ABSTRACT

Wireless local area networks (WLANs) are commonplace in many universities. Understanding the trends in the usage of these networks is becoming more important. Interesting results can be extracted about association patterns by analyzing WLAN traces from real scenarios. In this work, the library in the main campus of the Technical University of Catalonia (UPC) in Barcelona has been studied. Daily and weekly patterns of the WLAN connections are shown. The population accessing the network is mostly composed of infrequent users: half of the population accesses the WLAN once during each month. Many users associate to only one of the twelve possible access points, which means that, despite the widespread use of lightweight devices, many users are static. The results of this analysis provide general tools for characterizing campus-wide WLAN and a better understanding of usage and performance issues in a mature wireless network.

Keywords: Measurements, Mobility, Syslog, User Behavior, WiFi, Wireless Local Area Networks (WLAN), WLAN 802.11

INTRODUCTION

By the end of the previous decade, wireless communications were becoming widespread in many fields and commonplace in many environments, and people were becoming used to moving around while connected. Users are increasingly interested in taking advantage of the flexibility of wireless technology, and a boom in its implementation for local area networks has been seen. Universities have pioneered the development of infrastructure to provide connectivity all over campus. An example is the Wireless Andrew at the Carnegie Mellon University campus (Hills, 1999), an enterprise-wide broadband wireless network developed in 1993. Currently, it is common for a university to provide wireless connections for its employees and students. In educational environments, the use of laptops is becoming universal in classrooms. Mobile learning (mLearning) challenges universities to allow students’ wireless connections to the Internet whenever and
wherever they want while they remain within the university campus. Wireless technologies offer an excellent support for mLearning activities (Buending, 2009; Divitini, Haugalokken, & Norevik, 2002; Lehner & Nosekabel, 2002; Liu, Liang, Chan, & Yang, 2002; Sampson, 2006). To encourage the mobility of researchers and European students, the Education Roaming project (eduroam) was developed in 2003 (Wierenga & Florio, 2005), providing wireless connectivity through different institutions all over Europe. In this way, users from corporations taking part in the project can access the Internet using the wireless networks of other institutions participating in the same program.

Research has been carried out to understand the use of wireless networks in different scenarios, like campus-wide universities (Henderson, Kotz, & Abyzov, 2008; Hutchins & Zegura, 2002; Kotz & Essien, 2005; McNett & Voelker, 2005; Papadopouli, Shen, & Spanakis, 2005b; Schwab & Bunt, 2004; Tang & Baker, 2000; Zola, Barcelo-Arroyo, & Lopez-Ramirez, 2009; Zola & Barcelo-Arroyo, 2010), corporate networks (Balazinska & Castro, 2003), conference rooms (Balachandran, Voelker, Bahl, & Rangan, 2002), hotspots (Blinn, Henderson, & Kotz, 2005), and metropolitan area networks (Tang & Baker, 2002). All of these works differ in the way data are collected; tcpdump, the Simple Network Management Protocol (SNMP) and syslog are the most common tools. Tcpdump is normally used to sniff the traffic and analyze the applications run by users and the number of data managed in the network (Henderson et al., 2008; Kotz & Essien, 2005; Tang & Baker, 2000), while SNMP is applied to poll periodically the access points (APs) of the network (Balachandran et al., 2002; Balazinska & Castro, 2003; Blinn et al., 2005; Hutchins & Zegura, 2002; Tang & Baker, 2000) and obtain information regarding the authenticated/associated users and their approximate locations (i.e., the coverage range of the AP to which a user is associated). Information on the authenticated/associated devices at each AP can also be obtained through syslog (Kotz & Essien, 2005; Papadopouli et al., 2005b; Zola et al., 2009; Zola & Barcelo-Arroyo, 2010), a standard for forwarding log messages in an IP (Internet Protocol) network. Although polling-based trace collection is suitable for usage statistics, it is not very suitable for deriving the association patterns of users (Hsu & Helmy, 2006) because they tend to overlook details of association changes due to the polling interval. Differences may also be found in the duration of the period analyzed; some span a period of a week (Balachandran et al., 2002; Schwab & Bunt, 2004; Zola et al., 2009), in which case weekly cycles cannot be observed, others one month (Balazinska & Castro, 2003; Blinn et al., 2005); others three to five months (Henderson et al., 2008; Hutchins & Zegura, 2002; Kotz & Essien, 2005; McNett & Voelker, 2005; Papadopouli et al., 2005b; Tang & Baker, 2000; Zola & Barcelo-Arroyo, 2010), in which case monthly patterns can also be observed. Each work can also involve different numbers of users. In previous studies, number of users ranged from 74 users in the earliest study (Tang & Baker, 2000) to 195 during a three-day conference (Balachandran et al., 2002) and from one to eight thousand in wider environments (Balazinska & Castro, 2003; Blinn et al., 2005; Henderson et al., 2008; Kotz & Essien, 2005; Papadopouli et al., 2005b; Zola et al., 2009; Zola & Barcelo-Arroyo, 2010).

All previous works analyzed the wireless data during the early stage of their implementation, from 1999 (Tang & Baker, 2000) to 2004 (Henderson et al., 2008), and they refer to behaviors observed in North America. To our knowledge, no study has been published yet about European academic environments. In this work, we process data recently collected at the Technical University of Catalonia (UPC), Spain, from March to May 2009. UPC is composed of eight different campuses in Barcelona and its surroundings. Unlike Kotz and Essien, (2005), in which the authors analyzed behaviors at 161 buildings, we analyzed wireless local area network (WLAN) traffic at each building separately to deal with homogeneous data and not to mix behaviors from different populations.

The library at the main campus in Barcelona (BRGF) was selected. The aim was to broaden previous analysis at BRGF (Zola et al., 2009; Zola & Barcelo-Arroyo, 2010) by analyzing...
A Trusted Ubiquitous Healthcare Monitoring System for Hospital Environment
www.igi-global.com/article/a-trusted-ubiquitous-healthcare-monitoring-system-for-hospital-environment/183628?camid=4v1a

Fault Tolerant Cloud Systems
Sathish Kumar and Balamurugan B (2019). *Advanced Methodologies and Technologies in Network Architecture, Mobile Computing, and Data Analytics* (pp. 171-190).
www.igi-global.com/chapter/fault-tolerant-cloud-systems/214613?camid=4v1a