LOOMIA TILE

A Decentralized Platform for Identity and Personal Data

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Abstract

The LOOMIA TILE is a hardware device that transforms clothes into data-collecting and identity tools. It works in conjunction with the LOOMIA Electronic Layer (LEL), a soft flexible circuit embedded into textiles with the ability to sense changes in its environment, such as heat and touch. Users can transfer their data to a desktop application that allows them to manage and sell their data to market researchers. The app is completely serverless and leverages the blockchain for security and data integrity. In a world where personal data has become a precious commodity sold behind closed doors by large corporations, the LOOMIA TILE gives individuals the right to own their personal data, along with the freedom to choose how to share or sell it. In addition, the LOOMIA TILE's unique ability to associate an individual's physical identity, contained in their biometrics and habits, to their digital identity, contained in their online profiles and activities, presents an interesting starting point for a wide range of third party integrations. It makes it possible to build applications on LOOMIA technology to verify identity and facilitate secure payments passively and seamlessly, with no manual interaction or interface.

I. INTRODUCTION

> Personal data is the new oil of the Internet and the new currency of the digital world.
>
> *Meglena Kuneva, European Consumer Commissioner*

Right now, your identity is a string of numbers, dates, passwords, and images. Anyone with these digital assets can pretend to be you. LOOMIA suggests a protocol for multi-factor identity verification that bridges the physical world and the digital world to prove that the physical you is the digital you. We do this by using personal data collected from your garments, synced to an online profile and verified with a fingerprint. In short, we ensure that you are you by collecting personal data from what you wear.

Companies that collect personal data about their users typically claim ownership of that data for themselves and make a profit reselling it to large corporations. Personal data is bought and sold at a premium behind closed doors in an opaque industry whose value might be anywhere from $156 billion[12] to $300 billion[10]. LOOMIA does not believe in this future. The LOOMIA protocol ensures that your personal data continues to belong to you. Instead of companies profiting off of your identity, you can own and sell your data to brands, researchers, and other organizations who are interested in learning more about how you use their products and systems, thus creating a closed feedback loop with no middleman and

This whitepaper is intended only as a summary of certain selected information relevant to Crated, Inc. D/b/a LOOMIA ("LOOMIA") and the proposed tile token, business model, design and implementation. It is subject to material changes, updates and modification at any time for any reason and without notice.

allowing you to profit from being you.

In the process, LOOMIA's system solves a key problem for brands as well: smart apparel alone is projected to be a $130 billion global market by 2025[11], and yet there is no good way to track the performance, use, and longevity of apparel and other soft goods once they leave the store. Customer research can cost a brand or research group upwards of $100,000 per product to conduct surveys and focus groups, predict product outcomes, track inventory, and evaluate marketing campaign reception. Even after doing all those steps, the information they get is still very incomplete, collected with very limited context. LOOMIA provides an ethical way for brands and market researchers to obtain much more detailed data sets than ever before from a much larger number of users, without the effort and expense of mounting campaigns to harvest it themselves, and without users needing to take additional steps to provide it.

LOOMIA's solution is a system with three levels: the LOOMIA Electronic Layer, the LOOMIA TILE, and the Tile Platform, which supports the LOOMIA Data Exchange. See figure 1.

- **The LOOMIA Electronic Layer (LEL)** is soft, flexible circuitry integrated into garments that perform heating, lighting, sensing functions and gathers data about the user. The LEL is LOOMIA's current product offering and our current patented innovation.

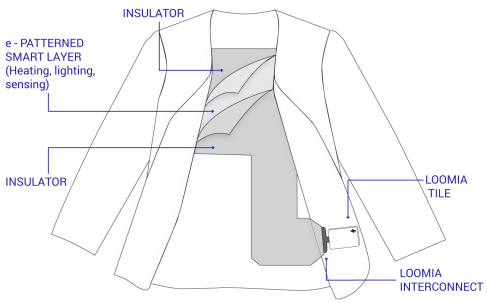
- **The LOOMIA TILE** is a hardware device that acts as a user's "keychain" for multiple items containing LELs. It stores the data gathered by the LEL until it is synced into the Tile Platform. It depends on fingerprint recognition to verify users' identity.

- **The Tile Platform** is a peer-to-peer (P2P) app which stores the data collected on the LOOMIA TILE, integrates it through a blockchain protocol to verify users' identities and date integrity, and gives users the ability to sell their personal data to brands and/or third parties.

- **The LOOMIA Data Exchange** is an online marketplace through which brands and third parties (which, in time, might include restaurants, banks, or transit authorities) purchase data directly from users to study in aggregate for product and service improvement. This data is delivered in an anonymized manner, with no identifying information included in the exchange beyond the user's public key on the Tile Platform. Companies and interested researchers gain novel and accurate data sets, while users earn money in the form of TILE tokens, which may be converted into other digital currencies or exchanged for special rewards with brands and 3rd parties on the Tile Platform.

