Handing multiple communications sessions for the next generation of wireless networks

Rodrigo Vaca[1] and **Víctor Ramos**[2]

[1]Huawei Technologies, [2]UAM-I Mexico

http://victor.ramos.online.fr

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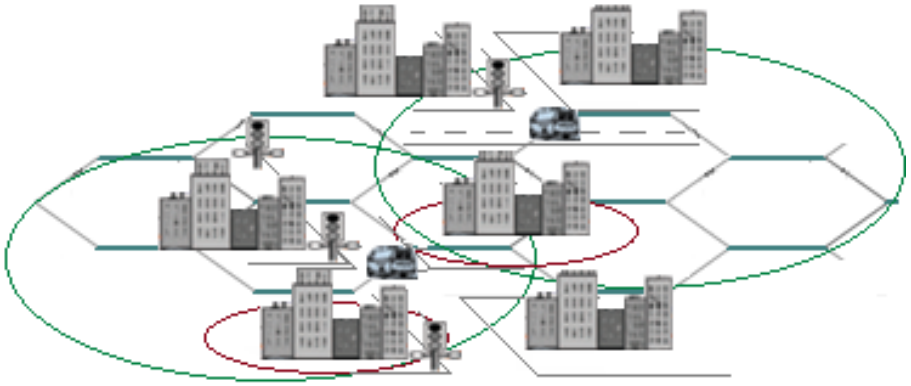
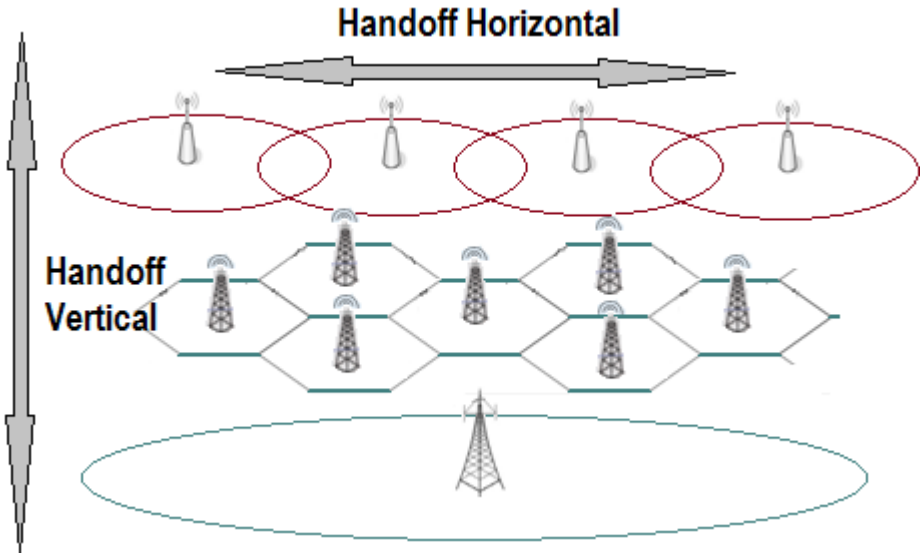
Outline

- Introduction
- Related work
- Handoff probabilistic algorithm
- Simulation results
- Conclusions and further work

