What was considered only recently a matter of science fiction, is quickly becoming the reality of today.

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Smart grids, digital twins, blockchain, predictive maintenance and smart meters are all clear examples of how the Internet of Things (IoT) is changing the fabric of today's more traditional business models and business execution.

Sustainability cannot exist in a silo, nor can it be driven by the same "old ways": to be successful at getting closer to the finish line of the sustainability race, we need digital technologies to support and supplement heavy, resource intensive and resource depleting activities.

BuiltIn's Mike Thomas offers 13 good examples of how IoT is driving efficiency for sustainability, from car sharing to data tracking, and from energy consumption monitoring to energy appliances control. Optimising the flow of real time data and information across all these areas significantly reduces the human environmental impact otherwise required.

According to Cyril Perducat, Executive Vice President IoT & Digital Offers at Schneider Electric, "35% of 5G technology applications are going to be in the utilities and manufacturing sectors. This is only going to increase the amount of data that is produced and that is going to be captured. We have a lot of data everywhere and, if we don't do anything about it and just focus on technology, like we have done in the past, we're just going to produce more insignificant data that no one will be able to use to create real value."

One thing is abundantly clear: not all data is useful data. Unless we constantly create new ways, systems, and algorithms to translate the enormous quantity of data out there into usable and valuable data, we have failed to monetise and capitalise on the advantages of IoT.

Reducing e-waste, creating agricultural sustainability, protecting the wildlife, maximizing renewable energy technologies and water preservation need not be capital intensive – they need to be intelligence (artificial or human) intensive.

91% percent of the world's population lives in areas where the air pollution levels exceed the World Health Organisation's guideline limits.

Artificial Intelligence (AI) and IoT technologies can be deployed in real time, and at minimal cost, to inform various local and regional authorities on the levels of pollution at given times, so that immediate measures can be taken.

As a society standing on the edge of the deepest man-made precipice, we have a choice: to change or be changed.

Cryptocurrencies

Some argue that the blockchain technology used by the cryptoverse (cryptocurrencies) may take down Amazon, Facebook, and Google – a scary or a welcome idea? There is a lot of hype, myth and speculation surrounding the cryptoverse: some wish to control it, some wish to destroy it, and some wish us all to buy into it. How much is fact, and how much is fiction?

Tim Draper argued that the cryptoverse is bigger than the internet, bigger than any revolution, bigger than anything we have seen; he believes that bitcoin, blockchains and cryptocurrencies will affect the entire world. For those who find it hard to grasp these concepts, and struggle to produce a clear, straightforward definition, cryptocurrencies are everything one does not understand about money combined with everything one does not understand about computers.

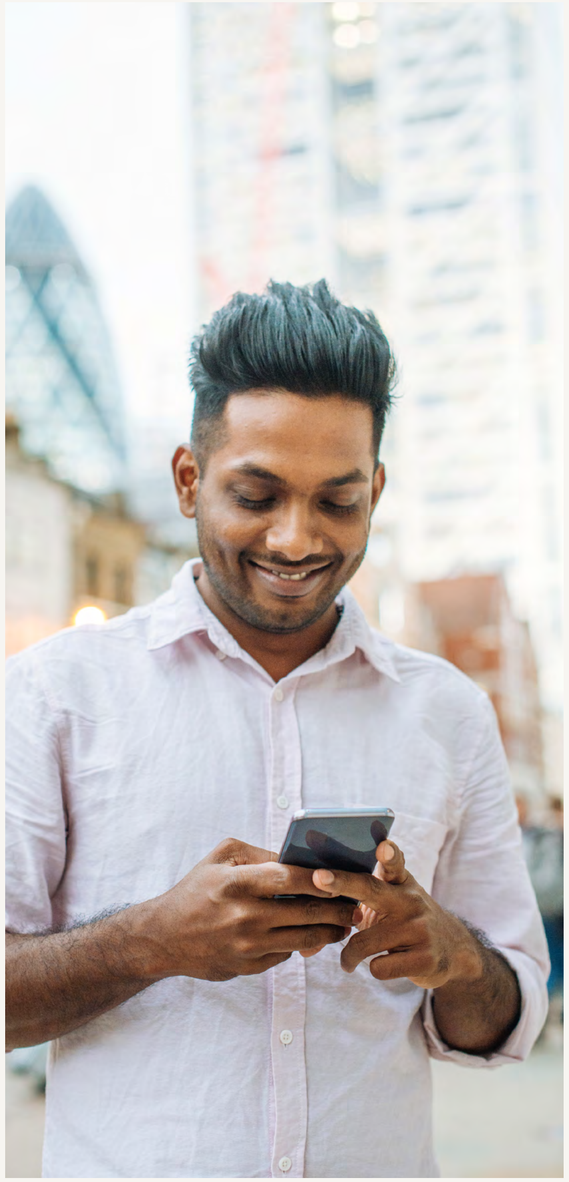
The total value of the world's money is 215 trillion dollars, while the total global debt associated with that money is 300 trillion dollars (as of February 2022). Each new dollar created by governments and banks as debt will need to be repaid by someone (it does not matter who) at some point in the future. But that repayment of the initial debt is not enough: that debt also has interest attached to it, so that will need to be paid too. There is not enough money in the world to pay off that debt and its interest – it is simply impossible. To add to the mind-bending complexity of it all, almost all the money in the world is in digital format: mere entries in very complex online banking 'ledgers'.

