D9NAMIC

Foreword

The unsurpassed reach of the Internet and the emergence of a range of new technologies have transformed virtually every corner of the digital media space. Yet, while consumers enjoy vastly more content and consumption opportunities, these changes have created a variety of pressures for market stakeholders to adapt to the new digital media landscape. D9namic [/dī namik/] strives to mitigate these pressures by creating an ecosystem that allows for fundamentally new ways to manage, consume, exchange, experience, and monetize digital media.

The revolutionary technology stack builds on years of research in the fields of complex dynamic systems computing, quantized information processing, neural-networking, and evolution algorithms - forming the core around which D9namic's blockchain driven ecosystem and communities develop.

The first community to run on **D9namic**

The first community to run on D9namic is PulsBeat, a platform that has its sights set on applying the innovative technology stack to the realm of digital music in order to address numerous problems including IP protection, fair payments, and ownership validation. Through a combination of the core stack and distributed ledger technologies, this mobile-focused platform solves the current problems with the music industry while providing many innovative new ways to experience, interact with, and create audio-driven content. Through a combination of the core stack and distributed ledger technologies, this mobile-focused platform solves the current problems with the music industry while providing many innovative new ways to experience, interact with, and create audio-driven content.

D9namic aims to usher in a new era of fair digital media, but we can't do it without you - the user; the developer; the artists; the visionary; the people. The possibilities with D9namic are vast and we want to give our users the opportunity to help decide the future direction of the implementation of the technology stack and participate in the resulting platforms, innovations, and communities that follow.

Introduction

The New Information Processing Paradigm

The human brain is a marvelous and complicated organ that has the ability to efficiently communicate, listen, and recognize patterns, while constantly learning and adapting to its environmental stimuli. It's internal neural network allows it to -in a very complex, yet logical fashion- store and process information (sights, sounds, etc.) unlike any computer to date. For years, computer scientists have been trying to understand and mimic how the brain works to see if they could translate it into real world solutions, but until now there existed no framework for the brain-like processing of digital information - a critical piece of the puzzle for the creation of a truly digital brain-like information system.

Enter the groundbreaking technology utilized by **D9namic**

Enter the groundbreaking technology utilized by D9namic, developed over the last decade, it is redefining the ways in which machines store, process, identify, and operate with information. Here, digital information has become a fluid, dynamic, and ever-adapting entity within a storage medium where information is no longer a finite rigid copy of itself, but a series of related schemas, that shrink and grow with each processing pass. This new paradigm allows information to evolve with the processing systems around it and has the ability to be completely searchable, distributed, and transparent when combined with blockchain technology.

What does all this mean? It means that the world of digital media is going through another transformative cycle enabling more efficient transfer, storage, and recall of digital information . It also means verifiable sourcing and a dramatic shift in the value of creative works. Lastly, it means a tectonic shift in the field of information processing that will usher in the next generation of digital storage, delivery, and distribution.

Tech Snapshot

The underlying technology behind D9namic utilizes an innovative and proprietary groundbreaking approach to encode, compress, store, manage, protect, distribute, present, and access digital data. With this technology, the ability to introduce new business and technological models that work within today's systems are possible. Let's take a look at a few of them.

Networking/Transmission

Efficient transfer in the network is achieved through AI utilization that manages and routes data delivery. This allows for greater immersive user experiences while decreasing costs and simultaneously addressing mobile network bandwidth issues.

This translates to **quicker** and more **accurate** identification

Processing, Pattern Recognition/ Separation

Using many of the principles found in the human brain's neural network, the proprietary technology utilized by D9namic de-constructs sound patterns in a non-linear fashion that improves the storage of audio files and the real-time recognition of patterns within the content itself. This translates to quicker and more accurate identification of content and provides unique capabilities to isolate and playback specific channels of the content as chosen by the user. Similar processing capabilities exist for visual media as well and represents the next evolution of this remarkable technology.

Data Encoding, Security, and Synchronization

Complimentary technologies to the unique data processing capabilities of the technology are the unique and innovative content encoding methodologies that significantly reduce the size of the content while preserving the full-fidelity nature of the media. If desired, these proprietary encoding methods can "improve" the fidelity above and beyond that of the original file.

As part of the encoding process, information can be inaudibly embedded throughout the content allowing for numerous applications, chief among which includes IP Protection. Combined with the immutability and transparency of a distributed ledger, trying to hunt down and trace who owns what content on the internet will be made simple.

The enhanced pattern recognition capabilities of the system, that functions in a similar manner to the non-linear methods the brain uses, allows for real-time fluid syncing of multiple audio sources once a sound pattern is recognized. This capability allows for precision playback from multiple, geographically dispersed and network agnostic devices with full control by either one or multiple originators.

The potential applications of this technology are far reaching as it applies to any industry that is digital media intensive, from entertainment to medicine and education. All digital media platforms can benefit greatly from implementing all or part of D9namic's suite of technologies, Overtime, all these verticals will develop their own independently driven communities and innovative business solutions that will build out the D9namic Media Ecosystem (DME).

How Information is Processed Today

The Media Delivery Challenge

In today's digital age where everything is stored, delivered, and consumed online, one of the largest impediments to greater experiences is bandwidth. With varying economic strata, communication infrastructures, content infrastructures, regulations and economic constraints, one the most challenging obstacles for media companies is to be able to deliver their content, in full resolution, fidelity, and tempo in an efficient manner. Consumer demand for applications that support media rich, bandwidth hungry content is on the rise from all current and new platforms. These include 4G/5G mobile networking, Internet of Things (IOT), 3D/4D entertainment, high bandwidth gaming, Full HD/4K/8K (UHDTV) video, Hi-Res audio, Virtual Reality (VR), Augmented Reality (AR) and other rich media applications, all of which suffer from the limited bandwidth provided on existing frequency spectrums allowed by governments. Prices at spectrum auctions are showing the effect of the demand with skyrocketing prices and intense competition for the amounts being offered.

Based on Cisco Visual Networking Index (VNI-2017), global IP traffic will increase nearly threefold over the next five years. It is expected to grow at a Compound Annual Growth Rate (CAGR) of 24% from 2016 to 2021. Global Internet traffic will be equivalent of 127 times the volume of the entire global Internet today.

By 2021
58%
of the population will be using the Internet
up from 44% in 2016

By 2021
61%
of Internet traffic per month, per user
up from 24 GB in 2016

By 2021
3.5
networked devices and connections per person
up from 2.3 in 2016

By 2021
80%
of all Internet traffic will be video
up from 67% in 2016

By 2021
53Mbps
average broadband speed
up from 27.5 Mbps in 2016

By 2021
20Mbps
average mobile. speed
up from 6.8 Mbps in 2016

Traffic from wireless and mobile devices will account for more than 63% of total IP traffic by 2021. Smartphone traffic will exceed desktop traffic by 2021. IP video traffic will be 82% of all consumer Internet traffic by 2021, a trend currently seen in many Asian countries. Audio data will reach and may even exceed 50% of the overall global video data traffic load.

How do you resolve this without slowing down the introduction of new, innovate, and media rich technologies? Logic would dictate that there are three basic approaches to consider :

1) Increase available bandwidth.
2) Improve efficiency and speed of existing bandwidth.
3) Improve transmission methods, and make the transmissions smaller; more efficient.

Many companies have tried to address the economic and communication limitations imposed by the various infrastructures by utilizing different transmission and compression methods, delivery techniques, and caching technologies. Each have their own particular attributes and no one approach is perfect as it often results in a trade-off between quality (loss of) versus speed and efficiency.

Challenge : The Mobile Cellular Problem

With the projected explosion of Internet traffic; data loads and global data consumption approaching 3.3 ZB (billion of Terabytes) by 2021, where data video will account for 82%; network operators are quickly recognizing that a new approach of blending high-capacity connectivity with lower cost, and the ability to generate revenue off the content itself, will be required to profitably sustain these endeavors. It becomes imminent for the Communication Service Providers (CSP), and particularly the Mobile Network Operators (MNO), to look for and find a solution capable of sustaining such dramatic growth, and avoiding spectrum saturation and overload.