Introduction

The handover process





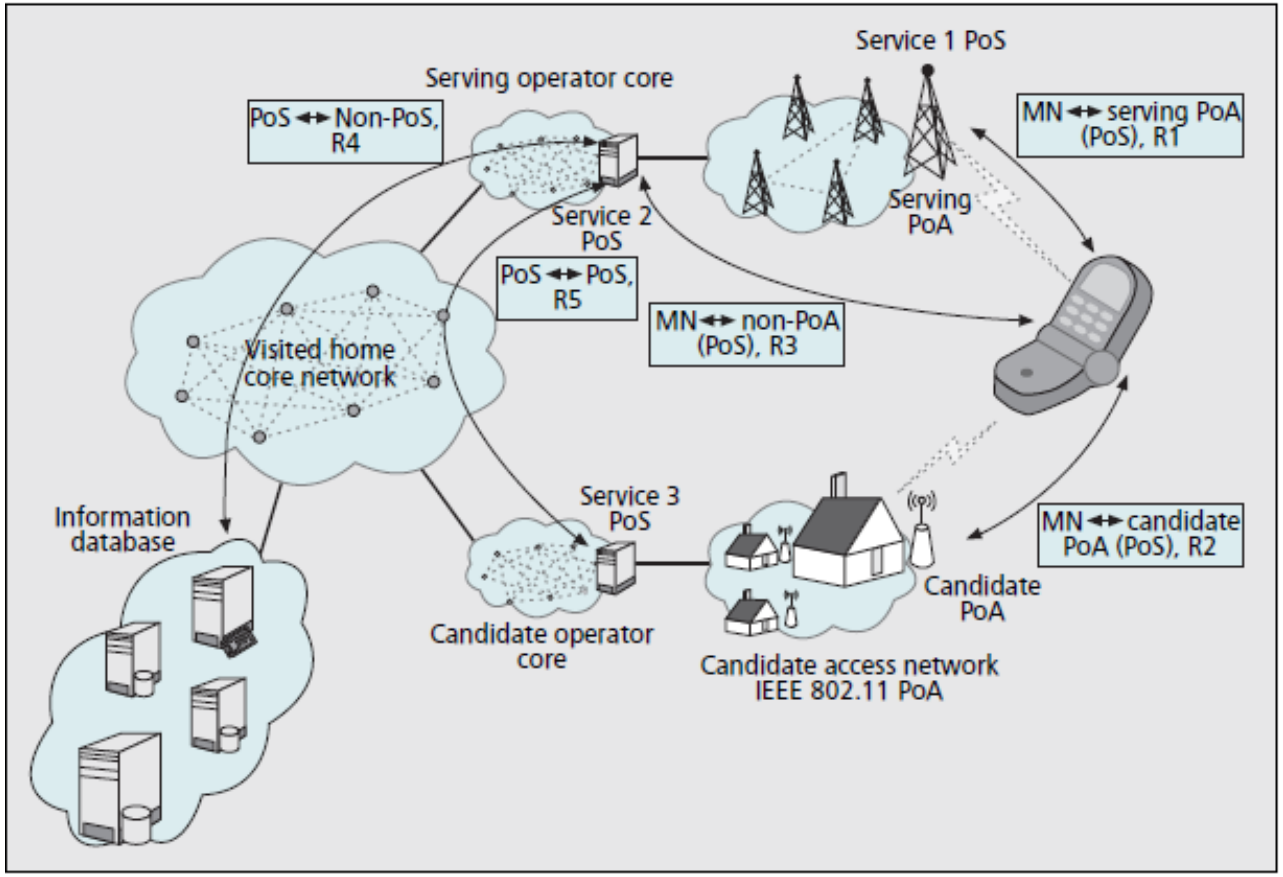
- Mobile users experiment handoff events while moving within a wireless network.
- **Handoff:** maintain the active connections when a mobile node switches from an access network to another.
- Tha handoff management process is a very important issue in heterogenous scenarios.

Media Independent Handover

- IEEE 802.21 Media Independent Handover.

- **Goals**:
  - Common structure for handoff.
  - Seamless handover in homogeneous and heterogeneous environments.
  - Three different services:
    - Events (MIES)
    - Commands (MICS)
    - Information (MIIS)

