




Implementing Switched Digital Video Solutions





As cable operators strive to deliver increased services to capture, retain, and delight video customers, they continue to face increasing challenges and opportunities for optimizing and managing their networks. Switched Digital Video (SDV) is a proven technology that helps operators efficiently deliver highly targeted content that encourages consumer loyalty, makes more efficient use of bandwidth, reduces churn, and optimizes the productive use of billable capacity.

With SDV, MSOs can offer greater channel selection and recover bandwidth to support more High-Definition (HD) television channels and deliver more niche content. They can also free up bandwidth to support additional high-speed Internet and VoIP services. SDV allows cable operators to improve Average Revenue Per User (ARPU) levels and more economically address niche programming requirements while taking fuller advantage of their networks.

Motorola offers end-to-end SDV solutions that allow operators to provide subscribers with access to an extended variety of highly focused digital content channels, without the need to commit dedicated bandwidth to each channel. Channels can be switched onto the network only when they are requested by one or more users. The benefits for cable providers are immediate because they can:

- Reclaim bandwidth
- Deliver highly targeted content to subscribers.
- Attract additional subscribers with niche programming
- Expand HD channel offering
- Increase bandwidth allocated to high-speed Internet customers

Once the decision has been made to proceed with implementing SDV, cable operators need to select a vendor with the products and services to enable an economical implementation that delivers bottom-line results. Motorola has SDV products available today and continues to add new products and features that will further enable more feature-rich implementations of SDV services.

Motorola also offers the professional services expertise needed to help cable operators extend existing infrastructure to support the cost-optimized delivery of SDV services that attract new subscribers and create a competitive edge in the broadband marketplace. With a wealth of experience in Video On Demand (VOD) and interactive television applications, Motorola provides the expertise needed to launch new applications and services for new revenue streams and increased customer retention.

Overview of SDV

SDV is the dynamic switching of digital video services on and off the physical cable plant, as determined by real-time subscriber usage and demand patterns. Certain services are designated by the MSO as “switched services,” and a switched service is only placed onto the cable plant if at least one set-top has requested that service. SDV therefore allows operators to make better use of bandwidth on the physical cable plant, since the number of broadcast channels is drastically reduced to only those channels sustaining high viewership levels.

Before SDV’s availability, program channels focused toward smaller audiences that valued specialized content were typically limited in availability, or else they were not broadcast

at all because advertising dollars did not generate a suitable return. Niche content — such as special interest channels or ethnically oriented programming — do not attract the mass subscriber interest of more popular channels, such as network channels, cable news channels, and sports channels. But even though the audience for a niche channel may be small, the aggregate of many niche channel audiences can be substantial. Specialty programming tends to encourage high subscriber loyalty rates, and it often allows a cable operator to gain a competitive edge in the market.

SDV therefore allows cable operators to provide subscribers with access to highly focused content channels, without the need to commit dedicated bandwidth to each channel. SDV allows cable operators to provide subscribers with greater content choices while at the same time more efficiently utilizing network bandwidth.

In an SDV environment, a switched channel is only placed onto the Hybrid Fiber Coax (HFC) network when one or more subscribers tunes to it. Once a switched service is streamed to a service group, subsequent subscribers within the same service group may tune into the same stream, allowing the cable operator to broadcast an SDV channel to a service group a single time to support requests from multiple subscribers. When the SDV infrastructure detects that no subscribers are viewing an SDV channel, it is marked for reclamation and can be removed from the HFC network to make room for other subscriber-requested channels, if necessary.

As operators begin to utilize SDV technologies, subscriber viewing habits can be monitored in real time and operators can then incrementally roll out increased SDV services that meet the demands of their networks and desired service capabilities. Cable operators can monitor utilization to determine over time which channels should be carried over the broadcast network and which should be made available via SDV. A solid rule of thumb is that 80 percent of the subscribers are watching 20 percent of the broadcast content, and the least-watched channels are prime candidates for being offered as switched services. Here, operators need to determine the top 20 percent of shows watched and continue to make them available via broadcast. Of the remaining 80 percent, operators would then look at usage patterns to determine which are the best candidates for SDV.

