ATM SW API Architecture Framework Implementation Agreement

April 12, 2005
Revision 1.0

Editor: Patrik Herneld, Ericsson, patrik.herneld@ericsson.com

The words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", “MAY", and "OPTIONAL" in the remainder of this document are to be interpreted as described in the NPF Software API Conventions Implementation Agreement revision 1.0.

For additional information contact:
The Network Processing Forum, 39355 California Street,
Suite 307, Fremont, CA 94538
+1 510 608-5990 phone info@npforum.org

Table of Contents

Table of Figures

Glossary

AAL	ATM Adaptation Layer: The standards layer that allows multiple applications to have data converted to and from the ATM cell. A protocol used that translates higher layer services into the size and format of an ATM cell. Examples of AALs are AAL1, AAL2 and AAL5.
AAL1	ATM Adaptation Layer 1 defined in ITU-T I.363.1. The type of ATM adaptation principally used for circuit emulation services over an ATM network.
AAL2	ATM Adaptation Layer 2 defined in ITU-T I.363.2. The type of ATM adaptation principally used for variable-bit-rate Voice-Over-ATM services.
AAL5	ATM Adaptation Layer 5 defined in ITU-T I.363.5. The type of ATM adaptation principally used for frame and packet transport over an ATM network.
AINI	ATM Inter-Network Interface
AIS	Alarm Indication Signal
ATM	Asynchronous Transfer Mode: A transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.
CID	Channel IDentifier
CPS	Common Part Sub-Layer
F4	OAM Flow on virtual path level
F5	OAM Flow on virtual channel level
HT	ATM cell Header Translation
IMA	Inverse Multiplexing for ATM: Inverse multiplexing of an ATM cell stream over multiple physical links and retrieval of the original stream at the far-end from these physical links. The multiplexing of the ATM

	cell stream is performed on a cell-by-cell basis across the multiple physical links.
OAM	Operations Administration and Maintenance: A group of network management functions that provide network fault indication, performance information, and data and diagnosis functions.
PNNI	Private Network Node Interface or Private Network-to-Network Interface
RDI	Remote Defect Indication
SSCS	Service Specific Convergence Sub-Layer
TC	Transmission Convergence: The TC sub-layer transforms the flow of cells into a steady flow of bits and bytes for transmission over the physical medium. On transmit, the TC sub-layer maps the cells to the frame format, generates the Header Error Check (HEC), and sends idle cells when the ATM layer has none to send. On reception, the TC sub-layer delineates individual cells in the received bit stream, and uses the HEC to detect and correct received errors.
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VPC	Virtual Path Connection
VPI	Virtual Path Identifier

1 Revision History

Revision	Date	Reason for Changes
1.0	4/12/2005	Rev 1.0 of the ATM SW API Architecture Framework Implementation Agreement. Source: npf2004.088.11.

2 Introduction

This document outlines the Architecture Framework for NPF ATM SW APIs and should be seen as a complement to the *API Software Framework (August 2002)* Implementation Agreement. It is intended as the basis for using network processing elements in the construction of networking equipment for ATM.

As Figure 1 shows, the NPF Software Architecture has its special Service API and Functional APIs for ATM. There are also ATM extensions to the Interface Management API and the Packet Handler API. These APIs can be used for configuring and managing ATM functions on Network Processing Elements (NPEs). The Packet Handler API comprises a service level API that supports input and output sessions for individual applications, and a Functional API that communicates directly with a Forwarding Element (FE). The System SW, shown as a grey area in the figure, can be very large or virtually nothing depending on the system size.

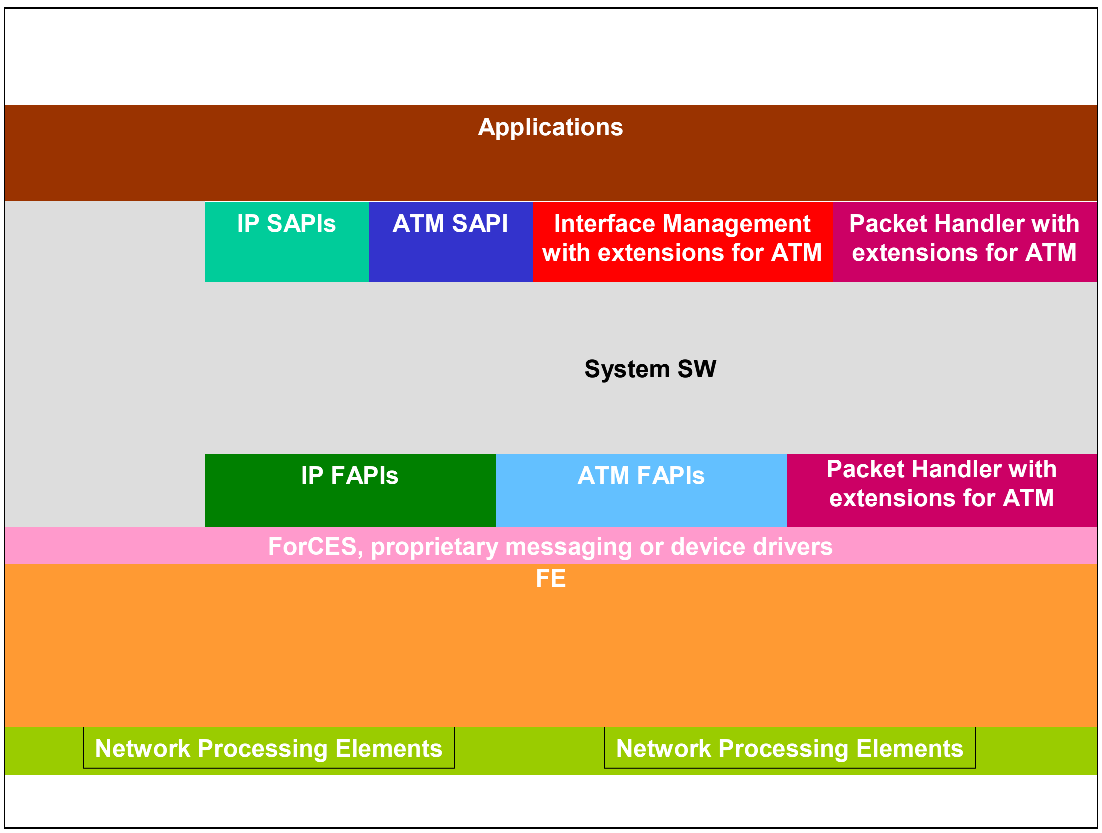


Figure 1 Overview of NPF Software Architecture APIs

2.1 Framework Model Overview

Figure 2 outlines an overview of the NPF SW API Architecture Framework for ATM. The ovals in the figure should be seen as examples of function areas controlled by the different API types, rather than a complete list of ATM APIs.

Figure 2 identifies two layers of functionality. The first layer (above the dashed line) is the System Abstraction Layer. This layer contains vendor independent system layer software, which provides an abstraction of the underlying system and is unaware of the physical system topology. The System Abstraction Layer is thus unaware of the existence of multiple ATM Blades. The APIs exposed at this layer are the Service API (SAPI) and the Interface Management API.

The second layer (below the dashed line) is the Element Abstraction Layer. The software at this layer is element aware. Thus, the software knows which specific ATM Blade to address. The APIs exposed at this layer are the Functional APIs (FAPIs) and the Packet Handler API. Like the SAPI and Interface Management, these are vendor independent.

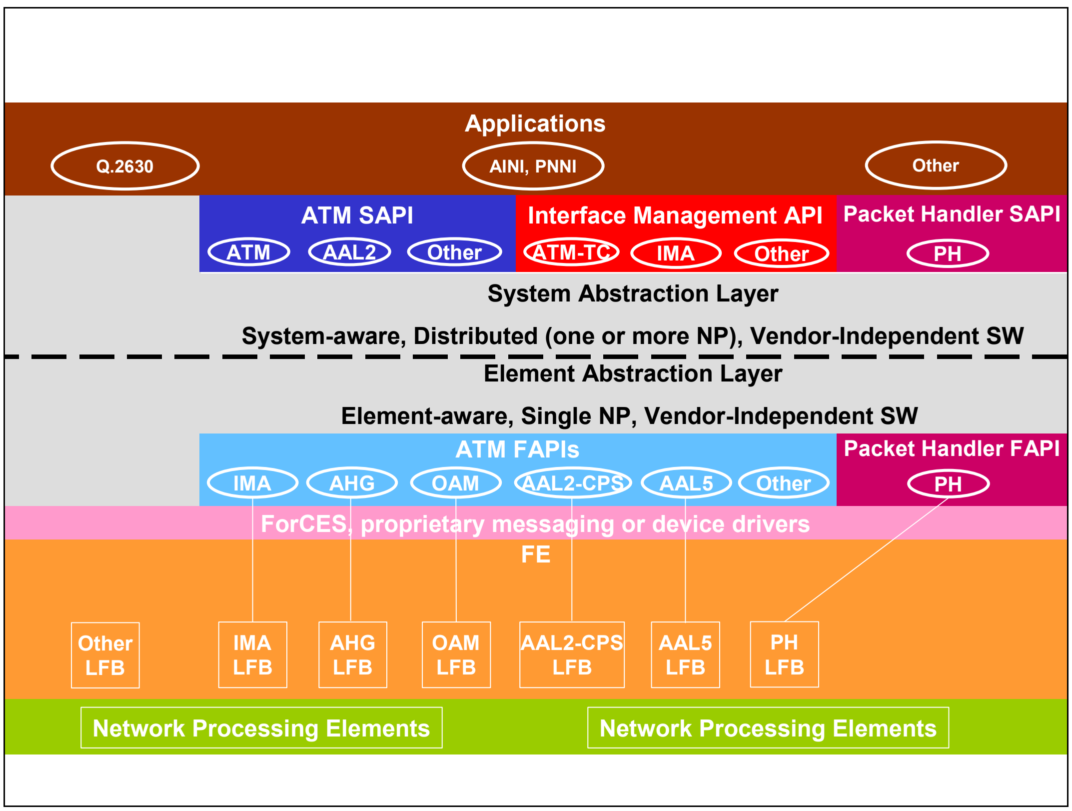


Figure 2 Overview of NPF SW API Architecture Framework for ATM[1]

[1] Note that the ovals should only be seen as examples of functions in the same way as the LFBs and the oval to LFB connections should only be seen as examples of LFBs and examples of connections.

The SAPI provides the illusion that it is running on a device that consists of a set of ports interconnected by a single switch fabric as shown in Figure 3. The SAPI supports functionality such as ATM and AAL2 connection handling, which could be used by protocols like AINI and Q.2630 for connection set up and release at the system level.

