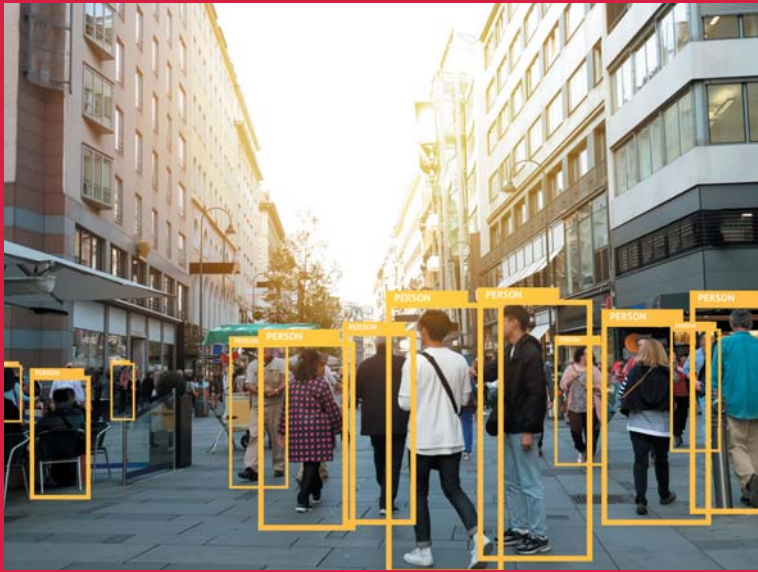


BLOCKCHAINS AND THE CIVIC NERVOUS SYSTEM

Alessandro Voto
Institute for the Future - Blockchain Labs



Alessandro Voto is the West Coast Regional Director for Consensus, a Brooklyn-based blockchain technology venture studio. He connects organizations and social entrepreneurs with the local blockchain community to build applications & services. Alessandro also serves as a research affiliate at Institute for the Future's Blockchain Futures Lab.

KEYWORDS

- BLOCKCHAIN
- BITCOIN
- SMART CONTRACTS
- CRYPTO-CURRENCIES
- SELF-GOVERNING PROTOCOLS
- DIGITAL IDENTITY
- DECENTRALIZED CITY MANAGEMENT
- GOVERNMENT-AS-A-SERVICE

In this article, Alessandro Voto takes us on a journey to explore how the rise of Blockchains protocol will transform city management enabling more distributed city governance and the emergence of a range of new urban services where machines and humans collaborate in new ways to store, move and transact. Projected to operate at a fraction of the cost of centralized protocols, those new services will be particularly adapted to underserved populations by providing mobile and secure identity for them and the value that they create.

INTRODUCTION

In a departure from the centralized “brain” of traditional city politics, blockchain-based civic nervous systems will distribute political intelligence and economic agency to the edges. Humans won’t be the only ones making decisions and acting on them. Machines and artificial intelligence agents will be equal contributors in the smart city symphony of the future.

The city is a distributed organism. Its inhabitants work symbiotically to turn raw materials into life-sustaining products and services for the greater whole. To move and protect the value they generate together, people depend on civic infrastructure like laws, markets and contracts. Together, these tools and their enforcers act like a city-wide nervous system, letting communities reliably respond to emerging needs and painful attacks.

Until now, we needed centrally-managed government and enterprise institutions to manage the records and processes behind this infrastructure at the city scale. In exchange, however, we gave these institutions the power to artificially limit our interactions so that they could extract profit or censor activities they deemed inappropriate. Furthermore, they became convenient targets for data breaches and third-party manipulation.

Recent advances in technology stand to eliminate the need for centralized bureaucracies, connecting peers directly to help them track and execute economic and social agreements themselves. One such technology, known as a blockchain, uses these direct links as a hedge against centralized civic power.

Blockchains are a kind of shared database that lets communities store records permanently across a network of computers. Any peer can submit a record for others to store in the chronological, synchronized chain alongside other's records. The records and their relative order are protected with bank-grade encryption to ensure they can't be altered, deleted, or forged by any single party on the network.

Blockchain technology will facilitate brand new kinds of cooperation within and across cities. It will extend trustworthy institutional protections and financial services to marginalized and poor people worldwide. It will reinvent the way we manage physical city infrastructure and digital community structures. What follows is a brief glimpse into the future of a blockchain-based civic nervous system.