Operations personnel need the ability to appropriately size the capacity allocated to switched services, ensuring a high statistical likelihood that a subscriber is rarely if ever denied access to a switched channel because of worst-case bandwidth constraints. The smaller the service group, the greater the likelihood that fewer unique channels will be watched simultaneously within that group. By carefully monitoring channel viewing patterns and service group capacity, MSOs can further reclaim bandwidth by setting smaller service group sizes when needed and switching relatively low-demand services efficiently. Motorola recommends that cable operators continuously monitor channel-viewing patterns to understand demand and split service groups when needed.

The ability to only switch on select services when they are requested allows cable operators to more efficiently utilize remaining bandwidth for higher-revenue billable services so they can offer more HD services, a broader spectrum of content, higher-speed data services, and VoIP. Subsequently, edge devices become more flexible — and more productive — resources, since they can be effectively shared by SDV, VOD, and data services. With SDV, cable operators can offer significantly more channels so they can compete more effectively with satellite operators. Highly granular monitoring of channel viewing patterns creates additional opportunities for cable operators to merchandise accurate viewing statistics and attract highly targeted advertising revenue.

SDV can help operators further reduce bandwidth overhead by supporting the introduction of new video codecs. Operators today have widely deployed MPEG-2 video services to the vast majority of deployed set-tops, but with SDV they can transmit more bandwidth-efficient MPEG-4 content to newer set-tops that support this emerging compression standard. MPEG-4 set-tops can identify themselves as such when requesting a switched service, allowing the headend to send MPEG-4 content to those set-tops that support it. SDV supports mixed mode networks with both MPEG-2 and MPEG-4 components by selectively streaming the appropriate content format to each individual device.

SDV Solutions from Motorola

Motorola offers end-to-end SDV solutions so cable operators can more efficiently leverage their existing infrastructure by switching channels in direct response to subscriber demand. Motorola also offers the professional services expertise to help operators design, deploy, and operate SDV solutions. By selecting leading edge, standards-based SDV solutions from Motorola, cable operators can cost-effectively implement SDV and integrate SDV solutions with existing infrastructure and access networks resources. The following products are key to Motorola SDV solutions, and they can be efficiently integrated with existing headend, infrastructure, and access network resources so that cable operators can swiftly implement SDV.

Switched Video Manager (SVM)

Switched Video Manager (SVM1000 and SVM2000) platforms are responsible for managing which SDV streams are active at any given time and for directing streams to the appropriate set-tops requesting them. An SVM keeps track of who is watching which channels, and it communicates with the ERM to establish requested channels. The SVM maintains the SDV channel table and keeps track of the number of set-tops tuned to each SDV service. The SVM family combines the video compression benefits of SDV with the advantages of sharing QAM resources using open network management protocols. Based on a distributed architecture, members of the SVM family utilize a Linux platform, are managed by a browser interface, and are compatible with open systems standards.

Edge Resource Manager (ERM)

The Edge Resource Manager (ERM1000) manages all of the narrowcast QAMs in a headend as established by the cable operator's policies. This means that narrowcast edge QAMs can be used as a generic resource by an expanding group of services, including VOD, SDV, video-rich navigation, and more. The ERM1000 runs Linux, and it is interoperable with Motorola and leading third-party QAMs. It offers a web-based user interface and is integrated with Motorola VOD solutions, as well as other leading third-party VOD solutions. The ERM receives requests for edge QAM resources, such as bandwidth and MPEG program numbers, and will select the appropriate QAM to satisfy the bandwidth requirements of the request. It enables the ability to share edge QAM resources between multiple services so that cable operators can efficiently provision services based on real-time consumer demands.