The inherent limitations of today's mobile wireless cellular frameworks (including upcoming 5G networking) are that they struggle to solve quite many real world challenges, including:

- Inconsistent data rate throughout the coverage area (~100:1 cell center to cell edge).
- Poor cell-edge performance that degrades even further by inter-cell interference.
- Poor performance in high-density user scenarios due to bandwidth sharing.
- Limited and inconsistent capacity gains through MIMO (only up to 4x over SISO).
- Spatial processing (MIMO, CoMP, beam-forming) highly sensitive to Doppler/mobility.
- Poor vertical 3D performance in high-rise buildings.
- Inability to accurately determine user location.
- Cellular transmissions is vulnerable to interception and decryption.

To overcome these challenges while cutting their operating and capital expenses, the stage is set for newer technologies that will:

- Optimize the Big Data flow and network operations, changing it to more technologically advanced software defined and AI managed architecture.
- Real-time intelligent computing for increasing the spectral efficiency of LTE and Wi-Fi Systems.
- Video and audio data reduction and correspondent content acceleration.

Approach : Network Virtualization

Cellular Service Providers (CSPs) and particularly Mobile Network Operators (MNOs) are on an inevitable march towards virtualization as IT hardware infrastructure, including compute, storage, and IP traffic policy control functions, continue to grow and expand in their functionality, to keep pace with the technological change. The networking itself is the next logical area where network operators can virtualize. As applications increasingly tax networks for bandwidth, flexibility, and speed, the notion of overbuilding networks to accommodate peak traffic loads becomes untenable and unaffordable. It is no longer acceptable to purchase application-specific hardware, engineer, and configure it for that unique application, and expect it to be in-service for 10 years or more. What is needed is greater agility and control of the network and its core functions. This virtualization implies programmability using AI driven software to control key aspects of the networking process.

Today, many network functions are implemented as special-purpose, custom-built devices. These devices have custom hardware, firmware, and chipsets that help accelerate performance. Using Network Functions Virtualization, more and more of that same functionality is being implemented in software rather than in hardware; where network functions that previously were possible only via highly customized hardware and software can now be implemented totally with software alone. This basic fact drastically changes the network landscape for communication service providers, MNOs, and other network operators.

Following the recommendations of the **(ETSI)** and the **(ISG)**

Following the recommendations of the European Telecommunications Standards Institute (ETSI) and the Industry Standards Group (ISG), Network Functions Virtualization has emerged as the means to virtualize network functions over Software-Defined Computing.

Network Virtualization gives service providers and operators the opportunity to lower their network infrastructure costs while speeding up the configuration and deployment of new network services. This new, more flexible, software-based network service environment allows service providers and operators to quickly spin up new network services such as cDM Cloud, shortening the process from months or weeks, to days or even minutes. This business agility creates a significant competitive advantage as it allows network operators to pursue new markets and opportunities that were not economically viable using traditional networking hardware and software, and do so much more quickly.

The New Frontier

D9namic utilizes the next evolution in content transport that delivers High-Fidelity music and other types of media over the internet as small bursts of data in a fraction of the time and bandwidth it takes to stream. Data Bursting represents an innovative and proprietary approach to media consumption and social communications. The following section describes the components that form the building blocks of this revolutionary new method of data transmission over the internet.

Communications Layer Solution

The cognitive Data Management (cDM) Cloud

The cognitive Data Management Cloud (cDM) is an AI-based, cloud computing data management ecosystem that solves the media delivery challenge for modern networking and Big Data marketplaces by focusing on data reduction, data acceleration, data storage, and data security. Driven by principles of chaotic information processing, nonlinear system dynamics, evolution algorithms, and a proprietary mechanism called MSML formalization (multiple structure / multiple level) the cDM Cloud achieves brain-like processing capabilities that result in highly efficient information handling. This capability is a direct result of computing with complex information systems that take the form of harmonically structured digital data sets.

The **cDM cloud** is capable of **significantly reducing** the amount of data

Inherent to this efficiency, the cDM cloud is capable of significantly reducing the amount of data (information volume) that has defined an original harmonically constructed signal, while preserving its information value [read: smaller file size, without loss of content quality]. This process not only allows for a reduction of the media-data, but is also important in the associated development of highly efficient multimodal data transportation mechanism, as well as an inter-media, inter-data synchronization capability. This means that various types of data; and specifically media from different location sources distributed across the globe; can be transmitted faster and synchronized on a user's receiving device, on demand via the Internet, while automatically accounting for all the inconsistencies over the data delivery path in real time.

Inherent to this efficiency, the cDM cloud significantly reduces the amount of data (information volume) that has defined an original harmonically constructed signal, while preserving its information value (e.g. smaller file size, without loss of content quality). This process not only allows for a reduction of the media-data, but is also important in the associated development of highly efficient multimodal data transportation mechanisms, as well as an inter-media, inter-data synchronization capabilities. This means that various types of data, and specifically, media from different localized sources distributed across the globe; can be transmitted on demand faster and synchronized via the Internet on a user's client device while automatically accounting for all the inconsistencies over the data delivery path in real time.

Harmonic Data

In order to take advantage of the facilities provided by the cDM Cloud, digital information must be harmonically structured. This data, when seen as complex information systems, can be represented as a set of differential equations similar to those used in Quantum Electronics to describe quantum system behavior. Here the threshold energy value is defined as an acceptable probability of an event where random chaos fluctuations are recognized as acoustic or a visual structures and are determined by performing a computational experiment or by direct application of a theoretically-derived formula through a process that includes the calculation of

the surface area of n-dimensional sphere (Sn) of a single unit radius in a time-frequency domain, using the following implicit function.

Let P be a probability of occurrence of structure f in totally chaotic signal x. Assume an N-dimensional vector. Consider the sphere has a structure with classifier f, if the ratio of energy M of its first components to its total energy is less than k. In this case the explicit expression of probability of occurrence of structure can be calculated as:

$$P(N,\ M,\ K) = \frac{S_{M-1}\, S_{N-M-1}}{S_{N-1}} \sum_{1=0}^{N=M=1} \sum_{q=0}^{M=1} \left[\frac{C^{1}_{N-M-1} C^{4}_{M-1}}{2^{N-2} i^{M} (2l+2q-N+2)} (-1)^{M-l-q} \left(e^{i(2l+2q-N+2)\arcsin\sqrt{k)}} - 1 \right) \right]$$

In case the indices in the sum terms possess the values 2l+2q-N+2=0 the following replacement is made:

$$\frac{e^{i(2l+2q-N+2)\arcsin\sqrt{k)}} - 1}{i(2l+2q-N+2)} - \arcsin\sqrt{k)}$$

Sn – is the surface area of n-dimensional sphere of a unit radius and is determined as:

$$S_{2\int} = \frac{(S\pi)\,(\int-1)\int}{(2\int-1)\int}, S_{2\int+1} = \frac{2\pi^{\int+1}}{\int!}$$

where K is the targeted energy threshold of the first M components of an N dimensional vector divided by total vector energy.

As a result of this process, cDM neural net can compute a new set of data representing the original signal with significantly reducing data set (information volume) that has defined an original harmonically constructed signal, while preserving its information value. This process not only allows for a reduction of the data, but is also important in the associated development of highly efficient multimodal data transportation mechanism (which aims for self-forming, self-configuring, and self-healing system where the media and communications channels undergo rapid changes, where broadcasting nodes are freely enter and leave the network), as well as an inter-media, inter-data synchronization capability. As identified above, this means that various types of data; and specifically media from different location sources distributed across the globe; can be transmitted on demand faster and synchronized on a user's client device, while automatically accounting for all the inconsistencies over the data delivery path in real time.

Active Fluid Sync

The network is also able to: identify and forecast network conditions, including node-to-node communications and its corresponding performance; adapt to constantly changing conditions and balance the needs of many users while complying with their rules-of-engagement; and intelligently utilize multiple interacting capabilities for situation assessment, planning, and prediction.

