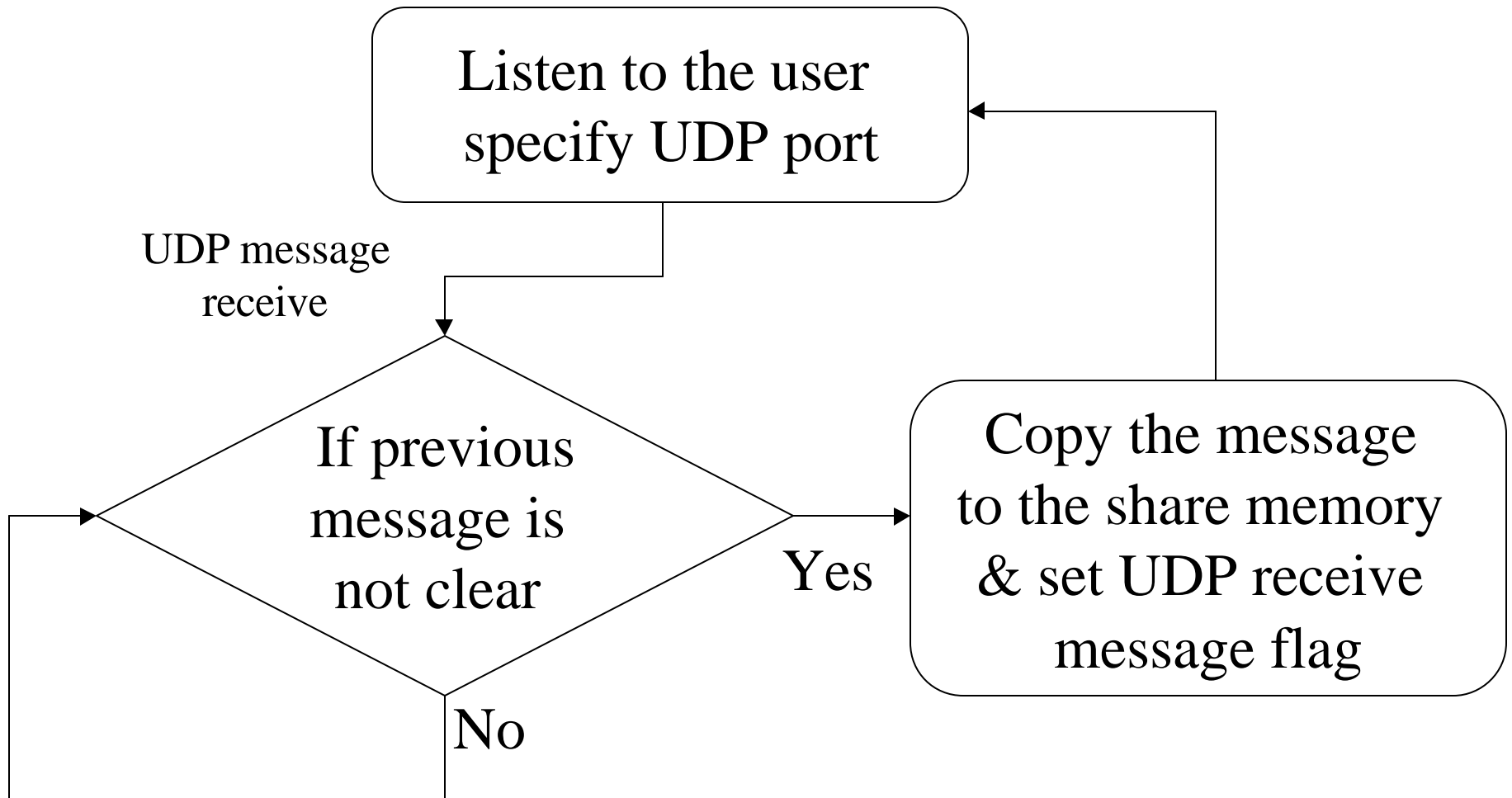
State Event Matrix

Event \ State	IDLE	WAITING	CONNECTED	HOLDING	PAUSE	RESUMING	DISCON
UI_INVITE	WAITING, 1	WAITING, 5	CONNECTED, 5	HOLDING, 5	PAUSE, 5	RESUMING, 5	DISCON, 5
UI_BYE	IDLE, 3	IDLE, 3	DISCON, 19	DISCON, 19	DISCON, 19	DISCON, 19	DISCON
UI_HOLD	IDLE, 3	WAITING, 3	HOLDING, 15	HOLDING, 3	PAUSE, 3	RESUMING, 3	DISCON, 3
UI_RESUME	IDLE, 3	WAITING, 3	CONNECTED, 3	HOLDING, 3	RESUMING, 18	RESUMING, 3	DISCON, 3
UI_ANSWER	IDLE, 3	WAITING, 7	CONNECTED, 3	HOLDING, 3	PAUSE, 3	RESUMING, 3	DISCON, 3
UI_CANCEL	IDLE, 3	IDLE, 23	IDLE, 23	IDLE, 23	IDLE, 23	IDLE, 23	IDLE, 23
INVITE	WAITING, 2	WAITING, 6	CONNECTED, 6	HOLDING, 6	PAUSE, 6	RESUMING, 6	DISCON, 6
