Open IMS Core with VoIP Quality Adaptation

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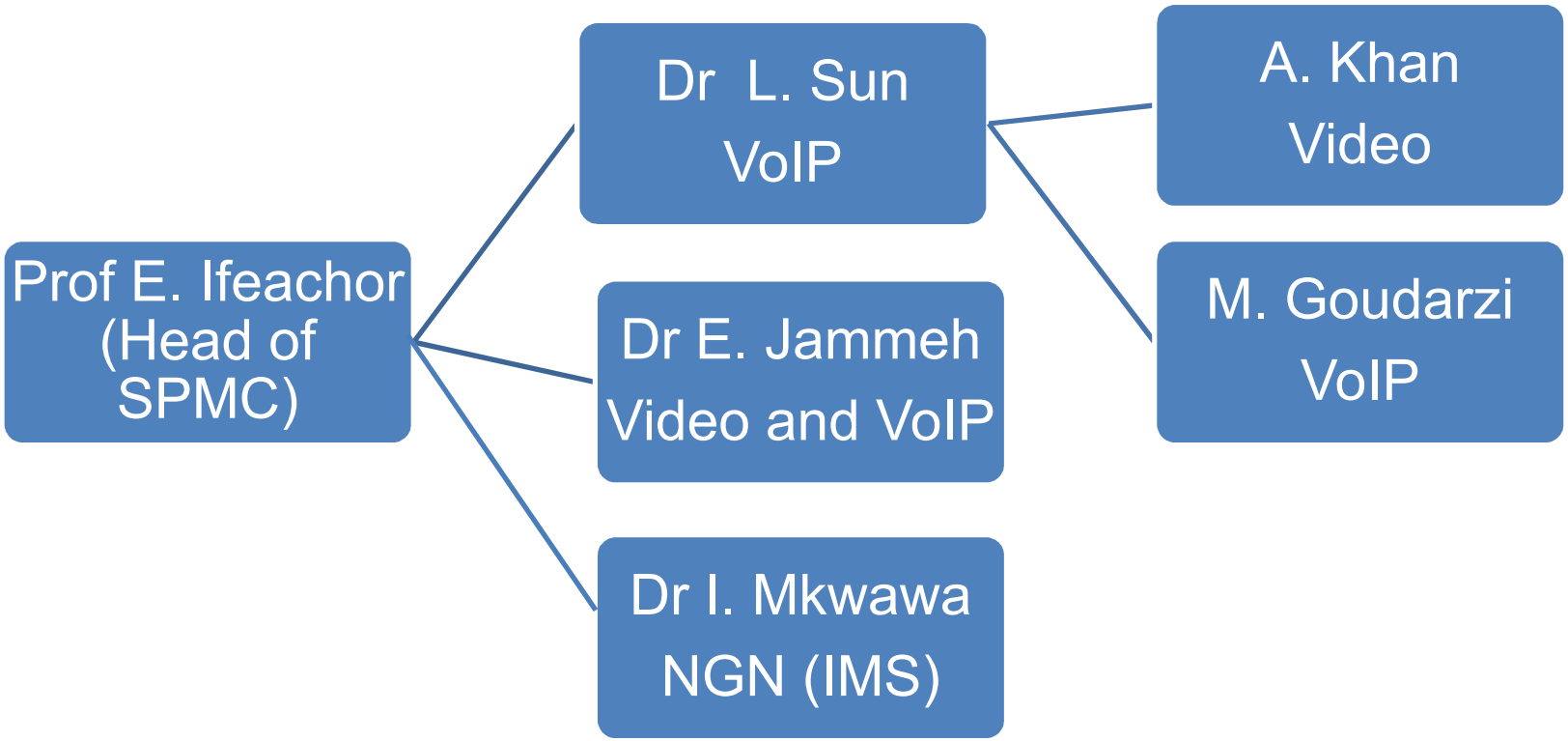
Presentation Outline

- Background
  - Bigger picture @ UOP
  - Current status and motivations
  - Aims of the project
  - Open IMS core with Android platform
- Main Contributions
  - Testbed showing two communicating IMS clients perform VoIP quality adaptation
  - VoIP quality adaptation in terms of MOS
  - Towards novel IMS compatible user centric network management solutions
- Conclusions and Future Work

Bigger picture @ UOP!

Adamantium Project Team @ UOP SPMC



Current Status and Motivations

- Current 3G mobile handsets do not have adaptation mechanisms
- With network congestion handsets have no mechanism to adapt send bitrates to help release network congestions
- Most of the ongoing research focuses on adding more services on clients side
  - None offer VoIP quality adaptation *so far*…
  - This works extends to QoS mechanism

Aims of the Project (1)

- Develop a test bed with two communicating IMS clients
- To perform VoIP quality adaptation under open IMS core Android platform as an IMS client using AMR codec with two modes (AMR475 and AMR122)
- Initial step towards Novel IMS compatible user centric network management solutions

Aims of the Project (2)

- Android was available from December 2008
- Already being used by major mobile operators
- 2 AMR modes used in this work to demonstrate the concept of VoIP adaptation
- In UOP we are looking at both VoIP and Video
- The test bed will bring together all the elements of our research at UOP and will be available for use by both other academics and commercially!

Aims of the Project (3)

- This paper uses a VoIP model developed by Sun and Ifeachor for VoIP QoS monitoring
- Android gives a platform to develop the next generation network applications that are QoS aware
- This is the **First paper published** about enhancing the next generation networks (IMS) to be QoS aware *(to our knowledge!)*

