

SCALABLE AND INTELLIGENT CONTENT DELIVERY FOR FIXED AND MOBILE NETWORKS

Juniper Networks Media Flow Solution

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Executive Summary

Service providers are striving to deliver the already massive and rapidly growing volumes of online video with efficiency and quality. In addition to these efforts, providers are seeking ways to control both OpEx and CapEx while creating new revenue opportunities.

Recognizing these needs, Juniper Networks has partnered with Ankeena Networks, a Juniper Networks® Junos® operating system application development partner, to integrate Ankeena's advanced software with a variety of high-performance Juniper platforms. The end goal is to create an open and flexible media infrastructure that supports the efficient delivery of video and Web content services at lower cost and with a high quality end user experience.

Introduction

The market has experienced exponential growth in online video traffic over the past few years, often doubling every six months.¹ Subscriber wireline and wireless networks cannot be built fast enough to accommodate the insatiable demand for content from any and all sources. End users, news organizations, and social networks, among many others, generate immeasurable content daily. Users need to view the vast wealth of media rich content anywhere, anytime, and on any IP-enabled device, and their expectation is to have a TV-like viewing experience. Moreover, consumption patterns are unpredictable.

The market for IP video caching, in particular, is growing due to the growth of Internet content, as well as viewers' demand for personalization and flexibility. There is also an emerging trend to deliver content simultaneously to a large audience across three screens (PCs, TVs, and mobile devices). The technical implication of this volume growth and content diversity is that networks must efficiently handle multiple data formats, protocols, streaming bit rates, and device types. They must also adapt to the change in traffic patterns, especially across three screens, without reprovisioning. The potential business impact is that continuous network investments can easily outstrip revenues.

Current Deployments

The challenges described above pose unique problems that are not solvable in traditional networks because they do not adequately address issues of latency, scalability, and flexibility.

Latency—General-purpose file system storage devices lack content awareness and are inefficient for handling rich content. For example, disk I/O throughput times and the inherent indirection and file fragmentation encountered with regular file systems increase latency.

Session scaling—General-purpose OS schedulers/kernels are not optimized for handling large numbers of concurrent sessions and meeting bandwidth demands.

Flexibility—General-purpose caching systems lack multiprotocol and multimedia support.

Furthermore, the current content delivery model is quickly becoming obsolete. Many providers run multiple networks, with each network delivering content to the same customers on different end devices. For example, providers might have an unmanaged network that is delivering over-the-top (OTT) traffic to customers with best-effort delivery. They might also peer with content delivery network (CDN) providers to distribute their content globally.

This multi-network content delivery model is expensive and difficult to scale as traffic demands continue to increase. Consequently, service providers are looking for new ways to distribute the content to multiple devices at scale and with reduced costs.

¹ Source: IDC

The Juniper Networks Solution

The Juniper Networks Media Flow Solution collapses Internet streaming video and other rich media content onto a converged, managed, and efficient architecture. The solution combines media intelligence, storage organization, multitier caching, and network optimization with high-performance storage systems. The result is lower latency, reduced bandwidth consumption, and massive scaling, which in combination offer superior viewing quality of online media and lower operational costs.