BYE	IDLE, 4	IDLE, 24	IDLE, 14	IDLE, 14	IDLE, 14	IDLE, 14	IDLE, 14
HOLD	IDLE, 4	WAITING, 3	HOLDING, 7	HOLDING, 4	PAUSE, 4	RESUMING, 4	DISCON, 4
RESUME	IDLE, 4	WAITING, 3	CONNECTED, 4	HOLDING, 4	RESUMING, 7	RESUMING, 4	DISCON, 4
RSP_OK	IDLE, 4	CONNECTED, 9	CONNECTED, 4	PAUSE, 16	PAUSE, 4	CONNECTED, 9	IDLE, 17
RSP_ACK	IDLE, 4	CONNECTED, 8	CONNECTED	PAUSE, 22	PAUSE	CONNECTED, 8	DISCON, 4
RSP_BUSY	IDLE, 4	IDLE, 10	CONNECTED, 4	HOLDING, 4	PAUSE, 4	RESUMING, 4	DISCON, 4
RSP_RINGING	IDLE, 4	WAITING, 11	CONNECTED, 4	HOLDING, 4	PAUSE, 4	RESUMING, 4	DISCON, 4
TIMEOUT	IDLE, 3	IDLE, 12	IDLE, 13	IDLE, 13	IDLE, 13	IDLE, 13	IDLE, 13
RSP_NOK	IDLE, 21	WAITING, 21	CONNECTED, 21	HOLDING, 21	PAUSE, 21	RESUMING, 21	DISCON, 21

