



Blockchain Solutions for People-Centric Cities

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Abstract

DigitalTown is working with a network of communities around the world to introduce self-funding platforms that are locally governed and locally owned, where residents and visitors search, connect, share and transact locally and directly and with little or no service fees. Each implementation of the DigitalTown platform and App can be owned by local stakeholders, whether by the governing entity or by the residents themselves. Each local resident can secure a permanent digital identity which can be validated by one or more verifying authorities.

The foundation of the platform is the SmartWallet. It is the link between an individual, their data, and their crypto assets within the DigitalTown network. Every user that signs up with DigitalTown receives a free SmartWallet. It contains the account used for Single Sign On, and combines this verified identity with a public facing profile, location, personal preferences, links to social media accounts and the ability to pay a person or business.

A permissioned Ethereum blockchain implementation provides the platform for the smart contracts that enable instant payments and a token based economy.

The model is designed to scale from the smallest village to the largest metropolitan area, providing a framework for local governance with global interoperability.

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1. Overview of the DigitalTown Movement

Around the world, small businesses are closing at an unprecedented rate. When a local business fails, local jobs are lost, revenue from local business tax is lost and the surrounding community is impacted by a loss of nearby products or services. As people commute further for work or move away entirely, the very communities that define our cities are impacted. It's headline news when big brands close stores, but there is no significant coverage of the gradual decline of independent local businesses and the impact this has on the city.

The trend cannot be explained as simply a symptom of the shift to online retail. Most local business have independent websites and there are plenty of companies providing tools to create and manage an online presence. The root cause of the issue is that we have allowed specific verticals to be dominated by a small number of large companies at the cost of the economic wellbeing of our local economies.

The DigitalTown solution is comprised of four key pillars.

- The City as the brand
- Verified online identities
- Secure peer to peer payments
- Rewarding engagement

The goal of our technology is to help people search, connect, share and transact locally and directly with little or no transaction fees. We create discoverable online communities where residents and visitors can participate in local economic success while co-creating quality of life.

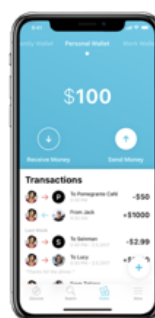
DigitalTown Inc. is rolling out its Smart City solution in North America, with Cities scheduled for release throughout 2018. The Smart City solution is supported by iOS and Android apps which can be locally branded if desirable for driving local adoption or improving integration with municipal services.

2. The DigitalTown SmartWallet

The *SmartWallet* is not simply a method of digital payment, but like the wallets we carry in our pockets and purses, it's a representation of our identity, preferences, information, affinities and multiple forms of payment.

The *SmartWallet* is the link between an individual, their data, and their crypto assets within the DigitalTown network. Every user that signs up with DigitalTown receives a SmartWallet. It contains the account used for Single Sign On, and it combines this verified identity with a public facing profile, location, personal preferences, links to social media accounts and the ability to pay a person or business instantly anywhere in the world without transaction charges.

The DigitalTown SmartWallet profile can be linked to a personal Domain such as *Cartwright.Uno* for the digital nomad, or *Mike.Austin.City* for the lifelong Austinite, providing every resident of every city a permanent online address that they own and control. While every resident is entitled to a free identity URL, some vanity URLs may incur a fee.



Self sovereign identity

- Verified and attested
- Distributed data
- Shared ownership
- Fiat money
- Cryptocurrency
- Tokens

Figure 1 - SmartWallet

2.1 Verified online identity

Identity is much more than the account you use to login. It's about proof that you are who you say you are. An estimated 1.1 Billion people in the world are unable to prove their identity, that is 1 in every 7 individuals. The DigitalTown platform provides a free verified identity to every resident of every city, and we encourage the interoperability of applications and services through this identity.

Until quite recently all user accounts were stored on central servers . We have all seen the news reports of data breaches resulting in sensitive data being leaked. Our goal is to establish individual control, security, and full portability of an identity. People and businesses can store identity data on their own devices and provide it efficiently to those who need to validate it. This all takes place without relying on a central repository of identity data.

Starting with an Email, and using a variety of techniques we can verify any individual and take significant steps to establish a trust based relationship.

Techniques used include:

- Public Records – we have access to databases on data that enable us to validate names, email addresses, phone numbers and physical addresses.
- Physical Mailing – the use of a one-time code mailed to a physical address.
- 3rd Party Attestation – integration of a network of approved digital notaries who can review documentation including passports and driving licenses and issue signed attestations.

