Network

A Virtual Dream and Decentralized Brain Computer Protocol

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Abstract:

A decentralized brain computer network would allow anyone in the world to participate in exploring the frontier of the brain while creating a strong forcing function to accelerate the number of neurons we can currently interface with. A network of peer-to-peer brain computers would empower individuals to own the data that would flow between brains and computers. By creating a network of open, permissionless protocols for brain computers, a diverse set of stakeholders will govern and guide its future. Virtual dreams as a novel medium could become an alternative reality to explore the nature of reality and accelerate progress in the mind sciences. Other brain computer applications could be developed as tools for individuals to heal and liberate themselves and others.

Contents

Introduction

When Satoshi Nakamoto published the Bitcoin whitepaper in 2008, presenting a solution backed by code to an old computer science problem, he was able to create the foundation for an alternative system to the legacy financial system. Thanks to cryptographic breakthroughs that have been made over the last few decades, the leaders who built on Satoshi's shoulders continued and expanded upon her legacy by building an alternative, decentralized financial network. In a similar vein, there have been tremendous scientific breakthroughs in the world of neuroscience. We are witnessing the birth of brain computer interfaces and the beginnings of the brain as a frontier. The brain's great frontier is itself. We can now take steps to catalyze this neuro revolution by creating an alternative system which will accelerate our understanding of the brain and allow us to answer long-standing questions about consciousness itself.

In order to ensure that the light of consciousness stays on and the journey of humanity continues with its sense of exploration, curiosity and wonder as it has for the past centuries, we must build tools that allow us to journey inward. We will not solve some of our most important existential problems until we are able to come together and coordinate more effectively. In order to prevent historical loops of self-destruction, we need to increase our collective levels of consciousness. We must explore the true nature of reality and create tools to liberate ourselves from the infinite loops that run our lives.

We will create virtual dreams as a novel medium through an open and permissionless network in order to guarantee that dreams as they become virtual will be in the hands of the individual. Virtual dreams represent a novel mental model and means of expression by connecting to the subconscious part of ourselves.

In order to create a new world, we need to empower individuals to see themselves and the world with new eyes. This starts with seeing ourselves and the

world differently on an individual, local level. It starts with having awareness about the many loops that govern our reality. Only when an individual knows how to break the infinite loops that run their reality can we say that the individual has attained liberty. If we are not free from mental afflictions and continue to suffer in myriad ways, we are unable to enjoy the material wealth that we have created for ourselves. If we rely on dependencies to make us feel better temporarily, we only look out the window toward freedom but never open the door and go through it.

Since we began exploring the world, we have embarked on a journey of outward exploration. We have created material wealth for the ordinary person that kings and queens of past centuries could only dream of. For most of history we have been on a search for the expansion of matter and it has unleashed material progress that we have never seen in history. This journey continues as we yearn to continue our search amongst the stars and start civilizations on other planets. The dream to go to Mars is becoming reality.

Looking at the core of this exploration, the premise upon which this reality rests is that consciousness is a derivative of matter. And yet what if this is not true? If matter is merely a derivative of consciousness, then another journey awaits that will take us into into the opposite direction, the journey inward, of exploring the brain and beyond that the mind to ultimately discover the true nature of reality. There is already an alternative reality emerging and becoming visible if we pay attention and stay present to every moment. It has existed for a long time in plain sight and has eluded most of mankind throughout its history despite its search for answers to existential questions about life itself.

If we take a look at the progress of games over the last few decades, we can appreciate where we are headed. From the Gameboy to open world games to massively multiplayer online games, games have constantly improved over the last few decades resembling reality ever more. The day will come when games will surpass reality and we will improve upon them in ways we cannot imagine today. We already live in a world that offers virtual and augmented reality devices. Tomorrow we will have brain computer interfaces powerful enough to create

virtual worlds in which we will experience reality through an avatar that will feel more real than reality.

If we take a look at dreams they could become the symbol of this virtual world. For centuries dreams have been important in religions and cultures around the world, yet we have arrived in a world today, where we think dreams impart no meaning. We think of them as unreal and we usually forget them the minute we wake up. We lose our awareness while asleep and forget what happens between falling asleep and waking up. We feel that dreams have no value. And yet what if dreams are our vehicle to this new world. We invented and evolved film, music and games into rich mediums of communication. They are part of our language and we could not imagine living without them. They help us to communicate our feelings and what we want to express to others. They have become part of our culture. It is only natural that as we build better technology we will evolve the media of today and build something that is even richer and more immersive than what came before.

Despite the vast progress we have made in history so far, the next big frontier is yet to be explored. It asks us to look elsewhere, not outward, but inward. It is remarkable that despite the material progress we have made, we are at the beginning of exploring what still seems an invisible frontier. It may be counterintuitive but the brain's next great frontier is itself. Just as there is no limit as we look out to the stars and onto other planets, there is no limit to human imagination. We are at the beginning of discovering the true nature of reality. We need to look inward to finally find the answers to understand ourselves and dreams will be our vehicle to explore this new reality.

The purpose of this paper is to create a map for virtual dreams and the decentralized brain computer we are building. We will release separate papers in the future that will share implementations and frameworks of what this paper only outlines in theory. There are many pieces to this puzzle and as we progress we will provide more answers. Ultimately, we need to demonstrate that we can build the network not only in theory, but in reality.

The State of the World

Throughout history we have explored the outer world and achieved great material progress in many different respects. Indeed in the realm of matter, we have made discoveries and inventions that have improved our lives considerably. Most individuals have access to tools and technologies that generations of previous eras could not buy with any amount of money. The smart phone that we hold in our hands today gives us access to more information than what presidents had access to just a few decades ago.

The world was not always as interconnected and networked as it is today. There was a time when explorers still sailed around the world looking to discover new land. Today we have satellites swirling around the globe mapping out every square of land on this planet. For a long time in history most people did not have access to the most basic things that we take for granted in our world today. If we look at the big picture, we have certainly come a long way. Now we long to start civilizations on other planets in order to preserve the light of consciousness.

Leading humanity into space, Elon Musk is making life multi-planetary by establishing a self-sustaining city on Mars. Early in his life, he came to the conclusion that if we can expand the scope and scale of consciousness, we are better equipped to ask the questions about the answer, which is the universe. If we become a seafaring civilization, we are able to dramatically expand consciousness and life as we know it.

