2

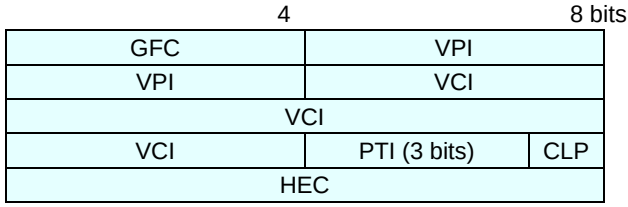
ATM

ATM relies on cell-switching technology. ATM cells have a fixed length of 53 bytes which allows for very fast switching. ATM creates pathways between end nodes called virtual circuits which are identified by the VPI/VCI values.

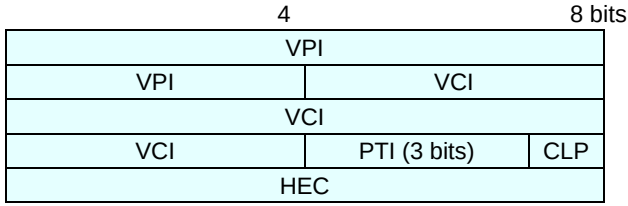
This chapter describes the ATM UNI and NNI cell header structures and the PDU structures for the various ATM/SAR formats including: AAL0, AAL1, AAL2, AAL3/4 and AAL5.

UNI/NNI Cells

The UNI or NNI cell header comprises the first 5 bytes of the ATM cell. The remaining 48 bytes comprise the payload of the cell whose format depends on the AAL type of the cell. The structure of the UNI and NNI cell headers are given here:



UNI cell header



NNI cell header

GFC
Generic flow control (000=uncontrolled access).

VPI
Virtual path identifier.

VCI
Virtual channel identifier.
Together, the VPI and VCI comprise the VPCI. These fields represent the routing information within the ATM cell.

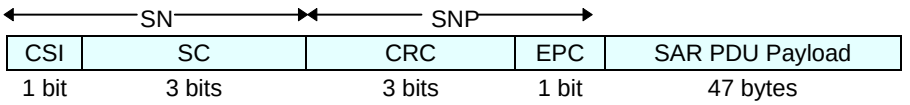
PTI
Payload type indication.

CLP
Cell loss priority.

HEC
Header error control.

AAL1 PDU

The structure of the AAL1 PDU is given in the following illustration:



AAL1 PDU

SN
Sequence number. Numbers the stream of SAR PDUs of a CPCS PDU (modulo 16). The sequence number is comprised of the CSI and the SN.

CSI
Convergence sublayer indicator. Used for residual time stamp for clocking.

SC
Sequence count. The sequence number for the entire CS PDU, which is generated by the Convergence Sublayer.

SNP
Sequence number protection. Comprised of the CRC and the EPC.

CRC
Cyclic redundancy check calculated over the SAR header.

EPC
Even parity check calculated over the CRC.

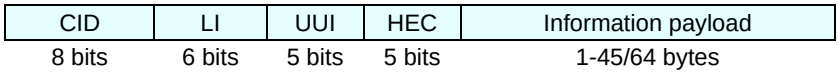
SAR PDU payload
47-byte user information field.

AAL2

AAL2 provides bandwidth-efficient transmission of low-rate, short and variable packets in delay sensitive applications. It supports VBR and CBR. AAL2 also provides for variable payload within cells and across cells.

AAL2 CPS Packet

AAL type 2 is subdivided into the Common Part Sublayer (CPS) and the Service Specific Convergence Sublayer (SSCS). The CPS packet consists of a 3 octet header followed by a payload. The structure of the AAL2 CPS packet is shown in the following illustration.



AAL2 CPS packet

CID

Channel identification. Values may be as follows:

0 Not used
1 Reserved for layer management peer-to-peer procedures
2-7 Reserved
8-255 Identifies AAL2 user (248 total channels)

LI

Length indicator. Length of the packet payload associated with each individual user. Value is one less than the packet payload and has a default value of 45 bytes (may be set to 64 bytes).