As an individual interacts with a Smart City Platform, engaging in discussions or participating in community projects, the trust grows between the contributing individual, other residents and local businesses.

2.3 Secure peer to peer payments

Your Verified Identity is linked to a payment wallet that can hold a growing number of different fiat currencies, alongside a growing number of cryptocurrencies. Anyone can top up their wallet using their credit or debit card, or transfer cryptocurrency directly into their SmartWallet.



Figure 2 - Payment via QR Code

Once funded, they can immediately pay someone, or be paid, via e-mail or QR Code. The recipient uses the app to display the QR Code for their wallet, the sender scans, enters the amount and sends. Transfers are instant.

With Cryptocurrencies, we manage the interaction with the public blockchain, providing a simple solution for anyone to pay or be paid without the complexity of creating or managing a crypto wallet. We currently handle any currency exchange which means you can pay in UK Pounds from USD wallet with no friction.

2.4 Rewarding Engagement

To encourage people to interact both with the platform, to support local businesses and to take an interest in the local community, we created a reward program that we call Community Points.



Figure 5 - Earning Community Points through interaction

Community Points must be earned into existence.

For example:

- Create a discussion on the Community page – earn Community Points
- Create a community project to clean up downtown – earn Community Points
- Create a news article and earn a Community Point each time someone reads it

Once earned, these Community Points can be exchanged for goods and services with local business at a value determined by the local business. They are not linked to any specific city but rather are global and can be used anywhere.

In issuing Community Points and encouraging Businesses to assign a value, it's important not to create yet another model that penalized the small businesses. This is not an ask to the business to sell products at a discount. We need to create demand in the local businesses to ensure they attract the people who have earned Community Points.

A business can use the Community Points they earn to buy advertising and improve their company's visibility. This focus on using Community Points to buy advertising ensures a deep-pocketed advertiser cannot outspend a small advertiser by simply using a credit card.

In addition to advertising, we created a solution with the ability to send a message to a specific demographic of users. For example, a coffee shop may want to tell me that a new blend of coffee is now available and invite me to try it. The business will use Community Points to reward the Reader for reading the message not pay an advertising company. A twist on traditional Advertising in that we are rewarding the User for their time not selling advertising. A business that has no direct need for Community Points can donate them to good causes who in turn can reward volunteers for their service.

3. Community Engagement

To encourage residents to think locally and act locally, as well as to promote habit-forming use of the mobile app, we added a community engagement component to the product.

The Community Engagement product consists of the following components:

- **Local Map** - add a Pin, Label or Tags to the community Map. A user can link a photo or document to the pin, sharing information about a point of interest. They can also choose to share their location with contacts in their contacts list.
- **Local News** - Providing live updates on local news with the ability to comment on and share the articles, including citizen journalism contributions.
- **Community Discussions and Polls** - Anyone can post a discussion which can be commented on and shared. A discussion can include a Poll to gather feedback. Discussions and polls can be public or be closed to non-residents.
- **Community Projects** – A resident can create a local project, schedule ‘Work Party’ days when work will be done (E.g. Fix a local Playground) and allow people to donate time, resources or money to the cause.
- **Messaging** – The ability to send a message through the City App directly to a specific demographic of users. For example, a coffee shop may want to tell me that a new blend of coffee is now available and invite me to try it. The business will use *Community Points* to reward the Reader for reading the message, not DigitalTown to send it.

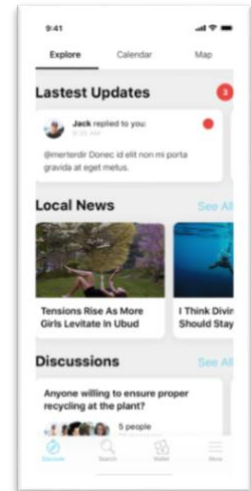


Figure 6 - Engagement

It is initially through this engagement that Community Points are earned into existence.

4. Revenue

Each city platform will earn revenue by withholding a percentage of the value of all transactions.

Over time, the cost of transacting through the platform will reduce directly in relation to the revenue earned by the platform with the expected result that over time some categories may be entirely free, e.g. table reservations. The percentages already represent a significant saving for business already working with the large online retailers.