Switched Video Operations Manager (SVOM)

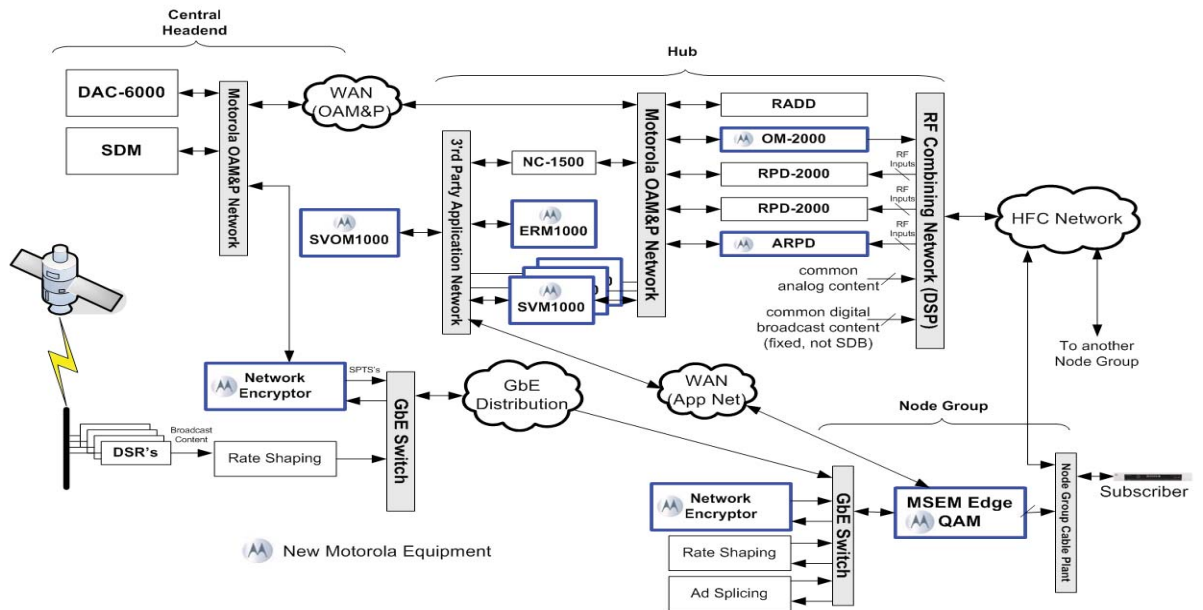
The Switched Video Operations Manager (SVOM1000) configures and manages the many components involved in SDV deployment. It is deployed centrally and supports configuration, monitoring, and data collection for SVMs and ERMs. The SVOM drives centralized report generation. Based on the Linux operating system, it offers a web-based user interface and allows cable operators to centrally configure channels for SDV services, manage service group mappings, and administer SVM, ERM, and QAM relationships. It collects usage and statistics information and allows cable operators to centrally measure important information and generate reports on critical operational topics such as:

- Channel usage
- Set-top usage
- Channel change rates
- Service group bandwidth utilization

Operations staff can turn to the SVOM1000 for system management, reporting, and statistical analysis, and use it to centrally configure switched digital services. They can monitor channel usage to select the least-watched channels in the broadcast lineup, so that these channels can be removed and made available as switched services based on subscriber demand.

Implementing SDV Solutions from Motorola

The SVM, ERM, and SVOM are the cornerstones of Motorola's SDV solutions. MSOs can integrate these products into their existing networks with the assistance of professional services expertise from Motorola. The following is a sample implementation:



A representative SDV implementation in an existing HFC network.

Subscribers select a switched channel in the same manner as they select broadcast channels. The switched channels are mapped as “virtual channels” in the Electronic Programming Guide (EPG) in the same manner that broadcast channels are mapped today. The difference, however, is that when a subscriber uses the remote control for a Motorola set-top to select a switched channel, a message is sent to the SVM requesting the channel. If no one else in the subscriber’s service group is watching that channel, the SVM will place the content on the network and direct the set-top to the content’s location. If someone else in the subscriber’s service group is already viewing that programming, the subscriber simply joins to that previously established narrowcast channel. Whether a channel is broadcast or switched is transparent to the subscriber, and cable operators can provide consumers with seamless access to a greater variety of programming while more efficiently managing bandwidth.

As previously mentioned, once a subscriber tunes to a channel designated as switched, the set-top sends a channel change message indicating the desired channel and the service group information. A Motorola Advanced Return Path Demodulator (ARPD) receives the tune message from the set-top. The traffic is then sent to an associated NC1500 for interactive control and command processing before being passed to the SVM. The SVM determines source details for the requested channel and identifies the QAMs feeding the subscriber’s service group. The SVM then signals the ERM to establish the requested content on the QAM channel that it determines will best support the channel based on the information received. The ERM then directs the APEX to join the multicast transmission and bind to the frequency and program number. From there the SVM updates the channel carousel and returns the frequency and program number to the set-top, which tunes to the frequency so the subscriber can view the program.

