Asynchronous Transfer Mode

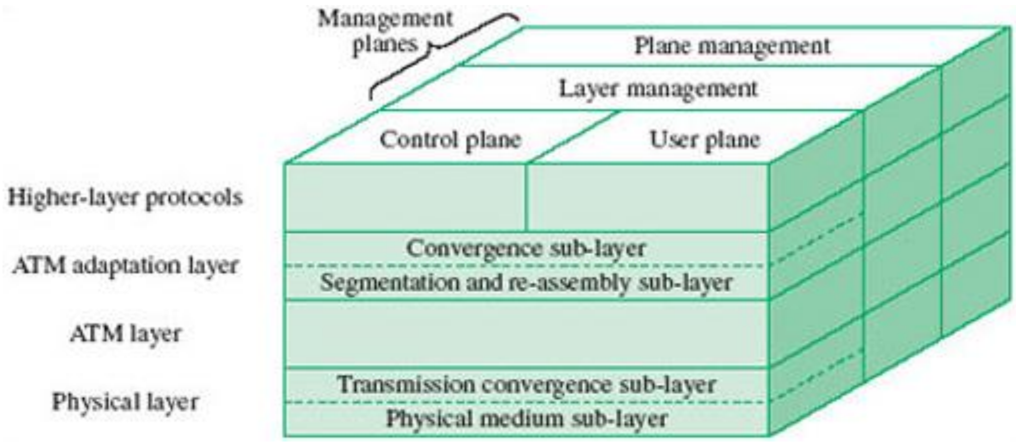
Asynchronous transfer mode is a switching and multiplexing technology that employs small, fixed-length packets called cells. A fixed-size packet was chosen to ensure that the switching and multiplexing function could be carried out efficiently, with little delay variation. A small cell size was chosen primarily to support delay-intolerant interactive voice service with a small packetization delay. ATM is a connection-oriented packet-switching technology that was designed to provide the performance of a circuit-switching network and the flexibility and efficiency of a packet-switching network. A major thrust of the ATM standardization effort was to provide a powerful set of tools for supporting a rich QoS capability and a powerful traffic management capability. ATM was intended to provide a unified networking standard for both circuit-switched and packet-switched traffic, and to support data, voice, and video with appropriate QoS mechanisms. With ATM, the user can select the desired level of service and obtain guaranteed service quality. Internally, the ATM network makes reservations and preplans routes so that transmission allocation is based on priority and QoS characteristics.

ATM was intended to be a universal networking technology, with much of the switching and routing capability implemented in hardware, and with the ability to support IP-based networks and circuit-switched networks. It was also anticipated that ATM would be used to implement local area networks. ATM never achieved this comprehensive deployment. However, ATM remains an important technology. ATM is commonly used by telecommunications providers to implement wide area networks. Many DSL implementations use ATM over the basic DSL hardware for multiplexing and switching, and ATM is used as a backbone network technology in numerous IP networks and portions of the Internet. A number of factors have led to this lesser role for ATM. IP, with its many associated protocols, provides an integrative technology that is more scalable and less complex than ATM.

In addition, the need to use small fixed-sized cells to reduce jitter has disappeared as transport speeds have increased. The development of voice and video over IP protocols has provided an integration capability at the IP level. Perhaps the most significant development related to the reduced role for ATM is the widespread acceptance of Multiprotocol Label Switching (MPLS). MPLS is a layer-2 connection-oriented packet-switching protocol that, as the name suggests, can provide a switching service for a variety of protocols and applications, including IP, voice, and video.

