Switched Digital Video Architecture Guide

for System Release 2.8/3.8/4.3 and Later

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 in System Release (SR) 2.8/3.8/4.3. This document also provides descriptions and illustrations of how SDV functionality has been incorporated into our digital network.

Purpose

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

- The basic concepts of SDV
- A general overview of the SDV architectures supported in SR 2.8/3.8/4.3, including an overview of its implementation in a Regional Control System (RCS) environment
- 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 the representative who handles your account.

This document does not describe how to install, configure, operate, maintain, or troubleshoot SDV. That information can be obtained from other 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

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.

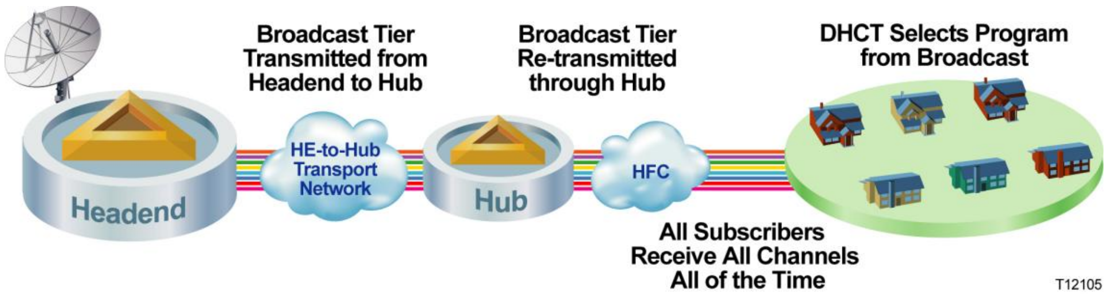
In This Chapter

- 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

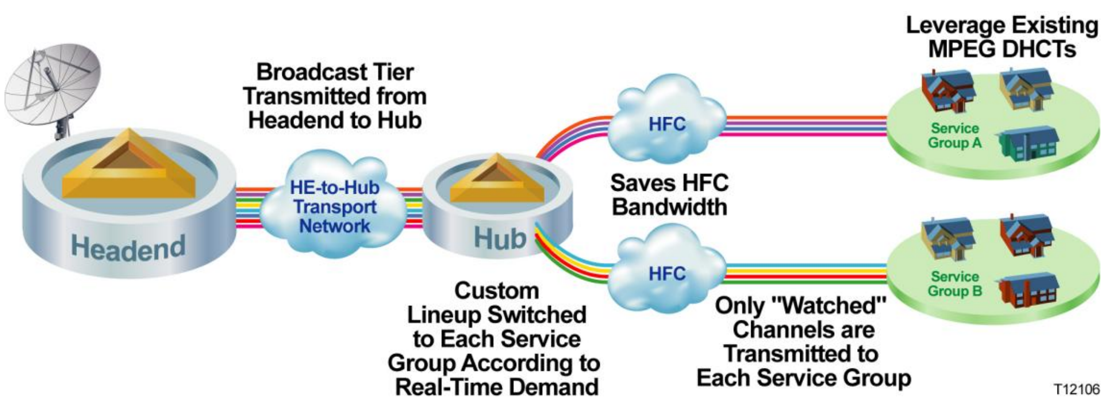
The advent of SDV technology promises to fundamentally change the way the industry delivers digital entertainment. With SDV, service providers have the ability to offer a wider variety of programming while managing HFC network bandwidth in a sustainable way.

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 SDV System

Introduction

This chapter provides an overview of the hardware and software components used in the two common architectures: the classic architecture, which uses the Model D9500 SDV server, and the optional configuration, which uses the Model D9510 Universal Session and Resource Manager (USRM). The USRM is available as a software upgrade to the Model D9500 SDV Server.

This chapter also provides an overview of the components used when an SDV architecture is deployed in a Regional Control System (RCS) environment.