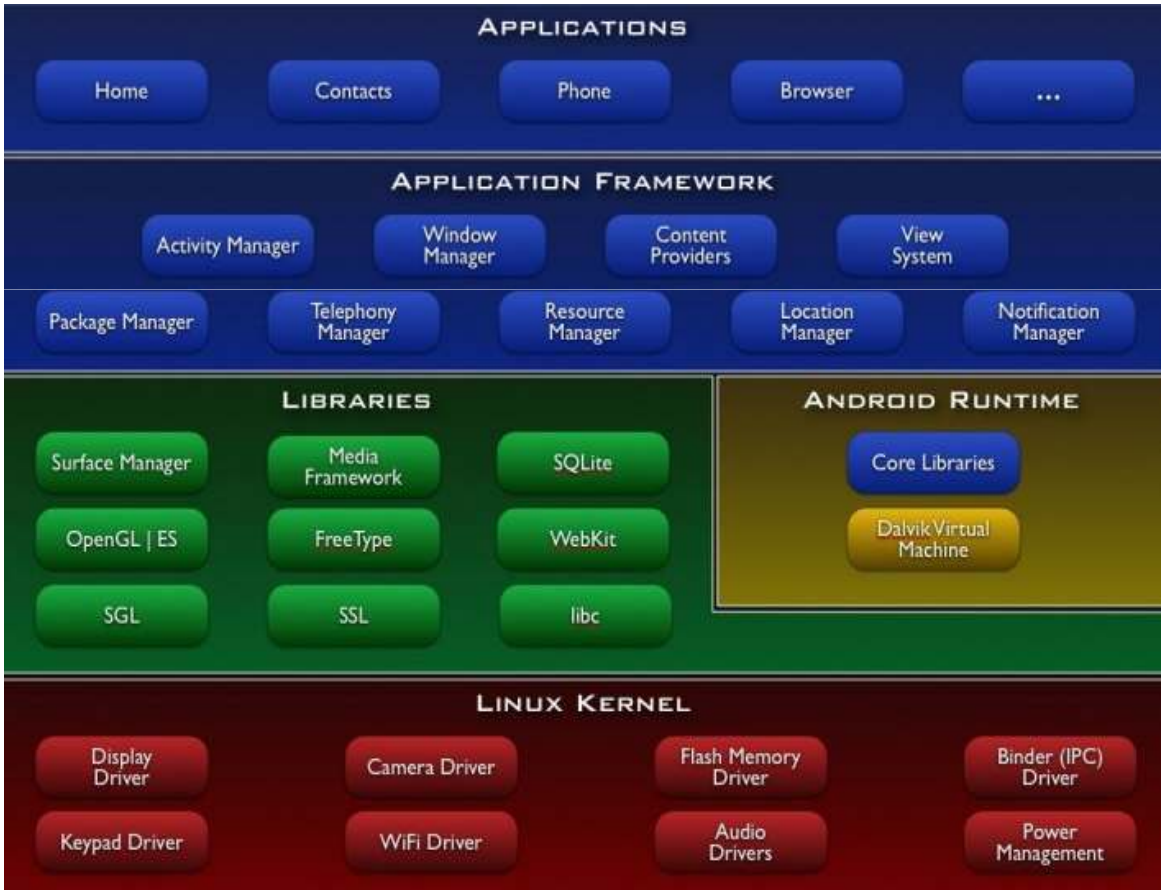
Background – Android IMS Client (1)

- Open handset alliance
- A group of more than 30 Technology and mobile companies
- Android platform is an open Software stack for mobile devices

Background –Android IMS client (2)

Testbed uses SIPDROID SIP Client app. Built on MjSIP by HSC.SIPDROID Released under GPL. SIPDROID

Modified to support basic IMS signalling flow and Installed as a package in the Android emulator



Background –Android IMS client (3)

Android Platform chosen as it provides a platform to test adaptation mechanism

Currently Android emulator does not support audio capture and RTP part of the SIPDROID was emulated.

Background –Open IMS core (1)

Core elements

of IMS Architecture:

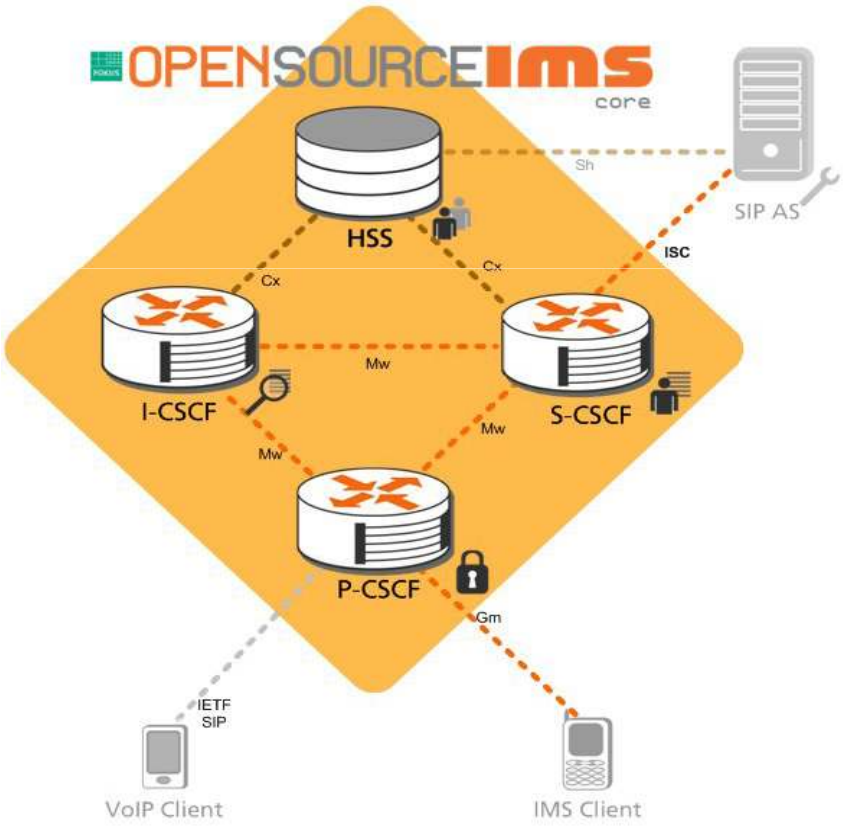
Call Session Control Functions

P-CSCF

I-CSCF

S-CSCF

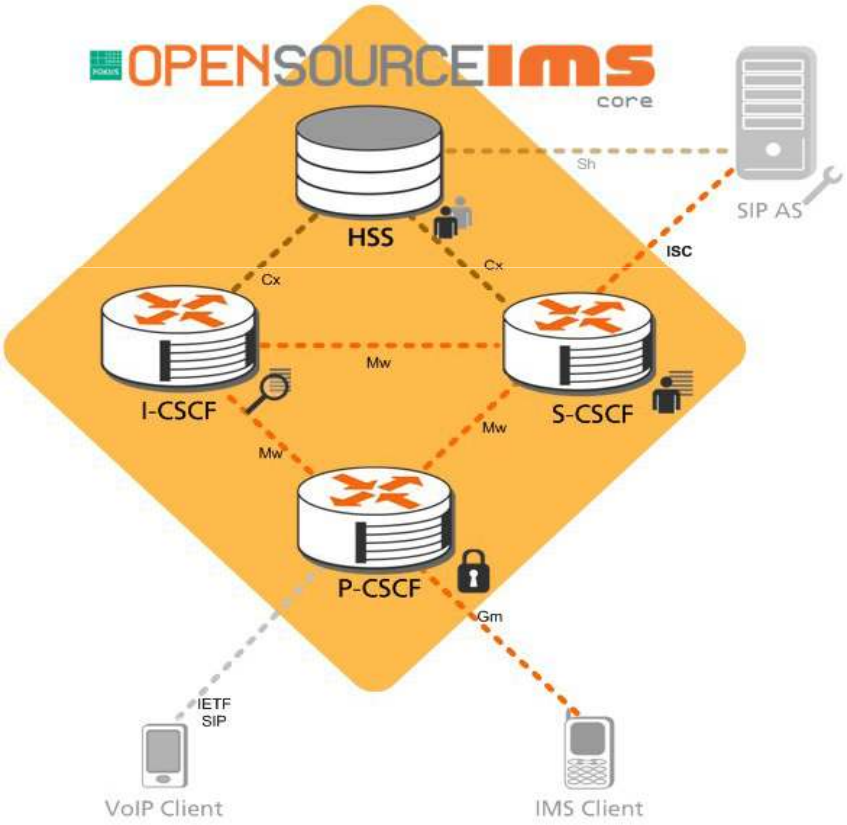
HSS (Home Subscriber Server)