UUI

User-to-user indication. Provides a link between the CPS and an appropriate SSCS that satisfies the higher layer application. Values may be:

0-27 Identification of SSCS entries
28, 29 Reserved for future standardization
30, 31 Reserved for layer management (OAM)

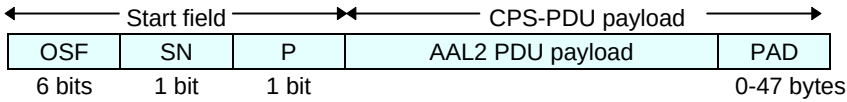
HEC

Header error control.

Information payload
Contains the CPS PDU as described below.

AAL2 CPS PDU

The structure of the AAL2 SAR PDU is given in the following illustration.



AAL2 CPS PDU

OSF
Offset field. Identifies the location of the start of the next CPS packet within the CPS-PDU.

SN
Sequence number. Protects data integrity.

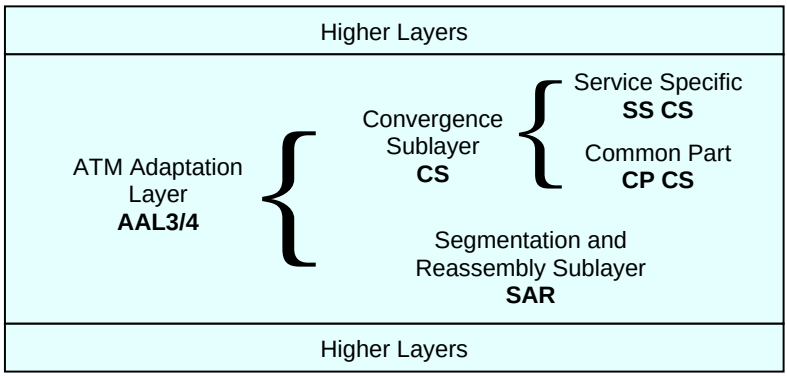
P
Parity. Protects the start field from errors.

SAR PDU payload
Information field of the SAR PDU.

PAD
Padding.

AAL3/4

AAL 3/4 consists of message and streaming modes. It provides for point-to-point and point-to-multipoint (ATM layer) connections. The Convergence Sublayer (CS) of the ATM Adaptation Layer (AAL) is divided into two parts: service specific (SSCS) and common part (CPCS). This is illustrated in the following diagram:



AAL3/4 Packet

AAL3/4 packets are used to carry computer data, mainly SMDS traffic.

AAL3/4 CPCS PDU

The functions of the AAL3/4 CPCS include connectionless network layer (Class D), meaning no need for an SSCS; and frame relaying telecommunication service in Class C. The CPCS PDU is composed of the following fields:

Header ←		Info →		← Trailer →			
CPI	Btag	Basize	CPCS SDU	Pad	0	Etag	Length
1	1	2	0-65535	0-3	1	1	2 bytes

AAL3/4 CPCS PDU

CPI

Message type. Set to zero when the BAsize and Length fields are encoded in bytes.

Btag
Beginning tag. This is an identifier for the packet. It is repeated as the Etag.

BAsize
Buffer allocation size. Size (in bytes) that the receiver has to allocate to capture all the data.

CPCS SDU
Variable information field up to 65535 bytes.

PAD
Padding field which is used to achieve 32-bit alignment of the length of the packet.

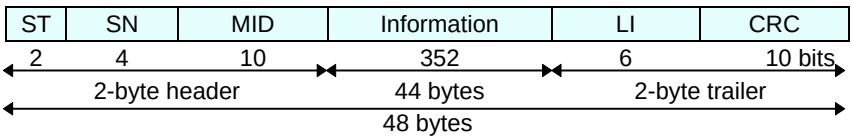
0
All-zero.

Etag
End tag. Must be the same as Btag.

Length
Must be the same as BASize.

AAL3/4 SAR PDU

The structure of the AAL3/4 SAR PDU is illustrated below:



AAL3/4 SAR PDU

ST
Segment type. Values may be as follows:

Segment type	Value	Meaning
BOM	10	Beginning of message
COM	00	Continuation of message
EOM	01	End of message
SSM	11	Single segment message

SN
Sequence number. Numbers the stream of SAR PDUs of a CPCS PDU (modulo 16).