Cable operators can streamline operations by making SDV channels available directly from satellite downlinks. A Motorola DSR satellite multiplex decrypter allows cable operators to decrypt satellite downloads, a Motorola CherryPicker® Application Platform (CAP)-1000 rate limits the content and encapsulates the video in IP, and the Motorola Network Encryptor 1000 then encrypts the clear channels for transmission. The traffic then flows through a Gigabit Ethernet IP distribution network to the requesting service group for delivery to the subscriber.

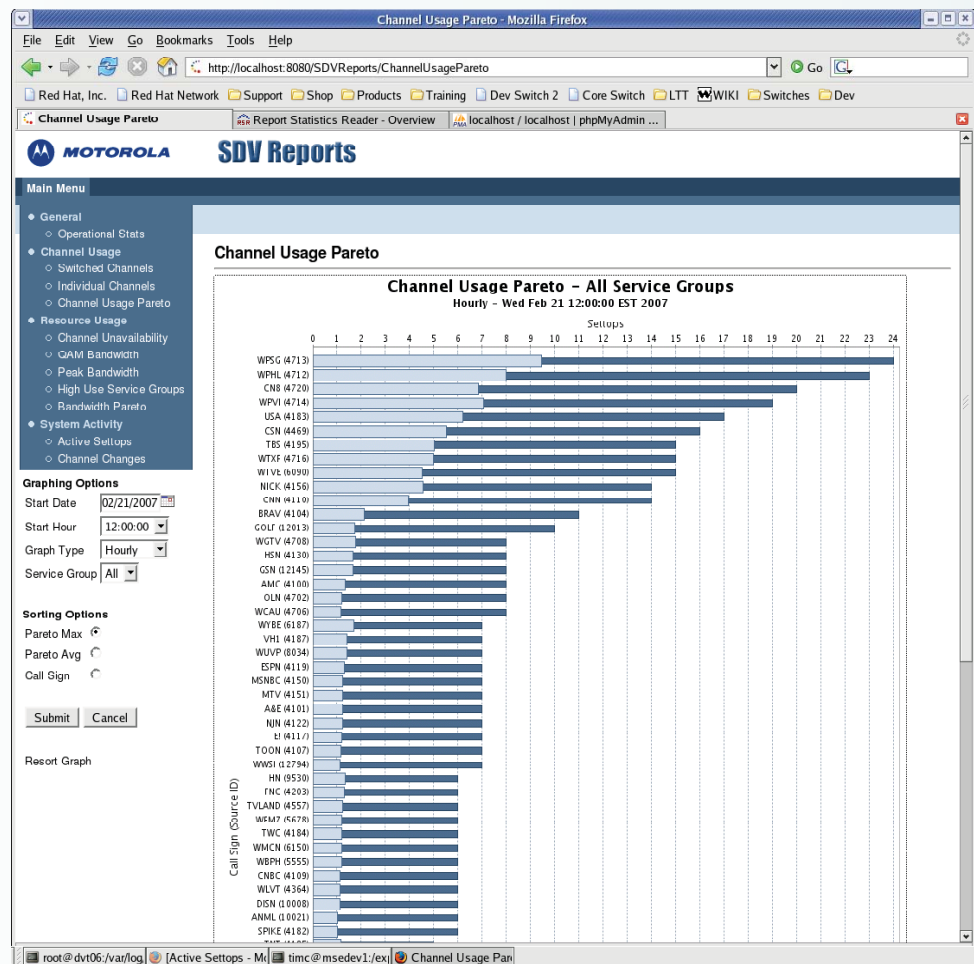
Other Motorola products are also utilized when implementing SDV. In this example, the QAM is a Motorola APEX1000, an all-purpose edge QAM that supports up to 48 QAM channels in a 1 RU chassis. The Motorola OM 2000 out-of-band multiplexer/modulator is in a 1 RU chassis and it is deployed in the hub and transmits signaling downstream to the set-top. Motorola’s Network Encryptor 1000 is a 1 RU platform deployed in the node

that provides central encryption for SDV and VOD services.

