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# Cryptographic City

## Decoding the Smart Metropolis

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## 8 Bitcoin Cities

If you are in any doubt about the relevance of cryptocurrency to the city, then consider Bitcoin City. In 2021, the president of El Salvador declared Bitcoin legal tender. So businesses had to accept the digital currency as well as U.S. dollars. The country had already abandoned its own currency, the colón, in 2001. Even more interesting from an urban perspective is the president's adoption of a new idea for a city, Bitcoin City.<sup>1</sup> The electricity grid of the new city is to be powered by geothermal energy from the Concha-gua stratovolcano. The city plan is designed by Mexican architect Fernando Romero. The city will sit beside the volcano and follows a common utopian circular plan form. It will be ecologically sustainable, and the Bitcoin "mining" will also be powered by electricity generated from geothermal energy.

The International Monetary Fund (IMF) has urged El Salvador to abandon the use of Bitcoin as national currency, stressing the "large risks associated with the use of Bitcoin on financial stability, financial integrity, and consumer protection."<sup>2</sup> Vendors are reluctant to exchange Bitcoin for goods and services, not least due to the volatility of the currency and the time it takes for the Bitcoin blockchain to validate a transaction. Currencies rise and fall relative to one another, encouraging speculation as investors trade optimally one currency for another. For all the benefits of peer-to-peer, private, cash-like digital transactions, the implementation of the blockchain so far has encouraged widespread speculation, with subsequent impact on urban life.

### Money Markets

Cryptocurrencies are ripe for speculation. People buy Bitcoin online with money from their own bank accounts, or money transferred from some

other source. They can then spend their Bitcoin with vendors who accept the currency. You can buy Bitcoin by registering with a website. That then interfaces with a Bitcoin wallet on your laptop or smartphone. As a risk-averse investor my own forays into cryptocurrency were modest. In July 2017 I bought £100 worth of Bitcoin. One Bitcoin was then worth about \$6,000.<sup>3</sup> That gave me about 0.02 Bitcoins (to six decimal places). My digital wallet resides on my smartphone, which I took with me on a holiday in Ukraine as a backup in case I had trouble with my debit card. I was mainly interested in testing how easily I could transact in Bitcoin. As it happened, no vendor there was able or willing to accept payment in Bitcoin. So, it was not much use to me for buying goods. After I returned home, I encouraged a colleague to open a Bitcoin account and transferred £20 worth of Bitcoin to his wallet. That was simple enough and we organized the transfer directly via our smartphone wallets. Around the same time, I kept my eye on the value of my crypto assets on currency markets. It was rising rapidly. My £100 less £20 rose in value over the space of five months to £510. As a cautious trader I decided to sell and transferred £480 of the currency to my regular bank account, leaving £50 behind to reap the rewards of a further rise. Soon after that the value of Bitcoin plummeted. So, I got out in time, and I was ahead on the deal. Had I borrowed £100,000 from a bank and spent it on Bitcoin during that period of reckless speculation then I would have accrued £480,000, enough to buy a London bedsit, and the government would have done well from the tax on my capital gain. Other punters have been more successful. One student informant told me: “Back then I invested mainly in ETH and Litecoin, using Kraken and Coinbase, and I also had to get a bit creative to cash out part of the tokens. The purchase and sell prices were around ten times up. It was enough to help me buy an ice cream shop on a Greek island with a friend, but in hindsight it would have been considerably more if I had waited until 2021 to sell.”

Needless to say, the value of cryptocurrencies relative to real (fiat) currency is unstable. Rather than spend their cryptocurrency on goods, people tend to buy and sell it in the expectation that it might rise in value. Since its release, the value of Bitcoin rose rapidly. It created Bitcoin millionaires, and many people of course lost money when its value dropped.