II. The LOOMIA Electronic Layer

The LOOMIA Electronic Layer (LEL) is a soft, flexible electronic layer that moves like a fabric, but works like a circuit board. LOOMIA specializes in producing soft, flexible circuits that integrate into textile products. These circuits can deliver heat and light and sense changes in adjacent materials.



Their size, shape, and function can all be customized for many different use cases. Because the circuits are made from soft components which look and feel no different from fabric, they can survive frequent machine

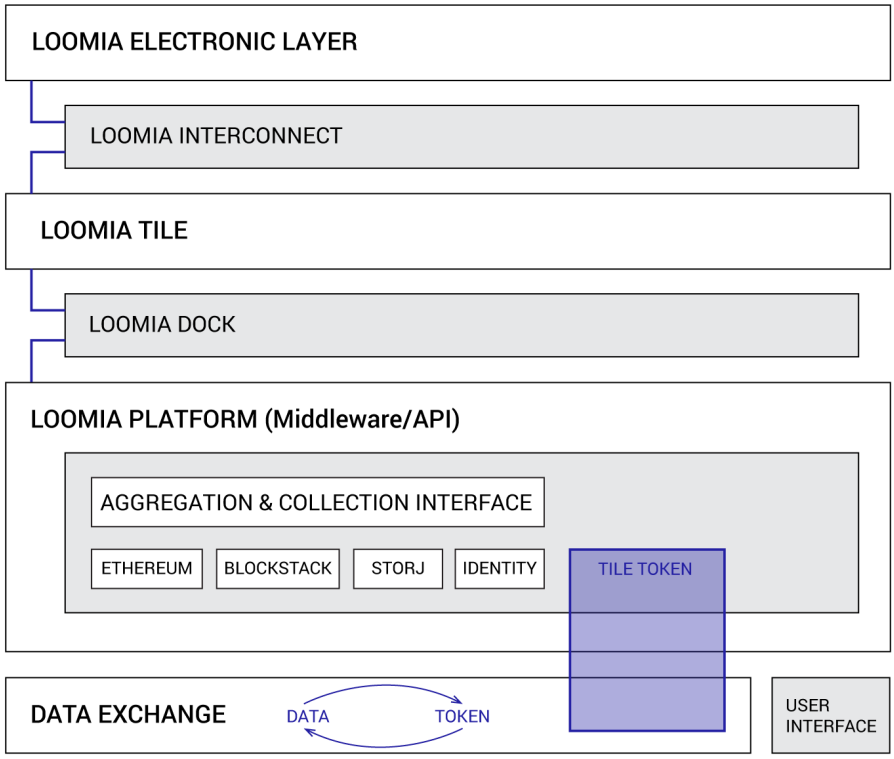
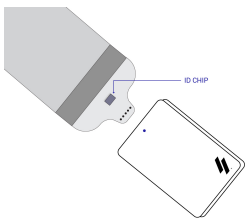


Figure 1: *Hardware and software in the LOOMIA stack*

washing and exposure to the elements, which would destroy other mechanisms like flexible PCBs. LEL technology is explained further in Patent Filing USPA 20170086513.

All LELs come pre-assembled with a LOOMIA Interconnect, a hard-to-soft connection which can mount to various connectors, including USB and JST.



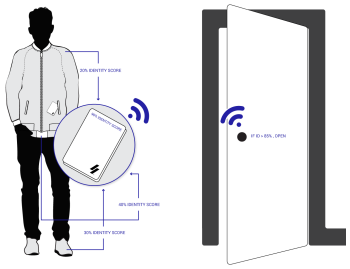
For use with the LOOMIA TILE, all LELs will come mounted with a magnetic pogo pin connector. The LOOMIA Interconnect houses all components that require logic (for example, a component with the functionality of an Attiny85) and the LOOMIA Tag. The LOOMIA Tag is a pattern on the LOOMIA Interconnect that identifies each unique piece of clothing with information about the brand, SKU, material, size, and more. It can be read by the LOOMIA TILE when the user plugs it in, but it could also be read by other technology when the user enters or leaves a store, attends an event, or boards transportation, which would enable it to work in third party applications as a ticket or an anti-theft device. The LOOMIA Tag could also be used during soft goods production to authenticate branding and ensure proper manufacturing processes all the way through the supply chain, while tracing the full lifecycle of the product from start to finish.

III. The LOOMIA TILE

The LOOMIA TILE serves two different functions. In its first function, it acts like a "keychain" with all your soft goods registered as "keys," gathering all of the data collected through them in a single place. Each LOOMIA Electronic Layer will pass a specific resistance from its garment to the TILE, allowing it to identify that garment uniquely through a general-purpose input/output (GPIO) pin. Through its connection to the LEL, the TILE can collect data about the specifications of the garment (size, color, etc.), how many times the garment was worn, and for how long, when, and where. In its second function, the LOOMIA TILE acts like a "MetroCard" which you can reload with TILE tokens in order to make purchases at LOOMIA Rewards locations, through an NFC chip which approves transactions and transfers TILE tokens seamlessly.

The TILE has the capacity to support "multi-signature" identity verification schemes with three possible security thresholds. *Low security:* the presence of your registered garments. *Medium security:* the presence of your gait (accelerometer) and perhaps some measurements of your usual bodily and environmental conditions. *High security:* fingerprint recognition.

