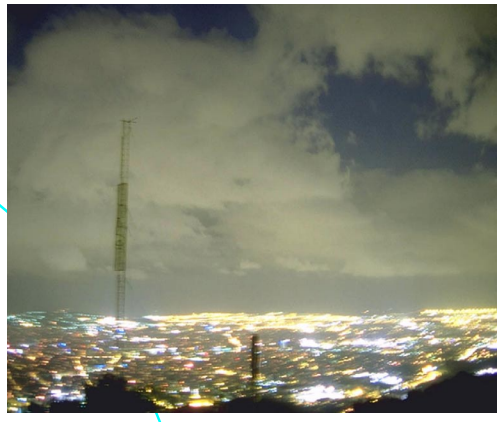
Tests in the Wireless Local Loop

Wth its small size and features such as the generation and analysis of AAL1 or IP ping, Victoria is the ideal tool for the installation and maintenance of the new wireless access networks that use ATM to simultaenously carry voice, data and video services



Application Note navaatm_wll30e

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TrendCommunications

The growth in popularity of the Internet has brought about a sizeable increase in the bandwidth needed for users to access the network, and as new services come on the scene, this need could grow still further.

Wireless systems are one of the most recent solutions put forward for the implementation of broadband access networks that offer users the capacities they require for current and future services.

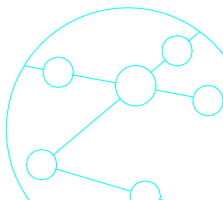
INTRODUCTION

A whole range of technologies can be used for constructing the wireless local loop, from microwave point-to-point links to the latest developments in point-to-multipoint technology, such as LMDS (Local Multipoint Distribution System) or MMDS. One the other options to have been considered is mesh wireless architecture, which is made up of small smart nodes connected by a series of point-to-point wireless links.

Each of these technologies operates in a specific band of the spectrum. When LMDS technology is used, for instance, the frequencies assigned to implement the wireless local loops are typically above 20 GHz. The technologies used to implement wireless systems use any of the three multiplexing techniques, TDMA, FDMA or CDMA, and they are usually based on PSK or QAM modulation.

The architecture of access networks with wireless local loop can be divided into two distinct parts, the user side and the network side, both of these connected via radio:

- on the network side we find the network element that acts as an interface between the fiber or cable network and the radio infrastructure (radio transmitters/receivers, modulators/demodulators and aerials). This node is often called the base station because its fulfils a similar function to that of a base station in mobile networks. This node takes on the task of multiplexing the information received by the radio links from different users and transmitting it to the cable network, and vice versa, ie transmitting the information received by the cable network to each end user by means of the radio links. This network element can also implement local switching functions, thus allowing the users who are connected to communicate with each other without having to go through the cable or fiber network.



- CPE (customer premises equipment) providing different interfaces that is connected via radio with the base station. Potential users run from residential subscribers to companies and businesses. Services include POTS (Plain old telephone service), Internet access, leased lines, VPN and other services that may appear in the future. The types of interface will be Ethernet, E1/T1, n x 64 kbit/s, POTS, ATM 25.6, etc.

