Switched Digital Video Architecture Guide

Please Read

Important

Please read this entire guide. If this guide provides installation or operation instructions, give particular attention to all safety statements included in this guide.

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About This Guide

Introduction

This document provides a high-level description of the Switched Digital Video (SDV) network. This document also provides descriptions and illustrations of how SDV functionality has been incorporated into the Cisco Digital Broadband Delivery System (DBDS).

Purpose

The purpose of this document is to provide the following information:

- The basic concepts of SDV
- A general overview of the SDV architecture
- An understanding of how various hardware and software elements of the DBDS interact to provide the SDV offering

Scope

This document provides only an overview of the SDV elements and architecture. For more detailed descriptions, contact your Cisco Marketing Manager.

This document does not describe how to install, configure, operate, maintain, or troubleshoot SDV. That information can be obtained from other documents as listed in the ***Related Publications*** (on page vi) or by calling Cisco Services.

Audience

This document is written for the following audiences:

- System operator marketing managers who are responsible for determining how service offerings should be packaged
- DBDS system administrators
- Digital Network Control System (DNCS) operators
- Cisco Services engineers
- Call-center personnel
- System operators who are responsible for maintaining SDV
- Other parties interested in a general knowledge of SDV

Related Publications

You may find the following publications useful as resources when you implement the procedures in this document. Check the copyright date on your resources to assure that you have the most current version. The publish dates for the following documents are valid as of this printing. However, some of these documents may have since been revised:

- *GQAM Modulator Software Version 3.1.9 Release Notes and Installation Instructions* (part number 4011763, expected publish date: late 2006)
- *Netcrypt™ Bulk Encryptor Software Version 1.1.3 Release Notes and Installation Instructions* (part number 4009746, expected publish date: late 2006)
- *Provisioning the DNCS to Support SDV Services User Guide* (part number 4012948, expected publish date: late 2006)
- *SARA Application Server 3.4.1 Release Notes and Installation Instructions* (part number 4012158, expected publish date: late 2006)
- *SARA Application Server 3.4.1 User's Guide* (part number 4012159, expected publish date: late 2006)
- *System Release 2.7 Release Notes* (part number 4012155, expected publish date: late 2006)
- *System Release 3.7 Release Notes* (part number 4012156, expected publish date: late 2006)
- *System Release 4.2 Release Notes* (part number 4012157, expected publish date: late 2006)
- *Configuring and Troubleshooting the Digital Emergency Alert System* (part number 4004455, published October 2006)
- *Series D9500 Switched Digital Video Servers Installation and Operation Guide* (part number 4012584, published May 2006)
- *Netcrypt™ Bulk Encryptor Hardware Installation and Operation Guide* (part number 4001444, published October 2005)

The SR 2.7, SR 3.7, and SR 4.2 versions of the DNCS include online Help that you can access from the DNCS. However, if you would like to order a CD of the online Help separately, you can order the following PC version:

SR 2.7/3.7/4.2 Online Help (PC Version) (part number 4012121, expected publish date: late 2006)

Document Version

This is the second release of this document.

1

Introducing Switched Digital Video

Introduction

The growth in service bandwidth available to the cable service provider has far outpaced the increases in available access network bandwidth. This growth is due, in part, to upgrades and rebuilds. This same expansion of available services has also created a situation in which, at any given time and in any given service group, most services are not being viewed. Thus, bandwidth for an edge device (for example, a QAM modulator) and access network bandwidth is wasted because many of the services that are continuously broadcast to subscribers are not being watched. SDV is a technique that recaptures such potentially wasted access network bandwidth by delivering selected services only where and when users are actively requesting service. This technique is performed through program switching.

This chapter provides a brief review of traditional linear broadcasting over a Hybrid Fiber-Coax (HFC) network and contrasts this with how SDV operates. In addition, this chapter describes the benefits of SDV to the cable service provider.