Like the LOOMIA Electronic Layer, LOOMIA TILEs have a unique identifier on its integrated chip. The LOOMIA TILE uses a blockchain-friendly chip for identification, meaning it will have a device ID, a public key, and a private key. This could be a Chronicled[3] chip, or another chip with easy blockchain integration. (Figure 2 shows a code sample for a device ID and private key set up through the Chronicled chip.)



Multiple LOOMIA enabled devices can work together to give a high degree of confidence in confirming identity.

However, the unique identifier on a LOOMIA TILE's chip is not associated with a user until the TILE reads a fingerprint and associates itself with that user. When a user uploads data from a TILE, the data is associated with the account belonging to the owner of the fingerprint presented, not the owner of the TILE. Thus, the TILE is not a personalized item that can be stolen along with the data and tokens associated with it, but rather an interface that can be personalized to any user with the touch of a finger. Even if two users, Alice and Bob, share both a garment and a TILE, Alice can only access her data, and Bob can only access his, as illustrated in figure 3.

Once a TILE recognizes a fingerprint for which it has collected data before, it can make decisions for the user based on their previous preferences and needs. In time, these decisions could become increasingly complex, such as setting the temperature of a garment based on the user's ideal body temperature or making payments automatically to the user's favorite coffee shop. All code and smart contracts involving the LOOMIA TILE will be open source, making it easy for third parties to use LOOMIA technology to support their own applications. In time, interface elements in garments or other soft goods could automate or expedite many interactions which currently require a smartphone, such as checking-in on services like Yelp, Facebook, and Foursquare. (For more on third party integrations, see section VII.)

The LOOMIA TILE mates to a LOOMIA Dock in order to recharge its battery, recharge its associated LEL's batteries, and connect to a computer with the Tile Platform app. When the LOOMIA TILE recognizes the user's fingerprint inside of the LOOMIA Dock, they will be signed into the Tile Platform app, where they can choose whether to transfer data between their TILE and their account, sell data, or simply charge their batteries without any

```
DEVICE ID:
bf91dd2b6b46
PRIVATE KEY:
b29cc7b09bdd6205da2477aa18291e6a2f39ac3512df783ec2a2b45122308c3f
PUBLIC KEY:
04a2deae632d702b1441351315e44a256707f77a8f13a43adee78932ba161c40a95977a573207276e447ff95b8012d
e15da929d77882af0b63539fc96f16124d13

Each Chronicled chip
POST https://discovery.chronicled.com/api/2.0/thing
{
 urn_identities: [
   "ble:1.0:bf91dd2b6b46",
"pbk:ec:secp256r1:04a2deae632d702b1441351315e44a256707f77a8f13a43adee78932ba161c40a95977a5732072
76e447ff95b8012de15da929d77882af0b63539fc96f16124d13"
 ],
 properties: {
  name: "Alice_LOOM",
  description: "LOOMIA_tile"
 },
 spec_name: 'chronicled_thing_spec_1.0',
 spec_organization_id: "chronicled-system",
 organization_id: "b8SKriR"
}
```

Figure 2: *Chronicled code sample*

other action.

All data is visualized in the Tile Platform's interface, where the user can view it before deciding which data to decrypt and sell. Data will only become available to interested parties once the user decides to sell it; the user will always retain the right to choose what data they will sell, as well as when they will sell it, and to whom. For example, a user might choose to sell their biometric data for health and fitness rewards while keeping their location data confidential. Buyers can incentivize users to sell the kind of data they find most useful by providing different kinds of rewards, and users can incentivize brands to align with their lifestyle by selling their data for the rewards they value most.

Because the data on the LOOMIA TILE is encrypted, it is useless to other parties until it is sold by the user. In order to view their data, store it for future use, or sell it on the LOOMIA Data Exchange, the user must first sync their TILE to the Tile Platform.

IV. The Tile Platform

The Tile Platform is the P2P software that collects and manages data from the LOOMIA TILE and exchanges information with the network of LOOMIA users. The Tile Platform is serverless; it is designed so that at no point does the app need to offload data or connect to a central server. Each instance of the app connects to other user instances. The first generation of the app is designed to run on a desktop.

The Tile Platform's stack is made up of three distributed applications working together, as shown in figure 4:

1. The **decentralized app** for user interactions and data collection

2. The **decentralized data storage** for long-term housing and and retrieval of data

3. The **blockchain** for distributed, verifiable, universal record keeping

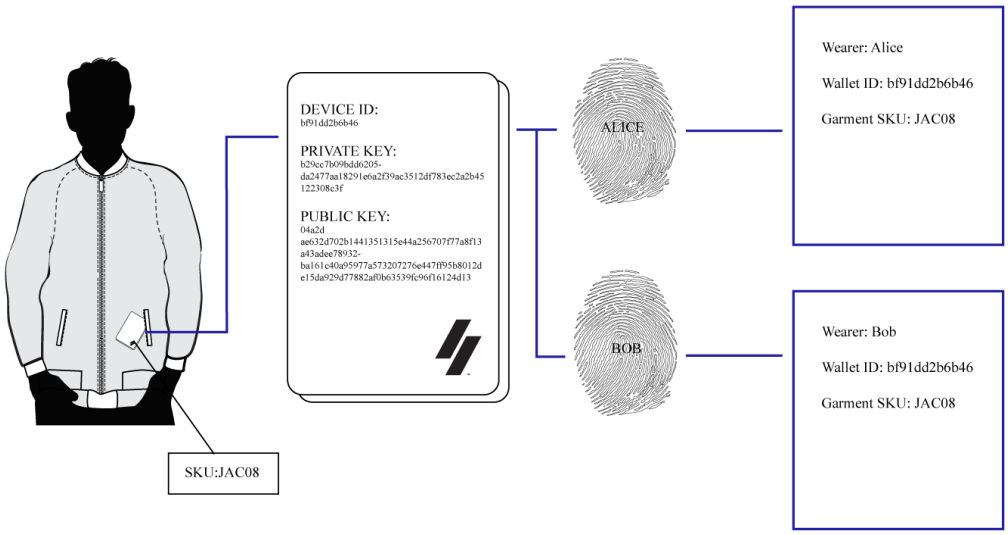


Figure 3: *Multiple users sharing the same tile.*

This section will describe the function of each of those applications separately. Taken together, they have an architecture similar to Blockstack[2], and they use many Blockstack protocols, modified to suit our needs. Blockstack's peer network, called Atlas, gives a global index for information discovery. In Atlas, every node maintains a full replica of the network's data, so the network needs no overhead to maintain a routing structure, and it is also very resilient against targeted node attacks, since every node has its own copy of data. The nodes in Atlas store data in the form of zone files, which are identical in structure to a Domain Name System (DNS) zone files. The peer network accepts a zone file only if its hash has been pushed to the blockchain, which allows each peer to be confident that records have not been tampered with. At the moment, zone files are so small that each node is easily able to keep a full copy of the hash table. However, if this ceased to be true in the future, it would introduce only minor storage requirements.

Blockstack uses their own naming system known as BNS, Blockstack Naming System, which is meant to replicate the functionality of DNS without a central party. This system is a remarkable achievement, since it was long assumed that a decentralized system could not provide human-meaningful names, which is to say, it could not ensure that each user registered only one account. This seeming impossibility, often referred to as Zooko's triangle problem[7], has only recently become solvable with the advent of blockchains. When we move to run Atlas on Ethereum, we will use the ENS (Ethereum Name Service), which like BNS has the ability to provide human-meaningful names.

i. The Decentralized App

The Tile Platform app is responsible for the following functions.

- **Collecting the data from the LOOMIA TILE.** At the end of the day, when a user syncs their LOOMIA TILE to their account through the LOOMIA Dock, their data transfers to the Tile Platform app, where it can be aggregated and visualized. The LOOMIA app will also register new

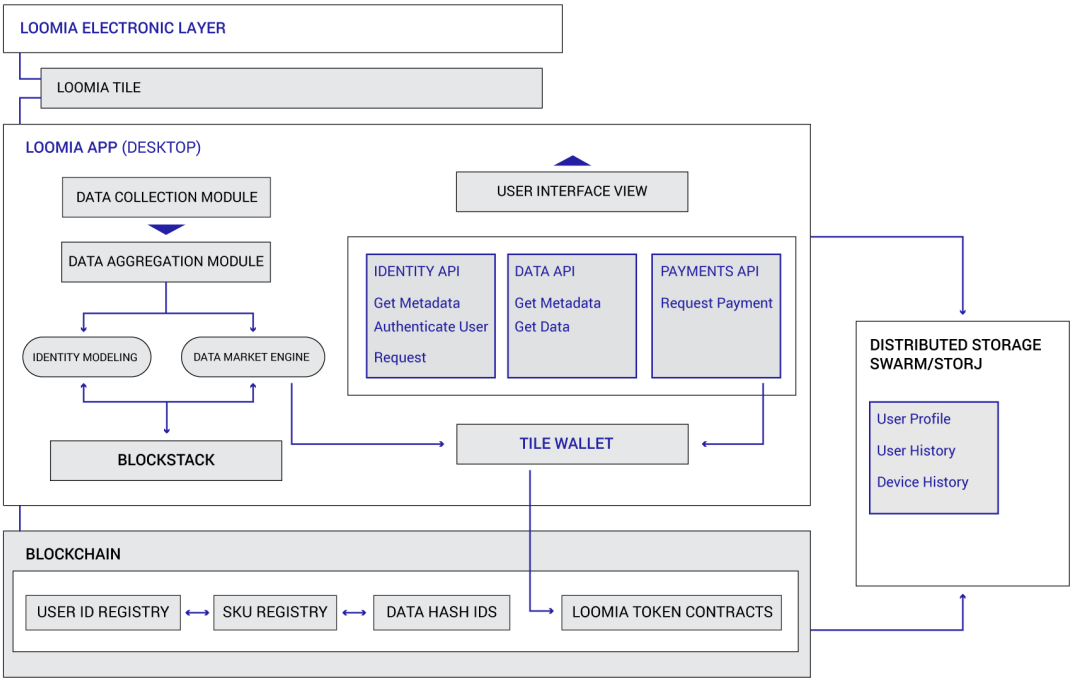


Figure 4: *The software platform*

LOOMIA-enabled devices through the same process, via the LOOMIA TILE and the LOOMIA Dock.