In the current state of the technology in 2022, very few merchants accept Bitcoin. They do not have the means to process it, they can't be sure of its

value relative to fiat currency, and although transactions are processed in real time, they are not instantaneous. It can take from ten minutes to a day for the consensus among miners to release Bitcoin to the vendor. That may suit online purchases but is unfeasible for buying goods in a shop, when the vendor needs to know the transaction is secured before you walk out of the door. At the time of writing, cryptocurrencies don't yet outcompete the convenience of chip and PIN debit and cash cards, and mobile phone transfer accounts such as Kenya's M-PESA.<sup>4</sup>

There are costs to maintaining fiat currency: printing notes, stamping out coins, banking infrastructures, the materials and energy that have gone into office buildings, main street banks, and iron safes. But cryptocurrencies also entail costs. I've already alluded to the cost of the electricity to run a Bitcoin mining operation. The costs of running a blockchain are not trivial, and they are additional to the costs of banking infrastructures that already exist. Verification of cryptocurrency transactions is costly to the environment.<sup>5</sup> Competition among miners to verify blocks of transactions and thereby earn Bitcoin has escalated the computer processing needed to compete. The process requires hardware and power and generates heat as an unsustainable resource burden on the environment. The idea of "sustainable cryptocurrency mining"<sup>6</sup> that uses energy from sustainable and renewable energy sources, as claimed for Bitcoin City, remains a topic of research. The mining effort also concentrates the computational effort to corporations and countries that can afford to support these processes. After all, the verification process by the validators (miners) only delivers value in so far as it sustains the blockchain, and the cost of that escalates due to competition. This concentration of economic power has political implications and arguably reconcentrates power among the few that can afford to run a mining operation, rather than the many. That is antithetical to the original cryptocurrency ethos, at least as promoted.

Digital currencies, as part of the sharing economy, ostensibly enable peer-to-peer exchange independent of centralized control hierarchies. They carry the benefits and vices of cash economies. As with black and grey economies, you can exchange digital money for goods and services without being traced or having to declare income to the tax department.<sup>7</sup> But digital money is also corporatized. My Bitcoin wallet is connected to a network node or hub in Luxembourg. As indicated in chapter 7, Bitcoin "mining" is dominated by big companies with CPU farms in China, and large

“pools” of profit-sharing miners that work against the idea of a decentralized system. Where large profits are involved, it is common for successful grassroots enterprises and initiatives such as cryptocurrencies to succumb eventually to the pressures of scale. Either they grow to become big corporations or consortia, or big firms take them over.

Alternative blockchain models are emerging. The incentives are high for researchers and developers to devise methods that obviate the exorbitant energy, CPU burden, and electricity costs of validating blocks of transactions, especially in light of the climate crisis and attempts to meet carbon reduction targets. A substantial part of the cost resides with the *proof of work* (PoW) process by which validating nodes on a blockchain compete to solve a numerical puzzle, the solution to which is then circulated to all other verifying nodes and embedded into the latest block of transactions. The winning miner in this contest is rewarded with some cryptocurrency. It is a competitive process with potentially high financial rewards, producing an incentive structure that according to a review article by Fahad Saleh has “triggered a computational arms race among PoW validators. That arms race manifests in PoW blockchains expending an exorbitant level of energy.”<sup>8</sup>

One solution that’s offered to the arms race is to develop methods that assign the validation procedure randomly to computers on the blockchain network. The randomness is weighted toward those that are already most heavily invested in the cryptocurrency of that blockchain. The validation process is known as “proof of stake” (PoS). On the face of it, a randomly selected validating computer has no incentive to reject illegal blocks that come its way. The method also implies that control of the blockchain will reside with the richest participants, those with the highest stake. Saleh’s article shows how neither tendency diminishes the functioning of the blockchain, nor does it cause a “rich-get-richer” effect.<sup>9</sup> The developers of the Ethereum (ETH) blockchain that supports Ether cryptocurrency claim to have switched Ethereum to a PoS validation method in September 2022, incurring the risks of adjusting a system that already listed transactions worth millions of dollars.<sup>10</sup>

### Smart City Contracts

Blockchain technology intervenes in the narrative ecology of the city aided further by its support for smart contracts.<sup>11</sup> As with a line in a bank

statement, blockchain-enabled cryptocurrencies such as Bitcoin store lines in a shared ledger indicating payer, payee, date, amount, and the goods or services to be exchanged. Money transactions provide the prime application and the motivation for developing blockchain technology. But it has other uses. Instead of a text line indicating the product being exchanged, that line could include a piece of computer code that implements some consequential action in response to a trigger event. The Ethereum blockchain platform (ethereum.org) supports the idea of transactions as code. An Ethereum ledger line can contain a “smart contract” as an active piece of computer code that carries out some actions as part of a blockchain transaction.<sup>12</sup> The signatories to the contract are anonymous, but the code, the contract, is visible to anyone on the public ledger. Distributed knowledge that parties have entered into an agreement helps keep them accountable.