MID
Multiplexing identification. This is used for multiplexing several AAL3/4 connections over one ATM link.

Information
This field has a fixed length of 44 bytes and contains parts of CPCS PDU.

LI
Length indication. Contains the length of the SAR SDU in bytes, as follows:

Segment type	***LI***
BOM, COM	44
EOM	4, ..., 44
EOM (Abort)	63
SSM	9, ..., 44

CRC
Cyclic redundancy check.

Functions of AAL3/4 SAR include identification of SAR SDUs; error indication and handling; SAR SDU sequence continuity; multiplexing and demultiplexing.

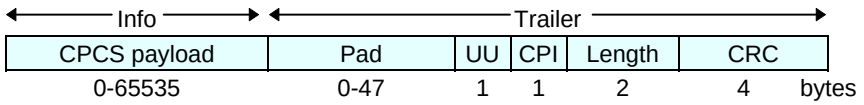
AAL5

The type 5 adaptation layer is a simplified version of AAL3/4. It also consists of message and streaming modes, with the CS divided into the service specific and common part. AAL5 provides point-to-point and point-to-multipoint (ATM layer) connections.

AAL5 is used to carry computer data such as TCP/IP. It is the most popular AAL and is sometimes referred to as SEAL (simple and easy adaptation layer).

AAL5 CPCS PDU

The AAL5 CPCS PDU is composed of the following fields:



AAL5 CPCS PDU

CPCS payload

The actual information that is sent by the user. Note that the information comes before any length indication (as opposed to AAL3/4 where the amount of memory required is known in advance).

Pad

Padding bytes to make the entire packet (including control and CRC) fit into a 48-byte boundary.

UU

CPCS user-to-user indication to transfer one byte of user information.

CPI

Common part indicator is a filling byte (of value 0). This field is to be used in the future for layer management message indication.

Length

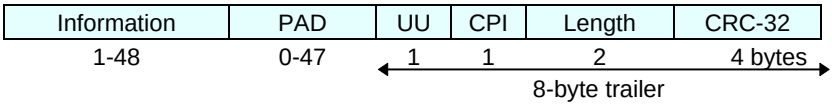
Length of the user information without the Pad.

CRC

CRC-32. Used to allow identification of corrupted transmission.

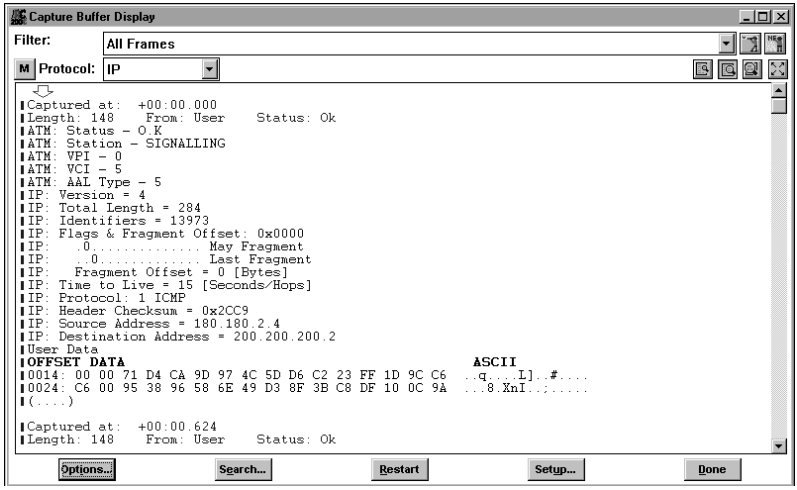
AAL5 SAR PDU

The structure of the AAL5 CS PDU is as follows:



AAL5 SAR PDU

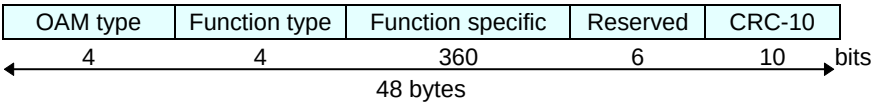
The fields are as described for the AAL5 CPCS PDU.



