White Paper

# Standardizing Full Motion Video Services for Operational Effectiveness

## Executive Summary

The Department of Defense (DoD) Full Motion Video (FMV) networks were fielded based on specific platforms deployed to meet the unique requirements of individual mission types. This approach has driven the deployment of independent network architectures that do not leverage standards to enable interoperability or the flexibility to accommodate evolving customer demands for Community Of Interest (COI) requirements and access. A standards-based common network architecture should be established in order to improve interoperability and flexibility to address evolving COI requirements.

## Challenge

The current proliferation of unique FMV technologies and architectures has limited the DoD's ability to cost effectively adapt to the growing demands for access to critical mission video. This challenge is further exacerbated by the lack of standards employed across the breadth of platforms being deployed.

As the demand for access to video content generated by an increasing number of Remotely Piloted Vehicle (RPV) platforms and sensors continues to grow, the complexity and cost of maintaining the disparate ground infrastructures also continues to rapidly increase. Additionally, this complexity has made it progressively more difficult to accommodate the fluid nature of COI requirements. Along those lines, the need for clarity concerning which source feed is required to provide mission capability on any given day for a specific COI necessitates a simplification of the overall FMV architectural approach. Complexity limits the agility necessary to support today's operational tempo.

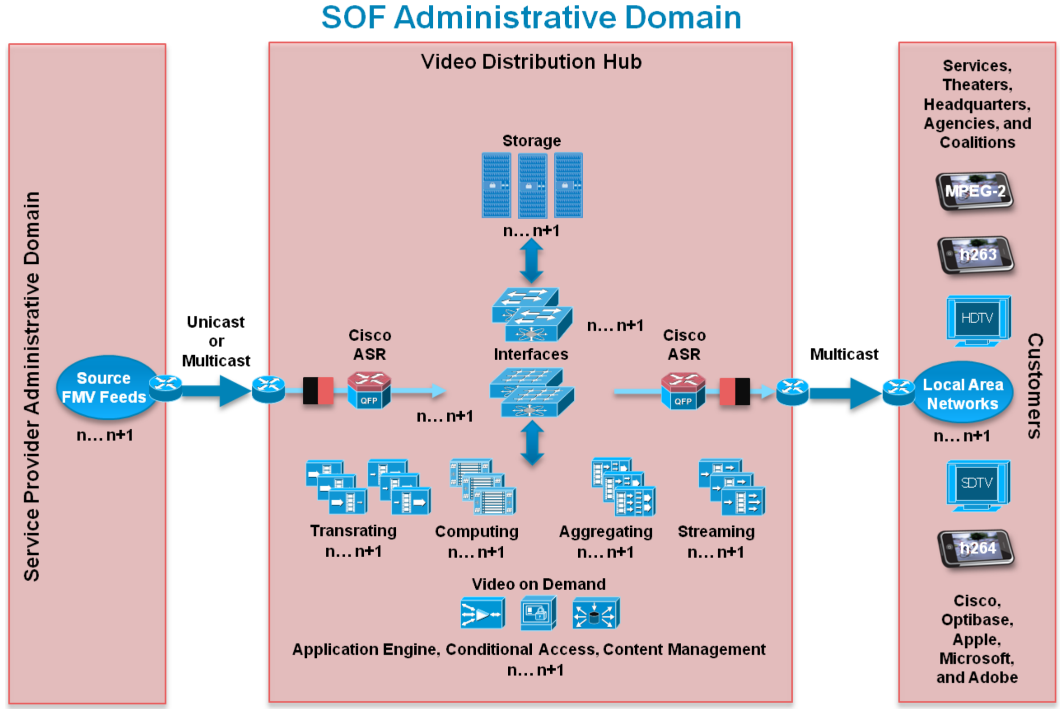
## Solution

A standardized approach to FMV architectures that are able to support a breadth of RPV platforms is a necessity. Some of the capabilities, which must be defined, include video formats, encoding standards, security, and "live source" versus "processed and posted" video content. Other follow-on considerations include video storage parameters, the availability of metadata, and whether or not there is a highly available multicast network to deliver content. These requirements are a few of the basic factors that can help establish a standards-based end-to-end DoD FMV architecture.

The concept of a tiered, distributed Video Distribution Hub (VDH) design should be considered as an alternative solution to establish a simplified and standardized FMV service for the DoD COI. The VDHs would receive source video feeds in definable quantities (with quality) simultaneously, so that the incorporated components can scale with the aim to compute, store, transrate, aggregate, and stream conditioned video feeds to the end users.