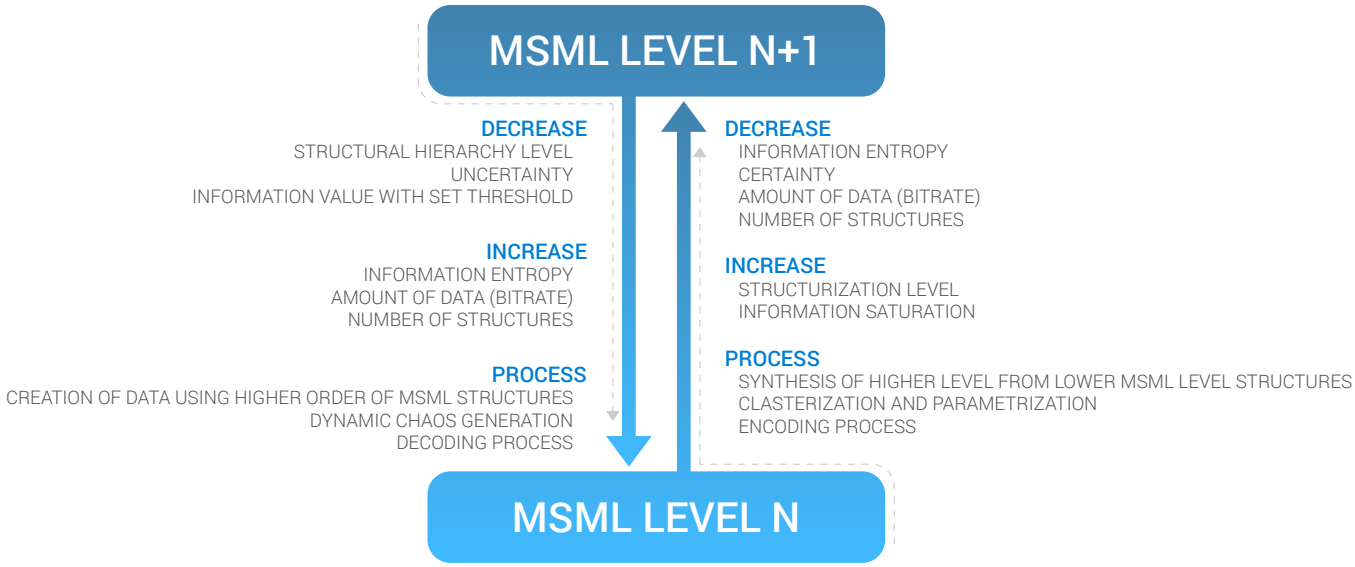
One of the key core technologies of D9namic data synchronization process is the technology called Active Fluid Sync (AFS). This is where two harmonically constructed signals are coordinated by their spectral data representations, even, when such correlations are very weak. Using a method for calculating the ratio of a frequency to the sum of its neighbors for each individual frequency Sm(w) allows the system to "equalize" distortions making them virtually disappear.

$$Sm(w) = \frac{S(w)}{\sum_{k=-r}^{r} s(w-k)}$$

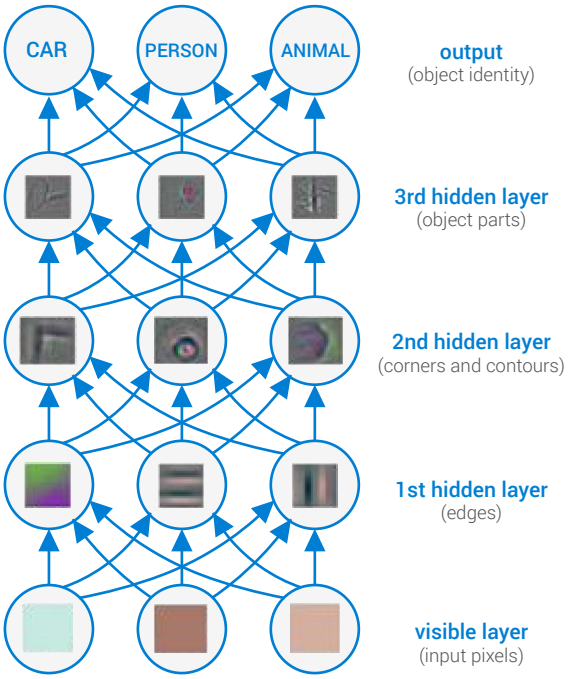
The resulting correlation requires large number of samples to be calculated. For this purpose the D9namic cDM cloud simplifies the analysis and generates identical spectrums from the signals with different frequencies by taking identical time-interval data, calculating the discrete sets of the derivatives of the continuous spectrum (the larger number of calculations - the higher accuracy of the result is achieved), and converting the spectral coefficients in areas of corresponding grid frequency of sampling, thus closing the existing “gap” between two signals with every cycle, eventually synchronizing them.

MSML Formalization

In order to describe how the cDM computes with harmonic data a system needs to be defined that can succinctly determine and quantify the extent of the information received . To do so, a new formalization framework was constructed to represent audio and visual harmonic data (see diagram below). This process was developed by utilizing deep learning, in which the zero-level MSML is the input of a neural network, and the highest MSML levels are the output layer thereof.



Deriving this formalization in the context of musical compositions (see diagram below) the input values become the sampled signal (instead of "input pixels") and the recognized words of the lyrics or sound melodies become the "object identity" at the output.



Specifically, the formalization process for audio is derived and trained using two General Adversarial Networks (GAN). Here one neural network generated the believable music, while the other tried to distinguish it from the real composition. After millions of trails, the final process was discovered and optimized giving the cDM cloud the ability to compute with non-linear

dynamic systems (harmonic data) resulting in increased data compression and improved content reproduction quality.

Alsom, correspondingly trained, similarly constructed neural nets will make possible to utilize the MSML data reduction Engine for the translation of many forms of disparate data (audio, video, etc.) allowing new patterns/relationships to be detected, thus reducing the overall amount of data storage/transmission necessary.

Limited Data Embroidery (LDE)

As described above, Limited Data Embroidering (LDE) mechanism allows data to be embroidered into a harmonic signal (for example, a music file). Such embroidering is inaudible across the entire frequency spectrum and agnostic to digital and to sufficiently high quality digital to analog transformations. As a part of the embroidered data, for example, information about which devices were used to encode and decode can be added for superior content protection or even a random data (text) can be encoded and inaudibly carried out within the signal itself for its secure deciphering on the recipient end.

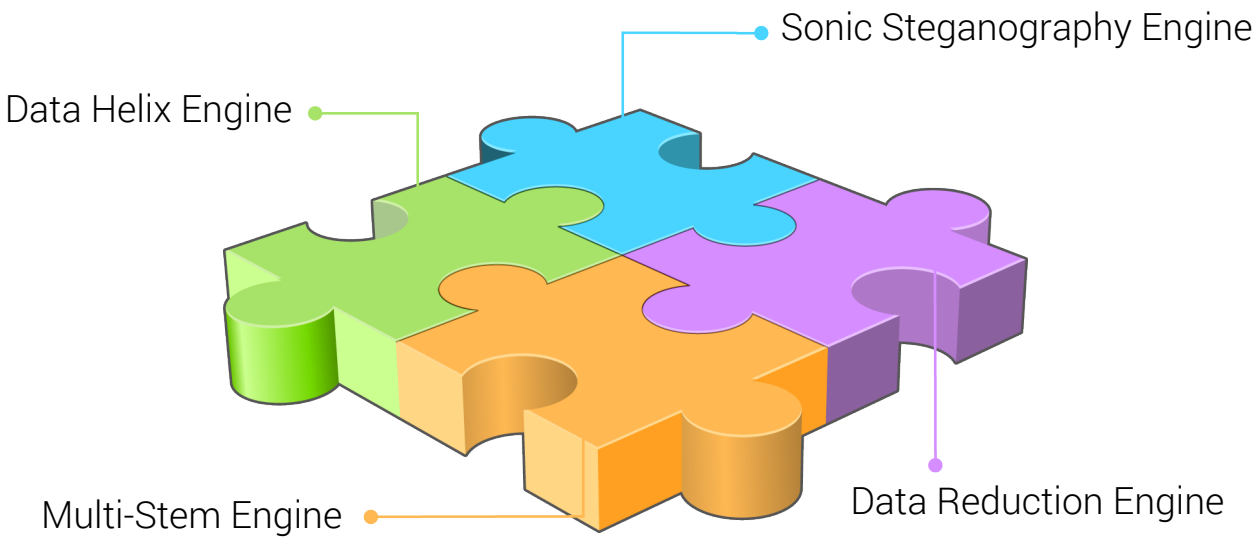
The **cDM** is capable of embedding any information represented in a digital form as a **harmonic structure**

The LDE invention is primarily designed to add (embroider) hidden data in a harmonically constructed singal, for example, an audio file that transmits that data over analog or digital communication channels with eventual extraction of such hidden data. A neural network trained to perform these functions adds the hidden data using psychoacoustically optimized quantization thresholds. As a result, storage of a hidden data, for example, data about copyright, license, etc., is performed in a perceptually indistinguishable and non-extractable way if the key that is used to generate the reference pseudo-random data is not known and, at the same time, is resistant to various distortions of the signal that carries it.

