The Internet of Value and Internet of Things

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1 Internet of Things and Related Business Models

With IoT came the proliferation of sensors for light, sound, vibration and temperature; sensors for everything imaginable. The data from these sensors became extremely helpful in tracking, measuring, controlling and monitoring remotely. This capability led to the introduction of many new business models and innovation in existing business models. Some of the prominent IoT-based business models include (Chaabane 2017):

- **Product-as-a-service:** the customer does not buy the product, but rents/leases it from either the manufacturer or a third party. The responsibility of maintaining the equipment lies with the equipment owner (i.e. the manufacturer or the mediator). IoT played a prominent role in this model, as the remote monitoring of equipment became simpler, and acceptance of this model increased. The healthcare industry is a big adopter of this model (see Chapter "Blockchains, DLTs and the Future of Payments"), as healthcare equipment is expensive and requires proactive maintenance.
- **Performance-as-a-product:** the ownership of equipment is necessary or desired, but the performance of the machine can still be outsourced with this model. For example, the cost of maintenance of jet engines in aircraft can be extremely expensive and might have a significant impact on the business. In this event, the business owner would like the experts (manufacturers) to be responsible for the performance of the machine. Most jet engine manufacturers offer some sort of

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care package for which they guarantee the performance of the engine by remotely managing and monitoring it and performing maintenance.

The IoT has also enabled a variety of new methods for doing business and has found a good niche in the sharing economy with the following applications:

- **Revenue Sharing:** through new services provided to end-customers. One such example is bag tracking services provided by airlines. A passenger's bag will be tagged with a sensor provided by an airline partner, and this service can be purchased for an additional fee. The revenue generated is shared between the airline and the tag provider.
- **Cost-saving Sharing:** it is hard for businesses or individuals to keep tracking the usage of a commodity. In this model, a third party can monitor and regulate the usage with the help of IoT sensors and help save on costs of usage. The savings are shared between the business/individual and the service provider.
- **Product/Asset Sharing:** whereby a big asset like a car can be shared among multiple users who only pay for the usage of the asset. This model is very similar to the product as a service model, but in this case, the asset is used by multiple users.

2 Inefficiencies in Current IoT Business Models

Almost all business models that depend on IoT have significant inefficiencies, leading to a higher costs to the consumer/end-user. The primary reason for these inadequacies is the presence of a human intermediary. Although the intermediaries are an overhead, they are necessary to ensure privacy, integrity and trust in the transactions.

The presence of intermediaries leads to the unwillingness of the consumer to share sensitive data (e.g. personal health data). Although IoT sensors can collect a wide variety of data, the availability of that data to unlock its full potential is very limited. Even though current IoT business models are successful, there is significant value yet to be unlocked.

3 How the IoV and Blockchain Can Help

Blockchain technology is facilitating peer-to-peer contractual behaviour without any third party required to "certify" IoT transactions. It answers the challenges of scalability, single point of failure, trust, record-keeping, time stamping, privacy, trust and reliability in an extremely consistent manner (Satish143 2017).

Blockchain/DLT can ensure integrity and privacy without the need for any intermediary. The technology can bring trust in a system, encouraging people to share sensitive information, as well as enabling two machines to work together and fully trust the data, as it is written on a tamper-proof ledger. This can enable unhindered

transactions across the ecosystem without ever being mediated by a third party, resulting in various new business models.

The blockchain-IoT integration approach brings countless new opportunities, such as (Alam 2019):

- **Building Trust:** because of the security features among the various connected devices; only verified devices can communicate in the network and every block of the transaction will first be verified by miners and then can enter the blockchain.
- **Savings in Costs and Time:** this approach reduces the cost because it communicates directly eliminating intermediary and third-party nodes. It provides direct communication, thus reducing the time taken in transactions from days to seconds.
- **Security and Privacy:** by facilitating secure access to data. Blockchains are not designed to store large amounts of data, but they can provide "control points" to monitor data access.
- **Creating the right incentive structure:** to share IoT/cross-sectional data which can have the most disruptive impact across different industries. Blockchain (and tokenisation) can be used to solve the "how and why sharing data" dilemma. Once data is shared, it can be more easily validated, authenticated and secured (Corea 2018).

4 The IoT/Blockchain Business Model Canvas and Industry Applications

Osterwalder and Pigneur (2010) proposed the "Business Model Canvas", providing nine building blocks, as shown in Table 1.