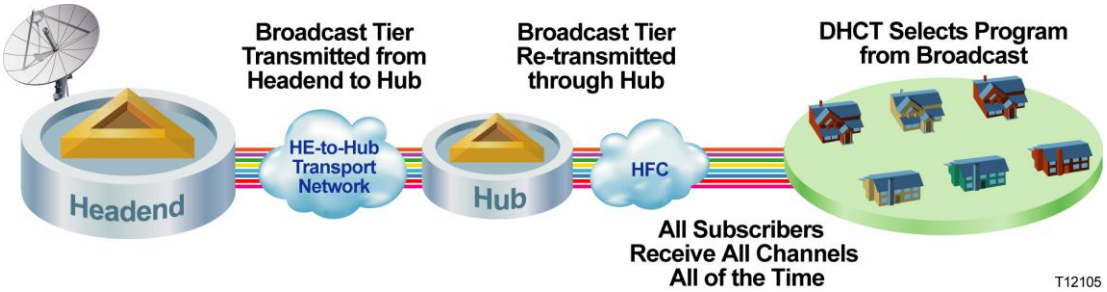
In This Chapter

- Traditional Linear Broadcasting 2
- The Switched Digital Solution 3

Traditional Linear Broadcasting

Overview

The following diagram illustrates the traditional method of "linear" broadcasting over HFC. Some "narrowcasting" is done in that not all hubs need to carry all the same content. However, any broadcast content that is selected for that hub is transmitted continuously to all subscribers.



This method of linear broadcasting is extremely simple and has worked reliably and cost-effectively for both cable service providers and consumers. However, increases in channel offerings and higher-bandwidth programming content, such as high-definition (HD) programming, have resulted in a greater demand for bandwidth. This bandwidth demand cannot be readily satisfied by continuous access network upgrades and rebuilds. It is no longer cost-effective to continuously increase bandwidth for services with low viewership. Cable service providers have a need for a new architecture that will reclaim wasted bandwidth and improve the subscriber's experience without requiring endless bandwidth expansion. SDV represents that new architecture.

The Switched Digital Solution

Overview

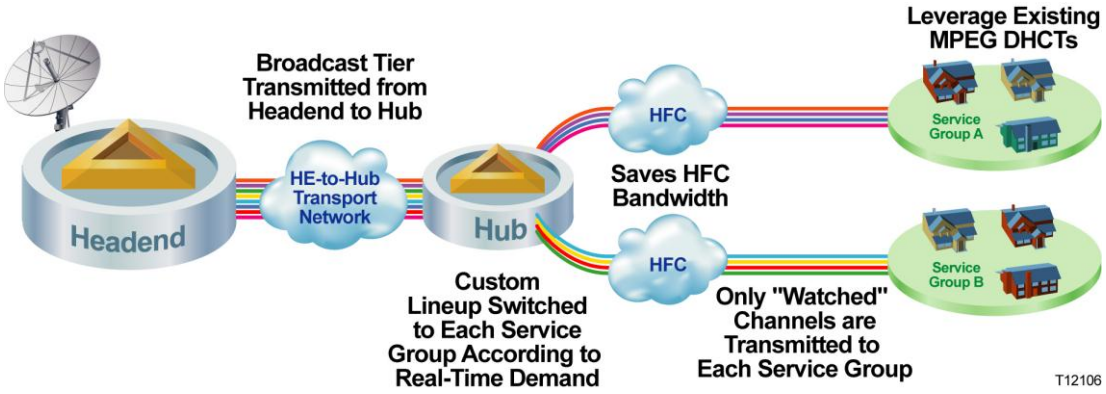
The advent of SDV technology promises to fundamentally change the way the industry delivers digital entertainment. With SDV, service providers have the ability to offer a wider variety of programming while managing HFC network bandwidth in a sustainable way.

In a manner similar to a telephone system, which switches a smaller number of lines upon the demand of a larger number of customers, the SDV architecture switches only selected content onto the HFC upon the demand of one or more viewers. Thus, content that is not requested by anyone in a service group does not occupy HFC bandwidth or require edge modulator resources.

