Title: Surrogate Signalling Support for Mobile ATM Networks

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Abstract: This contribution proposes a solution to the problem of supporting mobile ATM devices and is in response to the request for technical proposals made in [1]. It describes the use of a remote signalling mechanism to provide low complexity mobile access points (APs) with signaling capabilities.

1 Introduction

A number of contributions to the ATM Forum have proposed how mobility should be incorporated into fixed ATM networks. At one extreme, the additional functionality required to support mobility is viewed as a range of services which must be deployed in parallel to those already supported within the wired network. In effect, these services hide end-systems from the management issues (e.g. registration, handoff, routing and signalling) concerning mobile terminals and mobile networks. At the other extreme, the addition functionality required to support mobility is viewed as an integral part of ATM. With this approach, the software on each ATM switch (i.e. signalling and routing) must be modified or upgraded in order to support mobility.

In the short term we believe there will be reluctance (because of the increased cost and disruption caused) to upgrade switches with mobility enhanced software. In addition, as it is likely that the ATM switches from which many networks will be constructed will consist of technology from multiple vendors, upgrading an entire network to support mobility will cause additional disruption and expense. Therefore, to ensure that the integration of wireless ATM with existing ATM infrastructures is rapid, smooth and cost-effective, we believe that mobility should be supported by deploying special purpose mobility devices and services in parallel to those which are already found within ATM networks (e.g. an ATMARP server). Furthermore, we believe that the access points (AP) that form the interface between the wired and wireless domains should be of low complexity and hence low cost. Unfortunately, by cutting the level of computational complexity available in APs reduces their functionality and removes their ability to support signalling. Signalling is however essential in order to give APs switching capabilities (i.e. to setup VPI:VCI translations between the wired and wireless domains). This paper therefore describes how APs of low complexity can be provided with signalling capabilities.

2 Access Point Switching

Within a wireless ATM architecture it is possible, at one level, to view an AP as a simple two-port switch that transfers ATM cells between the wired and radio domains. However, within the radio domain mobiles and APs communicate over a shared medium and so some form of media access control, arbitration and addressing mechanism is necessary to enable distinct communication channels to be established between APs and mobiles. To achieve this level of addressing, APs need to be able to map the VPIs and VCIs of ATM cells arriving from the wired domain into an addressing format, which allows ATM cells to be switched to the channel corresponding to the correct destination mobile. Additional information (such as a unique identifier assigned to mobiles by APs via a well-known broadcast meta-signalling channel) combined with the VPI:VCI used in the radio domain should be mapped by the AP to a VPI:VCI within the wired domain; and vice versa. Without this level of addressing (e.g. if the VPIs and VCIs used on the wired network were used within the radio network) every mobile within a particular domain would have to process the contents of every signalling cell to determine to whom the message was intended.

In order to address mobiles, we propose that APs should map the VPIs and VCIs used by ATM cells in the wired domain into two distinct addressing entities. The upper address should contain a number know as the mobile identifier (this is used to address individual mobiles within a particular radio cell), while the lower partition contains a VPI:VCI which identifies the connection belonging to a particular mobile. We adopt this approach (rather than using the VPI of an ATM cell header to address mobiles) as we believe mobility enhancements should not place restrictions on the number of available VCs or VPs in either the wired or wireless domains. With the proposed approach, it is possible to extend both virtual circuits and virtual paths into the wireless domain.

If mobiles are addressed in the manner described above, it is possible to view the channels that emerge from an AP into the radio domain as analogous to the ports of a conventional ATM switch. In effect, an AP is an ATM switch that possesses one physical and a variable number of virtual I/O ports. Thus, APs must be capable of supporting the functionality such as switching, cell header translation, signalling and routing which is common to conventional ATM switches.

3 Surrogate Signalling

To provide APs with the same level of functionality as that provided by normal ATM switches (e.g. support for SVC setup), some mechanism must be in place to interpret and handle signalling messages received from ATM switches residing in the wired network and from mobile hosts (and switches) within the radio network. However, in order to reduce the complexity and cost of APs, we believe that APs should be designed to be as simple as possible. As a result, APs will not provide the necessary resources (e.g. a real-time operating system) to support even the most efficient signalling software. Instead, we propose that a surrogate signalling agent (SSA) should perform signalling on behalf of APs.