Writing about the role of blockchains in a sharing economy, Arun Sundararajan explains the smart contract method: “The smart contract protocol can specify, as computer code, terms under which certain obligations are fulfilled, and can execute actions like sending a payment or deactivating a file once there is evidence of the contract’s terms being fulfilled.”<sup>13</sup> He lists some of the benefits, or at least changes in business practices, that may follow the adoption of smart contracts: “Smart contracts are autonomous if after they are finalized, the initiating agents theoretically never need to have contact again. Smart contracts are also self-sufficient to the extent that they are able to marshal their own resources. Finally, smart contracts are decentralized; they are distributed across network nodes rather than residing in a centralized location, and are self-executing.”<sup>14</sup> Smart contracts need involve no one but the parties who have signed up to them. The record of their existence resides in the Ethereum blockchain.

Smart contracts require a means of interfacing with the world in which they are to operate.<sup>15</sup> An “oracle” is an item of hardware or software that channels information to the smart contract on the blockchain: that the goods have been received, the warranty has been invoked, the goods have been sold on to another buyer, or that other conditions of the contract have been met.

The idea of the smart city aligns well with the concept of smart contracts. The professional work practices of city governors, architects, and others are populated with formal contracts. A 2020 study showed that video games, currency exchange, and gambling exhibit greatest smart contract activity,

but researchers and blockchain specialists have identified property contracts as a major area of application.<sup>16</sup> Chainlinklabs.com asserts the relevance of smart contracts in real estate, with examples such as defining conditions under which property ownership can be transferred, securing collateral for loans, triggering rental payments, and transferring real estate ownership based on predefined conditions.<sup>17</sup>

Researchers have examined the application of smart contracts to building information modeling (BIM). BIM is a widely accepted platform for designing, documenting, and managing buildings and construction projects involving integration across all specialties, and is supported by established computer-aided design suppliers such as Autodesk and Bentley Systems. A smart contract item could be used to describe and visualize a parameterized building component (e.g., door, wall, staircase, street furniture), with attendant actions, constraints, and rules for use. The code in the contract could also indicate how agents can deploy, exchange, copy, reproduce, or dispose of such digital assets. BIM researchers Shojaei Alireza and colleagues assert, “Building Information Modeling (BIM) due to its data-intensive nature and the level of details presented in an appropriate model is an excellent way to tie different sections of the work to a smart contract.”<sup>18</sup> At the time of writing, these applications hold promise but are as yet untested in the BIM marketplace.<sup>19</sup>

Smart contracts bring into relief challenges presented by codified and automated contracts. Try as we might to be exact, contracts are ambiguous, contingent instruments that fit particular situations. The automation of a complex contract implies that the contract code accounts for every eventuality in the domain of application. Furthermore, peer-to-peer contracts will have to draw on expertise, or at least contract templates put together by knowledgeable experts. But secure contracts that automatically facilitate the actions they prescribe is an alluring prospect for the smart city.

### **Blockchain Urban Metaphors**

I began chapter 7 with cryptocurrencies and drifted to the underlying technology of the blockchain, a powerful tool for securing information flows via encryption methods. How does this narrative relate to the city? The digital world has long brought metaphors to bear on how we think of cities—as

flows of data, networks, circuits, grids, and an “Internet of Things,” as if cities are made of bits, memory (RAM), sensors, actuators, and with communication systems, inputs, outputs, and operating systems. The metaphor of the blockchain is potent. It provides analogues with city living, not least as we think of the data-intensive smart city, the overlay of integrated and responsive digital infrastructures that draw on big data streams from mobile apps, sensor networks, social media feeds, and transport information, to make buildings and transport systems more responsive to changing conditions.<sup>20</sup> In so far as we credit these expectations, we might assume that such infrastructures will operate under centralized control. Blockchain technology claims the potential for an alternative, localized, grassroots, and democratized dimension to the smart city.

