Robust and Scalable P2P Streaming for Future Media Internet

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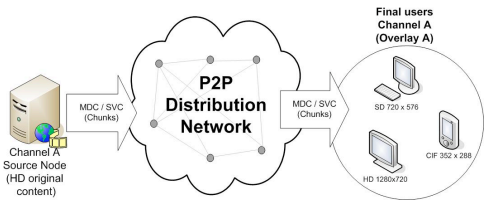
Introduction

The impact of Peer-to-Peer (P2P) traffic is growing fast and supposes the major part of current Internet traffic. Moreover, today video streaming represents the most bandwidth-hungry application and this tendency is envisaged to grow fast, even more with P2P streaming applications.

Future Media Internet will require to share and distribute high quality multimedia contents in a flexible, efficient, and personalized way through dynamic and heterogeneous environments. One approach for fulfilling this, is by means of taking advantage of P2P distribution techniques and the use of source coding techniques such as Multiple Description Coding and Scalable Video Coding.

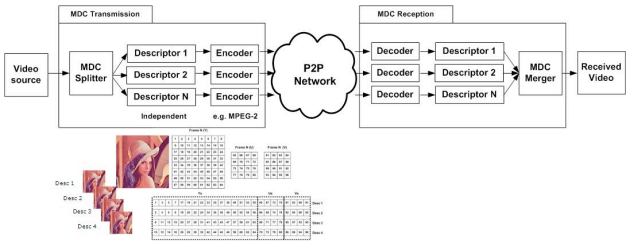


Multiple Description Coding (MDC)

MDC encodes a media resource into N different sub-bitstreams (N≥2), called "descriptors". Descriptors are all independently decodable and are meant to be sent through different network paths in order to reach a destination.

Receivers can play the split media when any descriptor is received. The quality is proportional to the number of descriptors received.

MDC provides error-resilience to media streams. Since an arbitrary subset of descriptors can be used to decode the original stream, network congestion or packet loss, which are common in best-effort networks (such as the Internet), will not affect the continuity of the stream but will only cause a (temporary) loss of quality.

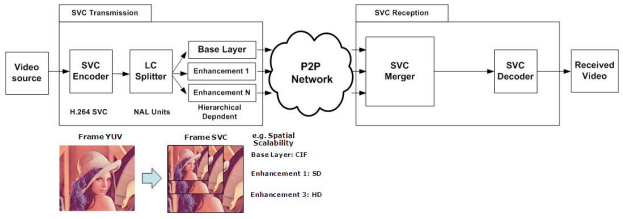


Scalable Video Coding (SVC)

SVC adapts the video information to the network constrains by splitting the images into different hierarchical and dependent layers (similar to MDC descriptors).

These layers represent the quality of the image, hence, from the base layer, each successive layer improves the image quality, getting the full picture quality with the total amount of layers used. SVC is an extension of the H.264/MPEG-4 AVC video compression standard.

It must be noticed that the main difference between MDC and SVC is that MDC creates independent descriptors (can be balanced or unbalanced) whereas SVC creates hierarchical dependent layers (unbalanced).



Future Media Internet Trends and Challenges and Source Coding

Future Media Internet is envisaged to provide efficient mechanisms to share and distribute rich multimedia contents with high quality anywhere, anytime, and using any terminal connected through different access networks. It is required to create new transport protocols, new multimedia encodings, "cross layer" interaction, efficient intercommunication among machines, creation, and distribution of rich contents (such as new 3D contents), community & cooperative networks, and to take advantage of P2P mechanisms. Research on these areas will allow to develop and deploy novel applications covering Future Internet requirements while improving the Quality of Experience (QoE) of users.

MDC and SVC are a good approach in order to cover some of them. They can work together if necessary.

Requirement	MDC	SVC
Content adaptation	Yes	Yes
Robustness against loss effect	Yes	No
Scalability	Yes	Yes
Flexibility	Yes	No (Codec dependent: H.264)
Real-time communication (live / pre-recorded)	Yes / Yes	Yes / No

By applying MDC techniques in a P2P Live streaming application called CoolRuc (i2CAT Foundation), we enhance the robustness of high quality (SD and HD contents) media distribution by improving the continuity index and the received objective quality under the effects of high packet loss in comparison with sending a single descriptor.

Conclusions

MDC/SVC allow to provide robustness and scalability to media streaming. They can enrich P2P streaming applications as validated with CoolRuc integraton. These techniques and P2P are expected to fulfill some Future Media Internet challenges. They suppose a good approach to enable personalized applications and services, operating under high heterogeneous and dynamic environments while maximizing the QoE. Finally, we encourage Future Internet initiatives to take these techniques into consideration when designing new protocols and architectures as possible enablers of innovative services and applications.

Future Work

Usage of MDC to reduce the start-up delay in P2P streaming applications.

Application of incentive mechanisms in order to improve the performance under the effects of churn and the presence of free-riders.

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