Initially the percentage withheld will be as follows:

- | | |
|---------------------------------|--------------------------------|
| • Peer to Peer Transfers | Free |
| • Peer to Business Transfers | 1% of amount transferred |
| • Lodging | 12% Net on all reservations |
| • Retail | 8% Net on all online purchases |
| • Dining - Takeout reservations | 8% Net |
| • Dining - Table reservation | \$0.75 per Table |

There are no hidden transaction fees in the DigitalTown platform, saving businesses an average of 3-5% in card processing fees. As the volume of transactions increase, and on a city by city basis, we envision moving to a model like Ethereum Gas [11] whereby a small fixed service fee is automatically paid to DigitalTown for each action on the platform rather than DigitalTown withholding a percentage of the revenue. The platform becomes funded by these fees.

5. Blockchain Technology

Blockchain technology was introduced to the world in 2009 with the launch of the bitcoin [1]. The true value in blockchain technology is not in its ability to enable cryptocurrencies, but in its distributed ledger and use of cryptography to remove the need for a central authority to establish trust between two or more people. Blockchain has the power to bring communities together, to enable safe interactions between people and businesses, and to remove the historical dependency and costs associated with centralized organizations.

When the technology first began to gain traction, building applications that leveraged blockchain required a knowledge of cryptography and mathematics as well as coding. Ethereum was introduced in 2014 as an open source distributed public blockchain network. Unlike Bitcoin, Ethereum provided a comprehensive scripting language that enabled developers to create and execute Smart Contracts without a deep knowledge of the underlying blockchain technology.

A Smart Contract can be thought of an account that is holding objects on the blockchain that includes several functions that perform predefined actions, a kind of “if this, do that”. The contract is defined at the point it is created, but the execution takes place on the Ethereum network (private or public). All computers executing the code must come to the same result and reach a consensus. In such way, we can be sure that the code was executed as it should be.

Ethereum is an open-source blockchain platform that allows anyone to build and use decentralized applications running on blockchain technology. The Ethereum Virtual Machine (EVM) can execute scripts using an international network of public nodes in a Proof-of-Work (PoW) model or be used to create a Private network of nodes that adopt a Proof-of-Authority (PoA) model. PoA does not depend on nodes solving arbitrarily difficult mathematical problems, but instead uses a set of nodes that are explicitly allowed to create new blocks and secure the blockchain.

Ethereum has had a dramatic effect on the speed of adoption of distributed applications and blockchain technology and is the platform that underpins the DigitalTown Blockchain technology.

5.1 Nodes

The blockchain network is simply lots of EVM (Ethereum Virtual Machines) or “nodes” connected to every other node to create a mesh. *Each node runs a copy of the entire blockchain* and competes to mine the next block or validate a transaction. Whenever a new block is added, the blockchain updates and is propagated to the entire network, such that each node is in sync.

Any computer connected to the Ethereum network which fully enforces all the consensus rules of Ethereum is called a Full Node. These nodes maintain a full copy of the blockchain, and form the backbone of the Ethereum system, keeping the entire network honest.

These Nodes have the role of ensuring transactions have the correct signatures, transactions and blocks are in the correct data format and that there is no double spending occurring in any of the blocks

The proof of authority consensus algorithm requires at least two voting nodes to reach consensus. We have initially deployed three nodes, one managed by DigitalTown and two managed by an independent partner, SettleMint.

Nodes can be added at any time by approved partners.

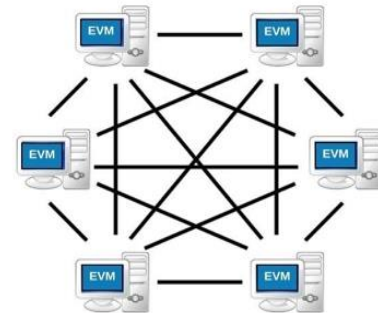


Figure 7 - DigitalTown Nodes

5.2 Proof of Authority vs Proof of Work

Proof of Work (PoW) requires that a certain amount of computational work to be done to solve an arbitrarily difficult mathematical cryptographic puzzle. This effort is called mining and the probability that one mines a block is proportional to hashing power. In turn hashing power is a function of hardware, network access and energy. In its current state, PoW is not only computationally expensive but also grossly inefficient with respect to energy consumption. It's estimated that the power required to add one block to the bitcoin blockchain now equates to the amount of energy used by the average home over a 7 day period.