With SDV, popular content continues to be broadcast continuously, while less popular content is held back and transmitted only upon request. Unlike video-on-demand (VOD), with SDV (after the content is transmitted) that stream is shared by any subsequent viewers requesting the same content within the same service group.

SDV also provides access to broadcast service while VOD is retrieving stored content from a server. As a result, SDV still uses the broadcaster's schedule to determine when a program airs.

The following diagram illustrates the typical SDV broadcast flow.



SDV Benefits

The SDV solution provides the following benefits to cable service providers:

- Enhanced bandwidth management
  - Provides an immediate bandwidth savings, compared with the linear delivery of broadcast content
  - Increases in effective bandwidth allow for expansion of HD, VOD, Voice over Internet Protocol (VoIP), and high-speed data (HSD)
  - Allocated bandwidth demand is driven by viewership (not the number of programs offered)
- Specialized broadcast program tiers
  - Create additional specialized content tiers for smaller demographic groups
  - Potential source of new premium subscriptions
- Distributed resource management
  - Resources (QAM modulators and Ethernet switch/routers) supporting multiple applications are managed by a single (master) resource manager, thus enabling sharing of those resources by all the applications, including digital service, VOD, SDV, and traditional broadcast, to name a few
  - Channel changes for high-speed, real-time applications (such as SDV) are managed by distributed application-specific servers
- Performance
  - Channel change times are transparent to home consumers (SDV channel change times are essentially equivalent to digital broadcast channel change times)
- Viewership statistics
  - Track and report channel change information for optimal system performance and bandwidth management, pre-setting highly viewed programs
  - Use information to optimize your programming options

Compatibility

In general, systems implementing SDV can continue to support other popular applications and technologies as described in this section.

Video-on-Demand

Most system applications will be transparent to SDV. However, applications wishing to share QAM modulators with SDV must strictly adhere to established standards for QAM modulator use. This requirement prevents SDV and VOD from independently sending streams to QAM modulators and overflowing channels that can cause service disruptions.

Important: A key specification that VOD systems must adhere to is the Time Warner Cable Session Setup Protocol version 2.3 (SSP2.3). Systems must comply with this specification before deploying the DBDS system release supporting SDV, if the systems intend to share QAM modulators.

DAVIC and DSG Out-of-Band

The SDV system uses the standard Internet protocol (IP) to communicate with set-tops. It does not matter to the system whether set-tops are communicating with the headend using either the Digital Audio Visual Council (DAVIC) protocol with DAVIC modulators/demodulators or the DOCSIS (DSG) protocol with DOCSIS Cable Modem Termination Systems (CMTSs). The SDV system will operate through either protocol.

Advanced Coding

The SDV system does not rely on any specific video or audio coding standards. It is based on standard MPEG transport packets over IP. Therefore, an SDV system will support any of today's coding standards including MPEG-2, H.264, and VC-1 as well as any future coding standard that can be carried in MPEG transport packets.

2

Elements of the Cisco SDV System

Introduction

Cisco has used a combination of new hardware elements and software additions to existing products to integrate SDV functionality into the DBDS. In addition, the system architecture leverages the standard Ethernet/IP switches already in use today for VOD.

This chapter provides an overview of the new and existing hardware as well as software components used in the SDV implementation.

In This Chapter

- Hardware Components of an SDV System 8
- Software Components of an SDV System 12

Hardware Components of an SDV System

Overview

This section provides a system diagram of a typical SDV system and describes the following major hardware components that support it:

- DNCS
- SDV Server
- GQAM Modulator
- Netcrypt Bulk Encryptor
- Digital Content Manager (Optional)
- DHCT
- Gigabit Ethernet/IP Switch-Routers

