FURTHER READING:

As a preview for further reading, the following reference has been provided from the pages of the book below:

Title: ATM FOR PUBLIC NETWORKS
Author: RONALD H. DAVIS
Publisher: McGraw-Hill

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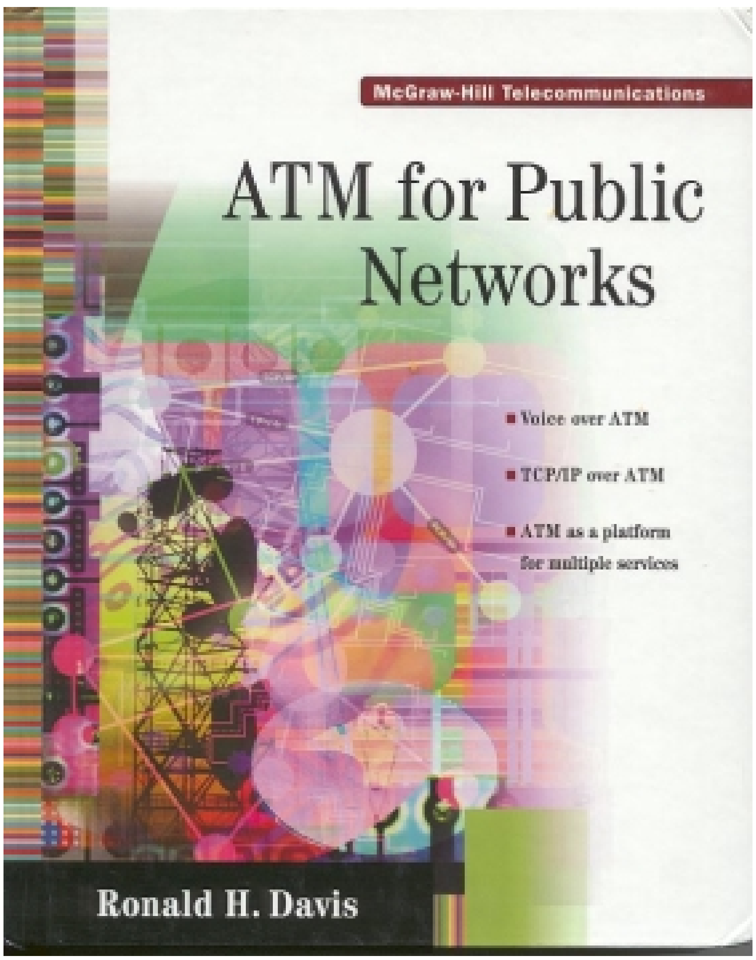
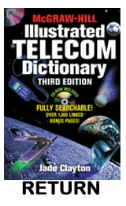


1. Introduction



The chapter presents an overview of key concepts that define ATM technology. The intention of this chapter is to give the reader an understanding of the structure and mechanisms employed in ATM communications. Specific topics discussed are the following:

- ATM Transport and Switching
- B-ISDN Network Architecture
- Quality of Service
- ATM Signalling
- Operations Administration, Maintenance, and Provisioning

Further detail on the topics discussed in this chapter can be found in the following chapters.

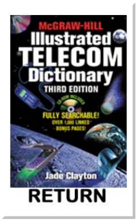
Standards that define ATM networks are established by two different organizations:

- International Telecommunication Union (ITU)—Formerly known as the CCITT, this organization issues international standards (called “recommendations”) for telecommunications.
- ATM Forum—An industry consortium that is focused on ATM. The activities of this organization included setting of technical standards for ATM systems and facilitating the market adoption of ATM technology.

The two organizations frequently use different terminology to describe the same concepts. In this chapter, and throughout this book, we will attempt to distinguish ITU and ATM Forum terminology and concepts where appropriate.