Every pay cheque we get in the Western world (and not only), gets split between various bills we have to pay, leisure activities, or to repay existent debt. The greatest majority of the transactions we make is either via direct debit, bank transfer, credit or debit card transactions, Apple/Google Pay, PayPal etc. All these transactions we make on a daily basis are nothing but pluses and minuses in digital legers stored online.

In 2008, at the peak of the financial crisis that almost crippled the world's economy, a person or a group of persons using the pseudonym 'Satoshi Nakamoto' published a white paper entitled 'Bitcoin: A Peer-to-Peer Electronic Cash System'. This/these individual(s) are considered to also be the creators of the bitcoin technology itself: 'With Bitcoin, we can create our own money … ' Stored in the virtual space, the cryptocurrency has no mass, no weight, no colour – in other words, it does not exist in the reality plane. And all this hype was started by none other than the multi-billionaire Roger Ver, also known as 'Bitcoin Jesus'. To ensure his movement had a future, he gave away thousands of bitcoins; for free, that is. If one could ascribe clear characteristics to bitcoin, one could simply call it anonymous cash that is not controllable by anybody. Ver calls bitcoin 'one of the most exciting inventions ever in the entire history of humankind' – is it, though?

There are more addresses in bitcoin's virtual world than there are atoms in the entire universe. The digital coins (i.e., bitcoins) cannot be copied and can never leave their ascribed 'deposit box.' There is an infinite number of such deposit boxes in the 'digital vault.' No one owns the vault, and no one can tamper with the integrity of the 'vault.'

Room 77, a bar in Berlin, was the first outlet to accept bitcoin as form of payment. And they did so over a decade ago, in 2011. There were no digital wallets back then, just laptops and a lot, a lot of very careful typing of the bitcoin addresses.



Credit cards manage almost 20 trillion dollars' worth of transactions per year. The fees related to these transactions are included in the price of almost everything we buy, both goods and services. Part of cryptocurrencies' attraction is represented by their take on the 'institution,' i.e., on the endemic corruption of massive global banks which have been found to launder money for criminals and drug lords, which have supported various political regime changes, which have unfairly charged customers for their mortgages and so on. There is an abundance of easily accessible and publicly available information on all these scandals.

Bitcoin and its many sister-cryptocurrencies were embraced by many, especially by the young and the digitally savvy generations, as a form of civil activism and civil rights movement, as a way of saying 'no' to the traditional, cumbersome, and inflexible banking and state-controlled or state-enabled wealth creation systems.