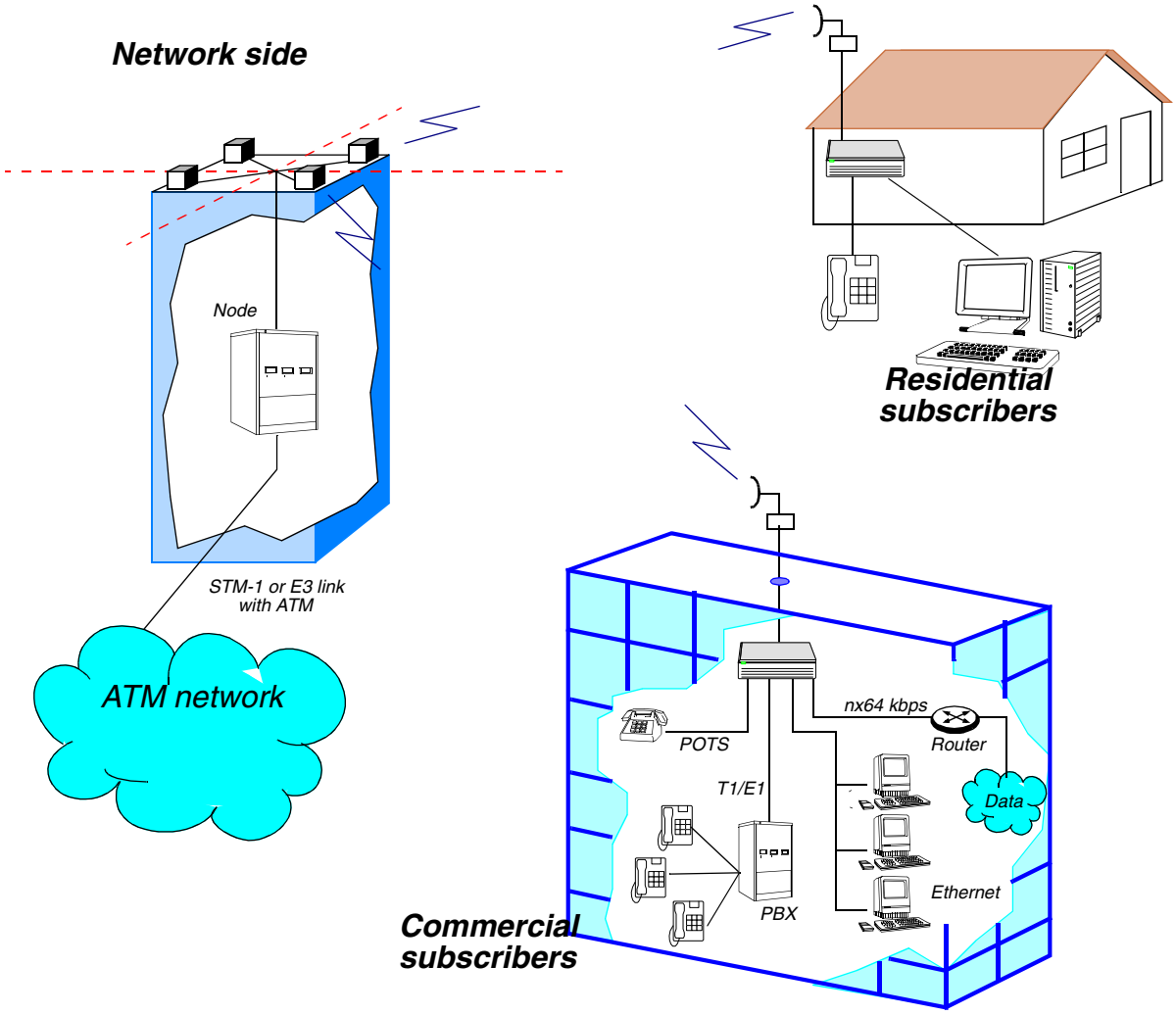


Figure 6 Elements of an access network with wireless local loop

Transport technology

ATM is the transport technology implemented in the majority of cases, amongst other reasons because it is the option that most efficiently allows for the simultaneous transmission of all the

possible services offered in the local loop: Internet access, leased lines, conventional voice, etc.

On the user side, the information received through the different interfaces is delivered to the adaptation functions that convert it into ATM cells. These cells are then sent through the ATM connections that have been established (PVCs) to their destinations (PSTN, Internet Service Providers, etc.)

On the network side, the node multiplexes the ATM connections coming from all the users into a single link at 155 Mbit/s or 34 Mbit/s, connected to a switch. Usually, switching functions are not implemented in this node. In the opposite direction, the ATM connections received by the fiber or cable link are transmitted to each of the users by the radio link.

The figure below shows the layers implemented in the equipment that makes up the wireless loop and the ATM connections.

