Advanced Media-based Smart Big Data on Intelligent Cloud Systems

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***Abstract*— Today's advanced media technology preaches an enthralling time that will enormously bear on daily life. Moreover the rapid raise of wireless communications and networking will ultimately bring advanced media to our lives anytime, anywhere, and on any device. According to National Institute of Standards and Technology (NIST), Cloud Computing (CC) is a scheme for enabling convenient, on-demand network access to a shared pool of configurable computing pores (for example networks, applications, storage, servers and services) which could be promptly foresighted and delivered with minimal management effort or service provider interaction. This paper proposed an efficient algorithm for advanced scalable Media-based Smart Big Data (3D, Ultra HD) on Intelligent Cloud Computing systems. The proposed encoding algorithm outperforms the conventional HEVC standard which demonstrated by the performance evaluations. In order to ratify the proposed approach in addition, a relative study has been carried out. The proposed method could be used and integrated into HEVC, as a Smart Big Data, without violating the standard.**

***Index Terms*—Algorithm, HEVC media, 3D, Ultra HD, Big Data Delivery, Cloud Computing.**

I. Introduction

During the last years, a novel technology became popular as a term with the aim to be used to depict the surprisingly rapid increase in the volume of data in the structured and unstructured form. This new popular term called Big Data (BD). BD technology is a broad term for data sets so wide or intricate that conventional data processing applications are insufficient. Rarely, it also mentions to a specific size of data set. Precision in BD may lead to more certain decision making, and better decisions can result in greater operational productiveness, cost reduction, and cut-rate risk [1]. From this scope, we realize that the BD is now equally important both for business and the internet. This happens instead of more information lead to more accurate analyses [2] [3].

The real issue is not that you have acquired large amounts of data, but whether it has any value or not. Hopefully, by envisaging that the organizations would be able to acquire information from any source, harness the relevant data and analyze it with the aim to get quick answers, we will achieve the following: 1) reduce costs, 2) reduce time, 3) produce new commodities and to optimize their offerings, 4) make more intelligent decisions.

Furthermore, in the last years, there is a standard of High-Efficiency Video Coding, known as HEVC, which is the latest compression standard. This type of video compression standard could be used and transmitted as data sets, which could be defined as Smart Big Data. HEVC was officially approved in January 2013 and became the successor of the H.264/MPEG-4 or AVC standard. The new technology called HEVC also known as H.265 and MPEG-H Part2. Compared to AVC video coding the new technique of video coding, HEVC provides about two times the data compression ratio at the proper level of video quality, or essentially meliorated video quality at the same bit-rate.

Moreover, the HEVC video coding patronizes resolutions up to 8192x4320, including the 8K UHD. The data used by the HEVC could also be characterized as BD due to their large volume [4]. The basic goal of HEVC standard is the circumstance that there is a presentation of considerably better compression performance in contrast with the current existing standards. This could be in the range of 50% bit rate reduction in nearly the same video quality, compared to H.264/MPEG-AVC standard [5]. Thus, the HEVC was design created with the aim to offer high-quality streaming media, even on low-bandwidth networks. Resulting from the fact which it consumes only the half bandwidth compared to AVC [6]. Cooperation between the ISO/IEC MPEG and ITU-T VCEG has the result that the JCT-VC organization developed the HEVC. The ISO/IEC group refers to it as MPEG-H Part 2 and the ITU-T as H.265. In January of 2013, the first version of HEVC was created and published in June 2013. In 2014, the second version was completed and approved and then published in the beginning of 2015. In addition to this, 3D-HEVC expansions for 3D video were completed in the beginning of 2015. As we can observe from Table 1, the new HEVC technology in the sector of video coding saves a large quantity of bit-rate compared to related video coding techniques.

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TABLE I
Average Bit-Rate which saved for the equal PSNR for applications

Encoding	*The Bit-Rate savings relative to*

	H.264/MPEG-4 AVC HP	MPEG-4 ASP	H.263 HLP	MPEG-2/H.262 MP
H.263 HLP	~	~	~	16.4%
MPEG-4 ASP	~	~	5%	19.9%
H.264/MPEG-4 AVC	~	44.6%	46.7%	55.5%
HEVC	35.5%	63.8%	65.2%	70.9%

Multiple goals in the sector of high-quality video coding can be accomplished by the new HEVC design. Some of those are coding efficiency, data loss springiness and ease of transport system assimilation [7]. The main target of HEVC standard is to increase the data condensation by 50% over the prior technology of H.264 while keeping the same image quality at the expenditure of computational cost. With the aim to substantially improve coding efficiency compared to H.264/MPEG-4 AVC HP designed HEVC [8]. HEVC standard provides many conformations modes, depending on the application scenario, for efficiency, computational magazines, processing delay, parallelization and error resilience techniques. Furthermore, an HEVC coded video cohesion is typically separated into small intervals called GOP (Group of Pictures). The innovative idea in which the progressive scan video would be used and no coding tools were added particularly for intertwined video has the result of the design of HEVC [8].

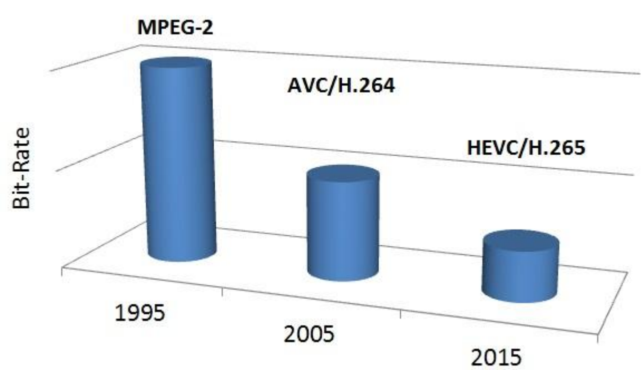

Fig. 1. Compression Gain of HEVC.