- **Matching data against models of realistic, genuine data.** The app will limit the amount of data that can be loaded in a given time period, to prevent fraudulent data from being loaded into the platform. If a user is loading data daily, they will only be able to upload an amount of data that can be reasonably collected in a day. The app's models are calibrated among peers and adjusted over time.

- **Encrypting data and backing it up** to the decentralized data storage in the Tile Platform stack, or to other external storage venues chosen by the user.

- **Allow users to sell their data** according to preset thresholds. A user could choose to keep all their data locked down or automatically sold upon an offer. The automatic sale can be limited based on the type, sensitivity and size of data being released. It can also be restricted based on the payment amount being offered, and the reputation of the buyer.

Over time, prices for data will be calibrated to match the supply and demand for information in the LOOMIA Data Exchange. The process of receiving payments in the form of TILE tokens and spending those tokens to get rewards is managed by the user's wallet inside of the app.

ii. The Decentralized Data Storage

Since users will be holding important and valuable data themselves, having a seamless backup system is fundamentally important. The LOOMIA platform will leverage Blockstack's storage implementations, which in-

cluded backing up encrypted data-chunks to Dropbox, or blockchain-based distributed storage systems such as Storj[14]. If a user's TILE or app gets lost or corrupted, everything can be reclaimed from this distributed storage. The user's private key is all that's needed to decrypt their data capsule.

We are currently working with Storj Labs[8] to integrate Tile software with the Storj platform, the most robust and developed distributed storage platform. Storj creates encrypted portions of a file called shards which are stored redundantly throughout the network. The routing is built on Kademlia[9], a distributed hash table (DHT) allowing for a distributed network with efficient message routing. Storj adds additional message types to support Quasar[15], a peer-to-peer publish/-subscribe system. LOOMIA TILE tokens will be directly convertible via a smart contract to STORJ tokens so users do not need to hold STORJ to use the platform.

An additional distributed storage such as Swarm[1], which is tightly tied to Ethereum, may also be used for convenience (albeit currently less robust). Swarm uses a distributed preimage archive (DPA) for storage as well as the bzz:/ protocol for sending and retrieving data. Swarm's DPA protocol stores information in strings of bytes according to their hash value, which are assumed to be collision-free, just like ethereum addresses. The repository of data stored through the DPA is the Distributed Hash Table (DHT), in which each node has an address that is within a short distance of the hashes of the data it has contributed. Nodes will store only the data whose hashes are closest to itself, and once a node reaches storage capacity, it will discard the data whose hashes are furthest away. Thus, each node has the ability to add new data to the DPA, retrieve data which it has previously stored, and provide routing information to nodes which are closer to the data being retrieved. Each node also breaks large chunks of data into a tree of smaller blocks, in which the key of each root block can be used to retrieve its children until the whole data chunk is reassembled.

iii. The Blockchain

The blockchain provides the constant backbone to ensure data authenticity, so that individual nodes can join and leave the network with no impact on the network's integrity and operations. The blockchain ensures that zone files are correct by matching the hash for the file stored on the blockchain with the hash retrieved from distributed storage. This allows users to connect and get correct routing information for communicating with the rest of the network. (The routing algorithm LOOMIA uses is leveraging Blockstack and Kadmelia routing.)

- **A directory of every registered LOOMIA product.** This directory of SKUs is updated every time new LOOMIA-enabled products are manufactured. When a new product is authenticated by the LOOMIA app, it checks this registry to ensure that it is an authentic LOOMIA-enabled product.

- **Aggregated user data,** which is periodically hashed and written to the blockchain, creating a history that is verified in time. The length of this time series of hashes impacts a user's identity score. This will act as a cryptographic secure tagging of IDs.

- **Payment rails,** which enable the user to transfer tokens to other users inside of LOOMIA and to other integrated distributed storage platforms such as Storj, Sia, or Filecoin.

iii.1 Device registration

All LOOMIA products will be registered on the blockchain. In the post-manufacturing phase a public/private key pair is generated for the product and the public address is written to the blockchain with that item's ID. This address represents the owner of the product.