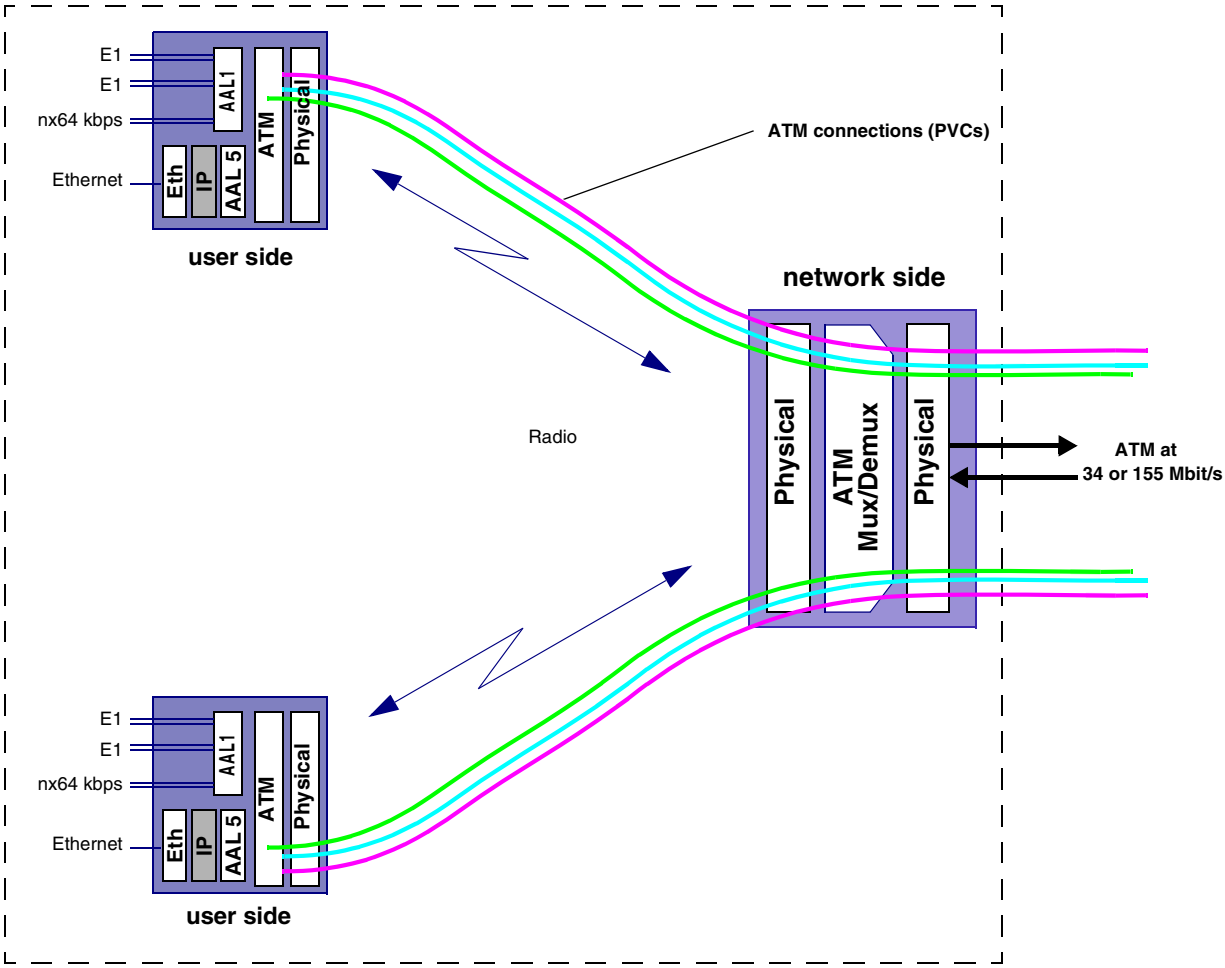


Figure 7 Layers implemented in each of the network elements

MEASUREMENTS

The ATM connections configured in the wireless loops are used almost completely for the transport of user cells that make use of the services offered by the AAL1 and AAL5 layers. Services for the emulation of E1 or nx64 kbit/s circuits and the transmission of video or audio use the facilities supplied by the AAL1 layer, while those of the AAL5 layer are used for data transmission (Internet access, Virtual Private Networks, etc.).

Victoria implements all the necessary functions for checking that the equipment is correctly installed and operating properly, and that the ATM connection is correctly configured in the radio link. For this purpose, functions such as the transmission of test sequences using cells with AAL1 or the transmission of IP ping messages using cells with AAL5 are used.

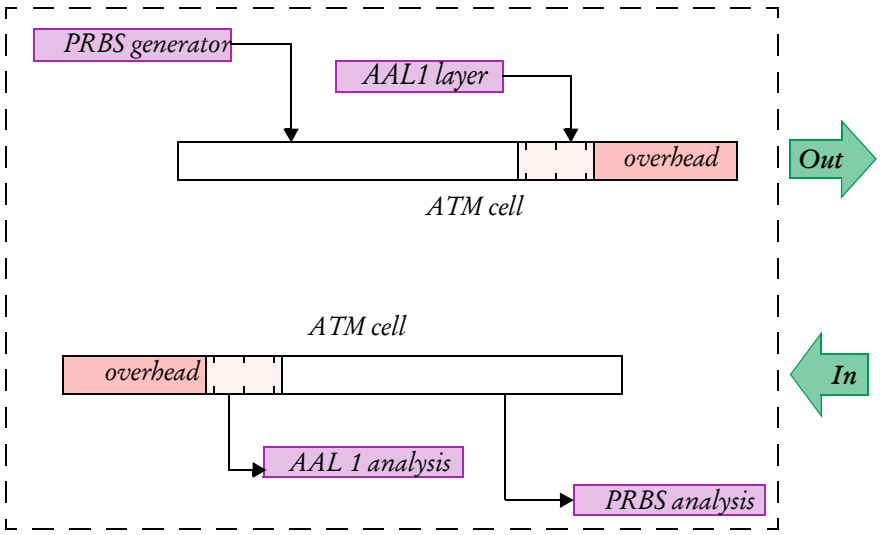


Figure 8 Generation and analysis of AAL1 cells transporting a PRBS in Victoria

AAL1 connection (out of service)

Once the equipment and the aerials have been installed, it will also be necessary to set up the ATM connections (PVCs) between the user's equipment and the device used to access the desired service: PSTN, NSP (Network Service Provider), remote end of a leased line, etc.