Figure 1 demonstrates the gain's compression through the years from MPEG-2 video coding to AVC/H.264 video coding and to the recent HEVC/H.265 video coding. We could observe that from MPEG-2 to AVC/H.264 the bit-rate of saving target was decreased by 50% and also from AVC/H.264 to HEVC/H.265 the bit-rate of saving target was also decreased by 50%.

Also, a new generation of services, based on the concept of the "cloud computing", has made its appearance in the recent years with the purpose of providing access to the information and the data from any place at any time, so restricting or eliminating the need for hardware equipment. The use of computing logistical resources, as well as the software level, through the use of services transported over the internet defines the term of CC. Nowadays, Cloud Computing services constitute one of the world's largest areas of competition between huge companies in the IT precinct and software, such as Google, Amazon and Microsoft, which are striving to take an advantageous position, to this promptly growing industry [9] [10]. Although Cloud is useful for computing and storage [11] [12] [13], the conventional computation offloading techniques cannot be used for the smartphones directly because these techniques are broadly energy-unaware and bandwidth hungry [14] [15].

Also, the strenuous computations and the mass storage, which are supported by clouds, are often inadequate. Such insufficiencies motivate us to blend the technology of CC and the Big Data. As an emerging technology, CC consolidates multiple technologies for maximizing capacity and performance of the existing substructure [16] [17] [18]. Moreover, CC could offer an improved version that could be more "intelligent", thus we have an Intelligent and more Sustainable Cloud Computing systems.

With this work we proposed an efficient algorithm for advanced scalable Media-based Smart Big Data (3D, Ultra HD) on Intelligent Cloud Computing systems. The proposed encoding algorithm outperforms the conventional HEVC standard which demonstrated by the performance evaluations. Also, with the aim to ratify the proposed approach additionally, a relative study has been carried out. Then, we will try to conclude that the proposed method could be used and integrated into HEVC, as a Smart Big Data, without violating the standard. Finally, by surveying the integration of Big Data in Cloud environments, we open new challenges in the field of this integration.

The rest of this work is organized as follows. Section 2 discusses the related work. Section 3 gives a brief introduction to Scalable HEVC on Clouds (SHevcCloud). Section 4 describes the proposed Scalable HEVC algorithm on Clouds and also analyzes its theoretical performance. The simulation results count on a practical system is demonstrated in Section 5. Finally, Section 6 concludes this paper.

II. Background Research

During the last years, several techniques for HEVC-media have been contrived [19-45].

In [19] researchers proposed an innovative perception-based quantization with the aim to remove nonvisible information in high dynamic range (HDR) color pixels by exploiting luminance masking so that the performance of the HEVC standard is meliorated for HDR substance. Specifically, profile scaling count on a tone-mapping curve computed for each HDR frame is introduced. The suggested method in [19] has been integrated the HEVC relation model for the HEVC range extensions (HM-Rext). The performance of this proposed process was assessed by numbering the bitrate depletion against the HM-Rext. At the end, the results compared with HEVC at the same quality indicate that the recommended method accomplishes important bitrate savings, up to 42.2%, with an average of 12.8%. The [20] presents a computationally scalable algorithm and its hardware architecture able to support intra encoding up to 2160p@30 frames/s resolution. More specifically, the scalability permits a tradeoff between the throughput and the compression efficiency. Respectively, the encoder is capable of checking a variable number of nominee modes. Also, for the processing of the predictions that generated from the reconstructed samples uses the shared hardware resources. Thus, with the aim to support intra 4×4 modes for the 2160p@30 frames/s resolution, the encoder incorporates a separate reconstruction loop. With the aim to decrease the complexity of the quantization process in HEVC with RDOQ, [21] investigated two schemes (the RDOQ bypass decision and the simplified level adjustment. Additionally, the simplified level adaptation method only estimates the difference in rate–distortion costs among the candidate quantization levels with the aim to enable the encoder for selecting an optimal quantization level at a much reduced computational cost. Moreover, the proposed simplified level adjustment scheme is designed so that it could be implemented in lookup tables.

Also, in [22] there is an introduction of two ways to reduce the complexity of the inter/intra-mode search process of the to-be-encoded blocks in the dependent texture views (DVts) of 3D-HEVC. Also, there is a proposal of a hybrid complexity reduction scheme that utilizes the two-mode prediction approaches, which are the motion information of the base texture view (BVt), and the rate deformation cost of the already encoded blocks in the BVt and DVt. Concluding, the proposed evaluations confirmed that hybrid complexity reduction scheme reduces the 3D-HEVC codec complexity by 67.70% on average for the DVt compared with the 3D-HEVC encoder. In the other hand, the state-of-the-art method reduces complexity by 25.74% on average. In [23] for the HEVC standard and its multiplayer extensions, including SHVC and MV-HEVC extensions, there is a proposal of asoftware parallel decoder architecture. More specifically, the suggested multilayer HEVC decoder is collateral friendly and patronages both wavefront parallelism to simultaneously procedure adjacent rows of the frame and frame-based parallelism to decode a set of temporal and spacial frames in parallel. Then, the authors of [24] with the aim to decrease the encoding complexity for HEVC proposed an all-zero block detection scheme prior to DCT. Also, in [24] a modern AZB detection scheme is proposed for the case that Hadamard transform is used as a deformation metric for RDO in HEVC. At the end, the experimental results of [24] show that the proposed scheme descries 87.79% of actual AZBs with 2.87% false alarm rate in average, outperforming the state-of-the-art method. The [25] delineates an extension of HEVC standard for coding of multi-view video and depth data. The proposed approximation offers 50% bit rate savings in contrast with HEVC simulcast and 20% in comparison with a straightforward multi-view extension of HEVC without the newly developed coding tools demonstrated in [25] by the objective and subjective results presented. Moreover, a fast CU size decision algorithm for HM was proposed by the authors of [25].

