Evaluation method for multimedia applications by Scenargie emulator

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ABSTRACT

It is highly essential to evaluate multimedia applications based on the quality perceived by users. We have developed an emulation capability on Scenargie, a comprehensive simulation framework to accommodate this need. The emulation technique allows operational codes of applications and communication system models to synchronize as if simulation models are part of a physical communication system. In this paper, we describe that the users of our developed emulator can perceive the quality of real multimedia applications with various system configurations, and also describe quality deterioration due to network conditions.

Keywords: simulation, emulation, performance evaluation, quality of experience, multimedia.

1 INTRODUCTION

IEEE802.16m and LTE-Advanced are under standardization process toward to the next generation mobile communication systems. These communication systems are expected to provide higher data rate of downlink as well as uplink to achieve content-rich multimedia applications. In order to evaluate these applications, testbeds using physical systems or computer simulations are commonly utilized. However, they have pros and cons respectively.

As for testbeds, we can evaluate system performance and quality of applications under reality-based situations. Yet it is almost impossible or too difficult to evaluate concept-level system and various network system configurations and topologies. Also, it requires more time and cost than computer simulations.

As for computer simulations on the other hand, we can configure system parameters and evaluate several situations easily. However, evaluation metrics are mostly limited to system performance such as throughput and delay. To evaluate the quality of multimedia applications, it is important to measure service quality that users can perceive (Quality of Experience: QoE). Computer simulations cannot provide such capability by itself.

Therefore, we have developed an emulation capability on Scenargie, a comprehensive simulation framework [1]. Our developed emulator seamlessly integrates operational physical systems and simulated virtual networks. In this paper, we describe the quality evaluation method for real multimedia applications with our developed emulator. We also describe how it enables us to evaluate QoE for real multimedia applications through demonstrations.

2 QUALITY EVALUATION METHOD FOR MULTIMEDIA APPLICATIONS

QoE is an important metric to evaluate multimedia applications. Two requirements to evaluate applications by QoE are derived; (1) to evaluate the quality user perceive through experiencing applications directly, (2) to evaluate an overall network system. Subjective evaluations are widely utilized to evaluate multimedia applications such as video streaming services. However, evaluation targets are mostly limited to applications. Also, system performances such as packet error rate and delay are given as input parameters and are out of evaluation scope.

Meanwhile, as for computer simulations, applications are modeled as sources of traffic generation. If we assume reality-based situations, we have to model not only applications but user behaviors. However, user modeling is very difficult, and simple models such as Poisson distribution are assumed as traffic generation interval and service duration. As a result, both evaluation methods by physical system and computer simulation do not meet two requirements mentioned above. Therefore, we have designed and developed an evaluation method with an emulator to meet these requirements.

Figure 1 shows the relationship between network system layers and evaluation methods. Network system layers include radio propagation environment under physical layer and user over application layer. Three evaluation methods are described in Figure 1. First method is testbed which utilizes physical systems including network systems and handsets. Second method is computer simulation in which network systems and applications are modeled. Third method is emulation which combines physical systems and simulations seamlessly. Emulation can be built in two

implementation types. One is that only application is physical system, and other parts are modeled and simulated.

In this case, physical system and simulation are combined by TCP/IP using socket connection. The other is that a device driver is introduced, and layers under data link are simulated. This implementation enables us to evaluate multimedia applications by using real handsets.

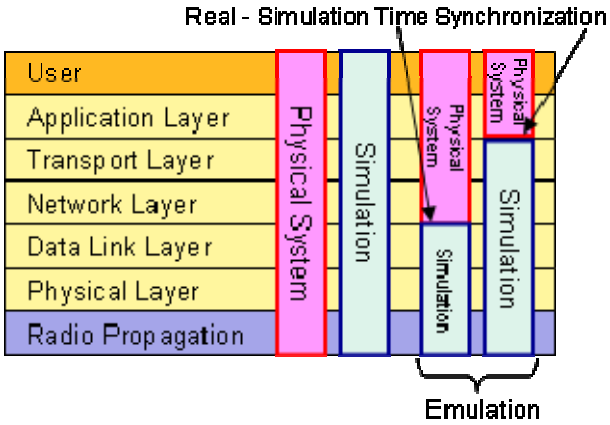

Figure 1: Network system layers and evaluation methods.

3 EMULATOR

3.1 Scenargie

We have developed an emulation capability on Scenargie, comprehensive simulation framework [1]. Scenargie is not limited to conventional network simulation framework, and it integrates Geographical Information System (GIS) tool and database system. It is designed to alleviate pre process and post process works such as creation of evaluation scenarios and analysis of simulation results both for engineers and for researchers. Also, it discloses source code for all network system models. Therefore, engineers and researches can customize and validate models by themselves, and that improves validity and reliability of simulation models. In addition, time synchronization is required to achieve emulation capability. As Scenargie runs faster than real time and other commercial and noncommercial simulators [2], it is best for emulation.

3.2 Emulation engine

Figure 2 shows the architecture of our developed emulator. Emulation engine relays packets between real multimedia applications and synchronizes simulation time and actual time. First, emulation engine receives packets from real application and simulates packets behavior under a given simulation scenario. Then, emulation engine reflects simulation results such as packet loss or latency to actual packets and forwards packets to receiving application. This mechanism enables us to evaluate applications according to dynamic changes in system parameters and topology while testbeds using overall physical systems cannot handle such situations. Also, the users of our emulator can perceive the quality of real multimedia applications with various system configurations and also quality deterioration due to network conditions.

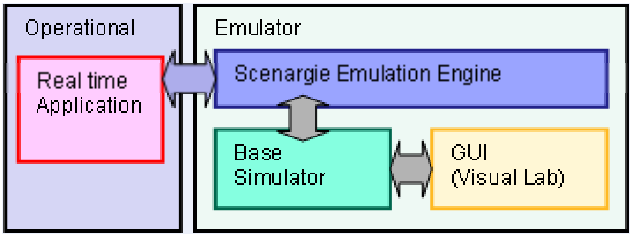

Figure 2: Emulation architecture.

4 DEMONSTRATION

Figure 3 shows the demonstration concept of our developed emulator. We have adopted wireless LAN system as simulated virtual network system and Skype as a real multimedia application. We have installed Skype in two laptop computers and also installed our developed emulator in one of them. Our emulator can operate as a proxy server and relay packets between two Skype applications. Specifically, we have utilized iptables in Linux and configured it to forward packets from real applications to our emulator. This setting enables the emulator to receive UDP packets from Skype and send to the receiving side. All packets entering the emulator are simulated under a modeled network system considering radio propagation. Many communication nodes (access points and mobile terminals) can be virtually and easily deployed as target communication system. As a result, we can watch behaviors of actual packets by Graphical User Interface (GUI) and also perceive the voice and video qualities of Skype after simulation.

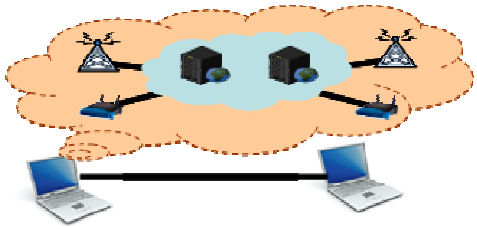

Figure 3: A combination of physical and simulation systems.

5 CONCLUSION

In this paper, we have described our developed emulator to evaluate real multimedia applications. The emulator integrates simulation and physical system, and it leverages the benefits from both to evaluate QoE. For further research, we plan to extend emulation capabilities such as handling physical handsets to achieve more intuitive and reliable evaluations.

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