The quest to manifest outward has been astounding and it will continue to trend towards material abundance. There are still millions of people in poverty who are not part of the global economy. There are still many problems to be solved and inventions to be made to improve upon the human experience. Despite wars and turmoil, the train of progress has continued its march forward. In that way so much progress is still ahead of us and we stand at the beginning of game-changing inventions that will propel us to new heights.

In order to appreciate and preserve where we are, we must make strategic choices and create a sustainable future for everyone. We must move forward in a way that respects and preserves nature. We must think about future generations. What has propelled us forward for centuries to this date may no longer be sufficient to create the future that we need to build. We cannot sacrifice nature in order to achieve more growth. We need to create sustainable modes of harnessing the earth's resources and unleash the human spirit.

Our mode of outward manifestation has served us in many ways, yet it is not the only frontier that is possible to explore. In order to preserve the light of consciousness, starting a civilization on another planet is a noble cause. However, some questions we may only answer if we start to look inward. The answer to our problems is as much outside as it is inside of us. The world as much as we expand it outwards will never be enough. While it is certainly useful to go to other planets in order to guard against existential risk on this planet, we must start to see that there is another frontier waiting to be explored. It waits inside of us.

If we look at the mind, we must acknowledge that we have not made that much progress. We still know very little about the brain, let alone about the mind. As a society we have mental health problems that remain unacknowledged in the shadows of our economy. We do not spend enough resources searching for solutions to the mind virus that is rapidly growing in our world and from which hundreds of millions of people are suffering.

We understand this on an individual level. We live in a world where we have more stuff, but we are still not happy. We long for more yet more material things never fill that gap. The more we have, the more we realize that more never solves some of our problems. No matter where we go, we take our problems with us. No matter how much we accumulate in terms of resources of any kind it will never be enough. Until we realize that we must look inward, it is unlikely that we find the answers to some of our deepest questions.

We are standing at a time in history where the exploration of the mind and the journey inwards is yet to begin. Even if only few people are paying attention to this

invisible frontier, there is a deeper understanding behind the nature of reality. Throughout centuries, Tibetan Buddhists through the use of meditation and dream yoga have rigorously explored the nature of the mind.

The West in its search of material progress has not focused on this quest. If we look at the world's problems, many of them are of the mind and no matter how much we focus on matter, we will not solve them. We must shift our mental models to see ourselves and the world differently.

In some regard our technology exacerbates our problems and does not encourage us to look inward. It shortens our attention span, when we need tools to increase our attention skills. Unfortunately technology can also keep us away from the present. Despite being connected to each other through many different channels, we are still disconnected in many regards.

Above all, we are unable to break free from the infinite loops that run our lives. Every day we wake up and superimpose onto the world our perceptions that taint and misguide our lives. The longer we allow these infinite loops to run our waking reality, the harder it is to gain awareness and break out of them. In our unawareness, we have built these loops and without meditation or lucid dreaming it is difficult to become aware of our mental patterns.

As far as our understanding of reality is concerned, we accept reality as we perceive it to be, not as it is. The filters through which we perceive reality are so ingrained in our mental models of the world that it is difficult to see through them. These loops come to define us, rob us of energy and disable our ability to be present. They are so subtle that we do not notice them and we remain ignorant allowing them to run our reality. Infinite loops put us into the modes of the past or the future, neither of which is the present where reality occurs. This type of unawareness shackles us and leaves us impaired to see through the true nature of reality.

Since the very foundation of science has been laid we have assumed that matter derives consciousness. But what if it is the other way around? If matter is merely a derivative of consciousness, there is more to reality than we realize today.

Building toward a revolution in the mind sciences, we need to create tools that will allow us to probe into the nature of reality reliably and truthfully. Meditation and lucid dreaming are already great tools that nature has given us. And we can model any tools that we build from what nature has provided. We must be open and curious to keep searching for the answers while the journey inwards is only about to begin. The manifestation of the outward world on its basis of matter as the foundation of consciousness is not necessarily coming to an end. However, as we continue to explore the mind, we pay more attention to an emerging, alternative reality. In some way it has always been there. We just did not pay attention to see it and regard it as important.

If we have better tools to explore the nature of reality, then we can empower individuals to help themselves. They can then break free from those infinite loops and discover a new reality. They can change the patterns that govern their lives and build a new world for themselves and others. As they experience reality with a new sense of self they could integrate those insights to gain more awareness and attain a higher level of consciousness in a lasting way. They could stop the suffering that they have created themselves. They could realize that they are in control of their own destiny. As they remove these mental afflictions that they suffer from which often creates other problems resulting in the suffering for others, they could liberate and heal themselves.

It is good to look outward exploring the universe and create more material progress. We must also start to look inward and realize the alternative reality that awaits. To meaningfully answer the questions of consciousness, we need tools that can reliably probe into the nature of reality.

A New Telescope

Despite this kind of outward progress that we have made in the world, we stand at the beginning of another revolution that lies inside ourselves. As previously eluded, the brain's next great frontier is itself. To ultimately understand the nature of reality we need to have tools that will enable us to explore the mind. As we create machines that will accelerate our understanding of the brain, we must not forget to go beyond the brain and into the mind in order to discover the true nature of reality.

In our quest toward revolutionizing the mind sciences, we are standing in history at a moment similar to when Galileo began looking through the telescope. Many centuries ago, Galileo had ordered the telescope from the Netherlands to investigate upon the nature of reality and discover the very principles that laid the foundation for modern day science.

In order to start this journey, we need to have better tools and technology that will enable its exploration. Meditation is a great ally. It is available to anyone at no cost, yet despite its many benefits few people practice regularly and therefore never quite reap the benefits of it. As attention spans get shorter and people keep getting pulled from one thing to another, few are unwilling to make the investment it takes to get to the life-changing benefits.

