AI for quality enhancement of video streaming for ageing adults' entertainment in rural areas

M. Jesús-Azabal, J. Galán-Jiménez, J. García-Alonso

Purpose Video streaming has emerged as a leading main multimedia trend, offering entertainment to the ageing adult population (Cui, K. et al.). This technology serves as a valuable tool for alleviating feelings of loneliness, allowing for the enjoyment of both recorded and live content, including films and video calls. Such services necessitate high Quality of Service (QoS), dependent on the availability of technologies such as 4G, 5G, and cloud computing. However, many isolated rural areas suffer from a lack of communication infrastructure, attributed to either the necessary financial investment or geographical challenges. In these contexts, the deployment of streaming-based applications becomes a challenge, adversely affecting the quality of life for the rural populace. Mobile Adhoc Networks (MANETs) present an alternative solution for these scenarios, supporting data transmission between devices without the need for a centralized control unit and utilizing wireless interfaces such as WiFi or Bluetooth. Thus, these devices can move around, changing network's structure and leading to varying connections. Yet, this dynamic nature poses its own set of challenges, introducing instabilities in the links and complicating the consistency of the network (Goyal P. et al.). This abstract outline a communication architecture designed for video streaming over MANETs in remote rural regions. Utilizing a Machine Learning (ML) model, it classifies connections by their stability to optimize video frame compression. **Method** Referencing Figure 1, the architecture differences two key node types: senders and receivers. The first one is responsible for broadcasting video, both live-streamed or stored. To adjust video quality based on the current stability of ad-hoc links, sender node periodically pings nearby devices to evaluate communication metrics (1 and 2) and predict stability with the ML-trained model (3). Variables such as latency, bitrate, connection attempts, and bit error rate are considered to classify links into three distinct reachability levels: stable; semi-stable, and unstable. Accordingly, video frames are compressed based on the prevailing communication conditions (4). Furthermore, some unstable links may become unreached by the sender, requiring receiver nodes to route streaming towards these devices, pinging nearby nodes, classifying new links, and adapting compression to the stability (5). This strategy enables video broadcasting to devices beyond the range of the wireless interface. **Results and Discussion** A proof-of-concept was developed to assess the ML classification's effectiveness and the QoS improvement. Utilizing a boosted decision tree algorithm, the model was trained with actual MANET communication data. Subsequently, the model was integrated into a smartphone application, implemented to broadcast live-video. Four laboratory tests were conducted with three real smartphones: one acting as sender; another as a stable receiver node, close to the sender; and another smartphone situated beyond the sender's range. In this arrangement, latency was recorded and compared to results from non-adaptive streaming scenarios. As depicted in Figure 2, latency is significantly reduced with the proposed architecture, enhancing QoS and offering a viable option for video streaming in disconnected rural areas.

References

Cui, K., Zou, W., Ji, X. *et al.* Does digital technology make people healthier: the impact of digital use on the lifestyle of Chinese older adults. *BMC Geriatr* **24**, 85 (2024). https://doi.org/10.1186/s12877-023-04651-1

Goyal P, Rishiwal V, Negi A. A comprehensive survey on QoS for video transmission in heterogeneous mobile ad hoc network. *Trans Emerging Tel Tech*. 2023; 34(7):e4775. doi: 10.1002/ett.4775

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Affiliation: Departamento de Ingeniería de Sistemas Informáticos y Telemáticos, Universidad de Extremadura.

Email: manuel@unex.es; **ORCID iDs: (**0000-0003-0824-6956); (0000-0002-5476-7130); (0000-0002-6819-0299).

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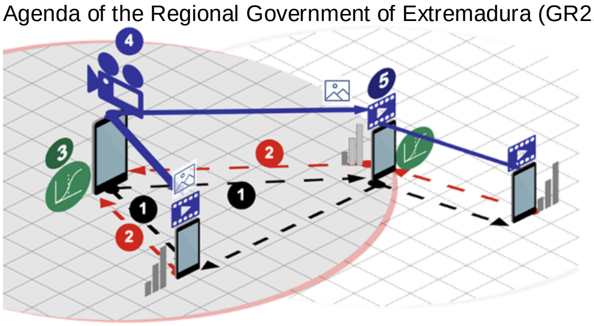

Figure 1. Steps of communication architecture

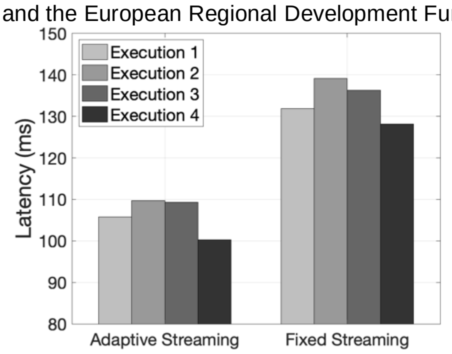

Figure 2. Latency results comparison