In this case, the wireless part of a PVC connection set up to transport an unstructured E1 circuit is checked.

Test traffic is generated made up of cells carrying a PRBS and AAL1 layer. Once these have been inserted on the network side of

the wireless link and in the connection to be checked, the PRBS will be received in the AAL5 cells that are transmitted in the opposite direction again by programming a loop in the 2 Mbit/s interface in the user's device.

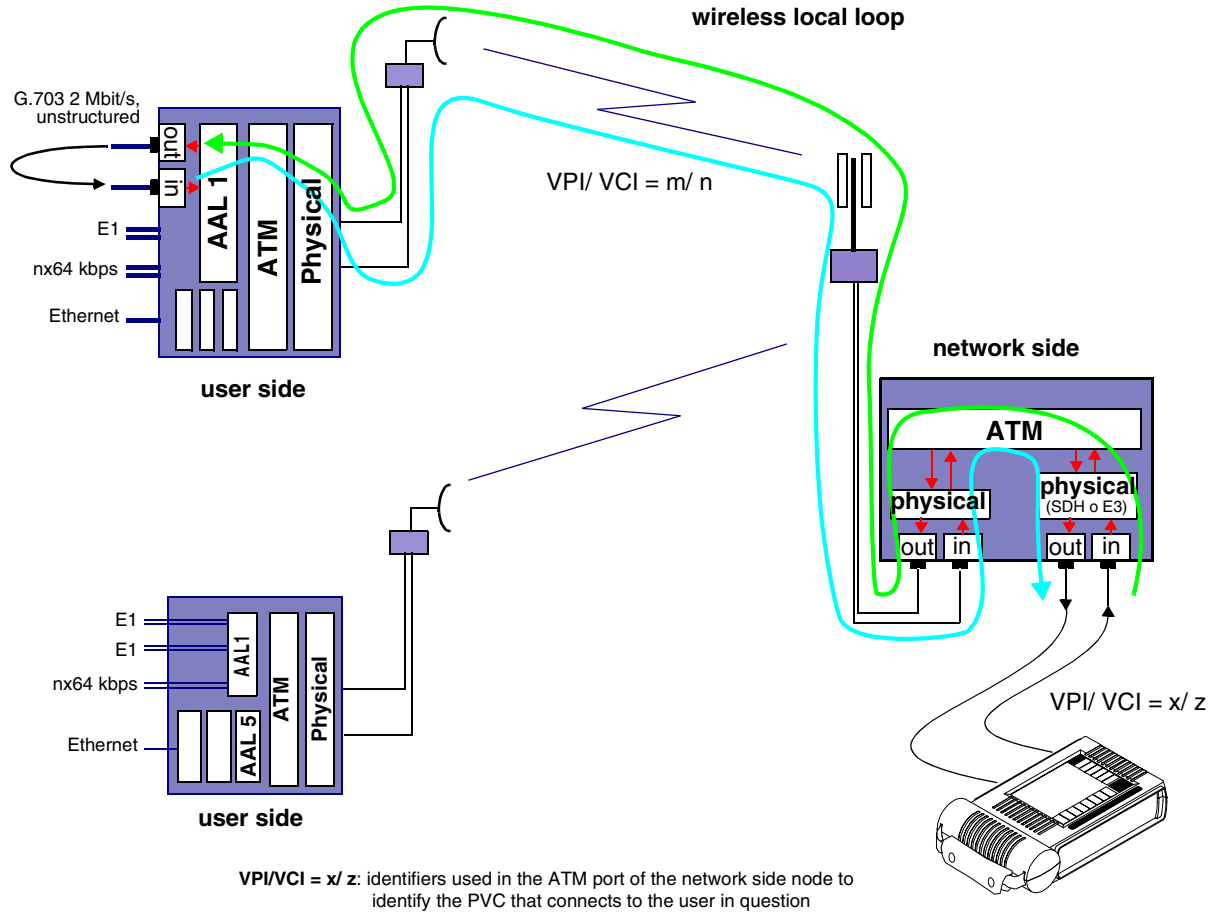
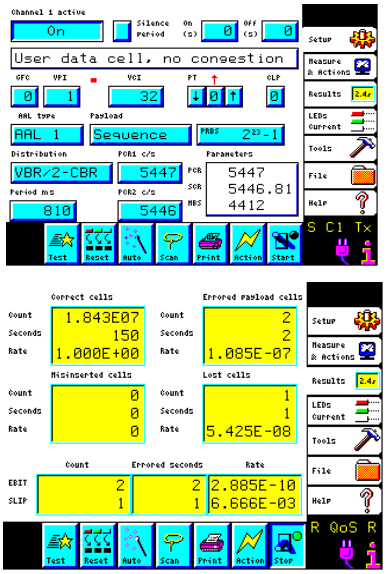