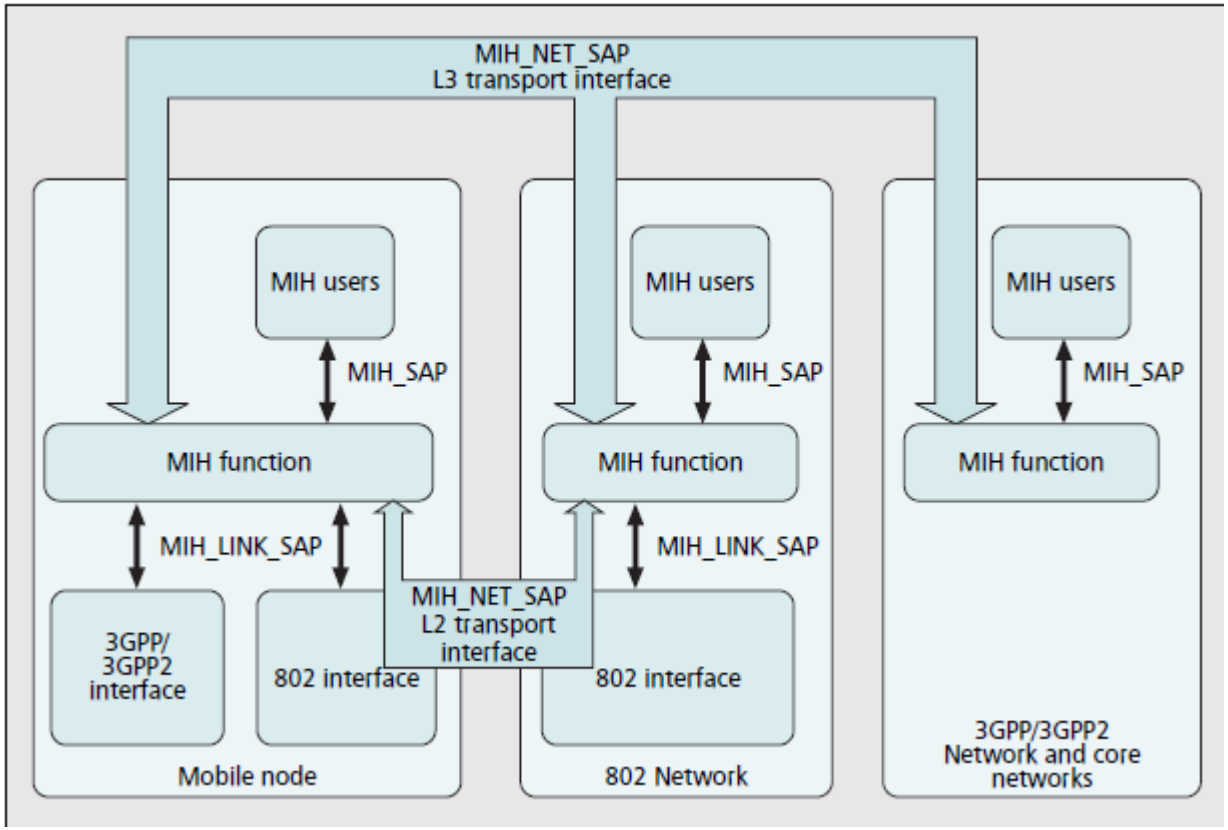
802.21: Reference Model



- **Coexistence** among wireless networks.
- Coverage maps.
- Link parameters.

802.21: Architecture

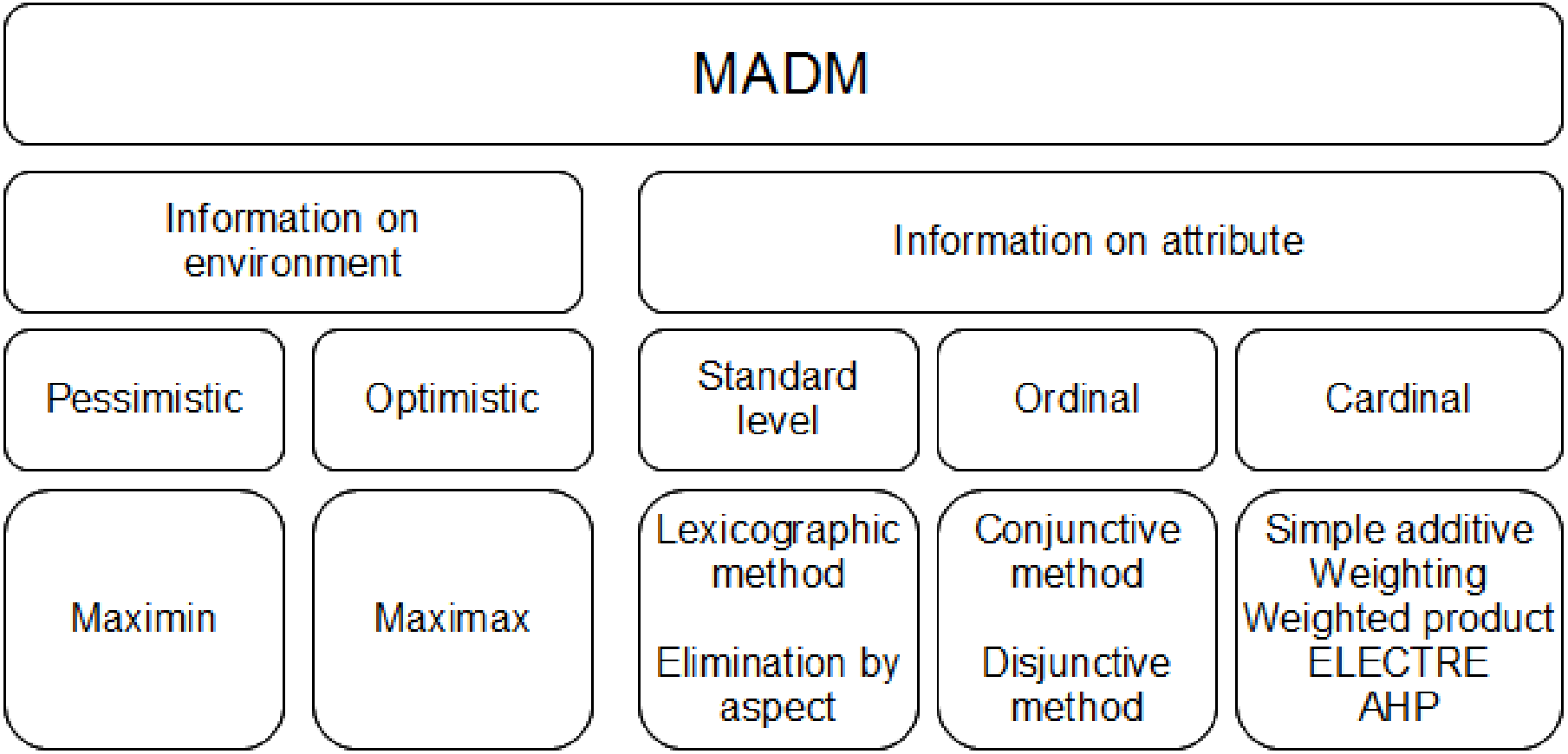
Communications sessions are kept while MIH interfaces exchange information.



