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Software-Based Validation of the Differentiation Scheme for Ethernet and Wireless LAN Access Network Types Using an End-to-End Approach

Pritee Parwekar, Dept of CSE, SRM Institute of Science & Technology, SRM University Delhi - NCR Campus, New Delhi, India

https://orcid.org/0000-0002-2439-1507

Adilya Bakambekova, School of Engineering, Nazarbayev University, Nur-Sultan, Kazakhstan

Talgat Bizhigit, School of Engineering, Nazarbayev University, Nur-Sultan, Kazakhstan

Yeldar Toleubay, School of Engineering, Nazarbayev University, Nur-Sultan, Kazakhstan

ABSTRACT

Different access network types are characterized by a variety of attributes which include link bandwidths, physical media, capacity, and reliability. Therefore, the question of accurately identifying whether the sender uses a wired ethernet connection or a wireless LAN connection comes into place. This article aims to analyse, simulate, validate, and improve the existing classification scheme which is based on measuring entropy of packet pair inter-arrival times and median. A riverbed modeller (former OPNET) is used for simulating the different scenarios. Small-scale experiment conducted on campus at the Nazarbayev University (NU) validates the insignificance of the packet probe size chosen for the classification.

KEYWORDS

Access Network Types Classification, Entropy, Median, OPNET, Riverbed

1. INTRODUCTION

There are a number of possibilities on constructing a network based on different types of links. HFC (hybrid fibre coaxial cable), ADSL (asymmetric digital subscriber line) and Dial- Ups are commonly used link types in a residential area. Furthermore, 802.11b or wireless LAN connections are gaining popularity in residential and office environment. In the paper, they will be referred to as WLAN, Ethernet, ADSL, cable modem and dialups. Since each type of connection has its unique traits, such as symmetry of upload and download bandwidths, physical media and capacity of each link type, user behaviour differs for different types of links. For instance, wireless and dial-up connections could have short connection durations, while cable and ADSL have longer connection durations.

Ethernet and switched Ethernet will be referred equally as a high-bandwidth Ethernet connection. However, ADSL, cable and dialup connections are not commonly used nowadays, so only Ethernet and WLAN network types are considered. Accurate connection type classification is not applicable

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easily, since the end system either have no knowledge about connection type or report inaccurate connection type, which may result in the degraded connection of network.

Wi-Fi is useful technology for continuous advances and updates. However, there are few harmful effects of allowing old legacy IEEE 802.11b transmissions in modern WLAN deployments. Lopez-Aguilera et al. (2019) has analysed IEEE 802.11, coverage range and throughput performance among subsequent amendments is compared and also explained the drawbacks and benefits of including protection mechanisms. Broby et al. (2019) has suggested a working policy and its parameters to generate a full path policy for every function node to improve the overall network resource utilization. Loeser et al. (2004) in their work on communication over switched network have discussed use of commodity Switched Ethernet technology can be used for low-latency hard real-time communication. Patent by Zhang et al. (2019) has proposed to select the network route combining traditional route table entries and session specific identity policy information to enable a network operator to apply separate policies to different network entities based on their credentials whereas Liu (2019) in his patent has provided a network registration method and registration device for a terminal, and the terminal supports network standards of multiple operators. The network registration method includes the identification code of a subscriber. Identity module is obtained after the subscriber identity module is installed on the terminal. It is required to choose the required connection and protocol suitable for the given network. The selection of a connection plays an important role in real-time networks and now in internet of things (IoT) networks communication technologies for the diverse needs for information exchange in micro grids are studied by De Souza et al. in their work on Microgrid design and implementation. With the use of different types of hardware, it is required to have a standardization of technology both in operational and internet. Felser et al. (2019) have shown a merger of operation technology and information technology which is a requirement of real time applications.

The classification scheme used and analysed in this paper is adopted from Wei et al. work and it provides end-to-end determining of the access network type. Types of access networks are Ethernet and WLAN. The packet-pairs are sent from sender A to receiver B, and results based on the packet- pairs from node B would deliver the classification type. The approach considers entropy of the inter-arrival time of packet pairs and median from node B. The graphical results obtained from a combination of entropy and median would deliver different characteristics for each access network. The main objective of this paper is to consider the simulation of the classification scheme in the cases of different packet probe sizes, as well as performing the actual experiment. This works organization starts with chapter 2 which contains background for the access networks types, while chapter 3 will deliver the connection classification schemes. Furthermore, the analytical basis will be provided in chapter 4. Final two sections contain an empirical data and conclusion for this paper.

2. BACKGROUND

In this paper, two most popular access networks were considered for the classification purpose. Therefore, this section provides an opportunity to recognize the access network type by identifying the mechanism inside an access protocol. The IEEE 802.11 standard will be described and the main differences of it from Ethernet will be shown.

2.1. IEEE 802.11 Standard

In wireless network connections, it is important to control the access of the shared media over multiple stations. Thus, IEEE 802.11 standard for WLAN is used as definition of the physical layer and the media access control (MAC) layer for the network as given in IEEE Computer Society LAN MAN Standards Committee. As shown by Ambhati et al. (2019) the IEEE 802.11ah (Wi-Fi HaLow) aims for longer distance, low data rate and scalable network. IEEE 802.11ah offers sufficient data rate for frequent bidirectional communication Seferagić et al. (2019) have checked scalability of IEEE 802.11 ah for low-latency time-critical control loops and sensor data reporting.