Lucid dreaming is the night time version of the day time practice of meditation and it represents a fantastic laboratory to explore the nature of our own mind. In the West, lucid dreaming has been recognized since the 1970s when researchers Stephen LaBerge and Keith Hearne almost around the same time scientifically proved lucid dreaming. Through pre-agreed eye movements, they were able to send a signal from the dream world into the material world at the moment when they became lucid. While the West likes to pride itself on being first, when it comes to lucid dreaming, the East had explored lucid dreams for many centuries long before it was confirmed a scientific endeavor in the Western world.

In Tibetan Buddhism, dream yoga, an even more encompassing concept for lucid dreaming, had been explored for centuries before it peeked the interest of scientists in the West. Indeed Tibetan Buddhists have a long history of exploring the mind and may hold many answers to our questions of what constitutes the nature of reality. Similar to meditation, with practice lucid dreaming is also available to anyone at no cost. It is also endogenous in that it does not require anything external to be used or put into the body in order to experience it.

Psychedelics have been going through quite a few volatile decades, as the surge of interest that had peaked in the 1970s was stifled by regulatory pressure to ban the various substances that produce the psychedelic effect. It was thanks to people such as Ram Dass that the movement lived on. These days there has been somewhat of a renaissance in the psychedelic field and resurgent interest in scientifically investigating the benefits of psychedelic substances further. Unfortunately, due to regulations around the world, they are still inaccessible for most people. As psychedelics gain broader acceptance in society, they will still require to be consumed under medical supervision. They hold a lot of promise and it is good that they are being investigated further as potential tools to heal people.

Ideally therefore we need to create a technology that would resemble a lucid dream in its nature. We need to make it available in such a way that anyone can experience it without sleep and training to become an oneironaut, who is someone that regularly experiences lucid dreams. As with the telescope we can use it without being consumed by it. As the brain computer industry continues to increase its capability to simultaneously map more neurons, it will become possible to create a synthetic version of lucid dreaming as a technological medium.

As brain computer interfaces allow us to interact with more neurons in the brain, that is millions instead of thousands now, we will be able to create virtual dreams. As we develop virtual dreams and create them into a medium similar to film or virtual reality, the unlimited energy and spirit of human imagination will make them more real than reality. Instead of wearing a headset, it will feel as if we are experiencing that reality as we experience waking reality. Virtual dreams will

adopt the best properties of all other media that we have today and we will constantly improve upon them. Later on we will be able to share virtual dreams and allow them to be experienced by others. Eventually, virtual dreams will become a multiplayer game in a virtual world.

Therefore, we need to create brain computers that are powerful enough to usher in this era of virtual worlds, in which virtual dreams become the medium through which we communicate with others and experience an alternative reality.

The Neuro Revolution

In order to be able to create novel technology to introspect our minds and explore the nature of reality, we must rely on the underlying technology that would enable the creation of such tools. It will be thanks to brain computer interfaces, the foundational technology that connects the brain and the computer, that are still in their infancy, which will allow us to build those tools. Before we can build the vehicles of the mind, we need to build the engine that can power those vehicles. Only then can we use those vehicles to travel the inner world of the mind.

As a thought experiment, before looking at the history and state of brain computers, let us briefly explore the properties of the ideal brain computer. In order to create virtual dreams, we need brain computers powerful enough to interface with millions of neurons in the brain and communicate them to the outside world and vice versa. In other words, we require capability to read and write into every single neuron in order to edit neurons, stimulate, augment or strengthen them. We need to create a two-way feedback loop between the brain and the computer in which neurons represent the medium of communication that we can alter and change. This technology would allow computing abilities from thought. A brain computer would augment and integrate into our limbic system and cortex. In short, we need a networked brain in order to edit and direct ideally every single neuron in such a way that we can create a link to the virtual world.

To create this type of brain computer, however, is a monumental task, as we currently are only able to record a few thousand neurons simultaneously. Neurons are simple in some way that they can either fire an action potential or they cannot. Yet there is an inherent complexity to them, as neuroplasticity allows each neuron to constantly change and influence the brain's neural pathways. We would need to get into the millions to be able to start creating magical things out of the close to one hundred billion neurons that travel inside the brain. Imagine when we are getting closer to interfacing with all neurons in our brain simultaneously.

Eventually, we will connect brains together in order to interact with trillions of neurons in a network of brains.

The brain computer needs to be ultra high-bandwidth in terms of ability to transmit information back and forth between brains and computers. It should last a long time because procedures to install or replace the device will be costly. It needs to communicate in both directions, in order to enable a two-way feedback loop between brains and computers. Safety and security are also paramount. We need to create a brain computer that is as non-invasive as possible and it definitely needs to be as safe as possible no matter how invasive it ends up becoming. The ideal brain computer would also need to be one in which the user owns the data that flows between the brain and the computer through cryptographic guarantees.

We need open standards that will allow everyone to govern the future of brain computers instead of having it governed by a few powerful stakeholders. In the development of this technology, ethical questions need to be applied and cannot be skipped over by private interest. We also need to think about this now and not when the technology has been released. In that regard open, permissionless protocols need to be used to ensure data is not mined by special interest.

Most importantly, it will be up to all of us to imagine the future of brain computers. In the long run, we are not only going to connect brains to computers, but also enable brain to brain communication. If we are going to create virtual worlds, we need to be mindful about the foundation that we put into place. We need to enable viewpoints from a diverse set of stakeholders in order to maximize the potential of brain computers.

In order to get to this future, the primary goal of the industry is to create a strong forcing function that would accelerate our growth rate of simultaneously recorded neurons. We first need to discover the whole map before we can explore the brain let alone probe into the nature of the reality by investigating the mind. If we could interface with one million neurons simultaneously that would open the gateway for so much progress. In order to get there sooner rather than later, we need to work together and find common ground to unite in our quest to explore the

brain. As we are able to create a forcing function that will increase the number of neurons we can interface with simultaneously, the things we will able to do will increase exponentially. It is not a simple endeavor to get to this future and we have a long way to go.

We are heading into unknown territory and there will be an endless amount of opportunities. This should encourage us to share our intelligences and work closer together instead of maintaining a closed environment. If we set a foundation based on open and permissionless principles, we can all share a much larger pie. We can also unleash the creativity of so many stakeholders that have yet to enter the space. We will be stronger united.