Figure 8 - Proof of Work vs Proof of Authority

These factors incentivize miners to centralize hashing power rather than creating a truly decentralized network where anyone can participate. Miners have consolidated into small set of large mining farms or large mining pools and act as *de facto* authorities on the network. There is increasing concern over the small number of mining pools that control more than 51% of the bitcoin network and the impact on security.

Proof of Authority (POA) is an alternative to Proof of Work that can be used when creating private chains. POA does not depend on nodes solving arbitrarily difficult mathematical problems, instead the owner defines a set of nodes called "Authorities" that are explicitly allowed to create new blocks and secure the blockchain.

We operate a Proof of Authority (PoA) model with nodes being operated by DigitalTown and invited Trusted partners. Long term, our goal isn't to maintain a private network. We will consider any third party wishing to be able to facilitate the transfer Fiat or Cryptocurrency to register one or more nodes as part of the Trusted DigitalTown blockchain network.

5.3 Tokens

In its simplest form, a public blockchain can be thought of as a shared ledger. It's a list of accounts and values associated with those accounts, but one where a user may only insert and read data but never change it.

With all the focus on Cryptocurrencies, its often overlooked that the stored values, which we refer to as Tokens, could represent anything. In the true definition of a Token, they are simply a visible representation of something else.

These Tokens can represent shared ownership of a physical or digital asset or reward points for a business.

5.4 ERC20 & Smart Contracts

Smart contracts, also known as self-executing contracts, blockchain contracts, or digital contracts are essentially a set of instructions and rules converted to code, stored and replicated on a blockchain platform and managed by the network of computers that run the blockchain. A SmartContract can be used to define the rules for and to store Tokens.

ERC20 is a standard interface for tokens designed to allow interaction with other smart contracts and decentralized applications built on the Ethereum Blockchain. These types of tokens are essentially a subset of Ethereum tokens.

The DigitalTown Smart Contracts are ERC20 compliance and provide a core set of functions that include:

- Create Wallet
- Mint Token
- Transfer Token
- Burn Token
- Get Account Balances

5.5 Cryptocurrency wallets

There are several independent blockchain platforms supporting their own Cryptocurrencies. The best known is Bitcoin, but there are hundreds of others including Ethereum, Lumens, Ripple and Litecoin. To hold a Cryptocurrency, you need to create a Wallet, and not every wallet is compatible with every currency. Each wallet comes with a Private and Public Key which need to be stored securely, and with some platforms (e.g. Bitcoin) you are also required to store a wallet id.

For the average consumer, the process of buying and storing cryptocurrencies can be challenging. As a result, companies like Coinbase and Binance have emerged as proxies to the technology. A simplified user interface enables users to create a wallet, buy currencies, and trade through a simple website secured by a Password and Onetime Passcode via a mobile phone.

These platforms do not enable consumers to use these currencies to transact with businesses.

6. How DigitalTown use Blockchain Technology

There are five key components to the DigitalTown solution that leverage Blockchain technology.

- Verified Identities – Although we have not adopted self-sovereign identities at this point, we provide a way to render identity on a Blockchain.
- Secure peer to peer payments – The ability to record Fiat Currencies and transact through the smart wallet. We call these *FiatTokens*.
- Community Points – The ability to reward consumers and creators of content in a form that encourages engagement with local businesses, and in turn rewards local businesses for encouraging engagement. We call these *Community Points*.
- Cryptocurrencies in the SmartWallet

The ownership of *FiatTokens* and *Community Points* will initially be managed only through the DigitalTown Smart City platform and Apps, with Contracts executed on our private Ethereum network of nodes. Our long-term goal is to provide a platform that does not depend on DigitalTown being an authoritative third party and that will allow the secure transfer of ownership independently using cryptographic proof and not DigitalTown as the authority.

6.1 Self-sovereign identity

Identities for the DigitalTown platform are currently stored in a database. We support OAUTH2 standards and have published an API that is available to anyone who wishes to use DigitalTown as an Identity Authority, enabling DigitalTown users to connect to their application without creating a new user account. We plan to move to authentication of our platform being via Self-Sovereign identities using attestations to prove identity. This will be either through development or partnership.

