End-to-end IP Service Quality and Mobility

- Lecture #9 -

Special Course in Networking Technology

S-38.215

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Planned contents & draft schedule

1.	Introduction	Jan 13th
2.	Characteristics of mobile applications	Jan 20th
3.	Service quality requirement characterizations	Jan 27th
4.	Challenges of mobile environment	Feb 3rd
5.	Mobility and QoS in GPRS	Feb 10th
6.	Mobility and QoS in 3GPP systems	Feb 17th
7.	Mobility and QoS with Mobile IP	Feb 24th
8.	Mobile IP QoS enhancements	Mar 3rd
9.	**Edge mobility and SIP**	Mar 10th
10.	Inter-system mobility	Mar 17th
11.	End-to-end QoS management	(Mar 31st)
12.	Summary	(Apr 7th)

Dates in parentheses to be confirmed

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Agenda

- Definition of edge mobility.
- SIP.
- SIP and QoS.
- Link layer QoS.
- Summary.

Goal for the lecture

- Understand the concept of edge mobility.
- Basic understanding of SIP.
- Edge mobility mechanisms.
- Service quality support mechanisms on L2.

Edge mobility

- Edge mobility means here application of micromobility schemes at the edge of the network.
- Edge mobility does not solve availability challenge, but can help in multi-service support.
- Macromobility typically needs to be addressed as well:
  - MIP
  - SIP
- Edge mobility can make use of different micromobility schemes:
  - Smooth handovers
  - Etc.
- Service quality support instantiation needed.

Edge mobility example

- Service instantiation, e.g., streaming service started.
  - SIP registration.
- Service quality support instantiation
  - Establish service quality support state in an edge router.
- Local mobility handled with micromobility scheme.
  - Service quality state transferred from access router to another as the terminal moves.
- Large-scale mobility handled with SIP.
  - E.g., (R)CoA.
  - Preferred access method.

SIP

- SIP is IETF's protocol of choice for session management.
  - Session is a set of related service events belonging to a service instance.
    - Service events are typically supported by connections, e.g., TCP/IP socket connections or UDP/IP microflows.
  - A session typically has more than one endpoint involved.
  - Session management subtasks:
    - Create sessions.
    - Modify sessions.
    - Monitor sessions.
    - Terminate sessions.
- Session creation may include capability negotiation -> SDP (not mandatory part of SIP).

[Wisely, Ch. 4] Vilho Räisänen

Session example

- Video telephony session between Britney and Clark with application sharing.
- Connections:
  - 2 x stream for video (RTP/UDP/IP).
  - 2 x RTCP stream for video.
  - 2 x stream for audio (RTP/UDP/IP).
  - 2 X RTCP stream for audio.
  - 1-2 TCP/IP connections for application sharing.
- Session negotiated using SIP.
- Connection related data are exchanged using SDP.

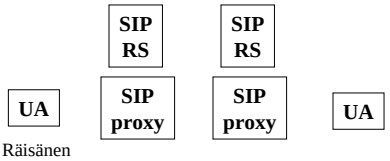
[RFC1889, RFC1890] Vilho Räisänen

Basic operation of SIP

- SIP is a text-based protocol.
- SDP messages can be embedded in SIP messages.
- Different **methods** for session initiation have been or will be defined.
- INVITE method example on the left between two user agents.
- Example of other methods: REGISTRATION between user agent and SIP registration server.