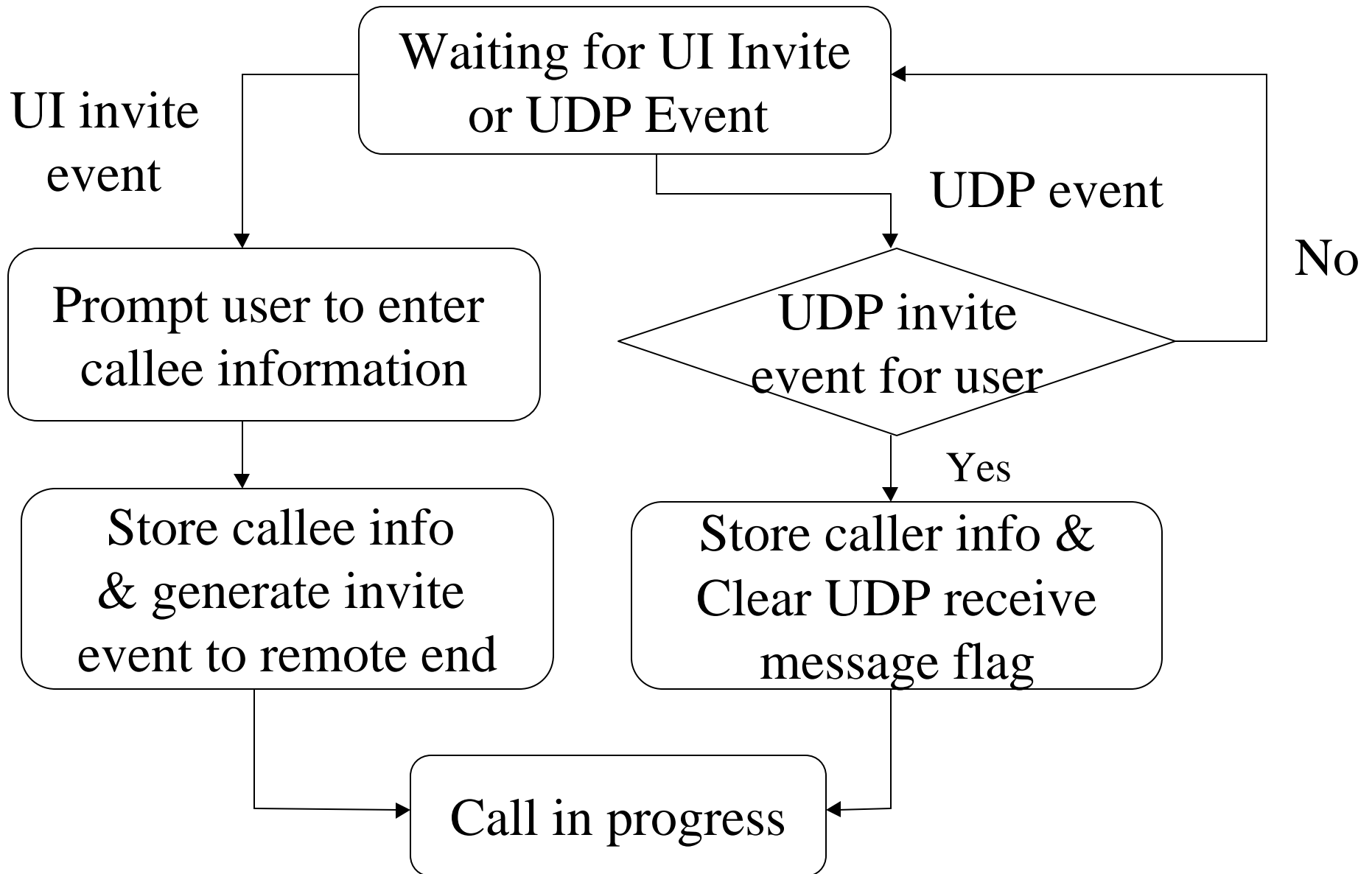
Program Flow(1/4)