Based upon site configuration and the use of additional Motorola products, other value-added services may also be enabled. For example, Start Over™ functionality can allow a subscriber to start a program that is in-progress from the very beginning so that the entire show could be watched. If a subscriber tunes to the 11:00 news at 11:25, the subscriber can opt to watch the entire newscast as a VOD stream.

Improving Operations Through System Monitoring

The SVM feeds statistical usage data to a centralized SVOM, which maintains a database that is optimized for reporting. Centralized aggregation of viewing statistics is essential for profitably deploying SDV services, and the SVOM provides cable operators with tremendous flexibility for analyzing usage and selecting the ideal channels for switching. Pareto charts are available for monitoring channel usage. Motorola recommends that cable operators run in a monitor mode before actually enabling the switching of channels. This enables the operator to do a thorough analysis of channel usage, which can be used to drive decisions on channel selection and service group optimization (i.e., whether any service groups need to be split). If average usage for a channel turns out to be less than one set-top per service group, the channel is a good candidate for being made available as a switched service.



Pareto charts allow cable operators to monitor channel utilization and select the optimum channels to be delivered as switched services.

MSOs can run reports for individual service groups, selected service groups, or for all service groups, and they can also capture information to compare viewership of several competing channels. Resource reports can be generated to present multiple views of bandwidth usage for service groups. Cable operators can therefore understand the load on each service group and proactively recognize when they need to add capacity or split nodes. The SVOM also allows operations staff to generate system activity reports, such as those highlighting the number of active tuners by time of day, channel change volumes, and message loads for selected service groups.

Professional Services are Key to the Solution

Cable operators can turn to Motorola for a fully redundant SDV solution with industry-standard EPG support. The SVM, ERM, and SVOM platforms are Linux-based systems managed via browser-based interfaces, and this solution enables efficient QAM sharing with SDV, VOD, and high-speed data services. It supports Motorola's QAMs and other leading third-party QAMs, and supports the switching of both SD and HD channels. Cable operators can run in a monitor-only mode for initial trials, and after carefully analyzing reports on channel usage they can select the channels ideal for offering as switched services.

Motorola offers the professional services expertise that augments internal engineering resources so that cable operators can swiftly and efficiently enable SDV services. Motorola engineers help cable operators implement best practices for sizing the upstream and downstream network resources required to support the efficient deployment of SDV services. Motorola recommends sizing guidelines for the interactive system to support the increase in traffic without impacting operation. Any new deployments can be run in a monitor mode so operations staff can gain a solid understanding of the system usage. From this monitoring, Motorola engineers can recommend the ideal channels to switch based on measurable usage data.

Initially, Motorola recommends that QAMs be installed in a 1:2 ratio to the number of channels that will be transitioned to SDV. If an operator chooses to switch 80 SD channels, Motorola therefore conservatively recommends 40 SD channels of switched bandwidth per service group. Motorola leverages sizing and loading spreadsheet models that enable the efficient calculation of equipment requirements to support SDV implementation.

Our SDV Implementation Services leverage our deep broadband knowledge, core video capabilities, and expertise in overall digital headend and interactive network technologies. Highly skilled and experienced Motorola engineers deliver the end-to-end implementation services that ensure a seamless transition to Motorola's standards-based and robust SDV solution. With a wealth of experience in VOD and interactive television applications, Motorola provides the expertise needed to help MSOs launch new applications and services that increase revenue streams and customer retention.

Motorola SDV Implementation Services

Using Motorola SDV Implementation Services, operators enjoy professional and low-risk deployment of a highly optimized Motorola SDV solution that minimizes downtime. Motorola's SDV solutions require the coordinated support of Motorola personnel and customer headend and network personnel. With Motorola providing an end-to-end solution and managing the installation, there are three phases for SDV implementation:

- Preparation
- Hardware Installation and Verification
- Roll Out

Preparation Phase

The preparation phase includes Site Assessment, System Design, and a Kickoff Meeting. The Site Assessment will focus on gaining a shared understanding of existing system infrastructure. Motorola will work with the cable operator to develop a detailed description of the current system, which is necessary for the generation of a detailed design. The Site Assessment includes gathering data on:

- The number of OMs, NC1500s, and RPDs deployed and the number of set-tops on each device
- Number of hubs
- Number of service groups per hub
- Number of set-tops per service group
- Current network infrastructure in place
- List of channels currently offered
- Aloha network assessment
- Rack, power, and cooling

During the System Design, Motorola and the cable operator will discuss Motorola's architecture recommendations for SDV, and Motorola will develop a detailed design. This design will include the SVM and ERM layout, and it will also include any Aloha two-way expansion/rework if necessary. Due to the substantial increase in the amount of traffic generated on the Aloha network, Motorola recommends limiting the size of any single

service group. The System Design takes into consideration the number of channels to be switched, the size of service groups, and various other factors. Based upon these factors, service group size will be determined and SDV QAMs per service group will be proposed.

Data from a monitoring phase of the implementation can be leveraged when determining which channels are good candidates for switching. Using this data, the amount of compression possible without blocking can be deduced. Typically we recommend that the SVM and ERMs sit as close to the edge as possible to eliminate any possible delays in session setup. Motorola and the cable operator will discuss SDV and network capacity, and then Motorola will provide sizing recommendations and a detailed design. The goal of the System Design is to have a Bill of Material (BOM) in place prior to the Kickoff Meeting.

During the Kickoff Meeting, the cable operator and Motorola will conduct a detailed design review and discuss in detail Motorola's SDV solution and recommendations. We will present how the system and the services will work, and we'll review the BOM and the necessary purchase order covering the hardware and services required for the SDV implementation.

Hardware Installation

System Readiness begins with network configuration, which is typically handled by the customer's internal network team. In a distributed implementation, this typically includes verification of capacity to transport the multicast traffic, which is the IP-encapsulated video traffic to each hub location. It also means configuration of the production switches to permit the routing of this multicast traffic to the appropriate destinations. It also includes network IP address assignments for all the SDV gear and associated production switch configurations.

Application network configuration includes the installation of additional switches, if necessary, to support not only the SDV servers but also the Network Encryptor, APEX Edge Devices, and Cherry Picker grooming devices. Additional work needed can range from service group splits to reduce very large service groups (1000+ subscribers) to expanding the Aloha network capacity. Other than opening a communication port on the OM1000 and adding the SDV service name to the DAC channel map, there is no reconfiguration required to the existing headend hardware.

Each hub location will need to be prepared to accommodate the impending hardware installation. This could include an increase in cooling capacity and/or installation of additional rack space and wiring for power. SDV System Installation consists of installing and configuring the SDV hardware platforms:

- **SDV Servers** — The SDV servers consist of the SVMs, ERMs, and SVOM. The SVOM is typically installed in the main headend, and the SVMs and ERMs are located in the hubs feeding the local service groups. The initial configuration required by these devices includes server name, IP address, redundancy, time server, etc. The more detailed configuration covering all the system topology comes later.
- **Cherry Picker®** — The Cherry Picker is responsible for taking in the source video and generating rate limited Single Program Transport Streams (SPTS) encapsulated in an IP multicast. Cherry Pickers are typically installed in the headend for channels with no local advertisement insertion. Additional Cherry Pickers would be installed in the hub for channels that include locally inserted advertisements. Configuration of this device includes feeding of the switched channels into this device and mapping each switched channel to an output multicast and port.
- **Network Encryptor** — The Network Encryptor receives the SPTS multicast from the Cherry Picker and encrypts the video and generates a new SPTS multicast with the encrypted video. The Network Encryptor will typically be found in the same locations as the Cherry Picker and configuration of this device includes the multicast addresses corresponding to the output of the Cherry Picker.
- **APEX Edge Devices** — APEX is a dense QAM and will carry the active switched channels. QAMs from the APEXs are wired to each service group, and its QAMs will initially only carry switched channels. The main configuration required in the APEX is TSID and frequencies corresponding to each service group to which it is wired.

Channel Monitoring

During the site assessment, a small portion of the SDV system can be installed to gather usage information on channel popularity. This data can be leveraged to determine which channels should be switched to optimize the implementation.