Background –Open IMS core (2)

Proxy-CSCF

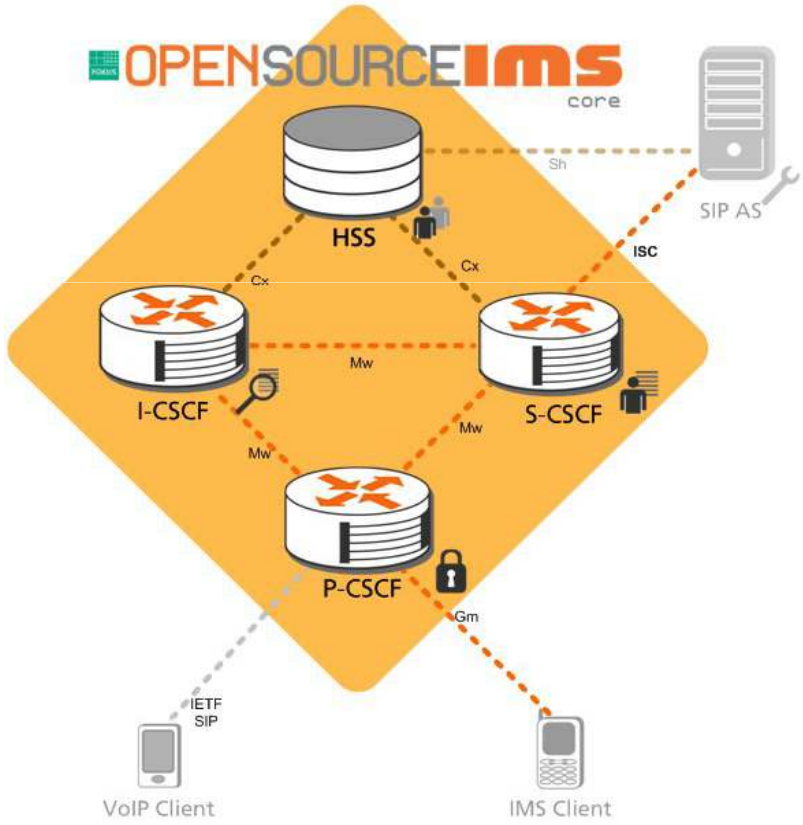
- First point of contact within the IMS
- Accepts request and serves them internally or forwards them



Background –Open IMS core (3)

Interrogating-CSCF

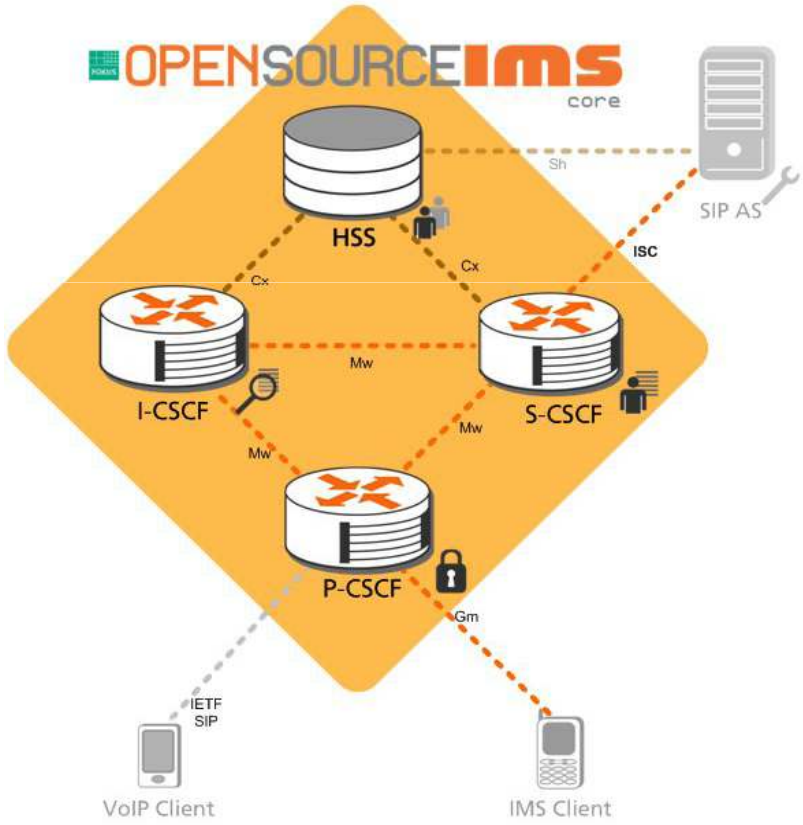
- Contact point within an operator's network for all connections destined for a user of that network or for a roaming user.
- Multiple I-CSCF's within an operator's network



Background –Open IMS core (4)