In essence, the SSA handles signalling on behalf of each AP. To control each AP, a number of provisioned signalling channels between the SSA and each AP must be established when APs are first installed. The SSA then uses these channels to obtain configuration information about APs (via a very simple AP management protocol) and through which it mirrors their VPI and VCI translation tables.

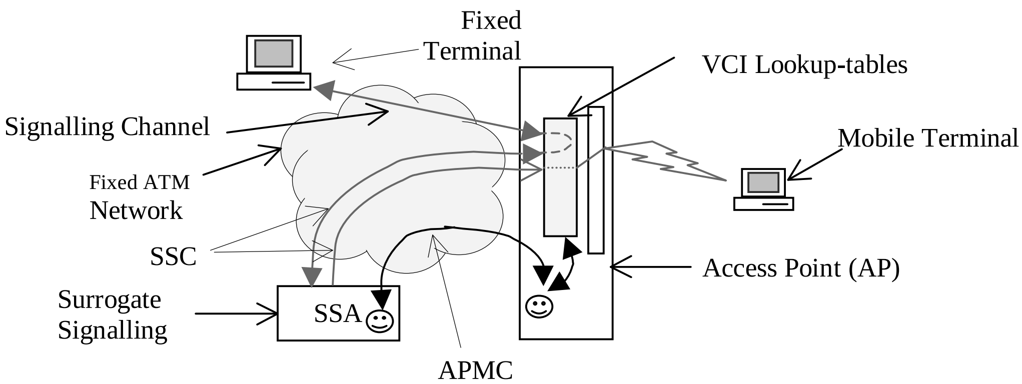

Figure 2. Surrogate Signalling Support for APs

Figure 2 shows the application of surrogate signalling within our proposed wireless ATM architecture [2]. The diagram shows the minimum number of communications channels that must be established between the SSA and an AP in order to re-locate its signalling stack to the SSA.

When signalling messages are received by an AP from within the wired network on a pre-assigned channel (e.g. VPI 0 and VCI 5 for UNI), they should be re-directed (switched) to the SSA via one of its surrogate signalling channels (SSC). The SSA can configure APs to perform this task automatically by modifying the contents of their VPI:VCI translation tables so that the default signalling VPI:VCI (within the wired domain) is mapped to the VPI:VCI that corresponds to an SSC. This SSC must be the provisioned VC (PVC) on which the SSA expects to receive re-directed signalling messages for a particular AP.

3.1 Surrogate Signalling (Fixed Network to Mobile Terminal)

When the SSA receives re-directed signalling messages from an AP, it must decide whether it can allocate resources and so permit signalling to proceed. In order to make this decision, the SSA must determine if the AP from which the re-directed signalling message was received has sufficient resources to allow a new SVC to be set-up. It must do this by either consulting the management information (e.g. a MIB) which it maintains for each specific AP or it must contact APs directly and request the necessary information.

In order to obtain this information, a bi-directional AP management channel (APMC) must be provisioned between the SSA and each controlled AP. In essence, the APMC is required to allow the SSA to gain access (i.e. read and write) the VPI:VCI translation tables of each AP. The mappings within these tables can then be modified in order to set-up and tear-down SVCs (i.e. as the signalling code that resides on a normal ATM switch does).

Once the SSA has decided that an AP can accommodate a new SVC, the SSA must obtain (or allocate) a free SVC. This it does by manipulating the VPI:VCI translation tables of APs via the APMC using a switch management mechanism based on the General Switch Management Protocol (GSMP) [3]. The new SVC must then included in a new signalling message that the SSA passes back to the AP.