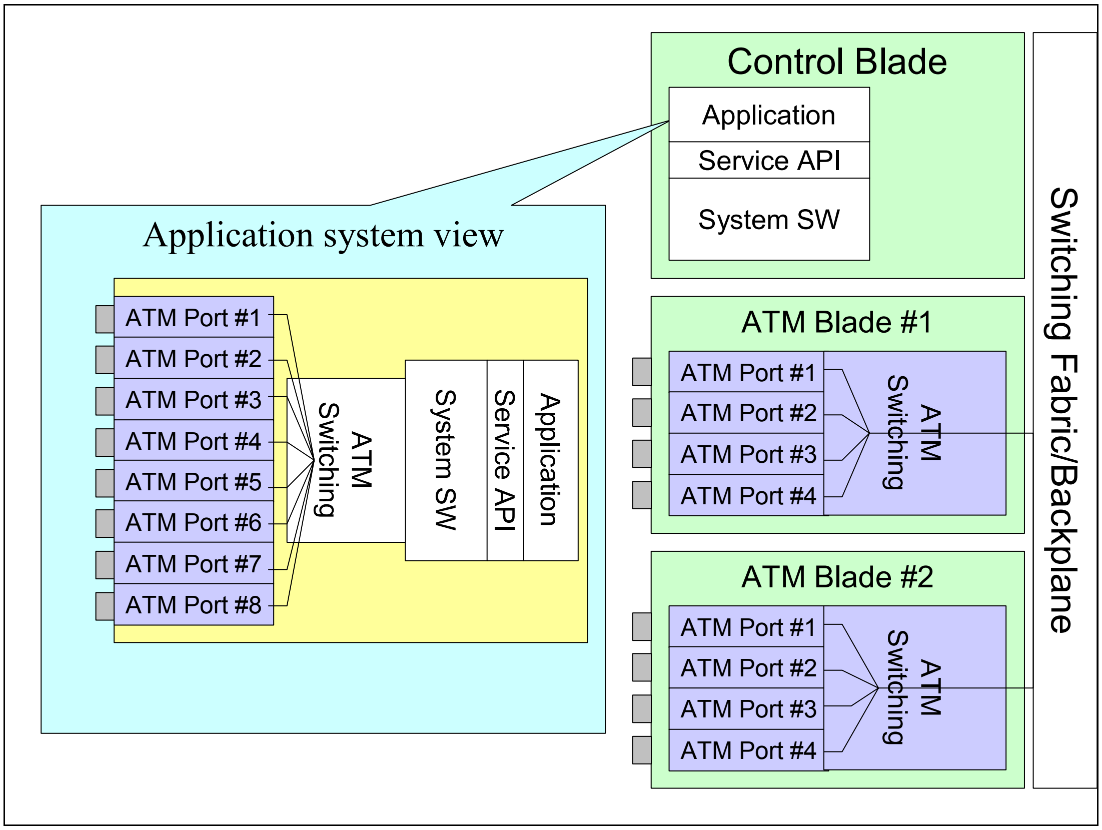


Figure 3 NPF SAPI hiding physical system topology

The Interface Management API is located at the same level as the SAPI and is used to manage interfaces on which ATM cells are transported. Examples of such interfaces are ATM Transmission Convergence for SONET/SDH and Inverse Multiplexing for ATM (IMA).

FAPIs are, like the SAPI, vendor independent, but users of them must be aware of the physical system topology with multiple ATM blades and their individual capabilities. The functionality on the Forwarding Element (FE) below the FAPIs is modeled by means of Logical Functional Blocks (LFBs), each representing a specific functionality in the data plane. Each LFB has got one and only one FAPI managing the LFB functionality. Depending upon if the LFBs are remotely situated or not, they are reached by ForCES, proprietary messaging or device drivers. By using the FAPIs, a program should be able to execute correctly on any vendor platform conforming to the LFB model. Examples of ATM LFBs/FAPIs could be: IMA, ATM Header Generator (AHG) and OAM.

The Packet Handler API provides support for transmitting and receiving ATM cells and AAL packets from/to the Control Plane Software. In Figure 2, the line between the PH LFB and the Packet Handler API exemplifies this.

To clarify the level of SAPI and FAPIs, an example of a large ATM switch system is shown in Figure 4. In a large system there are a lot of system and element aware software located in between SAPI and FAPIs. The system vendor would normally develop this system and element aware software. The SAPI would be located on the control blade above the system-aware software. Typical users of the SAPI are signaling stacks and management I/F with no or limited system awareness. A configuration database, used to store e.g. permanent connections, could be attached to the system-aware software at a level below SAPI. FAPIs could be located both on the ATM blades and on the control blade. The red lines indicate examples of control paths to the LFBs. As Figure 4 shows, the LFBs can be part of NPEs from different vendors.

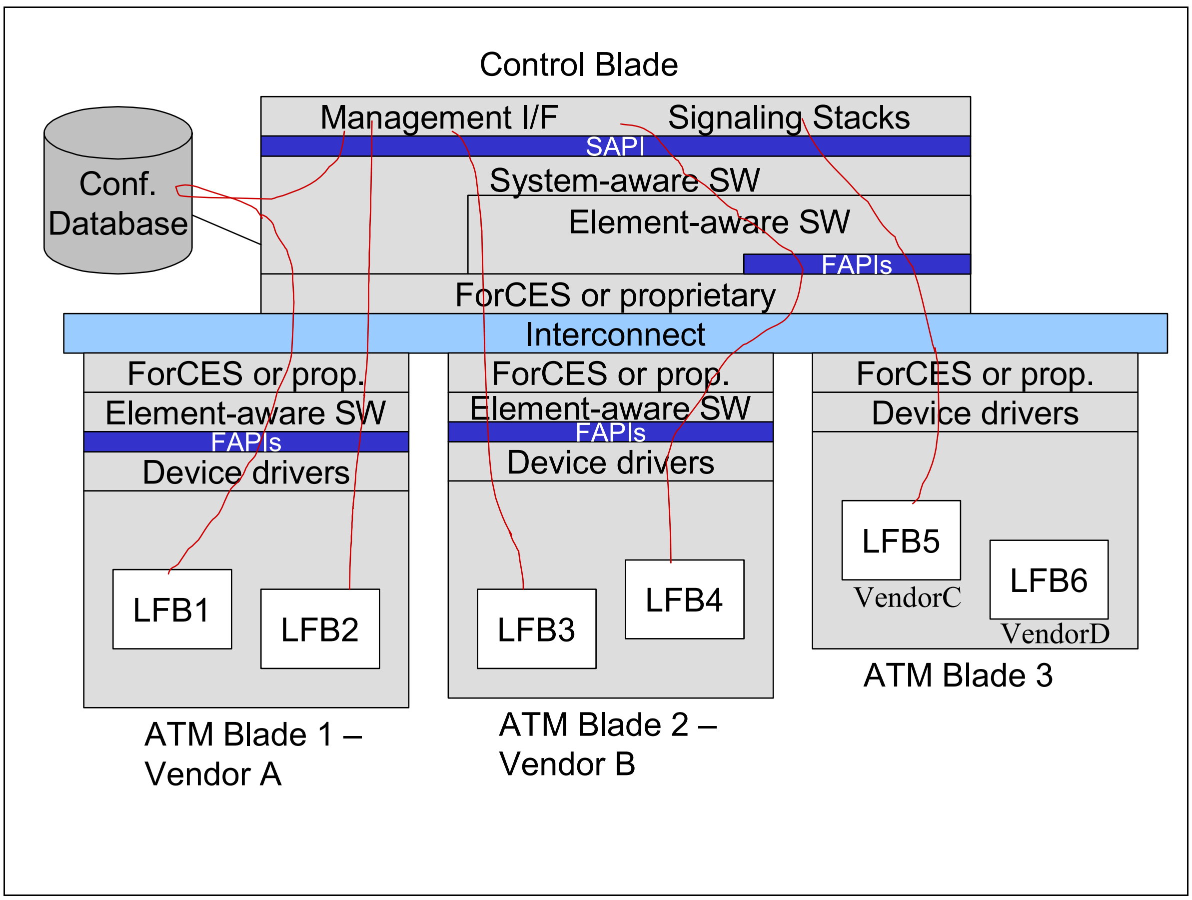


Figure 4 Example of control paths in a large ATM switch system

The virtual links on an ATM Forwarding Element can be categorized into three different types by means of their scope - external links, internal links and backplane switch links. An external link is characterized by that it is visible externally to the ATM FE and carries traffic across an ATM Network Interface. Internal links on the other hand, are only visible within the Forwarding Element and do not carry traffic through any FE external interface. An internal link also terminates a virtual connection in at least one of its end points. A backplane switch link is, like an external link, visible externally to the FE, but instead of carrying traffic across an ATM network interface, it carries traffic to another FE within the system via a backplane interface. The backplane could for example be realized as an Ethernet Switch or as an ATM based Switch Fabric.

Two or more links can be connected together by a cross-connect. When more than two links are connected together by a cross-connect, the links belong to a point-to-multipoint connection. Such a connection is always unidirectional, while a point-to-point connection could be either unidirectional or bi-directional. Figure 5 shows how different types of links can be connected together on an ATM FE. It also defines receive and transmit directions for the different link types. Cross-connect one connects an internal link A from a termination on the FE, with an external link B crossing an ATM Network Interface. The figure also shows that another external link C can be added to the cross-connect, making the connection a point-to-multipoint connection. In that case, the connection can only be unidirectional, meaning that traffic is only going in the direction from the termination towards the ATM Network. Cross-connect two connects an internal link A with a backplane link, while cross-connect three connects an external link with a backplane link. In both these cases the backplane links are going via a backplane interface to another FE in the system. Cross-connect number four connects an external link A with another external link B. Finally cross-connect number five connects an external link A from a termination on the FE.