As a by-product, the components also can provision content management for on-demand services through conditional access based on delayed requests. With baselined requirements, two concurrent VDH locations can process and condition source feeds identically, thereby increasing uptime with load-balanced processes that reduce the exposure to risk across the network design. Additionally, there are fewer logistics hurdles, and maintenance downtime is minimized during upgrades, modifications, and insertion of new components during modernization and maintenance cycles. **Figure 1** depicts a high-level embedded architecture.

**Figure 1.** **Embedded Architecture**




Germane to this internal VDH structure are the routing and switching platforms that form the basic foundation of the architecture. These platforms will perform at a high rate, providing quality connections, and are enabled to meet numerous and scalable bandwidth requirements from the service provider's transport. This internal structuring should not overshadow "outbound" requirements, toward the customer's Local Area Networks (LANs), where the end users require networks capable of consuming the deliverable content to address the warfighters' missions.

As the various video feeds enter (inbound) the VDH architecture, routing and switching platforms (e.g., a Cisco Aggregation Services Router [ASR] or Cisco Nexus Switch) need to identify, tag, and direct the source packets to the correct components for processing and conditioning. Computing components are essential to forming the data center portion of the design (e.g., Cisco Unified Computing System [Cisco UCS] B- and C-Series servers). With the ability to support a cloud-computing model, virtualized applications (e.g., content management, advanced encoding, and content streaming) can process video feeds in accordance with pre-established conditions (e.g., metadata tags and transrating) and into requested multi-format output streams (e.g., Moving Picture Experts Group-2 [MPEG-2], H.264, High-Definition TV [HDTV], etc). These processes serve as the "engine" of the VDH that prepares and packages content for delivery.

This VDH architecture would use Source-Specific Multicast (SSM) to transport video data from the source to the end user. It provides a transparent multicast network that is implemented and shared in both the black transport and red network of the VDH. The cryptographic device acts as a proxy for the multicast messages between the black and red networks using the Internet Group Management Protocol (IGMP) bypass feature in these devices. In addition, SSM is easily deployable, especially in a redundant manner, and no additional engineering is necessary, as compared to the any-source multicast method. However, SSM requires IGMP Version 3, and as of this writing, the middleware applications that the COI is considering do not meet this capability. This limitation requires an effort in order to overcome it in an SSM implementation. Architecturally, the VDH divides the multicast domain and the troubleshooting boundaries. The added benefit is the ability to manage smaller multicast domains to identify problems where shared resources could quickly “team” to overcome difficulties.

It is deemed highly unlikely that all users will have the same encapsulation and format requirements, with some sites requiring multiple and different rate feeds of the same content. As a result, aggregating capabilities to shape content for correct multicast delivery and transport is necessary in order to meet requirements. Video content, when prepared and conditioned, has to be streamed across the network in order to be used — and because it is presumed that user clients will have dissimilar viewing capabilities, multivendor streaming services (for example, Optibase, EchoStorm, Apple, Adobe, Microsoft, etc.) must be considered and acted upon.

Furthermore, not all user requirements need “live” broadcast-quality (MPEG-2) video content. Provisions must therefore be made for storage so virtualized software (“middleware”) applications (e.g., computing services) can prepare, render, and schedule content for “delayed” and “on-demand” customer requests. This discussion leads to the actual configuration and size of the VDH storage needs. The storage size and composition is directly correlated to the quantity and dimensions of daily video content that is processed, multiplied by the number of days required to have the content available for archived (e.g., historical) records and delayed or ”on-demand” requests.

Finally, the term “tiered” was used to explain the concept of the VDH architecture solution with the ability to maximize efficiencies by allowing flexibility in the design. In order to further provide additional video provisioning and conditioning in a specific focused manner for exacting requirements, every centralized architecture should have design allowances to accomplish smaller, remote, tactical, yet distributed constructs based on locations with “surgical” requirements (for example, closer “down range”). Typically, these additions tend to be unforeseen, spontaneous, and impromptu endeavors (e.g., contingencies or exercises). These modular configurations are due to strict consumption requirements such as mission-relevant feed-control access (e.g., classification policies), specialized processes and dissemination procedures (for example, metadata conditioning or analytical processing), or technology inclusions unique to “the last mile” to accommodate local-site mission and technical requirements (e.g., direct “live” engagements). With the ability to construct add-on capabilities in a “tiered” approach that are based on unique tasks that are tailored to “down range” specific customers (i.e., United States Special Operations Command [USSOCOM]), the capability to proactively provide more timely, controlled, and mission-specific data is dramatically increased.

In summary, to meet the growing demands for access to FMV content across the DoD COI, a standards-based approach, reducing complexity and improving interoperability and accessibility, should be implemented. To accomplish this, cross-boundary coordination will be required by the individual mission/platform communities to refine requirements and establish the foundation of a standardized FMV architecture.

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