URBAN IDENTITY UNBUNDLED

Civic participation begins with identity and citizenship. Whether it's a person, a corporation, or a device, unique identifiers help us extend our trust to the right groups and protect ourselves from malevolent actors. For this reason, one of the most important functions a blockchain can serve is to manage personal and organizational identity information.

Currently, drivers licenses, passports, social media profiles, and other forms of institutional identity are what makes you *you*. Without them, it's difficult or impossible to access financial services and legal protections. Worldwide, the United Nations estimates that there are 1.5 billion people who currently live without formal identity, excluding them from the urban services and protections it provides.

With blockchain-based identity services, anyone can cheaply establish a unique digital identifier. They can then start associating data about their activities and relationships with the identifier through subsequent transactions on blockchain. Each additional tamper-proof record helps paint a higher-resolution picture of one's trustworthiness. Since anyone on the network with a copy of the blockchain can access these records, urban denizens can easily find and establish ties with new collaborators according to strict and verifiable criteria, all without a central identity manager.

Blockchain projects like Consensus' Uport and Blockstack Labs' namesake identity system will open up entirely new possibilities for identity management. City schools and mentors will pass unforgeable learning badges to their students, letting students port micro-credentials to new geographies and educational venues.



“THE CITY IS A DISTRIBUTED ORGANISM. ITS INHABITANTS WORK SYMBIOTICALLY TO TURN RAW MATERIALS INTO LIFE-SUSTAINING PRODUCTS AND SERVICES FOR THE GREATER WHOLE. TO MOVE AND PROTECT THE VALUE THEY GENERATE TOGETHER, PEOPLE DEPEND ON CIVIC INFRASTRUCTURE LIKE LAWS, MARKETS AND CONTRACTS. TOGETHER, THESE TOOLS AND THEIR ENFORCERS ACT LIKE A CITY-WIDE NERVOUS SYSTEM.”



Organizations will have their own blockchain personas, with their civic and environmental impact audited and visible to others. Even municipal robots will have their identity tracked to ensure they are performing up to code and not deviating from their duties.

The notion of citizenship will scale past administrative hurdles as blockchain transactions reveal rich information about people's contributions to their community. Once-vulnerable migrant populations will earn "global citizenship" beyond national borders through applications like Bitnation. Since blockchains don't necessarily require static, formal identity information to participate usefully in them, we might also see minimum-viable-identity governance systems and one-time-use ID's that expand access to services for people deeply concerned about their privacy and security.

Whether through rich self-sovereign identities or disposable personas, blockchain-based identity will let people lay true claim to their data and, importantly, their wealth.

CIVIC VALUE NETWORKS

Bitcoin, a digital form of currency, both introduced the concept of a blockchain and became its first killer use case. Bitcoin has a software-defined money supply, released first to "miners" that

use their personal computers to process new transactions for the network. Once the coin is mined, its owner can pass it along by submitting a transaction record to miners for inclusion in the public blockchain. All of this is done without formal identity using only cryptographic addresses to hold and move funds. By logging transactions across a massive network of pseudonymous peers instead of a central payment processor, anyone with an Internet connection can accept or send the currency without fear of censorship or rent-seeking middlemen.

Bitcoin and other so-called "cryptocurrencies" will open flows of value between city residents and global partners that challenge long-standing borders and regulations. The global poor and the ultra-elite alike will use these frictionless networks to access international investment opportunities and banking services never afforded to them before.

Since all payments can be traced back to the accounts that initiated them, people and organizations will opt to associate their "true" identity with their accounts to hold themselves and others accountable for spending money. City governments will have their own accounts, known in blockchain parlance as wallets. Citizens will fund government wallets with transparent tax contributions, authorize spending as a crowd, and carefully audit transaction ledgers to minimize corruption and wasteful spending. NGO's will do the same with tools like Bitgive to help philanthropists track their impact on developing urban centers.