Purchasers receive the private key of the item's blockchain address when they purchase

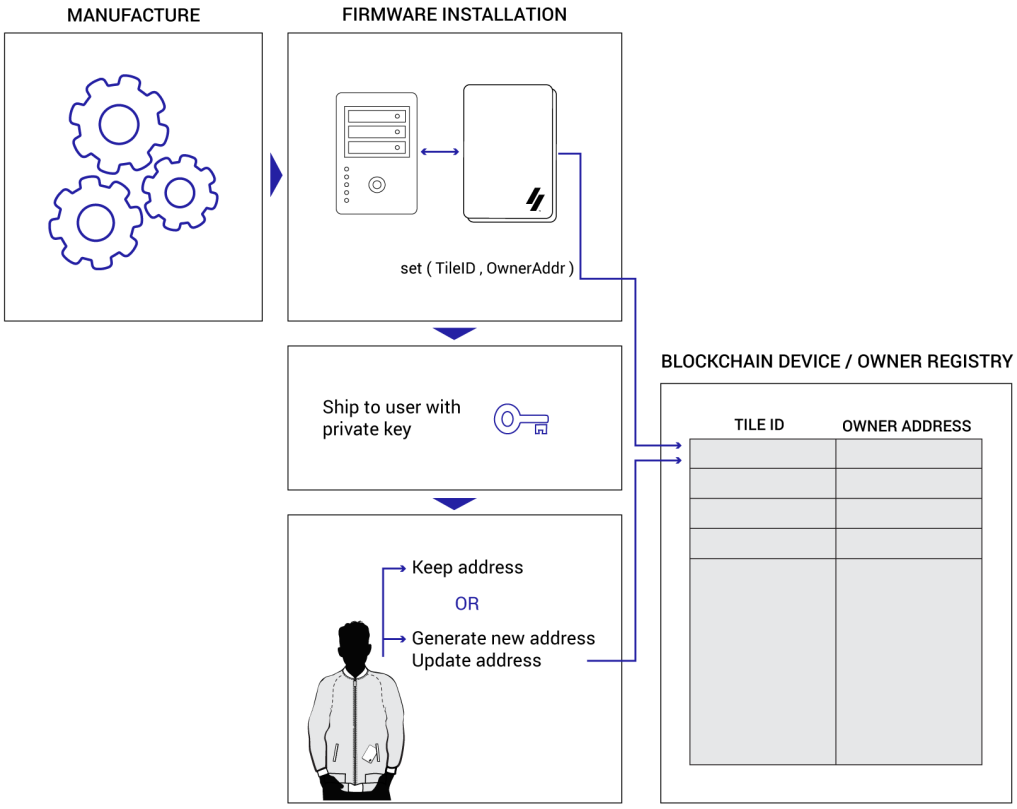


Figure 5: *Registering a device on the blockchain*

the product. The purchaser can then choose to update the owner address to one of their choosing, or to keep the address generated for them (which is less secure, but more convenient). See figure 5. The update method can naturally only be invokable by the owner.

```
function updateDeviceOwner(string
    deviceId, address newOwner) {
  if ( msg.sender = devices[deviceId] )
        devices[deviceId] = newOwner;
}
```

iii.2 Writing data to the blockchain and proving its authenticity

When updating the blockchain with a new record, the app will create a hash of that record and store that. The smart contract will verify the addition is valid, for instance, that this device record has not been updated within 24 hours (we throttle the number of records added to prevent false record entries).

```
function addNewRecord(string deviceId,
    address deviceOwner,
    bytes32 newDataHash)
{
    uint lastEntrytime =
        records[deviceId].entryTime;
    if (now >= lastEntryTime + 24 hours
        && records[deviceId].owner ==
            deviceOwner) {
        records[deviceId].entryTime = now;
        records[deviceId].dataHash =
            newDataHash;
    }
```

}

When data is transferred to a buyer the record is produced along with the transaction showing that hash of that data written to the contract. In this way data cannot be falsified after the fact.

Even without any provision for buying and selling data, the Tile Platform would have some value for consumers simply by collecting all of the data about their soft goods in one system, from which they can easily retrieve it to provide proof of purchase or to claim support under warranties and get replacements or repairs for their damaged goods. But the main value in the Tile Platform's massive aggregation of data comes from the rewards that users can earn with it, when they sell their own data on the LOOMIA Data Exchange.

V. The LOOMIA Data Exchange

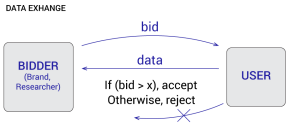
Before a user chooses whether or not to sell their data, the LOOMIA app sorts it into many different categories, which allows both users and buyers to be selective about what kind of data they want to sell and acquire. Some categories will be defined according to the World Economics Forum's conventions for classifying personal data.

- *Volunteered data:* completed survey forms, profiles, and other attestations written by users explicitly for the use of researchers
- *Observed data:* recordings of the action or condition of the user, which can be captured by researchers without any conscious effort or declaration by the user
- *Inferred data:* conclusions about the user drawn from statistical analysis of volunteered or observed data, similar to credit scores

Other categories will sort data by its structure, rather than its content:

- *Independent data points:* how often a user is doing a particular activity or interacting with a given product (for instance, wearing a given jacket, or going outside in cold weather).
- *Related data points:* how often two independent data points correlate (e.g. wearing a given jacket while going outside in cold weather).
- *Static data points:* identity parameters which broadly define the marketing demographic and basic persona of the user, independent of detailed product-use behaviors.