Moreover, in [26] the authors can determine CU depth range and skip some specific depth levels rarely used in the former frame and neighboring CUs. Finally, the proposed algorithm could particularly decrease computational complexity while maintaining nearly the same RD performance as the original HEVC encoder as these presented in [26] by the experimental results. A comparison between the compression capability of sundry generations of video coding standards and the means of peak signal-to-noise ratio (PSNR) and substructure testing results provided in [27]. Furthermore, the authors of [27] applied a consolidated approach to the analysis of designs, including H.262/MPEG-2 Video, H.263, MPEG-4 Visual, H.264/MPEG-4 AVC, and HEVC. Concluding, equivalent substructure reproduction quality as encoders, which conforms to H.264/MPEG-4 AVC when using approximately 50% less bit rate on average, could be reached by the results of subjective tests for WVGA and HD sequences point out that HEVC encoders. Also, in [28] there is a consideration of a classification of motion activity. Concluding this paper, the experimental results exhibit that the encoding complexity could be decreased by up to 38% on average in the random access main profile configuration with only a small bit-rate growth and a peak signal to noise ratio (PSNR) decrement, compared to HEVC test model (HM) 7.0 reference software. An algorithm that provides the possibility of applying for both CU and PU parts is proposed by the authors of [29]. Moreover, there is a proposal of a CU splitting algorithm based on the rate–distortion cost of CU about the parent and current levels to terminate the CU decision early, with the aim to reduce the computational complexity. Also, in terms of PU, the authors of [29] develop fast PU decision counted on spatio-temporal and depth correlation for PU level. Furthermore, the [30] with the aim to alleviate the encoder computation load offers a modern method to decrease the candidates in RDO process. Moreover, the proposed scheme offers 20% and 28% time savings in intra high efficiency and low complexity cases on average compared to the default encoding scheme in HM 1.0 with almost the same coding efficiency demonstrated by the experimental results of [30].

The [31] proposed a HEVC standard which is fulfilled its target to reach more than 50% improvement in video compression over the existing H.264 Advanced Video Coding standard. Concluding the work of [31], the experimental results demonstrate that for low-delay wireless video communications, the HEVC codec is more effective compare to the previous H.264 codec and shows better overall performance. In [32] described the complexity-related aspects that were considered in the standardization process. Moreover, a clue of where HEVC may be more complex than its predecessors and where it may be simpler was given by profiling of reference software and optimized software. The [33] offers an overview of the intra coding techniques in the HEVC standard being produced by the Joint Collaborative Team on Video Coding (JCT-VC). Also, the [33] discusses the design principles applied during the development of the new intra coding methods and additionally analyzes the compression performance of the individual tools. The [34] proposes a reusable design for the merging process used in

3D-HEVC, which could importantly decrease the implementation complexity by eliminating duplicated module redundancies. Finally, this proposed method of [34] has been adopted as a regulative coding tool in the 3D-HEVC international standard.

The contribution that the authors of [35] made fills the gap in enabling compliant and real-time networked HEVC visual applications. Also, it is taken farther by evaluating the transmission of 4k UHDTV HEVC-coded content in a typical wireless environment using both computers and mobile devices, with the aim to consider well-known factors like prevention, intervention and other unseen factors that affect the network performance and video quality. The [36] illustrates extensions to the HEVC standard which are active fields of current development in the relevant international standardization committees. The design for the extensions proposed in [36] deputizes the latest state of the art for video coding and its applications. The [37] introduces the SHVC standard technology and analyzes the performance of inter-layer prediction as an important characteristic. Finally, the authors of [37] proposed a gradient based fast decision algorithm, as a result of the fact that every coding unit with different sizes is traversed in both procedures makes it very time-consuming, with the aim to reduce the computational complexity of HEVC. As compared to the default encoding scheme in HEVC test model HM 4.0, experimental results of [37] demonstrate that the fast intra mode decision scheme offers almost 20% time savings in all intra low complexity cases on average with negligible loss of coding efficiency.

In recent years several studies for BD technologies have been devised [39-45]. The authors of [39] introduce a multi-objective approach using genetic algorithms. The goal of this is to minimize two objectives, the execution time, and the budget of each node executing the task in the cloud. The contribution of [39] is to propose an innovative adaptive model to communicate with the task scheduler of resource management. The proposed model periodically queries for resource consumption data and uses to calculate how the resources should be allocated to each task. Through this work, the authors believe that the proposed solution is timely and innovative as it provides a robust resource management where users can perform better scheduling for BD processing in a seamless manner. The [40] makes three contributions to the Special Issue's theme of enhancing organizational resource management. One is to establish an archetype business process for BD initiatives. The second contribution directs attention to creating a dynamic capability with BD initiatives. The third identifies drawbacks of resource-based theory (RBT) and it's underpinning assumptions in the context of BD. Moreover, in [40] there is a discussion about the lessons learnt and draws out implications for practice and business research. Also, this work's intellectual and practical contributions are count on an in-depth case study of the European ICT Poles of Excellence (EIPE) BD initiative and evidence from the extant literature.

