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Full-Service VDSL

Focus Group
White Paper

Grooming of Video Broadcast Network Content in the Digital Headend

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ITU-T FS-VDSL Focus Group White Paper

GROOMING OF VIDEO BROADCAST NETWORK CONTENT IN THE DIGITAL HEADEND

Summary

This White Paper describes the Digital Broadcast Network content processing at the Service Node.

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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1. INTRODUCTION

The delivery of video services over access networks enabled by emerging xDSL technologies is a key element of a Full Service Network (FSN.) It provides service providers with a sound business model having easily identifiable revenue potential and end users with the tangible home entertainment benefits of 'digital convergence.' This paper will discuss some of the considerations and challenges in acquiring, formatting, processing and delivering video content to the consumer.

In the reference model shown in Figure 1, below the Service Nodes at the right side include the Digital Broadcast Network service. It is this service type that the digital headend provides through content acquisition, stream processing and protocol conversion.

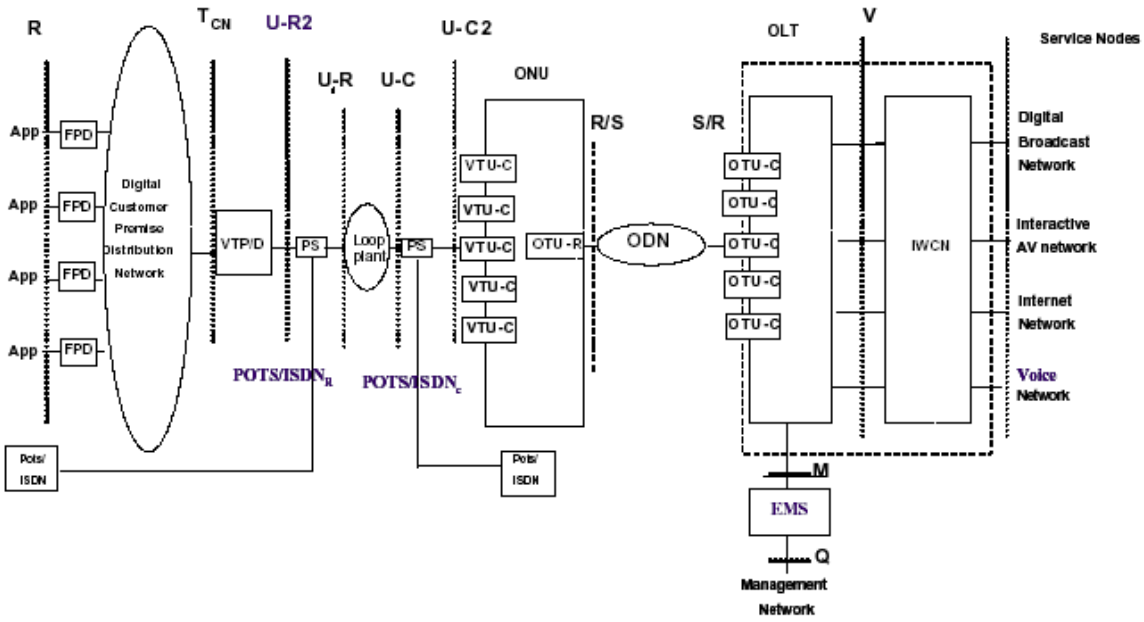

Figure 1: FS-VDSL Reference Model

This document focuses on the Digital Broadcast Network content processing at the Service Node.

2. END TO END VIDEO TRUNKING MODEL

The Society of Motion Picture and Television Engineers (SMPTE) has defined a model of video content delivery that has three distinct segments of activity. Content creation entails moving video elements from sites such as the news crew on location, sports venues and/or a post production house to the central studio for compilation into the final content segment. This is known as the ***Production*** phase and includes all content creation activities. The worldwide delivery of finished content from the centralized studio or content owner to the regional locations is termed ***Distribution*** in the SMPTE model. Once obtained at a regional location, the ***Emission*** of content would include the final transmission to the end consumer via terrestrial broadcast, traditional cable operations and our present subject of a service providers' use of DSL. Some services, such as direct to home satellite, combine the Distribution and Emission steps into a single delivery step from a central satellite uplink facility to consumer. For the remainder of this paper, we will concern ourselves with the acquisition of video content at the Distribution/Emission interface and the formatting and conditioning of that content for delivery over DSL access networks.