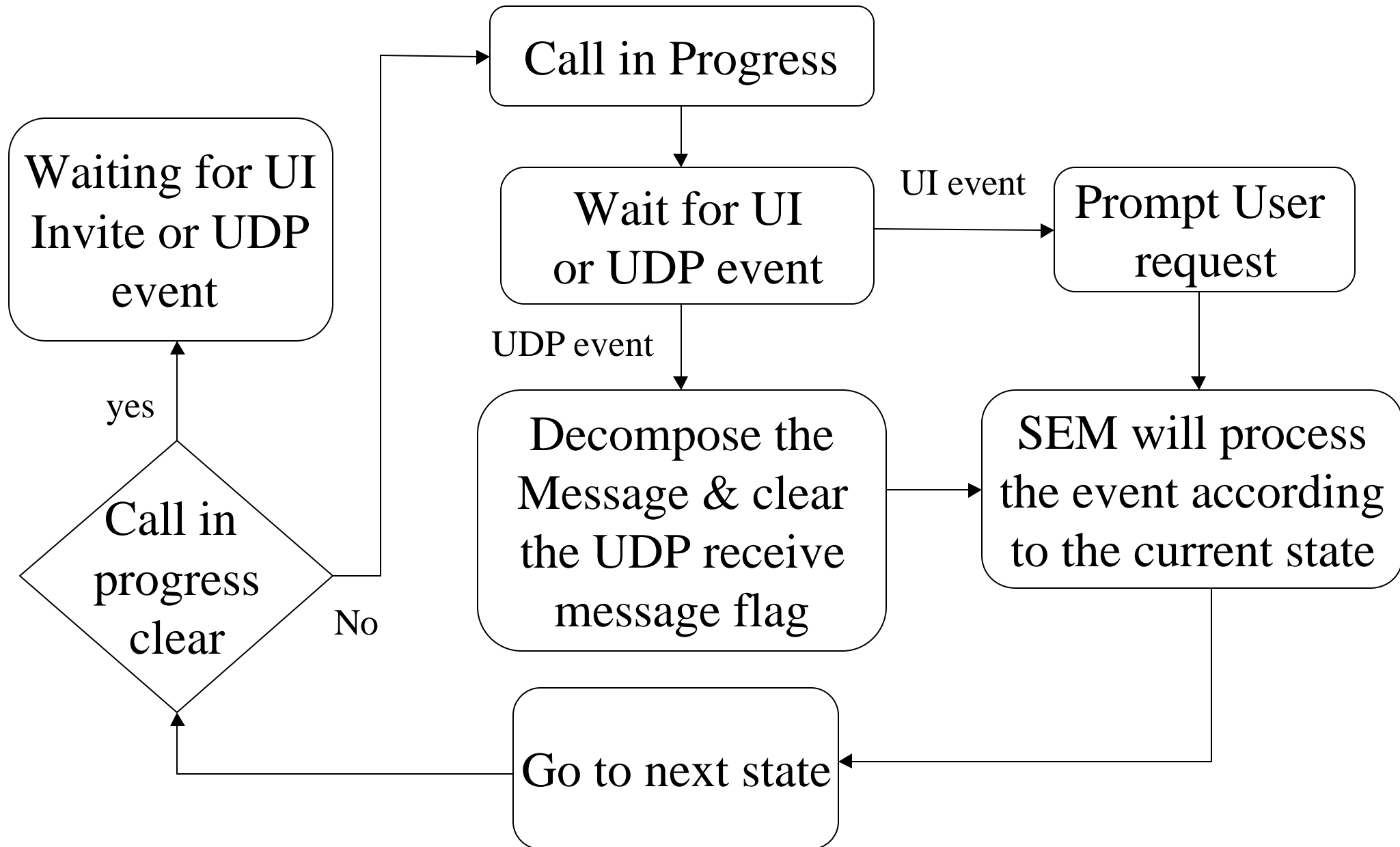
Program Flow (2/4)



