Mobility Support Using SIP

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Overview

pure-IP mobility ↔ IP over GSM, 3G, …

- SIP
- mobile applications
- mobile IP issues for Internet telephony
- mobility support using SIP
- performance
- future work
Internet Telephony Architecture

- MG
- MGC
- GK
- proxy
- gateway
- PSTN
- Internet

- RTP
- circuit-switched voice
- SIP
- H.323
- Megaco/MGCP/MDCP

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SIP (Session Initiation Protocol)

- SIP = “out-of-band” signaling protocol for establishing sessions/calls/conferences/…
- multimedia data typically uses RTP
- may travel completely different path than data
- session = audio, video, shared application, game, chat, …
- session description: SDP, …
- “personal mobility” = single address for multiple end systems ||, ~→
SIP Operation

1. called server may map name to user@host
2. callee accepts, rejects, forward (→ new address)
3. if new address, go to step 2
4. if accept, caller confirms
5. …conversation…
6. caller or callee sends BYE

may “fork”
SIP Operation in Proxy Mode

1. INVITE henning@columbia.edu
2. location server
3. INVITE hgs@play
4. 200 OK
5. play
6. 200 OK
7. 200 OK
8. ACK henning@columbia.edu
9. ACK hgs@play
SIP Operation in Redirect Mode

1. INVITE henning@ieee.org
2. 302 Moved temporarily
   Contact: hgs@columbia.edu
3. ACK henning@ieee.org
4. INVITE hgs@columbia.edu
5. 200 OK
6. ACK hgs@columbia.edu

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SIP Status

- IETF “Proposed Standard” (Feb. 1999), RFC 2543

- range of implementations: server, PC client, embedded systems ("Internet phones")

- 2nd bake-off: about 15 implementations

- extensions planned for “buddy lists”
Aside: Where is Mobile IP Needed?

**Not** needed if short-lived, restartable client-server connections:

- **http**: short, stateless
- **smtp**: short, restartable
- **pop, imap**: short, restartable
- **telnet**: yes, but rarely used by mobiles (?)
- **ftp**: restartable, rare
- **chat, irc**: yes, but fixable (proxy, protocol)
Requirements for VoIP Mobility

- fast hand-off, preferably without network support:
  - voice packet every 20–50 ms
  - FEC can recover 2–3 packets

- low packetization overhead:
  headers IP+UDP+RTP 40 bytes
  G.729 payload 8 kb/s, 10 ms $n \cdot 10$ bytes

- simple end systems
Mobile IP Issues

- encapsulation
- dog-legged routing
- binding updates still through HA
- may fail with IP address filters
- stack/infrastructure changes
SIP Mobility Overview

- pre-call mobility ➔ SIP proxy, redirect
- mid-call mobility ➔ SIP re-INVITE, RTP
- recovery from disconnection
SIP mobility: pre-call

- MH acquires IP address via DHCP
- optional: MH finds SIP server via multicast REGISTER
- MH updates home SIP server
- optimization: hierarchical LR (later)
SIP Mobility: Mid-call

MH→CH: new INVITE, with Contact and updated SDP
SIP Mobility: Multi-stage Registration

Don’t want to bother home registrar with each move

Contact: alice@CA
From: alice@NY
Contact: 193.1.1.1
REGISTER
INVITE

Los Angeles
San Francisco
CA
NY

From: alice@NY
Contact: 192.1.2.3
REGISTER
INVITE

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802.11 Movement Detection: Ad-Hoc Mode

no “access point” ➔ regular station as BS

- BS serves as default router
- periodic multicast beacon
- pick best: driver provides SNR, strength
- could use regular multicast packets for quick BS discovery
802.11 Movement Detection: Infrastructure Mode

access point (AP) for BSS

• attachment handled by MAC layer, invisible to application

• BSSID is contained in 802.11 packet, but
  – BSSID not visible to application
  – driver doesn’t get notified if MH attaches to new AP

• modified driver that polls hardware?
Handoff Performance

MH

beacon
Discover
Offer
Request
Ack

bs
beacon interval

DHCP

INVITE

200

CH

handoff interval

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Open Issues

- handoff performance in a loaded network
- soft hand-off: IP-level vs. application proxies
- soft hand-off for 802.11 infrastructure mode possible?
- RTP issues: collision detection
Conclusion

- mobile telephony = most common mobile application
- all-IP network: can’t punt hand-off
- terminal mobility as special case of personal mobility
- SIP-based mobility ➔ immediate deployment
For more information...

Papers:  http://www.cs.columbia.edu/IRT

RTP:  http://www.cs.columbia.edu/~hgs/rtp

SIP:  http://www.cs.columbia.edu/sip