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Core Network Solutions

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CORE NETWORK SOLUTIONS

Summary

This White Paper describes possible solutions to core networking which support of the delivery of the full range of services supported by the FS-VDSL architecture.

Source

This White Paper was produced by the CPE-SA Working Group of the ITU-T FS-VDSL Focus Group. Please refer to the FS-VDSL web site at http://www.fs-vdsl.net for more information.

This document contains general overview information and should not be construed as a technical specification.

As the FS-VDSL Specifications are revisited, a revised version of this White Paper may be issued.

This White Paper is part of a set of White Papers, published by the ITU-T FS-VDSL Focus Group; for a complete and updated list of published White Papers please refer to the FS-VDSL Focus Group web pages at www.fs-vdsl.net/whitepapers and at http://www.itu.int/ITU-T/studygroups/com16/fs-vdsl/wps.html

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FS-VDSL WHITE PAPERS

CORE NETWORK SOLUTIONS

1. INTRODUCTION

There are a wide variety of ways in which the home network, the access network, and the core network can be constructed. This ability to support different networking scenarios is essential to the FS-VDSL architecture as it allows compatible implementations within the different circumstances of network operators around the world.

The purpose of the core network is to connect the geographically distributed access networks to service nodes. While there may be some circumstances where it makes economic sense to have a service node for every access network, and therefore to avoid the need for a core network, it is likely that most network operators will find that the costs of a core network are more than outweighed by the cost benefits of consolidating the service nodes. Moreover, some operators may wish to have different service nodes for different services.

It should be noted that some core networking may be needed to support the service nodes, for example, to upload content to video servers or to connect an Internet Services service node to a common Internet peering point. This form of networking is not part of the end-to-end networking as defined by within FS-VDSL architecture. however, the core network may be used to support this transport requirement.

2. CHOICE OF CORE NETWORKING PROTOCOLS

As defined by the FS-VDSL architecture, the layer 2 protocol used by the access network is ATM. The layer 3 protocols, which the access network carries transparently, are less prescribed by the FS-VDSL architecture. Broadcast TV, VoD, and voice services can each be carried natively on ATM or can be carried on IP. Internet, Intranet, and Extranet access must use an IP layer 3. The following table summarises the constraints the choice of application encapsulation places on the choice of core networking options.

TABLE 1

Core Networking Protocol Options

Application	Encapsulation	No Core	ATM Core	IP Core	Other Core
B-cast TV	MPEG-TS/ATM-VC	Yes	Yes	No	*
	MPEG-TS/IP	Yes	Yes	Yes	Yes
VoD	MPEG-TS/ATM-VC	Yes	Yes	No	*
	MPEG-TS/IP	Yes	Yes	Yes	Yes
Internet, Intranet, Extranet Access	IP/Bridge	Yes	Yes	Yes	Yes
	IP/PPP	Yes	Yes	Yes	Yes
	IP/Tunnel/IP	Yes	Yes	Yes	Yes
Voice	Voice/ATM-VC	Yes	Yes	No	*
	Voice/IP	Yes	Yes	Yes	Yes

* This depends on the core network protocol – many practical options are not designed to carry ATM-VCs.

As can be seen from the table, the choice of an IP based encapsulation is compatible with any core network.

3. NO CORE NETWORK

It is possible to host the services in the same location as the OLT. This means that there is no requirement for a Core Network. The service nodes are therefore directly connected to the OLT using ATM interfaces. This is illustrated in the following Figure 1.