Figure 9 *Set-up and connections for measuring a connection with AAL1 cells*

- Connect Victoria to the ATM port of the node on the network side and select the type of ATM interface: STM-1 optical or electrical, E3, OC-3c, etc.
- Configure channel 1 of the Victoria with the corresponding VPI/VCI values for the PVC transporting the E1 circuit for the user whose connection is being checked.
- Configure channel 1 to generate traffic in c/s that emulates the traffic generated by a CBR connection transporting an E1 circuit. (Distribution = 2-CBR; PCR1 = 5447; PCR2 = 5446; Period (ms) = 810)



- Configure channel 1 of the generator so that the cells transmitted transport a test sequence (word or PRBS) using the AAL1 layer.
- Configure channel 1 of the analyzer with the same VPI/VCI values as the generator. Select AAL1 as the payload of cells received by channel 1 and the same test sequence as that programmed in channel 1 in the generator.

The cells received in channel 1 let us:

1. measure the BER (bit error rate) of the connection and detect slips by analyzing the PRBS
2. detect errored cells, lost cells and misinserted cells by analyzing the specific fields of the AAL1 layer.

In order to access the results of this analysis, select the option *ATM layer* on the initial results screen and then select the button *QoS Error Rate*. Victoria shows counters with the number and rate of correct cells, errored cells, lost cells and misinserted cells, together with the number and rate of bit errors and slips.

This measurement checks the quality and configuration of the wireless part of an ATM connection. In addition, it is possible to check each of the connections and wireless links with each user from a single central point (network side node) simply by changing the VPI/VCI values in channel 1 that identify each connection.

AAL5 connection (out of service)

Other connections in the wireless links are used to transmit data and offer services like Internet access. In this case the cells transport encapsulated information in the AAL5 layer. To check that these connections are set up correctly, IP ping messages are generated through the ATM connection being analyzed, aimed at making sure that communication exists with the user devices that generate/receive the IP information.

As well as checking communication with the user device, the IP ping message also checks the length of the delay.

In order to generate IP ping messages with Victoria :

- Program channel 1 of the generator and analyzer with the VPI/VCI values that have been assigned, in the ATM port on the network side, to the connection being checked. It is recommended that the fields GFC, PT and CLP should all be given the value 0. (***Note:*** *it is recommended that channel 1 of the generator and*