The cDM is capable of embedding any information represented in a digital form as a harmonic structure. This approach utilizes an audio file for secure storage and retrieval of sensitive personal information, for example, banking information, without being detectable except by special LDE decipher software. This allows the utilization of any music file as a kind of acoustic QR code with special references. In the future, there auto acoustic references will work even with voice payments, that will flow as a natural conversation, like the one we might have with a human personal shopper or a bank employee.

Data Layer Solution

The Cognitive DynamicMedia Processor



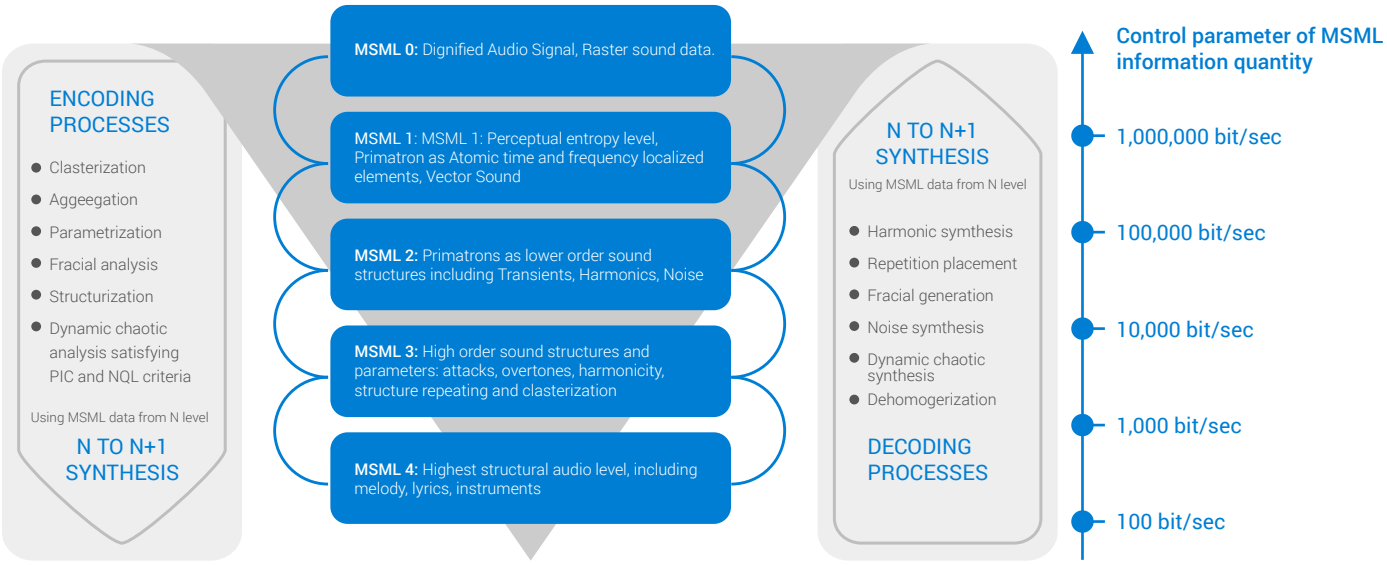
The cognitive Dynamic Media Processor (cDM Processor) is at the heart of innovation utilized by D9namic. It is engineered based upon theories drawn from quantized (discrete) information processing, dynamic chaos, neural-networking and evolution algorithms. These theories create the base for a proprietary digital genetic-lice algorithm where data is represented as a complex information system, rather than a linear/flat representation, like that of current methodologies.

The cDM processor can be viewed as an extremely sophisticated “fractal-like” sound object resynthesis system that offers an unprecedented number of arrays consisting of: (i) multi-waveform “harmonic” generators, with “intelligent” small step pitch envelopes; (ii) “intelligent” volume envelopes; and (iii) phase inverters and amplifiers. During re-synthesis, the output is passed through multi-mode lters, where adjustable 'intelligent' modulators allow the manipulation of parameters until the regenerated sound becomes sonically indistinguishable from the original. Instead of using a single “model” to analyze and recreate all the sounds presented to it, the cDM Processor is simulating a form of brain-like processing, called a neural net, to create unique models for each and every component of every sample.

The cDM processor itself consists of 4 key modules: 1) The data reduction engine; 2) The Multi-Stem processing engine; 3) The Data Helix rendition engine; and 4) The Data Steganography Engine.

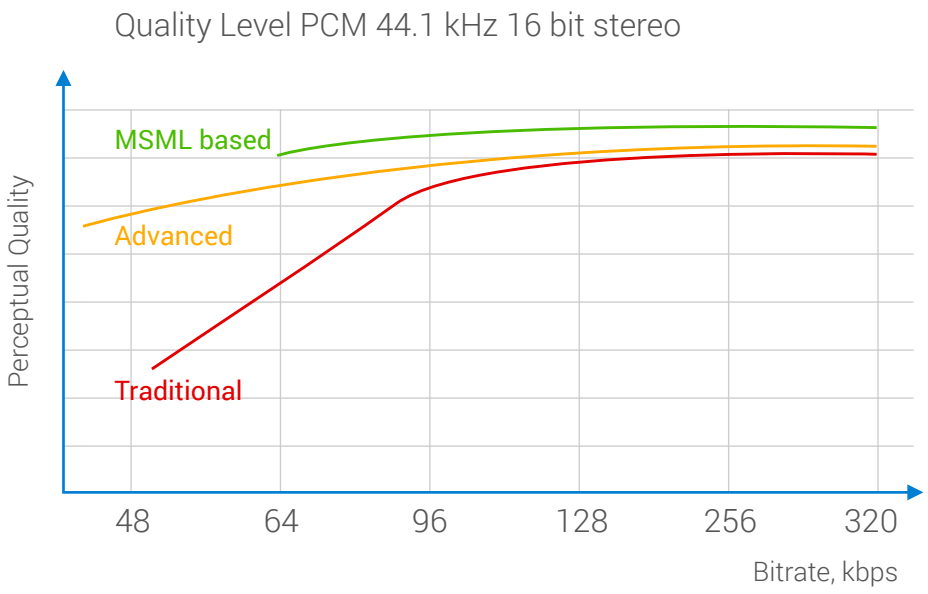
The Data Reduction Engine

The Data Reduction Engine performs the analysis, decomposition, and reconstitution of digital media using the previously discovered principles of MSML information formalization, structuring, and processing. Functioning much like the brain, the data reduction engine performs complex hierarchy processing while retaining the associative representations of data relationships that can be reconstituted when called upon to "synthesize" the object in question. For example, acoustic data is represented in a 4-dimensional space consisting of time-, frequency-, amplitude-, and information value-localized objects. This innovative and novel approach has enabled unique ways of storing and retrieving information that produces drastic reductions in size of the original inputs, without perceptual loss of quality.



Information quantity decreases with increase of MSML level hierarchy

The engine controls the process of audio data reduction across all hierarchy layers to reduce information quantity at every next layer of associations, while preserving the information value at each level within the frames of allowable deviation (see image above). Starting with a non-compressed data set and using MSML (multiple structure / multiple level) processing methodology, the resulting audio has the highest to-date quality/bitrate ratio, even with a 20X reduced dataset, when compared to the quality of conventional 256 kbps and 320 kbps signals.