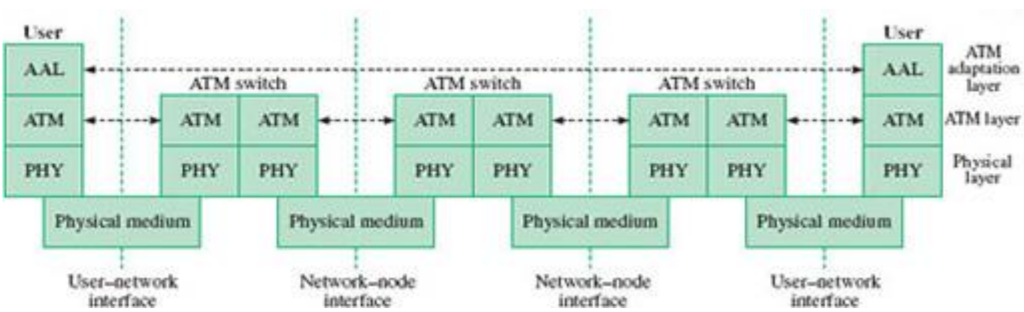
Protocol Architecture

The *asynchronous transfer mode* (ATM) protocol architecture is designed to support the transfer of data with a range of guarantees for quality of service. The user data is divided into small, fixed-length packets, called cells, and transported over virtual connections. ATM operates over high data rate physical circuits, and the simple structure of ATM cells allows switching to be performed in hardware, which improves the speed and efficiency of ATM switches. The first thing to notice is that, as well as layers, the model has planes. The functions for transferring user data are located in the user plane; the functions associated with the control of connections are located in the control plane; and the co-ordination functions associated with the layers and planes are located in the management planes.

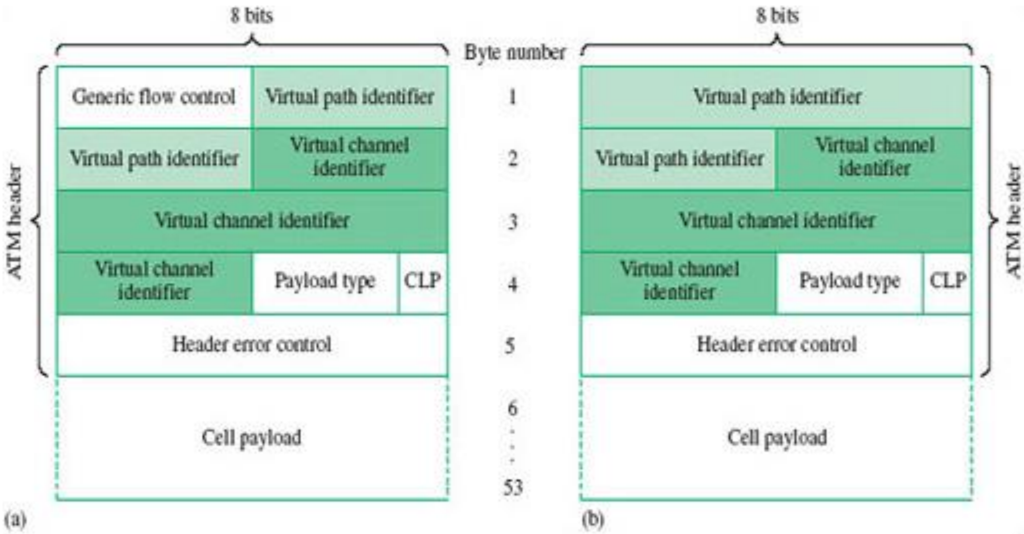


The three-dimensional representation of the ATM protocol architecture is intended to portray the relationship between the different types of protocol. The horizontal layers indicate the encapsulation of protocols through levels of abstraction as one layer is built on top of another, whereas the vertical planes indicate the functions that require co-ordination of the actions taken by different layers. An advantage of dividing the functions into control and user planes is that it introduces a degree of independence in the definition of the functions: the protocols for transferring user data (user plane) are separated from the protocols for controlling connections (control plane).

The protocols in the ATM layer provide communication between ATM switches while the protocols in the ATM adaptation layer (AAL) operate end-to-end between users. one between the users and the network (user-network interface), and the other between the nodes (switches) within the network (network-node interface).



Before describing the functions of the three layers in the ATM reference model, I shall briefly describe the format of ATM cells.



Each ATM cell consists of 53 bytes: the header is five bytes long and the remaining 48 bytes (the cell payload) carry information from higher layers. The only difference between the two types of ATM cell is that the cells at the user-network interface carry a data field for the flow control of data from users. This means that only eight bits are available for virtual path identifiers, rather than 12 bits at the network-node interface.

The virtual connections set up in ATM networks are identified by the combination of the *virtual path identifier* and *virtual channel identifier* fields. These two fields provide a hierarchy in the numbering of virtual connections, whereby a virtual path contains a number of virtual channels.