Since Bitcoin, developers have spawned many so-called "cryptocurrencies" like it. Dogecoin, for example, was a bespoke currency that gained success from its playful branding marked by poor language translation and Shiba Inu dogs. Others reinforced serious beliefs of financial sovereignty, like the Sioux Indian Tribe

did with its own cryptocurrency called Mazacoin. In cities of the future, people will hold their wealth in a great number of tokens, each with their own transaction rules, backing assets, and community connections. Some will be fully fungible to encourage massive investment, while others will be limited to singular uses.

Projects will issue tokens to track people's contributions to resource pools and help meter access to them. La'Zooz, a blockchain-based ridesharing app, provides tokens to drivers for offering rides that are redeemable for rides from others in the future. Transactive Grid, Solar Coin, and the Energy Web Foundation are three projects aimed at establishing renewable energy microgrids where neighbors can pay each other for spare electrons without passing through a central energy company.

Though today's early blockchains require slow confirmation across the network to maintain security, new developments in the field will soon allow parties to transact offline at lightning speed, settling with the greater network only when necessary. This technique, known as a payment channel, will enable micro-payments to flow between people with little to no transaction cost. This means Internet user can pay WiFi router owners for access on a per-byte basis. Polluters might pay per carbon emission. Muralists might receive donations per glance from eye-tracked onlookers.

Low-cost financial flows will also make municipal crowdfunding easier, transforming the city's form with help from its residents. With a growing total market capitalization of over \$80 billion as of May 2017, there will soon be a great deal of frictionless liquidity available to pull from. With this in mind, a blockchain real estate investment company called FOAM imagines a world where architects can propose new real estate projects like a Kickstarter campaign, then allow investors from anywhere to effortlessly gain an equity stake in their production. Investors and other stakeholders could then vote on matters related to the project, making each city project an experiment with decision-making built directly into its structure. This brings us to the next blockchain

DISTRIBUTING THE SMART CITY

In a departure from the centralized "brain" of traditional city politics, blockchain-based civic nervous systems will distribute political intelligence and economic agency to the edges. Humans won't be the only ones making decisions and acting on them. Machines and artificial intelligence agents will be equal contributors in the smart city symphony of the future.

To harness the trusted security of a blockchain in a smart city context, developers will hold more than just static information and asset registries on-chain. They will also store bits of computer code called smart contracts to perform complex operations without relying on a single third party to execute them. First coined by legal scholar Nick Szabo in 1994 and later implemented through a blockchain protocol called Ethereum, smart contracts act as a robotic escrow agent and notary, to which people can send assets and data if they agree to the contract's terms. No one can change the agreement, censor people from interacting with it, or prevent it from executing, unless explicitly specified in the code itself.

"TO HARNESS THE TRUSTED SECURITY OF A BLOCKCHAIN IN A SMART CITY CONTEXT, DEVELOPERS WILL HOLD MORE THAN JUST STATIC INFORMATION AND ASSET REGISTRIES ON-CHAIN. THEY WILL ALSO STORE BITS OF COMPUTER CODE CALLED SMART CONTRACTS TO PERFORM COMPLEX OPERATIONS WITHOUT RELYING ON A SINGLE THIRD PARTY TO EXECUTE THEM."

With this powerful new ability, cities can replace tedious bureaucratic processes with transparent and efficient decentralized applications. We will see land rights, trade agreements, incorporation documents, voting systems, and more re-invented to be self-enforcing, freeing up costly labor while opening up new opportunities for collaboration that would otherwise be costly to arrange. Ethereum even has an easy-to-follow tutorial on its site for "how to build a democracy on the blockchain", complete with voting, membership, and asset control processes. As cities experiment with simple governance tools like these, they will share their best practices as open-source "governance as a service" applications.

Machines will engage in smart contracts alongside humans, not just running the code, but even deciding when and how to invest wealth allocated to them or take on jobs opportunistically. Filament, a Reno, Nevada based blockchain company, is already creating embeddable mesh networking chips to let machines buy each other's time and resources through smart contracts in rural and urban environments. Machines might some day "own themselves", opening up for capital investment and information from humans and bots only when necessary to fulfill their hard-coded duties.

Blockchain technology hold immense potential for reinventing the way we build, manage, and trade within and across cities. Civic designers will be tasked with designing these unstoppable systems with an eye to human needs, preventing blockchain uses that reinforce old models of injustice. A new civic nervous system is about to wake up, and it's up to us to teach it the future we want.