IP frames encapsulated over ATM

F4/F5 OAM

The structure of the F4 and F5 OAM cell payload is given in the following illustration.



F4/F5 OAM PDU

CRC-10

Cyclic redundancy check: $G(x) = x^{10}+x^9+x^5+x^4+x+1$

OAM type / Function type

The possible values for OAM type and function type are listed below:

OAM type	***Value***	***Function type***	***Value***
Fault Management	0001	Alarm Indication Signal (AIS)	0000
		Far End Receive Failure (FERF)	0001
		OAM Cell Loopback	1000
		Continuity Check	0100
Performance Management	0010	Forward Monitoring	0000
		Backward Reporting	0001
		Monitoring and Reporting	0010
Activation/ Deactivation	1000	Performance Monitoring	0000
		Continuity Check	0001

OAM F4 cells operate at the VP level. They use the save VPI as the user cells, however, they use two different reserved VCIs, as follows:

VCI=3 Segment OAM F4 cells.
VCI=4 End-end OAM F4 cells.

OAM F5 cells operate at the VC level. They use the save VPI and VCI as the user cells. To distinguish between data and OAM cells, the PTI field is used as follows:

PTI=100 (4) Segment OAM F5 cells processed by the next segment.
PTI=101 (5) End-to-end OAM F5 cells which are only processed by end stations terminating an ATM link.

RM Cells

There are two types of Rate Management (RM) cells: RM-VPC, which manages the VP level and RM-VCC, which manages the VC level.

The format of RM-VPC cells is shown in the following illustration:

ATM Header: VCI=6 and PTI=110 (5 bytes)
RM protocol identifier (1 byte)
Message type (1 byte)
ER (2 bytes)
CCR (2 bytes)
MCR (2 bytes)
QL (4 bytes)
SN (4 bytes)
Reserved (30 bytes)
Reserved (6 bits) + CRC-10 (10 bits)

RM-VPC cell format

RM protocol identifier

Always 1 for ABR services.

Message type

This field is comprised of several bit fields:

Bit	*Name*	*Description*
8	DIR	Direction of the RM cells: 0=forward, 1=backward.
7	BN	BECN: 0=source is generated; 1=network is generated.
6	CI	Congestion Indication: 0=no congestion, 1=congestion.
5	NI	No increase: 1=do not increase the ACR.
4	RA	Not used.

ER

Explicit rate.

CCR

Current cell rate.

MCR

Minimum cell rate.

QL
Not used.

SN
Not used.

RM-VCC cells are exactly the same as RM-VPC cells, except that the VCI is not specified. The cell is identified solely by the PTI bits.

Reserved VPI/VCI Values

A number of VPI/VCI values are reserved for various protocols or functions, e.g., 0,5 is used for signalling messages. The following table contains a list of all reserved VPI/VCI values and their designated meanings:

VPI	VCI	Description
0	0	Idle cells. Must also have GFC set to zero. Idle cells are added by the transmitter to generate information for non-used cells. They are removed by the receiver together with bad cells.
0	1	Meta signalling (default). Meta-signalling is used to define the subchannel for signalling (default value: 0,5).
Non-zero	1	Meta signalling.
0	2	General broadcast signalling (default). Can be used to broadcast signalling information which is independent of a specific service. Not used in practice.
Non-zero	2	General broadcast signalling.
0	5	Point-to-point signalling (default). Generally used to set-up and release switched virtual circuits (SVCs).
Non-zero	5	Point-to-point signalling.
	3	Segment OAM F4 flow cell. OAM cells are used for continuity checks as well as to notify and acknowledge failures.
	4	End-to-end OAM F4 flow cell.
	6	RM-VPC cells for rate management.

VPI	VCI	Description
0	15	SPANS. The Simple Protocol for ATM Network Signalling is a simple signalling protocol, developed by FORE systems and used by FORE and other manufacturers working in cooperation with FORE, for use in ATM networks. Refer to Chapter 3 for more information.
0	16	ILMI. The Interim Local Management Interface is used to manage and compare databases across an ATM link. This is used for signalling address registration, RMON applications, SNMP, etc. Refer to *ILMI* in this book for more information.
0	18	PNNI signalling.