Table 1 shows how cross-border payments operate today, highlighting the variety of issues that come to light based on the utilisation of a large number of siloed intermediaries.

Based on work by Liu (2018), three different general business models for IoT-Blockchain and their application to key industries can be created (using the Business Model Canvas) that could showcase how these industries could be disrupted by new business models.

1. **C2C (Customer to Customer):** This model can enable transactions between two customers directly without the need of a third party, as trust is established by the network. For example, the owner of a self-driving car can earn extra money by renting it out to anyone who needs it. Normally, the owner of the vehicle is unsure of the renter's driving capabilities and does not trust the other person. However, in the case of self-driving cars applied to a blockchain-based solution, the owner of the vehicle can be far more confident about renting the car to a stranger as there is an existing shared record of his driving performance. This is shown in Table 2.
2. **C2M (Consumer to Machine):** Customers can interact directly with machines and upgrade their features with digital payments, as shown in Table 3.

Table 1 Business model canvas: nine business model building blocks (Osterwalder and Pigneur 2010)

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value proposition</th><th>Customer relationships</th><th>Customer segments</th></tr>
<tr><td rowspan="3">Who are your key partners?
Who are your key suppliers?
Which key resources are we acquiring from our key partners?
Which key activities do our key partners perform?</td><td>Which key activities do our value propositions require?
Our distribution channels?
Customer relationships?
Revenue streams?</td><td rowspan="3">What value do we deliver to our customers?
Which of our customer's problems are we helping to solve?
What bundles of products and services are we offering to each customer segment?
Which customer needs are we satisfying?</td><td>Which type of relationship does each of our customer segments expect us to establish and maintain with them?
Which ones have we established?
How are they integrated with the rest of our business model?
How costly are they?</td><td rowspan="3">For whom are we creating value?
Who are our most important customers?</td></tr>
<tr><td>Key resources</td><td>Channels</td></tr>
<tr><td>What key resources do our value propositions require?
Our distribution channels?
Customer relationships?
Revenue streams?</td><td>Through which channels do our customers want to be reached?
How are we reaching them now?
How are our channels integrated?
Which ones work best?
Which ones are most cost efficient?
How are they integrating them with customer routines?</td></tr>
<tr><td colspan="3">Cost structure</td><td colspan="2">Revenue streams</td></tr>
<tr><td colspan="3">What are the most important costs inherent to our business model?
Which key resources are the most expensive?
Which key activities are the most expensive?</td><td colspan="2">For what value are our customers really willing to pay?
For what do they currently pay?
How are they currently paying?
How much would they prefer to pay?
How much does each revenue stream contribute to overall revenues?</td></tr>
</table>

Table 2 C2C (customer to customer) business model canvas—self-driving cars

Key partners	**Key activities**	**Value proposition**	**Customer relationships**	**Customer segments**
Self-Driving Car Companies Blockchain Platform Investors Self-driving car owners	Dapp Development Maintenance and updated **Key Resources** Venture Capital Software R&D	Cash Free Taxi Service Secured Transaction Record Chance to earn additional money with spare resources Wider Scope of digital currency New method to freelance	Automated service Co-create Value **Channels** Dapp Social Media Marketing	Self-Driving Car Owners Passengers
Cost structure			**Revenue streams**	
Software Development Salaries Marketing			Advertisement Value-added Services Acquisition	

Table 3 C2M (consumer to machine) business model canvas—upgrade the equipment

Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationships**	**Customer Segments**
Equipment Manufacturer	Pluggable Feature Development	Incremental revenue for Manufacturer	Automated service	Equipment owners
Blockchain Platform	Payment processing	Pay-as-you-go upgrades for customer	Co-create value	Third party providers
Digital Payments Provider	**Key Activities**		**Channels**	
Customer	Software R&D		Equipment interface	
Cost structure			**Revenue streams**	
Feature Development Marketing			Value-added Services	

Table 4 M2M (machine to machine) business model canvas—automated supply chain

Key partners	**Key activities**	**Value proposition**	**Customer relationships**	**Customer segments**
Equipment Manufacturer Blockchain Platform Digital Payments Provider	Machine to machine interaction development Payment processing **Key activities** Software R&D	Incremental revenue Increased process efficiency	Automated service Co-create value **Channels** Equipment to equipment interaction	Equipment owners Third party providers
Cost Structure			**Revenue Streams**	
Feature Development Marketing			Value-added Services	

3. **M2M (Machine to Machine):** Machines talking to each other can reduce supply chain delays and create revenue for the manufactures/producers (see Chapter "Blockchains, DLTs and the Future of Payments"). For example, the truck in the yard can talk to warehouse autonomous fork-lifts regarding its presence on the loading gate. All the interfaces on the supply chain can be automated using a machine to machine interface. This can be seen in Table 4.

