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Title	Real time ATM implementation for remote access to home-automation and entertainment networks
Author(s)	Cucos, A. and Corcoran, P.M.
Publication Date	1998
Publication Information	Cucos, A. and Corcoran, P.M. (1998) Real Time Atm Implementation For Remote Access To Home-Automation And Entertainment Networks Consumer Electronics, 1998. ICCE. 1998 Digest of Technical Papers. International Conference on
Item record	<a href="http://hdl.handle.net/10379/4037">http://hdl.handle.net/10379/4037</a>

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# TUAM 2.3

## Real Time ATM Implementation for Remote Access to Home- Automation and Entertainment Networks

Alexandru Cucos and Peter M. Corcoran

*Dept. of Electronic Engineering, University College, Galway*

**Abstract** - Remote access to a home automation network via an Asynchronous Transfer Mode (ATM) network is described. Real-time access to such networks is important in applications where the inherent latency of TCP/IP does not guarantee a response to real-time events on the home network.

### 1. Introduction

Remote access to a home automation network from a computer with an Internet connection, using an Internet/Home Bus gateway is already possible [1, 2]. However, an inherent limitation of the TCP/IP protocol is its inability to provide an end-to-end delay guarantee in the case of applications which must provide real-time responses to events on the home network. [An example of such an application might be a "network diagnosis service" [3] which would remotely analyze and test the behavior of your home network and the devices connected to it. Such a service will be needed by modern consumers as more and more domestic appliances become Home Bus enabled].

Thus, in this paper, particular emphasis is placed on the potential to implement real-time access to the home network.

### 2. System Overview

The core advantage of a pure ATM network over a TCP/IP hybrid network is its ability to handle delay-sensitive applications. It boasts a comprehensive set of network protocols to specifically address real-time traffic. These include a range of service classes for transporting various types of data, as well as circuit-emulation capabilities. ATM specialized service classes for real-time support include, "Constant Bit Rate" (CBR) and "Variable Bit Rate - Real Time" (VBR-RT) are two service classes applicable to real-time applications.

There has been a lot of real-time research addressing the issue of providing end-to-end delay guarantee. End-to-end in a networked environment can mean many things to an application. We classify end-to-end into three different levels :

- (i) Application-to-application (AtA),
- (ii) memory-to-memory (MtM), and
- (iii) network interface-to- network interface (NtN).

Each of these different real-time implementations is summarized briefly below:

*AtA* is where the guarantee is provided from the moment the sending application generates the data to the moment the receiving application retrieves the data.

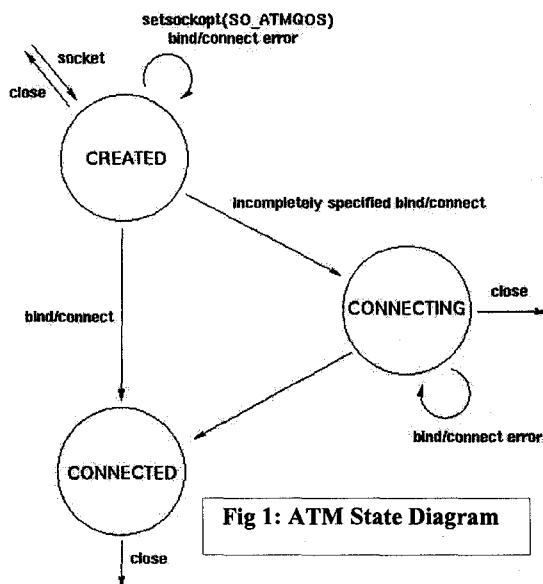
*MtM* is where the guarantee is provided from the moment when the data is taken from the sending host memory to the moment when the data is deposited into the receiving host memory, regardless of when the data is generated by the sending application and when the receiving application actually retrieves the data.

*NtN* is simply the network guarantee from when the data is transmitted from the sending network interface to when data is entirely received by the receiving network interface.

Different application scenarios require different levels of end-to-end guarantee. As the bandwidth of most Home Bus applications is relatively small the application can use NtN without significant problems.

We have implemented an example home service application, programmed using the BSD network socket model. In ATM, the fundamental communication paradigm is the connection. The state diagram shown in Fig 1. illustrates the life cycle of PVC sockets. During connection preparation parameters are set and general local resources (e.g. socket descriptors) are allocated. During connection setup local networking resources (bandwidth, connection identifiers, buffers, etc) are allocated.

After these two steps are completed then real-time data exchange between Home Automation Network and remote end-system is possible. Finally, during connection tear-down communication is stopped and resources are de-allocated. The reader is referred to [4] for further details.



In Fig 2. we show the basic elements that enable remote access of an Home Automation Network. The dynamic data structures which provide a real-time representation of a Home Automation Network can be relocated to the remote end-system, or "application client" due the high speed connection-oriented nature of the ATM Network.

Home Automation Network traffic is continually monitored and interpreted and these data structures updated accordingly. The integration of a typical home networking protocol with the ATM transport layer is also described and the potential benefits of using ATM

over a conventional TCP/IP wide area network are discussed.

### 3. Conclusions & Findings

In this paper we show the potential advantages of accessing a home automation network via an ATM connection. Such a system can provide real-time access and control services to the home from remote locations over an ATM based wide area network (WAN).

Significant potential exists to apply such technology to the development of added-value services for the next generation of consumer electronic products for the home.

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