Cisco's Hardware Approach

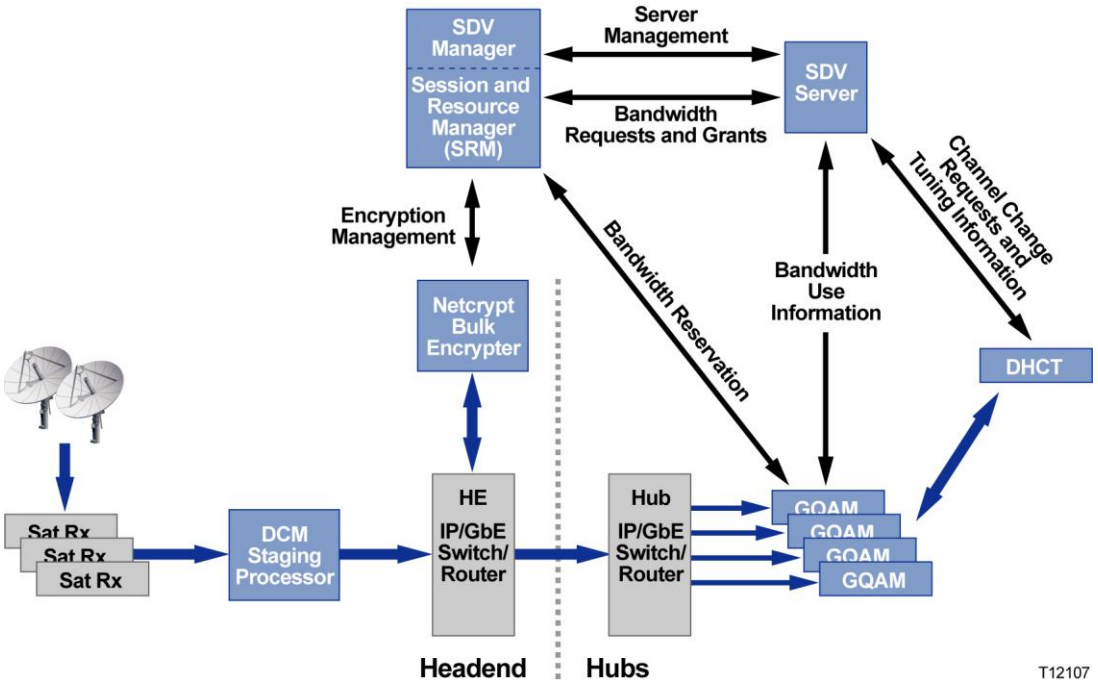
Cisco has upgraded the software on existing DBDS hardware elements such as the DNCS, GQAM modulator, and Digital Home Communications Terminals (DHCTs) to work with the SDV technology. These existing hardware elements are designed to interact with a new hardware device, the SDV Server. SDV also requires the functionality of the Netcrypt Bulk Encryptor. Standard Ethernet/IP switch-routers are integral to the operation of the system.

To allow for an efficient use of network resources, the SDV system is designed to share QAM bandwidth between SDV and VOD services as well as traditional broadcast. For additional information on VOD interoperability, see ***Video-on-Demand*** (on page 5).

Note: Cisco will work with your site to determine your specific hardware needs.

SDV System Diagram

The following system diagram shows the major hardware components that are used in a typical SDV system.



DNCS

The DNCS serves as the overall session and resource manager for SDV as well as multiple applications. A number of software upgrades and new software elements have been added to the DNCS.

Note: For more information about the DNCS software upgrades, see ***Software Components of an SDV System*** (on page 12).

SDV Server

Cisco's SDV server provides the switching control element for the SDV system. The server is designed to provide high-speed channel change services to mask the impact of switching. The server is also designed for the high availability using an N:1 redundant configuration, if desired.

The architecture provides scaling and reliability using multiple servers to share the load, as well as backup units to allow for seamless upgrades in the unlikely event that one of the primary servers fails.

GQAM Modulator

SDV requires the use of session-based QAM modulators with Gigabit Ethernet (GbE) interfaces. At the present time, the GQAM is the only QAM modulator that meets these requirements. All interfaces are open and available, and the system is designed to support future modulators meeting these requirements.