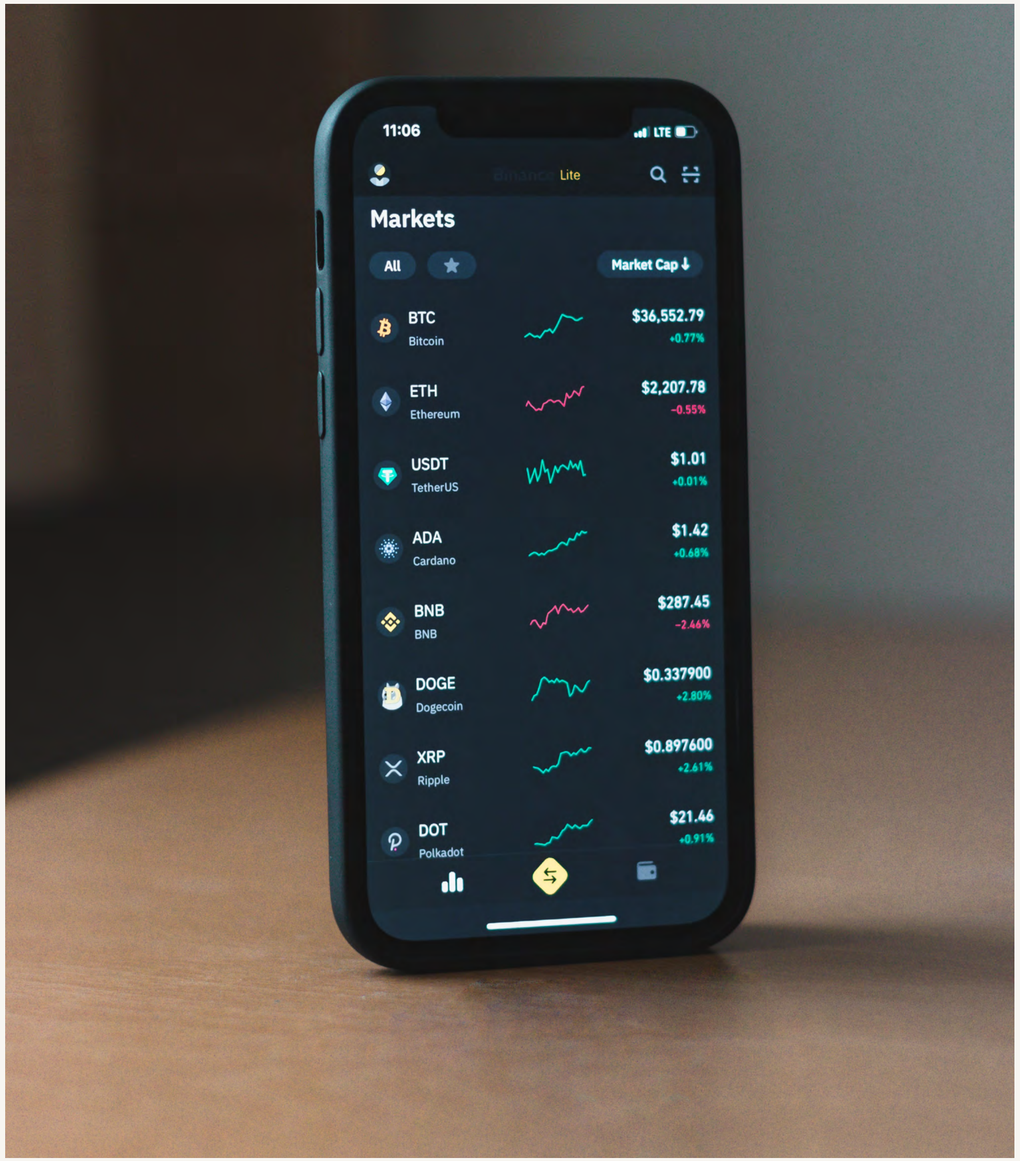
The big idea behind bitcoin is that of instantaneously being able to send money live, over the internet, with no 'banking fees,' no 'transfer fees,' no 'urgency fees,' no 'currency exchange fees' and no 'transaction' fees.

But who and what is actually running bitcoin and the cryptoverse? The answer to this question is not as simple as it may seem: they are run by a digital global network of very powerful mining computers. When a payment is made from one's bitcoin wallet to another's bitcoin wallet, that information is shared with the global hive network within seconds.

The 'stackability' of the blockchain transactions, including their inclusion into new layers of blocks, with uniquely numbered transactions, make futile any attempt to interfere with the transactions that have occurred since the updating of the global system; this updating takes a maximum of 10 minutes and every second thousands of transaction 'layers' are stacked atop a transaction that was made only a millisecond ago. To tamper with that transaction would mean to tamper with the entire 'stack of layers' of the other transactions.

The immutability of bitcoin means that no one can tamper with a transaction once made via blockchain, and no one can spend that uniquely numbered blockchain coin twice.

