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Multi-Screen IPTV: Enabling Technologies and Challenges

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***Abstract* — This paper presents several considerations of multi-screen services in the context of over the top delivery. Enabling technologies and challenges on digital rights management (DRM), entitlement management, content and workflow management system, video transcoding/streaming architecture, authentication, authorization, and accounting, as well as content delivery network are discussed.**

Index Terms — Multi-screen, IPTV, Content Management System, Video Transcoding, Video Streaming, DRM.

I. INTRODUCTION

These years, advanced digital media compression technologies, high throughput wireless data link, and device innovations have made media experience on many Internet-connected consumer electronic devices more and more enjoyable. There are already numerous Over-the-Top (OTT) video services emerging in the market offering live TV, on-demand video and user generated content over users' broadband Internet connections. It is a common belief that OTT video service has been poised to be the next major application on the Internet.

IPTV operators' "walled garden" digital TV systems have delivered HD/SD video experience to consumers via STBs. The recent innovation of multi-screen service presents an OTT extension of the "walled garden" IPTV infrastructure. It allows subscribers to consume content anytime, anywhere and on any devices. Multi-screen service has brought several opportunities to operators. It maintains customer loyalty, and provides platforms for them to generate revenue through advertising, VoD rental, and other value-added and interactive wireless/wireline services. As a complementary service to IPTV operators' high-quality walled-garden service, it helps operators to reach new subscriber groups, and grow ARPU by offering more values to subscribers.

However implementing a compelling multi-screen experience is not easy. IPTV operators are facing several challenges. Consumers want a high-quality, consistent video experience across STB/TV, PC, and mobile devices. This requires a unified backend support with centralized content management, authentication, single sign-on, billing and entitlement management. On the other hand, IPTV operators have already built services around each device platform. How they could smartly leverage these existing infrastructures, integrating them to offer a consistent and compelling OTT experience while increasing ARPU and reaching new subscriber groups is a critical challenge.

II. SYSTEM ARCHITECTURE

Fig.1 shows the mutli-screen service components in different domains. Service provider and network provider serve as the bridge between content provider and consumer devices to allow users to consume any content choice (audio, video, documents, images in the form of linear broadcast, on-demand, Internet-sourced content, or UGC with various resolutions UltraHD, HD, SD, PD, 3D) any time on any device, and access from many network types (managed QoS-assured network, best-effort Internet, fixed or wireless network). Next generation targeted advertising solutions, on the other hand, direct advertisement content to finely classified groups of consumers based on their interests, demographics, geographic regions, and other observable behaviors.

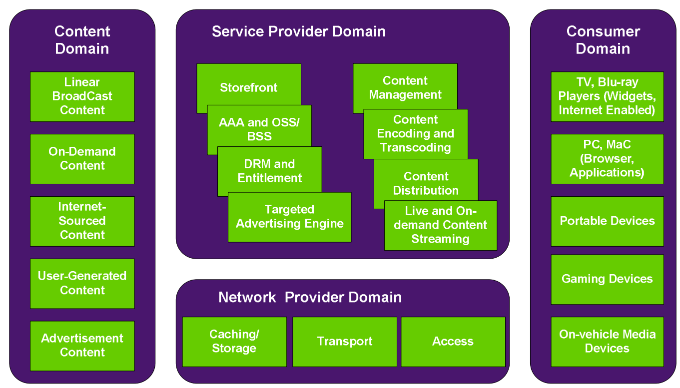

Fig.1 Multi-screen Service Enabling Components

III. ENABLING TECHNOLOGIES AND CHALLENGES

A. Content and Workflow Management System

Several central challenges of multi-screen service for operators include the ability to publish one asset across multiple viewing platforms (large screen TV, smart phone, tablets, netbooks, laptops, and desktop PC), support of flexible business models (ad-supported model, pay-per-view, download to own, download to rent) and the support of various packing and bundling plans. Traditionally, operators use several local asset management systems (AMS) to manage different types of content, while lacking of consistent workflow across systems. This is not enough in the multi-screen case; just imaging the same piece of content might need to be prepared for tens of devices with different screen sizes, resolutions, DRMs, and streaming protocol requirements. To address these challenges, it is important to have a backend management system to unify asset ingestion, content and entitlement management and workflow process across all supported platforms. The automated workflow system coordinates the whole life-cycle of the content across multiple screens, from content submission, ingestion, metadata association, content transcoding, encryption, commercial packaging to subscriber consumption.