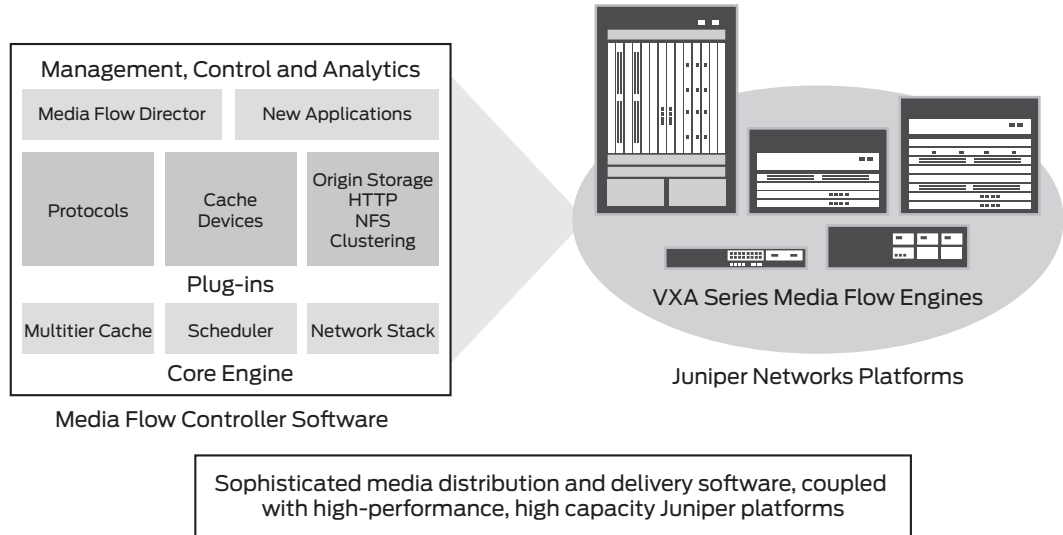


Figure 1: The Juniper Networks Media Flow Solution

The initial phase of the Media Flow Solution consists of Juniper Networks Media Flow Controller, Media Flow Manager, and the Media Flow Engine (Figure 1).

- The Media Flow Controller is Junos-Ready software developed in partnership with Ankeena Networks (and based on their Media Flow Director software). Ankeena Networks is leveraging the Junos OS software development kit (SDK), a comprehensive toolkit that enables application developers to innovate on top of Junos OS and Juniper platforms.
- The Media Flow Manager is an advanced management system that manages the distribution of content across multiple Media Flow Controller instances that may be deployed throughout the service provider network (at the origin, mid tier, and edge, for example).
- The VXA Series Media Flow Engine is a portfolio of purpose-built cache appliances that are powered by Quad-Core Intel processors and host the Media Flow Controller software. The Media Flow Engine can be configured with up to 8 TB of 3-tiered cache with RAM, SSD, and SAS storage options.

The combination of the Media Flow Controller and Media Flow Engine offers a high-performance, scalable, and cost-effective solution for dynamic hierarchical caching. The solution supports a wide variety of small and large objects, and dynamically adapts itself to deliver the most optimum network throughput. The Media Flow Solution provides a very high number of transactions per second (up to 40,000) for small objects, while for large objects; the appliance provides network throughput options that scale through 10 Gbps. This combination of high-performance, reliable, and scalable platforms with advanced content and storage-aware software is optimized for the efficient distribution and delivery of media rich online content. The Media Flow Solution is designed for service providers of all types, and offers support for applications and business models such as Internet CDN (iCDN).

Media Rich Content Flow

Initially, the Media Flow Solution will distribute and deliver media rich content from the provider to the subscriber in these simple steps (Figure 2).

1. The subscriber sends a request for a media file to a URL.
2. Domain Name System (DNS) redirects the request to the VXA Series Media Flow Engine hosting the Media Flow Controller.
3. The Media Flow Controller requests the media content from the Web site.
4. The Media Flow Controller retrieves the media content from the Web site.
5. The Media Flow Controller serves the file to the subscriber at a suitable bit rate.
6. The Media Flow Controller places the media file in native storage on the VXA Series Media Flow Engine.

Future requests for the same content are served from the VXA Series Media Flow Engine.