In This Chapter

- Hardware Components of an SDV System 8
- Software Components of an SDV System 15

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 (or optional USRM upgrade)
- Gigabit Quadrature Amplitude Modulation (GQAM) Modulator
- Continuum DVP eXtra Dense QAM Array 24 (XDQA24)
- RF Gateway (RFGW)
- Netcrypt Bulk Encryptor
- Digital Content Manager Model D9900 (D9900 DCM), optional
- Digital Home Communications Terminal (DHCT)
- Gigabit Ethernet/IP Switch-Routers

This section also provides a system diagram of an SDV system that is deployed in an RCS environment.

Our Hardware Approach

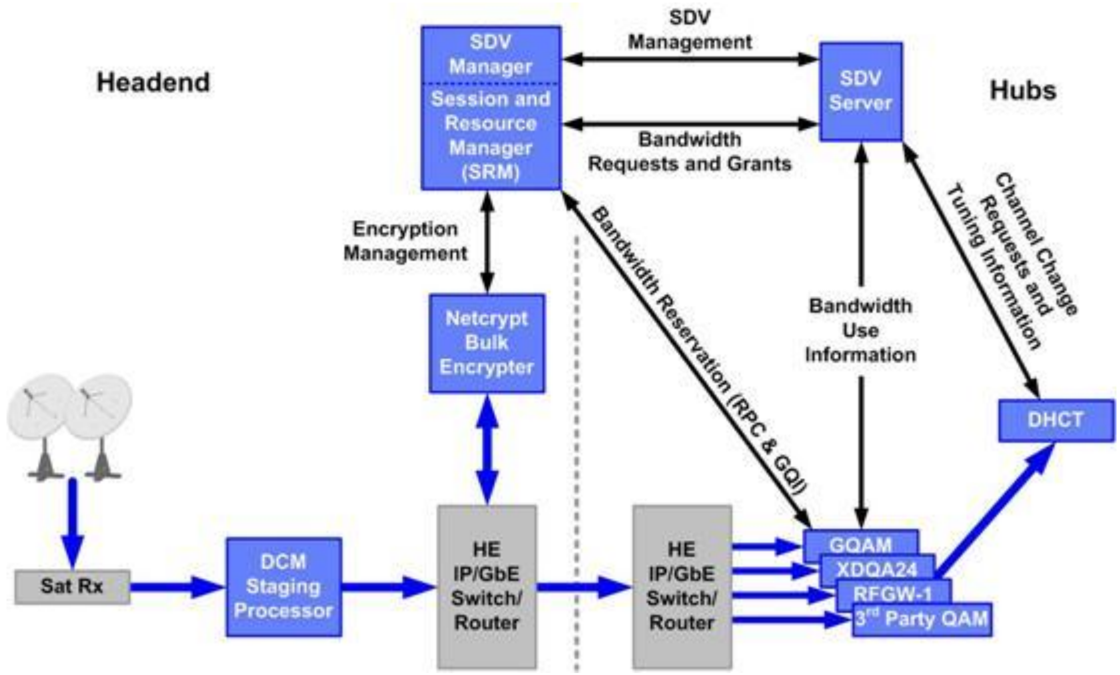
We have upgraded the software on existing DBDS hardware elements such as the DNCS, GQAM modulator, and Digital Home Communications Terminals (DHCTs) to work with the SDV technology. These existing hardware elements are designed to interact with a new hardware device, the SDV Server. SDV also requires 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: We will work with your site to determine your specific hardware needs.