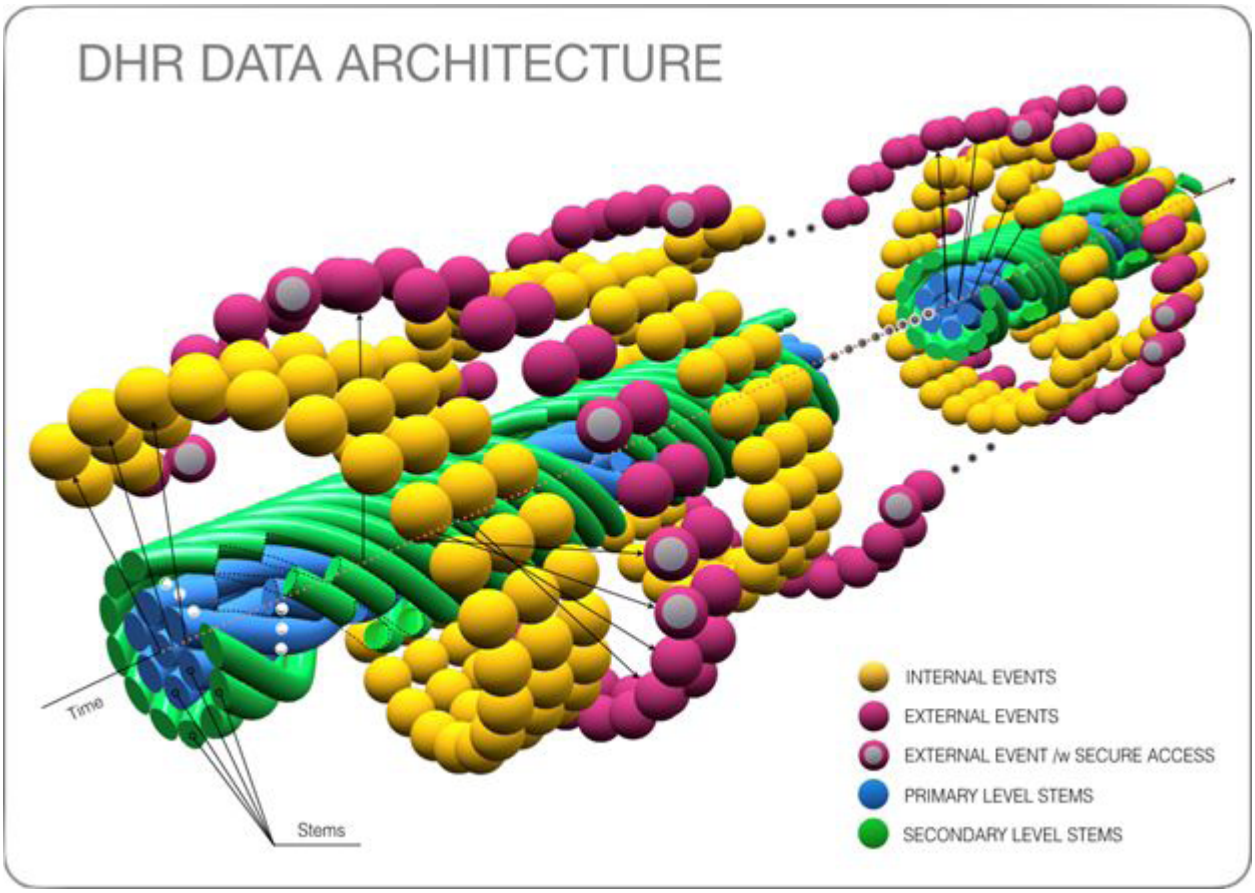
The multiStem Processing Engine

The multiStem processor uses fractal modelling and novel principles of stochastic modes in non-linear systems (known as dynamic chaos) to dramatically reduce computational complexity and improve processing speed of the underlying media format. Fundamentally, the processor is able to ingest complex maps of relational data , and operate with it from a programming standpoint by performing analysis on various portions of the media and linking them to codeable objects. Under the hood, it acts as an extremely sophisticated “fractal-like” object resynthesis system, allowing for unique ways of digitally operating with media.

The multiStem Processing Engine that supports D9namic enables unique capabilities for the next generation of digital media. DualStem mode allows extraction and manipulation of media without creating audible and visual distortions in the original media data fabric. For example, a stem of a single instrument or a vocal performance can be extracted from an entire composition with an overall final bitrate that is much smaller than a simple combination of the two stems. This feature is extremely important in re-creating a live presence experience in sound driven games, movies, sports and musical scores for mixed reality systems. Similarly, with regards to the media-delivery challenge, this new type of media functionality creates new monetization opportunities while still retaining the systems drastically reduced bandwidth and operating costs.

Data Helix Rendition Engine

The Data Helix Rendition (DHR) Engine combines the cDM transformed digital data with existing programmable objects in a way that allows for easy storage, retrieval, synchronization, and operation within a distributed network of machines. The “data supporting the multimedia may be tunneled via an integrated two-way information channel (“data-helix wrap”), along with the corresponding data that represents the various structures of the media fabric, supporting systems, and methods for unification of end-point measurements and outcomes, despite chaotic personalization inputs.This data-helix wrap includes data gathered during the MSML formalization synthesis process, and any external information that is linked to the media .



With respect to audio, DHR represents innovative way to construct “poly-directional” multimedia experience. Formalized as a digital DNA-like process, it performs fully synchronized construction and playback of the complex audio-visual experience, dynamically choreographed by the playing music, while simultaneously securely carrying any sort of metadata related to the playing content. Such data Helix wrap substantially increases informativeness and personalization of the received media, further enhancing its entertainment and monetization capabilities.

Sonic Steganography Engine

The Sonic Steganography Engine (SSE) can encode inaudible blocks of data and embed them into the harmonic fabric of a meaningful signal (for example, a music file). Using phase distortions within the signal that are minimally sensible to a typical human ear, SSE embroiders data into the audio harmonics, which means that blocks of data can be incorporated into an audio file that become not only inaudible, but also many times lower in energy than the typical distortions of any modern recording equipment, diverging by tens of decibels below the level of typical recording noise. It is important to note that these blocks can only be extracted from the media file using special deciphering software.

The deciphering software extraction process is done using a correlation function with adaptive pseudo random filters that have an ultra-large base, where the autocorrelation function

$$\Psi(\tau) = \int_{-\infty}^{\infty} f(t) f^*(t-\tau) \mathrm{d}t$$

of the pseudo-random signal containing thousands of samples has one major maximum hundreds of times greater than the side lobes. As a result of this convolution

$$\int_0^x f(x-y)\, g(y)\, dy.$$

of the Sonically Steganographed audio signal with a security key representing a special pseudo-random sequence, it becomes possible to extract the added so called LDE (Limited Data Embroidering) data despite not only the signal, but even the signal interferences being many times greater in amplitude, when the exemplary pseudo-random sequence matches with that recorded in the signal, allowing corresponding neural network to obtain the peak of the autocorrelation characteristic that is hundreds of times greater than the amplitude of the latent signal.

As a result, any deciphering device which does not “know” the original pseudorandom sequence will not be able to differentiate between useful data and meaningless background noise. Also, the human ear cannot hear any distortions in the adui signal or observe any difference because the energy level of the added signal is below the level of any distortion created by the signal transformations due to the over the air transmission.

Implementation of the following principles gives the system a minimum level of computational complexity in the process of adding sonically steganographed information into data that represents a harmonically constructed signal that:

- uses decoded data for Sonic Steganography superposition prior to the inverse discrete cosine transform of MDCT (Modified Discrete Cosine Transform)
- adds LDE data to the lowest audible portions of the spectrum
- and uses pseudo-random phase modulation for the hidden addition of LDE data

Supplemented by a number of other proprietary details, the Sonic Steganography Engine is an essential part of the cDM processor which can also be utilized to securely add, store, and transfer data that cannot be detected and decoded unless the keys (both private and public) used to generate pseudo-random sequences are known.

Application Layer Solution

Any application running on the cDM Cloud on a user device becomes part of the cDM Multi-model Delivery mechanism, which is controlled by the cDM suite of software defined intelligence module called MediaToll.

cDM Cloud Media Toll

The MediaToll plays a central role in powering the D9namic cDM Cloud intelligence application layer by integrating a content controller system that will consist of an array of licensing, blockchain, database, e-Commerce and security software solutions. This technology stack, utilizing blockchain principles, will help content providers to tackle basic media issues such as media/content protection, licensing, distribution and payment collection. Content providers will manage their own business models and licensing profiles. It will provide real-time access to content provider's accounts, media usage statistics, GeoBorder policies, billing functions, and software updates. All will be recorded and managed on the blockchain to ensure security and immutability via a decentralized ledger.

Implemented as a suite of cloud based software defined modules, MediaToll will also provide communication and coordination between entire set of the D9namic cloud based data handling components, including the: Data Transcoding Engine; Content Distributed Storage (CDS) db Engine; D9namic Authorization and Security Engine; and Users' dataBANK Engine.

Inside the cDM Tollbooth, the functionality of transcoding and media identification is handled by the Data Transcoding Engine, that can extract metadata from the processed file, such as publisher's data, content descriptions, artwork, etc. from various verified public and commercial source.