2. ATM Transport and Switching

An ATM transport network is structured into two layers: an ATM Layer, which involves the switching aspects of the network, and a Physical Layer, which involves the transmission aspects. ATM Layer transport functions are independent of the Physical Layer. The ATM Layer is further subdivided into two levels that represent the switching levels supported within the network [1]:



- Virtual Channel (VC)—a generic term used to describe a capability for the unidirectional transport of ATM cells. The cells carried over a specific VC are identified by a Virtual Channel Identifier (VCI).
- Virtual Path (VP)—a term used to describe a bundle of VCs. The VCs associated with a VP are transported over a transmission path within the network as a group. Each bundle of VCs is identified by a Virtual Path Identifier (VPI).

The VPI and VCI values are carried in the header of the ATM cell and, as we will see later in this chapter, these values are used for routing the cell across the ATM network. The relationship between virtual path, virtual channel, and transmission path is shown in Figure 2-1.

The Physical Layer is subdivided into three levels that represent the transmission levels supported within the network:

- Transmission Path—represents a logical connection between the point at which information is assembled into a standard frame format for transport over a transmission medium at a given data rate, and the point at which the frame format is disassembled. Examples of frame formats for ATM are SONET, SDH, and PDH [2][3][4]. The transmission path is commonly referred to by the term *path.* Network Elements that exist at the ends of a transmission path are referred to as *Path Terminating Equipment* (PTE).
- Digital Section—a transmission medium, together with associated equipment, required to provide a means of transporting information between network elements, one of which originates

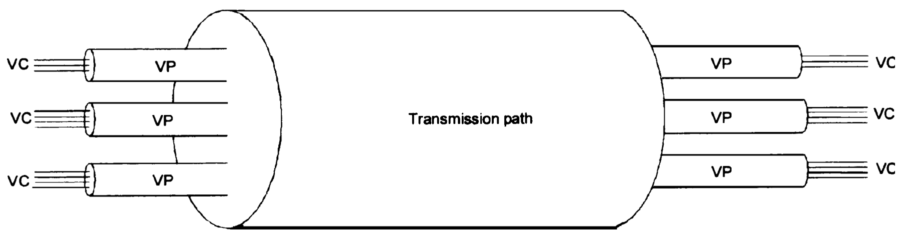
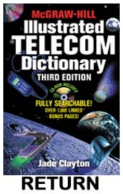


Figure 2-1. VP, VC, transmission path relationship.



the line signal, and the other, which terminates the line signal. Network Elements that may terminate digital sections have the capability of multiplexing or demultiplexing traffic into a composite signal with a higher or lower data rate. Other terms for Digital Section include *Multiplex Section* (SDH) and *Line* (SONET). The Network Elements are referred to as *Line Terminating Equipment* (LTE). Note that a digital section may exist between two LTEs, two PTEs, or between a LTE and a PTE.

- Regenerator Section—a transmission medium, together with associated equipment, required to regenerate a signal on the medium. The only capability required of network elements that terminate regenerator sections is the ability to regenerate a signal. The network element need not have the ability to modify the content of the signal. In SONET systems, this is merely called a *section*. Network elements that provide this capability are called *Section Terminating Equipment* (STE). A section may exist between any pair of networks elements (PTE, LTE, STE).

We can now construct a hierarchical model showing the conceptual relationship between the ATM Layer and Physical Layer. This is shown in Figure 2-2, which introduces two new concepts: Virtual Path Connection (VPC) and Virtual Channel Connection (VCC). These will be discussed further in the next section.

2.1 The ATM Switching Concept

As mentioned earlier, the ATM Layer consists of VC and VP sublayers. These sublayers form the basis of switching within ATM networks. Correspondingly, there are the two levels of ATM connection:

- Virtual Path Connection (VPC)—extends from the point at which virtual channels are assigned VCI values and associated with a virtual path, to the point at which virtual channels are removed from the virtual path or have their VCI values modified. These points are referred to as the VP connection endpoints.
- Virtual Channel Connection (VCC)— extends between points where adaptation layer functionality is performed. The adaptation

