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Wideband Local Access: Wireless LAN and Wireless ATM

Kaveh Pahlavan, Ali Zahedi, and Prashant Krishnamurthy

Center for Wireless Information Network Studies
Electrical and Computer Engineering Department
Worcester Polytechnic Institute
Worcester, MA 01609
Tel: (508) 831-5634
Fax: (508) 831-5491
kaveh@wpi.edu, azahedi@wpi.edu, prashant@wpi.edu

INTRODUCTION

Although Wireless Local Area Networks (WLANs) and Wireless ATM (WATM) both provide Wideband Wireless Local Access (WWLA), there are differences and similarities among the two. WLAN is a mature technology with available products and market, WATM is an evolving technology that has not yet tested the market. WATM is perceived to be a service provided by the operating company. WLANs are considered as products sold by the manufacturer. WLANs provide an access to legacy LAN applications. WATM is expected to provide end-to-end ATM connectivity and Quality of Service (QoS) in the wireless channel. In this paper we address these issues in further detail and provide an overview of the global WWLA activities.

We are emerging at the beginning of a new and exciting era for the wideband wireless local access (WWLA) industry. After a decade of self realization for this industry, WLAN and inter-LAN bridges are finding their way into the health care, manufacturing, finance, and educational markets. According to the January 1997 Frost & Sullivan's report on the North American Wireless Office Hardware market, the total 1996 revenue for wireless offices was $390 million of which $218 million was from WLANs. The IEEE 802.11 standard for WLANs is emerging as a mature standard presenting a well defined technology that is being adopted by the manufacturers and accepted by the users. Chipsets have been developed according to the IEEE 802.11 standard, making software creativity easier for developing new applications towards expanding the market. ETSI's RES-10 group has defined another alternative technology, HIPERLAN I, which primarily has a focus towards ad-hoc networking applications and supports higher data rates. More recently, research around wireless ATM has soared like an epidemic, engaging numerous companies in examining the suitability of yet another alternative standard technology for WWLA.

The successful emergence of the market for WLANs operating in the unlicensed ISM bands has underlined the need for additional unlicensed bands. The continual demand of the WWLA industry for additional unlicensed bands in useful spectrum, initiated by WINForum, has resulted in the release of a 20 MHz unlicensed band around 1.9 GHz for asynchronous and isochronous applications in 1994 and 300 MHz of unlicensed bands earlier this year at 5 GHz referred to as the U-NII bands (formerly SUPERNet). On the other hand, the pan-European third generation cellular service (UMTS) is considering connectionless packet switched networks as class D bearer services. Under the research arm ACTS, the MEDIAN, WAND, SAMBA, and AWACS projects are addressing WWLA services. The Japanese are engaged in developing their own WWLA technology and at the same time several Japanese companies are involved in developing WLAN products for the US market.

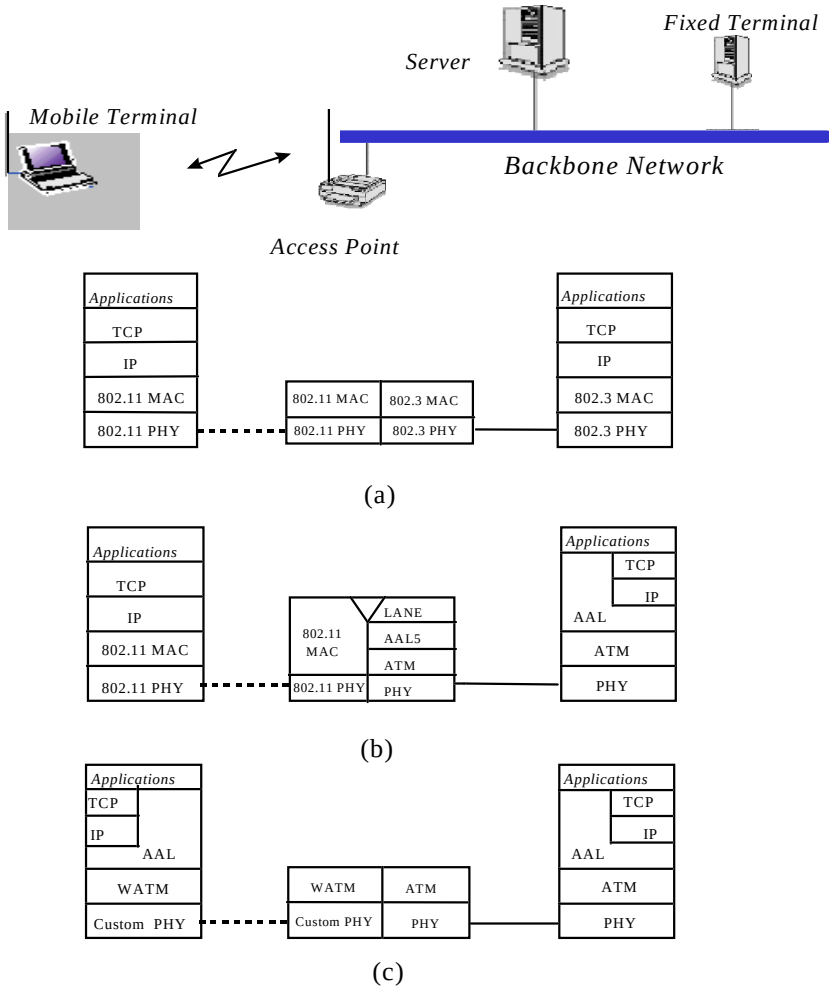

Figure 1 : WLAN connection to the backbone.

