White Paper: Dimension, Inc. Strategic Plan for BigData

Dimension Inc is well known for development of advanced image processing technologies pertinent to high-performance video applications such as IoT, Surveillance, Analytics, Video Conferencing, VR/AR, and Streaming Video Platforms. In particular, Dimension has focused upon image and video *reconstruction*, *denoise*, and *compression* (CODEC) as those processing components most critical to video system performance optimization. From a technical perspective, this work has been successful in creation of new algorithms of extraordinary power. Most notably, combination of *superresolution reconstruction*, *spatiotemporal denoise*, *Nyquist refinement*, and *superresolution-based video compression* have together enabled video processing gain at levels heretofore unavailable in the video technology marketplace.

In recent work, Dimension R&D has challenged itself with identification of new and emerging market sectors for which Dimension's technology may prove beneficial. Once such is the *video analytics* ('VA') domain. From a systems perspective, video analytics applications are quite simple. As shown in figure-1, source video is applied to a bank of machine learning ('ML') classifiers that serve to detect and report objects appearing within a video sequence. In experimentation with such systems, Dimension has discovered an essential relation between video analytics *quality of result* ('QoR') and input video quality. To wit, *the error rate of any machine learning classifier one might employ for purposes of video analytics is highly dependent upon input video resolution and signal-to-noise ratio* ('SNR'). In retrospect, this result may seem obvious. However, it is one thing to guess at a relationship and yet another to prove its existence and then quantify it. Succinctly stated, Dimension has done exactly the latter, the most notable result of which is the *video preconditioning* ('VPC') system.

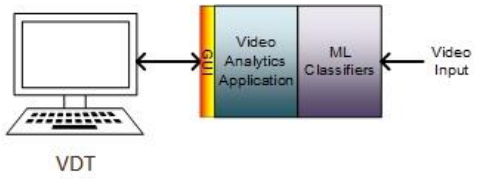

Figure-1: Exemplary Video Analytics System

In a recent expansion of technical focus, we see in figure-2 Dimension has combined those previously mentioned image processing algorithms in creation of a *video preconditioning pipeline* technology that serves to optimize performance of those *neural-network* (NN) based *machine learning* classifiers we employ in *video analytics* applications. More precisely, VPC generates a composite processing gain that minimizes classifier error rates across a broad swath of input video quality. For example, use of VPC as a VA front-end can be expected to improve overall quality-of-result (QoR). It should be noted where input video is noisy or exhibits reduced bandwidth, this improvement can be dramatic.

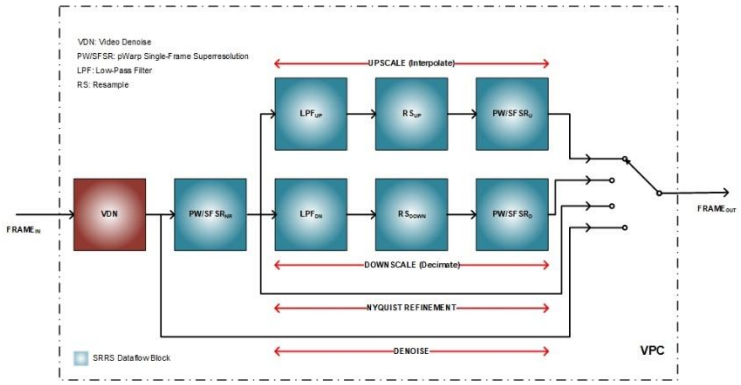

Figure-2: Video Pre-Conditioning (VPC) Block Internal Structure

As described, the *VPC advantage applies to all video analytics systems*. Arguably, this alone constitutes a highly significant result. However, it soon became apparent Dimension could go much further. With the proven success of VPC, it was a small conceptual step to consider just how VPC might be applied within context of *any ML-based information processing on video content*. It was at this juncture, Dimension shifted its attention to the problem of *BigData*. In this consideration, two facts became apparent; (i) while the term BigData is currently prominent in the media, a formal definition of the term seems absent and (ii) whatever we might take to constitute BigData, more than 50% accrues in form of video. Here, we will sidestep the former in adopting a working-definition of BigData in terms of the sum total of all our electronics communications. Now, with this conceptual stake-in-the-ground, it seems reasonable to conclude the cited 'more than 50% video' represents a significant strategic opportunity for application of VPC technology within context of BigData exploration, or for that matter any extraction of video-based information from the BigData DATAVERSE.