Is Bitcoin the real answer to financial freedom and independence for everyone? If we were all to adopt bitcoin now, what would happen with the world's economic system as we know it? How long would it take us, as a global society, to recover from the financial crash and collapse of the banking system as it currently stands? How will the new 'wealth' be measured?



If one wants to trade in certain items that are not necessarily legal or endorsed by various governments around the world, one could easily argue that cryptocurrencies are the sure way to pay for such items, the currency's complete anonymity and lack of traceability ensuring that there are no 'digital fingerprints' between the buyer and seller.

The supporters of freedom of expression/choice uphold that the largely opioid-driven deals that took place in the darkness of the infamous Silk Road are just that: one's freedom to choose what they smoke, inhale or inject.

Logically, cryptocurrencies can be – and are used – for illegal purposes; but so are dollar bills, Euros, offshore banks and similar. To blame a medium, or a means, for the illegality or inappropriateness of something that has a buyer/user at one end and a seller/provider at the other is not necessarily fair.

Evident in this regard is the prosecution of several federal agents who attempted to steal over $800,000 worth of Bitcoin from the Silk Road proceeds. The moment the agents tried to 'unload' them, they were caught because every transaction, just like every bitcoin, is unique and recorded in the blockchain for eternity.

There is no limit, for instance, to the number of copies one could make of e-books, songs, videos and, put simply, there is an infinite number of digital copies one could make of anything but bitcoin. For the first time ever in the world of investment, banking, financial transactions and not only, a web of thousands of computers across the world allows for a virtual coin to have an unique fungible aspect whose main feature is the paradox of its current existence, too: its scarcity.

According to Investopedia, there are over 18,000 cryptocurrencies in existence as of March 2022 and, although many of these cryptocoins have little to no following or trading volume, some enjoy immense popularity among dedicated communities of backers and investors.

Cryptocurrencies see a fall in their mining block reward in four-year cycles, and their popularity – which translates in their mining – is directly driven by a simple principle of supply and demand. Bitcoin's protocol will stop when 21 million bitcoins are reached, unlike the hard cash which continues to be minted as banknotes and coins come out of circulation or new hard currency injections are directed by national banks.

Supporters of the cryptoverse revolution are very vocal in terms of the benefits that digital currencies can offer to those individuals whose national currency means, more often than not, nothing. Devaluation of a nation state's currency – such as, most recently, the Russian ruble – means that the trading of that currency on the foreign markets is less attractive thus less powerful in relation to the US dollar or the UK pound.

Democracies have clear, open, and transparent rules when it comes to cryptocurrencies: their use, their trading, and their translation into conventional currency. But the democracies of today's world make up for less 15% of the world's population. For instance, the poverty-stricken population of Venezuela (a country whose oil reserves are the largest in the world, surpassing those of Saudi Arabia), cryptocurrencies are slowly becoming an accepted way of life and living.

JP Morgan Chase is one of the largest banks in the world, its transactions amounting to USD 16 trillion daily. Its CEO, Jamie Dimond, recently argued that bitcoin is worthless and that cryptocurrencies will end up being regulated by governments. One may understand that the advent of the cryptoverse poses a significant challenge to the traditional banking models and to the way business transaction proceeds have been – and for the greatest part still are – being carried out today. But, to 'close' or even regulate bitcoin or the multitude of cryptocurrencies out there would simply be impossible. As long as there is a World Wide Web, free for many and accessible to many, digital currencies will continue to exist, be traded and be used, even though some politicians naively believe that they can stop open source software.

Innovation and technological revolution are here not only to stay but to evolve. Only a catastrophe of global proportion such as a nuclear winter or an outright global conflagration could, potentially, permanently, or temporarily disrupt the cryptoverse revolution. As with almost any and all digital technologies, it is the user of that technology that renders its use for good or for bad purposes.

Blockchain

Technology can help or hinder, and its use by large corporates can provide clear insights into their commitment to transparency, accountability, and traceability of their entire supply chain: from farm to table, from factory to supermarket shelf.

A digital ledger of transactions that is duplicated and distributed across the entire network of computer systems, blockchain technology removes human error and hidden transactions, making it almost impossible to cheat or hack into the system.