With these three Canvas/Models, we can examine how these can be applied to specific industries, as in Table 5, where the examples tell us more about what model fits what business and what the main dynamics are.

5 Blockchain Projects Utilising IoT

Many blockchain projects utilise IoT to facilitate business processes in nearly every sector imaginable. This section examines examples of companies utilising blockchain and IoT and with what use cases.

IOTA is one example of a cryptocurrency for the IoT industry. The main feature is the tangle, a DAG for storing transactions (Popov 2018). The tangle can be considered the next evolutionary step of the blockchain, offering features required to establish a machine to machine micropayment system. Other authors in this book elucidate on the tangle (see Chapter "Consensus: Proof of Work, Proof of Stake and Structural Alternatives") consensus mechanism.

IOTA states that its technology is being used in several different areas including mobility and automotive, global trade and supply chains, industrial IoT, EHealth, smart cities, customs and border management and digital identity. A few more of these will now be examined in detail to see how IoT is enabled with IOTA.

Table 5 Models applied to specific industries

Industry	Application/product	Model
Automotive	Pre-paid direct hire of autonomous vehicle Self-parking and automatic updates On-demand features upgrade	C2M, C2C, M2M
Healthcare	Personal medical records monetisation Personalised pre-emptive healthcare services	C2M, C2C
Retail	P2P transactions without an intermediary such as eBay	C2C
Logistics	Consumer to machine interaction	C2M, M2M
Smart homes	Lifestyle data monetisation Automatic product ordering and payments	C2M, C2C, M2M
Insurance	Pre-usage based insurance Automatic claims settlement Personalised medical insurance plans	M2M, C2M
Manufacturing	Personalised manufacturing	M2M

Within the Smart Cities area, IOTA could be used to gather information from IoT sensors from people and objects within the city. This could then be reported to both residents and authorities. IOTA is involved in Project Alvarium (Yarger 2019) alongside Dell Technologies and the Linux Foundation. This project is creating an open-source technology stack with multiple stakeholders working together and enabling large scale complex integrations. This can form the technology stack that systems in smart cities are built on top of. Within the eHealth arena, IOTA has been used by SmartOptz, allowing patients to monitor their own healthcare data and share it with others (SmartOptz PLT 2020). IOTA has also been used by Pact[1] to facilitate the sharing of healthcare data among institutions and patients via an API that interfaces with the Tangle. Finally, turning to the mobility and automotive industry, IOTA is being utilised by Jaguar and Land Rover, where cars are being created with built-in wallets enabling them to make and receive payments for selling data, paying for parking and tolls.

As well as IOTA, there are several other projects that utilise blockchain and IoT. Modum[2] is a blockchain company that is creating trusted digital ecosystems for sensitive goods and digitalising supply chains. With reference to IoT, Modum produces MODsense devices that can be used to track items in a supply chain that interface

[1] PACT Care BV—https://pact.care/.
[2] Modum.io AG—https://modum.io/.

with their blockchain solutions. The MODsense One device monitors temperature and is particularly suitable for pharmaceutical supply chains (Modum.io AG 2020).

OriginTrail[3] is another example of a blockchain company that is creating an ecosystem dedicated to making global supply chains converge. One particular use case for IoT devices is in smart farming. Here, OriginTrail is protecting data from Kakaxi's[4] IoT farming devices, fostering consumer trust in the provenance of their food. Kakaxi's IoT devices integrate cameras and climate-monitoring devices, collecting data such as temperature, humidity, day-length and rainfall (OriginTrail 2020).

6 A Final Remark on AI and 5G

5G: Low latency is one of the key requirements of most of the use cases with IoT. Current 4G networks are unable to cope with the volume and speed required for these use cases to work. Consequently, IoT implementation is limited within controlled environments, barring a few implementations such as autonomous cars. 5G is expected to provide a network speed of 100 gbps, which is almost 20 times faster than 4G networks. The upgraded speed and capacity will enable use cases which are currently not prevalent.

Artificial Intelligence (AI): M2M communication is increasingly going to be independent of any intervention, requiring machines to become intelligent. AI will play a key role in machine decision-making.

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[4] KAKAXI, Inc— https://kakaxi.me/.

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