Figure 1

Directly Connected Service Nodes

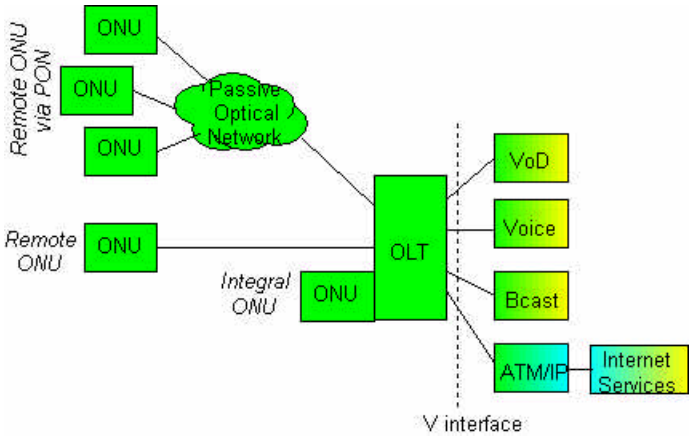


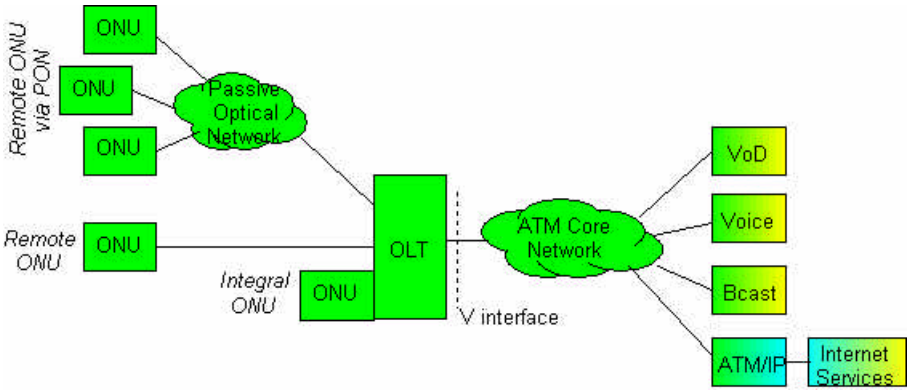
Figure 1 also illustrates three basic configuration options for the access network. These are a combined OLT and ONU, a ONU subtended from the OLT using a direct fibre, and a set of ONUs subtended from the OLT using a passive optical network..

4. ATM CORE NETWORK

Many network operators have a need to centralize their service nodes and therefore a core network is needed to connect the OLT to the service nodes. As the OLT is functionally an ATM cross-connect, it can be connected to an ATM network, offering seamless ATM transport of ATM VCs and ATM VPs. With an ATM core network no protocol interworking is required between the V interface and the core network. The requirement on the ATM core network is that it fully supports all the connection parameters for all flows across the V interfaces across the core network. This scenario is illustrated in the following Figure 2.

Figure 2

ATM Core Network

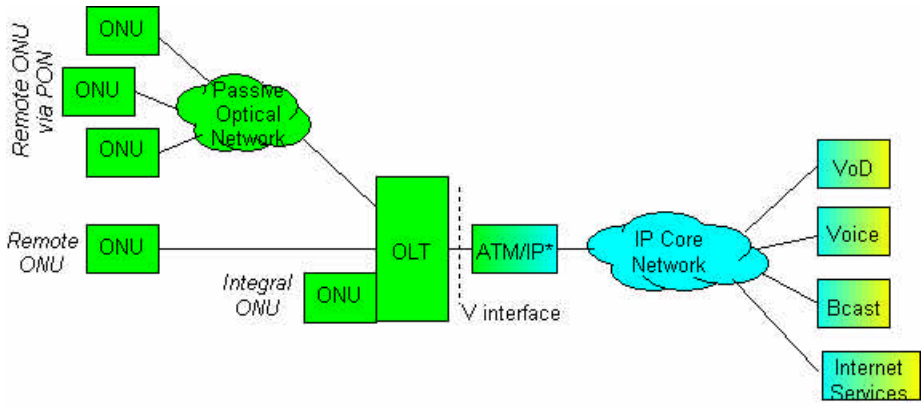


5. IP CORE NETWORK

IP is the home networking protocol. While the FS-VDSL specification does allow services to terminate the IP protocol in the VTP, placing the service protocols directly on the ATM VCs, the IP protocol can be extended transparently across the access network. When this option is chosen in the VTP, the IP protocol layer is always present at the V interface. This allows the ATM VCs to be terminated after the V interface and the core network forward at the IP layer. This is illustrated in the following Figure 3.