In addition to transparency and the much needed environmental and social governance reporting that all respectable corporates should provide today, blockchain technologies achieve much more: they can offer unparalleled insights into the entire chain of operations of any large organisation, identifying lagging times, gaps, deficiencies, and trends within that system.

According to Irannezahd et. al (2021), real-world applications of blockchain technologies in supply chain management face significant challenges, and no deployment of any blockchain system should be commissioned without performing a full, organisation wide, readiness assessment.

However, irrespective of how ready an organisation may be or not to deploy blockchain tech for its supply chain, circularity and abidance by the circular economy principles can hardly be claimed without it: trust, traceability, and transparency emerge as critical factors in designing circular blockchain platforms in supply chains (Centobelli et al., 2021).

In 2020, Forbes published a list with the top 50 users of blockchain technologies across the world, and supply chain management features abundantly across these business mammoths, for instance:

- In Australia, Nestlé used Amazon's blockchain product to help launch a new coffee brand, "Chain of Origin," where consumers can look inside the coffee's supply chain to see at which small farm the beans were planted and where they were roasted.
- BMW has a pilot program with suppliers with plants in Europe, Mexico, and the U.S., and is using blockchain to track materials, components, and parts across its supply chain.
- De Beers' new software, Tracr, follows diamonds, which have undergone 3-D scans, as the gems are mined, cut, polished, and sold, signalling that the end is in sight for the cruel 'blood diamond' trade.
- Dole's new level of traceability starts on the farm and ends at the grocery aisle, and Walmart customers can now check where their fruit comes from by scanning a code used by farmers.

- Honeywell's GoDirect Trade platform collects information about aircraft parts over their entire life cycle and makes it available to potential buyers prior to the sale.
- The olive oil giant CHO has been tracking its gourmet Terra DeLyssa oil, helping generate eight data points, including the orchard where the olives were grown, the mill where they were crushed, and the facilities where the oil was filtered, bottled, and distributed, each captured on the blockchain and accessible via a QR code on the bottle.

Above are just some of the examples related to the successful application of blockchain technologies and blockchain marketplaces in supply chain management and its much-coveted transparency.

According to Gartner, in 2022 the Supply Chain Management enterprise software market will reach $20.4B, and blockchain's shared, distributed ledger architecture is becoming a growth catalyst for IoT's adoption and commercial use in global organisations.

There is, undoubtedly, a significant gap between supply chain transparency and traceability in the developed countries, and the same in the developing countries. While, at first sight, one might be inclined to assume that these are mostly related to fluid legislation and lax regulation – let alone corruption, nepotism, and favouritism – they are mostly related to network reliability and availability.

Kshetri (2021) argues that blockchain's characteristics are especially important for enforcing sustainability standards in developing countries because these can help address several challenges various stakeholders face in promoting sustainable supply chains in those regions.

In his paper published in the International Journal of Information Management, Kshetri lists the main barriers to blockchain technology implementation in developing countries:

1. unfavourable institutional environment,
2. high costs,
3. technological limitations,
4. unequal power distribution among supply chain partners, and
5. porosity and opacity of value delivery networks.

Despite the extensive literature on Blockchain, in recent years no clear framework has defined – or has been agreed on - whether a supply chain should implement blockchain or not, according to a research paper published by Aslam et al. (2021) in the Journal of Innovation & Knowledge.

The interrelation between information confidentiality, usability, traceability, transparency, and optimisation requires various visibility layers, and the data feeding into the system needs to be as accurate and as timely as possible. Blockchain is, without a doubt, a major step towards streamlining operations and improving operational performance. Its integration, albeit often seamless, is as dependent on a myriad of variables as it is on the IT systems/marketplaces it uses.

Is this the right time to create the architecture of a blockchain-based sustainable supply chain visibility management platform, centred on context-awareness? One that is secure, auditable, and mutually benefiting sustainable supply chain information sharing, in heterogeneous context-aware scenarios, whilst recognising the underlying characteristics of sustainable supply chain visibility? Sunmola (2021) believes it is.

With many documents involved in supply chain management, the risk of fraud and forgery increases. Given the large number of stakeholders in logistics chains, the level of transparency is often lost (Cerny, 2021) and the much needed accountability of sources, process, means and methods becomes utopic.