A History of Brain Computers

Before we dive into the history of brain computers, let us define what a brain computer interface, or brain machine interface can do. As the name suggests, a brain computer allows for direct communication between brains and computers. It acquires brain signals converting them into outputs that could carry out particular actions. One of its first use cases is that brain computer interfaces can restore lost sensory motor functions or improve human cognitive functions even if this can only be done in a limited way today. In their simplest terms, brain computers allow brain signal generation that encode intention, which the brain computer subsequently decodes and converts into an action of an output device thereby realizing the initial intention. These devices are geared toward recognizing patterns from neural activity.

Going back into history, Luigi Galvani in the 18th century demonstrated the relationship between electricity and nerve activity when he partially restored the dead leg of a frog. At the end of the 19th century, Italian physician Camillo Golgi discovered the neuron as the core unit that makes up the brain's and nervous system's enormous communication network. All neurons are part of a continuous, interconnected network. Every brain contains around 100 billion neurons and over 20 trillion individual neural connections.

The invention by German psychiatrist Hans Berger of EEG, or electroencephalography, at the beginning of the 20th century allowed for human brain mapping in it earliest stages. In 1924, Berger was to become the first person to record human brain waves. It was not until the 1950s that scientists figured out how neurons communicated with each other through what is known as the action potential.

In 1969, Eberhard Fetz at the University of Washington proved signal from a single neuron could control a meter needle. A monkey became the subject of the first brain-machine interface when the researcher trained the monkey to fire a

neuron that would reward him with bananas. The monkey quickly learned how to control the firing rate of a single neuron. His research has continued to demonstrate the brain's plasticity and its ability to reconnect neurons in order to unlock or recover certain functions that once existed. As the capabilities of computers and our knowledge of the brain was limited at that time, progress was slow.

A few decades later in the 1970s the University of California received a grant from the National Science Foundation followed by a contract from DARPA. In 1973, UCLA professor Jacques Vidal coined the term brain-computer interface when he stated in a challenge in his 1973 paper that called for the ability to control an external object via EEG signals. By 1977, he was able to control graphical objects on a computer screen. In 1988, Farwell and Donchin showed how to spell words on a computer screen. In 1998, Philip Kennedy injected a BCI into a human.

So far the primary use cases have been to restore sensory motor functions or improve upon cognitive function in very basic ways. Slowly we are getting beyond what is currently possible and extend the technology to allow for novel use cases. The dream of being able to control reality through thinking is no longer a dream. Already we have built brain computer interfaces that allow us to direct objects with one's thoughts albeit in a limited fashion. The use cases will only grow with time and the history will continue.

The State of Brain Computers

The problem is how do we get information out of the brain or record neural activity and how do we get information into the brain or stimulate neurons in such a way that neural patterns are changed. It needs to be a two-way feedback loop between the brain and computer, whereby we can increasingly get more information out of the brain and more information into the brain. We want to change neurons or stimulate them in certain ways in order to perform certain actions outside the brain. We need to specifically increase the number of neurons we can interface with and we need to accelerate its growth curve in order to start exploring the brain's frontier in a real way.

If we look at current brain computer interfaces, there are three useful metrics suggested by scientific author Tim Urban. First, scale or how many neurons can be recorded at the same time. Second, resolution, or the depth that the brain computer can record. This is divided into spatial resolution which measures closeness of how individual neurons are firing and temporal resolution which measures when activity of the recording is happening. Third, invasiveness, or as the name suggests how invasive do we have to go into the brain in order to install the brain computer.

There is fMRI, which relies on magnetic resonance imaging technology, in order to generate images of the brain and body. While it can scan the whole brain and be operated non-invasively, its resolution is rather low.

There is EEG, which puts an array of electrodes on the head in order to record electrical activity in different regions of the brain. An EEG, however, only records brain activity and does not produce an output. While its scale is high and it is also non-invasive, it has low spatial resolution and medium temporal resolution.

Up next is ECog, which is similar to EEG, except the electrodes are placed under the skull. It is therefore more invasive with a high scalability, yet spatial resolution is still low while temporal resolution is high.

Even more specialized, Local Field Potential is even more invasive as it relies on micro electrodes. A needle is inserted into the brain which then is able to read the electric charges from the neurons in that area. Its scale is therefore small as it only measures the region of where the needle is placed. Single-Unit Recording, which is even more invasive, has a very high resolution. It only captures the resolution of a single neuron, and therefore the scale is tiny.

We have brain computer interfaces that can restore sensory motor functions. For example, we have those that can give artificial eyes or ears. There is deep brain stimulation which has had some impact on people with mental health problems.

For the computer industry to take off we had Moore's law. For the neuro revolution to take off, we need something similar. Thus far, we have what is known as Stevenson's law which measures the number of neurons we can simultaneously record. Unfortunately, it only doubles every seven years. That is just too slow.

Fast forward to today, we have a series of startups that develop their own technologies. DARPA has already funded academic teams for non-invasive brain computer interfaces. To list a few companies that develop brain computer interfaces, in no particular order: Neuralink, Kernel, OpenBCI, Openwater, etc. Indeed there is a whole list of private companies exploring the uncharted territory of brain computers and each company has their own unique way of doing it. As capital intensity is lowered to build a brain-computer interface, there will be more startups exploring this frontier. It is too early to tell which brain computer interface will become the most successful. We must focus on succeeding as an industry together.

Open Neuro Protocols

Today the brain computer industry is mostly comprised of private entities, academic research teams and government organizations. Governments support academic teams or startups with financing and academic teams provide startups with talent. In some cases those academic teams spin out startups on their own. This may be too simplistic of a picture, yet it illustrates the crux of the issue, which is that innovation is closed. Under this system everyone is incentivized to hold secrets to stay competitive. While competition is healthy and spurs innovation, it does not optimize for what would be possible if every stakeholder was incentivized to collaborate towards shared goals.

The most important goal for the industry as a whole is to create a forcing function that would accelerate the number of neurons we can interface with in order to set a foundation from which we can explore the brain and the mind. The best way to achieve that is when every stakeholder is incentivized to collaborate in an open-source environment, which would encourage others to build on top of what has already been created.

It would also create an environment that is more accessible for everyone. We could have people participate that are currently excluded. The more accessible and the less capital is required to enter the space, the more innovation we will have across the board. If we had more composable brain legos and everyone would have access to them then people from all of the world could tap into this brain computer network to build their own things.