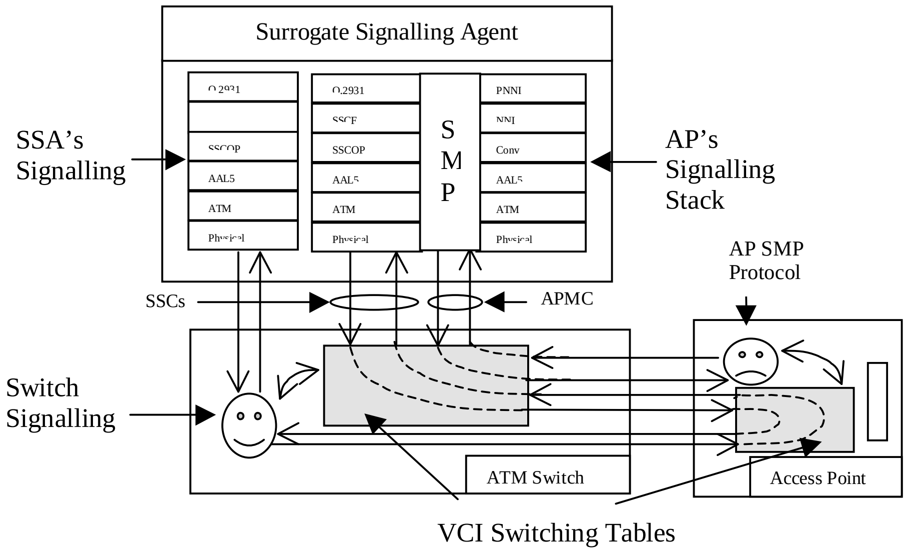

Figure 3. Surrogate Signalling support for SVCs between SSA to AP

When a signalling message is returned to an AP from the SSA, it must be encapsulated in a MAC frame before transmission across the radio interface [2]. This MAC frame must also include the mobile identifier of the mobile to which the signalling message should be directed (see section 2). However, before a signalling message can be passed into the radio domain, it (and the mobile identifier of the destination mobile) must be transferred from the SSA to the AP on an SSC. This SCC must be set-up on a per mobile basis (i.e. when a mobile first registers) and can be either a provisioned VC or a SVC (as we shall now explain).

Figure 3 illustrates how a SVC can be set-up between the SSA and an AP using surrogate signalling. When a SVC is requested by the SSA, the signalling message generated will be passed through the wired network as normal (setting up the SVC as it proceeds) until it reaches the destination AP. Here, the AP will then re-direct the signalling message (i.e.

a mapping from the signalling VPI:VCI to the SSC will exist in the AP's VPI:VCI translation table) back to the SSA. When the SSA receives the signalling message (which originated from itself) the SSA will deduce that the end-system for which it is directed is in fact one of the APs under its control. The SSA will then terminate the signalling message (i.e. it will allocate a terminating VPI:VCI in the APs switching tables via the APMC). Finally, in order to complete the setup of the SVC, the SSA must generate an acknowledgement (e.g. a UNI CONNECT) signalling message (on behalf of the AP) and return it to itself via the network. This it does by passing the signalling message back to the AP on a SSC that is provisioned when the AP is first installed.

3.2 Surrogate Signalling (Mobile Terminal to Fixed Network)

In the previous section, surrogate signalling is discussed with the premise that only fixed terminals initiate connections. However, it is possible that mobile terminals may want to establish SVCs across the wireless network to terminals that reside in the fixed network. The applicability of surrogate signalling in reverse should therefore also be considered.

When a mobile transmits a signalling message into the radio domain (as a MAC frame), the signalling VPI:VCI (of the specific mobile) will be contained in the ATM cell header and the mobile identifier will be contained in the MAC header. Thus when an AP receives signalling messages, it must extract both the mobile identifier and the mobile specific signalling VPI:VCI. The AP must then use both these values in order to lookup the VPI:VCI of the SSC on which it must re-direct the signalling message to the SSA.

When the SSA receives a signalling message over the SSC, it must process its contents in order to determine if it can allocate the required resources on behalf of the AP. If it can, it allocates the return SVC and updates the VPI:VCI translation tables in the AP. It then includes this SVC in the signalling message before returning the signalling message back to the AP over a further SSC.

When the signalling message is received back at the AP, the VPI:VCI entry in the header is replaced by the VPI:VCI mapping provisioned in its VPI:VCI translation tables by the SSA (i.e. using the AP management protocol). This entry should correspond to the VPI and VCI allocated to the signalling protocol within the wired network. Finally, the signalling message is passed to the up-link ATM switch in the wired network.

4 Summary

In this paper we have proposed surrogate signalling as a means of providing low complexity APs (and mobile end-systems) with signalling support. Surrogate signalling allows SVCs to be set-up and torn-down on APs via a remote surrogate signalling agent (SSA). In essence, the SSA receives signalling messages from APs, processes them on their behalf, and, if necessary, modifies their VPI:VCI translation tables; this it does via an AP management channel. It then constructs a new signalling message and returns it to AP from which the original signalling message was received.

5 References

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