Via: SIP/2.0/UDP kryptonite.org:5060
From: Britney <sip:britney.spears@scooby.doo>
To: Clark <sip:clark@superheroes.org>
Call-ID: 1000001@scooby.doo
CSeq: 1 INVITE
Subject: High-flying stuff
Contact: Britney <sip: britney.spears@scooby.doo>
Content-Type: application/sdp
Content-Length: 160

<SDP goes here>



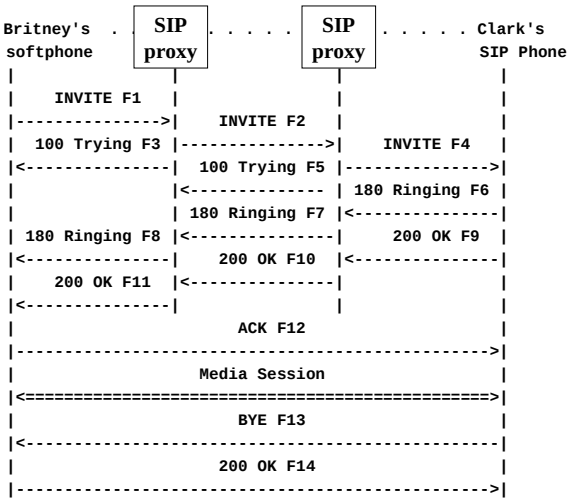
[Wisely, Ch. 4, RFC3261]

SIP and user location

- User reachability is based on SIP Universal Resource Identifier (URI) – application level reachability.
- SIP URI is globally unique Network Address Identifier (NAI) that can be used for locating the user.
  - Example: sip:britney.spears@scooby.doo.
- SIP UA sends its current IP address, port number, and transport protocol to registration server using REGISTRATION method.
- Draft proposal for in-session mobility: SIP REFER method.
  - One end of the communication asks the other end to contact the named resource.
  - Could be used for call forwarding.

[RFC3261, draft-ietf-sip-refer-07.txt]

INVITE example



[RFC3261]

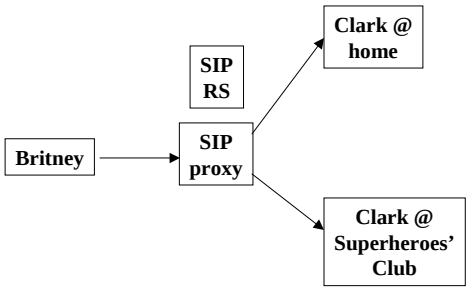
Further SIP functionalities

- A user can have multiple simultaneous registrations active.
  - In such a case, INVITE method is forwarded to all active terminal addresses.
- If all SIP signalling goes through a SIP proxy of the service provider, application of user-predefined session control is possible.
  - Call forwarding rules according to A subscriber.
  - Time-dependent call forwarding rules.
  - Application type dependent forwarding rules.
  - Locating unknown endpoint: chess@superheroes.org.

=> More flexibility and end user control possible than with IN services.

[Wisely, Ch. 4]

Example



SDP

- Session Description Protocol (SDP)
  - Conveys information about streams in a multi-media session.
  - Media streams can be point-to-point or multipoint-to-multipoint.
- Data provided by SDP:
  - Session name.
  - Period of time that session is active (important for multicasting).
  - The media the session consists of.
  - Information pertaining to media flows:
    - Addresses.
    - Ports.
    - Media type (audio/video/…).
    - Transport protocols (e.g., RTP/UDP/IP).

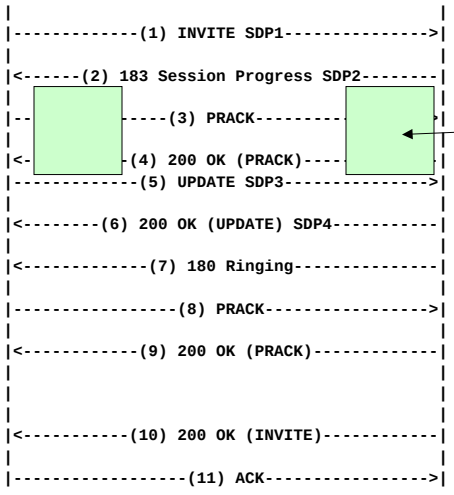
v= (protocol version)
o= (owner/creator and session identifier)
s= (session name)
i=* (session information)
u=* (URI of description)
e=* (email address)
p=* (phone number)
c=* (connection information)
b=* (bandwidth information)

[RFC 2327]

SIP and service quality support

- Basic SIP protocol does not specify how resource reservation is performed.
- Service quality support can be provided with SIP extensions.
  - Example: 3GPP R5: authorization token extension.
- RFC 3312 proposes a framework for integrating service quality support into SIP.
  - Service quality support itself is not defined.
  - Approach based on preconditions: set of constraints for the session that need to be met with.
  - RFC 3312 proposes embedding preconditions into SDP.

