# Management of Heterogeneous ATM Networks Based on Integration of Mobile Agents with Legacy Systems

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**Abstract**

Regardless of the well-known performance and scalability deficiencies, the centralized client-server paradigm based network management architecture, coupled with Simple Network Management Protocol (SNMP) for data networks and Common Management Information Protocol (CMIP) for telecommunication networks, remains the prevailing solution in the network management arena. The main reason for this are the huge investments that Telcos and the enterprise network connectivity providers have invested. Although significant research and development efforts have been spent in recent years in building alternative solutions, based on distributed management paradigm, their role is still minor. In this paper we propose a third solution, combining the distributed computing benefits based on mobile agents technology with the legacy code of existing client-server based network management systems. We believe that such model provides a cost-effective solution, while permitting significantly to reduce the bottlenecks of client-server based solutions. We demonstrate our solution by applying it to the tasks of PVC configuration management in heterogeneous ATM networks.

The “client/server” architecture has become a bottleneck due to the increasing traffic caused by the network element “request/response” sessions generated in this model. It is evident that this architecture became inefficient in these aspects, and needs some changes to improve its efficiency. The SNMP and CMIP protocols are based on static and centralized “client/server” solutions, where every element of the network sends all the data to a central location that processes the whole data and provides the interface to the other operator. Because of that, management applications have scalability problems and produce too much traffic in the network.

Regarding PVC management, it is well known that PVC management is considered as one of the most important tasks in the overall ATM network management. There is no standard or uniform way for the network operator to set up PVC in a heterogeneous network environment. Because the ATM switches are manufactured by different vendors, each with its own proprietary management interface, it is time-consuming and, and in many cases, practically impossible to configure and set up required PVC.

In order to solve the above-mentioned limitations of the "client/server" paradigm, we suggested a solution based on mobile agents. With the use of mobile agents, the problem of robust networks is greatly decreased because of the holding time for connections can be significantly reduced, and in many cases requires only the time that is spent for moving the agents between the devices. The existing classic procedures in network systems tend to be monolithic. Mobile agents do not statically reside on network devices; therefore, they can be created on demand, and destroyed when no longer required. The mobile agents are usually smaller than the corresponding procedures in the classic network management systems because they normally perform a single task. In general, mobile agents can reduce the load on the manager side thanks to the partitioning of a large management task that can be delegated to such mobile agents.

Mobile agents paradigm is one of the solutions enabling the introducing of the decentralized management architecture into network management. As we mentioned earlier, it is very interesting to try to integrate legacy systems management with the new decentralized management solutions because the legacy technology provides access to management information and services. The mobile agents technology allows incorporating of the mobile code into the existing local management services, permitting in such way to perform intelligent tasks closer to management data. The function of SNMP in this new environment will be mainly local data collection. The mobile agents based management applications need to coexist with legacy management systems. The mobile agents are well suited to develop new network management services, although it seems much more attractive to use these services from installed management applications than to develop separate specialized applications. This way, mobile agents can be introduced to solve specific problems for larger management frameworks, which are still based on classic centralized network management paradigms.

The PVC operations and configuration are the principal management tasks in ATM networks. The heterogeneous and proprietary management systems provided by ATM switch vendors have created an environment, where it is very difficult to automate the management processes. The management situation will become more and more unpredictable as networks continue to grow in size and complexity.

In order to integrate the facilities of SNMP legacy management with mobile agents technology - to complement the "client/server" architecture, we have created a methodology to deal with PVCs in ATM networks. A prototype of such system using Concordia [1] was developed, which offers a general view of implementing PVC configuration tasks in ATM networks (Figure 1). The establishment, reconfiguration and release of PVC are considered in our work.

The Concordia Server, that provides the necessary intelligence to configure an ATM networks, must be present in each device. In case if the ATM switch does not execute the JVM – the mobile Java code, the components of the system must reside in another Network Component (NC) that is executed in a separate host responsible for the management of its resources. The Concordia Server is composed by several components written in Java. Each component, depicted in [2], is responsible for a part of the server in a modular and extensible way.