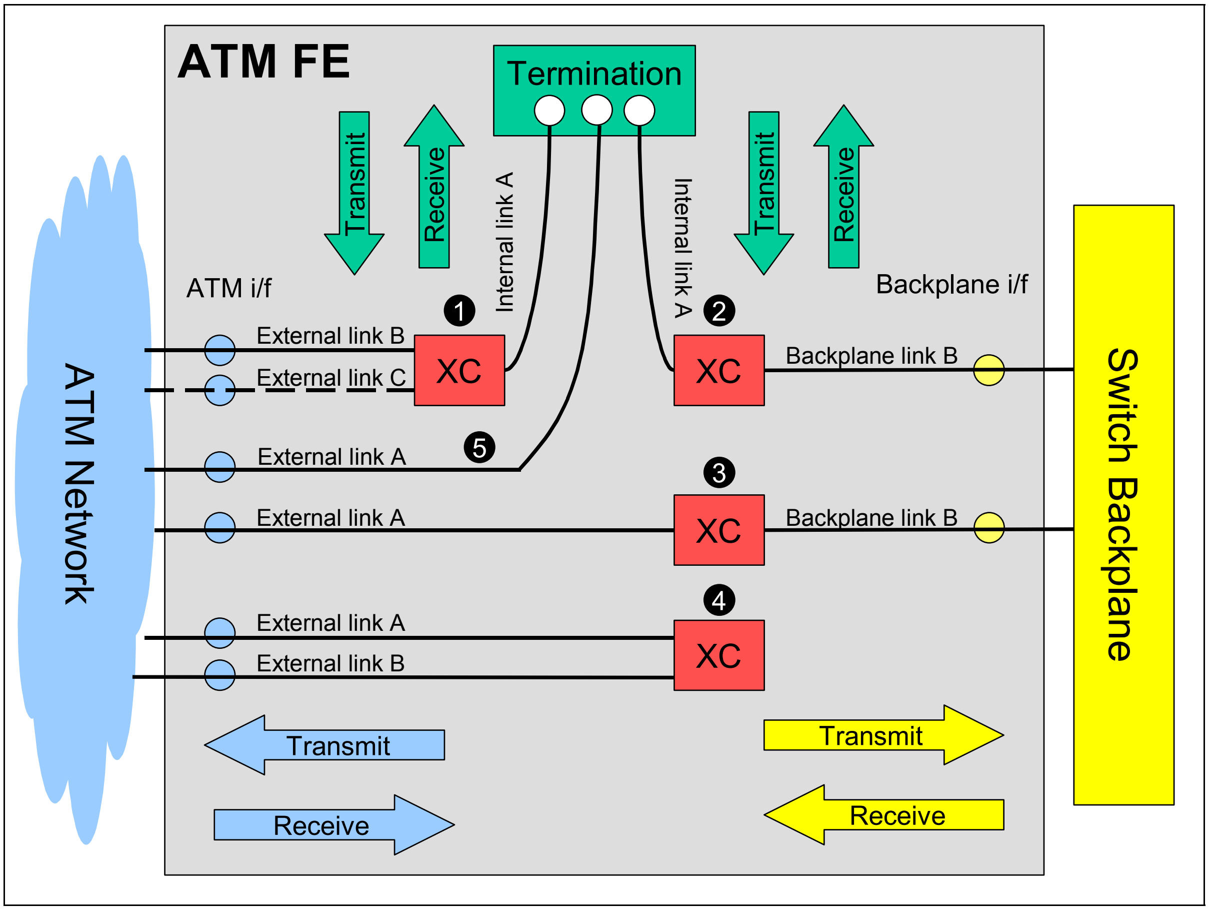


Figure 5 Link types and directions on an ATM FE

3 Service API

The ATM SAPI supports configuration and management of ATM Layer and ATM Adaptation Layer functionality, from a system point of view. Figure 2 indicates two main function areas handled by the ATM SAPI, namely control of ATM connections (VPCs and VCCs) and control of AAL2 channels respectively.

The ATM connection control area handles setup and release of VPCs and VCCs. At setup of a VPC and VCC, information used for VPI/VCI translation, Traffic Management and OAM is associated with the connection. If the VCC is to be terminated in the node, the connection is also associated with needed AAL0, AAL1, AAL2 or AAL5 information. In addition to the functions for setup and release, the ATM connection control area also provides functions for retrieving alarms and performance counters.

Since AAL2, in contradiction to the other ATM Adaptation Layers, is an own network layer and not only a termination, there is an own function area for configuration and management of AAL2 channels. This is mainly used for setup and release of AAL2 channels. At channel setup, information used for Channel Identifier (CID) translation and Traffic Management at the AAL2-CPS level is sent through the API. If the AAL2 channel is to be terminated in the node, AAL2-SSCS information is also provided through the API.

4 Interface Management API

The ATM extensions to the Interface Management API support configuration and management of interfaces used by the ATM Layer, from a system point of view. Those are different types of interfaces used for mapping of ATM cells on the physical media, such as IMA and ATM Transmission Convergence for different physical medias. Configuration and management of the ATM Port are also included in the ATM extensions to the Interface Management API. The ATM extensions do not include any control of ATM connections (VPCs and VCCs) or AAL2 channels respectively; the ATM SAPI handles this control.

5 Functional APIs

The FAPIs are aware of the system topology and are used for configuration and management of a specific Forwarding Element (FE). They support ATM and ATM Adaptation Layer functionality as well as functionality for mapping ATM cells on the physical media. Each FAPI has a one-to-one relation to a Logical Functional Block (LFB) in the Forwarding Element (FE). The LFB is a logical representation of the functionality that the FAPI controls.

While there is only one SAPI covering ATM, there are a number of FAPIs with corresponding LFBs, representing the ATM area. Different combinations of these LFBs represent different FE implementations. The following sub-sections give an overview of the FAPIs/LFBs within the ATM area.

5.1 ATM Configuration Manager

ATM being connection oriented by nature requires that multiple LFBs in an FE are being updated for a given circuit establishment. For example, establishment of a bi-directional AAL2 terminated virtual connection requires the following LFB data structures to be updated:

- ATM Header Classifier
- ATM OAM Receive
- ATM Policer
- AAL2 CPS Receive
- AAL2 SAR SSCS Receive
- AAL2 CPS Transmit
- AAL2 SAR SSCS Transmit
- ATM Traffic Manager
- ATM OAM Transmit
- ATM Header Generator

When these LFBs are located on the same FE, the number of function calls required to be made by the FAPI client to carry out operations (create, delete etc.) could be optimized by having an entity that aggregates the parameters of the function calls to be invoked on individual LFBs to configure various ATM objects like connections, channels, interfaces etc. This entity is called the ATM Configuration Manager LFB and it is responsible for configuration and management of the other ATM LFBs on an FE. It provides APIs for:

- ATM interface configuration and management
- ATM connection configuration and management
- AAL2 channel configuration and management
- ATM OAM services

The FAPI client invokes FAPI function calls provided by the ATM Configuration Manager. The ATM Configuration Manager then distributes the configurations to the underlying LFBs. The mechanisms used to distribute such configurations are vendor specific and thus not in the scope of NPF. The relationship of the ATM Configuration Manager with other LFBs in the ATM area is as shown in Figure 6 below:

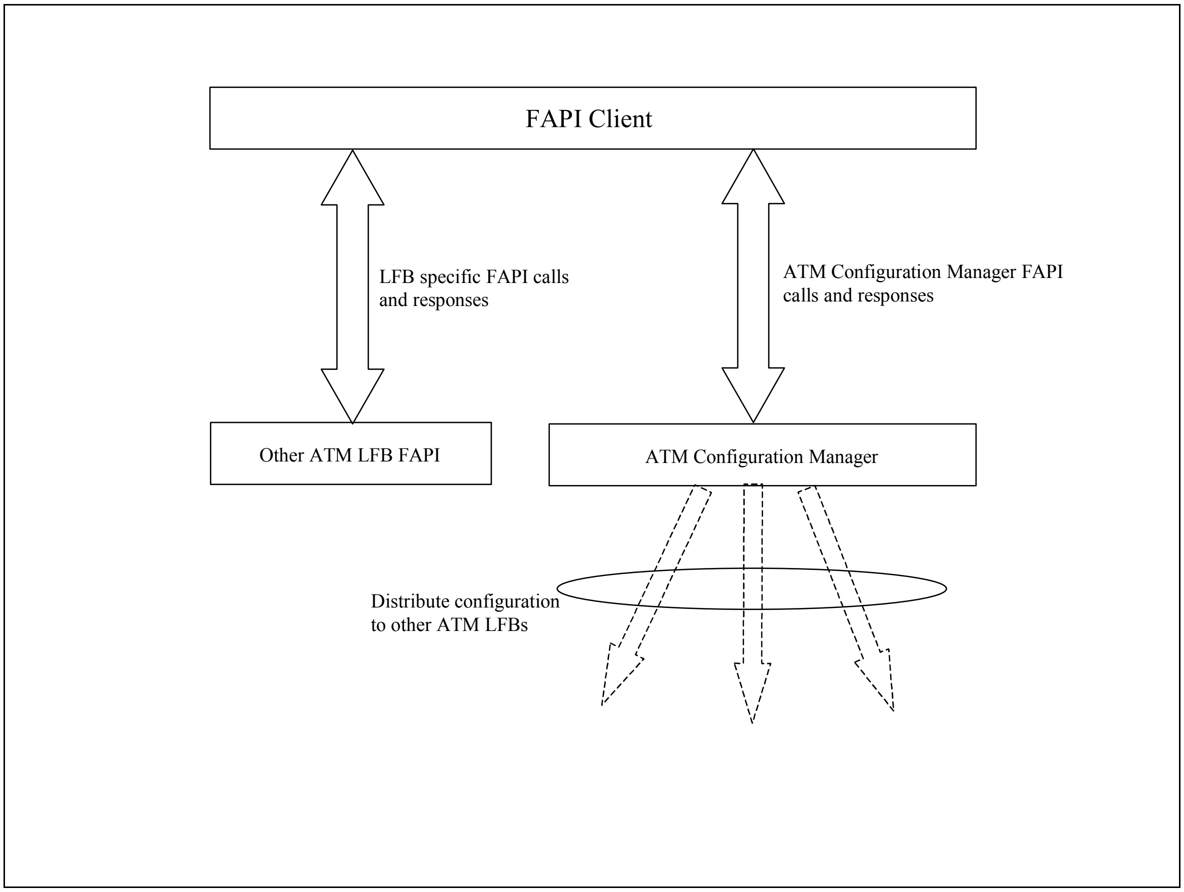


Figure 6 ATM Configuration Manager, relationship with other LFBs.

5.2 ATM Header Classifier

The ATM Header Classifier LFB receives ATM cells together with ATM Interface ID metadata. The LFB uses the Interface ID metadata to identify the interface as either UNI or NNI. It uses the VPI from the ATM header along with the interface type to determine the VP link on which the cell was received. If the VP is terminated at this node, the VCI of the ATM header is used to determine the VC link on which the cell was received. The ATM SDU is then extracted and sent together with metadata identifying the FE global VPL and VCL identities as well as PTI and CLP. If the VP is not terminated on the FE, the ATM Header Classifier generates a VCI metadata instead of the VCL ID metadata.

5.3 ATM Header Generator

The ATM Header Generator LFB receives ATM SDUs together with metadata identifying the FE global VPL and VCL identities as well as PTI and CLP, from the previous LFB. It uses these metadata to determine the ATM header and form the ATM cell, which it hands off to the next LFB together with metadata identifying the ATM Interface.

5.4 AAL5 Receive

The AAL5 Receive LFB receives ATM SDUs accompanied with VCL ID, PTI and CLP metadata from the previous LFB and performs re-assembly of the ATM SDU’s to create AAL5 packets. It forwards the AAL5-CPCS SDUs together with metadata specifying the CPCS Loss Priority, User-to-User Indication, frame length and bounded higher layer interface.

5.5 AAL5 Transmit

The AAL5 Transmit LFB receives AAL5-CPCS SDUs accompanied with connection ID, CPCS Loss Priority, User-to-User Indication and frame length metadata. It uses the received metadata to create a CPCS trailer and segment the packet into ATM SDUs. To identify whether an ATM SDU is the last ATM SDU or not in a packet, the LFB produces the PTI metadata. It also produces VCL ID as well as CLP metadata. These produced metadata are then passed to the next LFB in the chain together with the ATM SDUs.

5.6 ATM Policer

The ATM Policer LFB monitors received ATM SDU's and checks that they conform to a negotiated traffic contract. It uses the VPL or VCL ID, received as metadata, to look up the traffic contract of a specific virtual link. The traffic contract is used to perform UPC or NPC functions on the received cell stream and depending of the result, the ATM policer may perform the following actions:

- Cell passing
- Cell Tagging by changing CLP metadata from 0 to 1
- Cell discarding

The ATM Policer may also be configured to perform Partial Packet Discard (PPD) or Early Packet Discard (EPD). In this case it uses the payload type metadata to identify the last ATM SDU of the frame.

5.7 ATM Traffic Manager

The ATM Traffic Manager is used to ensure that the traffic on a virtual link complies to and does not violate the established traffic contract. It uses the received VPL or VCL ID and CLP metadata to look up the virtual link and its corresponding QoS and bandwidth characteristics. To secure these characteristics, the ATM Traffic Manager uses various mechanisms like buffering, queuing, scheduling and traffic shaping.

The ATM Traffic Manager may also be configured to perform Partial Packet Discard (PPD) or Early Packet Discard (EPD). In this case it uses the payload type metadata to identify the last ATM SDU of the frame.

5.8 AAL2 CPS Receive

The AAL2 CPS Receive LFB receives ATM SDU's from the previous LFB and extracts CPS packets interleaved on the ATM cell stream. Each AAL2 path configured in the AAL2 CPS Receive LFB may be associated with up to 256 AAL2 channels. These channels are identified by a unique VCL Identity (identifying the AAL2 path) and a channel identifier, CID. By using the VCL ID contained in the metadata received with the input ATM SDU and the CID in the CPS packets extracted from the ATM SDU, the LFB identifies the AAL2 channel instance and produces a FE global Channel ID, a User-to-User Indication, a Length Indicator and a CID (0-255) metadata. These metadata are handed over to the next LFB together with the AAL2-CPS SDU.

5.9 AAL2 CPS Transmit

The AAL2 CPS Transmit LFB receives AAL2-CPS SDUs together with metadata specifying a FE global Channel ID, a user-to-user indication and a length indicator. With the FE global Channel ID it looks up the AAL2 Path and the CID. The AAL2 CPS Transmit LFB uses the user-to-user indication and the length indicator metadata together with the CID to build an AAL2-CPS packet header, which it appends to the AAL2-CPS SDU. Finally the AAL2 CPS Transmit LFB multiplexes the AAL2-CPS packet into the ATM SDU, which it forwards to the next LFB accompanied with VCL ID, PTI and CLP metadata.

The AAL2 CPS Transmit LFB can also separate the traffic into a configurable number of QoS queues. A configurable part of the AAL2 path bandwidth can be assigned to each QoS queue.

5.10 AAL2 SAR SSCS Receive

The AAL2 SAR SSCS Receive LFB receives CPS SDU's from the previous LFB and performs re-assembly of the CPS SDU's to create SSSAR SDU's. Depending on the configuration of the ATM AAL2 channel on which the SSSAR SDU is received further processing by the SSADT and SSTED sub layers may be performed.

5.11 AAL2 SAR SSCS Transmit

The AAL2 SAR SSCS Transmit LFB receives packets to be transferred on AAL2 channels from the previous LFB. The AAL2 CPS SDU's created by the AAL2 SAR SSCS Transmit LFB are passed to the next LFB in the chain.

5.12 ATM OAM Receive

The ATM OAM Receive LFB does ATM OAM processing on the ATM SDU received from the previous LFB. OAM flows are related to bi-directional Maintenance Entities (MEs) corresponding either to the entire ATM VPC/VCC, referred to as the VPC/VCC ME, or to a portion of this connection referred to as a VPC/VCC segment ME.

Before the start of any OAM operation, the boundary needs to be drawn for the paired endpoints. The MEs terminating the ATM links are configured before as an endpoint of the VPC/VCC or endpoint of the VPC/VCC segment. End-to-end F5 flows terminate at the endpoints of a VCC, while the segment F5 flows terminate at the VCC segment endpoints. Similarly, the end-to-end F4 flows terminate at the endpoints of a VPC, while the segment F4 flows terminate at the VPC segment endpoints. The ATM OAM Receive LFB performs the OAM functions configured for the OAM flow terminations. It may also be configured to perform passive monitoring of OAM flows.

The ATM OAM Receive LFB uses the received VPL ID, VCL ID, VCI, PTI and the CLP metadata to determine whether the incoming ATM SDU belongs to an OAM or user cell and to determine what actions to be taken.

When continuity check procedures are enabled for a F4 or F5 flow, the ATM OAM Receive LFB checks the continuity of the connection by monitoring that it receives either user cells or CC cells. If the continuity is lost the LFB automatically sets the connection into AIS state, reports an LOC defect to the FAPI client and generates RDI cells to the ATM OAM Transmit LFB through a special OAM cell output.

When the ATM OAM Receive LFB receives an AIS cell on an OAM end-point, it sets the connection into AIS state, reports the AIS defect to the FAPI client and generates RDI cells to the ATM OAM Transmit LFB through a special OAM cell output.

When the ATM OAM Receive LFB sets a VP end-point into AIS state, it at the same time automatically sets all VCs included in the VP into AIS state. In this case, F5 AIS is generated in the forward direction at intermediate points along the VC and F5 RDI is generated in the backward direction at VC end-points.

When performance monitoring is enabled for a F4 or F5 flow, the ATM OAM Receive LFB maintains statistics for the user cells received on those flows. It also might generate BR cells periodically based on the configured block size. These BR cells are sent to the ATM OAM Transmit LFB through the special OAM cell output mentioned above.

The ATM OAM Receive LFB identifies Loopback cells. If it is a returned Loopback cell that matches the end-points source id the LFB shall notify the FAPI client with the result of the loopback procedure, a Loopback cell that shall be looped back at an end-point shall be sent to the ATM OAM Transmit LFB without intervention from the FAPI client.

5.13 ATM OAM Transmit

The ATM OAM Transmit LFB does the insertion of the ATM OAM cells in the transmitted ATM cell stream. The ATM OAM cell insertion may be requested by the ATM OAM receive LFB as a response to received ATM OAM cells, detected fault conditions, performance monitoring functions performed by the ATM OAM receive LFB. The ATM OAM Transmit LFB also performs OAM cell insertion as directed by the FAPI client to carry out procedures like activation/deactivation of continuity check/ performance monitoring procedures, alarm generation, loopback initiation.

When performance monitoring is enabled for a F4 or F5 flow, the ATM OAM transmit LFB maintains statistics for the user cells transmitted on those flows and generates FPM cells periodically based on the configured block size.

When continuity check procedures are enabled for a F4 or F5 flow, the continuity check cells are automatically generated by the ATM OAM transmit LFB. The CC cells may be generated periodically or if no user cell for that flow has been transmitted for the continuity check period as specified by the FAPI client when activating the continuity check procedure.

The ATM OAM Transmit LFB receives ATM SDUs from either the normal ATM SDU input or from the special OAM cell input connected to the ATM OAM Receive LFB.

OAM flows are related to bi-directional Maintenance Entities (MEs) corresponding either to the entire ATM VPC/VCC, referred to as the VPC/VCC ME, or to a portion of this connection referred to as a VPC/VCC segment ME. Before the start of any OAM operation, the boundary needs to be drawn for the paired endpoints. The MEs terminating the ATM links are configured before as an endpoint of the VPC/VCC or endpoint of the VPC/VCC segment. End-to-end F5 flows terminate at the endpoints of a VCC, while the segment F5 flows terminate at the VCC segment endpoints. Similarly, the end-to-end F4 flows terminate at the endpoints of a VPC, while the segment F4 flows terminate at the VPC segment endpoints. The ATM OAM Transmit LFB performs the OAM functions configured for the OAM flow terminations.

5.14 Switch Address Classifier for ATM

The Switch Address Classifier for ATM LFB receives ATM SDUs from the previous LFB. It uses the SW_ADDR and the SW_IF_ID metadata to identify the backplane link. The ATM SDU is sent together with the produced BPL_ID metadata to the next LFB in the chain.

5.15 Switch Address Generator for ATM

The Switch Address Generator for ATM LFB receives ATM SDUs from the previous LFB. It will use the BPL_ID metadata and produce the SW_ADDR and the SW_IF_ID metadata that is being used for identification over the backplane. The ATM SDU is sent together with the produced SW_ADDR and SW_IF_ID metadata to the next LFB in the chain.

5.16 Switch Address Classifier for AAL2 CPS

The Switch Address Classifier for AAL2 CPS LFB receives AAL2 CPS SDUs from the previous LFB. It uses the SW_ADDR, SW_IF_ID and the CID metadata to identify the AAL2 channel. The AAL2 CPS SDU is sent together with the produced BPL_ID metadata to the next LFB in the chain.

5.17 Switch Address Generator for AAL2 CPS

The Switch Address Generator for AAL2 CPS LFB receives AAL2 CPS SDU’s from the previous LFB. It will use the BPL_ID metadata and produce the SW_ADDR and the SW_IF_ID metadata that is being used for identification over the backplane. The AAL2 CPS SDU is sent together with the produced SW_ADDR and SW_IF_ID metadata to the next LFB in the chain.

5.18 ATM Cross Connect

The ATM Cross Connect LFB receives ATM SDUs from the previous LFB. It will cross connect the incoming link to one or more outgoing links. The ATM SDUs are sent together with the produced ATM_SCOPE metadata on the outgoing link(s) to the next LFB.

5.19 AAL2 Channel Cross Connect

The AAL2 Channel Cross Connect LFB receives AAL2 CPS SDU’s from the previous LFB. It uses the incoming CHNL_ID to identify the AAL2 channel and to produce the new CHNL_ID metadata identifying the cross connected AAL2 channel. It will also produce a CHNL_SCOPE metadata that could be used by a redirector to determine the following LFB. The AAL2 CPS SDU is sent together with the produced CHNL_ID and CHNL_SCOPE metadata to the next LFB in the chain.

5.20 ATM IMA Transmit

The ATM IMA Transmit LFB receives ATM cells from the previous LFB. It uses the incoming IF_ID metadata that identifies the IMA group that the ATM cell belongs to. The ATM cell is sent together with the produced IMA_LINK metadata to the next LFB in the chain.

5.21 ATM IMA Receive

The ATM IMA Receive LFB receives ATM cells from the previous LFB. It uses the incoming IMA_LINK metadata for identification of the IMA group that the ATM cell belongs to. The ATM cell is sent together with the produced IF_ID metadata to the next LFB in the chain.

5.22 AAL1 Transmit

The AAL1 Transmit LFB receives packets to be transferred on VC links from the previous LFB. The AAL1 frames created by the AAL1 Transmit LFB are then segmented into ATM SDU’s and passed to the next LFB in the chain.

5.23 AAL1 Receive

The AAL1 Receive LFB receives ATM SDU’s from the previous LFB and performs re-assembly of the ATM SDU’s to create AAL1 packets.

5.24 ATM TC Transmit

The ATM TC Transmit LFB receives ATM cells from the previous LFB. It will map the ATM cells to the frame format and generate the Header Error Check (HEC). It will also send idle cells when the previous LFB has no ATM cells to send.

5.25 ATM TC Receive

The ATM TC Receive LFB receives frames from which it delineates individual ATM cells, and uses the HEC to detect and correct received errors. The ATM cells are sent together with the produced IF_ID metadata to the next LFB in the chain.

6 Packet Handler API

The Packet Handler API comprises a service level API that supports input and output sessions for individual applications, and a Functional API that communicates directly with a Forwarding Element (FE). For ATM the Packet Handler APIs are used to transmit and receive ATM cells and AAL packets between the Control Plane Software and LFBs in the Forwarding Element. The interface could for example be used by an AAL5 termination application to transmit and receive AAL5 packets.

7 References

[1] NP Forum – Software API Framework Implementation Agreement Revision 1.0

[2] NP Forum – Software API Framework Lexicon Implementation Agreement Revision 1.0

[3] ITU-T Recommendation I.363.1: B-ISDN ATM Adaptation Layer specification: Type 1 AAL (08/96)

[4] ITU-T Recommendation I.363.2: B-ISDN ATM Adaptation Layer specification: Type 2 AAL (11/00)

[5] ITU-T Recommendation I.363.5: B-ISDN ATM Adaptation Layer specification: Type 5 AAL (08/96)

[6] NP Forum – ATM Configuration Manager Functional API IA (NPF work in progress)

[7] NP Forum – ATM Header Classifier Configuration Functional API IA (NPF work in progress)

[8] NP Forum – ATM Header Generator Configuration Functional API IA (NPF work in progress)

[9] NP Forum – AAL5 Receive Configuration Functional API IA (NPF work in progress)

[10] NP Forum – AAL5 Transmit Configuration Functional API IA (NPF work in progress)

[11] NP Forum – ATM Policer Configuration Functional API IA (NPF work in progress)

[12] NP Forum – ATM Traffic Manager Configuration Functional API IA (NPF work in progress)

[13] NP Forum – AAL2 CPS Receive Configuration Functional API IA (NPF work in progress)

[14] NP Forum – AAL2 CPS Transmit Configuration Functional API IA (NPF work in progress)

[15] NP Forum – AAL2 SAR SSCS Receive Configuration Functional API IA (NPF work in progress)

[16] NP Forum – AAL2 SAR SSCS Transmit Configuration Functional API IA (NPF work in progress)

[17] NP Forum – ATM OAM Receive Functional API IA (NPF work in progress)

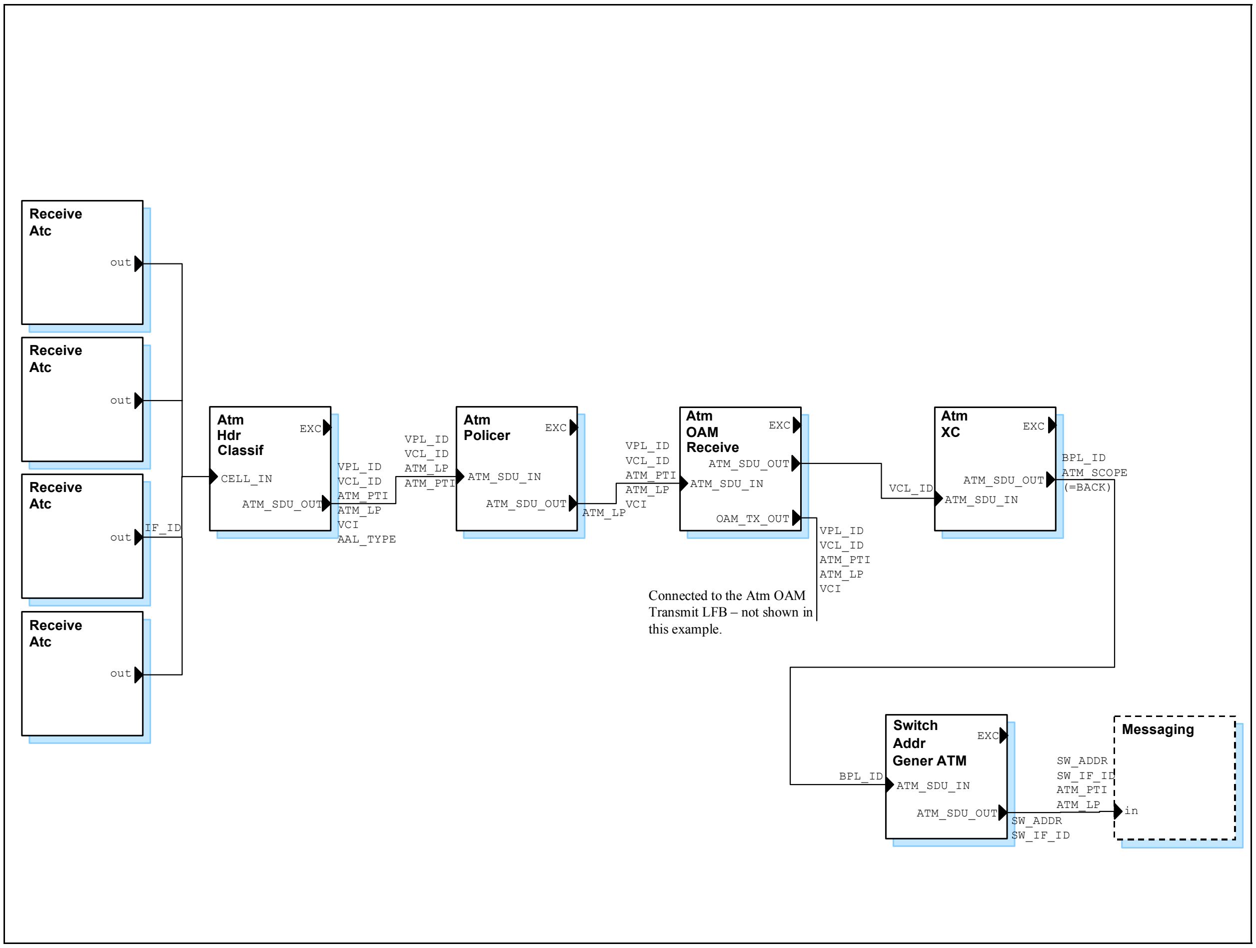
[18] NP Forum – ATM OAM Transmit Functional API IA (NPF work in progress)

APPENDIX A LFB TOPOLOGY EXAMPLES

The examples in this section SHALL NOT be regarded as normative for how topologies within an FE shall be constructed. They SHOULD rather be seen as informative illustrations of how different ATM LFBs could be combined together and the metadata flow between these.

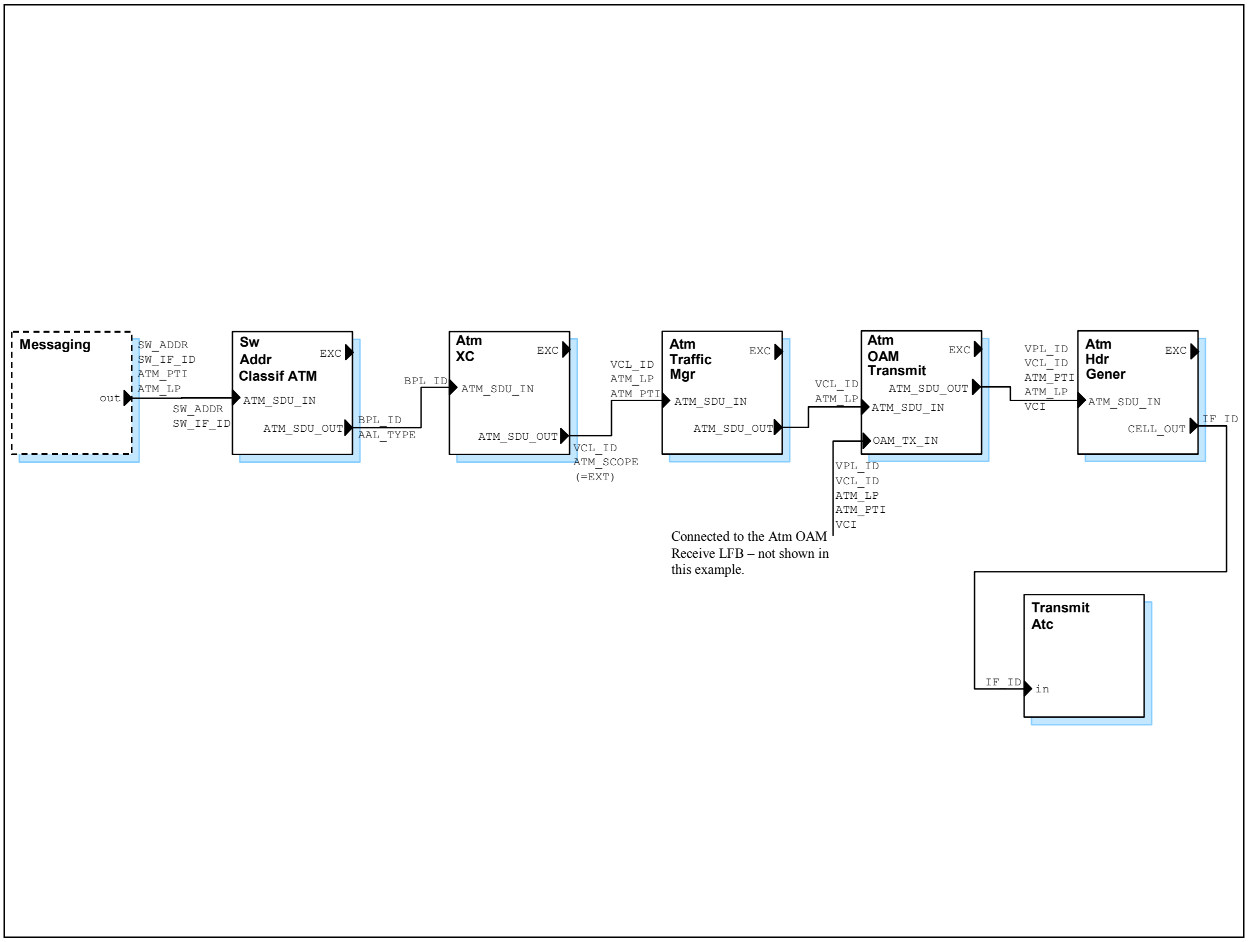
A.1. ATM VC LINK (TERMINATED VP), EXTERNAL TO BACKPLANE

The topology example below shows an FE with four ATM TC ports and a backplane for FE interconnection. The ATM TC ports acts as ATM cell source and the backplane acts as ATM cell sink. The FE has policing and OAM functionality. The Switch Address Generator LFB will produce the metadata SW_ADDR from the API parameter switchAddress, the incoming metadata ATM_PTI and ATM_LP are passed transparently to the Messaging LFB. The Messaging LFB will packet and transport the metadata along with the ATM SDU to the next LFB located on the boundary of another FE. Note that the ATM XC LFB must be used in this case, connecting an external link to a backplane link.



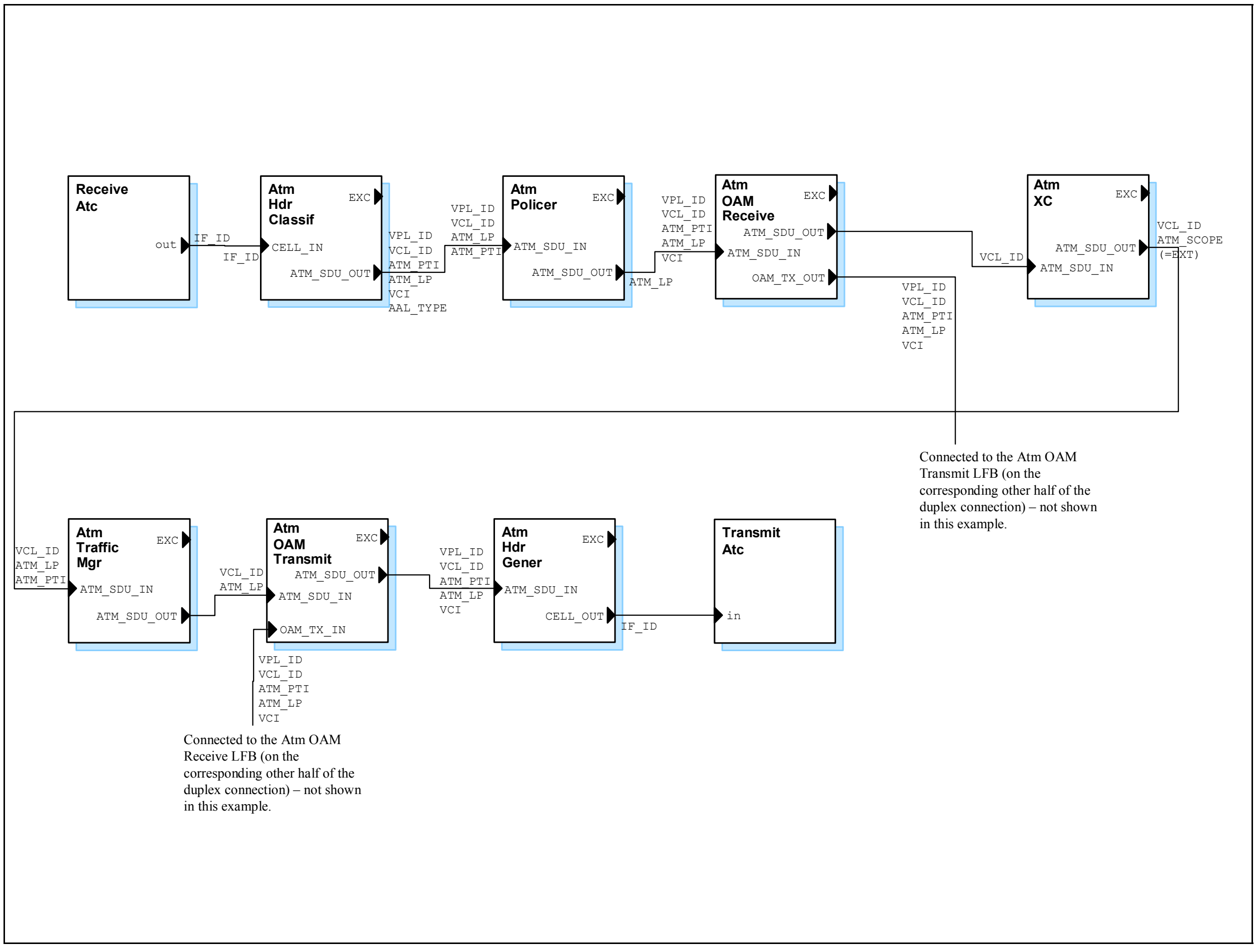
A.2. ATM VC LINK, BACKPLANE TO EXTERNAL

The topology example below shows an FE with one ATM TC port and a backplane for FE interconnection. The backplane acts as ATM cell source and the ATM TC port acts as ATM cell sink. The FE has traffic management and OAM functionality. The ATM Switch Address Classifier LFB will consume the SW_ADDR and the SW_IF_ID metadata and as a result produce a BPL_ID metadata that identifies the backplane link. The ATM XC LFB will cross connect the backplane link to an external link. The ATM Header Generator LFB will add a new external ATM header for the ATM VC links. Note that the ATM XC LFB must be used in this case, connecting a backplane link to an external link.



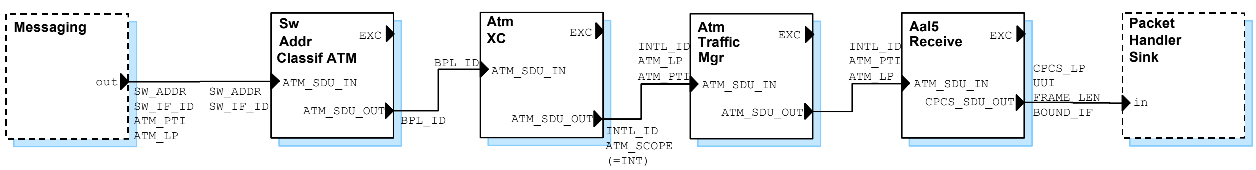
A.3. ATM VC LINK, FE INTERNAL CROSS CONNECT

The topology example below shows an FE with one receive ATM TC port and one transmit ATM TC port. The receive ATM TC port acts as ATM cell source and the transmit ATM TC port acts as ATM cell sink. The FE performs internal cross connection between ATM VC links. The FE has policing, traffic management and OAM functionality. The ATM XC LFB performs the VC link cross connection. The ATM Header Generator LFB will add a new external ATM header for the ATM VC links. Note that the ATM XC LFB must be used in this case, connecting an external link to an external link.



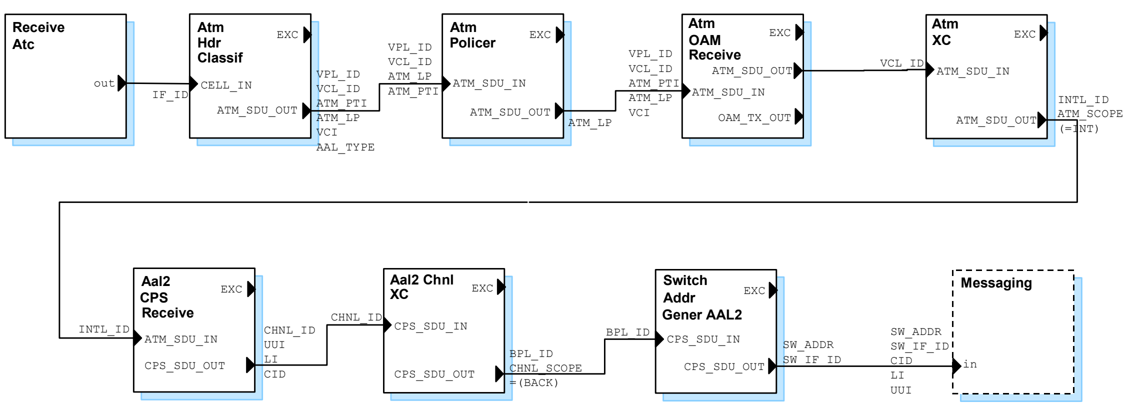
A.4. AAL5, BACKPLANE TO PACKET HANDLER

The topology example below shows an FE with a Packet Handler sink (host termination) and a backplane for FE interconnection. The backplane acts as ATM cell source and the Packet Handler acts as ATM cell sink. The FE has traffic management functionality. The ATM Switch Address Classifier LFB will consume the SW_ADDR and the SW_IF_ID metadata and as a result produce a BPL_ID metadata that identifies the backplane link. The AAL5 Receive LFB performs re-assembly of the ATM SDU's to create AAL5-CPCS SDUs that are delivered together with the needed metadata to the Packet Handler Sink LFB. Note that the ATM XC LFB must be used in this case, connecting a backplane link to a termination (via an internal link).



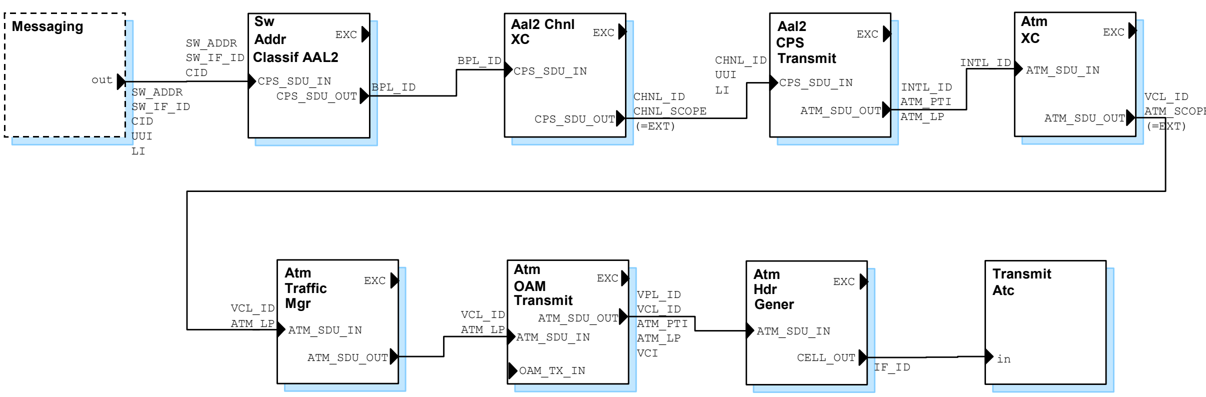
A.5. AAL2, EXTERNAL TO BACKPLANE

The topology example below shows an FE with one ATM TC port and a backplane for FE interconnection. The ATM TC port acts as ATM cell source and the backplane acts as ATM cell sink. The FE has policing and OAM functionality. The AAL2 CPS Receive LFB receives ATM SDUs from the previous LFB and extracts AAL2 CPS packets interleaved on the ATM cell stream. The Switch Address Generator LFB will produce the metadata SW_ADDR and SW_IF_ID. The Messaging LFB will packet and transport the metadata along with the CPS SDU to the next LFB located on the boundary of another FE. Note that the ATM XC LFB could be omitted (two ways to do this), connecting an external link to a termination (AAL2 CPS Receive LFB). The AAL2 Channel XC must be used in this case, connecting a channel link to a backplane link.



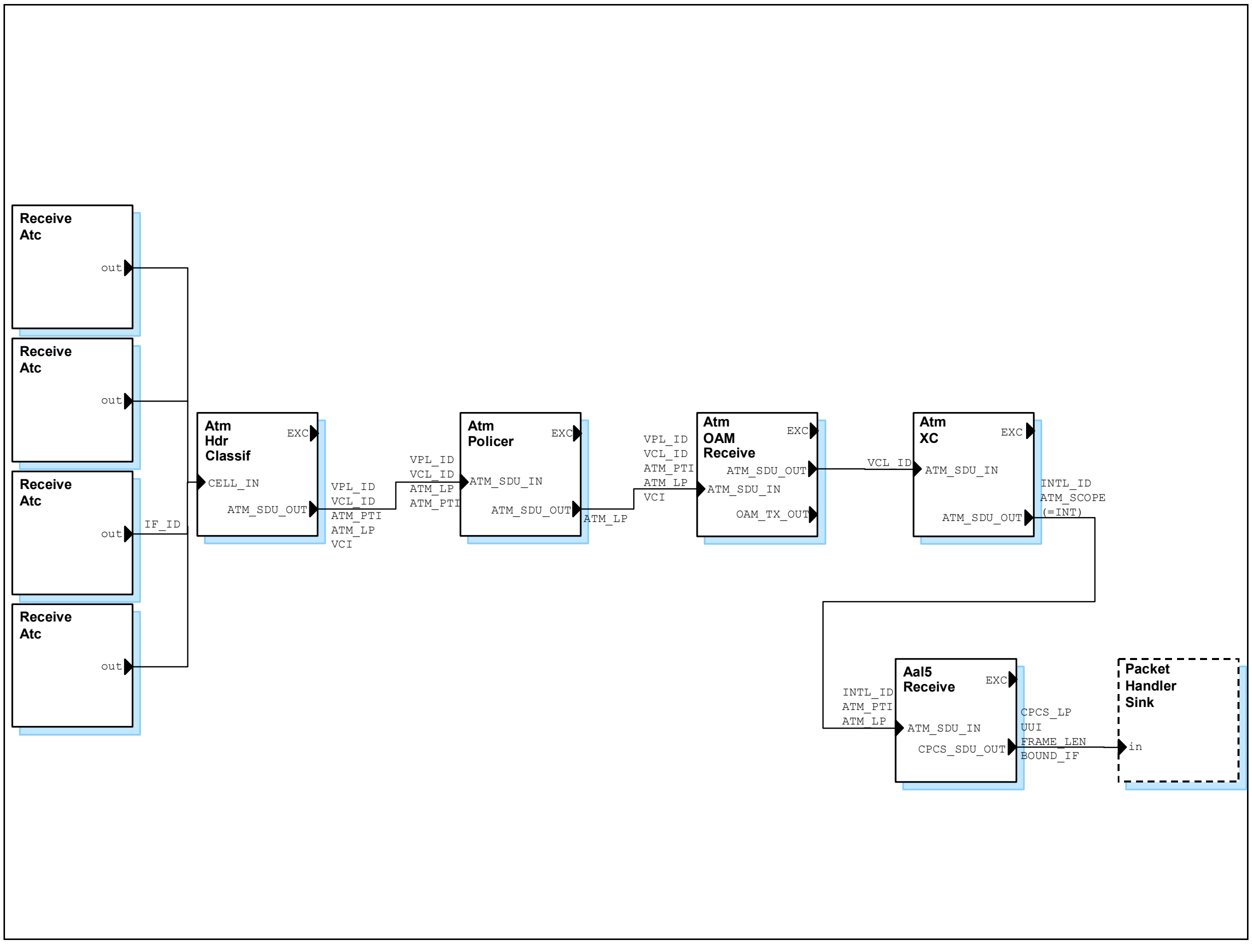
A.6. AAL2, BACKPLANE TO EXTERNAL

The topology example below shows an FE with one ATM TC port and a backplane for FE interconnection. The backplane acts as ATM cell source and the ATM TC port acts as ATM cell sink. The FE has traffic management, OAM and AAL2 multiplexing functionality. The Switch Address Classifier AAL2 LFB will consume the SW_ADDR, SW_IF_ID and the CID metadata and as a result produce a BPL_ID metadata that identifies the backplane link for the AAL2 Channel XC LFB. The AAL2 CPS Transmit LFB receives CPS SDUs that is multiplexed into ATM SDUs. The ATM SDUs are forwarded together with the produced metadata to the next LFB. Note that the ATM XC LFB could be omitted (two ways to do this), connecting a termination (AAL2 CPS Transmit LFB) to an external link. The AAL2 Channel XC must be used in this case, connecting a backplane link to a channel link.



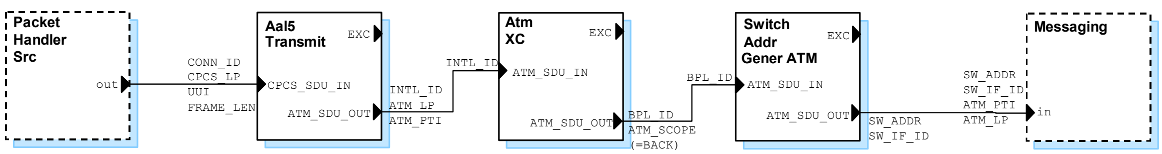
A.7. AAL5, EXTERNAL TO PACKET HANDLER

The topology example below shows an FE with four ATM TC ports and a Packet Handler sink (host termination). The ATM TC ports acts as ATM cell source and the Packet Handler acts as ATM cell sink. The FE has policing and OAM functionality. The AAL5 Receive LFB performs re-assembly of the ATM SDU's to create AAL5 packets delivered to the Packet Handler Sink LFB. Note that the ATM XC LFB could be omitted (two ways to do this), connecting an external link to a termination.



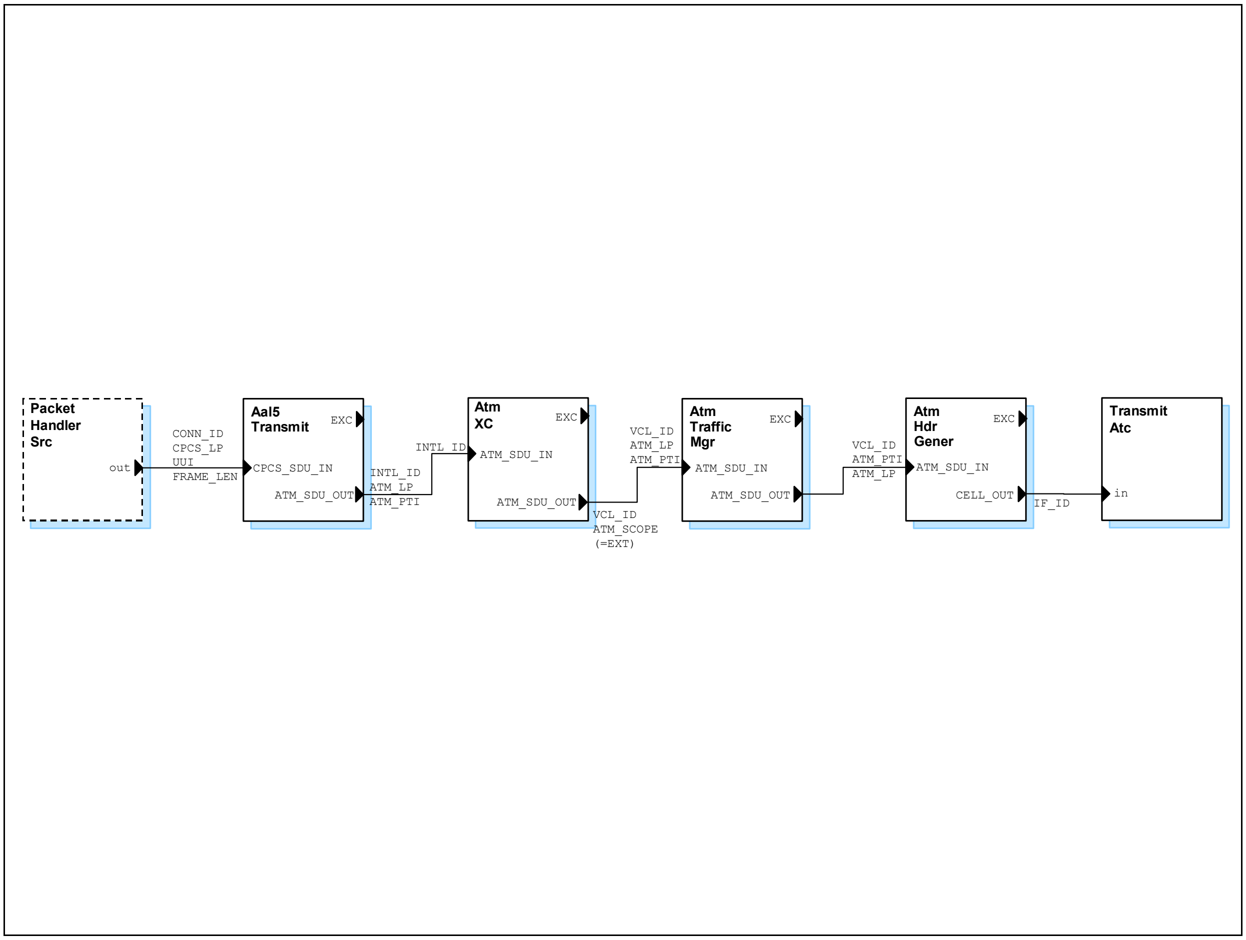
A.8. AAL5, PACKET HANDLER TO BACKPLANE

The topology example below shows an FE with a Packet Handler source and a backplane for FE interconnection. The Packet Handler acts as ATM cell source and the backplane acts as ATM cell sink. The AAL5 Transmit LFB receives packets to be transferred on VC links from the Packet Handler Source LFB. The AAL5 frames created by the AAL5 Transmit LFB are then segmented into ATM SDUs and are, after the ATM cross connect, passed to the Switch Address Generator ATM LFB. The Switch Address Generator ATM LFB will produce the metadata SW_ADDR from the API parameter switchAddress, the incoming metadata ATM_PTI and ATM_LP are passed transparently to the Messaging LFB. The Messaging LFB will packet and transport the metadata along with the ATM SDU to the next LFB located on the boundary of another FE. Note that the ATM XC LFB must be used in this case, connecting a termination (via an internal link) to a backplane link.



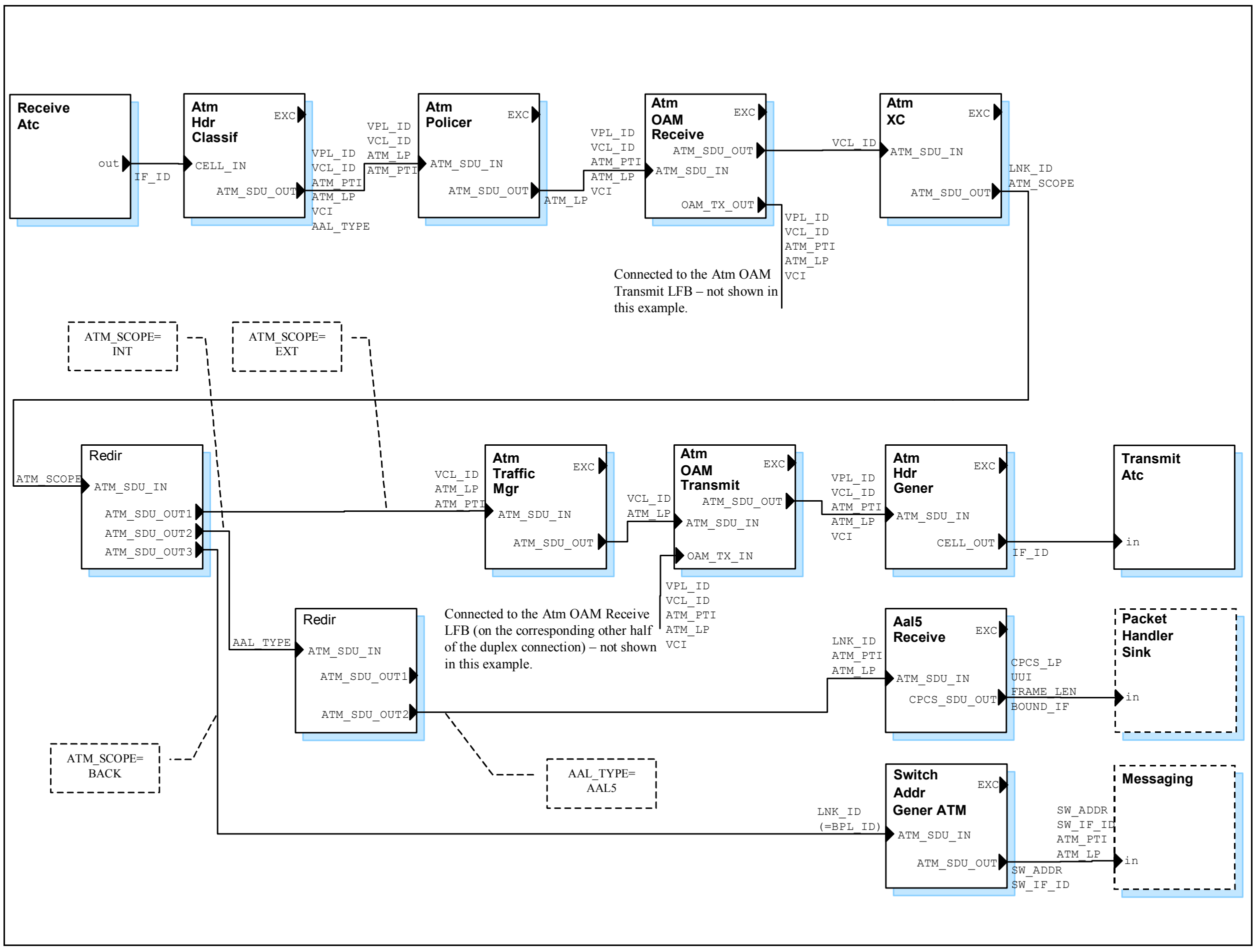
A.9. AAL5, PACKET HANDLER TO EXTERNAL

The topology example below shows an FE with a Packet Handler source and one ATM TC port. The Packet Handler acts as ATM cell source and the ATM TC port acts as ATM cell sink. The FE has traffic management functionality. The AAL5 Transmit LFB receives packets to be transferred on VC links from the Packet Handler Source LFB. The AAL5 frames created by the AAL5 Transmit LFB are then segmented into ATM SDUs and passed to the ATM XC LFB. Note that the ATM XC LFB could be omitted (two ways to do this), connecting a termination to an external link.



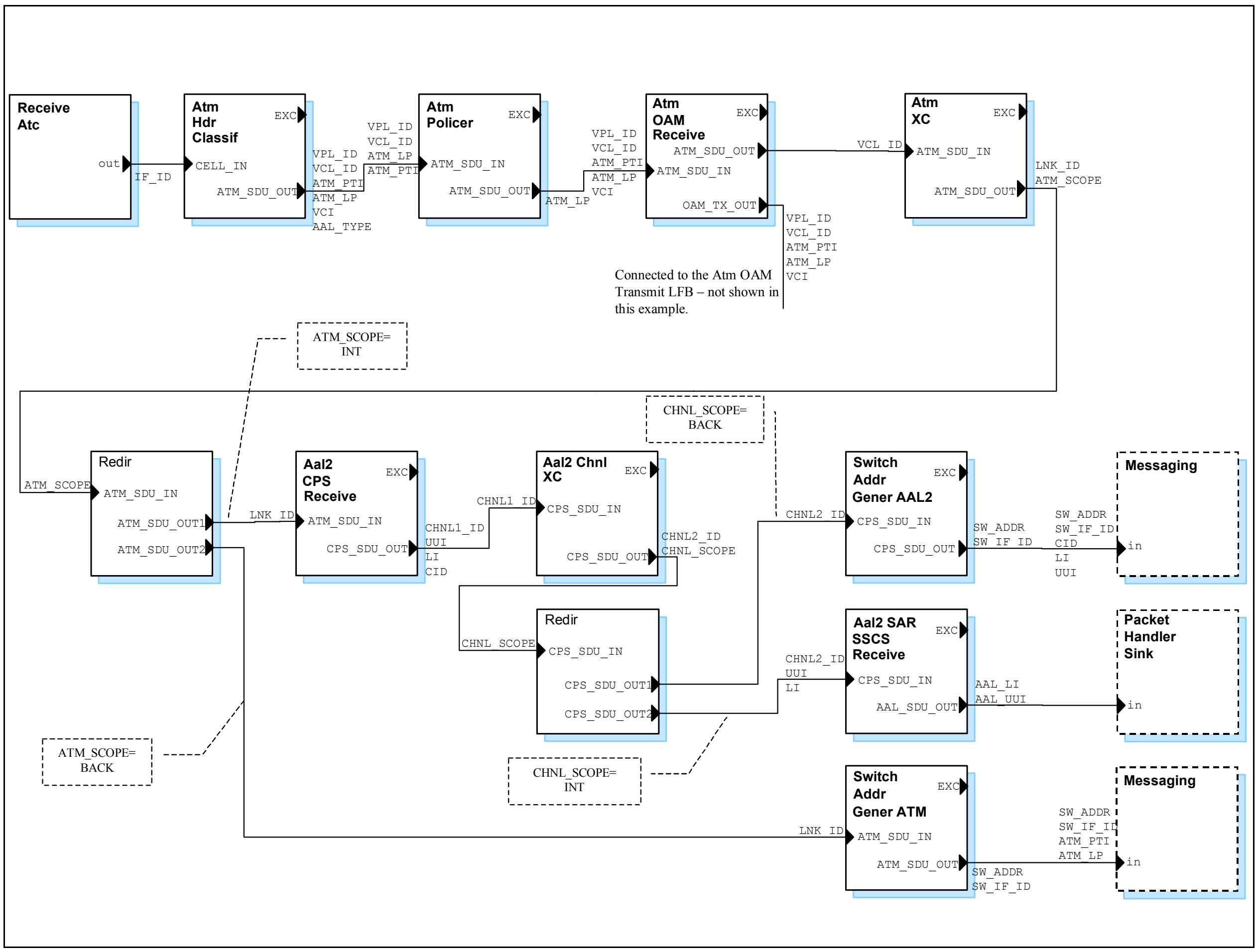
A.10. REDIRECTOR USAGE EXPLAINED BY EXAMPLE 1

The topology example below shows an FE with one ATM TC port, acting as cell source, and three different possible cell sinks. The metadata AAL_TYPE and ATM_SCOPE generated by the ATM Header Classifier and the ATM XC are used by the respective Redirectors to select the output destination for the ATM SDU. When AAL_TYPE is set to UNKNOWN and ATM_SCOPE is set to EXT an FE internal cross connection between ATM VC links is performed. An FE external cross connection over a backplane is performed when the AAL_TYPE is set to UNKNOWN and ATM_SCOPE is set to BACK. The third case shown is an AAL5 termination that is performed by using the AAL_TYPE set to AAL5 and ATM_SCOPE set to INT.



A.11. REDIRECTOR USAGE EXPLAINED BY EXAMPLE 2

The topology example below shows an FE with one ATM TC port, acting as cell source, and three different possible cell sinks. The metadata AAL_TYPE, ATM_SCOPE and CHNL_SCOPE generated by the ATM Header Classifier, the ATM XC and the AAL2 Channel XC are used by the respective Redirectors to select the output destination for the SDU. An FE external cross connection over a backplane is performed when the AAL_TYPE is set to UNKNOWN and ATM_SCOPE is set to BACK. An AAL2 channel cross connect over a backplane link is performed when the AAL_TYPE is set to AAL2, ATM_SCOPE is set to INT and the CHNL_SCOPE is set to BACK. The third case shown is an AAL2 channel termination to host that is performed by using the AAL_TYPE set to AAL2, ATM_SCOPE is set to INT and the CHNL_SCOPE set to INT.



APPENDIX B ACKNOWLEDGEMENTS

Working Group Chair:

Alex Conta, Transwitch, aconta@txc.com

Task Group Chair:

Per Wollbrand, Ericsson, per.wollbrand@ericsson.com

Working Group Editor:

John Renwick, Agere Systems, jrenwick@agere.com

The following individuals are acknowledged for their participation to VCBIS TG teleconferences, plenary meetings, mailing list, and/or for their NPF contributions used for the development of this Implementation Agreement. This list may not be all-inclusive since only names supplied by member companies for inclusion here will be listed. The NPF wishes to thank all active participants to this Implementation Agreement, whether listed here or not.

The list is in alphabetical order of last names:

Alex Conta, Transwitch

Pål Dammvik, Ericsson

Puneet Jain, Intel

Vinoj Kumar, Agere Systems

Arthur Mackay, Freescale

Michael Persson, Ericsson

John Renwick, Agere Systems

Vedvyas Shanbhogue, Intel

Per Wollbrand, Ericsson

APPENDIX C LIST OF COMPANIES BELONGING TO NPF DURING APPROVAL PROCESS

Agere Systems

Altera

AMCC

Analog Devices

Avici Systems

Cypress Semiconductor

Enigma Semiconductor

Ericsson

Erlang Technologies

ETRI

EZ Chip

Flextronics

HCL Technologies

Hifn

IBM

IDT

Infineon Technologies AG

Intel

IP Fabrics

IP Infusion

Kawasaki LSI

Motorola

NetLogic

Nokia

Nortel Networks

NTT Electronics

PMC Sierra

Seaway Networks

Sensory Networks

Sun Microsystems

Teja Technologies

TranSwitch

U4EA Group

Xelerated

Xilinx