There is much more to a product than its provenance and the process stages it goes through to reach its destination: forced labour, working conditions, human trafficking, banned or illegal substances, use of unauthorised substances and so much more.

No organisation, large or small, can claim its operations are in full compliance with the United Nations' Sustainable Development Goals, or with the circular economy principles, unless it can track and trace its entire supply chain system.

Metaverse

The interaction between humans and machine started several decades ago. Technology, especially that driven by innovation and ingenuity cannot be stopped in its tracks. With these, the limits of what was considered only recently a matter of science fiction, are quickly becoming the reality of today.

Living in a universe so remotely separated physically, intellectually, and emotionally from what many consider real life can be a daunting thought, particularly for those age groups who have grown up in a time where the industrial revolution and the ability of flying aboard a plane were the heights of both technology and their comprehension.

Living in an entirely virtual world and interacting with a variety of avatars and scenarios may be, for many, another form of escapism or 'headspace'. This may be particularly helpful for those who are mourning or grieving the loss of a loved one; they can choose a place of emotional and personal safety, a place that is completely inaccessible to outsiders, one where they can artificially make it possible for their loved ones to continue to live on.

In his quote to Circklo, Eric Weaver, the founder of Transparent Path, said 'We've all felt it: the deep feeling of loss when a loved one passes. The fervent wish we could still engage with them. Enjoy their personalities. Get their feedback or guidance. Or simply be around them. What if you could bring a loved one back to life, hear them speak in their own voice, have them react to your questions, and get realistic, true-to-life answers or advice?

And if you are a parent, you know the desire to stick around and help guide your children, whatever their age, as they make their way through life. Even after you pass on. What if you could leave an intelligent, true-to-your-personality "legacy version" of yourself behind in the metaverse after you pass — to both counsel and guide your survivors?'.

The potential of augmented and virtual reality is enormous. And the implications these bring for conventional and life sciences, both positive and negative, are almost as infinite as Deep Mind's computing and prediction capabilities.

To put it plainly: how can we get our heads around something which many of us – including the designers of the most sophisticated pieces of code and algorithms of the metaverse – cannot grasp? How can we predict the risks and opportunities of an alternative form of universe that, as a race, we find defining its parameters almost impossible?

We asked Hassan Al Noon, the Managing Director of Multiverse Innovation and one of the world's most prolific minds in artificial intelligence and deep technologies, for his thoughts on the future of the metaverse. In Al Noon's view, 'the metaverse is the natural next step in the digital transformation age. COVID-19 caused a rapid transformation of our digital mindset, and the metaverse will play a vital role in the way we interact with each other through the digital sphere in the years to come.'

The metaverse is something that computer geeks and gamers have been advocating and supporting for several years now. The metaverse did not start, nor will it end, with Facebook's rebranding or with Mark Zuckerberg's online reach, power or influence.

The beauty or nightmare of deep tech is that no one can own it all – yet, many can play a role in how that online reality is augmented, in the experiences that are created and in the technology that supports it all.

Foresight analysts, Futures Platform, argues that the metaverse is going to become a global virtual world, from a multitude of perspectives and points of view. If we can virtually go on holiday, anywhere we want, what is going to happen to the tourism industry worldwide?

If we can escape the mundane and the trivialities of daily current life, including the human physical interaction so many of us missed in the past two years, and retreat in – pretty much – our heads, what is the future for the hospitality industry?

If many of us find the online spaces the metaverse will open up for us far more entertaining and appeasing than the reality in our 'other' day to day world, what is the future of the human race going to look like? The mortality rates? What will happen to our brain functions and our capacity to discern fact from fiction?

There are, as with any emerging technologies, incredible opportunities too that can be further capitalised on by the metaverse. According to John Preston, Sociology Professor at the University of Essex, 'the metaverse will allow students to have an increasingly "cyber-physical" university experience, where the virtual world merges with the real one. Many students have already experienced something similar. During the pandemic, learning has shifted between online and in person.'

Today the humanity is at a tipping point of multiple global disasters: climate change, pandemics, resource depletion, famine, and nuclear threats. Collectively, and even individually, we can choose how advanced technologies such as the metaverse can help us all mitigate and even eliminate these problems or, conversely, we can choose to retreat in a virtual world that we use as the ultimate form of escapism for all our problems.

Technology in and of itself is never bad. It all depends on what we choose to do with it.

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