Instead of only having an industry in which private entities compete with each other in order to develop the best brain computer technology, why not create an alternative system by creating a network in which every actor is incentivized to work towards an open standard. In this system, everyone governs and decides upon the future direction of the industry.

We propose a network environment in which protocols are being developed that are open and permissionless allowing anyone in the world to access and build upon them. We need to figure out what we can do to catalyze a Cambrian explosion of decentralized brain computer protocols and brain application prototypes that could be used to heal individuals.

When we create open neuro protocols, we will also be able to govern more effectively instead of governments trying to regulate private entities. Companies will always be ahead of governments, being able to move more swiftly and use capital to influence the direction that governments dictate. If there was an open playing field, governance would be inherently the job of everyone that is involved. It would remove the friction between government and companies placing it into protocols. If we are playing in the open, this would bring certain advantages that are not possible in the closed environment that we are in right now.

Certainly ethics is a very important concern when it comes to the future of brain computer interfaces. We cannot be seriously place ethical questions into the hands of a few people that are controlled by private companies. Only through open protocols can we enforce ethical standards that represent the views of everyone involved. History has shown that private companies will use their power to sway other large stakeholders in the direction that they want without regard for the community at large. If private companies dictate the direction of the industry that would concentrate power in them and not lead to a situation where the course of this industry could be governed by everyone.

We also have to be realistic about a potential scenario in which a company offers a powerful brain computer. It will create a situation in which people will give up their rights and opt into the system that the private company creates. As we witnessed with the evolution of the internet, private entities may shape the public discourse to represent their own interest. We do not need to repeat the same mistake when it comes to the internet of brain computers. Private companies are incentivized to do what they are meant to do and that is maximize shareholder value and create profit. They have to compete in the marketplace in order to come

up with innovation that will allow them to gain market share and thrive in the market. This is very difficult and many companies fail. We do not need to undermine private companies nor do we need to rely on them exclusively. We can build an alternative system that holds everyone's power in check.

It is very difficult to change the existing system as it is already in place and large deployments of capital have already been made. This capital already pursues their own version of the ideal brain computer. We cannot stop this development nor should we strive to do that. What we can do, however, is create an alternative system that will connect all these technologies and bring all stakeholders together in order to incentivize everyone to work towards open neuro protocols. In this world we will still have companies and they will make profits, but it would not be a brain computer world that is controlled by private companies where governments are helplessly trying to catch up and regulate them. We have to do this now, because the longer we wait, the more difficult it will be.

The advantages if neuroscience was to become more open source are plentiful. It would allow all stakeholders to share code and collaborate in ways that would increase upside for everyone. It would make the field more accessible for new players. It would simply accelerate our progress in ways that no amount of capital and private companies can achieve. It would align the incentives in a way that would create more sustainable growth in the future. It would set the foundation for a more sustainable type of governance and respect the interest of the widest, most diverse group of stakeholders.

The difficult question is how get this alternative system bootstrapped given what we have. The current system holds large amounts of capital and is able to attract human capital which attracts further capital and talent. The alternative system needs to be able to match the current system in scope of financial and human capital in order to be taken seriously. In order to get this alternative system started, we need to create strong incentives to contribute to the network while interoperability to the legacy system is kept in place. Without community and capital it will be difficult to make any progress.

The goal is to create a vibrant ecosystem that would allow a different type of growth that is currently not being enabled by the existing ecosystem. It would not undermine the current system and it would benefit everyone. An alternative in which people could share code is a world that will accelerate faster toward its goals. Today private companies need to keep secrets in order to compete with each other and thrive in the marketplace. At the moment the cost of entry is very high because developing brain computers is very capital intensive. The capital that is required needs a return on its capital. Putting capital into open-source environments does not ensure a return on capital. That is a problem as open-source has not had a way to compete with a set of private companies for a long time.

As we can now build open, permissionless systems with crypto-economic primitives, we can build networks that incentivize early stakeholders to contribute capital of any form in return for the native token that the network distributes as it grows. In theory everyone would agree it would be useful to have an alternative system that invites everyone to build upon open, permissionless protocols. In practice, this is difficult to do unless we can financially reward those that risk whatever is valued at the beginning stages of a startup. Now we have the tools to do this in a meaningful way that can create a real alternative to a system of private entities pursuing innovation each in their own way.

In fact, it is great that there are already so many private companies that are spearheading this neuro revolution. We must hope that they will keep innovating and bring us closer to the future of an ideal brain computer. We merely offer an alternative that would augment the current system and supercharge it. It would accelerate the future that everyone is working hard to achieve. We are not here to change the current system as it exists. We are here to offer an alternative which would help everyone involved and increase the number of people participating. We will work with the leading brain computer startups, government organizations and academic teams to allow them to shape the evolution of the network. We will also not rely on any stakeholder from other systems to bootstrap the network as we invite anyone from anywhere in the world to join us.

We are not competing with companies that are developing brain computers. In fact we are not building brain computers. We are building a network of brain computers. When brain computers are ready to be released they can tap into the network. There are many things that can already be developed in anticipation of such a release and we can work with early prototypes and generations of brain computers in order to launch the network. These companies are building the hardware and software to run the brain computer. We are building the network between the brain and the computer through which the data will flow and the network that will connect the brain computer links to the virtual world. We create this network in such a way as to guarantee cryptographic entry into this virtual world and exit into the material world.

Masterplan

The purpose of the network is to accelerate the advent of brain computers as they only appear in our imagination today and create virtual dreams as a novel medium to explore the nature of reality. We will focus on creating an open, permissionless network that stands between brains and computers that can guarantee crypto-economic primitives in order to complement the brain computer industry as it currently exists and expedite its core mission of mapping all neurons in the brain.

We are building the network that will allow people to connect their brain computer link to the virtual world. That means we are going to work with everyone who develops brain computer interfaces and interact with academic teams and government organizations in order to create this type of open, permissionless system. At the same time, we are not relying on them to cooperate with us. While we strive to be interoperable, we also expect some parts of the legacy system not wanting to be involved with us, at least at first. We merely show an alternative path. As previously iterated, it is important to make this network as accessible as possible to the widest and most diverse set of people from around the world. Together with the internet, bitcoin and crypto-economic primitives, we are confident that we can launch a network that will be able to successfully run as an alternative system.