Continuing with the metaphor, as in the case of El Salvador’s Bitcoin City, “mining” is suggestive of volcanoes and geothermal energy. Blockchain processes also demonstrate the geological metaphor of stratification. In a blockchain, data is layered in a time-ordered sequence as a kind of stack. The oldest is the deepest, with layers of data cemented by computationally byzantine verification procedures. Cities are like that in some respects. As well as physical stratification, people talk about cities as layers and accretions of memories, some of which are inscribed in the fabric of a place. We want to peel back the layers and watch translucent layers interact as they get scoured and replaced. But at the same time, some like to think of a city’s memory strata as immutable. Try as they might, those who would like to hack the past find resistance from the accretion of embedded layers.

The blockchain also draws the urban scholar’s attention to the challenge of validation within authority structures. In a blockchain, the validity of one item of data depends on the validity of another. Some hierarchies are like that, as are the structures of city governance. But so are informal relationships in communities. The good pupil inherits the respect accorded to her teacher, who in turn is deemed a good citizen by local shopkeepers, who are in turn validated by the respect they gain from their customer base. This is a conservative model. In architecture as in city governance, we build on the credibility of the achievements of others.

I mentioned the process of mining to secure the blockchain. A hacker would need to expend substantially more energy than the miners to access and change the blockchain, decoding and peeling her way through the



layers of the blockchain. As outlined already, securing the blockchain is called “proof of work.” This is the process by which nodes in the blockchain network contribute CPU time and effort to solve the arbitrary but extremely difficult cryptographic puzzle, the solution to which gets printed into the blockchain to confirm the validity of a block of transactions. This is not entirely alien to social functions in the city. From a semiotic perspective, to expend effort is to indicate a commitment and to validate your intentions. Think of the circumstance where political campaigners go from door to door to persuade would-be voters. It is not always the reasoning that persuades people, but the fact that someone braved the weather and spent the fuel and body energy in an effort to come and talk to the potential voter at home. Would-be persuaders are even more persuasive when they invest effort in something—preferably related to their cause.

To expend effort is to prove that something is of value. Putting in the effort shows the strength of your conviction. There is an argument here justifying otherwise unprofitable civic projects: follies, memorial statues, pyramids, and public art. That someone cared enough to spend and risk valuable resources, money, design effort, good will, and reputation on a building, artwork, ornamentation, or infrastructure project strikes any city visitor as a statement that the city has values. There is care there.

Making something visible, or at least accessible in a public way contributes to trust. That is one of the attributes of the distributed ledger idea in blockchain technology. The structure and its content are visible to anyone who wants to inspect them. Transparency is a watchword of good governance. It is a way of keeping people honest.<sup>21</sup> As with digital surveillance, the blockchain idea amplifies such vehicles of trust. But blockchain transactions are purposefully peer-to-peer, with the most private parts of the transaction encrypted, as long as you don’t lose the key.

Having read up on El Salvador’s Bitcoin City proposal, I see that cryptocurrency is there in the symbols, narrative, and form of the city diagram, though as yet I don’t detect anything about land use, exchange, or commerce that draws on ideas of unregulated peer-to-peer exchange. The sharp boundary to the city’s circular geometry also works against the symbolism of sharing and openness. Nor is there a display of pipes, reservoirs, turbines, and steam valves that speak to sustainability and celebrate the thermal energy that is to power Bitcoin City.

Many contradictions come to light as we probe the city via the lens of the blockchain. A city as distributed ledger would lay everything out to be viewed, used, modified, and accessed. But, like my Bitcoin wallet, access is only granted to those with the private decryption key. There are many parallels here with the distribution of software and other online assets. You need the key to unlock the features you have paid for. As any architect knows who has had to draw up a key schedule, a building is a system of locks and keys. So is a city—a matrix of locks, keys, vaults, hidden spaces, security doors, cameras, contactless sensors, keypads, and passcodes—fixed and mobile. Under the blockchain metaphor, cities reveal themselves as hyper-encrypted, and the security of the smart city depends on that.