- Installation requires SVOM, ERM, and SVM platforms.
- Channel change monitoring requires the installation of a set-top client that supports SDV and can report on broadcast channels on those set-tops to be monitored.
- As statistics are gathered, the reporting capabilities within the SVOM can be used to identify which channels are the best candidates for switching. Simulations can be run to identify how much switched bandwidth would be required for a given selection of channels.

Ensuring Reliability Via Redundancy

Motorola recommends that cable operators deploy SVMs and ERMs with 1:1 redundancy with failover to ensure reliable operations. One server runs as the primary server, receiving all requests, and the other runs in parallel as a standby. Once a failure is detected, a standby server can quickly take control, typically with little to no impact to subscribers.

The next step is **SDV Configuration**. Based upon the system design, a detailed configuration spreadsheet will be generated for importation into the SVOM. This configuration spreadsheet is generated in conjunction with the site and includes details such as:

- Edge devices and QAMs
- QAM to service group mappings
- Channel lists for both broadcast and switched channels
- Switched channel information (source ID, channel name, multicast/source information)
- Service group to SDV device mapping. A single site typically would have multiple SVMs and ERMs, and because multiple SVM/ERMs are used it is necessary to link which service groups are controlled via which SVMs.

This configuration is then imported into the SVOM, and from there the relevant configuration data is distributed to each SVM and ERM. At this point, Motorola would execute its Acceptance Test Plan (ATP) to verify that the system configuration and the overall integration between all components are correct.

Roll Out

The Roll Out Phase consists of:

Service Group Testing — The purpose of Service Group Testing is to verify that a single test box can tune to switched channels, as well as receive video on all of the switched QAMs associated with each service group. The process would include connecting a set-top enabled for SDV to each service group and verifying that it can auto discover and tune to every switched frequency to confirm successful operation.

Friendly Launch — Once the system is installed and operational, we recommend a limited release to friendly service groups. A friendly trial would include a few hundred subscribers (typically employees) who are enabled to use SDV. During this period, the broadcast versions of the channels being migrated to switched are still active on the plant. This period of time allows for further testing and verification of overall system operation. It also gives headend personnel time to become proficient with the newly installed gear as they work with the Motorola engineers to track down any problems not identified during service group testing.

Service Group by Service Group Launch — After the operator is comfortable with the operation and support of the newly installed SDV solution, it can be rolled out to the entire market. Motorola recommends that the initial rollout be taken slowly. During the first few days, a small number of service groups per day would have SDV enabled to limit the potential support activities. After successfully enabling the first few service groups, the process can be ramped up and SDV can be enabled on a service group-by-service group basis.

Reclamation of Bandwidth — Once SDV has been successfully rolled out to the entire market, the broadcast versions of the now switched channels can be reclaimed. No work is required within the SDV system itself; rather, this would include the decommissioning of the broadcast QAMs currently supplying those channels.

Migrate Management of VOD Bandwidth to the ERM — Many customers are now choosing to migrate management of the VOD QAM bandwidth to the ERMs after successfully launching SDV. Leveraging open standards, the ERM can now take the once-disparate silos of QAMs for SDV and VOD and create a common pool of QAMs that can be efficiently shared.

Deploying SDV Solutions from Motorola

By broadcasting only the channels being viewed, SDV reclaims bandwidth for revenue generating video and data services. SDV solutions from Motorola leverage state-of-the-art products and professional services expertise to allow operators to repurpose bandwidth and optimize the use of infrastructure resources.

Using Motorola SDV Implementation Services, operators enjoy professional and low-risk deployment of a highly optimized Motorola SDV solution that minimizes downtime. Motorola's SDV solutions require the coordinated support of Motorola personnel and customer headend and network personnel, and we offer a proven methodology based on best practices for enabling smooth SDV deployments.

Cable operators can leverage SDV to support migration to MPEG-4 and to enable efficient QAM sharing with VOD and data services. By selecting end-to-end SDV solutions from Motorola, cable operators can increase the revenue generating services that can be offered on existing networks while minimizing capital costs and gaining a competitive advantage in a challenging marketplace. For more information about our SDV solutions, contact your Motorola account representative or visit www.motorola.com.



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