Multiple Attribute Decision Making (MADM)

- Tool for evaluating competing alternatives with multiple attributes.
- Several MADM problems, same characteristics
  - Multiple alternatives
  - Multiple attributes qualitative/quantitative
  - Attribute prioritization
  - Matrix comparisons.

Classification of MADM methods



Related work

AHP: Analytic Hierarchy Processes

- AHP: Allows to interpret **quantitatively, quanlitative** factors.
- **AHP**
  - Build hierarchies
  - Priority assignment
  - Logic consistency
- AHP decomposes a decision problem into several problems.
- **AHP** structures an MADM problem by attributes

Handoff decision making

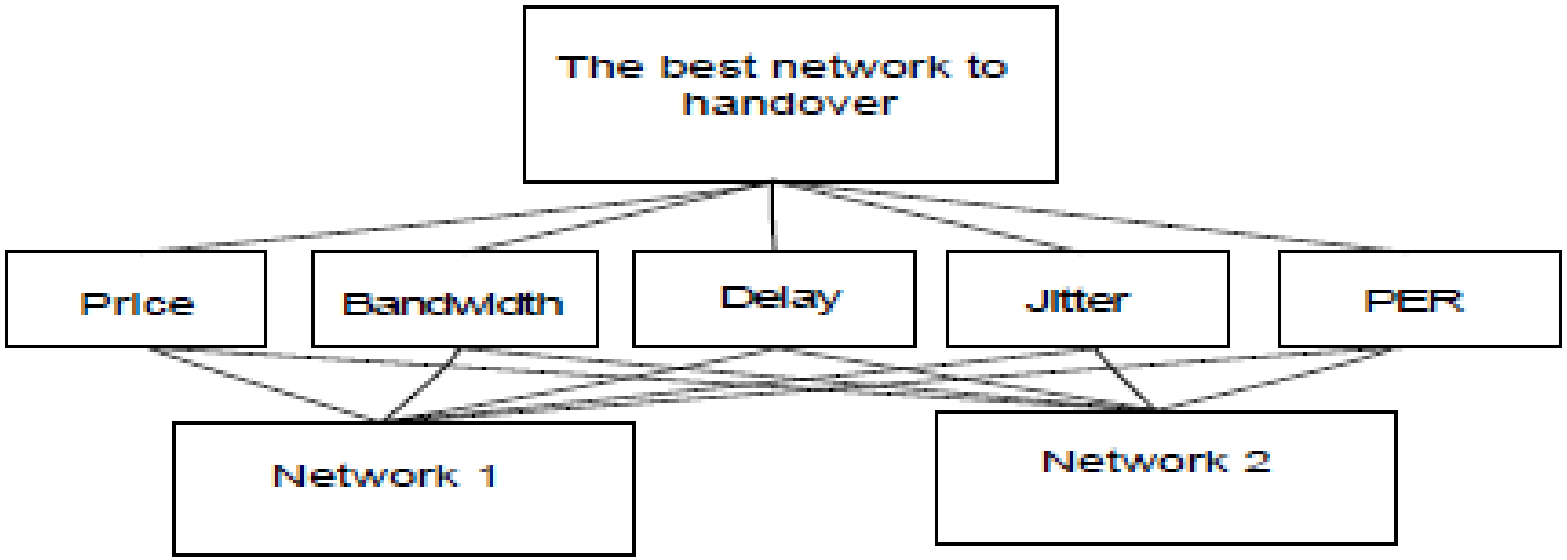
- Handoff decision making has been studied as a **deterministic** MADM problem.
- **AHP** is a decision making support which takes into account the different aspects of the decision making process.
- **Drawback:** AHP does not take into account the uncertainty of the judgements into the pairwise comparison matrix.