The important part in the D9namic encoding process is generation of audioDNA data. This is handled by CDS db Engine which generates unique identifiers and stores the corresponding database records. These records contain whole sets of data related to the unique D9namic cDM Cloud data object. The MediaToll CDS has complete set of APIs allowing related applications including web clients to access full set of functionality to add, remove, and edit creative content and its metadata.

The cDM Cloud **security**

The cDM Cloud authorization and security engine handles D9namic users accounts including registration, secured authorization, account permissions based on public data security rules and local user's permissions.

The Users databank (UDB) Engine dynamically collects and monitor users' activity and data in terms of system specific services including registrations, subscriptions, content purchase, distribution and storage, acquisition, ownership and exchange of the ecosystem vote and utility tokens. The UDB provides the means for platforms users to securely keep and monitor their activity throughout the wealth of the D9namic ecosystem services, related to media/content protection, licensing, distribution and payment, as well as converting the acquired data into an anonymous graph for "big data" analytics. Think of this as a blockchain wallet on steroids.

The D9namic Media Ecosystem (DME)

The DME is effectively a hybrid smart contract-based voting and project participation mechanism that operates both with blockchains that support ERC20 token like functions and its own Proof of Stake blockchain. This respectively allows participants of the ecosystem to vote on various ecosystem decisions and transmute their stakes into future projects that are built utilizing the core technology stack. The DME uses the public blockchain and its inherent properties for consensus computing to enforce the correct execution of the DME voting protocol, which means the DME does more than just utilize the public network as just a publicly viewable repository of vote counts and balances. Combined with the internal D9 blockchain staking and transmutation mechanics, the DME represents an evolution in the category of utility tokens.

Voting

The DME can in part be viewed as a decentralised and self-tallying internet voting protocol with maximum voter privacy using the public blockchain. The first half of the D9namic Media Ecosystem and its D9 token is created to guide the development and aid in decision making of the technology ecosystem - this includes things such as which projects should be focused on; how resources are utilized post the initial token distribution; and other high-level decisions that impact the health of the overall ecosystem and its participant communities and platforms. The process itself is written as a smart contract and unlike previously proposed Blockchain e-voting protocols, the DME does not rely on any trusted authority to compute the tally or to protect the voter's privacy. Instead, the DME is effectively a self-tallying digital contract where each voter is in control of the privacy of their own vote. The execution of DME contracts is enforced using the consensus mechanism that also secures the public blockchain.

It is critical that any kind of participant in the ecosystem, whether large or small, have the guarantee of privacy. With the DME's implementation of a two-round voting protocol and zero-knowledge proofs, individual votes can only be revealed by a full-collusion attack that involves compromising all other voters. And while all individual voting data is private, the collective voting data is publicly available and the DME protocol allows the tally to be computed without requiring a tallying authority.

Voting Example

An individual stakeholder selects from a template of existing smart-contracts with variable parameters that can be controlled by said stakeholder. These templates will first be limited to Value-Transfer, and later be expanded to community specific directive contracts, code change charters, and other custom contracts. In order to officially submit the smart-contract up for voting and depending on the type of contract and variables involved, the stakeholder must contribute a predetermined amount (based on the complexity of the contract and the cost of supplying computing power on the public blockchain) of the D9 token to be locked inside the contract. This deposit mechanism is used as a means to prevent spamming inside the network and will be constantly calibrated. A small fee of 0.25% is imposed onto the token deposit used to create and initiate the contract, which go to the continued development of the ecosystem.

Once the contract and parameters are decided, paid for, and posted, the next step requires participants of the DME to decide whether or not the original contract should be executed or not - thus starting the voting process. Here, participants register their intent to vote on the specific outcome - in this case let's assume it is a resource distribution from the main pool of collected funds to a specific platform within the ecosystem. In exchange for registering their intent to vote, the DME generates a series of keys and creates the conditions for a zero-knowledge proof using certain Transaction ID components of the public blockchain. Every registered voter then broadcasts their voting key and their zero knowledge proof on the DME public bulletin board. To ensure authenticity at this stage, the system ensures that all voters check the validity of all zero knowledge proofs before computing a list of reconstructed keys. Next, the voting actually takes place and every voter broadcasts their new public voting key and a solution to the zero-knowledge proof that verifies into either a 0 (no) or 1 (yes) condition. This concludes the voting procedure; the tally is computed, and the subsequent contract is either executed or discarded. The original D9 tokens locked inside the voting contract (less the fee and final costs of the vote) are then returned to the individual stakeholder.

Transmutation

Outside of using D9 coins to create and vote on various smart-contract actions, holders of the D9 token have the ability to initiate one-way transmutations of the D9 token into other sub-ecosystem-tokens that are created by a specific project(s) built utilizing the core technology.

The price of the **D9 token** on the open market

For example, if a user holding the D9 token is interested in a project being built inside the DME, they would stake a specific amount of D9 tokens for transmutation. This is done by sending the D9 to a particular burn address through a smart-contract that, in return, will send a predetermined number of project-specific tokens. The exchange rate of the D9 ecosystem token to the project token will be based of the initial fiat offering price of the project token (set by the creators of the project and hard-coded into the exchange-contract), and the price of the D9 token on the open market.

As an economical by-product of this one-way transmutation, project tokens within the DME would only ever have one specific fiat dollar value. This means that the internal economic systems of the communities and platforms built using the core technology do not have to worry about floating rates for their in-platform currency, thus exponentially simplifying the mechanics and incentivization problems inherent to a tokenized project.

D9 Distribution & Staking

Since the D9 token is inherently a Proof of Stake ERC20 like utility token used for voting and decision making, the typical consensus mechanisms are implemented. So unlike proof-of-Work, where the algorithm rewards miners who solve mathematical problems with the goal of validating transactions and creating new blocks, with proof of stake, the creator of a new block is chosen in a deterministic way, depending on their total balance, also defined as stake. This means that in the PoS system there is no block reward, so with the DME blockchain the miners take the transaction fees. It is important to note that only coins that are staked for transaction processing and validation are eligible to receive the transaction fees, D9 tokens that are freely held inside private wallets or inside voting contracts or have been transmuted are not included in the function of the Proof of Stake consensus algorithm.

The First Community - PulsBeat

Now that the potential and usage of the technology and the ecosystem has been articulated, it is time for D9namic to introduce a down-to-earth, consumer friendly platform that focuses on the realm of digital entertainment, more specifically music. PulsBeat is the culmination and practical application of the full stack of technologies described in the previous parts of this whitepaper and is aimed at delivering an unprecedented experience where Audio, Video, Gaming and text are combined seamlessly into an efficient mobile experience. Behind the scenes, AI network routing, data compression, secure and accelerated data delivery combine with the unique capabilities afforded by blockchain technology to bring about a revolution in the way the world will manage, consume, exchange, experience and monetize music.

Advantages Provided by Core Technology

Let's start with the advantages of using the core technology when it comes encoding/decoding audio content based on its ability to break down the content into harmonic patterns:

- Highly precise recognition of information objects and their sequences **(audioDNA)** within an audio/video track via a mobile device **(hundreds/ thousands of times better resolution time-interval identification than currently available audio identification technologies)**
- New ways of envisioning audio data via AudioDNA sequencing **(providing the means for efficient content identification, searching and tracking throughout the DME ecosystem)**.
- Compression of content via the data reduction engine results in content that is delivered in smaller, faster bursts of data, allowing for large volumes of data to be transmitted quicker and more efficiently than ever before over cellular networks **(decreasing data costs)**.
- Dynamic pattern recognition allows for instantaneous real-time syncing of media content between multiple devices, networks, and peers **(resulting in unique monetization and entertainment experiences at large scales)**
- Thanks to the MSML principles, the resynthesis of audio content is possible **(resulting in a fidelity preservation of the original work with substantially less data)**
- As a result of the structure of the harmonic files created using the core technology, isolation of the various vocal and instrument tracks is possible **(allow for seamless creation of engaging entertainment experience such as "Instant Karaoke", dynamic guitar chords, music score, etc)**
- Similarly the ability to isolate and playback specific aspects of the work in real time such as just the vocal tracks, or a specific instrument, enhances what musicians and creators can provide for their listeners, **(helping in the creative and refinement process and facilitating in easy melodic learning by consumers and amateur musicians looking to replicate or practice with the original work)**
- The LDE process allows for the weaving of external data into content without affecting or distorting any of the sonic properties of the original media **(allowing for immutable evidence of content origin, content attribution, and content registration)**
- Real-time multi-peer and in-sync content sharing becomes instantly available to an unlimited group of participants regardless of their hardware, network provider, and or network conditions **(advancing the real-time social capabilities of media)** as a result of the AFS technology stack implementation.

