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Emulation of heterogeneous networks for experimental environment

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Abstract

Information services are used on various places due to improved convenience and performance of hardware. Traditional information services were area of information exchange. However, current information services like ubiquitous computing, and Internet of Things(IoT) handle a variety of information such as location, temperature, and state of things. It is no exaggeration to say that information services are a part of infrastructure for human life. On the other hand, most information services composed on network environment. Furthermore, various technologies have been introduced in network environment from requirements for convenient and high speed. Communication devices such as laptop PC, mobile devices, and IoT devices use wireless network technology because it can uses Internet connectivity anywhere. In addition, various functions are introduced into wireless network technology for improvement of reliability. Network environment has become heterogeneous due to diversification of information services and communication devices and network technologies.

In heterogeneous network environments, communication devices are connected by different technologies. Therefore, in order to construct experimental environment, it is necessary to prepare various communication devices. In wireless network, network quality is depending on a density, mobility, and propagation characteristics. For this reason, unexpected events are likely to occur, and comprehensive verification is difficult. It is also difficult to reproduce the situation even if developer found defects and fixed them. To enable verification this environment, Network TestBED provides reproducible verification environment by construct wired, and wireless network environment. However, several Network TestBED are targeted to specific network technologies. Therefore, it is impossible to reproduce a heterogeneous network environment. Network TestBED is necessary to wireless network emulation not to depend network protocols for follows the evolving network technology. In addition, emulation of various communication media is necessary because network devices use them.

This thesis proposes two approach for heterogeneous network emulation. First, reproduction of propagation characteristics. Other one, reproduction of hi-fidelity wireless network. Reproduction of propagation characteristics apply propagation characteristics calculated from density, and mobility to network packets. Wireless network emulation independent of network protocol is possible by network emulation at lowest layer. Therefore, I expand applicable network protocols for software validation. Thereby, it possible to construct a verification environment introducing various network protocols. Reproduction of high-fidelity wireless network is enabling communication used various communication media over a wired network. Conventionally, when conducting verification of communication media, it was necessary to use a network simulator or use many actual devices. Network simulator does not possible to real time verification because computational effort increases by number of nodes. Additionally, it is necessary to modify verification target for network simulation. Verification used actual devices is possible to real time verification, but it is difficult to construct large-scale environment. Therefore, in this thesis, to provide API similar to actual devices to a verification target. Thereby, it is possible to real time verification and reproduce hi-fidelity wireless network emulation without modify verification target. This is allow the verification of various network technologies, and information services, thereby to help a more valuable information service.

Key Words: Wireless Networks, Network Emulation, Network system evaluation,
Network TestBED, Large-scale experimental environment