Understanding Asynchronous Transfer Mode - ATM

Introduction

As a technology ATM has been around for many years with the first standards having been with us for well in excess of 20 years. ATM has developed and evolved dramatically over this time and is regarded as an extremely robust and well understood technology used extensively in carrier network environments as well as a backbone technology for much of today's Internet traffic. While IP technologies have replaced it in many situations, it has also found many other applications including use in the 3rd Generation mobile (3G or UMTS) network environment as well as others such as wireless local loop applications and DSL (Digital Subscriber Lines), to name a few.

This course provides a solid understanding of ATM in terms of the technology as well as how it is applied to real-life applications. We look at ATM in a real way, giving the benefits to its use as well as highlighting some of the issues it creates. We include a wide range of application coverage, although it is normal not to cover all subjects to the same depth. We appreciate the areas that are of most (and of least) importance today and focus on these in greater depth. If a specific audience wishes to focus on specific areas, then we are very happy to do this.

Much emphasis is placed on ensuring the students leave the course with a thorough understanding of ATM and, to that end, we make use of a lot of exercises throughout the course.

Who should attend the course?

Anyone wishing to develop a solid understanding of ATM technology. A basic understanding of datacommunications/telecommunications is helpful.

Course Length

2 days

Course Agenda

- Introduction to ATM
- The ATM layer
- The Physical layer
- The ATM Adaptation Layer - AAL
- ATM Service Categories and Traffic Management
- Signalling for SVCs and Soft PVCs
- ILMI and OAM
- Private Network-Network (Network-Node) Interface - PNNI
- Voice and Telephony over ATM
- IP over ATM (Layer 2 Support):
  - RFC1483: Multiprotocol Encapsulation over AAL5
  - RFC1577 and RFC2225: Classical IP and ARP over ATM
  - LAN Emulation (LANE): Versions 1 and 2
- Frame Relay/ATM Interworking

1 Introduction to ATM

This section acts as an introduction to ATM, defining what it is and why its use is so popular in many

networking environments. We look at some of the applications that are driving ATM/'s deployment along with the nature of the types of traffic produced by them and which ATM so successfully supports.

Also discussed are some of the fundamental points behind ATM, which lay the ground for a more detailed understanding of the way in which ATM actually operates. What is ATM?

- Why use ATM?
- What applications are suitable for ATM?
- The nature of different traffic types
- An introduction to service categories - CBR, VBR (rt and nrt), ABR, UBR, UBR+ and GFR
- Some fundamental points to ATM
- ATM network reference points
- A small bit on the standards for ATM - ITU-T, ATM Forum, IETF, ETSI, ANSI etc...

2 The ATM Layer

One of the key factors behind ATM offering high-speed networking along with the ability to deliver Quality of Service guarantees, is the use of a small and fixed size cell. This section looks at the ATM cell header in detail with a description of the various fields within it and how the network and/or end-user equipment uses them.

- The ATM cell and a description of the various fields within it:
  - GFC (Generic Flow Control)
  - VPI/VCI (Virtual Path Identifier, Virtual Channel Identifier)
  - PT (Payload Type)
  - CLP (Cell Loss Priority)
  - HEC (Header Error Control)
- A look at VP (Virtual Path) and VC (Virtual Channel) switching - what it all means
- A look at the ATM switching fabric and buffering strategies
- Section summary and end-of-section review

3 The Physical Layer

The original idea behind ATM was for use on high speed transport mechanisms such as SDH and SONET. The original ITU-T recommendations described only two transport speeds of 155Mbit/s and 622Mbit/s.

Today, many other physical interfaces have also been defined for the support of ATM cells. This section will have a brief look at how ATM cells are actually transported on some of the physical interfaces. In addition, we also look at how ATM may be inverse multiplexed across a number of low speed lines to give a virtual higher speed line.

- A summary of the /'standardised/' physical interfaces
  - Example of cell based interface for clear channel operation
  - Example of framed interface carrying ATM cells
- Cell delineation using HEC field
- IMA - Inverse Multiplexing over ATM (Version 1 and 1.1)

4 The ATM Adaptation Layer - AAL

This section looks at the various different ATM Adaptation Layers in terms of how actual data from an application is taken and fitted into ATM cells. The structure of each AAL is looked at along with an explanation of which one is used for what type of application and why. Some examples are also given of real traffic and how it is broken up and fitted into the ATM cells.

- What is the ATM Adaptation Layer and what uses it?
- Different types of traffic - the need for different AALs

- AAL1
  - – Synchronous Residual Time Stamp (SRTS)
  - – Adaptive Clock Recovery
- AAL2
- AAL3/4
- AAL 5
- Some examples of actual traffic fitted into ATM cells through the use of AALs

5 ATM Service Categories and Traffic Management

Key to the successful operation of an ATM network is traffic management. Basically, traffic management is necessary to protect the users and the network to ensure that network performance objectives are met. When a connection is established across an ATM network, we need to be sure that this connection receives the required quality of service so long as it stays within its traffic parameters. We also need to be sure that other, existing, connections continue to receive their expected quality of service.