The bottom-line is, at the current level of technological evolution, we might consider BigData DATAVERSE as existing only in form of a conceptual icon. That is to say, beyond unstructured web-queries, there exists no machine compatible representation for which BigData accrues as an efficiently searchable information resource. This of course represents an impediment to any expanded application of Dimension technology because the BigData market sector is in effect non-existent. However, as a matter of strategic consideration, it is also obvious this BigData we envision will evolve as the next-big-thing within the video analytics milieu. It then follows BigData must itself be invented and, as the immortal John Lennon once advocated, we must think differently in doing so. Why is this? In terms of formal complexity, the BigData DATAVERSE is understood as *exascale*. More simply put, 'BigData' is indeed very big! It then follows, the essential problem of BigData devolves to one of exascale processing. It is this rationale that forms the basis for Dimension's consideration of processing infrastructure sufficient to development of video-based information processing applications on BigData DATAVERSE. This would of course include classic video analytics applications as we have come to understand them, but now with addition of more advanced information processing capabilities.

From what we now construe as the BigData application domain, Dimension has resolved the problem of BigData processing into three component tasks; (i) *assembly*, (ii) *exploration*, and

(iii) *discovery*. In simplest terms, BigData Assembly (BDA) is the rendering of an unstructured DATAVERSE into an efficiently searchable form. This task is comprised of an essentially autonomous process of building an entity-attribute graph (EAG) representation to which existing and readily available graph-search techniques may be applied. BigData Exploration (BDE) is then extraction of statistics on *keywords*, *declaratives*, and *relations* (KDR) pertinent to truth-value of some logical-conjecture-on-data (LCOD) posed within context of the analytics we wish to perform. BigData Discovery (BDD) is then the identification of *new* KDR elements, with subsequent reapplication of BDA, BDE, and possible restatement of any LCOD we apply within context of BDE. In effect, BDD will initiate invocation of BDA and BDE as subprocesses within context of an overarching problem of evaluating LCOD truth-values. Dimension's strategic vision is BDA, BDE, and BDD together form a complete processing infrastructure for development of video analytics platforms on BigData DATAVERSE. Based upon this notion, an integrated processing environment for BigData is proposed in figure-3, each component of which will employ VPC technology. From a larger perspective, we see Dimension is thrust into a position of not only developing new video analytics technology, but also contributing to an entirely new BigData market sector. It goes without saying, this has proven an exciting prospect for Dimension's further evolution as a technology leader.

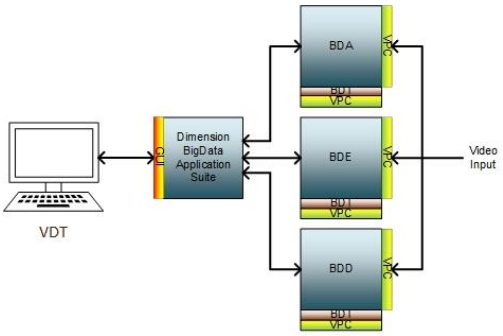

Figure-3: Dimension BigData Application Suite

It is also true each of the aforementioned BDA, BDE, and BDD incur significant nondeterminism. That is to say, these tasks are appropriately cast in terms of goal-directed, nondeterministic solution-search we understand as characteristic of *artificial intelligence* (AI) applications. Accordingly, AI architectural forms are indicated for each of these component processes. A highly simplified architectural form by which all component processes may be invoked is displayed in figure-4 for which we note the aforementioned BDD-initiated invocation of BDA and BDE AIs is implemented via a top-level supervisory process that is also AI. In this manner, the problem of BigData DATAVERSE processing further devolves to knowledge-based application of BDA, BDE, and BDD, the result of which we represent as a solution-state trajectory comprised of EAG node-visitations. In this particular architectural variant, we also note use of Dimension's *superresolution-enabled video compression* (SREC) based network video transport (BDT) along with a cloud-based BDA implementation. As displayed in figure-5, SREC implementation is further simplified and unified with use of VPC as an architectural building-block. It should be noted *the resulting hierarchical AI architectural-form is representative of an entire class of cutting-edge innovations*, most generally for AI technology and specifically for exascale processing on BigData DATAVERSE.