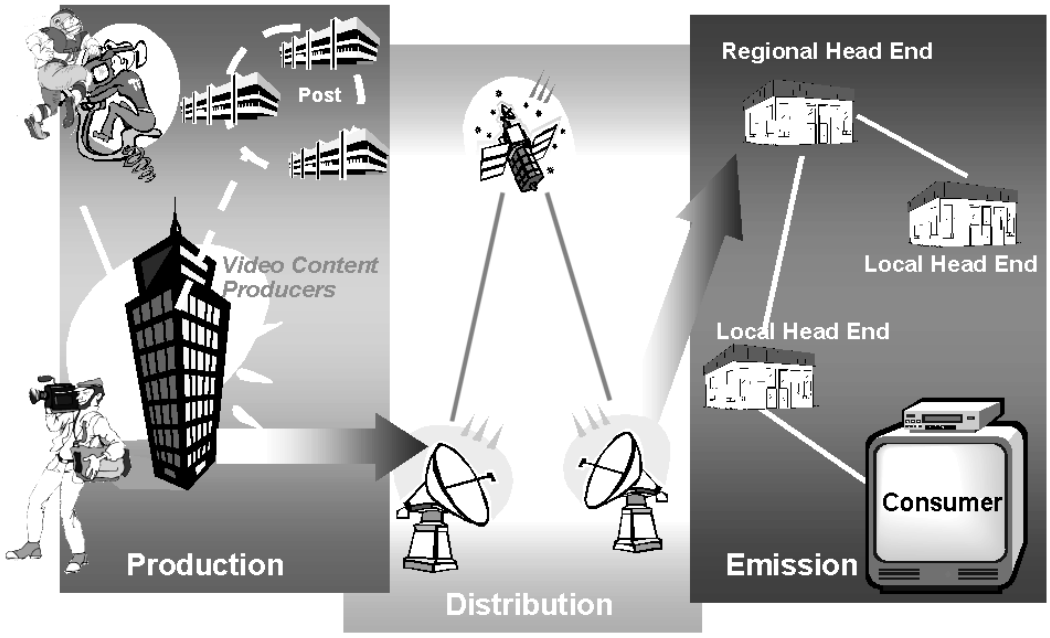

Figure 2: The SMPTE Video Trunking Model

3. SOURCES OF VIDEO CONTENT AT THE REGIONAL HEAD END

The regional head end is the location where content is received, formatted and processed to be compatible with delivery over the emission system (the access network.) Head ends are typically located in or adjacent to the Central Office facility. The first part of this process is the acquisition of content from the Distribution phase described in the SMPTE model above. Possibilities include the receipt of data files onto a local VOD/NVOD server via a data network or as separate media; videotapes or live feeds from local Public-access, Educational or Government (PEG) sources; off air or direct feeds from local broadcasters; and satellite delivery of pre-compressed

content. An additional possibility is the network connection (usually ATM over SONET/STM) of pre-formatted content from another regional location, as shown in the interconnection of head ends in Figure 2 above. (Refer also to Appendix II, Figure 29 of the FS-VDSL FGTS Part 2: System Architecture, Version 1.0.0.)

4. THE USE OF VIDEO GROOMING IN THE HEAD END

Content acquisition is the initial step in the activities that occur at the regional head end as shown at the left edge of the illustration below (Figure 3.) Note that the same head end can simultaneously feed the DSL plant along with cable and/or all fiber plants.

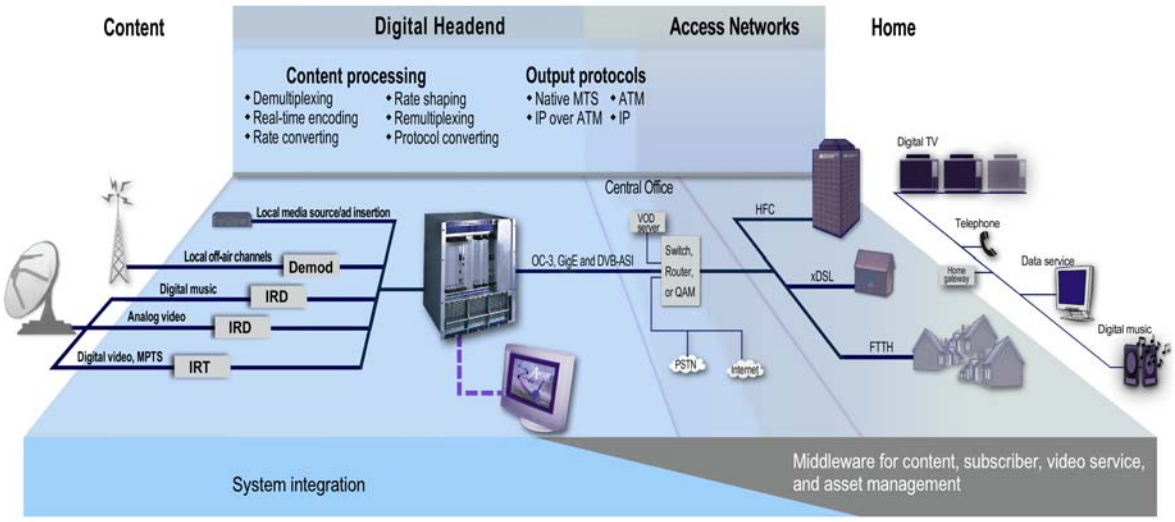

Figure 3: **Typical Digital Video Head End for FSN over DSL**

The industry uses the term video grooming to include all the processing and conditioning of content that is required to prepare it for delivery over a given transmission medium.