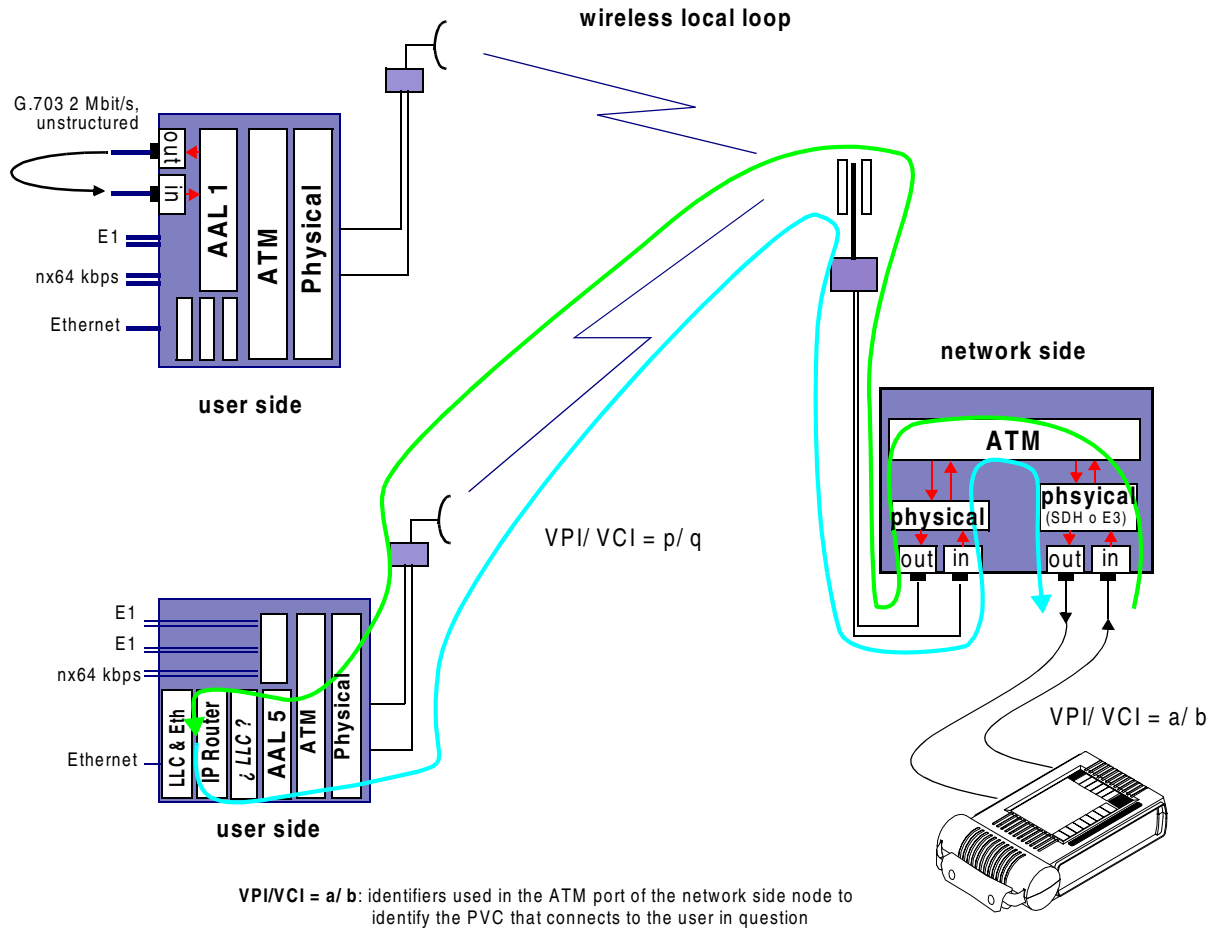


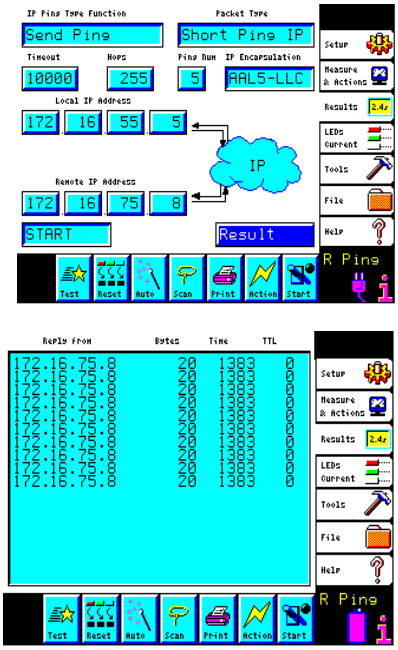
Figure 10 Set-up and connections for measuring a connection with AAL5 cells and IP packets

analyzer be deactivated, since during the generation and reception of IP ping messages, Victoria does not generate any other test traffic)

- Next, select the generation and analysis of IP ping messages function by pushing the corresponding option on the initial results screen

  On the screen for generation/analysis of IP ping, program the following parameters:

- Select the operating mode for sending messages and wait for the response *Mode: Send ping*
- Select long message (each IP ping message in 3 ATM cells) or short message (IP ping message in one cell)
- Configure the maximum time to wait before declaring that the IP ping reply has not been received *(Timeout)* and configure the



maximum number of routers the message can pass through until reaching its destination without it being discarded beforehand *(Hops)*

- When generating the IP ping, we must bear in mind the type of encapsulation of the IP datagrams through ATM and select the appropriate type in Victoria : *AAL5* when using VC multiplexing (IP + AAL5 + ATM) or *AAL5 LLC* when using IP encapsulation over LLC/SNAP + AAL5 + ATM
- Program the IP address assigned to Victoria (*Local IP address*) and the destination IP address (*Remote IP address*), which in this case may be the IP address assigned to the Ethernet port
- Select the number of consecutive messages to be sent then push the button *Start* to send the messages. While the messages are being sent and we are waiting for the reply, the button will be labeled *Stop*. When the label changes to *Start* again, this indicates that the test is complete and we can then push *Results* to see the results.

AAL1 connection (in-service)

By connecting Victoria to any point in an ATM link that is in service, either through an optical splitter or a monitoring point, it is possible to perform measurements on an in-service connection with AAL1 layer cells. Analysis of the fields of the byte added by the AAL1 layer lets us analyze correct cells, errored cells, lost cells and misinserted cells.