Next, up is the advantages of using smart network routing and the unique delivery methodologies of the core stack for the music industry. As the demand for media rich digital experiences increases and the demand for faster delivery of larger, more intense datasets rises, the compression and smart delivery mechanisms of the PulsBeat network become one if its biggest advantages to meeting the rising demands. Thus the PulsBeat network is poised to actually competitively benefit from the increasing consumption of data over mobile networks.

- AI controlled networks allow for real time delivery of content, over the internet, from servers around the world **(creating a smart network that intelligently distributes resources and routes traffic as congestion and inefficiencies form)**
- Smart routing in times of distress **(allows for increased network uptime and reliability)**
- Meticulous balancing of network resources **(creates efficient delivery paradigms that decrease costs and overhead for small and large networks)**

High Definition Mixed audio-visual **reality experience**

Overall, PulsBeat is a platform designed for the digital distribution and delivery of Audio, Video, Entertainment, and related textual data to the mobile user of today as a unified High Definition Mixed audio-visual reality experience. The culmination of these technologies come together to deliver a level of mobile engagement previously not possible due to the constraints and economics of cellular networks, compression algorithms, audio encoding /decoding and network control methodologies.

In leveraging the aforementioned technological advantages to solve the technical issues of today's networks, PulsBeat is also created to address the biggest infrastructural problems plaguing the music industry today; that of IP Protection, IP Fair Payments, and IP Validation. The writings below looks to dive into the problem deeper and put forth PulsBeat as a solution that is both entertaining and inherently enriching to use.

Current Market Problems

As music moves from ownership to access, two of the largest issues facing artists in the music industry are Intellectual Property (IP) Protection and Fair Payments for usage. In 2016, of the $15.7 Billion in Global recorded music revenue for sound recordings reported by the IFPI, only a small portion of the money beyond the initial recording advances ultimately makes its way to artists as ongoing revenue. In today's digital age, release cycles are faster, online streaming

services that deliver content are proliferating and varying creative revenue and licensing structures are making finances and revenue structures harder to comprehend and execute faithfully. What artists need is an ecosystem where the revenue flows, content consumption and delivery and revenue sharing distribution is transparent and fair. An ecosystem built upon a blockchain for tracking the value chain from content creation to consumer, with the appropriate technologies, will allow for IP Protection, fair payment and transparency. In essence, a P to P business model which allows information such as where revenue splits go (micro-payments), where and when content is consumed is achievable in the RMC ecosystem.

In a world where 60.4% (2017) of the music industry revenue is derived from streaming services, tracking consumption in a real-time manner is a challenge. Previous industry attempts at implementing unique content identifiers, including the International Standard Work Code (ISWC) and the International Standard Recording Code (ISRC) were often met with differences from online content streamers who had their own unique methods of tracking and reporting. Additionally, other business models where digital purchases, digital rentals, subscriptions and on-demand consumption are all digital content delivery models that have differing economics. Imposition of the application of an identification and usage process ultimately led to disparate implementation that were incompatible and difficult to decipher. Ultimately, how the revenue flows depends on which entity in the value chain negotiated the license contract.

The audioDNA Blockchain Solution

PulsBeat's audioDNA blockchain will enable a radical departure from the aforementioned music industry business model. Enabled by technologies of tomorrow, PulsBeat is a data rich audio media ecosystem that allows for transparent and innovative revenue models; near instantaneous and fair revenue distribution; enhanced content consumption metrics, unique incentivization models, and utilizes novel revenue streams for solving the problems of media in today's world.

The audioDNA Blockchain Solution

The audioDNA blockchain distributed ledger platform solves the problems of IP protection, payments, and validations via the following functionalities: ability of multiple entities to publicly record and store ownership of content; transparent accounting of revenue flows and payments throughout the value chain; incentivized content creation and consumption. Outside of the functions that serve to deal with the current market landscape, the audioDNA blockchain will also be the ledger for the RPMcoins, allowing PulsBeat to shift away from centralized business models. PulsBeat also believes that this shift will allow for more direct relationships/interactions to form between the content creator(s) and the content consumer(s).

6 Tenets of Blockchain Enablement within the audioDNA Blockchain

- Transparency of revenue and payment flows between all parties involved
- Fair Payments done in an efficient, transparent manner governed by Smart Contracts
- More data on content consumption, usage, distribution, ownership
- Allowance for flexible, custom revenue business models via use of separate smart contracts
- Easy method for content creators to "register" their content and have it attributed to one or many entities
- Immutability and security, inherent within the blockchain

Transparency

As previously stated, the revenue and payment flows within today's music industry are inefficient, antiquated, complex and extremely hard to understand, especially for content creators. Having all revenues and payment distributions recorded on the blockchain will allow for a degree of transparency into the flows between parties. New models can arise whereby the large, unknown middlemen who used to receive large and often viewed of as unfair portions of the revenue stream, can now be sidestepped.

Fair Payments

With the registration of each piece of content by the content creator, a distinct Smart Contract can be created to govern the revenue, payment, attributions and limitations of use for the content.

Registration

The audioDNA blockchain will be used as a registry of content ownership with attributions to one or more entities. The audioDNA blockchain, along with an application front-end will allow content creators an easier method for content submission/ registration.

Immutability and Security

The inherent nature of the audioDNA blockchain will compliment the technology stack leveraged by the DME to further provide and enhance security of the IP and transactions via the immutability of the said blockchain. Blockchains are "holders of the single truth" because they are distributed ledgers that are written once and never deleted.

Increased Data

Use of the blockchain to record content creation, consumption, transfers, etc will all allow a data driven ecosystem whereby anyone within the system will have real-time usage data like how, where, and when a particular piece of content was consumed.

Differing Business Models

Like the legacy music industry, different platforms and methods of consumption may require different revenue/payment models. The use of Smart contracts will allow for the differing revenue models to be implemented by different content creators. Within the contract, the revenue splits can easily be defined, enforced and recorded.

Another change in the business model will be the inherent nature of the blockchain, allowing for incentivization throughout the value chain. Business models to increase listeners can be created using basic incentivization to increase "plays" of the content. Gamification of the process, using the pairing of a video game with music library could take place, thus increasing "listenership".

Distribution and Consensus - Proof of Authentication

The **audioDNA Blockchain** is a variation of the typical Proof of Work consensus mining protocol.

The audioDNA Blockchain is a variation of the typical Proof of Work consensus mining protocol. Instead of forcing nodes to solve complex, mathematically intense problems for a chance to generate some of the RPMcoin, and to have the privilege to add the next set of transactions into a new block, the audioDNA Blockchain requires miners validate community submitted content by temporarily dedicating their processing power to this task. During the validation state, the node connects to the core repository of content and begins cross-referencing in an attempt to either reject or confirm the submitted work as original. This requires that the node have the entire audioDNA Blockchain present on their local drive as well as other special requirements. This type of mining will likely result in specialized software and hardware that will only be utilized by a select group of participants. However, this is not the only way to process transactions and mine the RPMcoin.

Pooled Cloud Validation

In order for mining to be accessible for light users, there is an option to use a more centralized approach. Any mobile smart devices running the PulsBeat application can choose to dedicate the entirety of their processing capacity to the cDM cloud (likely to be one of the largest official nodes on the audioDNA Blockchain) which will then utilize the host node to help it with processing the audioDNA of the pending content against a database of known harmonic structures.

This means that even light clients can generate new RPMcoins, and validate transactions by diverting their mobile processing power to the official node during periods of low-interactivity (sleep). During the times in which the user transforms their regular PulsBeat application into a full audioDNAnode, the other functionalities of the platform can not be utilized - partial hardware utilization is currently unavailable, but will be possible with newer releases of the protocol.

Deflationary Payout

The payout to the mining node will be a function of the length and number of the audioDNA files being submitted and factor in the inverse of the time it took to reference the host databases for ownerships and harmonic structures (audioDNA). This implies that as the database grows, the payout to a single node from content submission validation decreases. This creates a deflationary economic balance to the system, similar to that of the Bitcoin Blockchain itself. As more users engage with the network, there will be an increase: in submitted content for authentication; the amount of content validating transactions to process; and the size of the reference host databases. Translating into the bulk of the reward being generated from the individual transactions of the ecosystem, but less mining rewards coming from validation of new content. There are other speculative results of this type of mining, but that is outside of the scope of this whitepaper.