A literature review of BD and its related technologies, like CC and Hadoop, is presented in [41]. Also, the [41] focuses on the five phases of the value chain of BD technology and as a result examines the several representative applications of BD technology. Furthermore, in [42] the important concepts of BD technology are highlighted and also there is a discussion about the various aspects of BD. Furthermore, the authors of [42] define what BD is, and discuss the various parameters of its definition. Finally, in [42] there is a look at the process involved in the data processing and then reviewing the security aspects of BD and as a result, it proposes a new system for security of BD. Moreover, a definition and description of BI&A 1.0, BI&A 2.0 and BI&A 3.0 in terms of their key characteristics and capabilities are presented in [43]. Also, there is a report of a biometric study of critical BI&A publications, Researchers and research topics based on more than a decade of related academic and industry publications are presented in [43]. Additionally, an offer of six provocation with the aim to spark conversations about the issue of BD technology is shown in [44]. These provocations are the cultural, technological, and scholarly phenomena that rests on the interplay of technology, analysis, and mythology that dares extensive utopian and dystopian rhetoric. Finally, a multi-stakeholder approach for developing a suitable privacy regulation in the age of BD is presented in [45]. This argument is developed in five steps: 1) A review of the current academic debate on privacy regulation. 2) An argument that the framework for developing a suitable privacy regulation should not only focus on formal and procedural but also include some essential aspects to guard users and promote socially beneficial BD applications. 3) An examination of how the process leading to an appropriate regulation might be organized. 4) A discussion of the potential structure of a privacy organization that might conduct multistakeholder-dialogues as a preliminary step. 5) A discussion of their findings and suggestions.

In the sector of CC, there is also a majority of works available for study [46-52]. At the beginning, an exploration of the roadblocks and solutions to provide a trustworthy cloud computing environment are presented in [46]. CC is an evolving paradigm with tremendous momentum, but its specific aspects sharpen security and privacy challenges. Then, the [47] proposes a simple data protection model where data is encrypted by the use of the AES algorithm before it is launched in the cloud, thus ensuring data confidentiality and security. The key consideration dealt in the proposal of [47] is the encryption schema to secure data by making it unintelligible for all. Regarding [47], implementing AES for security over data provides benefits of less memory consumption and less computation time as compared to other algorithms. Furthermore, a survey of the Mobile Cloud Computing (MCC) was given in [48], which has the purpose of helping general readers that have an overview of the MCC including the definition, the architecture and the applications. Also, it was presented the issues, the existing solutions and the approaches of them in [48]. Finally, [48] suggest the future research directions of the MCC technology.

The [49] provides an extensive survey of MCC research while highlighting the particular concerns in MCC. Furthermore, a taxonomy count on the key issues in the area of MCC and a discussion about the different approaches that have been taken to tackle these issues were presented in [49]. At the end, there is a conclusion with a critical analysis of challenges that have not yet fully met, and highlight directions for the future work. In [50] it was detailed the security issues that arise as a result of the very nature of cloud computing. Moreover, the [50] presents the recent solutions that were presented in its literature with the aim to counter the security issues. Also, a brief view of security vulnerabilities in the MCC is highlighted. Finally, it presented the discussion on the open issues and future research directions. At the end, regarding the CC technology, the [51] offers a study on CC and suitable algorithms for load balancing such as ground robin scheduling, MapReduce algorithm, ACO and honeybee. Also, it was given a comparison between those algorithms on different properties of them. According to the [51], the ACO is the better load balancing algorithm compared to other algorithms. Concluding the first part of the related review, there is a study about Big Data technology. In [52] initially, there is an investigation of the importance of BD in modern life, and in terms of the economy, and also discussed the challenges that arise from Big Data utilization. Moreover, in [52] the potential of the powerful combination of BD and Computational intelligence is explored and a number of areas where novel applications in real world problems can be developed by utilizing these powerful tools and technologies is identified. To solve these problems, the authors of [52] presented an innovative data modelling methodology which introduces a novel biologically inspired universal generative modelling approximation called Hierarchical Spatial-Temporal State Machine (HSTSM). Finally, there is a discussion of various implications of policy, protection, valuation and commercialization related to BD, its applications and its deployment.

III. Integration of 3D Ultra HEVC Smart Big Data on Intelligent Clouds

Among all types of data in the Cloud storage, video has occupied a significant part because of the explosive video sharing on social networks and video-on-demand services for movies, TV programs, etc. For example, YouTube has claimed in 2015 that there are 400 hours of video uploaded to YouTube every minute. Moreover, to support users with various bandwidth requirements and device resolutions and full interactive playback in video streaming, usually, multiple versions at different bitrates, resolutions and frame rates are generated for each video, which is called simulcast in video streaming [31]. An alternative to satisfy these adaptive streaming requirements but with less storage is the scalable video coding (SVC), e.g. H.264/SVC and HEVC/SHVC, where a video is coded into one base layer (BL) and several enhancement layers (EL) [32] [37] [53].

