

A Cooperative Architecture with AI for Enhancing Multimedia QoS and QoE

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멀티미디어 QoS 와 QoE 개선을 위한 AI 기반 협력 아키텍처

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Abstract

The real-time network status information plays a vital role in supporting a desired level of Quality of Service (QoS) and Quality of Experience (QoE) for multimedia services. This paper presents a new approach for enhanced multimedia services using a cooperative architecture focused on improving both QoS and QoE. Leveraging an AI-driven high-level optimizer, decisions regarding video/audio encoding rates and data transmission rates between senders and receivers in the five-layer TCP/IP architecture. All layers share relevant information with the AI-based high-level optimizer. Through collaborative interactions with the help of an AI-based high-level optimizer, the proposed architecture can be used to adapt to dynamic network conditions.

I. Introduction

In today's rapidly evolving multimedia landscape, ensuring a certain level of QoS and QoE has become essential to meet the rising demand for seamless experiences [1]. This paper presents an AI-driven cooperative architecture for supporting optimized QoS and QoE for multimedia services considering various network conditions. In particular, with the use of AI, the proposed architecture enables decisions on appropriate video/audio encoding rates and data transmission rates, leading to the optimization of bandwidth usage and latency for multimedia services. It can provide a highly adaptive solution in the various network situations.

II. Method

Figure 1 presents a comprehensive overview of the AI-driven cooperative architecture, illustrating its layered structure and information flow between the components. At each layer of the architecture, pertinent network information is shared with the AI-based high-level optimizer in both sender and receiver for making decisions to optimize multimedia QoS and QoE according to the network status. For instance, the physical layer provides Signal-to-Noise Ratio (SNR), Signal-to-Interference-plus-Noise Ratio (SINR), Bit Error Rate (BER), Channel Quality Indicator (CQI), and Channel Reliability Information (CRI) are used while the data link layer provides Packet or Frame Error Rate (PER or FER), Frame Loss Rates (FLR), Source Decoding Information (SDI) and other relevant information.

Similarly, the network layer provides packet loss rate (PLR), delay, routing metrics, congestion level, and QoS class. The transport layer provides transport-related parameters such as window size, buffer size, and CRI, while the application layer shares information on latency, reliability, throughput, SDI, and application-level quality parameters. This collaborative exchange of layer-specific information can be used to help the AI-driven high level optimizer to make strategic

adjustments with involved layers, ultimately enhancing multimedia QoS and QoE for end users.

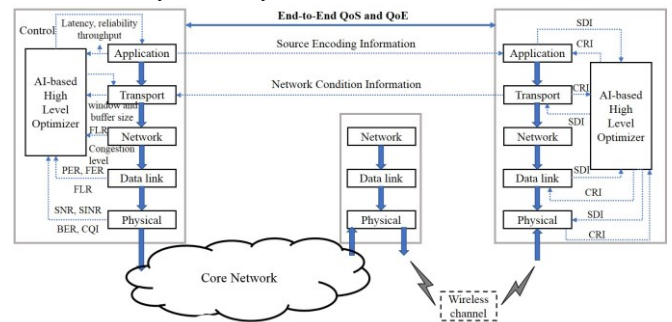


Figure 1: AI-driven cooperative QoS/QoE control architecture

III. Conclusion

In this paper, we presented an AI-driven cooperative architecture for supporting a desired level of multimedia QoS and QoE. Through the intelligent adjustment of encoding rates and data transmission rates with AI, it is possible to support the enhanced management of bandwidth usage and latency to maintain a certain level of multimedia services, providing a highly adaptive solution in the various network situations.

ACKNOWLEDGMENT

This work was supported by Institute of Information & Communications Technology Planning & Evaluation (IITP) grant funded by the Korea government (MSIT) (No. 2021-0-00484). This research was supported by the MSIT (Ministry of Science and ICT), Korea, under the ITRC (Information Technology Research Center) support program (IITP-2023-RS-2022-00156353) supervised by the IITP (Institute for Information & Communications Technology Planning & Evaluation).

REFERENCES

- [1] Zia, Kamran, Alessandro Chiumento, and Paul JM Havinga. "AI-enabled reliable QoS in multi-RAT wireless IoT networks: prospects, challenges, and future directions." IEEE Open Journal of the Communications Society 3 (2022): 1906-1929.