ATM Layer Testing

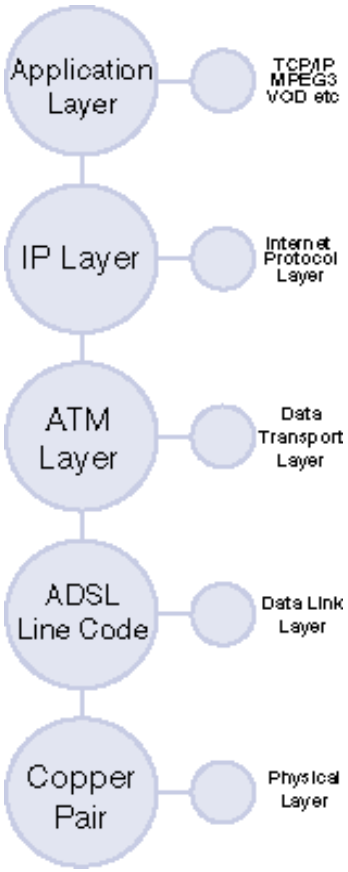
Application Note ANPF5 OAM-11

xDSL

TrendCommunications

VERIFYING AND TROUBLESHOOTING ATM CIRCUITS USING F5 OAM (OPERATION AND MAINTENANCE)

Introduction



Effective DSL service testing requires that every layer of the DSL stack can be tested individually; at the ADSL, ATM, IP, PPP and Application layer. The ATM layer is often overlooked as the source of problems in DSL applications, however problems with ATM mapping, VC continuity and lost or corrupted ATM traffic are all too frequent. Common symptoms include the 'Sync-no-Surf' scenario where users have a 'green light' on their modem but cannot access their ISP. Other test applications have typically focussed on IP level testing because ATM functionality is not available on the test equipment. Under these circumstances a simple IP Ping through to the Remote Access Server (RAS) can help determine the location of IP layer faults. However, if there is a fault at the ATM layer then the IP Ping will always fail because the ATM cells carry the IP Ping. This leaves the engineer unsure of how to proceed, with the prospect of spending valuable time consulting network plans and routing tables, before finally employing the services of network specialists to assist in the fault finding process.

Using the Aurora Presto layered approach to testing, this scenario is greatly simplified as follows:

- The customer modem is replaced with the Aurora Presto, which synchronises to the DSLAM; DSL performance statistics are available and the link layer is verified as operational (time taken < 1minute including powering up the Aurora Presto).
- The next stage is to verify the end-to-end connectivity at the ATM layer; is there a continuous ATM 'pipe' from the modem all the way to the RAS (Remote Access Server)? This is verified using F5 OAM cell flows and is facilitated on Aurora Presto by an OAM 'PING' generated on the Aurora Presto by a single button press (time taken < 30 seconds from synchronisation).
- If the OAM PING fails then there is problem at the ATM layer. Aurora Presto can conduct further investigation at the ATM layer using segmented OAM PING flows to isolate thelocation and nature of the fault. If the OAM PING passes then the IP layer can be targeted with the higher layer IP and PPP diagnostic features of the Aurora Presto.

An Introduction To OAM

Currently deployed DSL for the local loop uses ATM as the transport technology. The ATM transport begins at the customer premise modem (xTU-R) and extends beyond the DSLAM into the ATM network. ATM networks provided by public data carriers or large corporations are characterised by multiple switches in different locations with many users connected. The switches can be connected with multiple possible routes so that protection can be provided in the event of link or switch failure. The OAM functions of the network provide the necessary monitoring capability so that the network manager can be informed of the presence of faults and identify the location of both faulty routes and equipment. OAM cells on the ATM layer are an extension of the fault management functions of the physical layer. The most important data path for DSL connections is the F5 (virtual channel level) flow that extends out to the local loop (to the Customer Premises Equipment).

There are two kinds of F5 flows that can exist in a VCC. These flows are defined as follows:

- End-to-End F5 flow : used for communications between ATM VCC endpoints only.
- Segment F5 flow : used for communications within VCC segments.

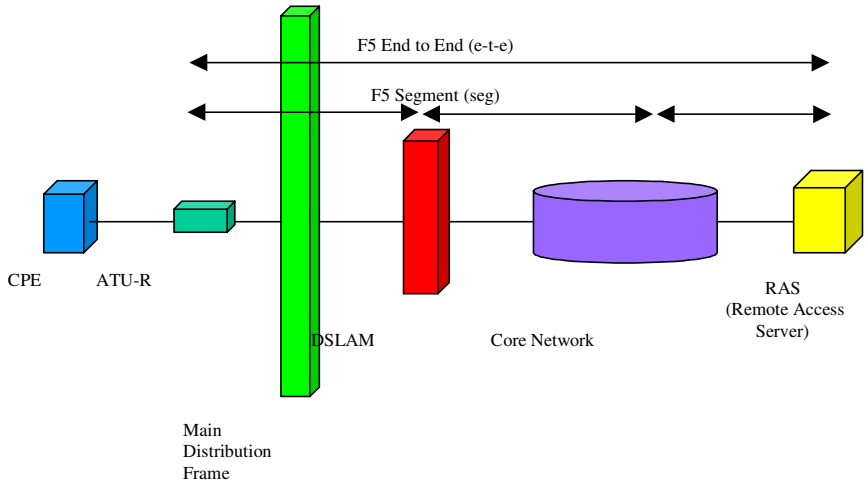


Figure 1 Typical Network Infrastructure.

There are a number of different types of OAM cells which can use either end-to-end or segment flows. Of these, the OAM loopback cell is the most useful in testing for connectivity. Segment VC OAM cells allow a network operator to monitor links between ATM nodes, the use of these is determined by each operator. Loopback cells of the Segment type are used when discovering the LIDs of ATM nodes along the VCC route; the end to end loopback cell is only used when sending to a VCC termination.

F5 OAM PING Generation vs ATM BERT

Both OAM PING and ATM BERT (ATM Bit Error Rate Test) can be used to prove connectivity at the ATM layer, however there are differences in the test strategy that needs to be applied to these two tests. The differences are highlighted in table 1.

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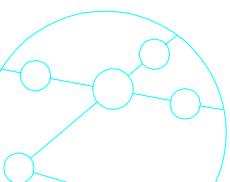
Table 1 F5 OAM and ATM Comparison

	F5 OAM Ping	ATM BERT
Single / Dual Ended	Single Ended or Dual Ended	Single or Dual Ended
In / Out of band flow	In Band, user data generally unaffected	In Band, user data may be affected at higher BERT bandwidths
Loopback Mechanism	Automatic, no 2nd user intervention required	Requires user intervention_
Bandwidth Testing	Not suitable for full bandwidth testing	Full bandwidth test capability

ATM BERT is generally used for qualitative testing of a link by means of a physical or virtual loop placed on an optical / electrical interface. ATM cells with a fixed, psuedo-random or user defined bit sequence payload are transmitted by the test equipment down the VC under test.

In this example the test equipment is the Aurora Presto which is the most comprehensive DSL tester on the market and allows real ATM BERT testing by using a dedicated ATM cell processor. The ATM cells are looped back towards the tester and the payload of the Rx ATM cell flow is compared with the payload of the Tx ATM cell flow for errors. Errors are reported as a bit error rate (BER).



Responding To An Incoming F5 OAM Loopback Cell Flow

CPE devices can typically be configured to respond to incoming F5 OAM loopback cells for in-band management and fault finding purposes. Many major PTTs are now insisting that all PE devices approved for use on their networks support passive OAM cell loopback. Due to its advanced ATM cellstream handling capability, the Aurora Presto can not only loopback ATM cells but can also provide comprehensive OAM statistics including AIS and RDI alarm cell counts.

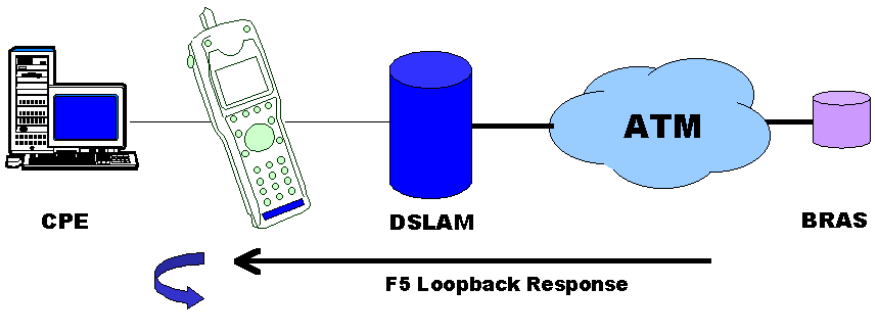


Figure 2 Incoming OAM Loopback Cell Response

Proving End to End Connectivity

The Aurora Presto F5 OAM functionality operates at the ATM layer and allows Aurora Presto to not only respond to incoming F5 OAM loopback cells (LB) from other ATM devices, but to generate outgoing F5 OAM LB cells.

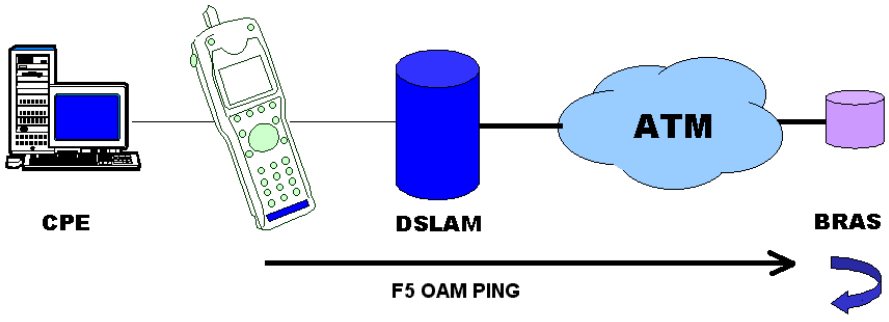


Figure 3 End-to-End OAM PING

End-to-End OAM Pings use a destination address of all 1's in the address field of the OAM loopback cell. According to the ITU-T I.610 OAM standard, all 1's in the address field determines that the loopback cell will be always be addressed to the ATM endpoint. As a result, Aurora Presto does not request a destination ATM address when transmitting end-to-end loopback cells.

This 'OAM Ping' facility allows the Remote Access Server (RAS) to be targeted by an end-to-end ing that operates at the ATM layer only. The end-to-end Ping is a 'one button' test that quickly answers the question "is the ATM path continuous between the ATU-R and the RAS, and is it correctly routed? ". If the answer to this question is 'Yes!' then the higher layer test functions of the Aurora Presto can be used to trace IP / PPP faults. If the answer is 'No!' then the advanced ATM capability of the Aurora Presto can be used to determine mismatched VCs and routing problems, beginning initially with a segmented F5 OAM Ping.

Fault Finding Using Segmented Ping

On a DSL link, the ATM endpoints are typically the xTU-R and the RAS. Between the xTU-R and the RAS there are a number of devices (typically ATM switches) that make up segments between the endpoints. A segment is a portion of a VCC delimited by two connection points (devices). The concept of segments within a VCC is illustrated in Figure 4.

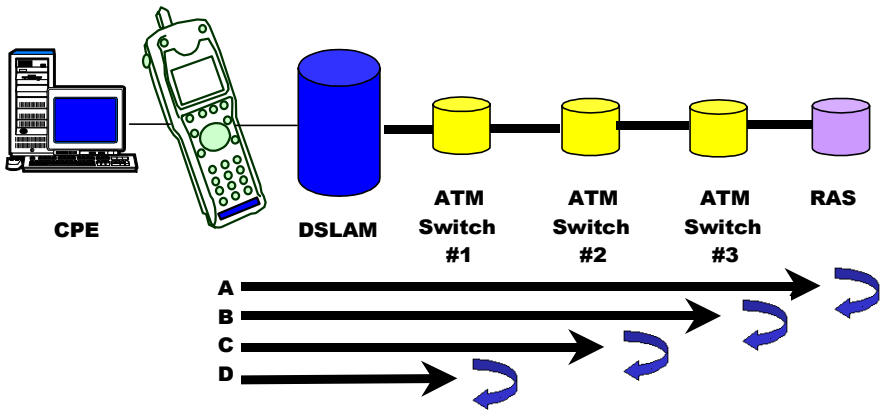


Figure 4 Segments within a VC

The ATM connection points (devices) will typically have ATM addresses assigned to them. These addresses can be used to target specific devices with an OAM ping using the address of the segment

connection point. Unlike and End-to-End OAM PING, a Segmented PING requires a destination OAM address to be specified.

Generating An OAM PING Using Aurora Presto

The following diagram shows the simplicity with which either an End-to-End or Segmented OAM Ping are generated by the Aurora Presto.

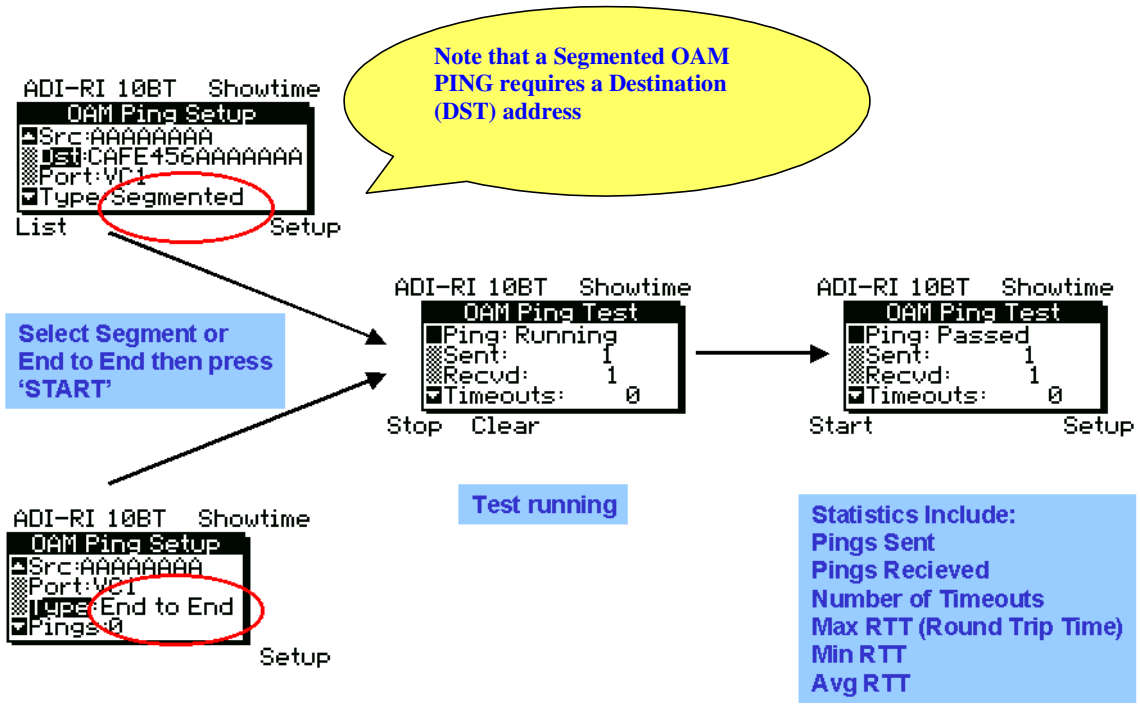


Figure 5 Generating an OAM PING on Aurora Presto

Fault Finding Using E-T-E and Seg PING

By combining the functionality of End-to-End (e-t-e) and Segment (Seg) PINGs, it is possible to follow a simple but effective method for fault finding on at the ATM layer.

A typical test method for fault finding in the ATM network described previously in diagram 4, is shown below in diagram 6.

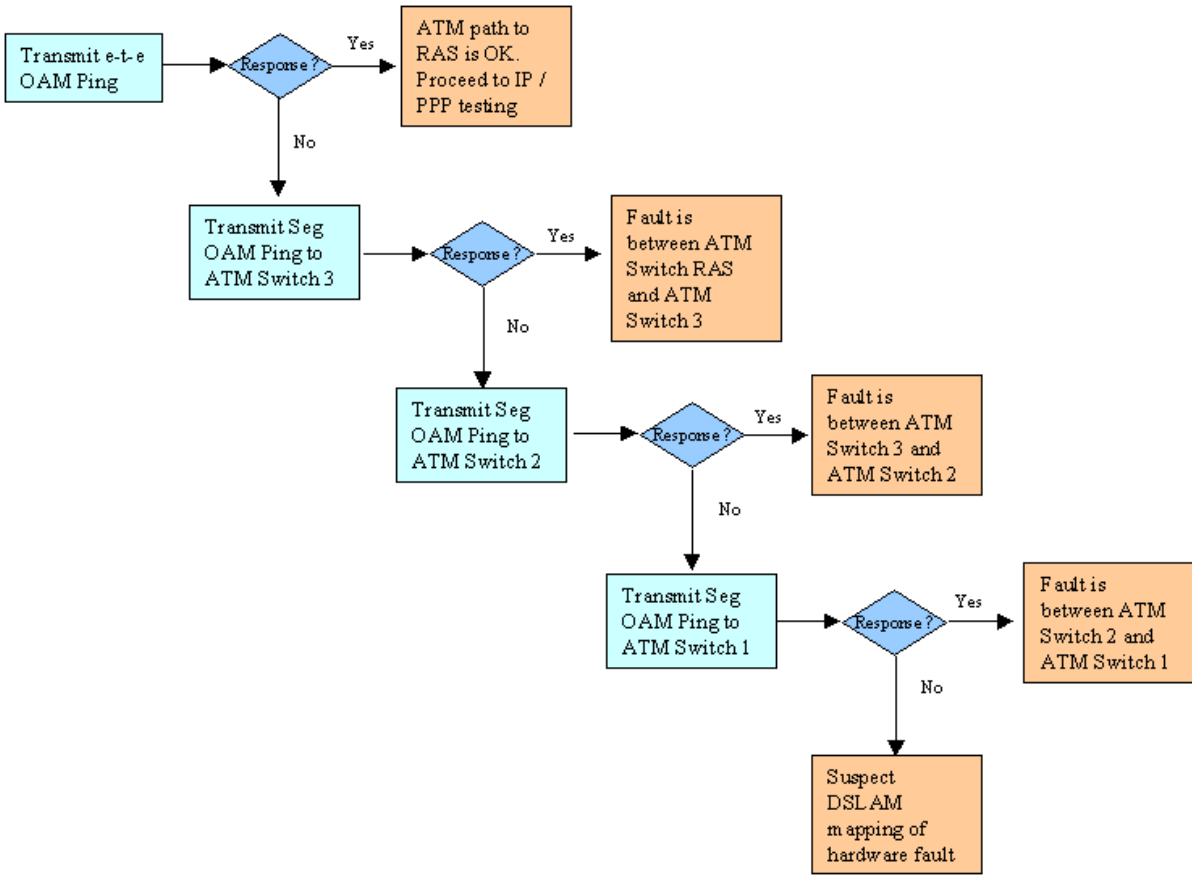


Figure 6 OAM Ping fault finding procedure

Typical Faults

Q F5 OAM cells are being transmitted towards Aurora Presto from the network - why is Aurora Presto not seeing the cells on the monitored VC and looping them back?

A Aurora Presto will automatically loopback incoming F5 OAM cells. Check that the selected VC is correct. If you are certain that the VC is correct, look under 'unmapped VCs' in the Aurora Presto ATM statistics. This will give you a list of the VCs (including VPI and VCI numbers) of the incoming cell streams. If there is a problem with VC mapping in the network or across the DSLAM then the cellstream will arrive on an incorrect / unrecognised VC. Aurora Presto will decode the header of incoming ATM cell streams and determine the VPI and VCI.

Q Aurora Presto is generating an OAM PING but why are there no responses being received?

A If the end-to-end PING is failing, using diagram 6 to locate the position of the fault in the network.

Causes of OAM PING response failure could include:

- There is no terminating equipment at far end of VCC (e-t-e ping only).
- PING is being sent into network on an incorrect VCC that is not terminated.
- VCC is routed incorrectly within the network and reaches the wrong termination.
- VCC routing is incorrect within the network and does not reach a termination.
- PING response is from incorrect destination device (according to LLID).
- Incorrect VCC has been used for sending the PING.