The SDV architecture supported by Cisco allows for sharing of QAM modulators by multiple applications, including SDV, VOD, traditional broadcast, and any new application requiring narrowcast bandwidth. For additional information on VOD ***interoperabilit***y, see Video-on-Demand (on page 5).

The GQAM device uses QAM techniques to modulate a digital signal onto an HFC network to deliver voice, video, and data to a DHCT. In the SDV system, the GQAM modulator's role is to bind a program to a session and then join the multicast group for the program.

Netcrypt Bulk Encryptor

The Netcrypt Bulk Encryptor is a network-attached encryption device designed for systems that use MPEG transport over user datagram protocol (UDP), IP, and Ethernet. The Netcrypt Bulk Encryptor has a maximum throughput of 4 gigabits per second, and is capable of encrypting up to 4000 input programs into a maximum of 4000 transport streams suitable for digital broadcast (switched or linear) and VOD.

The Netcrypt Bulk Encryptor receives SDV content from the Digital Content Manager (DCM) staging processor. The SDV content is encrypted based on the DNCS control, then transmitted to the edge switches.

Digital Content Manager Model D9900 (Optional)

The D9900 Digital Content Manager (DCM) is a compact MPEG processing platform that supports extreme video processing capability. The D9900 DCM comes in a 2RU chassis with hot swappable and redundant power supplies. The unit can be configured with up to four I/O cards, with each card having either ten ASI ports or two pairs of GbE ports. Additionally, the DCM can be fitted with up to four co-processor cards to support advanced MPEG processing functions. Because the cards are designed around general-purpose Field-Programmable Gate Arrays (FPGAs), the DCM will be able to support a multitude of advanced functions in the future through simple code downloads.

The DCM supports up to 8 Gbps of input and output capability. Each of the four co-processing cores is capable of transrating, statistically multiplexing, or rate limiting up to 500 standard definition (SD) streams or 125 high-definition (HD) streams. Each of the cores is also able to perform digital program insertion (ad splicing) on up to 250 simultaneous SD programs. This high processing power may be used for future applications such as H.264 and VC-1 to ensure that the product meets evolving architectures.

In SDV applications, the DCM acts as a signal groomer. It converts variable bit-rate streams to constant or clamped bit rates, and converts multi-program transport streams to multiple single program transport streams. The DCM also converts from various input interfaces to Ethernet/IP. The DCM may be used to insert ads into SDV streams.

DHCT

All Cisco DHCTs can support SDV.

Switch/Router

A key aspect of the SDV architecture described here is that SDV uses standard IP multicasts and the actual switching is done in standard IP routers with GbE interfaces. This makes it possible to leverage many existing VOD networks and allows the SDV network to evolve with IP technology and infrastructure advances.

Software Components of an SDV System

Overview

This section describes the following major software components that support the implementation of an SDV system:

- DNCS software
- SDV Manager software
- SDV Server software
- GQAM software
- Netcrypt software
- Digital Content Manager (DCM) software (Optional)
- DHCT SDV Client software
- Gigabit Ethernet/IP Switch-Router software

DNCS Software

A number of software upgrades and new software elements have been added to the DNCS. One major new element, the SDV Manager, currently runs on the DNCS platform. Other DNCS changes simply add SDV functionality to existing components. The following list provides examples of changes to the DNCS:

- QAM provisioning screens provide a means to assign individual carriers as VOD-only, SDV-only, or as shared VOD, SDV, and broadcast.
- Service group provisioning screens have added provisioning parameters to support SDV.
- When multicast sessions are configured on a Netcrypt Bulk Encryptor, the user can check whether the sessions are intended for SDV. If so, the information is automatically transferred to the SDV Manager.
- The DNCS now supports new message interface standards required for SDV.
- Group session-setup capability has been added to the DNCS to speed the establishment of the quantities of sessions demanded by SDV systems.

SDV Manager Software

The SDV manager software is the primary user interface for SDV servers and the system. It is designed to run on Cisco's DNCS platform, which eliminates the need for the customer to purchase an additional computer.