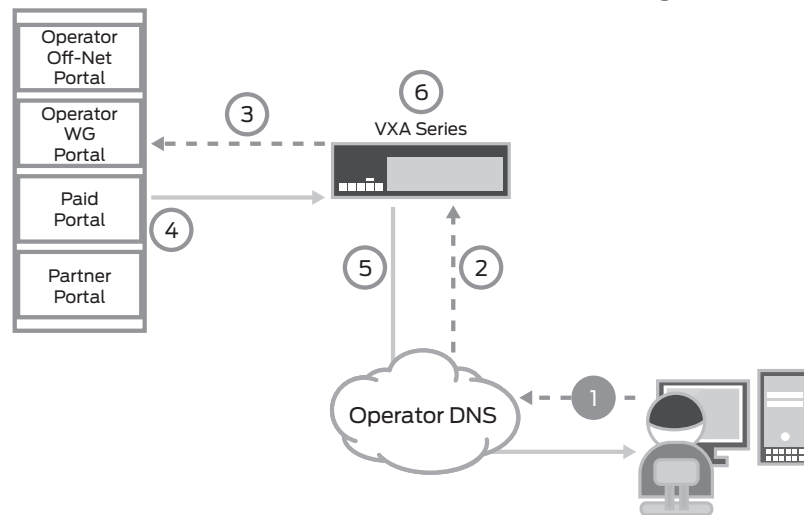


Figure 2: Media Flow Solution service flow

Media Flow Solution Deployment Models

Internet CDN (iCDN)

Caching is a fundamental building block of all CDNs, allowing content to be located closer to subscribers or viewers. An ideal use case for the Media Flow Solution is Internet CDN. The iCDN model supports content that is sourced from the Internet and is applicable to both fixed line and mobile networks. In this model, the service provider caches popular, media rich, Internet content close to the subscriber, and can also offer tiered services to subscribers that ensure a higher quality of Internet video experience. The VXA Series Media Flow Engine can be flexibly deployed in various parts of the network to store frequently requested content.

The Media Flow Solution provides key benefits to subscribers and network providers. From a subscriber perspective, deploying the solution at the network edge reduces latency and improves overall response times and stream quality. The subscriber further benefits from the advanced streaming support with assured QoS offered by the Media Flow Solution.

From a network provider perspective, the Media Flow Solution reduces backhaul bandwidth and transit costs. Content pulled once can be served to numerous subscribers from the network edge. In addition, content may be pulled on demand from the origin as needed versus pushed, thus reducing the amount of required storage space and the amount of backhaul traffic.

Mobile Traffic Optimization with iCDN

A key challenge that mobile operators are facing is handling the explosion of network traffic that is generated from 3G data cards. It is estimated that 70% or more of traffic is currently generated from data cards and this trend is expected to continue with the introduction of Evolved High Speed Packet Access (HSPA+) and Long Term Evolution (LTE) technologies. Currently, all of this traffic from data cards goes through the mobile service complex which includes services designed for slower 2.5G data traffic and not for the higher data speeds that 3G provides. Thus, mobile operators are already challenged with congestion in the service complex, as this architecture is complex and expensive to scale. If the projections for future traffic growth are even close, this will be a growing area of concern and a major challenge for mobile operators globally.

Mobile operators can solve this challenge by using the VXA Series Media Flow Engine at the edge of the mobile service complex (Figure 3) to offload 3G data traffic, thus keeping it from entering the mobile service complex and dramatically reducing or eliminating congestion due to 3G data. The VXA Series caches “hot” mobile content and serves this content closer to the subscriber, preventing traffic from entering the service complex and also improving the subscriber experience. The adaptive streaming support for a variety of smart phones and delivery using HTTP, Real-Time Streaming Protocol (RTSP), and Real-Time Messaging Protocol (RTMP) adds enhanced flexibility.

In addition, by combining the Media Flow Solution with the Juniper Networks Traffic Direct Solution, content ingestion into the VXA Series can also bypass the service complex by ingesting content directly from the Internet source, bypassing the service complex altogether. Also, stream quality to users may be adapted to optimize spectrum utilization allowing consistent delivery even during oversubscription events. For example, 20% oversubscription will cause edge cache to serve a low bit rate file to all users without causing jitter or buffering.