In order to make that happen, we propose an alternative system that incentivizes everyone to work together through proof of network and a token that gets distributed to those that verifiably provide value to the network. We intend to unite existing and new players into an open protocol, in which they have ownership over the direction of the protocol. Our protocol integrates technologies built by brain-computer interface companies. While we invite private companies developing brain computer interfaces to join the network, the success of the network will not be contingent upon any single actor. We derive our strength from being the

network with the widest range of stakeholders from around the world. We will be working with governments and academic teams from around the world in order to show that what we are doing represents a viable alternative.

As the network launches, we will invite everyone to join us and collaborate on our industry goal of mapping out all neurons in the brain. Anyone that provides reliable value to the network's mission of accelerating the advent of brain computers and virtual dreams as a novel medium will be able to get a stake in the network.

Our ultimate goal is to create virtual dreams as a medium and build an open ecosystem that is able to build on top of it. We have already been exploring technologies to increase the probability for lucid dreamers to become lucid at night. Our next step is to use early prototypes of brain computer interfaces to evolve that use case. We must demonstrate that we can be the ones that can create virtual dreams in the future. Any prototype also needs to be capable of breaking infinite loops for individuals. In that way, we have a dual mission of creating virtual dreams that will allow individuals to break through infinite loops. Our motivation for virtual dreams is to create a state of mind that aims for liberty. From the earliest prototype that we present to the public, we will always re-invest our resources into creating a new generation that will move us ever closer to our vision of virtual dreams.

To sum up the masterplan: create a network to accelerate the advent of brain computers by creating an open, permissionless ecosystem of diverse set of stakeholders who can verifiably provide value to the network in return for a token that will also be used as a tool to govern the future direction of the protocol. Ultimately, we are the network for individuals to connect their brain computer link to the virtual world in order to experience virtual dreams.

Initially we may have to build a version of virtual dreams that will be very expensive and unaffordable to most people. We will work hard to bring down the costs and make virtual dreams accessible to anyone. After all, we are not a company building a product, we are a decentralized organization creating an open,

permissionless network that will put forward the best technologies of all stakeholders to accelerate the industry and then use its position to create virtual dreams as a novel medium. It may be something that people will laugh at first, but as we continue to work on improving the medium with the help of our stakeholders from all over the world, we have a chance to create a novel medium that could be used to heal people in a lasting way.

Finally this is why we are developing virtual dreams. While they could and probably will be used for all kinds of entertainment purposes, our motivation is focused elsewhere. By creating virtual dreams we can offer an alternative path to mental health and prevent that the mind virus does not lurk in the shadows of our economy until one day it gets out of control and leads to devastating consequences for society. Moreover, this is about empowering the individual. If we can ensure that individuals have great tools to introspect and explore their mind, then individuals can probably figure out how to unravel the mental patterns that shackle them and get healthy again. If virtual dreams also exist as a medium, then there will be a strong forcing function of people creating algorithms and tools on top of this medium to guide people and help them see the light. Ultimately this is about raising the light of awareness to empower individuals to step into liberty themselves. The final step into liberty nobody can take except oneself.

Token Economic Model

We introduce a token into our network as a way to incentivize early stakeholders to bootstrap the network and allow them to govern the direction of the network for the future. The plan is to distribute the token among the widest group of stakeholders over time who have provided value in a verifiable way. Anyone who demonstrates that they have performed work that increases the value of the network, will be able to receive tokens.

As a general principle, we will introduce proof of network, a mechanism by which anyone from anywhere in the world can participate and get the token if they verifiably demonstrate that they have added value to the network. As the network evolves, the community of stakeholders that will govern the protocol may evolve the proof of network mechanism. In fact, after genesis distribution, the tokens will be distributed according to proof of network, which in turn the stakeholders that govern the protocol may evolve. The goal is to create a self-sustaining network in the virtual world and the token is merely a means to get there. The purpose of the token is to create an incentive mechanism by which the network will be bootstrapped and then use the token to secure the network and allow all stakeholders to vote on the future direction of the protocol. We will release a paper in the future that will outline the proof of network mechanisms.

With the onset of the network protocol launch, we will continuously broadcast problems that have to be solved. Whoever manages to solve the problem and provide proof of it, will get tokens in return for their work.

With the launch of the token, we will create Network Foundation, a decentralized foundation that is focused on bootstrapping the network according to the principles laid out in this paper. We will share further details about the architecture of the Network Foundation in a separate paper.

Initially, Link and the Network Foundation will help to distribute the token. As the network expands, the trust will be distributed and the reliance on Link and

Network Foundation slowly shifted towards the wider community. As time goes on, all stakeholders through means of governance will decide and approve upon problems that need to be solved in order to grow the network and maintain its security.

Network will start as a decentralized autonomous organization from inception. Link and the Network Foundation are committed to making the network as decentralized and distributed as possible. Link also established Network, a Wyoming based limited liability company in the United States, which may receive tokens from the foundation to fund initiatives and enter into contracts that will advance the cause of the network. Link will follow Satoshi Nakamoto's example and not spend the tokens for a long time. If the vision succeeds, Link may use the tokens to further invest into the future of virtual dreams.

On genesis day, 1/21 of the tokens, also known as the Satoshi Nakamoto allocation, will be given to Link, who birthed the network. 6/21 of the tokens will go to the Network Foundation that is dedicated to fund ongoing development of the network. 14/21 of the tokens will be distributed to the community through proof of network.

The node operators who will be running the network will need to stake the token in order to earn network fees that are being generated from any transactions that run through the network. In the future, the network will use the token to pay network node operators who will handle the connection from any single brain computer link to the virtual world through the network.