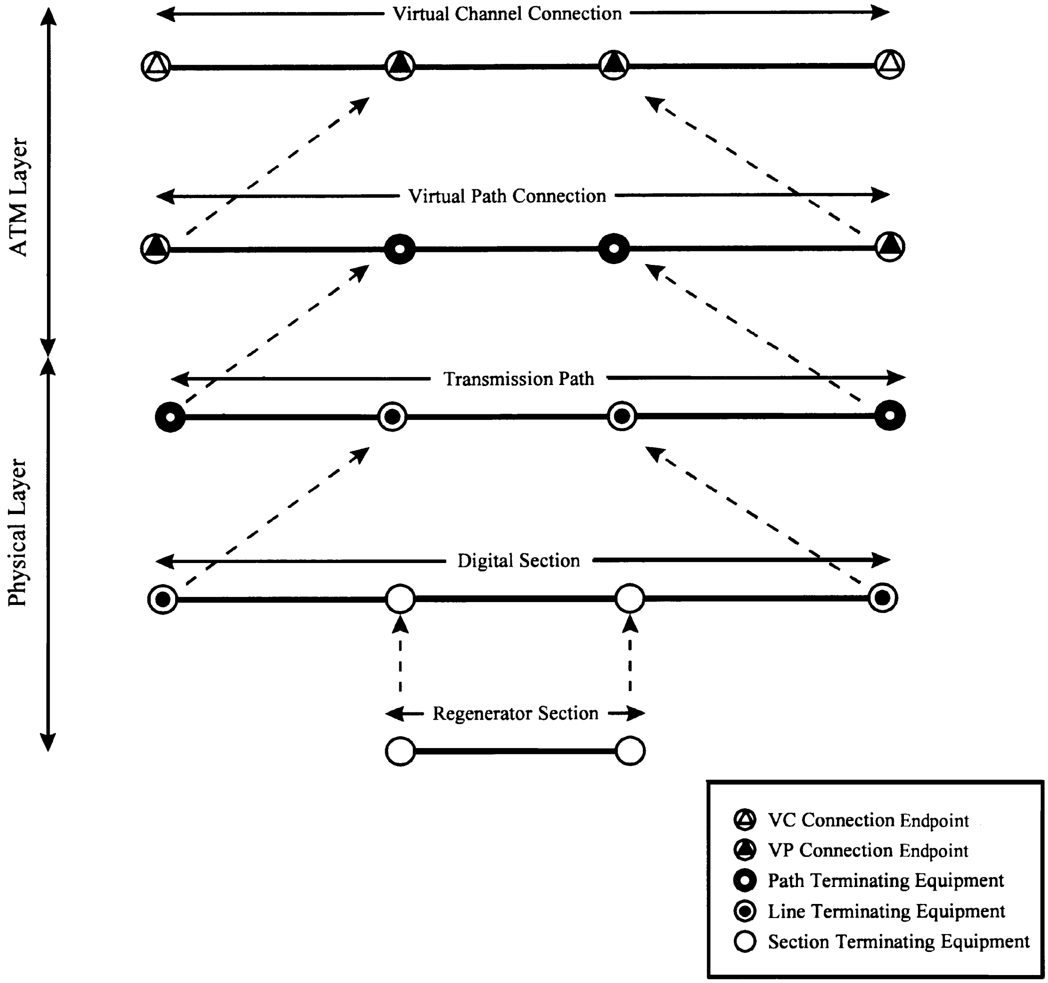
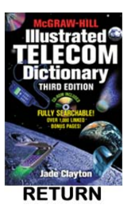


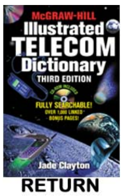
Figure 2-2. ATM transport architecture hierarchical structure.



layer for ATM will be discussed in further detail in the next chapter, but the basic function of the adaptation layer is to format data for transport over an ATM connection on the sending end of the connection. On the receiving end the adaptation layer extracts data from the ATM connection for presentation to a higher layer protocol which is to use the data. These points are the VC connection endpoints.

VP and VC connections are established by either of the following methods:

- Permanent Virtual Connection (PVC)—These are connections that are established, often by a network operator using manual procedures. Once established, the connection is maintained until manually torn down.
- Switched Virtual Connection (SVC)—These connections are established on demand by signalling procedures between connection endpoints. Under normal circumstances, these connections are maintained until terminated by the communicating parties.