Figure 3

IP Core Network



* A local ATM/IP service node may be implemented in the same equipment as the OLT (the ATM interface becomes internal to the equipment)

When the core network is IP, the QoS parameters specified for each flow must be met by the IP network such that the end to end flow at the IP layer performs as if it was supported by an end to end ATM VC with the specified parameters.

6. OTHER CORE NETWORK

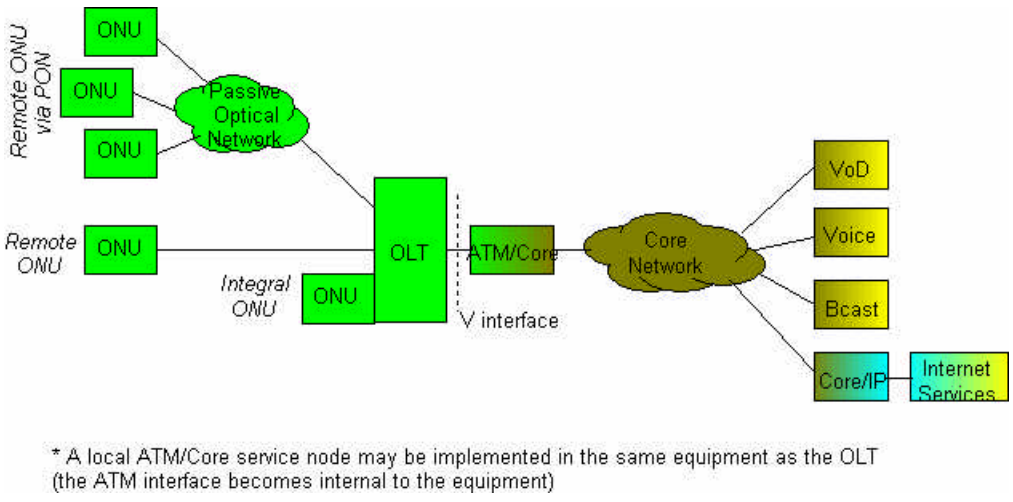
While ATM has been specified by FS-VDSL for the access network, other network protocols/technologies are possible in the core network. Examples include SONET/SDH, Ethernet, and MPLS. As the OLT is an ATM device, interworking is required between the OLT and this core network. There are three general ways that the interworking function can work.

- Encapsulate and multiplex one or more of the ATM VCs at the V interface into a conformant transport entity of the core network. In this case, the core network is effectively a layer 1 Network. The core network must transport the bundle of VCs in such a way that, when the encapsulation is removed, the ATM VC can be recreated so that all the VC connection parameters are met.
- Emulate the ATM VC with the transport entity of the network. In this case, the core network will be a layer 2 network like ATM. This emulation must be done in such a way that all the VC connection parameters are met.
- Terminate the ATM VCs and transport the higher layers transparently. In this case, the core network is effectively a layer 3 network. This should only be considered when IP is the layer 3 protocol and this case then becomes the IP Core Network scenario above.

This scenario is illustrated in Figure 4 below. It is assumed that the service node will contain sufficient functionality to terminate the core network protocol as well as the service protocol stack.