The token will carry the symbol N and supply will be limited to 1,000,000,000. There will be no mint or burn function. As the Bitcoin network is not capable of issuing tokens, we will issue the first version of the token on the Ethereum network, as an ERC-20 token. We also plan to create an NFT, an ERC-721 token with symbol NET, that will become the identity token and act as a passport to access the network when individuals will be able to use their brain computer link to connect to the virtual world. We will release a paper on the identity layer of the network in due time. In the future the token may be upgraded to enable it to

interact with smart contracts and brain computer systems. The network will strive to integrate with other protocols to leverage its capabilities. For example, Chainlink, which reliably and truthfully connects smart contracts to the real world, could help secure the authenticity and truthfulness of virtual dreams as they are shared with the world. 0x, which enables peer-to-peer trading of any type of digital asset, could be used to trade virtual dreams when they become a medium to be shared. We will strive to integrate with other organizations to make the network stronger. The supply will never be changed and no additional tokens will be issued under any circumstances.

Virtual Dreams

Standing at the beginning of a new decade that will enable things most would not deem possible, we must have the courage to do the impossible and dream a new dream. Let us ask how we can achieve what was never done before. What are things that we can invent that never existed before and will improve life? To create something that will allow us to see ourselves and the world from a new light.

Our ability to communicate enabled many inventions. Words in a way represent a source of magic. Language was foundational for everything else that followed. Writing enabled us to transfer ideas and knowledge on a more permanent basis. The printing press and publishing in general democratized that process while digitization centuries later made it accessible and global.

Everything starts in our mind and we need to believe that we can achieve what we set out to do even if the odds are against us. Even if the probability of success is low, if it is important and worthwhile, we must have the courage to do it.

We introduce virtual dreams, a novel medium to experience ourselves and the world in an alternative reality of our own mind at first and connected to other minds later. It is inspired from the concept of lucid dreaming, which occurs when we are conscious while dreaming. In other words, when we are awake in our dreams and explore the nature of our own mind. In the Western world, lucid dreaming has been a scientific reality for almost half a century. In Tibetan Buddhism, dream yoga has been practiced for over a thousand years. As of today, we already have virtual reality and the rate at which games progress is astounding. It bears repeating that games have become more like reality itself. Even at a modest rate of improvement, games in the future will be more real than reality.

This revolution will enable us to build technology to empower others to help themselves and break free from the mind games they are playing with themselves. Throughout history, we have embarked on a journey to create more material abundance for everyone while expanding outward that has created tremendous

progress for mankind. We shall not forget the journey that awaits inward and the liberty that we must search for to be truly free from the many loops that run through our mind and govern our lives. There are many types of freedom and the liberty of the mind is certainly an important one to keep in mind.

When Galileo established the foundation that science was built upon, he ordered the telescope from the Netherlands. The telescope was a tool to empirically probe into the scientific principles that Galileo was investigating. Similarly, we will soon be able to build tools that will enable us to investigate the nature of reality at a deeper level than was previously thought possible.

We discussed the history of other media such as motion pictures or video games. The media we have today did not always exist and today we cannot live without them. They have become an integral part of our culture and represent a way of communication we rely upon. Through them we can see ourselves and the world differently.

We discussed lucid dreams and meditation as tools for individuals to break free from infinite mental loops. Virtual dreams will exist as a vehicle to explore the mind. They will have similar properties to lucid dreaming and meditation in that they can empower individuals to help themselves.

We already live in a world of virtual reality and augmented reality. The next step is to send our avatar into the virtual world and experience virtual reality directly. We already have virtual reality gaming, even if that ends up as the analog version of virtual reality. While the gaming industry is fixated on a screen today, virtual, augmented or mixed reality represent the stepping stone for what is to come. In the future gamers will figuratively step into the screen and through virtual dreams control their digital avatar as they control their body.

Virtual dreams will feel similar to lucid dreams except that we may use brain computers to experience it on demand. As previously explained, lucid dreaming is the recognition and awareness that we are dreaming while we are dreaming, which typically occurs during REM sleep phase. The moment we have the realization that we are dreaming is the moment we become lucid. The reality that we experience

inside a lucid dream feels just as real as the reality that we experience when we are awake. In some way it feels even more real than reality. In some ways we cannot do what we can do during waking reality, but in many other ways we can do things that we could never do in waking reality.

Even though there are tools to help people lucid dream, this paper is focused on creating synthetic lucid dreams using brain computer interfaces resulting in the creation of virtual dreams. There are going to be different stages to virtual dreams. The first advanced iteration will be one in which we will be able to experience a virtual dream without being able to share it with someone else. It will only be a single player game at first. It will be a telescope to introspect the subconscious mind. Then, we will have virtual dreams that can be recorded and shared with others. Virtual dreams will become social in that we can share the dream that we experienced with others in such a way that the other person can be an observer of our dream. Finally, we will have virtual dreams as part of multiplayer virtual world and we will be able to experience them with others simultaneously. Others will be able to join in and the dream can be shared by multiple people at the same time, each person being able to influence the dream.

Virtual dreams need to become a cryptographic medium that individuals own running on an open, permissionless network that will connect brain computer links to the virtual world. The data that will flow between the brain and the computer will be in the hands of the individual. The network must be decentralized in order to guarantee it is open and permissionless. When an individual enters a virtual dream, they experience the dream knowing that they own the dream, and they would only share it with others through consent. No company mines data from the virtual dream unless there is explicit consent by the individual for a specific purpose to share data. That is why it is so important that the data that will flow between brains and computers need to be on a network that is decentralized, open and permissionless.

As we embark on this journey, we are aware that the technology for virtual dreams does not exist yet. We are working on early prototypes that resemble virtual

dreams in their spirit in order to demonstrate that we are capable of building this medium that also has the property to empower individuals to break infinite loops. It is paramount to set the foundation and create the possibility first. Ultimately, our promise for virtual dreams is only worth as much as our ability to bring it to life. Thankfully it will be up to all of us to shape this world of virtual dreams.

Brain Computer Applications

Another invisible frontier that is emerging is the journey inwards. With the advent of brain computer interfaces, we will create a novel kind of internet bridging brains and computers. It will enable us to cure all kinds of diseases and enable physical and mental mobility in ways that would seem magical to us today. Neuroscience has already made so much progress in the last couple of decades and yet we still know so little about this mighty little organ that the brain represents. Naturally we welcome the rise of brain computers, which will increase our understanding of the brain. And ultimately this frontier goes far beyond the brain and extends into exploring the mind itself in order to answer the important questions of consciousness.