AHP hierarchy of our problem

Goal: Handover to the network offering the best QoS for the mobile node applications.

Criteria: Quantitative/qualitative parameters by which alternatives are judged.

Alternatives: Possible options to choose



Our contribution

- Tawil, Pujolle and Demerjian[1], proposed a decision scheme to select the best suitable network. The problem is stated as an MADM problem.
- Yang et. al. [2], propose an MADM handover decision algorithm for WiMax and WiFi networks:
- The works in [1,2] assume that the handoff problem is a decision making process.
- **Drawback:** They see the problem as a **deterministic** issue.

Our contribution (2)

- We propose in [3] a novel method, similar to [2], but we model the handoff process as a **probabilistic** process.
- *In this work*, we present numerical comparisons between AHP and the classic RSS.

[1] Distributed handoff decision scheme using MIH function for the 4th generation of wireless networks**. ICTA 2008.**

[2] A vertical media handover decision algorithm across Wi-Fi and WiMax networks. **WOCN 2008**.

[3] A vertical handoff algorithm which considers the uncertainty during the decision making process. **WOCN 2009.**

Handoff probabilistic algorithm

The proposed method

- Insert uncertainty into the pairwise comparison judgements.
- Each entry in the AHP matrix is a stochastic variable
- Use of a **second kind Beta** distribution to for comparison judgements → Insert uncertainty.

$$\begin{bmatrix} 1 & B_{e2}(\alpha_1,\alpha_2) & .. & .. & B_{e2}(\alpha_1,\alpha_n) \\ B_{e2}(\alpha_2,\alpha_1) & 1 & .. & .. & B_{e2}(\alpha_2,\alpha_n) \\ .. & .. & .. & .. & .. \\ .. & .. & .. & .. & .. \\ B_{e2}(\alpha_n,\alpha_1) & B_{e2}(\alpha_n,\alpha_1) & .. & .. & 1 \end{bmatrix}$$

Probability that each target network is the best

- $I(i\text{h})$ is the set of permutations of the h elements excluding the j-th one.

$$P[y_j = y_{[1]}] = 1 - \sum_{i=1}^{n} \sum_{x_i=0}^{\alpha_i'-1} \frac{\Gamma(\alpha_j' + x_i)}{\Gamma(\alpha_j')x_i!} \left(\frac{1}{2}\right)^{\alpha_j'+x_i} +$$