SDV System Diagram with Classic SDV Servers

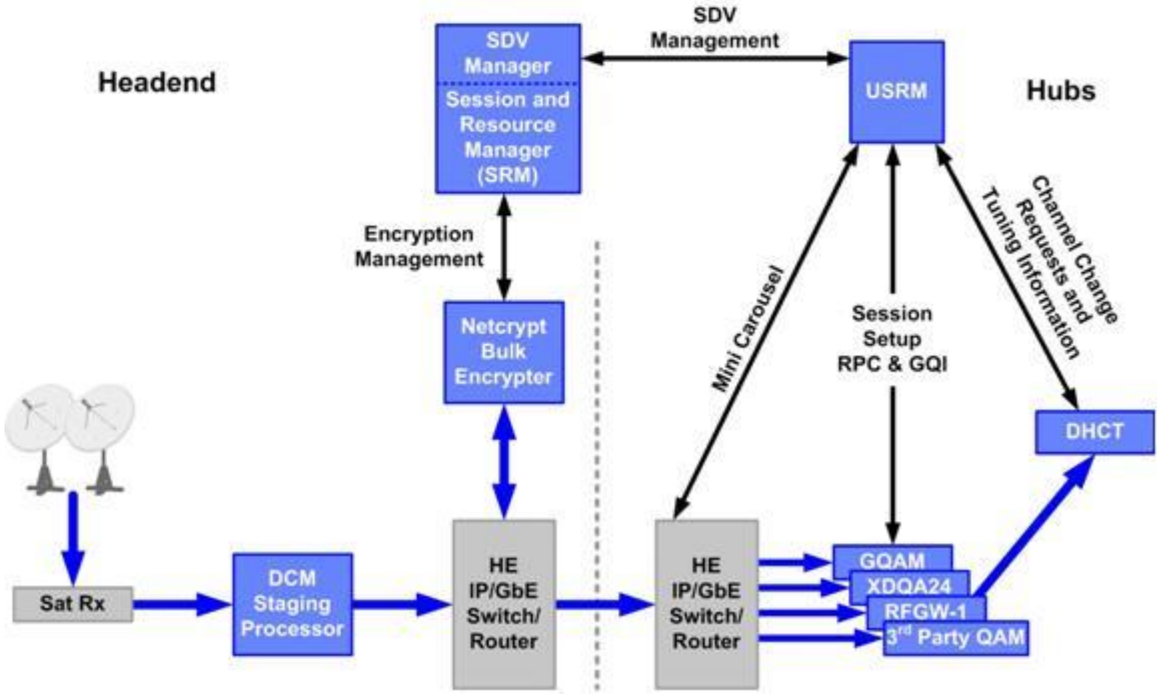
The following system diagram shows the major hardware components that are used in an SDV system that uses classic SDV servers.



Note: If you are using the Regional Control System (RCS) option, this configuration will differ from the diagram shown above. See ***SDV System with Classic Servers in an RCS Environment*** (on page 13) for more information.

SDV System Diagram with Optional USRM

The following system diagram shows the major hardware components that are used in an SDV system that uses the D9510 USRM.



Note: If you are using the Regional Control System (RCS) option, this configuration will differ from the diagram shown above. See ***SDV System with USRM in an RCS Environment*** (on page 14) for more information.

DNCS with SDV Manager and SRM

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 15).

Classic SDV Server

Our classic 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.

USRM (Optional)

The USRM is available as a software upgrade to the classic SDV Server. The USRM is designed for high service-velocity as a flexible software platform supporting plug-in applications and interfaces. You can upgrade the high-availability platform to support new functionality without interrupting your existing services. New applications and interfaces inherit existing platform capabilities.

The USRM demonstrates Cisco's direction in DBDS evolution toward our next-generation DBDS control system. It brings a new level of integrated control to VOD and SDV today, and is designed to quickly enable tomorrow's applications. It is a standard Intel/Linux-based server that supports many major VOD and SDV interfaces and protocols. The USRM is integrated with the DBDS and enables systems to distribute and scale the real-time session and resource management functions of the DNCS. USRM allows applications to access the network and then deliver the requested content to edge devices under its control. USRM supports all standard interfaces.