The PVC Configuration Manager component, responsible for the PVC management configuration tasks of the device, is a Concordia mobile agent launcher. It injects mobile agents into the ATM network. It also specifies the group of switches along the PVC path, besides initializing the VPI, VCI, bandwidth, etc.

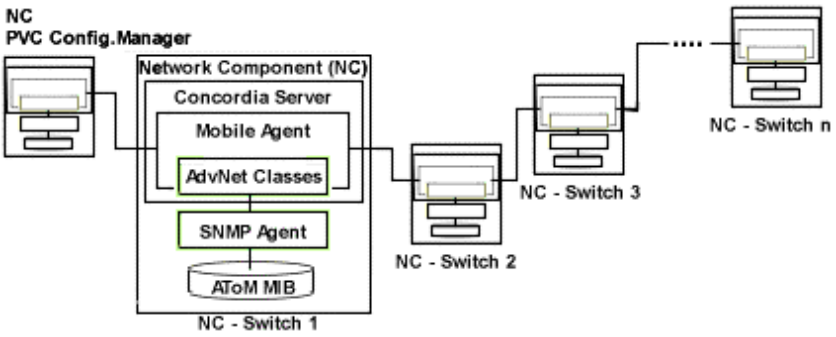


**Figure 1. Implementation Architecture**

To interact with SNMP agent to manage low-level resources, it is possible to include full SNMP-type capabilities into a mobile agent that performs the provisioning functions of the PVC. Therefore, it can issue the GET and SET functions for configuring the PVC by using some SNMP classes from AdventNet [3] available in Java. By importing these classes all Concordia mobile agents can perform the SNMP commands used by [4] to set up a PVC employing AToM MIB. AToM MIB [5], defined by IETF [6], is a standard MIB, which is oriented towards PVC configuration. An example of the SET command to the atmVclRowStatus (.1.3.6.1.2.1.37.1.7.1.13) in AToM MIB made by a Concordia mobile agent in Switch 1 is shown in Table 1.

**Table 1. SNMP SET Command**

```
// SnmpTarget Instance Creation
   SnmpTarget target = new SnmpTarget();
// Destination and OID selection
   target.SnmpTargetHost (“Switch 1”);
   target.SnmpObject (“.1.3.6.1.2.1.37.1.7.1.13.11.37.39”);
// SNMP Set Command to createAndWait(5)
   try {
         String result = target.SnmpSet(5);
   } catch (Exception e) {
         atmTrafficDescrParamTableError(e);
   }
```

In conclusion, it is important to note that we hide the heterogeneity of different vendor switches by using the mobile agents and making so the access to SNMP MIB database transparent to all switch technologies and vendors. Therefore the user does not have to worry about the idiosyncrasies of each switch type, and it is able to delegate the responsibility of configuration to mobile agents. The mobile agents are able to automate the PVC configuration tasks without the need of interventions by users.

Our future work will tackle the security issues of mobile agents as well as the reconfiguration of PVC dealing with the dynamic bandwidth negotiation for multimedia applications based on ATM networks.

## References


[1] Concordia System Page URL=http://www.concordiaagents.com

[2] Mobile Agent Computing – A White Paper URL=http://www.concordiaagents.com/MobileAgentsWhitePaper.html

[3] AdventNet v2c Release 3.3 URL=http://www.adventnet.com

[4] PAN, H., "*SNMP-Based ATM Network Management*," Artech House, Hardcover, 1998.

[5] AHMED, M., e TESINK, T., Internet Engineering Task Force, RFC 1695, "*Definitions of Managed Objects for ATM Management, Version 8.0 using SMIv2*" August 1992.

[6] The Internet Engineering Task Force (IETF) WWW Pages URL=http://www.ietf.org/