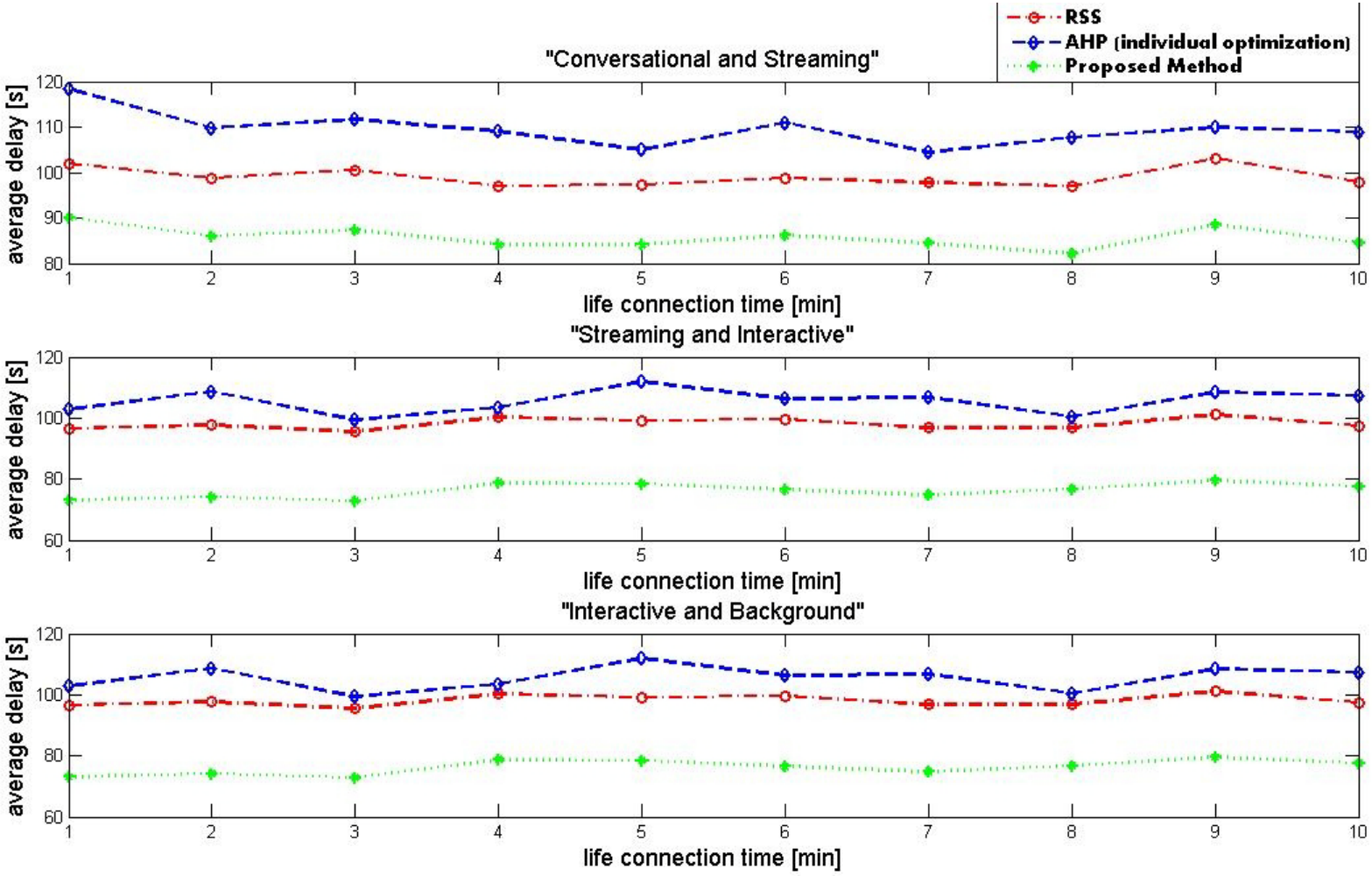
$$+ \sum_{h=2}^{n-1} \left[(-1)^h \sum_{I(i_h)} \sum_{x_{i1}-1}^{\alpha_{i1}'-1} \sum_{x_{i2}-1}^{\alpha_{i2}'-1} \cdots \sum_{x_{ih}-1}^{\alpha_{ih}'-1} \frac{\Gamma(\alpha_j^t + \sum_{l=1}^{h} x_{il})}{\Gamma(\alpha_j') \prod_{l=1}^{h} x_{il}!} \times \right.$$

$$\left. \times \left(\frac{1}{h+1}\right)^{\alpha_j' + \sum_{l=1}^{h} x_{il}} \right] \quad (5)$$