The user interface is fully integrated with the DNCS, reducing the time for system operators to learn how to control the system. SDV server control appears as new screens and buttons on the existing DNCS interface. New screens include a screen for global SDV parameters and a screen for individual SDV servers. New features have been integrated into existing DNCS screens. See ***DNCS Software*** (on page 12).

Some additional features of the SDV manager software include:

- Automatic download of programs and Netcrypt configuration information from the DNCS
- Simple Network Management Protocol (SNMP) control of remote SDV servers
- Redundancy
- Associations between program bit rates and multicast group destination addresses (GDAs)
- Alarm provisioning and monitoring

SDV Server Software

The SDV server application software provides the SDV switching control. The server software consists of two complementary components: the tnOS software platform and the SDV-specific application software.

The tnOS Software Platform

The tnOS software platform provides the basic data management, user interface, and redundancy infrastructure for the server software. This software platform is a mature, proven framework used for high-speed, mission-critical applications. The tnOS infrastructure provides the redundancy support to achieve the high-availability requirements of SDV. All status information for each primary server is maintained in the backup servers. As a result, the backup servers can assume control for a failed primary server within seconds.

SDV-Specific Application Software

The second component of the software application is the SDV-specific application software. Based on open protocols on all interfaces, this software provides full channel change services in a flexible package tuned with simple configuration parameters. The server provides a simple HTTP-based interface for the craft user for troubleshooting. The server provides an SNMP management interface (v1, v2c, or v3 protocols). The SDV-manager controls and provisions the server using the SNMP interface to provide simple, foolproof provisioning and operation.

Mini-Carousel

The SDV server generates a separate file for each service group and repeatedly transmits the file in "carousel" fashion to all the SDV clients in each service group. Each "mini-carousel" contains a list of programs already being transmitted to its service group, including the tuning parameters required to access them. This serves as a redundant tuning mechanism for the SDV client in order to enhance the reliability of channel change operation. For example, in cases of reverse path failure, the mini-carousel would provide an alternate means of tuning to established programs.

GQAM Software

Session-based operation (as opposed to table-based mapping of input streams to outputs) is required for SDV. The GQAM has always been a session-based modulator. The GQAM software, however, has been extensively upgraded to support SDV.

Besides support of other standard IP protocols through the GbE port (for example, ARP and ICMP), the GQAM software now supports Internet Group Management Protocol version 3 (IGMPv3). This enables the GQAM to support standard joining and leaving of multicast groups as well as to respond to queries regarding group membership in multicast groups. Additionally, the GQAM now supports new standard messaging interfaces required for SDV.

Netcrypt Software

The Netcrypt Bulk Encryptor software is designed to support SDV.

DCM Software (Optional)

The DCM software is designed to support SDV.

DHCT SDV Client Software

SDV functionality has been integrated into the Cisco Resident Application (SARA). Because all messaging interfaces are open and standard, other set-top applications are expected to support the standard SDV messages and behavior as well.

In SARA, the new "WatchSDV" application inherits all of the functionality of the existing "WatchTV" application. This functionality enables SDV to support picture-in-picture (PIP), pay-per-view (PPV), recording with multiple tuners, parental control, and other typical set-top applications.

Gigabit Ethernet/IP Switch-Router Software

The SDV system relies on standard IP multicasts and IP routing for the fundamental "switching" of the content streams.

In order to be suitable for SDV, the edge router software must support IGMPv3. ***See GQAM Soft***ware (on page 14). Other than this support factor, standard IP routing behavior is expected of the software. No special support for, or knowledge of, the SDV application is required in the routing equipment or network.

Cisco will recommend a router that we have tested, or we can assist you with qualifying the router you choose to use in this environment.

3

Customer Information

If You Have Questions

If you have technical questions, call Cisco Services for assistance. Follow the menu options to speak with a service engineer.

Access your company's extranet site to view or order additional technical publications. For accessing instructions, contact the representative who handles your account. Check your extranet site often as the information is updated frequently.

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