### The Politics of Cryptocurrency

I hope it is obvious by now that cryptocurrencies entail an ideology of decentralization that is attractive to many. The concept of decentralized commerce sounds suitably progressive and democratic. The ideology appeals to extremes on both the right and left of politics. For those on the right, cryptocurrencies support the idea of unregulated trade, individualism, small government, and self-sufficiency. The ideology harbors an undercurrent of right-wing, anti-establishment views as well as self-reliance and mistrust of the state. For researcher David Golumbia, digital currencies “emerge from the profoundly ideological and overtly conspiratorial anti-Central Bank rhetoric propagated by the extremist right in the U.S.”<sup>22</sup> By this reading, cryptocurrencies arguably are money for anti-establishment “preppers” suspicious of the “deep state” and other targets of alt-right opprobrium.

On the left, cryptocurrencies suggest a means to greater democracy, people power, and a break from large corporations and financial institutions (i.e., a break from capitalism). The banking crisis of 2008 eroded the trust of many in banks and financial institutions. That cryptocurrencies are “decentralized” suggests the democratization of money and empowering people over institutions. Like informal cash exchange, cryptocurrencies may encourage certain kinds of grassroots development. Many people in developing countries are mistrustful of banks, or don’t have the resources to borrow or benefit from what banking offers. Cryptocurrencies promise a means of empowering the “unbanked.”<sup>23</sup>

On the negative side, unscrupulous operators also see such communities as fair game for scams. The ubiquitous reach of the Internet delivers, promotes, and amplifies the operations of financial products and provides a vehicle for influence campaigns that exaggerate claims about cryptocurrencies. Cryptocurrency is mysterious to the average consumer, but tantalizing. There is plenty of scope for companies to deliver explanations that both clarify and confuse, deliberately or unintentionally. It is also easy to insert false claims into a narrative dressed up as a cryptocurrency project.

Bitcoin was the first successful cryptocurrency and now there are others, also known as “altcoin,”<sup>24</sup> including Ether, XRP, Litecoin, Zcash, Monero, and Dogecoin. Apart from their apparent utility, several factors amplify enthusiasm for new cryptocurrencies. The story of Bitcoin lingers as evidence that cryptocurrencies provide an opportunity to acquire wealth quickly. Some startups in the blockchain world recruit investors by selling “initial coin offers” (ICOs) as a way to raise startup funds. Investors buy the cryptocurrency at a favorable rate in the hope that their holdings will eventually increase in value.<sup>25</sup>

As well as enabling legitimate cryptocurrency schemes, these factors create a climate rich with opportunities for scams, get-rich-quick schemes, fraud, and fake systems that exploit the appeal of cryptocurrency narratives concerning, for example, wealth, decentralization, self-sufficiency, community, opportunity, education.

## Crypto Scams

I’ll conclude this chapter with a flamboyant illustration of a cyber scam. Cybercrimes extend to scams and faux cryptocurrency schemes. The “onecoin” scandal was such an illicit operation.

I first heard about onecoin through a BBC Podcast called *The Missing Cryptoqueen* by journalist Jamie Bartlett and producer Georgia Catt who investigated the scheme and the damage it has wrought on individual lives. As I listened to the first episode of the podcast, I thought I was hearing a mockumentary, or a mystery story in the form of a documentary, and perhaps an elaborate allegory of political scam culture about how easily people get duped into cults and adopt reckless chants at rallies. But onecoin is real—or at least it is a real fake, a dissimulation that exists. Onecoin

(and its company OneLife Network Ltd) effectively runs a pyramid selling scheme—a Ponzi scheme. You pay to join the network and get some pay-back as you recruit others to join. Those new network members in turn get a cut as they recruit more people. The more people you recruit and the more they manage to recruit others, the more money returns to you. The scheme preys on myths of multiplication. You multiply your financial investment in the scheme by recruiting others who in turn multiply returns to you, exponentially. Money percolates upward through the pyramid. The organizers and early members inevitably get most of the money. Of course, the market is finite, and later adopters run out of people they can coerce into buying into the scheme.