- Connect Victoria to the in-service link and configure channel 1 of the analyzer.
- Program the VPI/VCI values assigned to the in-service connection to be analyzed in the section where Victoria is connected.
- Select *AAL1* as type of AAL and *Live* as payload type.
- Push the button *Start* to begin the measurement.To view the results, access the same screen as described above for out-of-service measurements in AAL1: select the option *ATM layer* from the initial results menu and push the button *QoS Error Rate.*

Other in-service measurements

Generally speaking, it is possible to perform other measurements in ATM connections while they are in service. For instance,

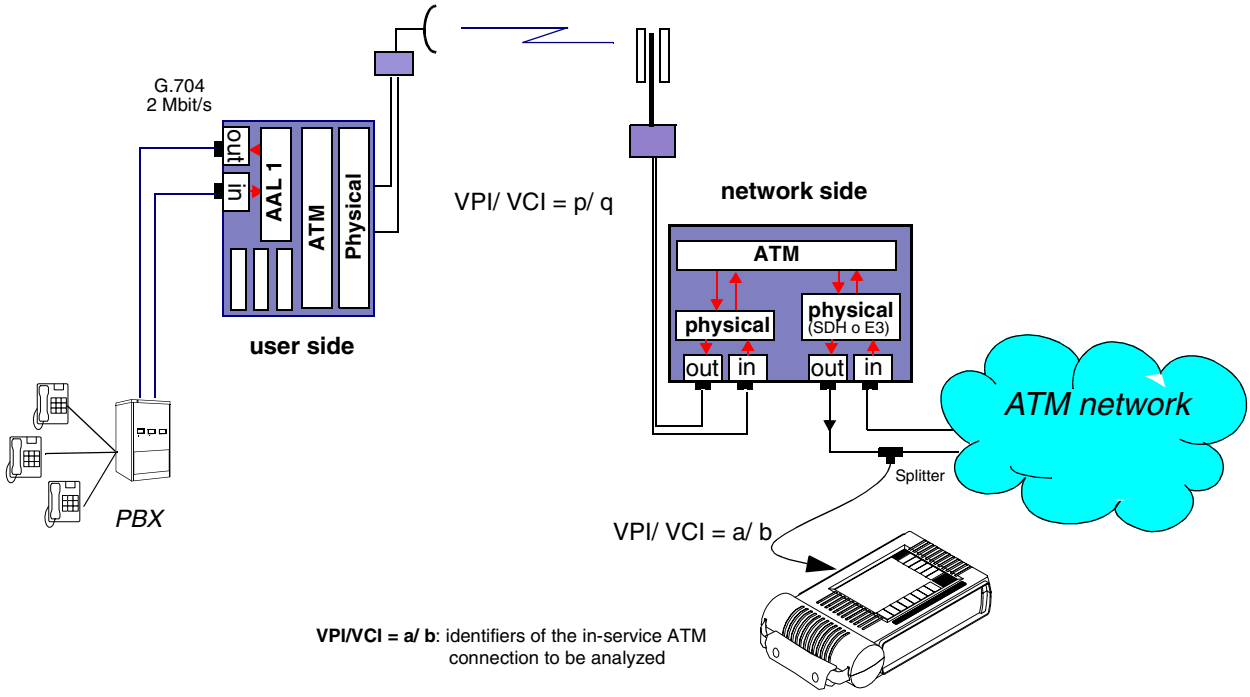
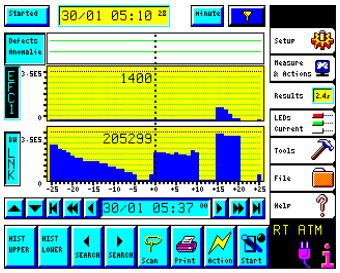


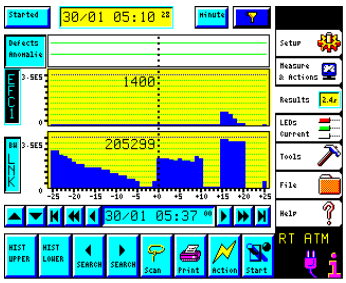
Figure 11 Connecting Victoria for in-service measurements

monitoring the ATM link provides information on the use of the connections by each user and any possible defects that may appear.



1. Check that the connections used (VPI/VCI values) are correct and not other values that may be reserved. This measurement should be carried out in both directions in the ATM link.

   Running the detection of active connections, Victoria shows all those ATM connections, VPI/VCI values, through which traffic is being transmitted. (Bear in mind that a PVC may be configured, the switches have the VPI/VCI inputs in their tables, without any traffic passing through them; in these cases such a connection would not be detected unless the OAM continuity check cells generation function were activated).



2. Check the user bandwidth for management and planning purposes. With the traffic histogram supplied by Victoria for different connections you will discover the profiles of your users and will be able to make improvements in configuration and planning.

   Current, average, maximum and minimum traffic values for a user for management and planning.

3. Check the bandwidth used in the link for planning and congestion control tasks. With the numerical data about the use of the ATM link and the histogram showing the traffic over time, you will be able to see how your circuits are being used and make your calculations about adding new users or increasing the

bandwidths supplied.

