Title: Wireless ATM Service Scenarios

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Abstract: This contribution discusses scenarios for the future deployment of wireless ATM.

1 Introduction

Many scenarios have been discussed for wireless ATM, ranging from wireless LAN solutions to metropolitan-area cellular systems, long-haul trunks and LEO satellite links. We believe that three principal scenarios for early deployment of wireless ATM are: the workplace, the home and to provide a 'wireless last hop'. We will address the requirements of each scenario in turn.

2 Workplace

In an office building environment, our view is that a wireless ATM system provides a seamless extension to the existing wired ATM infrastructure. It should therefore be possible to connect small, cheap base stations directly to the wired network like any other type of end-point. We envisage a large number of small cells, each big enough to provide coverage to a normally-sized open-plan office or several smaller rooms. Requiring a detailed analysis of the radio propagation environment is inappropriate for this scenario and therefore, cells will overlap one another, perhaps by a significant margin, to ensure universal coverage. Clearly, to reduce inter-cell interference and enable spatial re-use of the bandwidth, multiple channels are desirable.

The devices to be used in a workplace wireless ATM network fall into two categories: mobile and semi-fixed devices. In the latter category are end-points similar to those on existing ATM networks: video cameras, microphones, loudspeakers, large displays et cetera. The mobile category will include such things as portable multimedia terminals and PDAs and perhaps smaller versions of the 'traditional devices'. In certain specialised environments and vertical markets, such as hospitals, factories and shops more unusual end-points in both categories may be found.

We gain the advantages of speed and simplicity of installation or rearrangement, reduction of cable clutter, and for the smaller devices, mobile operation. In keeping with the 'seamless extension'

philosophy, we wish to make as few changes as possible to the existing standard protocols and adaptation layers and do not require applications to be aware of the wireless nature of the network connection, although in some cases this may be useful.

Each base-station should be able to support several active users of multimedia terminals; each application on a terminal may source several streams of audio and video simultaneously. Therefore we suggest that each base station should have a total wireless bandwidth of not less than 25Mbps. This is an accepted speed for low cost 'ATM to the desktop' and therefore we may benefit from re-using cheap pre-existing chip-sets and so forth. The system must also be able to cope with a situation where there are an unusually large number of end-points within a cell (for example during a meeting) without significant adverse effects on the channel utilisation.

Since devices may be mobile and transmission paths may vary due to changes in the radio environment, transparent handover between cells is necessary. Handover must be fast and non-disruptive of cell ordering so that user perception of quality of audio or video is not impaired. Furthermore, any quality of service that the system has undertaken to provide for a mobile's traffic is to be preserved where possible.

Many end-points will be battery powered and so will have to conserve power aggressively. This will have implications for the PHY: for example, it places a limit on the symbol rate which affects the choice of modulation scheme and so on. The MAC can also help to save power by indicating to the RF circuitry that it can power down when the channel is being used for other end-points' traffic. A mechanism whereby the host CPU itself can power down awaiting events from the WATM interface would also allow longer operation from batteries.

Because eavesdropping and spoofing are in general easier to do and harder to detect in wireless systems than wired, security must be carefully considered. Encryption must be included at the physical layer so that an attacker cannot perform traffic analysis by examining the end-point addresses; this will, however, increase the hardware cost. Furthermore, a registration scheme for end-points (perhaps similar to that employed in the GSM system) is required to prevent unauthorised use of the wireless ATM network.

3 Home

Wireless networking is particularly attractive in domestic environments where pre-existing wired network infrastructure is extremely rare and wiring installation is difficult, undesirable and too inflexible. In a home installation it is feasible for a single base station to provide coverage to the entire building: a range of up to perhaps 30m. Multiple channels will still be a necessity to prevent neighbouring systems from interfering with each other but we do not perceive a requirement for handovers from one base station to another. Furthermore, since the set of devices present within a cell is likely to be relatively static, issues such as registration and location management are greatly simplified.

Potential applications for a home-area wireless ATM network include:

- Portable enhanced television services, including video-on-demand, home shopping, banking, games et cetera;
- Wireless in-home networking and internet access for traditional PCs and mobile network computers;
- High quality audio distribution throughout the home, allowing more flexible positioning of audio components;
- Cordless telephony and replacement of miscellaneous legacy wiring systems.

Providing high-quality full-motion video over the air in particular is bandwidth intensive and again we suggest a 25Mbps target capacity per base station. There are, however, likely to be fewer end-points in domestic environments; this and the lack of handover support may allow a slightly simpler MAC to be employed. However, this would preclude (or at least complicate) the use of the same devices in both the home and the workplace and is therefore undesirable.

4 Wireless Last Hop

In this scenario, we envisage providing access to the public ATM infrastructure for a group of buildings using a wireless link. This differs from 'wireless local loop' schemes in that we anticipate each base station only giving coverage over a few hundred metres rather than several kilometres. This scheme is thus similar to 'fibre to the kerb' systems where typically a switch is located at the roadside and has one fibre port and a large number of low-speed co-axial cable ports. Both base station and subscriber units will be static devices, installed by qualified personnel and therefore more account can be taken of the local environment, antennae can be aligned with one another, and so on. Furthermore, the power budgets of both base stations and subscriber units are relatively unrestricted. The combination of these factors makes a very high data rate much easier to achieve since, for example, more advanced modulation schemes can be employed. We suggest that a base station in this case will be able to support around one hundred active users and will have an aggregate bandwidth of at least 155Mbps.

It is likely, if the unit is providing service in a residential area, that traffic will be highly asymmetric (because much will be due to multimedia-on-demand services). Thus it is important that the channel can be flexibly divided between upstream and downstream portions.

In contrast to the other two scenarios, which are essentially private networks, this is a public system and therefore there are many additional issues to consider such as charging, traffic policing et cetera. Although there will be a lot of common ground with wired access, there will be some differences due to the inherent shared nature of the medium. These issues require further study.

5 Conclusions

Three service scenarios for wireless ATM have been described. The workplace and home systems share a lot of common functionality and are similarly specified and therefore it is natural for these systems to have the same PHY and MAC, and for end-points to be able to operate in either environment. Indeed when situations such as a very large house or a block of flats are considered, the dividing line becomes rather blurred. The initial expense of the home system may be reduced by leaving out such features as low-level encryption and the high-level software.

The wireless last hop scenario is rather different from the workplace or home environments and accordingly places different requirements on the PHY and (to a lesser extent) the MAC.