Serving-CSCF

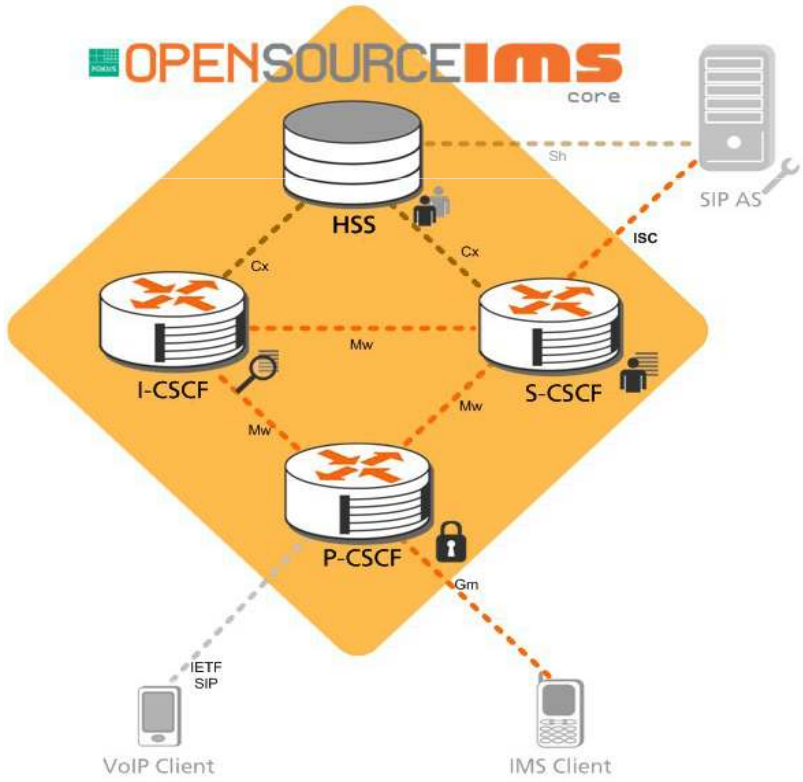
- Identifying user's service privileges.
- Selecting access to the home network application server and providing access to that server.



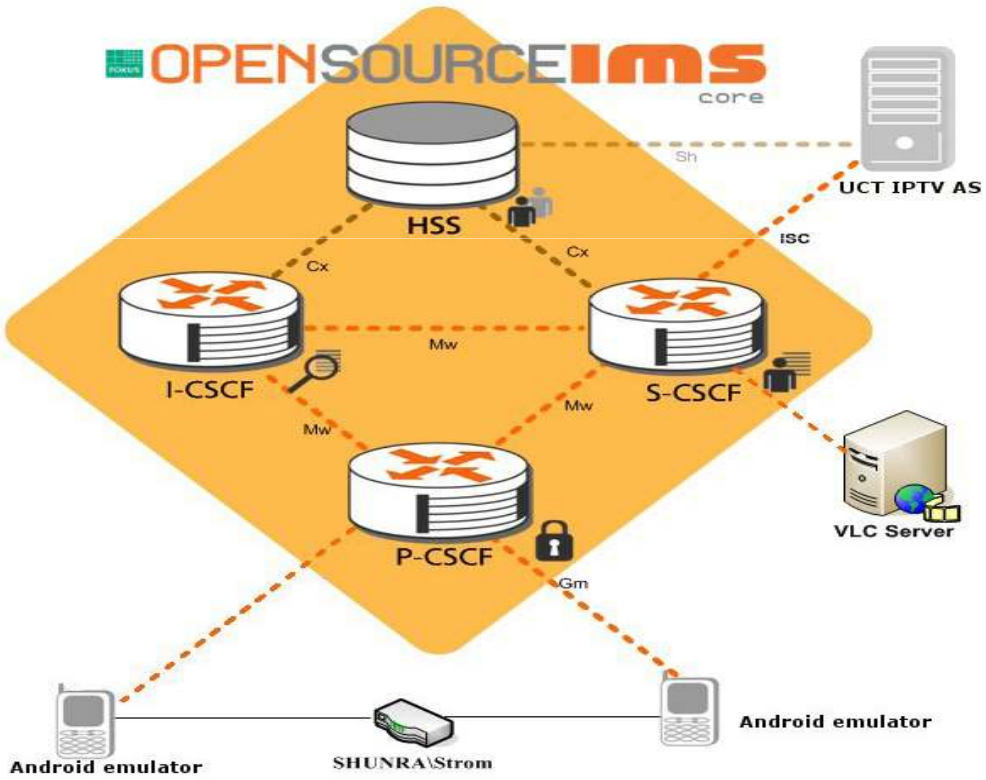
Background –Open IMS core (5)

HSS (Home Subscriber Server)

- Maintains database containing unique service profiles for end users. e.g. Current registration information, telephony services, IM service info, greeting messages, etc.

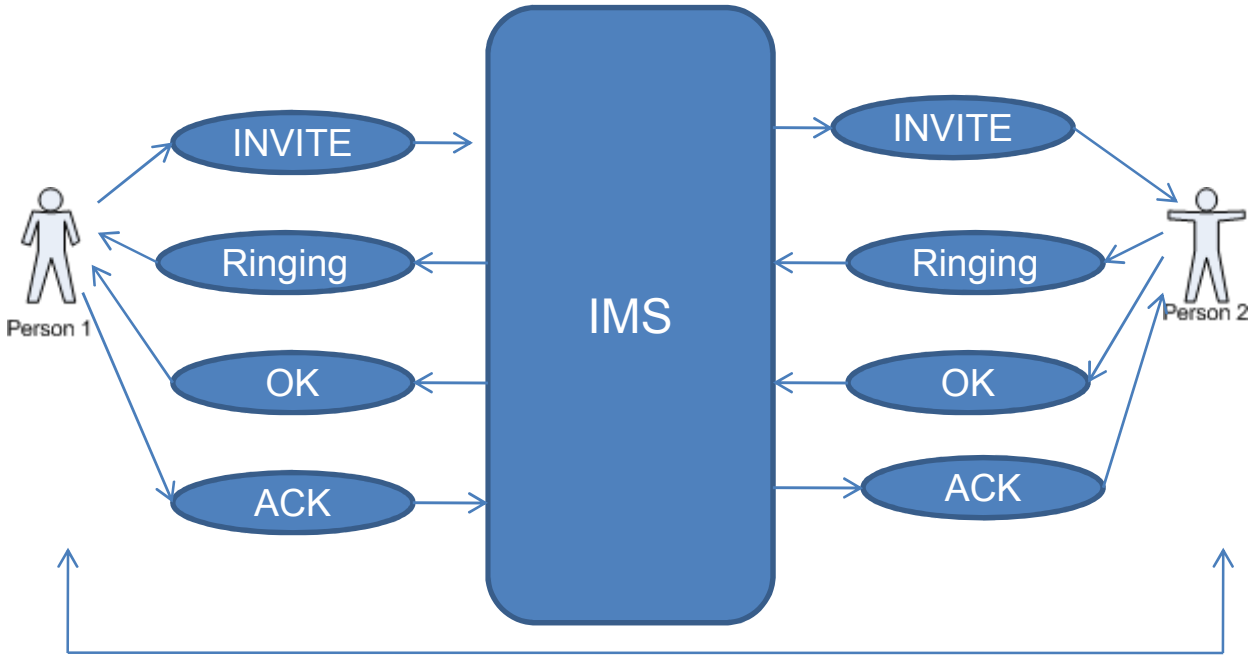


Testbed for VoIP Adaptation



VoIP Session Set-Up

SIP signalling (Users having a voice session)