Figure 4

Other Core Network



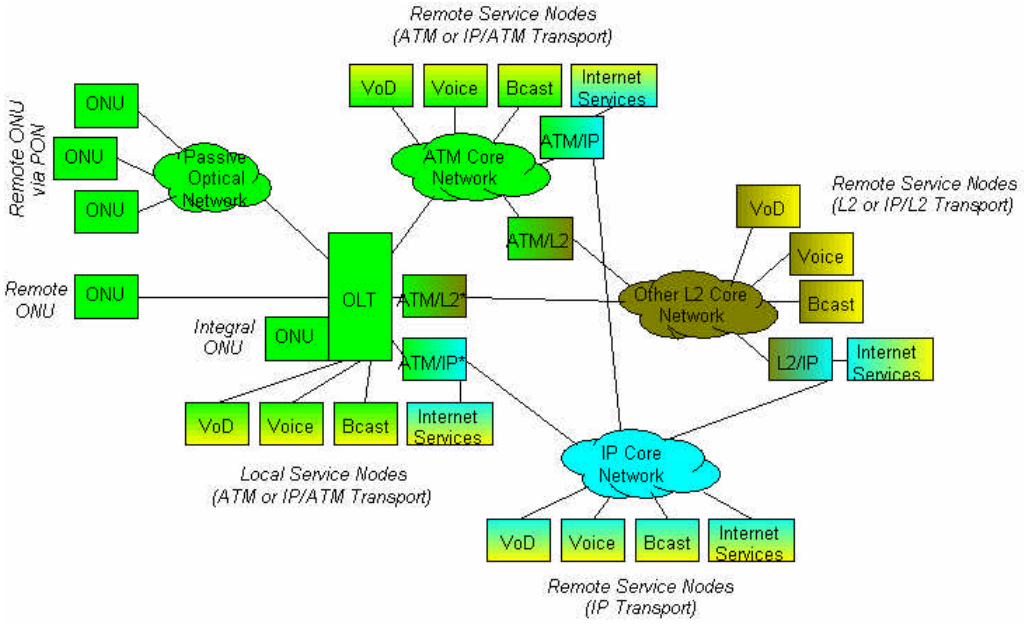
* A local ATM/Core service node may be implemented in the same equipment as the OLT (the ATM interface becomes internal to the equipment)

7. HYBRID CORE NETWORK

Many network operators do not have a single core network. This is highly likely as networks evolve and older generations of equipment remain in use while newer generations are introduced. The scenarios described above are not exclusive and can be combined in a wide variety of ways, many of which are illustrated in the following Figure 5.

Figure 5

Hybrid Core Network



* A local ATM/IP and/or ATM/L2 service node may be implemented in the same equipment as the OLT (the ATM interface becomes internal to the equipment)

8. CONCLUSIONS

The FS-VDSL architecture allows for a number of core network options. This meets the explicit requirements from network operators that the architecture be flexible to the different situations of different operators and also to allow the core network to evolve over time.

The two primary options available are an ATM core network and/or an IP core network. Each of these has advantages and disadvantages.

The advantages of the ATM core are that it can support any of the service encapsulations and it also has no major cost “bottlenecks”. The disadvantages are twofold. First, there is still a wide spread expectation that the costs of IP routing are falling faster than those of ATM. Second, and more subtly, all service provider and service selection is carried out using the ATM-VC provisioning. The operational complexity of this may be a significant consideration for some operators.

The advantage of the IP core network is that it reflects the general expectations of where core technology is driving, and, possibly more importantly, when IP is used, many features are available to support multiple service providers, service provider selection, and service selection (for example making use of PPP/RADIUS authentication). There are two major drawbacks at this point in time. First, the IP edge devices which terminate the ATM and interface to the IP core are currently based on a technology which becomes very costly when used for high capacity services such as video. Second, it is still a matter of considerable debate as to whether the QoS mechanisms available in an IP core are sufficiently robust to support voice and video services.

Given these strengths and weaknesses, many operators may consider a hybrid where broadcast TV and VoD are carried on an ATM core and Internet, Intranet, and Extranet access are carried on an IP core. The choice between VoIP and VoATM appears more open at this point in time.

9. GLOSSARY OF TERMS

A glossary of terms is available on the FS-VDSL Focus Group White Papers web pages at `www.fs-vdsl.net/whitepapers` and at `http://www.itu.int/ITU-T/studygroups/com16/fs-vdsl/wps.html`.