Attestations are still in a very early phase, and a complete solution will require key government agencies such as the DMV to adopt the standards and establish themselves as an attester as well as the establishment of a network of independent verifiers. This attestation model supports DigitalTown's practice of formally partnering with municipalities where practical even if a municipality does not initially choose to own the Platform.

6.2 FiatTokens

This SmartWallet enables users to store Fiat money [12] as opposed to requiring a user to buy a cryptocurrency to interact with the businesses on the platform. FiatTokens are a representation of Fiat money as Tokens in a Smart Contract. Tokens are minted and assigned to the user's wallet at the point they load money into the system. Money can be moved within personal wallets or to external third parties. Money can be moved between wallets of different currencies. Where required, an exchange rate is calculated at the time of transfer. Money can be withdrawn to any Bank or PayPal account at any time

While Community Points will provide Discounts or free services, the balance on any transaction can be made with the SmartWallet. Peer to Peer payments can also be made using the *SmartWallet*.

The *SmartWallet* can be used to make payments through the DigitalTown platform or App as an alternative to Credit or Debit Cards. Local businesses benefit as there are no transaction fees.

6.3 Community Points

Community Points can be used to reward engagement and incentivize residents and visitors to transact with local businesses. Following the initial grant of ten *Community Points* per user, new *Community Points* must be earned or traded. The goal is for *Community Points* to be exchanged for goods and services with local business at a value determined by local business.

Community Points are not finite and as such there is no implicit incentive to hoard them. They are intended to have velocity, i.e. to be used actively to incentivize desired outcomes that improve local quality of life and empower a thriving local economy.

Community Points are not linked to any specific City and are valid on any DigitalTown App or in any participating business.

Our goal is to encourage movement of *Community Points*. If a user does not interact with any App for a period of 3 months the *Community Points* they hold will begin to expire at a rate of 1% per week.

A business can use *Community Points* to buy advertising, improve merchandising, and/or sponsorship visibility on the App. Each verified business that signs up with the platform will be granted 100 *Community Points*, but all other tokens must be acquired through interaction with the users on the platform. This focus on *Community Points* to buy advertising ensures a deep-pocketed big-box advertiser cannot outspend a small advertiser by simply using a credit card. It also ensures that while the business is providing incentives to users, they in turn get value from the *Community Points* they acquire.

In addition to advertising on the platform, we will offer Businesses the ability to send a message directly to a specific demographic. The business will use *Community Points* to reward the Reader for reading the message, not DigitalTown to send it. This model rewards the consumer for their time.

A business that has no direct need for *Community Points* can donate them to good causes and/or reward volunteers for their service.

Community Point Tokens are represented in the SmartWallet in the same way as FiatTokens are represented. The balance of tokens can be seen by opening the wallet on either the Account page or App. Tokens can be transferred from wallet to wallet, using either the DigitalTown App to scan a QR code, or by logging into any Account page and providing the email address of the target recipient. Transfers are instant and there is no transaction cost.

6.4 Cryptocurrencies in the SmartWallet

The implementation of Cryptocurrencies in the DigitalTown smart wallet is designed to enable the average user to manage multiple cryptocurrencies, with the added feature that they can be readily exchanged for goods and services in Fiat Currencies.

We maintain one live Master Cryptocurrency wallet for each Cryptocurrency (e.g. Bitcoin) in the DigitalTown name, and use a SmartContract to represent the Cryptocurrency balance of each user.

Using this method, transactions take place in the wallet and not on the public cryptocurrency blockchain. This provides an instant user experience when moving funds from Wallet to Wallet as opposed to the public bitcoin network where transaction times are around 4 minutes. We simultaneously purchase the currency to ensure that we maintain the correct balance and protect ourselves from fluctuations in price.

We can provide the ability to buy bitcoin via credit or debit cards, crediting the user's wallet instantly and buying and storing the currency in the DigitalTown wallet. As transfers between wallets are not on the public blockchain there are no transaction fees.

When transferring cryptocurrency into the system from an existing external wallet we create a temporary Wallet configured to Auto forward incoming funds to the master DigitalTown wallet. As this temporary wallet is associated with a specific user, we can monitor the transactions to ensure the transfer is validated before crediting the SmartWallet.

6.5 Managing Private Keys

The integrity of a public blockchain depends on each user having their own Private and Public Key pair. These Keys are how the user proves they own their digital assets stored on a blockchain. The standard approach adopted by blockchain applications is either to require the user to download and store their key at the point it is generated, to create a Wallet with an independent third party, or to act as a proxy for interaction with the blockchain and store a Private Key on the user's behalf. The first two options create complexity and friction in the process, the last creates a dependency on a third party.