Actor: End User
Preconditions:
Registration with the IMS network
Postconditions:
Establishment of voice call
Continuous monitoring of voice quality

VoIP Session Monitoring

- Voice quality drops below a predetermined threshold:
  - Callee sends IM instructing caller to
  - Change AMR mode from AMR 122 to AMR475

- Voice quality goes above a predetermined threshold:
  - Callee sends IM instructing caller to:
  - Change AMR mode from AMR475 to AMR122

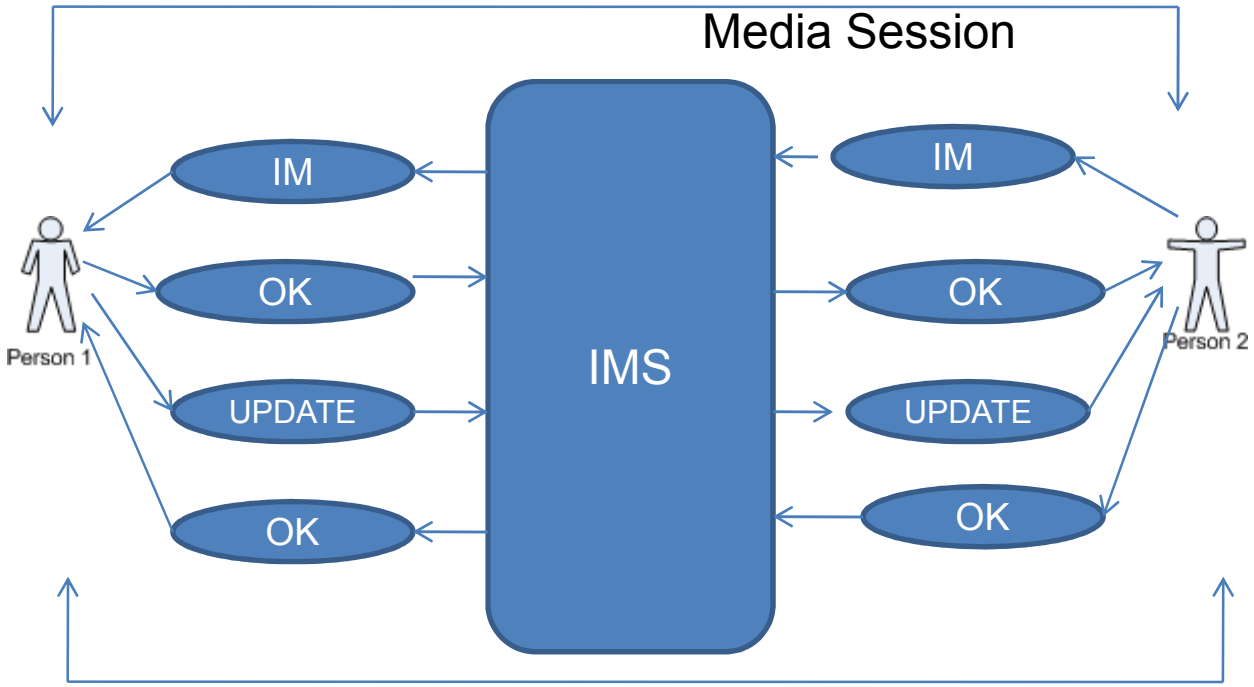
AMR475 is the lowest mode.

AMR122 is the highest mode.

Only 2 AMR modes considered (4.75kb/s and 12.2kb/s)

VoIP Session Update

SIP UPDATE session



Actor: End User

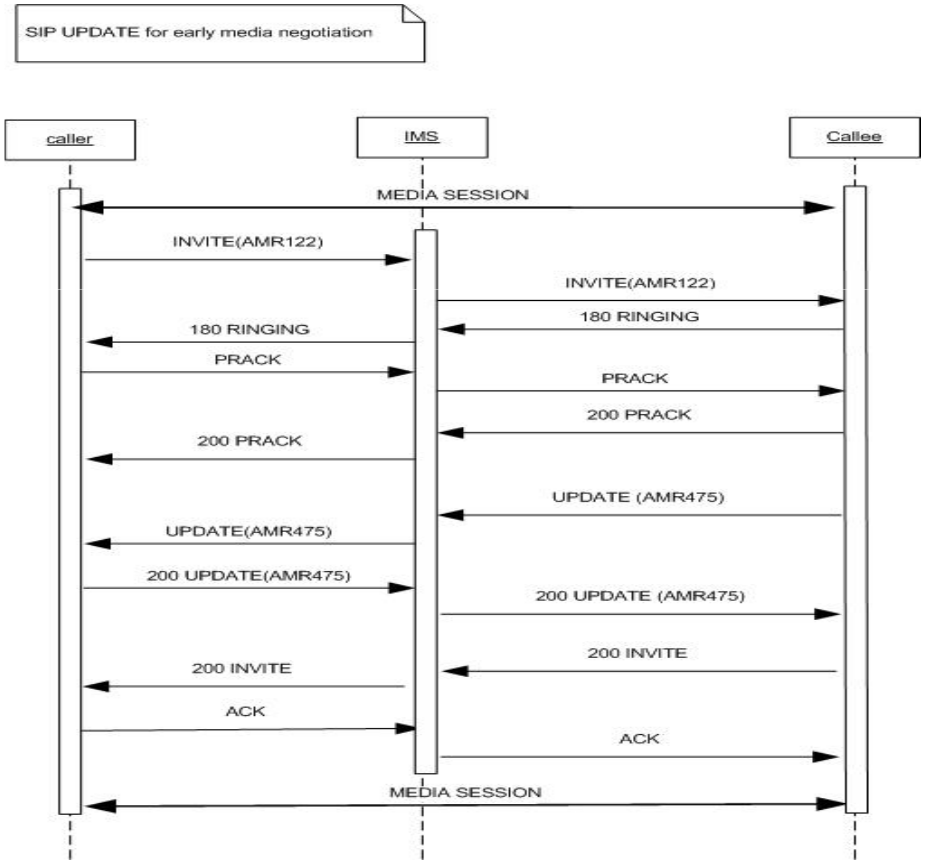
Preconditions:

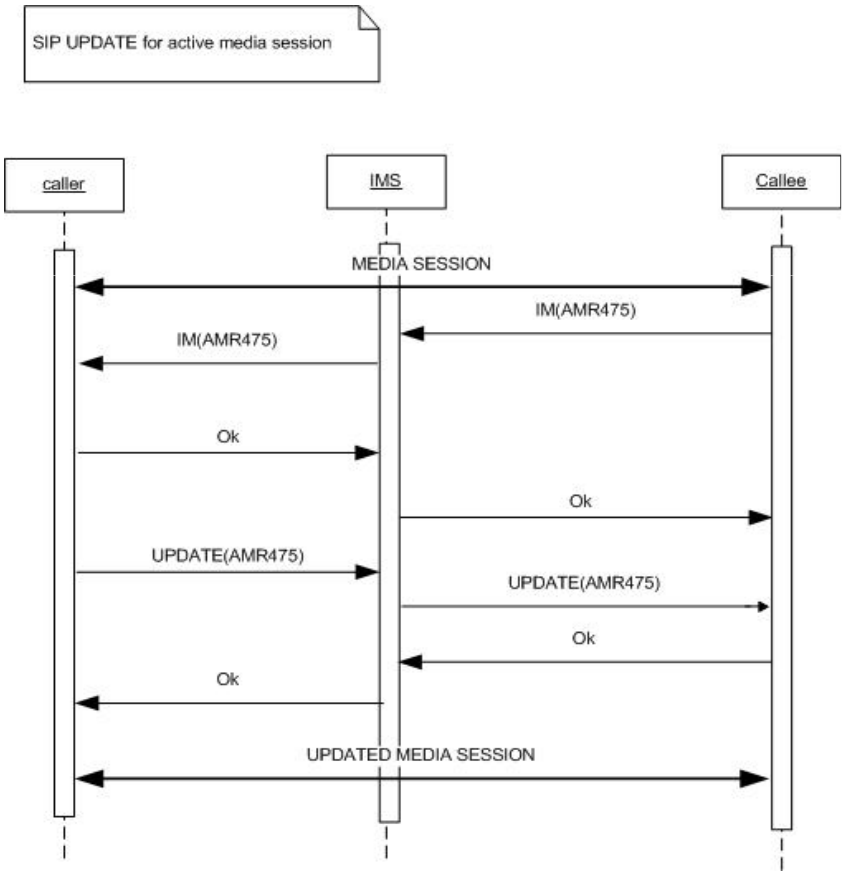
- Registration with the IMS network
- Voice session is setup

Postconditions:

- Improvement/ degradation of quality
- Change of AMR mode

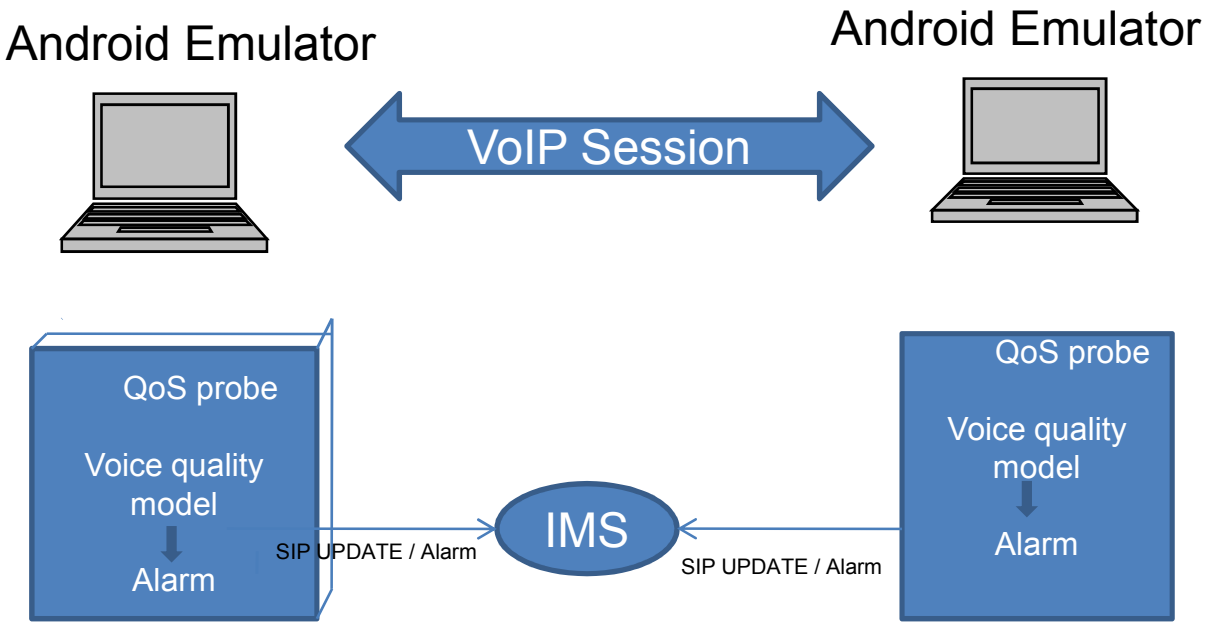
VoIP Session Set-Up & Update





VoIP Quality Adaptation (1)

VoIP Quality Monitoring



VoIP Quality Adaptation (2)

Adaptation Mechanism

$$MOS = f(delay, loss)$$

$$MOS = \begin{cases} 1 & R \le 0 \\ 1 + 0.035R + R(R-60)(100-R)7x10^{-7} & \\ 4.5 & R \ge 100 \end{cases}$$

$$R = 93.2 - I_d - I_e$$

$$I_d \begin{bmatrix} = 0.024d + 0.11(d-177.3)H(d-177.3) & \\ H(x) = 0 & x < 0 \\ H(x) = 1 & x \ge 0 \end{bmatrix}$$

$$I_e = a\ln(1+bp) + c$$

VoIP Quality Adaptation (3)