This section looks at the various aspects associated with traffic management and some of the schemes that ATM equipment uses to ensure that the network performance objectives are met.

- CBR (Constant Bit Rate), VBR (Variable Bit Rate) - rt and nrt, ABR (Available Bit Rate), UBR (Unspecificed Bit Rate), UBR+ (UBR Plus) and GFR (Guaranteed Frame Rate)
- Traffic parameters - SCR (Sustainable Cell Rate), PCR (Peak Cell Rate), MBS (Maximum Burst Size), MCR (Minimum Cell Rate) etc..
- CDVT - Cell Delay Variation Tolerance
- Traffic management defined
- Quality of Service (QoS) defined
- How an ATM network actually deliver a range of different qualities of service
- The Traffic Contract
- Connection/Call Admission Control (CAC)
- Usage Parameter Control (UPC)
- Generic Cell Rate Algorithm (GCRA)
  - – The "leaky bucket"
- Congestion in a network
  - – Frame Discard (PPD - Partial Packet Discard and EPD - Early packet Discard)
  - – Explicit Forward Congestion Indication (EFCI)
- Traffic Shaping

6 Signalling for SVCs and Soft-PVCs

ATM as a technology was designed from the ground up to provide â€˜dial-upâ€™ bandwidth on demand regardless of the type of application in use, i.e. voice, video, data or a combination of these. To achieve this, signalling messages need to be passed between the end user equipment and the ATM network and between ATM switches within the network. This section looks at how this signalling is implemented at the UNI (User Network Interface) as defined in UNI 3.1 and UNI 4 specifications.

- Definition of SVCs and Soft-PVCs
- Signalling functions
- ATM addressing
- Point-to-point and Point-to-multipoint
- Signalling AAL (SAAL)
- Q.2931 vs. UNI 3.1 / 4

- A description of and examples of signalling messages

7 ILMI and OAM

This section provides a look at the subjects of ILMI (Integrated Local Management Interface) and OAM (Operations, Administration and Maintenance). ILMI is used for the exchange of information between two attached devices on a UNI, NNI or PNNI. OAM primarily provides various facilities for fault and performance management of an ATM network.

- Integrated Local Management Interface (ILMI)
  - Management Information Database (MIB)
- Operations, Administration and Maintenance (OAM)
  - Loopback cells, AIS (Alarm Indication Signal) and RDI (Remote Defect Indication) cells etcâ€¦

8 Private Network-Network (Network-Node) Interface (PNNI)

This section looks at PNNI, which defines a standard for signalling and routing protocols to be used in a large and scalable network environment.

- Interim Inter-Switch Signalling Protocol (IISP)
- PNNI defined
- PNNI functions
- PNNI network and addressing hierarchy
- PNNI signalling
- Section summary and end-of-section review questions

9 Voice and Telephony Over ATM

ATM was always cited and, indeed designed, as a suitable technology for the communication of multimedia traffic including voice. There are many ways in which voice can be carried over ATM, and this fact is reflected in the many standards that have been developed by the ATM Forum and the ITU-T. We shall look at the various standard methods available, but concentrate on the support of voice over ATM Adaptation Layer 2 (AAL2).

- Circuit emulation using both the unstructured and structured modes of AAL1
- DBCES - Dynamic Bandwidth Circuit Emulation Service using AAL1
- An in-depth look at the support of voice using AAL2
  - ATM in the 3rd generation - 3G - UMTS mobile environment
  - Voice over DSL (Digital Subscriber Line)

10 IP over ATM (Layer 2 Support)

A number of key specifications have been defined for the support of LANs and LAN interworking via ATM. Specifications have been produced by both the ATM Forum and the IETF - Internet Engineering Task Force.

- RFC1483: Multiprotocol Encapsulation over AAL5
  - LLC Encapsulation and VC Based Multiplexing
- RFC1577 and RFC2225: Classical IP and ATP over ATM
  - SVC Operation
  - PVC Operation
- LANE Emulation (LANE)
- LAN Emulation defined
- LANE Components:
  - LAN Emulation Client (LEC)

– LAN Emulation Server (LES)
– Broadcast and Unknown Server (BUS)
– LAN Emulation Configuration Server (LECS)

- A description of LANE Operation
- A summary of the differences between LANE V1 and LANE V2

11 Frame Relay/ATM Interworking

Many of today/'s wide area networks are based upon the Frame Relay protocol. It is very efficient for the transport of data orientated traffic and is scaleable from low speeds to reasonably high speeds. Today, there is a growing demand to be able to inter-operate between Frame Relay and ATM and standards have been produced to that end.

- FRF.5: Network Interworking
- FRF.8: Service Interworking
- Mapping of ATM to Frame Relay and vice versa - VPI & VCI/DLCI, CLP/DE, EFCI/FECN, Traffic parameters etc...

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