Technical Considerations

In this case of PulsBeat to enable transmutation from the DME D9 token into the RPMcoin, straight blockchain technology, such as the Ethereum or Bitcoin blockchain will not be exclusively used due to inherent issues within each blockchain, notably increasing high transaction costs, delayed transaction times and an inefficient manner to support real-time micro-payments. The Bitcoin blockchain may be implementing the Lightning Network, but inherent design issues may still make this not a viable solution. The most notable issues will be with having to use a wallet that supports the Lightning Network, getting the Bitcoin to the Lightning network and what happens if the Lightning network node that your Bitcoin is on goes down.

D9namic based MediaToll solution that allows for off-chain transactions to occur efficiently

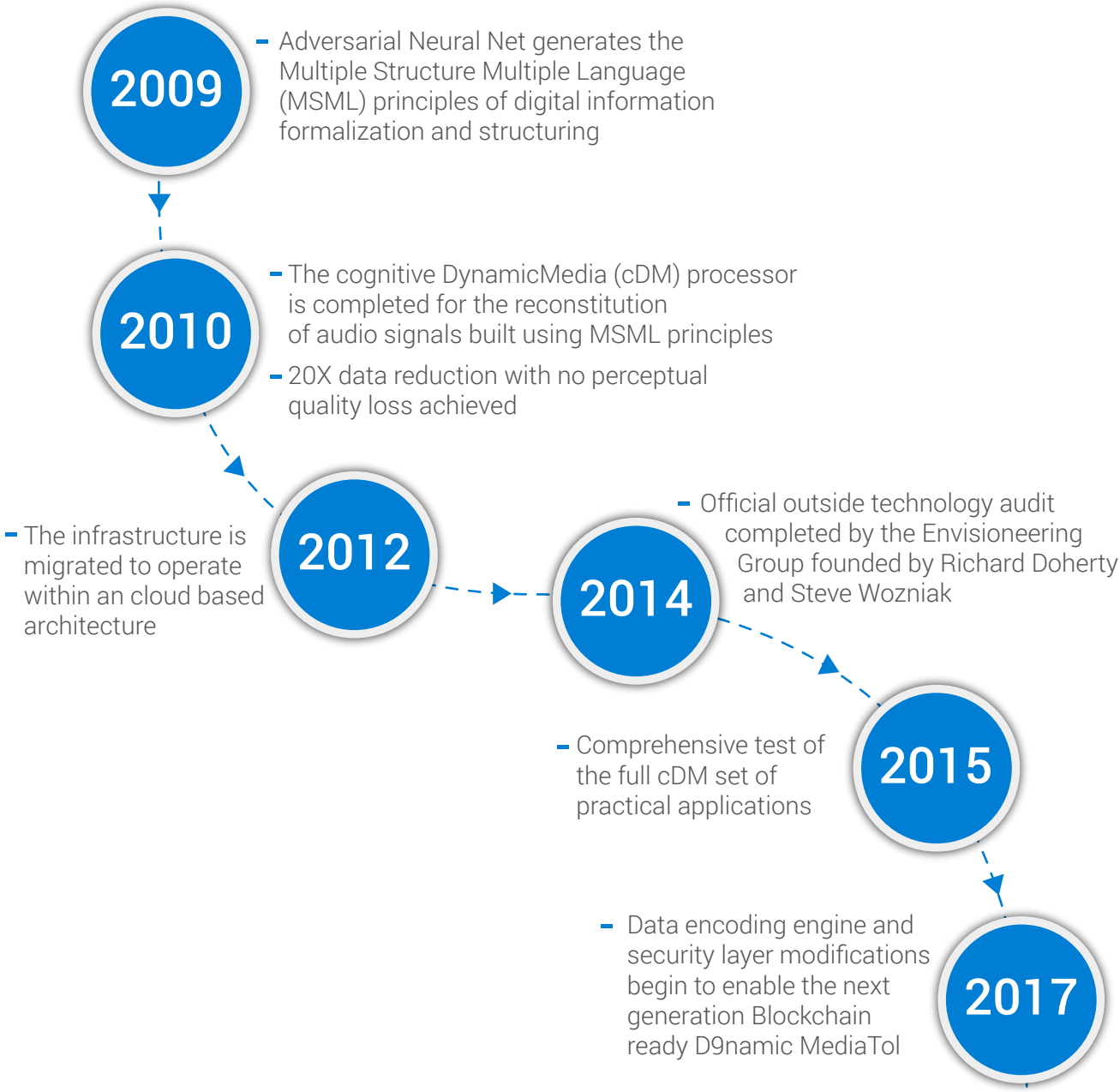
To avoid all of this, RPMcoins will operate on a sidechain which will allow for instantaneous micro-transactions at a lower cost as well as two way conversion of tokens between the main chain and the sidechain communities.

To decrease costs, improve transaction speeds and security, the PulsBeat platform leverages the D9namic based MediaToll solution that allows for off-chain transactions to occur efficiently. Very similar to how the Bitcoin Lightning network is intended to allow for faster, secure off-chain microtransactions, MediaToll was designed to handle real-time revenue splits, payments and accounting. Once a transaction has been completed in MediaToll, it will be posted, in summary, to the sub-community's sidechain.

Achievements and Roadmap

History

The underlying theories behind the D9namic technology stack can be traced back to the 1960's, where a prominent Russian physicist laid the groundwork for computing with nonlinear dynamic systems in the field of Quantum Electronics. In 2007, the theories were put into practice by a team of multidisciplinary scientists in order to create practical working technologies - the birth of D9namic. From there, the graphic below illustrates the evolution of these technologies until today.



Roadmap

Having build the foundational technology, 2018 will be the year in which these advancements are brought to the commercial market via a public distribution of the D9namic Media Ecosystem D9 utility voting and staking token to the community at large. The evolutions that follow after the release of the DME are subject to adjustment based on the inherent voting mechanism and are only estimated delivery dates based on expected technological and ecosystem environments.

Q2 2018

- Release of D9namic Whitepaper to the public
- Finalization of D9 ecosystem economics
- Test version of D9 voting platform goes into private alpha using Erc20 standard
- Community outreach and education campaign begins

Q3 2018

- Final platform for D9 token adapted to most efficient and secure blockchain
- Test of D9 voting platform goes into private beta using most secure standard
- Pre-Sale begins

Q4 2018

- ICO of D9 token
- Beta of D9 voting platform goes live to public

Q1 2019

- First official public resource distribution vote is conducted on the DME
- Framework for final mining mechanics is constructed for PulsBeat platform
- PulsBeat's pulsCoin utility token generation event
- PulsBeat alpha is released onto private test-net

Q2 2019

- Integration of AI based incentivization mechanics into PulsBeat begins
- Second official public resource distribution vote is conducted on the DME
- PulsBeat platform goes into private Beta

Q3 2019

- PulsBeat goes into select public Beta

Q4 2019

- PulsBeat Beta goes officially live worldwide
- DME opens for transmutation of D9 ecosystem token into other community tokens

Looking to the Future

D9namic represents a unique AI-driven digital ecosystem that is capable of providing advanced solutions for the modern digital marketplace in the areas of data reduction, data acceleration, data storage , community incentivization, user driven media economies, and data security. These solutions all stem from the innovation provided by the core mechanisms and technologies that run using MSML principles.

D9namic Media Ecosystem to create new disruptive models and opportunities

The capabilities of the D9namic cDM cloud when applied to the world of digital media, have currently been proven in providing superior multi-modal content acceleration and dynamic smart storage solutions, allowing dramatic storage optimization by building neuron-like connectivity between its content nodes, eliminating the necessity of storing multiple copies and facilitating the retrieval of such information coherently from different places at speed. The blockchain integration serves to advance the security, financial transparency, consumption mechanics, and IP registry tracking in the world of digital media. Yet, all of these aspect of the D9namic solution can actually be applied to many other fields such as: Medicine, Education, Fintech, Security, and Social Media. D9namic hopes that this technology will inspire the next wave communities to push the boundaries of what is possible and take advantage of the D9namic Media Ecosystem to create new disruptive models and opportunities inside new and exciting verticals.

D9NAMIC