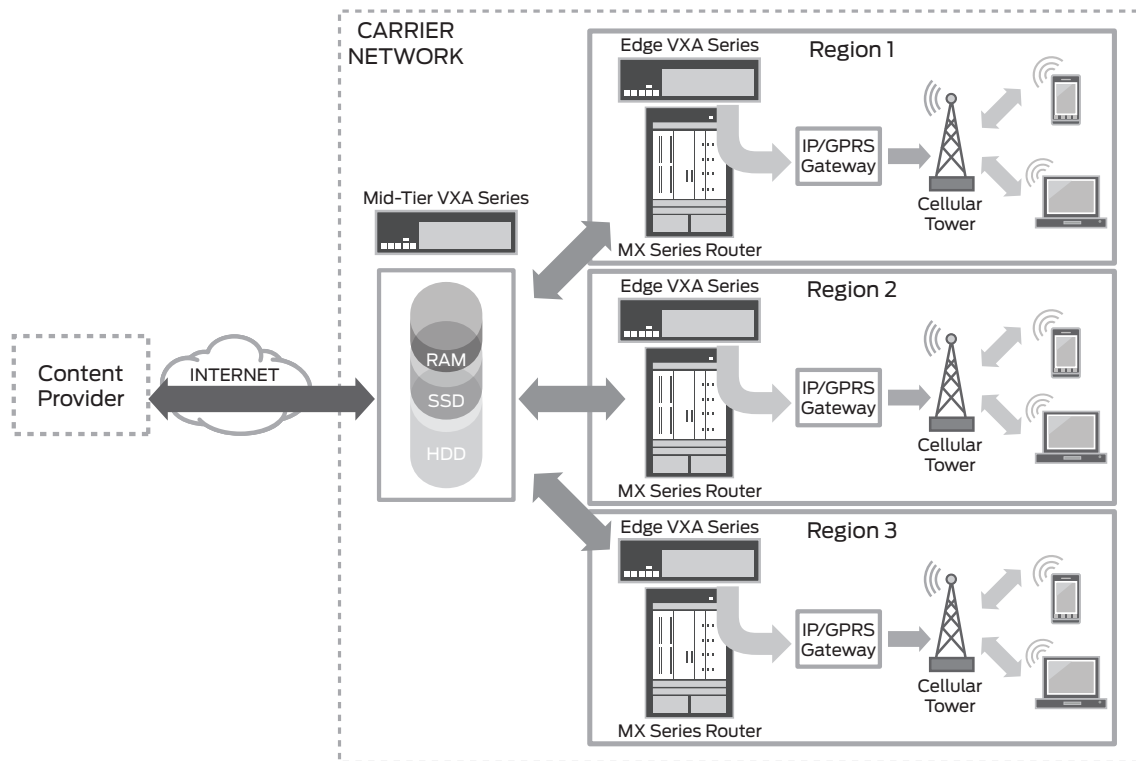


Figure 3: The Media Flow Solution in a mobile provider infrastructure

VXA Series Media Flow Engine Network Placement Options

The placement of Media Flow Solution components depends on network size and topology, as well as on the end goals desired (Figure 4).

Edge—Deployments where content is placed close to subscribers. This placement minimizes online transit traffic across the backbone, expediting content delivery to end users and improving their quality of experience.

Mid-tier—Deployments where the caching server is placed near high traffic exchange points. This placement offloads session termination (nontransparent) traffic from the origin server and increases bandwidth.

Origin—Deployments where content and cache are colocated to maximize efficiency of video distribution in the backbone. By caching at the origin, repeat requests need only hit the locally cached content and thus, do not need to reach the origin server. As such, content delivery is greatly accelerated, as is the ability to scale the performance of network storage file servers and Web servers. With this server consolidation, CapEx is also reduced.

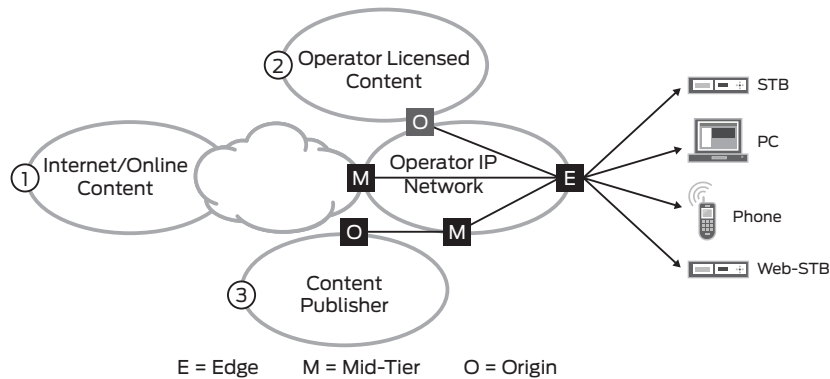


Figure 4: VXA Series Media Flow Engine network placement options

The Juniper Networks Advantage

Media infrastructure and delivery technologies play a major role in defining the quality of experience for consumers of online video, and they also contribute greatly to the incurred OpEx and CapEx in delivering these services. Juniper Media Flow Solution delivers online video with a TV-like experience to expedite content delivery and improve the bottom line.