GQAM Modulator and RFGW

SDV requires the use of session-based QAM modulators with Gigabit Ethernet (GbE) interfaces. At the present time, the GQAM, the XDQA24, and the RFGW meet these requirements. These devices use QAM techniques to modulate a digital signal onto an HFC network to deliver voice, video, and data to a DHCT. In the SDV system, these devices function to bind a program to a session and then join the multicast group for the program when using Classic SDV Servers, or join the multicast group for the programs when the USRM builds a session for the program.

GQAM Modulator: The SDV architecture 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 interoperability, see ***Video-on-Demand*** (on page 5).

XDQA24: The XDQA24 is a compact QAM array designed for routing, multiplexing, QAM modulation, and RF up-conversion. It allows participation in SDV, XOD, broadcast, and data applications.

RFGW: The RFGW is a universal edge-QAM device that offers industry-leading performance, and a standards-based solution for video, data, and converged video and data deployments requiring high density and maximum reliability. For additional information, refer to *Cisco RF Gateway Series RFGW-1 System Guide* (part number 4024958).

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 DCM staging processor. The SDV content is encrypted based on the DNCS control, then transmitted to edge switches.

D9900 DCM (Optional)

The D9900 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 of our 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.

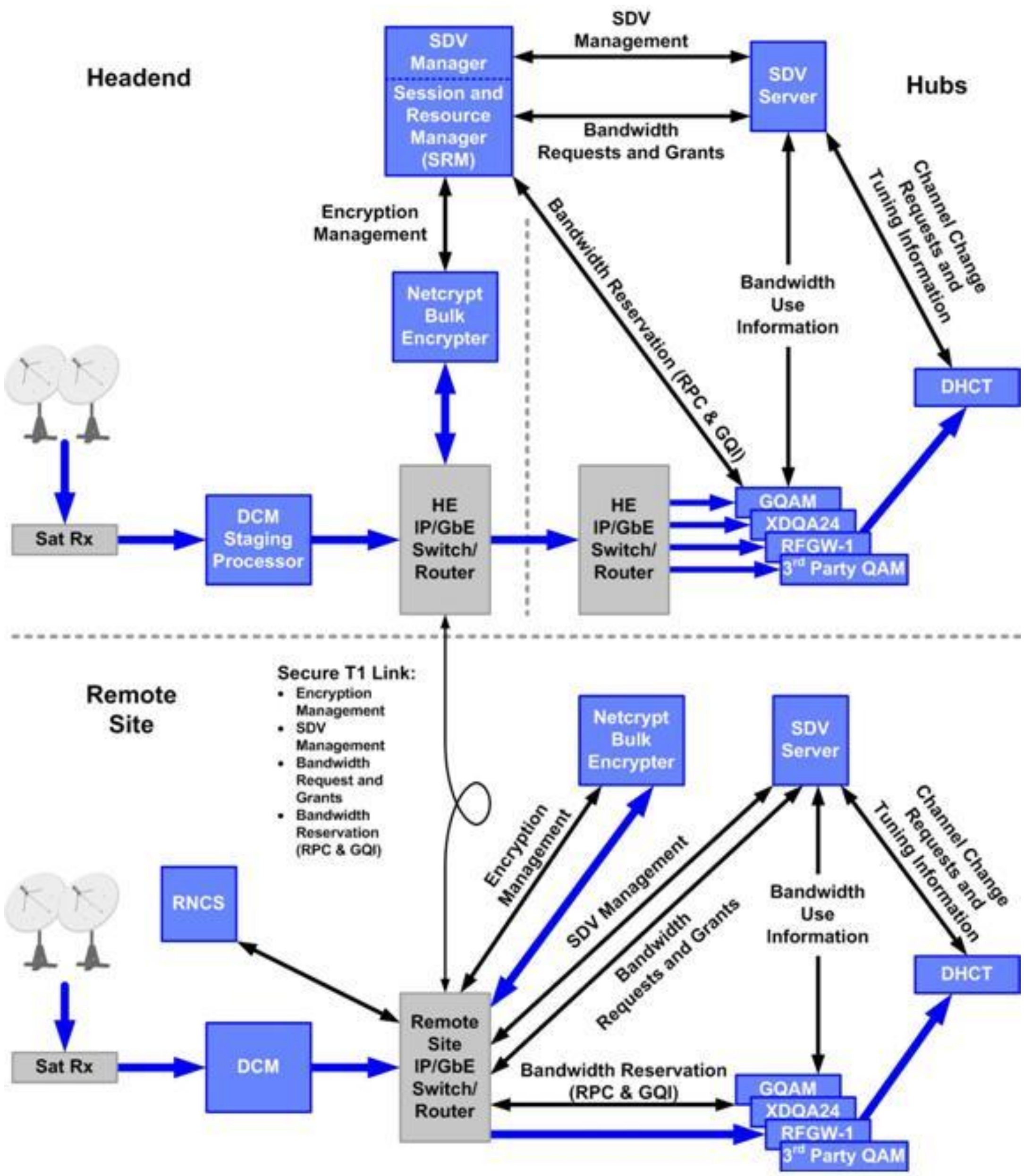
SDV in an RCS Environment System Diagram (Optional)