Knowing about the traffic in the link and its evolution over time, as well as whether there is traffic with congestion (EFCI=1), is essential if you are to plan the service and the number of users. With the histograms provided by Victoria you will see (with a resolution of as little as 1s) the busiest times of day, how long these periods last and the bandwidth used.

Detecting errors and alarms

Victoria also carries out an analysis of all the errors and alarms on the physical layer and the ATM layer, detecting any problem that may affect service to the users. Even when only one direction of the ATM link is being monitored, any problem in the opposite direction will also be detected through the backwards indications generated by the network elements.

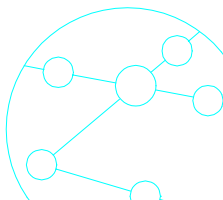
Continuously checking the bytes that carry error detection codes, such as B1, B2 and B3 for ATM over STM-1, offers the possibility of detecting whether errors are produced in the transmission section in the ATM output of the network side node. Generally speaking, the quality in this section must be high since they are usually optical links at 155 Mbit/s.

Likewise, any problem inside the ATM network that leads to an interruption of the connection in the direction network-user can be detected by Victoria . This is done by analyzing the backwards remote defect indication OAM cells (VP-RDI or VC-RDI).

CONCLUSIONS

New bandwidth requirements in access networks and the local loop make it necessary to use new technologies and systems that will modernize our current infrastructures. Wireless access networks based on ATM is one of the options available for implementing a broadband access network and local loop and for all types of services, often at a lower cost.

The fact that the elements that make up the network (user equipment, base stations, etc) are spread out over a wide area means that small, easy to handle devices are needed for installation, surveillance and maintenance tasks, as these are easier to move around with. What's more, there are some features, such as the ability to check circuit emulation services, analysis of AAL1 or IP



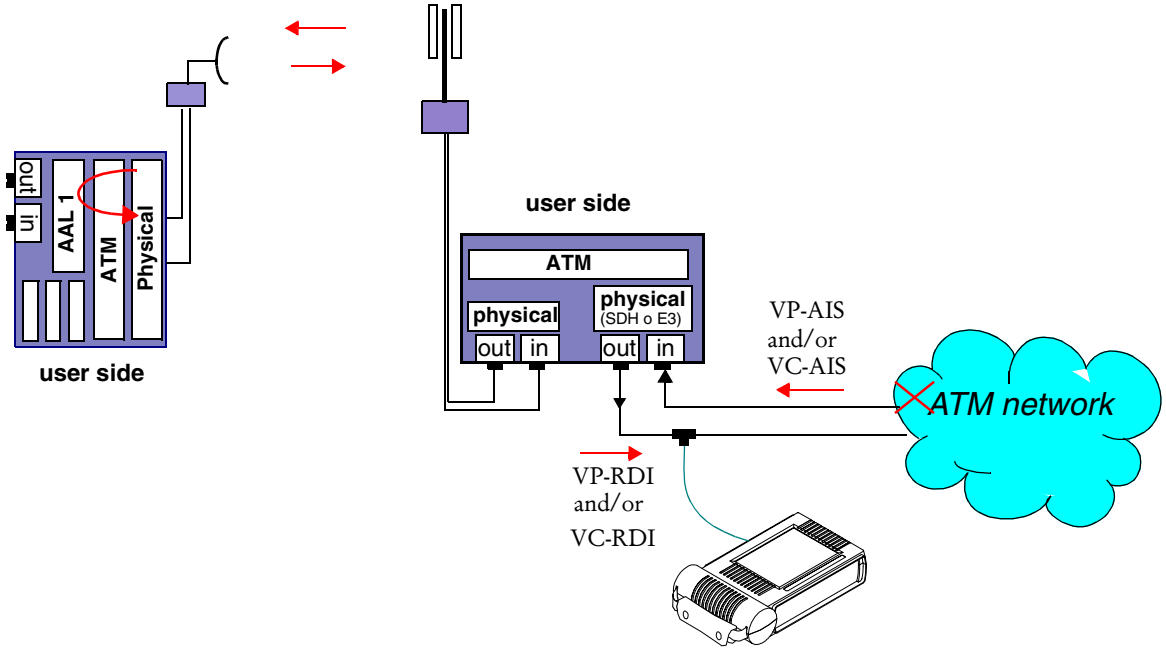


Figure 12 *Detecting alarms*

ping, that are a must. This makes Victoria the ideal tool for installers and operators working in this type of environment.

In the future, new measurements and new features may become necessary, and for this reason Victoria has been built based on totally reconfigurable FPGA technology, which means that it is fully upgradable and can incorporate new modifications and features.