HEVC based Distributed Scalable Video Coding for Surveillance Visual System

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Abstract— **Surveillance visual systems play an important role in modern life, especially in the Internet of Things (IoTs) era. However, the limitation of bandwidth, energy resources and the heterogeneity of devices, networks and environments have been asking for a more powerful video coding solution, which provides not only the high compression efficiency but also the flexible scalability capability. In this context, we propose a novel scalable video coding solution, particularly designed for surveillance video content, which typically contains low motion and static scenes, thus having high temporal redundancy. In the proposed video coding framework, the conventional video coding standard, i.e., High Efficiency Video Coding (HEVC) is wisely combined with the emerging distributed coding paradigm and following a layered coding approach to exploit the high temporal correlation between frames in surveillance video content. As assessed, the proposed surveillance distributed scalable video coding solution significantly outperforms the relevant coding benchmarks, notably with around 36,8% bitrate saving in average when compared to the HEVC simulcasting benchmark.**

Keywords—*surveillance visual systems, scalable video coding (SVC), distributed video coding (DVC), compression efficiency.*

I. INTRODUCTION

The past few years have seen the rise of video surveillance and its widespread adoption throughout the world. This adoption has been driven by a transition from analog to digital systems. It is more and more important to efficiently compress the long hours of video to facilitate transmission and storage. Real-world video surveillance applications require storing videos without neglecting any part of scenarios for weeks or months. Moreover, the heterogeneity of devices, networks and environments is also gaining a request for better video coding solutions, which provide not only the high compression efficiency but also the flexible scalability features.

Currently, several standard video coding solutions can partly satisfy the mentioned requirements, i.e., the Scalable Video Coding (SVC) standard [1], an extension of the well-known H.264/Advanced Video Coding (AVC) standard [2] and the recent HEVC scalable extension, named Scalable High Efficiency Video Coding (SHVC) standard [3], released in 2014. As reported, SHVC has significantly outperformed the prior SVC standard. The last ones, which also provides several options for decoding the bitstream is the HEVC-simulcasting solution. In this solution, the HEVC [4] is employed to compress the video data in several layers and the compression process is independently between layers. Despite of its simplification, the HEVC-simulcasting is still less attractive for a wide adoption due to its low compression efficiency.

Distributed video coding (DVC) is another coding approach, targeting the low complexity requirement at the encoder and the robustness to error propagation at the decoder [5]. DVC was developed from two well-known information theorems, Slepian-Wolf [6] and Wyner-Ziv [7]. DVC has gained many attentions in recent decades with a large number of contributions, notably on both practical coding architecture and improving coding tools [8-9]. In DVC, the temporal correlation is mainly exploited at the decoder side, in a so-called side information creation [10] while the encoder side is designed in a very light way. Hence, this coding solution is very attractive to emerging video coding applications, e.g., visual sensor networks, surveillance systems and remote sensing. Recent researches have also shown that DVC is generally suitable for video with low and static motion contents [5].

It is also observed that the surveillance video data typically contains the low motion and static scenes characteristics. Therefore, DVC should be a promising solution for compressing surveillance video content. In this context, we introduce an efficient scalable video coding solution, specially designed for surveillance video data, inspired from the strengths of both traditional predictive and distributed coding approaches. The proposed surveillance scalable coding scheme is developed based on a combination of the HEVC [4] and DVC [5], providing the quality and temporal scalability features. As assessed, the proposed surveillance scalable video coding solution significantly outperforms the relevant coding benchmarks, e.g., HEVC-simulcast and SHVC-intra.

The rest of the paper is organized as follows. Section II reviews background work on surveillance visual systems. Afterwards, Section III describes the proposed surveillance scalable video coding framework (labeled as S-DSVC). Section IV analyses the S-DSVC performance in comparison with the HEVC-simulcast and SHVC-intra for surveillance video sequences. Finally, Section V presents the main conclusions and ideas for future work.

II. BACKGROUND WORKS ON SURVEILLANCE VISUAL SYSTEM

To have an overall look on a surveillance visual system, this section starts with a brief description of the general surveil-