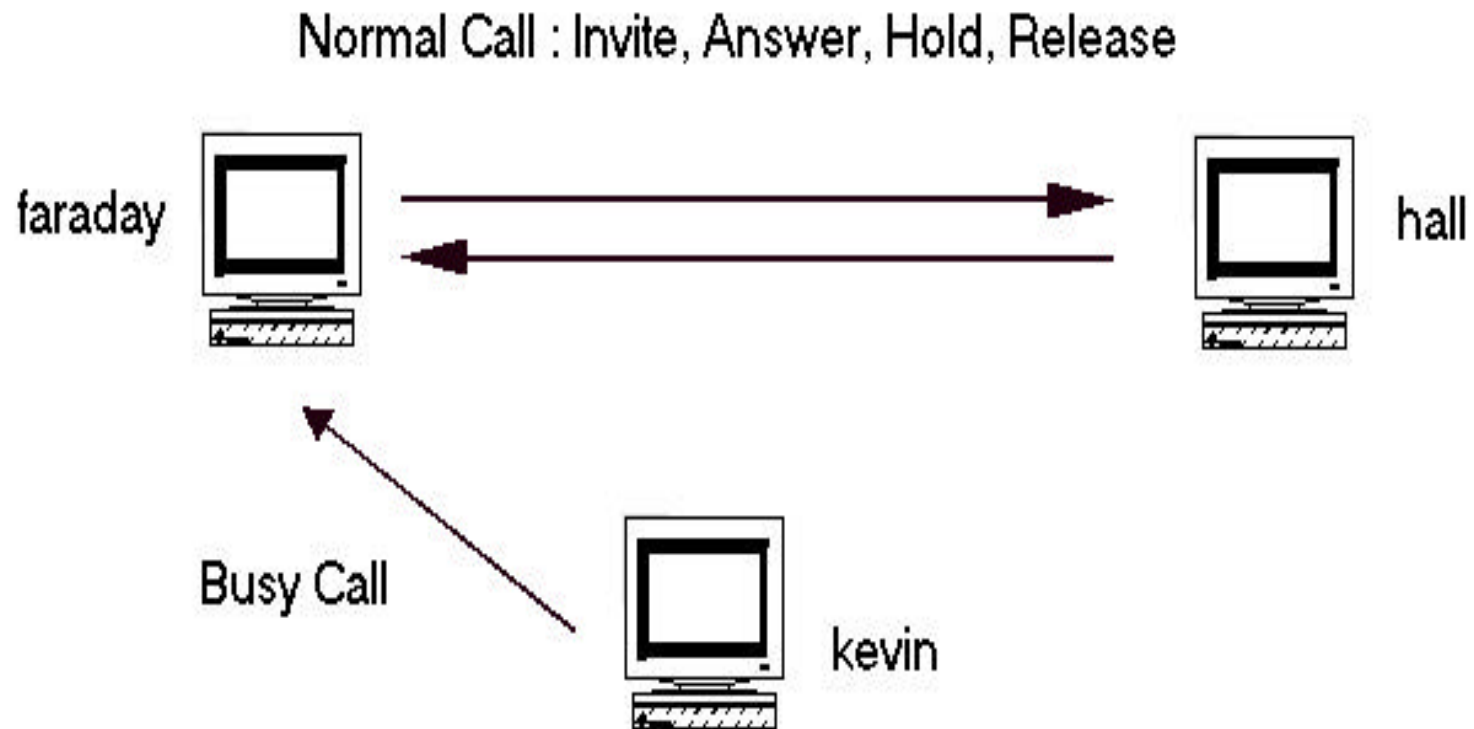
Program Flow (3/4)



Program Flow (4/4)



Test Environment



Conclusions

- Successfully implement SIP user agent prototype
- Demonstrate the basic call scenarios
- Gain experience in developing protocol stack & project planning
- SIP is lightweight simple protocol

Future Works

- Support rest of the basic methods: REGISTER, CANCEL, OPTION
- Implement transaction manager to allow multiple simultaneous SIP sessions
- Implement network servers: proxy and redirect
- Handle more call scenarios: call forwarding, call waiting, multi-party call
- Include SDP
- Traffic analysis

References

- RFC 2543bis-02, SIP: Session Initiation Protocol, IETF, November 24, 2000
- SIP Telephony Service Examples, IETF, November 2000
- Henning G.Schulzrinne and Jonathan D.Rosenberg, “The Session Initiation Protocol: Providing Advanced Telephony Services Across the Internet”, Bell Labs Technical Journal, October-December 1998.
- “Overview of the SIP Protocol”, the SIP Center, <http://www.sipcenter.com/overview.htm>
- SIP for Telephones (SIP-T): Context and Architectures, IETF, November 21, 2000