The following system diagrams show the major hardware components that are used when an SDV architecture using classic SDV servers or USRM is deployed in an RCS environment. RCS is an optional configuration.

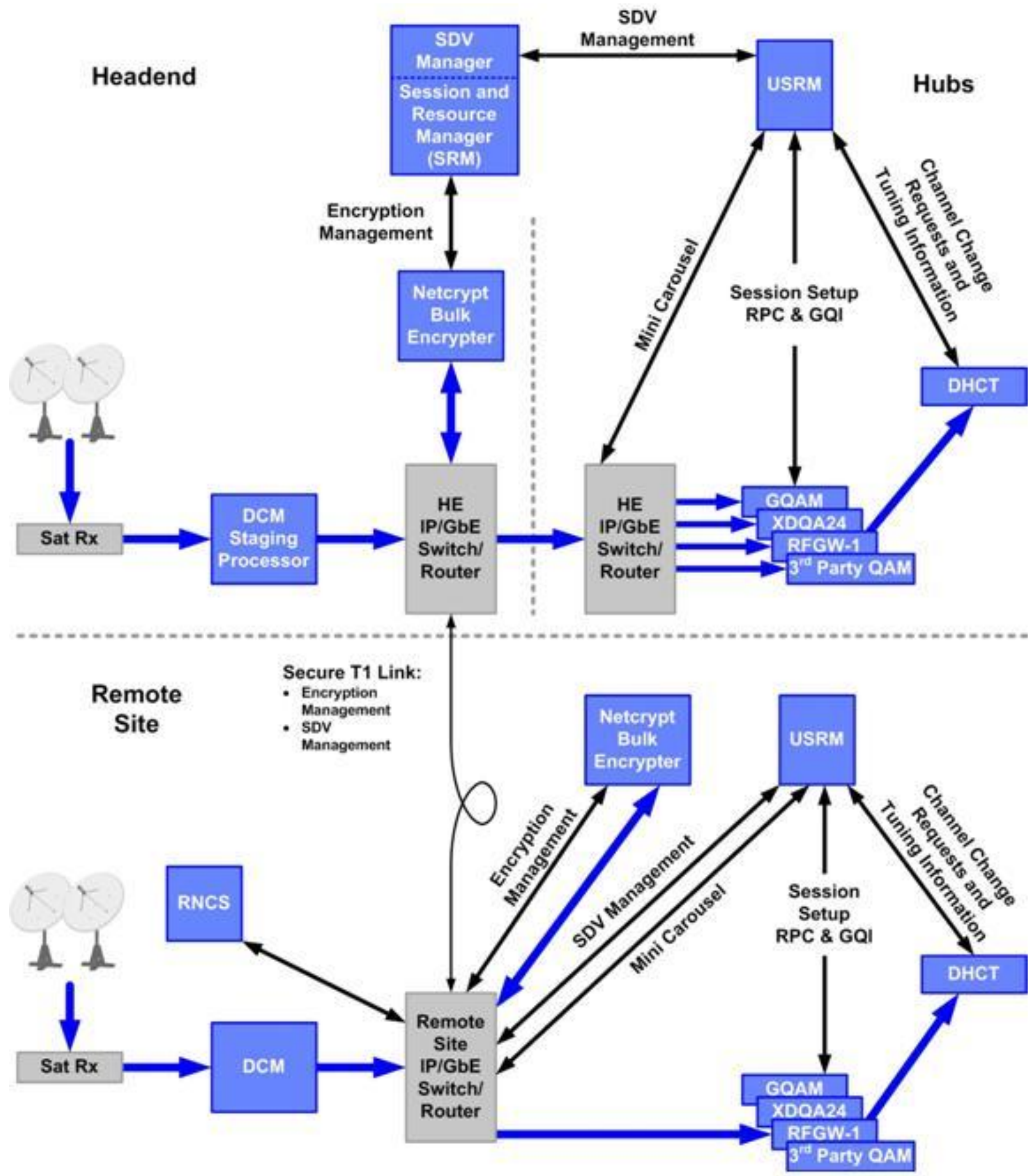
An RCS allows cable operators to manage several remote headend sites from a central DNCS. This architecture can reduce the cost of operations because it does not require a separate DNCS operator at the remote site. With RCS, a DNCS administrator at a central DNCS can provision and manage a Remote Network Control Server (RNCS) for each remote site. After each RNCS is configured, a centralized DNCS and SARA Server can communicate with these unmanned sites across a T1 data link.