A new challenge is created when every user has to manage and process big quantities of data everywhere and every time. This challenge is to use Smart BD in Intelligent CC, and though this new general challenge, other challenges arise. One main issue and big challenge for the use of BD in Intelligent Cloud environments is the transfer and the use of High Quality Video. High quality video is a new type of video coding that grows through the recent years. Some major types of High Quality Video coding are the 3D Ultra HD Video and the 3D HEVC. The main challenge of this work is to try to transfer and to use those types of videos as Smart BD through Intelligent Cloud environments.

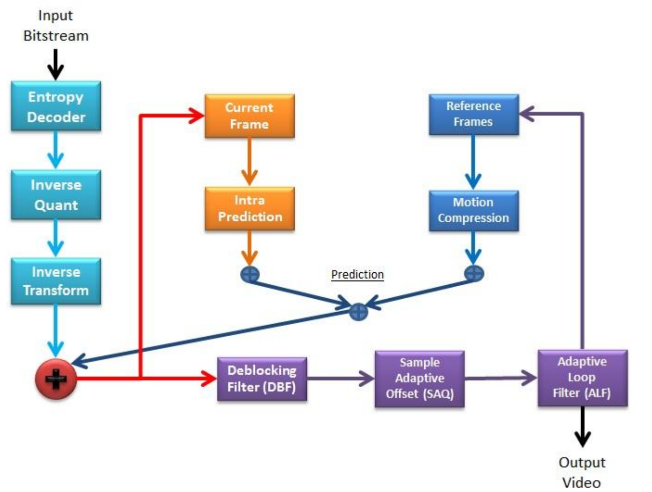

Fig. 2. Block Diagram of HEVC Decoder.

Figure 2 displays the operating procedure of the HEVC Decoder. We can follow the Input Bit-Stream from its entry to the decoder to its exit as an output video. The whole procedure of the HEVC decoder could be separated in four operating sub-processes, which are singled out in Figure 2 by their different color.

As already mentioned above, High-Efficiency Video Coding, or better publicly recognized as HEVC, is a video compression standard, one of the several potential successors to the widely used AVC (H.264 or MPEG-4 Part 10). It provides about two times more the data compression ratio at the same level of video quality. More specifically, the 3D-HEVC extensions for 3D video were completed in early 2015. Farther extensions remain in development for completion in early 2016, covering video containing rendered graphics, text, or animation as well as camera-captured video scenes. The 3D-HEVC is the third version of HEVC coding which was released on April 29, 2015. This third version adds the 3D main profile in HEVC/H.265 coding. The 3D main profile allows for the base layer which conforms to the main profile of HEVC [54]. The 3D-HEVC offers increased coding efficiency by the joint coding of texture and depth for advanced 3D displays. Through experimental analysis [55] it was shown that the 3D-HEVC is capable of achieving the same subjective video quality as the H.264/MPEG-4 AVC High Profile while requiring on average only about 50% of the bit-rate.

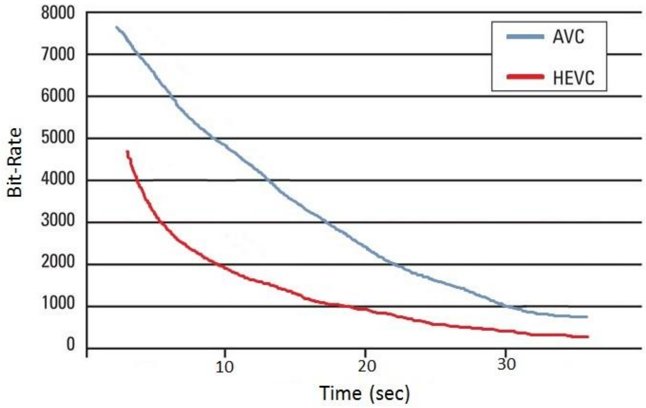

Fig. 3. AVC/H.264 vs. HEVC/H.265.

Figure 3 shows the quantity of data that compressed, or otherwise how the bit-rate decreased through time compering the AVC/H.264 video coding to HEVC/H.265 video coding.

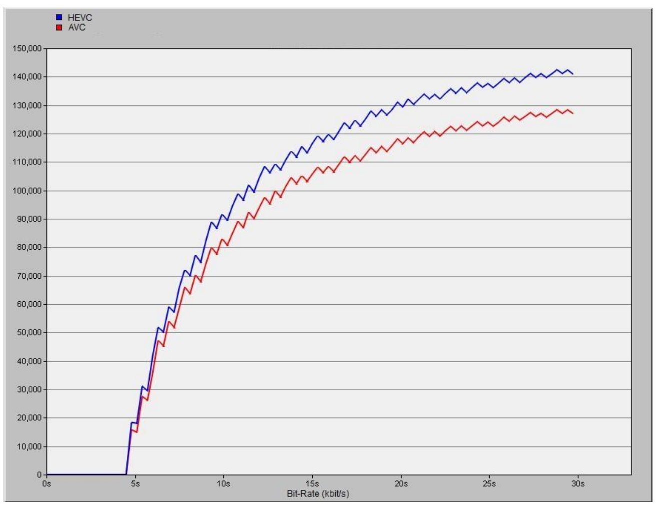

Fig. 4. HEVC/H.265 to AVC/H.264 comparison.

Figure 4 reveals that for very low bit-rates of HEVC and AVC provided almost the same quality, but pointing out that HEVC is much quicker. Figure 3 shows the amount of bit-rate of HEV and AVC through the time.

Furthermore, another recent type of video coding which also is a base of the updated version of HEVC is Ultra High Definition or better known as Ultra HD. Ultra HD in our days includes video types of 4K UHD in 2160p resolution and 8K UHD in 4320p resolution. Those two types of video formats were first proposed by the *NHK Science & Technology Research Laboratories* and later defined and approved by the International Telecommunication Union, better known as ITU [56] [57] [58] [59].