This grooming would include compression of video and audio to the standard(s) used by the CPE equipment, almost universally MPEG-2 for video and MPEG and AC-3 (Dolby Digital) for audio at present. Compression is applied to local content such as off-air and videotapes as well as to content received via a proprietary compression method that would not be compatible with the FPD.

Another grooming function is the process of de-multiplexing Multiple Program Transport Streams of Variable Bit Rate (MPTS, VBR) as received from satellite and converting them into multiple instances of Single Program Transport Steams of Constant Bit Rate (SPTS, CBR.) This provides several key benefits. It allows the

programs to be delivered individually to the subscriber over a copper connection while still allowing 'channel surfing' to be performed among all the available programs. In a typical implementation of this capability, each program may be assigned a 'channel' in the line-up of services and can be 'tuned' by requesting the appropriate ATM PVC or IP multicast address from the access network via user commands at the VTP/D or FPD. Transforming the VBR of the typical satellite delivered content to CBR is advantageous to efficiently utilize the DSL connection to the end subscriber. The peak bit rate of the VBR service might be as high as 9 Mbps or more, while an easily attainable CBR conversion will allow equivalent performance at 4.7 Mbps for VDSL, and additional rate converting can obtain streams of 3.2 Mbps or even less for use with ADSL. Unlike each satellite transponder's statistical multiplex that is a fixed combination of perhaps twelve or more content streams, each DSL subscriber may request a unique instance of from one to just a few programs. To allow any arbitrary combination to be selected from up to a few hundred possible programs, the use of CBR in the access network is indicated.

Additional grooming functions could include ad insertion, program splicing, and branding of content by overlay of logo information. Music services can also be supported which can provide AC-3 programming of several dozen different content streams, from Classical to Rock. On screen information as to artist and title, with links to web based shopping can be supported.

As indicated, the grooming function also includes the repackaging of the content into the appropriate network protocol, such as ATM or IP. It would also include demodulation from the delivery mode (QPSK for satellite or RF to baseband demodulation for VHF/UHF off-air transmissions) as well as decryption of these services when received in a secured, controlled access manner. Further, any desired re-encryption of the content for CA (conditional access) control plus any DRM (digital rights management) to be added to the content could occur in the grooming facilities of the head end. In many cases the capabilities and features inherent in the access network itself could obtain the desired level of subscriber security regarding CA.

5. VIDEO CONTENT DEPLOYMENT OVER DSL

By combining voice, data *and* audio/video entertainment services over a single copper connection, the service provider can effectively compete with digital cable networks. The Full Service Network delivered over DSL can provide the end user such convergence-enabled features as on-screen caller ID, interactive TV -- linking the video and data services, and convenient single vendor billing. DSL has the bandwidth to allow multiple concurrent video programs over a single subscriber drop. Existing CPE hardware offerings can support up to three independent 'tuners' including the MPEG-2 decoding functions in the VTP/D, while the architecture supports an arbitrary number of FPDs in the case of distributed CPE. VDSL also has the capability to support HDTV delivery, which can require up to 19.4 Mbps for each high definition content stream. As MPEG-2 encoding technologies continue to improve and the newer compression standards become available, such as H.264 (MPEG-4 part 10) the bandwidth for each stream will be further reduced. Standard definition content will be

able to be delivered at and well below 2 Mbps, and in the next several years HDTV will be possible at rates supported by full rate ADSL connections.

It is envisioned that many new services as well as enhancements on existing services and their combinations will be the outgrowth of the DSL enabled delivery of the Full Service Network functionality. While this discussion has focused on the use of FSN capabilities for the home entertainment applications, the use of video content is equally applicable to campus and multi-tenant environment. Training content on demand uses the resources and techniques that are developed for VOD, and the 'narrow-casting' of business related content such as real estate information and financial services are readily enabled. Because VDSL has an upstream bandwidth suitable for a single channel of high quality video, corporate communications across a campus can take advantage of the virtual presence benefits of broadband videoconferencing. Multiple sources of slightly lesser quality could also be supported in the upstream bandwidth for security uses such as surveillance, for peer-to-peer conferencing and for many other applications.

6. REFERENCES

[1] ISO/IEC 13818 – Information Technology – Generic Coding of moving pictures and associated audio information: Note that within this standard, 13818-1 is "Systems", 13818-2 is "Video", and 13818-3 is "Audio"

[2] ATSC Standard A/52A: Digital Audio Compression (AC-3) Standard, Rev. A

7. 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.