In the LOOMIA Data Exchange, buyers can broadcast their interest in and price point for buying specific kinds of data. In time, those buyers could include a wide range of third parties like delivery services and city planners, in addition to product brands. In response, users can sell each kind of data manually, or set it to be released automatically at a certain price point or to a certain buyer. In exchange for their data, users gets TILE tokens deposited into their wallet in the TILE application.



When a buyer makes a request for some type of data it flows through the network reaching all users, with the amount that will be paid on fulfilling the request. Each user's app will reply with the data if it meets the user's set threshold requirements. Figure 6 illustrates this.

VI. The TILE Token

The TILE token is the currency unit which provides access to the Tile Platform. For example, if a brand wanted to determine how many users wear their jacket, it would spend tokens to query the Tile Platform to get usage data. Or say, if a smart contract wants to reward users who's identity score is above some threshold, it could lookup a user's identity rating on the

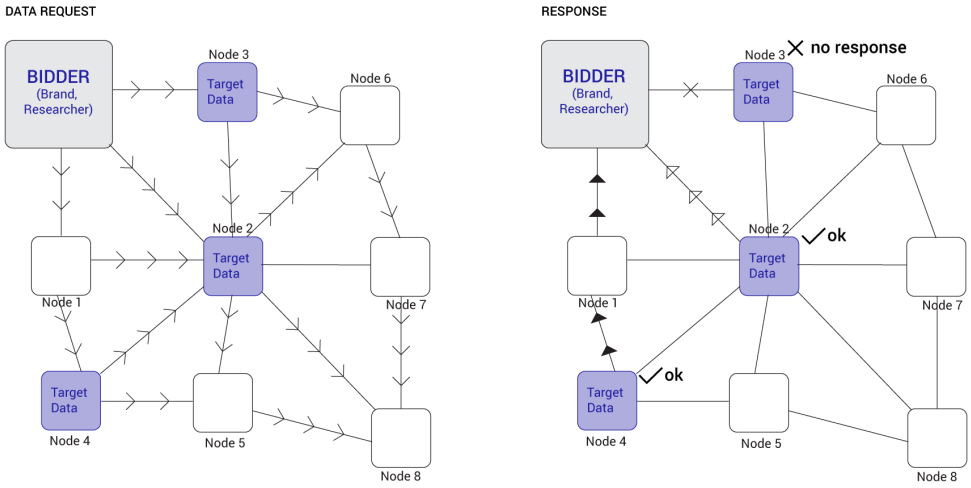


Figure 6: *Making a request for data*

registry contract that lists the score alongside the user's address.

The TILE token will start off as an Ethereum ERC20 token[5], and like any other Ethereum token can be transferred freely between users directly on the blockchain, with no reliance on the LOOMIA app in any way.

TILE is also convertible to STORJ tokens via LOOMIA's "token change" smart contract. This way users can access the Storj platform without directly holding STORJ tokens. Instead, our platform will convert TILE tokens at the time of need to STORJ to pay for data usage. Our "token changer" smart contract uses the Bancor protocol[6] to seamlessly convert between the two tokens. The Bancor protocol allows for an asynchronous exchange between two tokens (i.e. a buyer and seller do not need to appear at the same time), and autonomously sets the exchange price by constantly readjusting the current price toward an equilibrium between the purchase and sale volumes.

In addition TILE tokens are convertible to Bancor tokens (BNT) through a token changer smart contract. Having convertibility to BNT will allow TILE to be swapped via BNT to other tokens including Gnosis, Stox and Ether, since BNT has convertibility with them all.

The TILE token can also be used by third party apps that connect to the Tile Platform.

VII. Third Party Integrations

Since the Tile Platform is completely open source and peer-to-peer, there are no impediments for third parties to build applications on top of it, using LOOMIA technology to verify users' identity and facilitate the transfer of payments.

The sophistication of the LOOMIA TILE intelligence for transferring payments will grow over time. In the early stages of development, the TILE will require manual authorization for all payments. The TILE will use its indicator light to display a signal about the payment, and the user will validate it with their fingerprint. Future developments might allow the TILE to make small automatic payments below a certain threshold, or larger automatic payments to users with strong reputations and well-verified identities, which could allow for checkout-free shopping and dining. The Tile Platform also

could provide service opportunities by allowing users to assign a certain percentage of their rewards on the LOOMIA Data Exchange to the factory worker who made their clothes, or to other causes which they support.

Even without any payment transactions, the LOOMIA TILE's ability to confirm a user's identity reliably through their fingerprint has many interesting third party applications on its own. Other web services can query a user's LOOMIA address to get their identity attestations, as well as a score describing the probability that each attestation is true. For example, the TILE will rate someone to likely be above 21 years old if they go to bars and casinos and whose immediate social circle is over 21. Each user builds an identity profile through the course of their interaction with LOOMIA; as the user contribute more data, their identity profile grows, and other users can verify them with greater confidence. Thus, it would be very feasible for third parties to use the LOOMIA TILE to check whether a user has clearance to enter secured facilities, to unlock the user's car or home, to inform them of severe weather conditions in their area, or to share their location with other members of their social network, among many other examples.