B. Entitlement Management and DRM

Triple shift IPTV service defined by MultiService Forum [1] allows subscribers to stop watching linear TV program and VoD on one device, and resuming the viewing on the other device from the position it was stopped. For DRM-protected content, this type of application needs an interoperable cross-platform and multi-format DRM to support a wide array of devices and business models. However, historically various devices have developed their own DRM systems in the last ten years. An entitlement management is required to be in place to transfer content license or even transcryption content to the target device platform. To facilitate cross-platform DRM, several SDOs have taken efforts to develop interoperable DRM. Digital Media Project (DMP) is developing an Interoperable DRM Platform (IDP) specification to make DRM functions as plug-in tool on client devices. ATIS IIF published DRM service-side application programming interfaces in [2]. MPEG addressed this issue by defining an XML-based interoperable and flexible Rights Expression Language (REL) standard in MPEG-21 Part 5 [3].

C. Video Encoding/Transcoding and Streaming

Highly-efficient video encoding algorithm can ensure the optimum video quality under a limited transmission conditions. MPEG4 AVC is becoming a dominant encoding format after MPEG2. Next generation encoding technologies H.265 and high-performance video coding (HVC) are expected to improve compression efficiency by 50% over current technologies. Emerging 3D video also poses new challenges for encoding, transcoding, and transport [4].

Video is required to convert from one format to a different format on a target device platform with specified quality level and/or container format. This requires complex stream management and transcoding capabilities. These years have seen a couple of advanced approaches to offer various bit-rates and resolutions in one video stream, thus reducing transcoding stages and simplifying stream management cost. The scalable video coding (SVC) [5] encodes a base layer of video and the difference between other layers of video with higher quality. Wavelet video compression recently gains lots of tractions as well because multi-resolution properties of Wavelet transform have made it a strong candidate solution to provide high degree of scalability in quality, picture size and frame rate [6].

The encoded/transcoded video is packed and delivered to Internet by using a transport protocol. In recent years, adaptive streaming is used instead of traditional streaming and progressive download models. This technology allows devices to pick the best video quality based on available bandwidth. Video stream is divided into small chunks at various bit rates. These chunks are indexed and organized in the streaming server. If bandwidth drops, the stream transitions seamlessly to a lower bit rate. When bandwidth resumes and goes up the stream automatically uses a higher bit rate. Hybrid streaming and progressive architecture is also suggested in the case where users want to view high-quality video on WiFi or DSL link in a download to view mode, while in the cellular network, prefer a streaming mode to reduce network traffic.

D. Content Delivery

Multi-screen service could run over best-effort Internet. To improve viewing experience, operators could either build their own video edge/caching infrastructure based on service regions, or they could outsource the infrastructure to commercial CDN providers to leverage global PoPs and intelligent redirection and duplication algorithms.

E. Authentication, Authorization, and Accounting

RFC DIAMETER has been adopted by IMS (IP Multimedia Subsystem) for Authentication, Authorization, and Accounting (AAA), and could be used for IMS-based multi-screen service to enable unified AAA interface for services on all screens. Online charging system (OCS) provides real-time billing and credit control capabilities.

IV. CONCLUSION

Flexible and efficient content, workflow and entitlement management system, media encoding, transcoding, streaming and delivery, as well as AAA all play important roles in the successful deployment of a multi-screen service. IPTV architecture continues to evolve from its current non-NGN model, to NGN non-IMS based IPTV, and eventually to a model with full NGN IMS support [7]. IMS-based IPTV establish session, register and authorize users by sharing core IMS control functionalities. This will definitely facilitate the implementation of multi-screen services in a more efficient approach.

REFERENCES

[1] K. Ishikawa, K. Taniguchi, V. Sahin, "MSF whitepaper on time-shift, place-shift, and device-shift (triple shfit) IPTV services," MultiService Forum, Oct. 2009.

[2] *DRM Server-Side Application Programming Interfaces Interoperability Specification*, ATIS Standard ATIS-0800039, Mar. 2010.

[3] *Information technology-Multimedia framework (MPEG-21) Part 5: Rights Expression Language*, ISO/IEC 21000-5, 2004.

[4] G. B. Akar, A. M. Tekalp, C. Fehn, M. R. Civanlar, "Transport methods in 3DTV – a survey," *IEEE Trans. Circuits Syst. Video Technol.*, vol. 17, no. 11, pp.1622-1630, Nov. 2007.

[5] J. Ohm, "Advances in scalable video coding," *Proc. IEEE*, vol. 93, no. 1, pp.42-56, Jan. 2005.

[6] N. Adami, A. Signoroni, and R. Leonardi, "State-of-the-art and trends in scalable video compression with wavelet-based approaches," *IEEE Trans. Circuits Syst. Video Technol.*, vol. 17, no. 9, pp.1238-1255, Sep. 2007.

[7] E. Mikoczy, D. Sivchenko, B. Xu and J. I. Moreno, "IPTV services over IMS: architecture and standardization," *IEEE Commun. Mag.*, vol. 46, no. 5, pp. 128-135, May 2008.