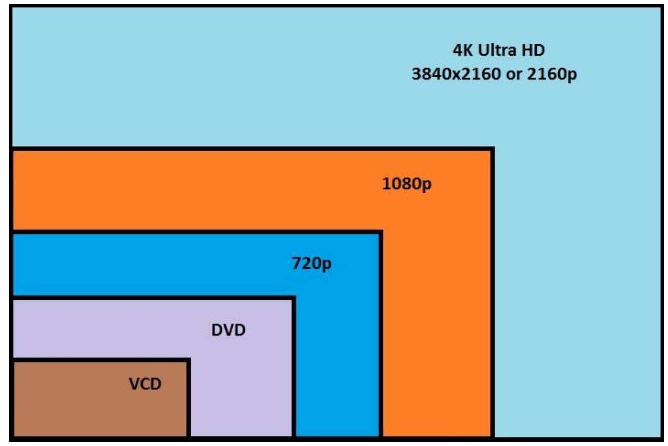

Fig. 5. Generation of video resolution.

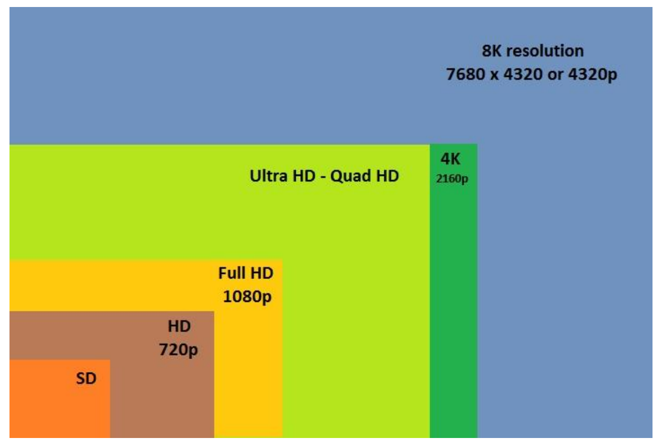

Fig. 6. Comparison of Resolutions.

Figure 5 and Figure 6 represents the differences between the resolutions of video codecs and their dimensions. More specifically, Figure 5 shows the big impact of 4K Ultra HD instead of the previous resolutions and the Figure 6 shows the effect in the dimension of the screen derived from the 8K Ultra HD and how bigger it is, compared to the previous resolutions. Moreover, Figure 5 and Figure 6 illustrates the generation of Display Resolutions by comparing the Display Analysis of each Resolution's size.

4K and 8K resolutions that were introduced by Ultra HD can also be defined as UHDTV [60] [61]. More specifically, 4K UHDTV or 2160p consists of 3840 pixels in wide view and by 2160 pixels in tall (8.29 MegaPixels). This is four times as many pixels as the Full HD which is consisted by 1920x1080 pixels (2.07 MegaPixels). Also, the 8K UHDTV or 4320p consists of 7680 pixels in wide view and 4320 pixels in tall (33.18 MegaPixels). This video coding brings the view closer to the detail level of 15/70mm IMAX. As an evolution of this video coding on August 22, 2012, the electronics company LG [62] released the first 3D UHDTV that supports the 4K system. This came as a follow-up to the SONY's released 4K 3D Projector with model name VPL-VW1000ES [63] [64] on May 31, 2012. The new type of video coded videos related on UHD, HEVC and 3D sized by a lot of bytes.

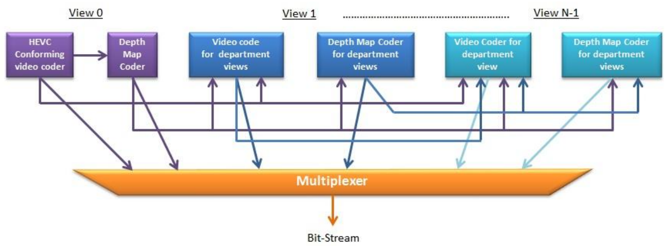

Fig. 7. Inter-View & Inter-Component Prediction in Basic Encoder Structure of 3D-HEVC.

Figure 7 shows the basic structure of a 3D video encoder of HEVC. 3D HEVC was developed for depth-enhanced 3D video formats, ranging from Conventional Stereo Video to Multi-View Video plus a depth consisting of two or more views and associated per-pixel depth data components.

Regarding the definition of BD, the data which set by a large amount of bites, can be defined as Big Data. The major issue of this work is to manage a large amount of data by 3D HEVC of 3D UHD videos, which is Big Data, through the Cloud environments. Thus, with the aim to allow every user to manage and process big amounts of data everywhere and every time a new challenge in the sector of telecommunications was created. The CC technology eliminates the need to maintain expensive computing hardware and software [65] [66] [67]. The CC resources and techniques could be influenced to address the conventional problems associated with fault tolerance and low performance causing bottlenecks to the use of BD technology [68] [69] [70]. The usage of BD offers the specific opportunity to reach an appropriate competitive strategic advantage provided to the users to use the right mix of BD analytics to discover relationships and patterns that could not be discovered otherwise [71]. Also, regarding the related review CC and BD are complementary to each other and some of the Big Data problems can be resolved with the CC techniques and solutions.