Advantages and benefits of the Media Flow Solution:

- No change to the network architecture or design
- No change to the router operation or end user configuration
- Protects resources and contains costs
- Reduces traffic across the network
- Improves responsiveness and flexibility
- Ensures quality of experience
- Supports differentiated services and business models
- Increases revenue potential for online media (in-net and off-net)

Multitier Caching

The Juniper solution minimizes latency by using a cache hierarchy for content storage where the placement of objects is based on dynamic load characteristics. Detailed analytics and statistics are used to automatically place objects within the tier's storage media based on popularity. The Media Flow Controller's storage intelligence addresses variable workloads of traffic, ensuring fast response times for end users and providing optimized caching and delivery of objects of different sizes.

Quality of Experience

Two Ankeena Networks technologies, SmoothFlow™ and AssuredFlow™, are key features of the Media Flow Controller and dramatically improve the end users' quality of experience.

SmoothFlow, based on adaptive streaming, provides a smooth viewing experience by dynamically detecting the available bandwidth and seamlessly varying the bit rate of the media being delivered. It allows viewers to enjoy media continuously without any buffering interruption.

AssuredFlow guarantees bit rates to clients based on their needs or service level agreements (SLAs) by ensuring sufficient output bandwidth for clients who need higher bit-rate media. This functionality can enable delivery of tiered services for additional revenue.

Scalability

General-purpose Web servers and caching proxies do not scale well for media workloads. One key issue is that they rely on the underlying OS scheduler for processing, as well as on network and disk I/O. For time sensitive media workloads, this implementation works only if the systems are significantly underutilized. As the system scales to more sessions and aggregate bandwidth, the bandwidth required by each session can no longer be assured. Furthermore, the OS scheduling primitives (threads and processes) add significant switching overhead, resulting in inadequate CPU scaling.

By way of contrast, the Media Flow Solution is optimized for scale. The Media Flow Controller is built on a highly scalable asynchronous task model that allows it to handle a large number of connections with low CPU overhead. This optimized protocol stack incorporates scaling (bandwidth and sessions), along with rate management and capacity-based admission control.

- The Media Flow Controller utilizes a unique rate-based model to dispatch tasks, which allows it to manage delivery rates specific to each connection as an inherent feature of the platform.