I recall my pre-digital school days when such pyramid schemes circulated by word of mouth. They seemed to involve posting money in an envelope back to someone who recruited you to join the scheme. You then had to recruit others who would send you money. Parents and teachers of course warned against participating. So, I never fully understood what it entailed, or got rich. More charitably, this approach is sometimes termed *network marketing*, relying on a dedicated group of individuals and their social contacts. In the case of onecoin you pay to join in fiat currency (i.e., £ or \$), and your income from the scheme accrues in onecoin, a supposed cryptocurrency. Members can see the value of onecoin rise relative to fiat currency on the onecoin website—or so it seems.

As it happens, there's nowhere to exchange onecoin for fiat money. You cannot deposit or exchange it at a bank. Merchants in on the scam only sell products if you pay in a combination of onecoin and fiat currency. Most important, the supposed value of the currency is only what the organizers say it is worth, and they keep inflating it to make members feel as though they are getting richer—and keep hoping that one day their virtual riches will convert to actual money. The tragedy for many people who buy into the scheme is that once they realize this won't happen, the cost, anxiety, blame, and guilt filters through their social network, straining relationships among friends and loved ones recruited to the scheme.

A telling video available on YouTube shows the onecoin founder, Ruja Ignatova, inspiring fans by demonstrating how much better onecoin is than Bitcoin, the promise it holds of future riches for its members, the strength of the community of members to determine how the currency

operates, the speed and convenience of transactions (unlike Bitcoin), the benefits of its delivery of learning materials, and so on. As a demonstration of how robust and community-centered the organization is, Ignatova explains how OneLife Network has just doubled the value of each person's onecoin account on the ledger. The crowd cheers.

The OneLife Network also sells education packages, for real money, that teach you about cryptocurrencies. It is a learning community after all. Here is the punchline: the BBC says that the founder made more than \$4 billion for herself. She has not been seen since 2017.

In spite of this disappearance and exposure in the media, as of 2021 the scam continued to recruit. There are other scams based on cryptocurrencies. There's dagcoin; I also discovered trumpcoin online.<sup>26</sup> I won't link to their websites lest that add to their connectedness and their claims to legitimacy. Investigators say there is in fact no blockchain to support or verify transactions in onecoin. If onecoin is anything at all useful it is merely a centralized database of transactions. Such Ponzi schemes trade in the claimed benefits of multiplication: riches that accrue from your own participation in a hierarchy of mass-produced wealth.

There are other scams that implicate cryptocurrencies. The circulation of false narratives in social media about adversaries is a deception that hurts the target, but garners support from the believers and hence funds via merchandising and donations. The "Luther Blissett Project" was an invention of an anonymous activist Italian art collective in the 1990s. Art commentator Eddy Frankel cites this collective as one of the inspirations for the QAnon conspiracy movement—social conspiracy co-creative performance as art project.<sup>27</sup> Other commentators, such as Izabella Kaminska, have linked the methods of QAnon to cryptocurrency.<sup>28</sup> The invocation of the letter "Q" and its made-up stories are supposedly sourced in the U.S. Intelligence Service. An interesting article in the *Financial Times* blog pages in 2020 argued, "Cryptic messaging, puzzle-solving and anonymity/pseudonymity feature prominently in both systems."<sup>29</sup> By "both systems" the author controversially binds QAnon conspiracy theories to Bitcoin. Art, conspiracy theories, performance art, and cryptography feed off inventive combinations, however edifying or perverse—a crypto-combinatorics as it were.

At the start of this chapter, I took El Salvador's initiative to create a Bitcoin City as an opportunity to discuss speculation in money markets, the risks and uncertainties of cryptocurrencies. I reviewed the idea

of blockchain-based smart contracts as instruments for automated transactions in the city. The blockchain idea serves as a way of framing our understanding of the city, suggesting various metaphors of city structure and living. We looked at the political affordances of cryptocurrencies, and finally the susceptibility of the city to crypto scams. I will return to some of the technical aspects of the blockchain in subsequent chapters. My discussion so far has been based largely on cryptography as a means of managing texts and numbers. In the next chapter I turn to the impact of cryptography on the city as a visual arena.



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