VIII. Conclusion

Users wear LOOMIA-enabled garments which collect data about their use patterns, their location, their body temperature, their body motions, and their environmental conditions, all tied to the garment's SKU. LOOMIA-enabled garments store data points during the day and transfer them to the LOOMIA TILE when they recharge at night. Simply by going about their day, users create very valuable data sets which provide brands with meaningful insights about how their products are really being used.

On the Tile Platform, users can sell their data to researchers and other interested buyers in an anonymized fashion in exchange for TILE tokens. These tokens can be converted to other digital currencies or used across businesses on the LOOMIA platform, offering a wide economy in which the TILE token has value. Participating business can develop reward plans based on TILE tokens to incentivize users to buy and wear their products. The more you wear a certain brand, the more brand-specific rewards you could get. A brand could even try to drive sales patterns by making limited-edition "high token value" items and promising to pay a higher price for data collected through those items than through others, which would naturally incentivize users to buy those items and use them more often.

The basic technology in the LOOMIA TILE system has the power to serve a wide variety of functions for different enterprises. Researchers with no interest in product development might still want to make use of LOOMIA's temperature, motion, and location data to study the safety conditions of industrial workers, to report in real time about the population-level effects of accidents and severe weather patterns, or to determine the best place in town to build a new housing development or franchise. If multiple third parties want to buy the same datasets collected from the same population of users, those users could receive royalties for each additional purchase. And as third parties harness the ability to build their own applications on top of the Tile Platform, the use-cases for enterprises could become even more creative and complex.

The LOOMIA TILE sits at the intersection of two new, fast-growing industries: smart apparel and personal data. As such, it is uniquely well-positioned to unite these two burgeoning fields in service of each other. Smart apparel needs better data in order to drive product development, and personal data needs better smart apparel in order to track a larger number of internal and environmental variables in a more consistent, ongoing, and non-invasive way. Personal data is already a sought after commodity for businesses in many industries, but it will become an even more valuable resource in the decades ahead as developments in data science lead to cheaper, faster, and more revelatory forms of analysis on larger datasets than ever before. LOOMIA's TILE

is a proactive, ethical plan for providing the high-volume, high-precision data sets that companies will seek while eliminating the middlemen, closing the feedback loop, and ensuring that individuals will retain the right to own the data that they create.

References

[1] Viktor Tron et al. *Swarm distributed preimage archive*. URL: https://github.com/ethereum/go-ethereum/wiki/Swarm---distributed-preimage-archive.

[2] Muneeb Ali et al. *Blockstack: A New Decentralized Internet*. URL: https://blockstack.org/whitepaper.pdf.

[3] Chronicled. *Chronicled Demo*. URL: http://demo.chronicled.org/.

[4] Luis Cuende and Jorge Izquierdo. *Aragon Whitepaper*. URL: https://github.com/aragon/whitepaper/blob/master/Aragon%20Whitepaper.pdf.

[5] ERC20. *ERC20 Token Standard*. URL: https://github.com/ethereum/EIPs/issues/20.

[6] Eyal Hertzog, Guy Benartzi, and Galia Benartzi. *Bancor Protocol*. URL: https://www.bancor.network/static/bancor_protocol_whitepaper_en.pdf.

[7] Dan Kaminsky. *Spelunking the Triangle: Exploring Aaron Swartz's Take On Zooko's Triangle*. URL: https://dankaminsky.com/2011/01/13/spelunk-tri/.

[8] Richard Kastelein. *LOOMIA Announces Collaboration With Storj Labs*. URL: http://www.the-blockchain.com/2017/10/19/loomia-announces-collaboration-storj-labs-introduces-smart-fabrics-consumer-data-blockchain-technology/.

[9] P. Maymounkov and D. Mazieres. *Kademlia: A peer-to-peer information system based on the xor metric*. URL: https://pdos.csail.mit.edu/~petar/papers/maymounkov-kademlia-lncs.pdf.

[10] Jason Morris and Ed Lavandera. *Why big companies buy, sell your data*. URL: http://www.cnn.com/2012/08/23/tech/web/big-data-acxiom/index.html.

[11] Jason Morris and Ed Lavandera. *Why big companies buy, sell your data*. URL: http://www.cnn.com/2012/08/23/tech/web/big-data-acxiom/index.html.

[12] Frank Pasquale. *The Dark Market for Personal Data*. URL: https://www.nytimes.com/2014/10/17/opinion/the-dark-market-for-personal-data.html.

[13] Status. *Status Whitepaper*. URL: https://status.im/whitepaper.pdf.

[14] Shawn Wilkinson et al. *Storj: A Peer-to-Peer Cloud Storage Network*. URL: https://storj.io/storj.pdf.

[15] Bernard Wong and Saikat Guha. "Quasar: A Probabilistic Publish-Subscribe System for Social Networks". In: *Proceedings of The 7th International Workshop on Peer-to-Peer Systems (IPTPS '08)*. 2008. URL: https://www.microsoft.com/en-us/research/publication/quasar-a-probabilistic-publish-subscribe-system-for-social-networks/.

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