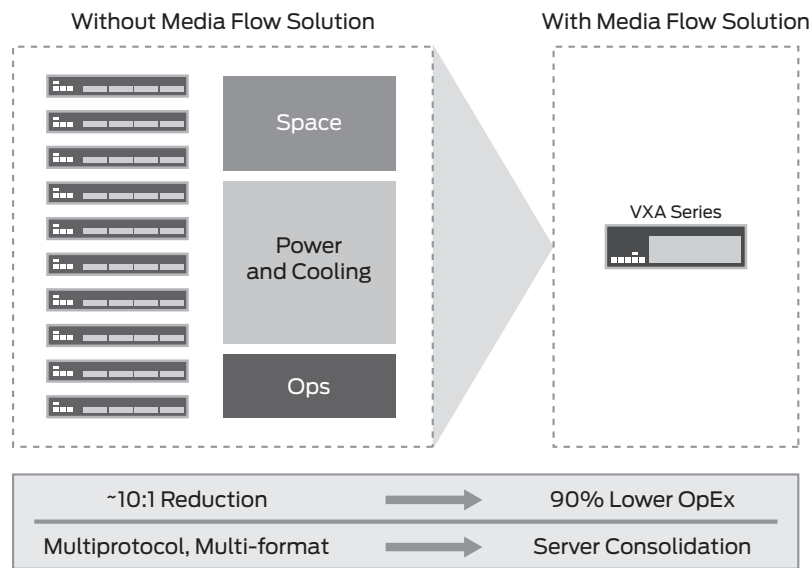


Figure 5: Reducing Costs Via Equipment Consolidation

- Managing interrupt timers and per-connection rates require sophisticated algorithms. The Media Flow Controller protocol stack interfaces with other Media Flow Controller components to ensure that the required rate for each connection is met. Based on the required rate of existing sessions, it also enforces session admission control to ensure that there is no over-commitment
- The Media Flow Controller protocol stack provides a highly scalable interface to the origin storage device (for example, using HTTP). Connections to origin servers are managed asynchronously with minimal resource consumption. Failures or slowdown of origin connections do not impact delivery from the local caches.
- The Media Flow Controller scalable solution offers up to 10x reduction in media delivery infrastructure costs related to hardware, rack space, power, and cooling. The Media Flow Controller, hosted on the purpose-built VXA Series Media Flow Engine, can deliver up to 1,000 percent improvement in media delivery throughput from a single general-purpose x86 server that supports one gigabit per second of media flows.

Multimedia, Multiprotocol Support

Flexible support for multiple formats and protocols obviates the need for provisioning servers per media type. Media Flow Controller delivers streaming content to any device via HTTP. It also supports Microsoft Silverlight and Adobe Flash. For communication with the origin server, HTTP, Network File System (NFS), and FTP (push) are supported.

The multiprotocol and multimedia capabilities, coupled with the high-performance Media Flow Engine, allow for server consolidation that results in reduced administrative costs when implementing and managing a purpose-built, content rich delivery appliance versus custom open source solutions, and it can drive up to a 10:1 reduction in OpEx.

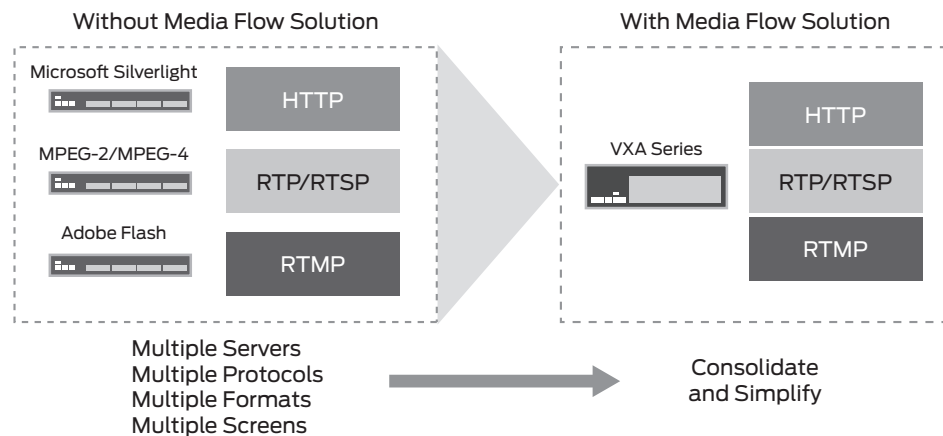


Figure 6: Reducing Costs Via Protocol Consolidation

Conclusion

Juniper Networks Media Flow Solution, which consists of Media Flow Controller, Media Flow Manager, and the VXA Series Media Flow Engine, converges support for traditional entertainment mediums with Internet-based delivery mechanisms, and it enables a broad set of content delivery business models. This optimal online video solution helps protect resources, contain costs, and monetize online media traffic.

The key features of this solution—efficiently caching objects of all sizes, multiprotocol delivery (HTTP, RTSP, RTMP), and multiple format support packaged in a highly scalable form factor—make Media Flow Solution ideal for supporting three screens media delivery in fixed and mobile networks.

This effort further validates Juniper's commitment to innovative new services and technologies that promote greater efficiency, reliability, performance, and scale, as well as heightened user experience at a reduced cost.

About Juniper Networks

Juniper Networks, Inc. is the leader in high-performance networking. Juniper offers a high-performance network infrastructure that creates a responsive and trusted environment for accelerating the deployment of services and applications over a single network. This fuels high-performance businesses. Additional information can be found at www.juniper.net.

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