Wireless access cannot be discussed without considering issues related to the backbone. There are four options to interconnect the two air interfaces, WLAN and WATM, to the two wired backbones, legacy LANs and evolving ATM networks, namely WLAN-LAN,

WATM-ATM, WLAN-ATM, and WATM-LAN. Figure 1 shows the protocol stack needed for the respective implementation of these interconnection techniques. The first option shown in Figure 1.a is addressed by the IEEE 802.11 community. The other two options are considered in the WATM community. The second approach, shown in Figure 1.b, has more overhead, is expensive, and less scalable. At this stage this technique is considered only as an interim solution for migration and proof of concept [AYA96]. The fourth option WATM-LAN is not considered because a WATM air interface assumes that the backbone network employs ATM switches. Therefore, we are left with two options WATM-ATM and WLAN-LAN which we will refer to as WATM and WLAN in the rest of this paper.

SERVICE SCENARIOS

The success of WLANs or WATM depends on the availability of the corresponding backbone wired infrastructure and the evolution of the software applications. The backbone wired network consists of long-haul and local backbones. Today, it is commonly assumed that the future long-haul backbone networks will employ ATM transport and ATM will also be the backbone of the third generation wireless telecommunication networks. However, there is an on going battle between the connection based ATM local backbones versus contention based local legacy LAN backbones. Whether the backbone network of the future uses ATM only for long-haul and the legacy wired LAN technologies for local access or whether we will have an end-to-end wired ATM network will be a major deciding factor on the success of WLANs or WATM. The battle between ATM and Gigabit Ethernet for wired local access is not yet resolved [MCG96] and an unbiased prediction of the direction of this religious war is extremely challenging and beyond the scope of this paper.

Service scenarios for the future WWLA can be categorized into private local networks in workplaces, universal access point in homes, and nomadic access in public places [GIL96]. The existing WWLA market is almost exclusively for the wireless office equipment using TCP/IP based applications over WLANs. The WLAN technology provides wireless access to the legacy LANs which support TCP/IP applications with minimal overhead. ATM in general has been shown to be inefficient in supporting legacy TCP/IP applications [LIP96, BER96]. The ATM local backbone is expected to be suited for the future multi-media applications supporting variety of traffic categories with a negotiable quality of service (QoS). Using RSVP for the TCP/IP applications the legacy LAN local backbone can support quality of service for multi-media applications [LAM97]. Potential wireless applications in home include universal wideband access for a variety of services such as cordless telephony, Internet access, and flexible positioning of audio systems. The WLAN technology can support all these applications but WATM could be more suitable for cordless telephone applications that may generate most of the in-home wireless traffic. Nomadic public access again depends on the availability of the backbone network. If the ATM networks are available in most public places, it may appear to be easier to provide traffic policing and charging mechanisms using WATM. If

legacy wired LAN backbones are available, WLAN technology can also provide charging mechanisms but it is rather challenging to enforce traffic policing.

MARKET AND PRODUCTS

One of the most challenging issues facing the WLAN industry is expanding the market. Those involved in traditional WLAN industry promote privately owned WLAN applications, such as a campus area networks - a market for PCMCIA cards and access points in large quantities. The more visionary "service providers" are eager to promote nomadic WWLA applications in public places, such as airports, to generate a new source of income through service charges. Today only WLAN products exist in the market and WATM services are expected to appear in the market only by the turn of the century.

In the past, the WLAN industry had a difficult time in predicting the development of the market. In 1990 the first generation WLAN products appeared in the market. These products, consuming around 20W (not suitable for laptops), were considered as an alternative that would avoid the expensive and troublesome installation and relocation costs of the coaxial cabled LANs. Under the assumption that WLANs would capture 10-15% of the coaxial cabled LAN market, early market predictions for WLANs were around $0.5-2 billion for the mid 1990's. However, by the time WLAN products appeared in the market, less troublesome twisted pair wiring technology, similar to existing telephone wiring, had already replaced the coaxial cabled LAN technology, so that the first generation WLANs did not meet the market predictions.

The second generation WLAN industry evolved in two directions. One group developed PCMCIA card WLANs for laptops to address the need for local mobility and its related applications. The other group added directional antennas to the first generation shoe-box type WLAN products and marketed them as inter-LAN bridges for outdoor applications [PAH95a, PAH95b, PAH85]. The existing WLAN products available on PCMCIA cards are either direct sequence spread spectrum (DSSS) or frequency hoping spread spectrum (FHSS) operating in ISM bands. The diffused IR technology is used for nomadic access in shorter distances for applications such as access for laptops to printers or in specific areas within the hospitals, such as radiology departments, where using radio signal is not encouraged. In addition to spread spectrum technology, other technologies such as direct beam IR (DBIR) and traditional radio are used for inter-LAN bridge applications. As we mentioned in the introduction the market size for these products is around two to three hundred million dollars.

The WLAN market currently aims at four categories of applications [WOZ96]: healthcare industry, factory floors, banking industry, and educational institutions. In the healthcare market, in addition to traditional equipment such as laptops, notebooks, and hand-held terminals, special wireless services such as electronic thermometer and blood pressure monitoring devices are expected to be involved in wireless local communications. These devices are used to provide mobile access to clinical and pharmaceutical data bases for the physician as well as entering personal health data. In manufacturing floors and the

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