TABLE II
BIG DATA FEATURES CONTRIBUTION IN CC FEATURES

Big Data Features / **Cloud Computing Features**	***Volume***	***Velocity***	***Variety***
Storage over Internet		**X**	
Service over Internet	**X**		**X**
Applications over Internet	**X**	**X**	**X**
Energy Efficiency	**X**	**X**	
Computational Capable		X	X

Table 2 exhibits the key characteristic of the two technologies which have been studied and used with the aim to use them for the experimental proposal. Based on the study conducted, the key characteristic of BD technology which contributes more the characteristics of CC technology is Velocity. Velocity contributes four from the five key characteristics of CC. Also, another thing that we can observe from Table 3 is that the characteristic Applications over Internet contributed from all the key features of BD.

IV. ADAPTIVE 4K, 8K, 3D MEDIA DELIVERY

Count on the CfP for 3D video technology that presented on [64], it specified that there are two test categories for the 3D video technology. Those two categories are the AVC-compatible and the HEVC-compatible/unconstrained. The proposed algorithm that introduced in this work is based on the model that presented on [72].

TABLE III
COMPARED TABLE OF THE RATE-POINTS FOR 3-VIEW TEST SCENARIO AVC AND 3-VIEW TEST SCENARIO HEVC

Test Sequence	**3-View Test Scenario AVC - BitRate**				**3-View Test Scenario HEVC - BitRate**			
	R1	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**
Ponzan _Hall2	170	280	440	740	220	320	490	780
Poznan _Street	370	780	1140	1900	420	720	1190	1960
Undo_ Dancer	380	740	1160	1890	440	790	1210	2020
GT_Fly	290	580	980	1450	350	610	1090	1610
Kendo	240	400	630	1000	290	440	680	1050
Balloons	270	440	740	1160	310	490	780	1210
Lovebird1	220	390	690	1240	270	430	740	1280
Newspaper	300	420	640	870	350	460	690	910

As we can observe form Table 3, comparing the two video technologies we can understand that there is an improvement by the use of the 3D view in the HEVC video codec. Based on the test coherences from [68] we have done measurements for both codecs and the Bit-rate results of those measurements are demonstrated in Table 3.

TABLE IV
COMPARED TABLE OF AVERAGE BIT-RATE SAVINGS OF MULTIVIEW AND SIMULCAST EXTENSION OF AVC AND HEVC

Test Sequence	**3-View Test Scenario AVC - Bit-Rate Savings %**		**3-View Test Scenario HEVC - Bit-Rate Savings %**	
	MultiView	***SimulCast***	***MultiView***	***SimulCast***
Ponzan_Hall2	19.97	40.86	22.03	44.98
Poznan_Street	12.34	46.97	14.40	51.09
Undo_Dancer	10.43	49.09	12.49	53.21
GT_Fly	18.35	53.51	20.41	57.63
Kendo	38.24	49.17	40.30	53.29
Balloons	29.10	45.13	31.16	49.55
Lovebird1	16.02	43.01	18.08	47.13
Newspaper	20.96	39.06	23.02	43.18
Average %	20.68	45.85	22.74	50.01

Table 4 shows the average Bit-Rate Savings of the measurements that have been done of MultiView and SimulCast extension of the AVC codec and the HEVC codec. Through Table 4 we can assume that the 3D-HEVC is more improved than the AVC, regarding both extensions. The measurements count on the test coherences are taken from the [72].

This work tries to link and offer the possibilities to can access on demand the video (Smart Big Data) that are saved in an Intelligent Cloud. For this purpose, we try to find the better way to Bit-Stream the availability of 3D-quality video as Smart Big Data through an Intelligent Cloud system. Through the related review and the aforementioned measurements and results, we assumed that the better way to stream a high-quality video, as a 3D-HEVC, will be through a new method.

Relaying to the work of [72] and regarding the related review we propose the following equation:

$$BW_{i+1}^{next} = BW_i^{last} * [(f(RTT_i, RTT_{i-1}) + g(p_i, p_{i-1}) + h(SINR_i, SINR_{i-1})) * a] + BW_{i-1}^{last-1} \quad (1)$$

where, α is a stable that indicates the importance of each factor, f(), g(), h() are three functions which reflecting the value change of each factor compared with the *last time window*, p is representing the *packet loss rate*, RTT is representing the *Round Trip Time*, SINR is representing the *signal to interference and noise ratio*, i represents the *sequence number* of the current time window, BW_i^{last} represents the *bandwidth of the last time window*, represents the bandwidth of the last time window-1, and BW_{i+1}^{next} represents the *bandwidth of the next time window*, which is the time we need.

Based on the proposed equation (1) we propose also an algorithm that implements it. Additionally, with equation (1) in the proposed algorithms, we also use the T_{win} which represents the time window, BL which represents Base Layer and EL which represents Enhancement Layer. This algorithm is showed in the following.