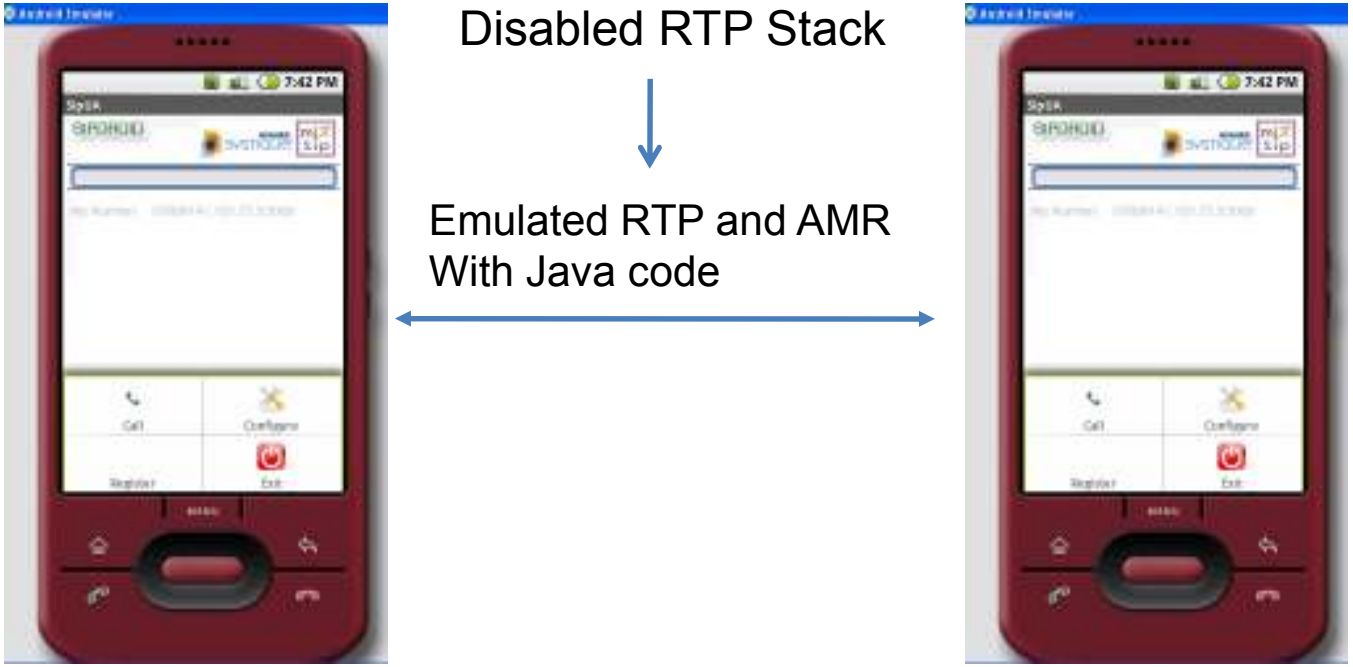
Initial Monitoring Android

$$MOS = f(loss)$$

SHUNRA

VoIP Quality Adaptation (4)

Initial Monitoring Android



VoIP Quality Adaptation (5)

Initial Adaptation Android

SIP IM
SIP UPDATE

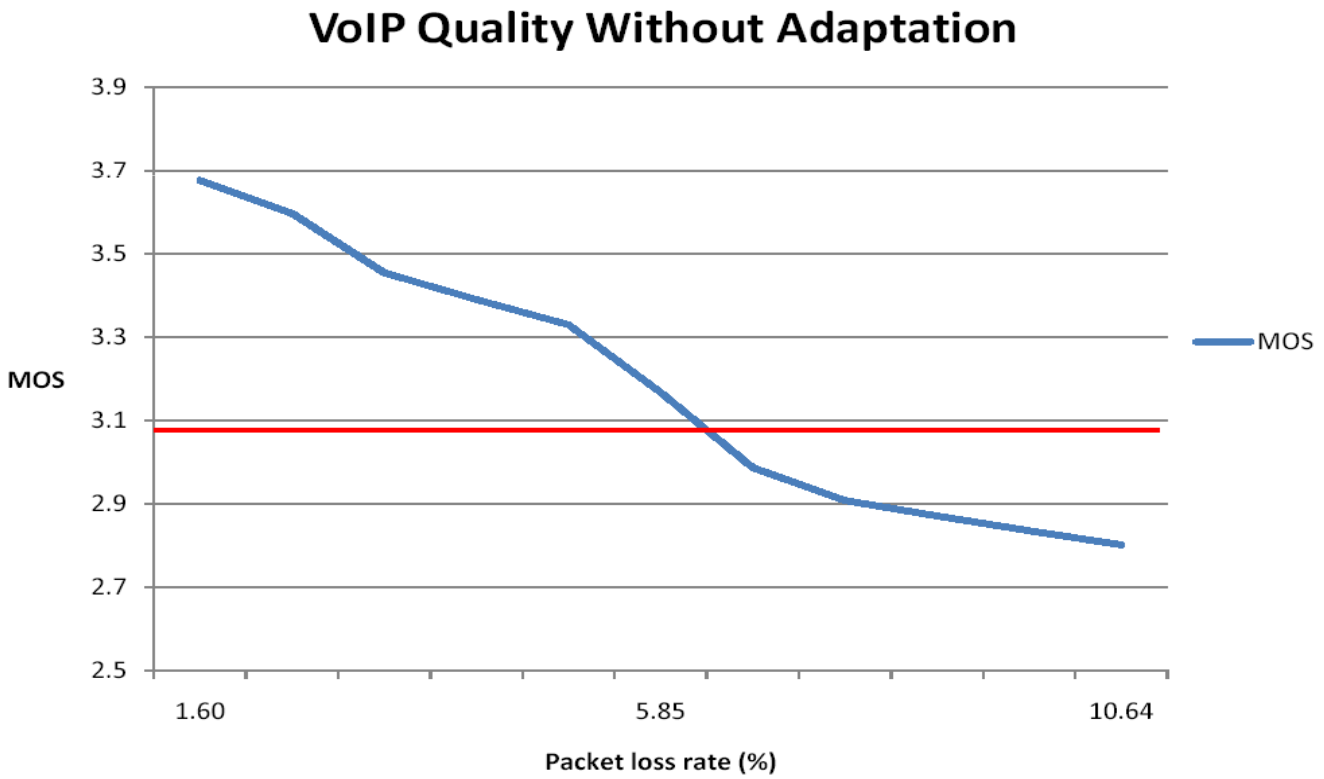
VoIP Quality Adaptation (6)