If we think about brain computer applications in general, the possibilities are endless. From helping the blind to see, or the deaf to hear, we can imagine any disability that originates from the brain to be fixed by brain computers. We are opening up a whole avenue of possibilities that will allow us to cure diseases that were previously considered incurable. So many of our diseases originate from the brain or mind and if we can go to the root of the problem then we might eliminate them long before they manifest in our body. Or if they have already manifested in our body we might be able to revert any negative changes.

If virtual dreams exists in the future, let us imagine what brain computer applications could be developed on top of this medium that would go toward the mission of empowering individuals to break through infinite loops. We can see algorithms being created to heal people from mental patterns that they are stuck with. We could say that any mental disorder is an infinite loop with certain properties and characteristics. As we enter into a virtual dream that someone created to help us resolve a specific mental pattern, we could be guided to gain awareness around that pattern and shown what blocks us from resolving the pattern.

Given that virtual dreams will be a safe environment similar to lucid dreams, individuals could be trained to overcome fears or blockages that they have developed that perpetuate their mental pattern or loop. They could build brain computer applications to target a specific infinite loop. Individuals could learn to overcome specific fears that they would have a hard time resolving during waking reality.

We could imagine meditation, yoga, tai chi or similar applications for daily mindfulness practice. In a fully virtual environment, these applications would still be similar in nature as to what they do now on our smart phones or virtual reality headsets, but they would feel so much more immerse. Our ability to focus and concentrate could be increased as we are teleported into an environment that helps us to disconnect from the endless loops of thought that keep us hostage during waking life.

We could create synthetic virtual psychedelics giving the dreamer the same psychedelic experience without having to worry about some of the drawdowns. As the psychedelic would be experienced in a much safer environment, it could unlock many benefits. And when the environment is safer, governments could be more open to support its development.

We could imagine an application developed by healers in which they install themselves as a guide and lead individuals through a scenario that replays their nightmare. As they go through the scenario, the guide would be there to help them and assist them to overcome their fear or mental pattern that blocks them. They could also make them aware of something that remains in the shadow of their conscious mind. We could create realities that would be difficult to re-create in waking reality. And even if they could, many people would be unwilling to face those situations in waking reality as they would strongly identify with their old sense of self.

An open brain computer network would enable all kinds of innovation to spring up as individuals and teams from all over the world could tinker and experiment with finding ways to heal people. We could build tools to actually heal people. We

could create healing algorithms that would resurrect individuals and give them a new sense of identity.

Principles

Decentralized. The future of technology rests on decentralized principles. The network needs to be open and permissionless in order to ensure access from the widest and most diverse group of stakeholders. We also need to make sure that the network will not be turned off by any nefarious actors.

Incentives. We want to align the incentive of early stakeholders to work together and contribute value to bootstrap the network successfully. We want to create a system that rewards individuals for solving problems that unlock growth for the network.

Identity. At the heart of virtual dreams are humans that use brain computer links to connect to a network that allows them to experience virtual dreams and connect with others in a virtual world. We need to ensure that individuals own the identity and the passport that they use to enter the virtual world will also be used as they exit into the material world.

Governance. The network will be bootstrapped by early stakeholders that get the token in return for providing value that grows the network. We propose a system whereby a diverse set of stakeholders will govern its future through a decentralized autonomous organization.

Open source. It is only because of open source systems that the network was able to exist and continues to exist. We stand on the shoulders of those giants who have created great open source technology. We value the community and will develop the network in an open source manner. We will connect with different stakeholders to ensure that we will have a secure, robust platform that will enable future innovation.

Safety. As we charter into the unexplored frontier of the brain and the mind, we must ensure safety at all times from the hardware that will allow us to go into the virtual world to keeping individual's identity and their data and dreams safe. We need to design the system as such that safety is a requirement. As an industry we need to strive to guarantee safety at all times. Safety is everyone's priority.

Conclusion

Our purpose is to accelerate the advent of brain computers and create virtual dreams as a novel medium in order to experience an alternative reality of the mind. We are building an open, permissionless network between brains and computers that will allow individuals to connect their brain computer link to the virtual world.

Virtual dreams as a medium will empower individuals to liberate themselves and give them tools to help themselves break out of the infinite loops that run their lives. We introduced virtual dreams, a novel medium that leverages brain computer links to connect to the virtual world. At first, similar to the experience of a lucid dream, individuals will be able to connect into their own subconscious mind and explore the mental patterns that govern their lives. As we improve upon the experience of virtual dreams, we will be able to record and share them with the world. This will allow others to experience our dreams and see the world from our point of view. Eventually, they will be able to be experienced with others simultaneously. Ultimately, the network will allow individuals to use their brain computer link to connect to the virtual world which will be built on crypto-economic principles guaranteeing that data will be owned by the respective dreamers. As the virtual world expands, we will create an identity passport which serves as an avatar to guarantee that entry into the virtual world and exit into the material world will be cryptographically secured at all times.

In order to get to this future of virtual dreams, we need to accelerate and catalyze the neuro revolution. We aim to unite the brain computer industry to collaborate and work together towards the primary shared goal of brain computers being able to interface with billion of neurons simultaneously. An open and decentralized brain computer network will allow a vast number of diverse stakeholders to explore this new frontier of the brain and mind in a meaningful way. We are not standing in competition with the industry as it currently exists and merely wish to augment what is missing. We want to guarantee that individuals

using the brain computer link of their choice can have peace of mind that they own the dreams they choose to go into.

By creating an open, permissionless network we will allow anyone from anywhere in the world to participate and build their own brain computer application. We also hope that existing players will join us in solving common problems that we are all facing together. As a result of the nature of permissionless systems, others will be able to create algorithms that could be used to heal individuals. They could heal those that are suffering from various mental patterns and different kinds of infinite loops. Our goal is to offer a neutral medium that would allow others to build brain computer applications that could heal people. We are building a medium for tools that individuals could use to change their own state of mind and increase awareness to make lasting changes in their own lives. Ultimately, we are creating virtual dreams to empower individuals to liberate themselves.

Despite the odds and obstacles, the adventure of this journey will be unparalleled as we explore this unknown frontier together. Virtual dreams will become a path for others to step into liberty and increase the light of consciousness.

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