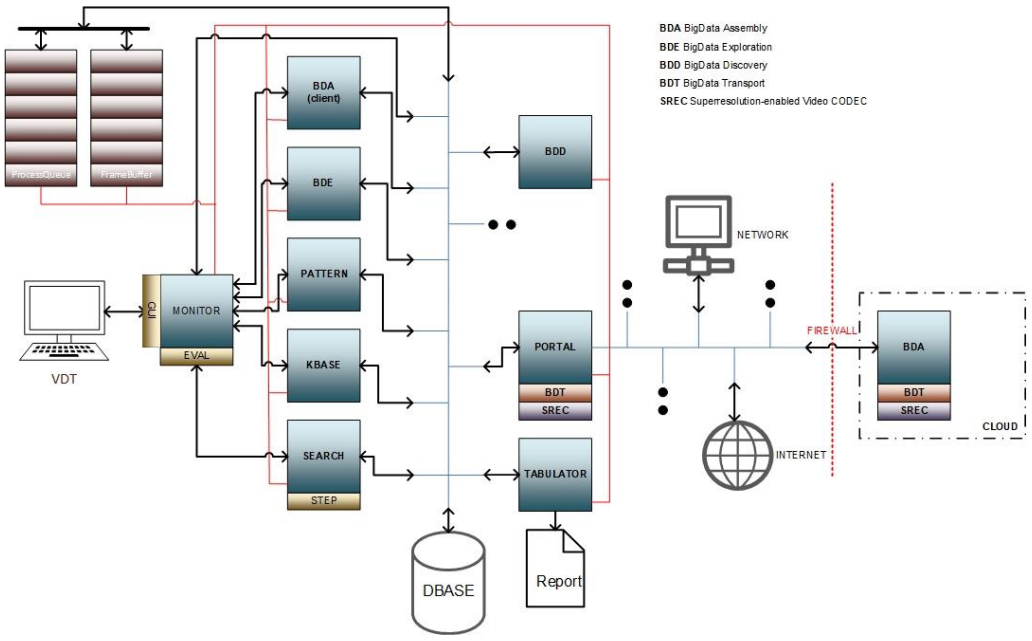

Figure-4: Cloud-Distributed BigData AI Architecture

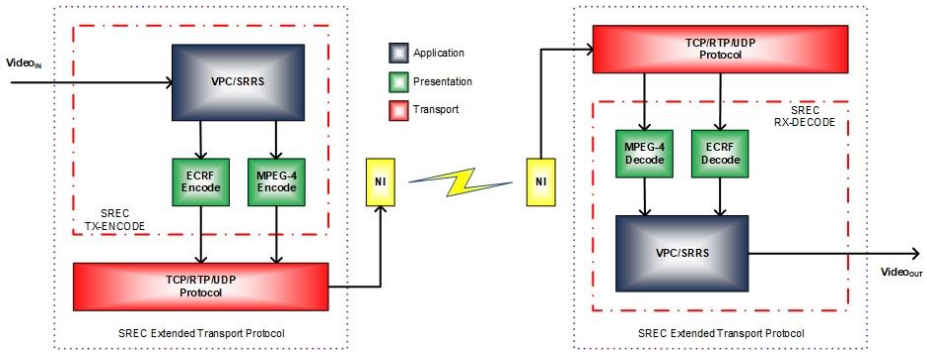

Figure-5: VPC-based SREC

In terms of Dimension's strategic IP development, the present status is patent-pending for each of VPC, BDA, BDE, and BDD technology components, (i.e., plus derivative forms based upon any hierarchical integrations thereof). Here, we note each of BDA, BDE, and BDD may be offered as stand-alone software applications or integrated as a unified BigData solution (re: figure-3). Per Dimension's overarching strategic plan, specific application scenarios will be addressed in cooperation with AI-capable technology partners for whom the emergent BigData market sector is of compelling interest. Accordingly, both technology acquisition and technology licensing options will be made available to prospective customers.