Initial Adaptation Android

AMR mode 1
AMR mode 8

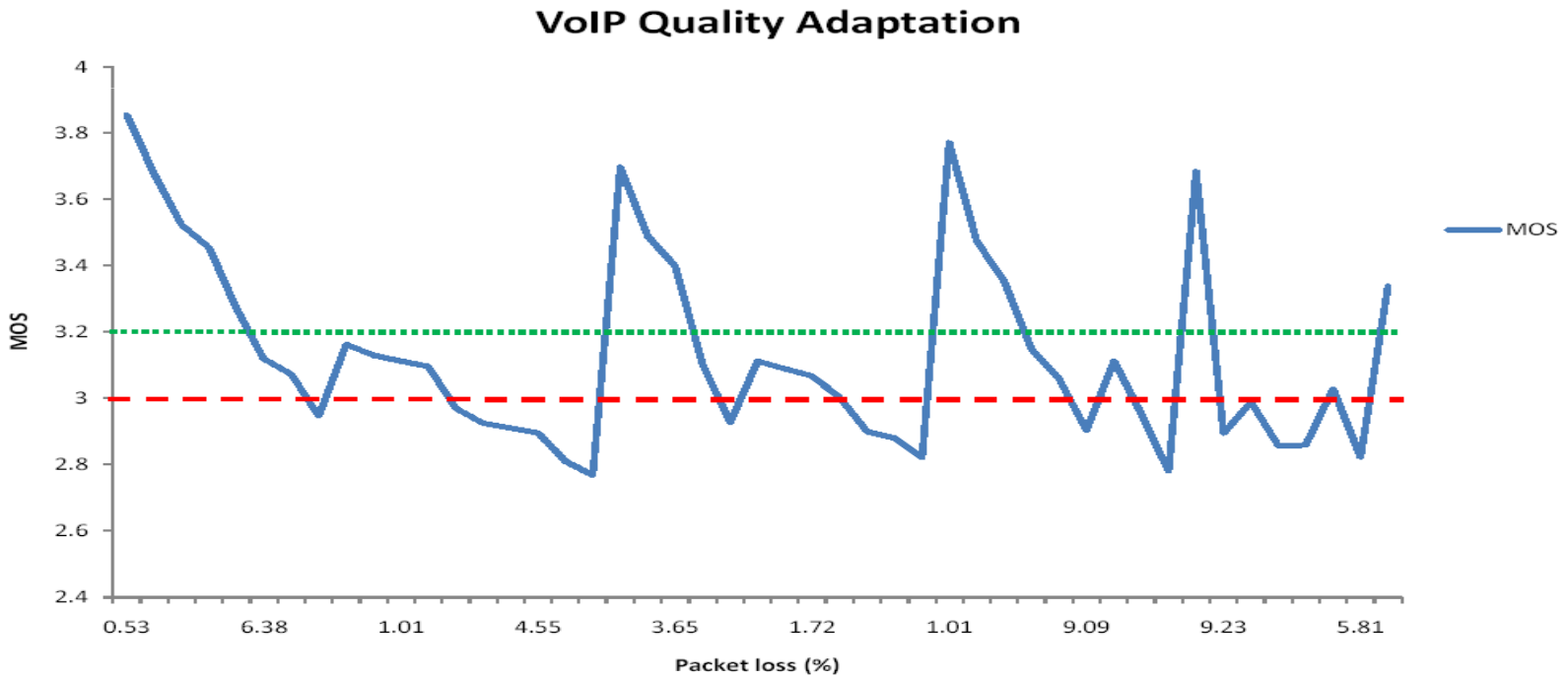
VoIP Quality Adaptation (7)

Initial Results Android



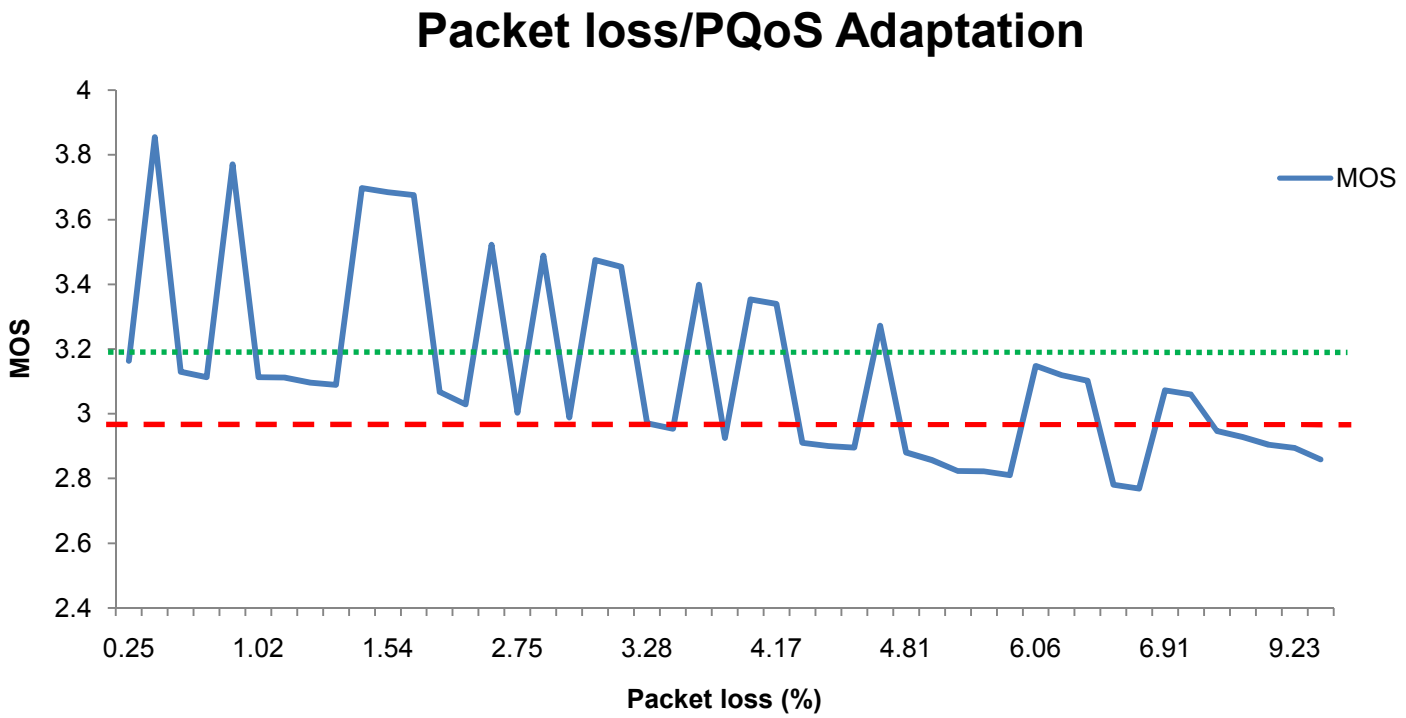
VoIP Quality Adaptation (8)

Initial Results Android (to account for network congestion)



VoIP Quality Adaptation (9)

Initial Results Android with increasing Packet Loss



Conclusions

Built an open IMS core testbed

- With VoIP quality adaptation using Android platform as IMS clients
- AMR codec with two modes (AMR122 and AMR475) for adaptation to prove concept.
- Shunra storm to emulate packet loss as network impairment.
- Extended current IMS infrastructure to add QoS mechanism in terms of VoIP quality adaptation.

Results show the importance of VoIP quality adaptation (clear gain in PQoS) mechanism during an IMS VoIP session.

Future Work

- Extensive subjective testing of PQoS models.
- UCT IPTV application and VLC streaming server for video adaptation
- Audiovisual PQoS Modelling.
- Extensive testing and evaluation of adaptation mechanism
- Fully working Android platform with added modules in IMS for monitoring and adaptation of voice and video IMS session.

References

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[1] A. Platform, “Android-an open handset alliance project,” Website, 2008, http://code.google.com/android/index.html.

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- Any questions?

Thank you!