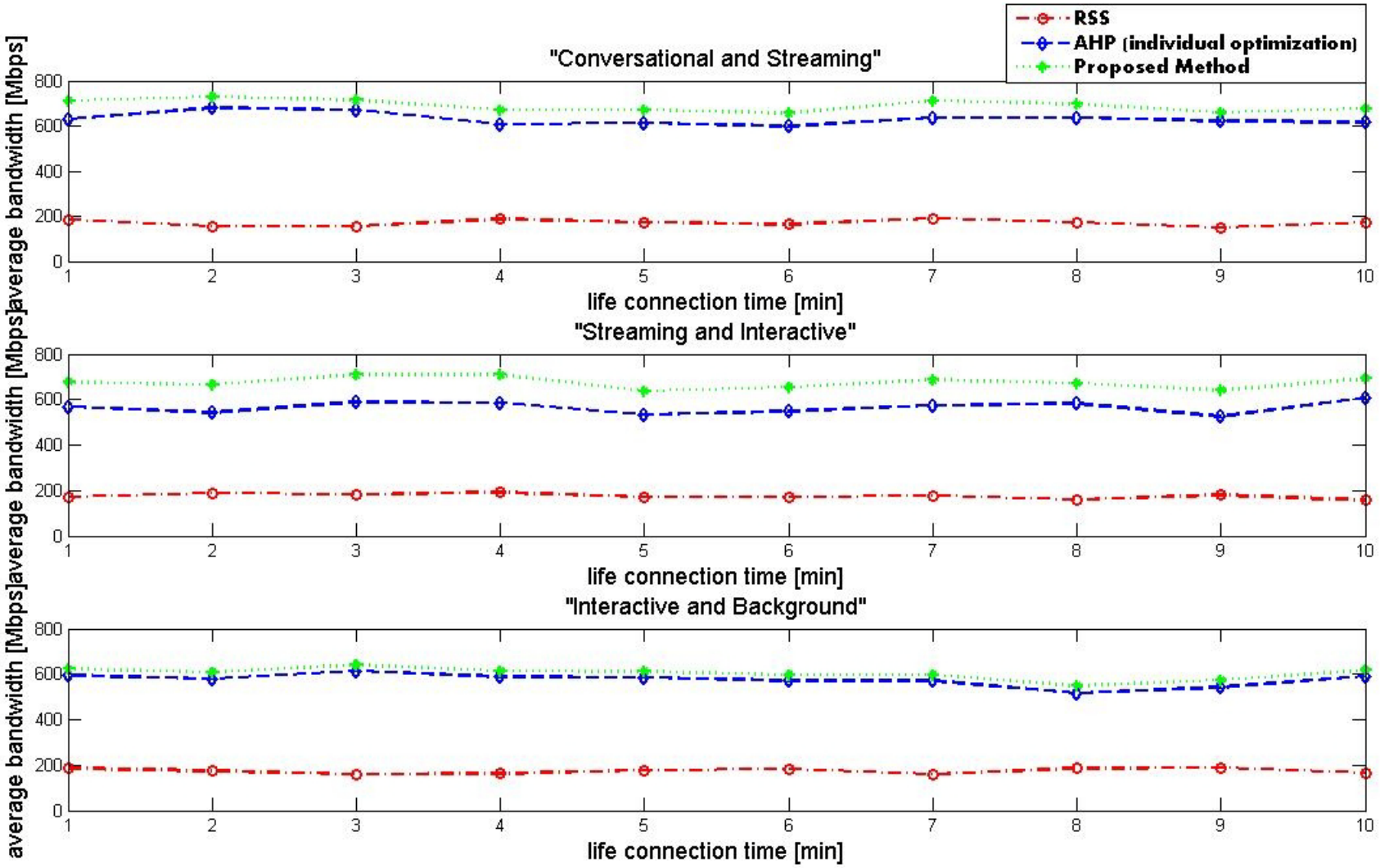
Performance comparisons

- **Coverage area:** UMTS and GPRS networks.
- **Traffic classes 3GPP:** conversational, streaming, interactive and background.
- **Simultaneous sessions at the mobile node:**
  - Conversational and streaming
  - Streaming and interactive
  - Interactive and background
- **Connection lifetime**: exponentially distributed, varied between 1-5 minutes.

Results



Results



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Conclusions

- QoS requirements must be considered in the handoff process.
- The proposed algorithm handoffs to the network with the best QoS when the mobile node carries multiple communications sessions.
- Our algorithm is sensitive to changes in the network conditions

Thanks! Merci !