2.1.1 Virtual Path Switching

Virtual path switching is shown in Figure 2-3. In this figure, virtual paths (containing virtual channels) identified by a VPI enter an ATM Network Element on one side and exit on the other with a different VPI. For example, the virtual path entering the network element with VPI=1, exits with VPI=6. This is called *virtual path switching*.

Note, however, that in each case of VP switching, the bundle of VCs within each VP remain the same even though the VPI has been changed (or *translated*). Since none of the VCs within the virtual path have been removed or have had their VCI values translated, the VPC remains the same even though the VPI value has been translated. This introduces additional ATM connection concepts:

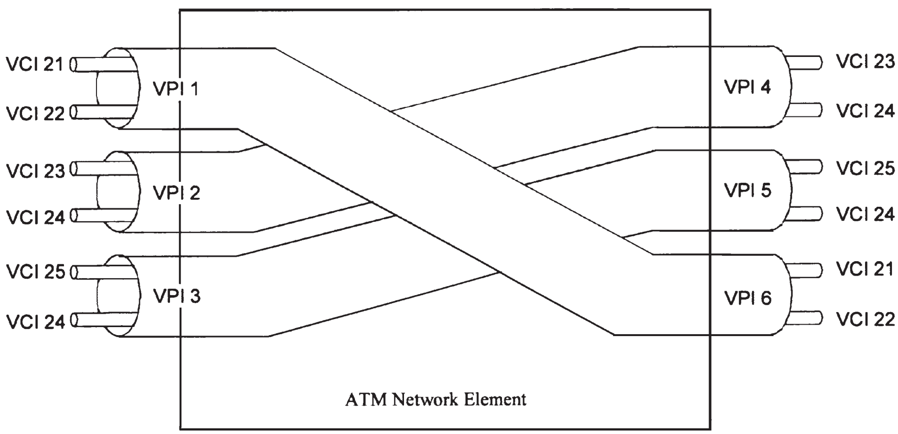
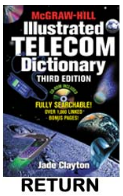


Figure 2-3. Virtual path switching.



- Virtual Path Connection Identifier (VPCI)—The VPCI is a value which remains constant throughout the VPC. Thus, in our example above, the virtual path with VPI=1 being translated to VPI=6 at a network element, would have the same VPCI value. The VPCI is not used for routing of individual ATM cells within a network and is therefore not carried in the ATM cell header. The VPCI is used, for instance, during VPC establishment, or to identify the VPC for network management.
- Virtual Path Link (VPL)—identifies a section of a VPC that has a single VPI value. Thus, the virtual path in our example above consists of two virtual path links: one link with VPI=1, and a second with VPI=6.
- Connecting Point—the point at which links at the same layer in the ATM transport hierarchy are connected. In Figure 2-3, the network element is the connecting point between virtual path links.

2.1.2 Virtual Channel Switching

Virtual channel switching is shown in Figure 2-4. In this figure there is translation of both VPIs and VCIs. The latter case is called *virtual channel switching*. Virtual channels associated with virtual path VPI=1 have their VCI values translated within the network element. The point at which a virtual channel has its VCI value translated corresponds to the termination of the associated virtual path. This is called a *Virtual Path Connection Endpoint*. Figure 2-4 also shows virtual path VPI=4 having its VPI value translated to VPI=5 within the same network element. However, since within the VP no VCs are added, removed, or have VCI values changed, there is no VPC endpoint within the network element for this virtual path.

There is no *Virtual Channel Connection Endpoint* shown in Figure 2-4. What the figure does show are Virtual Connection Links. The VCCs entering the network element over VPI=1 consist of two virtual connection links: for example, one of the VCCs consists of virtual channel links (VPI=1, VCI=21) and (VPI=2, VCI=24).

3. B-ISDN Network Architecture

Next we will discuss the elements in a B-ISDN network which carries ATM traffic. As shown in Figure 2-5, a B-ISDN consists of two components [5]: