Verifying the policing functions in the ATM network

Product note

OmniBER communications performance analayzer

To ensure the greatest benefit from ATM and guarantee the necessary Quality of Service, it is essential to implement ATM policing functions to monitor and control the ATM traffic. Consequently, it is vital that the operating of these functions is fully verified during installation and maintenance of an ATM switch. Failure to correctly police the ATM traffic may cause severe degradation in the delivered Quality of Service and poor throughput of customer traffic. This may ultimately result in the loss of revenue.

This product note describes a fast and easy method of verifying the policing functions within high speed ATM networks up to 2.5 Gb/s. Completion of the test described will ensure the highest level of confidence that the ATM network equipment can successfully police the various different traffic types carried across the network.

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Introduction

Asynchronous Transfer Mode (ATM) allows multiplexing and switching of a wide range of types of data in an integrated network - the Broadband Integrated Systems Digital Network (BISDN). This flexibility leads to many problems, not least how to guarantee the necessary Quality of Service (QoS) that each type of data service demands. As well as controlling the performance of the transmission system, the ATM network must control the flow of data for each connection to ensure it does not exceed its agreed transmission rate and characteristics.

ATM policing is the set of actions taken by the network to monitor and control traffic. Their purpose is to protect the network and the traffic carried on it from malicious as well as unintentional misbehavior. Policing protects the Quality of Service of other connections by ensuring that each connection does not exceed its negotiated traffic parameters.

ATM policing is often referred to as Usage Parameter Control (UPC) and Network Parameter Control (NPC). ATM cells exceeding the negotiated traffic parameters are considered to be non-conforming cells and may be discarded by the Network Element.

Tagging option and selective cell discard

For some types of ATM traffic, non-conforming cells can be tagged by the policing function rather than discarded. Cells are tagged by changing the Cell Loss Priority (CLP) bit from 0 to 1. In conjunction with the tagging option, selective cell discard may enable. Selective cell discard causes cells of CLP=1 to be discarded when buffer overflow occurs within the ATM network. The CLP=1 cells may have been transmitted by the user or may have resulted from tagging being applied in the policing function.

Typical applications

Testing of policing algorithms takes place at various phases of implementation. ATM equipment manufacturers need to verify that the policing mechanisms in their switches are designed and manufactured to specification. Network operators must ensure that policing mechanisms in the ATM switches that they select and purchase do indeed operate properly before deploying the switches. Network operators may also need to test the policing algorithms when troubleshooting faults in their ATM network.

ATM transfer capabilities and Service categories

ATM Service categories that can result in efficient transmission of many types of data have been defined by the ATM Forum as follows:

- Constant Bit Rate (CBR)
- Variable Bit Rate (VBR)
- Unspecified Bit Rate (UBR)
- Available Bit Rate (ABR)

There is not intended to be a one-to-one mapping between ATM transfer capabilities and the applications carried. However, each transfer capability may be appropriate to certain applications. For example, CBR may be best for real-time applications requiring tightly constrained delay variation (e.g voice, video and circuit emulation). It may be possible to carry these applications on an ABR connection. The choice of transfer capability in practice will depend on:

- Those supported by each operator.
- Actual Quality of Service provided on each.
- Acceptable performance of the user's application.
- Tariffs applied to each transfer capability.

Policing each Transfer Capability

ATM traffic is policed using the Generic Cell Rate Algorithm (GCRA). One implementation of this is known as the 'leaky bucket' algorithm. Some transfer capabilities require two GCRAs to be used - the dual leaky bucket. For a single GCRA, the following Traffic Parameters are used:

- Peak Cell Rate (PCR)
- Cell Delay Variation Tolerance (CDVT)

The PCR determines the maximum cell rate that can be tolerated. The CDVT allows for some CDV (or bunching of cells) to occur. For a dual GCRA, a second set of Traffic Parameters is also used:

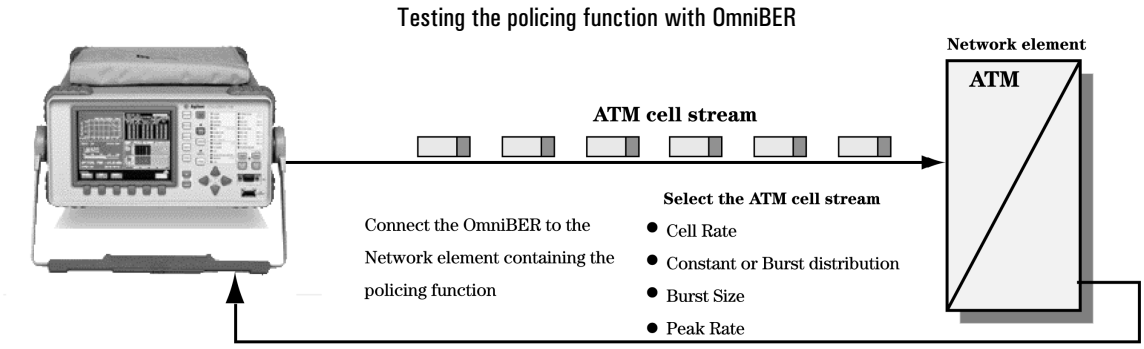
- Sustainable Cell Rate (SCR)
- Burst Tolerance (BT). BT may also be defined in terms of the Maximum Burst Size (MBS).

The two GCRAs operate simultaneously. The SCR is chosen to be equal to or greater than the average cell rate of the traffic. Three options for VBR are specified as shown in the table opposite. Also, the ATM Forum specifies real-time and non-real-time VBR. The quality of Service offered may be different for each but they are policed in the same manner.

UBR and ABR policing can be tested using CBR traffic.

To test the policing functions in an ATM Network Element, OmniBER generates worst case traffic for each ATM Service Category according to the enhanced traffic generator defined in the latest ITU-T Recommendation 0.191.

Using the OmniBER ATM transmitter, you can stress the policing function under test by increasing the value of each traffic parameter independently and verify that the policing function responds by discarding excess traffic.



ITU-T terminology

- Deterministic Bit Rate (DBR) is equivalent to CBR
- Statistical Bit Rate (SBR) is equivalent to VBR
- ITU Recommendations refer to CDVT as τ_{PCR} and τ_{SCR}

Note:

- T_{PCR} = 1/PCR
- T_{SCR} =1/SCR
- BT is related to MBS as follows: BT = (MBS - 1)(T_{SCR} - T_{PCR})

To test the CBR policing functions

The traffic is policed using a single GCRA with traffic parameters, PCR and CDVT.

First, test that the PCR is operating correctly.

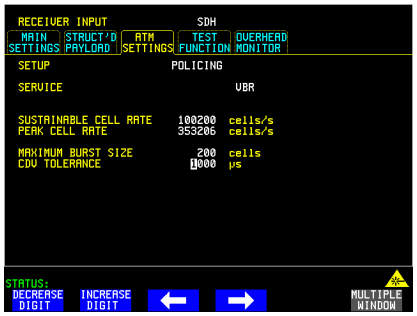
1. Set the transmit foreground distribution to CBR. Set the PCR and CDVT values to equal those of the Network Element under test.
2. Select test cell as the ATM payload.
3. Check that no non-conforming cells are generated. This may be determined from the Network Element (NE) under test. Alternatively, you can route the output from the NE back to the receive port of the OmniBER analyzer and make a cell loss measurement. No lost cells should be recorded.
4. Increase the PCR of the OmniBER transmitter until non-conforming cells are recorded.

Next, test that the CDVT is operating correctly.

5. Reduce the PCR setting to its original value.
6. Increase the CDVT value until non-conforming cells are recorded.

To test VBR policing functions

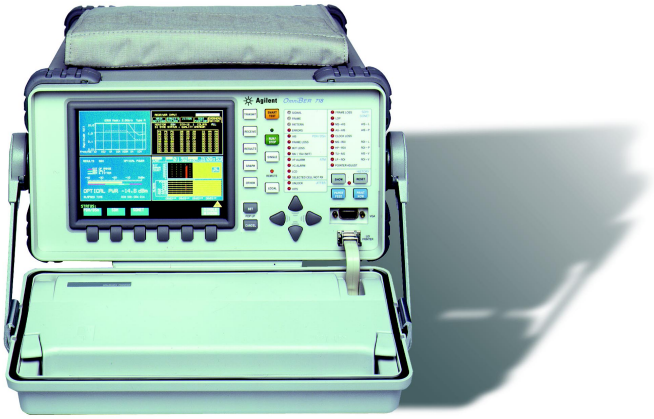
The traffic is policed using a dual GCRA with traffic parameters, SCR, PCR, MBS and CDVT. First, test that the SCR and BT are operating correctly:



1. Set the transmit foreground distribution to VBR. Set the PCR, SCR, MBS and CDVT values to equal those of the Network Element under test. (Note the relationship of BT to MBS in equation above.)
2. Check that no non-conforming cells are generated. This may be determined from the Network Element (NE) under test. Alternatively, you can route the output from the NE back to the receive port of OminBER and make a cell loss measurement. No lost cells should be recorded.
3. Increase the value of each parameter in turn (PCR, SCR, MBS and CDVT). Check that non-conforming cells are recorded.

Conclusion

ATM networks are becoming larger, busier and more complex. To avoid network congestion and fulfil Quality of Service guarantees, ATM policing functions are a vital component in traffic control. Testing these functions ensures you have this key contributor on your side.



OmniBER communications performance analyzer

Offers a modular, upgradeable one-box solution for installation, commissioning, and field maintenance. This rugged, portable tester allows comprehensive functional testing of SDH, PDH and ATM equipment including jitter generation and test. A 3.5-inch disk drive eases results retrieval, test firmware upgrades, and analysis.

Related Literature

The complete global tester to 2.5 Gb/s (OmniBER 718) 5968-8740E

OmniBER 718 technical specification 5968-8335E

OmniBER 718 configuration guide 5968-8012E

OmniBER product note:
Measuring service disruption times in high-speed ATM networks
5968-9137E

OmniBER product note:
Physical layer jitter testing in an ATM environment
5968-9883E

OmniBER product note:
ATM error performance testing
5968-9885E

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