Keys are not like PIN codes for the ATM. If you lose the keys you lose access to the wallet and everything in it. There is no support line you can call.

Creating an inclusive solution is core to our values and critical to our success. We accept that many of our target users will not be technical and do not wish to exclude them through unnecessary complexity. Users should be able to access their smart wallet from any computer or device.

All keys will be stored on behalf of users in our Private Key Vault (PKV). The DigitalTown PKV is an independent service that stores the Keys in an encrypted form and allows DigitalTown to access the key to be used as part of a blockchain transaction. The PKV will only be accessible from the internal DigitalTown network and will require a Decryption Key that is stored in memory on the DigitalTown server, obtained from the AWS Key Management Service on server application startup.

6.6 Migrating to a Public Chain

Blockchain technology is evolving at an incredible pace with undeniable parallels to the internet's early days. It's impossible to predict which technologies will achieve longevity.

As we are running an invitation based blockchain we can guarantee performance better than a public chain, but Ethereum does not currently provide the real-time solution required to enable us to create a wallet and immediately assign tokens to the wallet. To address this challenge DigitalTown currently maintains a cache in front of the blockchain. We carefully sequence each action on the SmartContract and treat the blockchain solution as a 'warm' rather than 'hot' storage. We maintain checkpoints to ensure the hot and warm storage is synchronized.

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Ethereum performance will improve with the release of the Casper Proof of Stake solution. However, based on the emerging technologies it's likely that DigitalTown will adopt an alternative blockchain platform that can guarantee the performance we require.

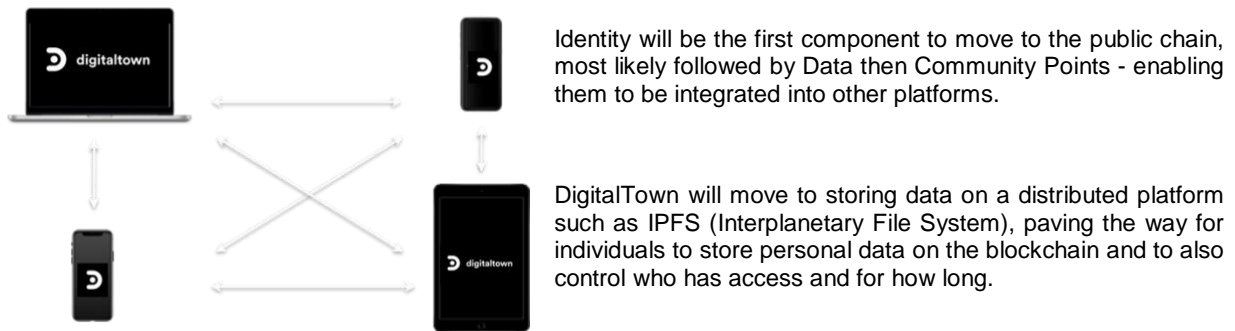


Figure 9 - Distributed App

Fiat Tokens, which represent actual Fiat Currency loaded into the wallet, will require DigitalTown to serve as the gateway that enables wallet loading. The peer-to-peer transfer of funds will not require DigitalTown's involvement.

Depending on the performance of the underlying technology supporting each Cryptocurrencies, DigitalTown may continue to be the gateway for loading Cryptocurrency funds into the SmartWallet.

The Public platform will be funded by tokens, like Ethereum Gas, so there is a need to educate the public that to get the benefits of a self-sovereign identity, control over data, and access to peer-to-peer payments they will need to pay transaction fees to the platform.

7. Conclusion

The solution outlined in this whitepaper represents the first steps on a journey to make our cities smart not by introducing technical solutions for street lights, parking or traffic management, but by bringing the people closer, helping to build communities and ensuring people engage with local business.

We achieve this through delivering three key solutions:

1. A globally accepted verified Digital Identity with easy, user-friendly key service
2. Frictionless, cost-free exchange of goods and services
3. Tokens that encourage residents and visitors to engage with the local community and businesses

Blockchain can be a technology for good. It enables DigitalTown to realize a Smart City platform that is owned by the people of a city, that rewards co-creation and engagement, and that supports a peer-to-peer economy.

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