PRACK example



Service quality support set up here.

[RFC3312]

Link layer: case 802.11

- IEEE 802 family has a set of standards for WLAN.
  - 802.11 Medium Access Control (MAC).
  - 802.11 physical layers (2.4 GHz, 5 GHz).
- Basic 802.11 MAC:
  - Mandatory: Distributed Coordination Function (DCF).
  - Optional: Point Coordinator Function (PCF).
- Proposed functionality for enhanced DCF mode in 802.11e:
  - Priorities in MAC layer.
  - Burst mode packet transfer.
- Also proposed: Hybrid Coordination Function (HCF)
  - QoS-enhanced DCF + centralized polling.

[Lindgren *et al.*,Evaluation of Quality of Service schemes…, in Proc. LCN 2001; Garg *et al.*, Wireless Access Server…, in Proc. ISCC'02]

Potential components for edge mobility

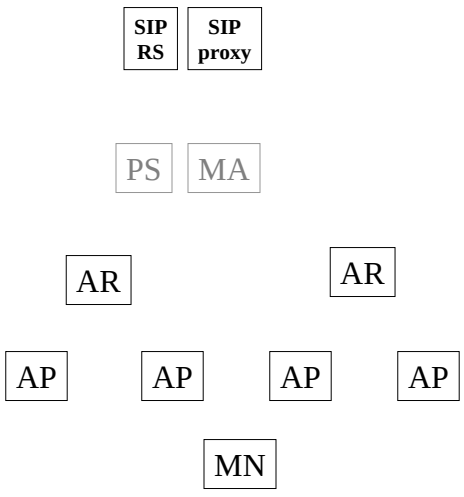
- Session mobility with SIP.
  - "Session nomadicity" with basic SIP.
  - In-session mobility with draft SIP REFER method.
  - Integration of service quality support with session initiation needs extension to basic SIP.
  - Requires that applications be run within SIP sessions.
- Where necessary, IP micromobility with some suitable scheme.
  - Smooth handover support + context transfers.
  - Mobile IP extensions.
  - …
- Also link layer mobility can be used: 3GPP R5.

Potential components…, cont'd

- Service quality support mechanism in edge network.
  - Best effort.
  - Best effort + conditioning.
  - Capacity reservation.
  - DiffServ / prioritization.
  - Per-flow signalled QoS.
- Service quality support instantiation mechanism in edge network.
  - Aggregate treatment.
  - Host-specific treatment.
    - Service quality support signalling.
    - Network-installed policy.

An edge mobility architecture

- MN is responsible for keeping RS up-to-date with respect to its address.
- (Micro)mobility controlled by MN, network, or both.
- Service quality instantiation controlled by MN or network.



Notes about SIP based mobility

- Pros:
  - Reachability and macromobility are handled with the same protocol.
  - Unified approach.
- Cons:
  - If micromobility scheme is used, separate protocol needed for that.
  - When is SIP mobility update triggered?
  - Not all components are standards yet.

Summary

- SIP provides for session management capabilities.
- Basic SIP only provides for core functionalities, but can be extended.
  - Resource management not integrated with basic SIP.
  - In-session mobility not part of basic SIP.
- It is possible to use SIP for macromobility given that necessary extensions are in place.
- Micromobility can be handled at network edge.
- Mobility and resource reservations typically require support from MN.