For more information on the RCS option, refer to *RCS Network Configuration Guide* (part number 4006381).

SDV System with Classic Servers in an RCS Environment



SDV System with USRM in an RCS Environment



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 or optional USRM software
- GQAM software
- XDQA software
- RFGW software
- Netcrypt software
- Digital Content Manager (DCM) software (Optional)
- DHCT SDV Client software
- Gigabit Ethernet/IP Switch-Router software

DNCS Software

The SDV Manager is a major element that runs on the DNCS platform in support of SDV. Other DNCS features, such as the following examples, also support SDV:

- 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 include provisioning parameters that 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 supports message interface standards required for SDV.
- Group session-setup capability is included on 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 the 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 15).

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 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.

USRM Software (Optional)

The USRM software enables systems to distribute and scale the real-time session and resource management functions of the DNCS. It allows applications to access the network and then deliver the requested content to edge devices under its control. The USRM can be configured to operate in one of two possible modes:

Supervised mode – The USRM is provisioned using the DNCS (or another SNMP provisioner). When the USRM is started, the USRM software requests provisioning from the DNCS before the USRM begins to provide services.

When the USRM boots, it issues an SNMP trap to the DNCS requesting provisioning. The DNCS uses SNMP to download to the USRM its configuration parameters that were set for it using the DNCS. This is referred to as solicited provisioning.

In addition, unsolicited provisioning occurs when the USRM configuration parameters are pushed from the DNCS to the USRM whenever a change in the USRM configuration is entered into the DNCS.

Unsupervised mode – Also known as standalone mode. The USRM is provisioned and configured directly using its web browser interface. No SNMP provisioner is available or used to provide provisioning and startup state.

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.

XDQA24

The XDQA24 software is designed to support SDV.

RFGW Software

The RFGW software is designed to support 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 SARA, our Resident Application. 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 Software*** (on page 17). 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.

We 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.

Cisco Systems, Inc.
5030 Sugarloaf Parkway, Box 465447
Lawrenceville, GA 30042

678 277-1120
800 722-2009
www.cisco.com

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