Algorithm 1

i=0
$BW_1=R_{BL}$
Transmit BL_1
Monitor BW_1^{last}
repeat
  Sleep for T_{win}
  Obtain p_i, RTT_i, $SINR_i$, and all the information we need from the client's report
  Predict BW_{i+1}^{next} (or $BW_{i+1}^{next} = BW_i^{last}$) (or $BW_{i+1}^{next} = BW_i^{last} + BW_{i-1}^{last-1}$)
  α=0
  BW_{EL}=0
  repeat
    α++
    if α>= i
      break
    $BW_{EL}=BW_{EL}^{\alpha}+R_{EL}^{\alpha}$
  until BW_{EL}>= BW_{i+1}^{next}
  Transmit $BL_i$and $EL_{i+1}^1, EL_{i+1}^2, \ldots, EL_{i+1}^{a-1}$
  Monitor BW_{i+1}^{last}
  i++
until All video segments are transmitted

Algorithm 1 represents the procedure implementing the equation (1) which consists due to our study the better way to stream a High-Quality Video, such as 3D-HEVC. Thus, in Algorithm 1 we test the data from *Last Time Window* compared to the functions which reflect the value change of each factor of the equation (1). In a limited number of loops, and as long as the time is "sleeping", the algorithm "calls" the value of the *Packet Loss Rate* of each loop along with *Round Trip Time* and the *Signal to Interface and Noise Ratio* of each loop, carried out from the client which streams the video. Then, the algorithmic mapping of equation (1) calculates the better way to stream the video by choosing a calculation scenario relaying on the type of the streaming video. Inside a loop which is repeated as long as the value of BW_{EL} is greater than or equal the value of BW_{i+1}^{next}, then the calculation takes as many times as the random variable α is greater than or equal to the value i, which is the *sequence number* of the particular transmission. After the iterative loop stops, the particular video begins to be transmitted to the client by streaming it. The running time of the Algorithm 1 is estimated less than one minute due to the need of quick response to the client and relaying to the calculations which need to be done.

V. EXPERIMENTAL RESULTS

By establishing the algorithm above we can procced the procedure of selecting and streaming the video we demand in the type of it that we demand. This procedure is showing in Figure 8.

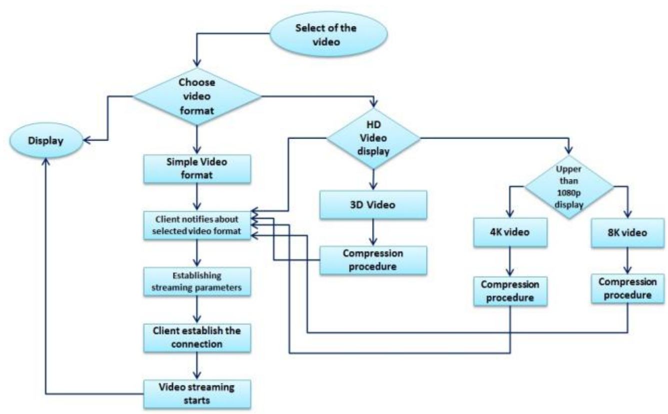

Fig. 8.Working flow of the video streaming procedure in an Intelligent Cloud environment.

With the study and the analysis of Figure 8 we can observe that the client of an Intelligent Cloud environment could access the video that the client demand, and based on the available options of view, the client can choose the type of display. The waiting time of using a larger sized video format for streaming is reduced with the use of the proposed algorithm.

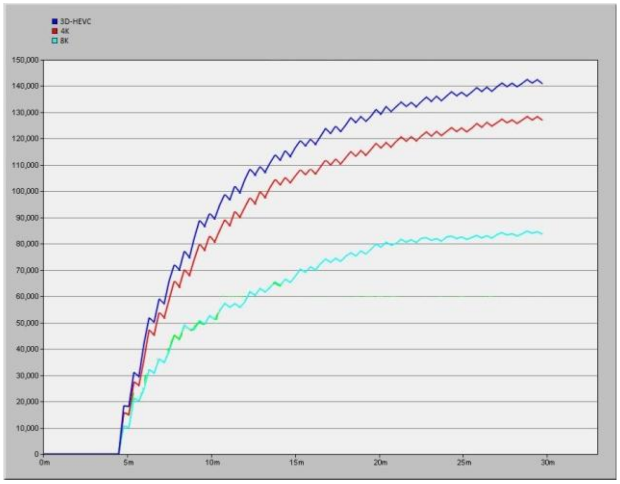

Fig. 9. Streaming results and measurements of three video formats.

Figure 9 demonstrates the differences between the bit-streaming of the three video formats which were used. As we can observe there is a closer response between the 3D-HEVC and the 8K display and also not a big difference regarding 4K display. Those measurements could show that even the large data volume of the 3D-HEVC video codec, the Bit-Rate through time is not very longer than a lower type video codec as the 8K or the 4K.

VI. Conclusion

In the last decades technologies like BD and Cloud became valuable for people that need information at any time in any place. Information such this can be a high quality video, e.g. a 3D-HEVC video format. In this paper, we study and survey the three aforementioned technologies in order to find their common features of their use and to propose an operation which would help the issue of streaming high quality video, as Big Data, through the cloud environments. Based on the fast growth of wireless communications and networking technologies, which are related increased in many of their features like the volume of their data in the structured and unstructured form. Also, as the technology of CC grows more options about its "on-demand" operation arise.

Thus, in this work, we proposed an efficient algorithm for advanced scalable Media-based Smart Big Data (3D, Ultra HD) on Intelligent Cloud Computing systems. With performance evaluations that have been made we demonstrate that the proposed encoding algorithm outperforms the traditional HEVC standard. By adopting this proposed method we assumed that it can be used and integrated into HEVC without violating the standard. Furthermore, by surveying the integration of BD, in general, in Cloud environments, we open new challenges in the field of this integration. This can be the sector of future research on the integration of those two technologies, and why not to have a huge improvement on their integration issues in order to have a better use of them.

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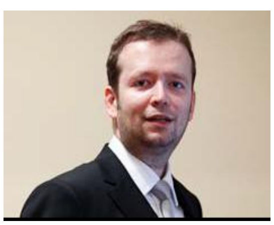

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