The Trusted IoT Alliance IoT Challenge Program:

Blockchain and the City Challenge

The Blockchain and the City Challenge competition is organized by the Trusted IoT Alliance, the open software consortium created in 2018 to support the creation of a secure, scalable, interoperable, and trusted IoT ecosystem. TIoTA's members are engaged with linking IoT devices and the companies operating them, and to consumers, service, communication and payment providers.

The core concept behind TIoTA is to leverage software advances in cryptography, distributed ledger technology, secure enclaves and other state-of-the-art-approaches to ensure fast and secure trust-building at an unprecedented scale and speed. TIoTA's members span hardware, communications, payment, logistics, and numerous other tech sectors.

Challenge Summary

The **Blockchain and the City Challenge** focuses on blockchain-based use cases for urban transportation, urban industry, decarbonized mobility and various other related use cases that combine Blockchain, IoT and city life in Europe.

The main goal of the Blockchain and the City Challenge is to jointly develop solutions that provide real world value-add to the many aspects of city life in the near future, including new services.

Our intent is to drive the creation of an ecosystem that will jointly bring the new solutions to market, based on direct user feedback and field trials.

To do that, the Challenge will bring together large companies and organizations, start-ups and other solution providers who will work alone and in small groups to provide solution proposals, Proof of Concepts and eventually pilot implementations to fulfill the requirements outlined by the Challenge, described below.

Challenge Requirements

The theme of city life presents a much wider canvas than previous TIoTA Challenges. Therefore, we are focusing the challenge on a handful of core topics, including:

- Urban industry
- Urban decarbonized mobility
- And related services.

The central Challenge lifecycle is the journey of an inhabitant of a large European city (in this case, Lyon, France), in a possible near future. He will commute with multimodal urban transportation means, including, for example, smart parking and smart charging services. During the day, he will engage with digital services for power and light, urban factories, a FabLab, a repair shop, a logistic service, and so on.

The Challenge looks at a complete journey, and the infrastructure leveraging it. Context assumptions about city life and Challenge constraints include:

- Priority to collective or shared transportation means
- Priority to decarbonized energy in urban daily use
- Traceability of energy purchases
- Multimodal transportation with one pass
- Multi-service for urban life with one pass
- Availability of 4G and 5G networks
- Light industry and FabLabs disseminated in the city
- Urban logistics
- Availability of hardware and software to connect various machines, tools and objects to blockchains and DLT.

Challenge Infrastructure

The infrastructure will comprise a set of decentralized market places or data hubs, which can be used by different stakeholders according to the requirements outlined above. Furthermore, it is important that the means of onboarding new solutions are simple. In particular, they should not require the use of complicated and advanced APIs and data structures. They should fit in well with MS Excel-like data transfer mechanisms and with typical IT environments, including corporate firewalls and VPNs.

We believe a number of interesting use cases can be built on this core infrastructure. For example:

- Collaboration
- Privacy and security: Ensuring citizen privacy and security safety
- Smart urban environment: Smart parking
- Track and trace of materials and vehicles

- Urban logistics, last kilometer delivery, and track and trace for transportation logistics
- Multimodality for urban transportation.

These use cases must be supported by the concept of smart, value-adding apps. Examples of these apps include Analytics, Privacy and Security apps.

IoT is at once an opportunity and a risk. An overview of the key use cases and the general setting of the challenge is provided on the Challenge website. The website is frequently updated.

Technologies and Architectures

The core of this challenge lies in the combination of four technologies:

1. Internet of Things
2. AI and Big Data
3. Distributed Computing
4. Wireless Technologies

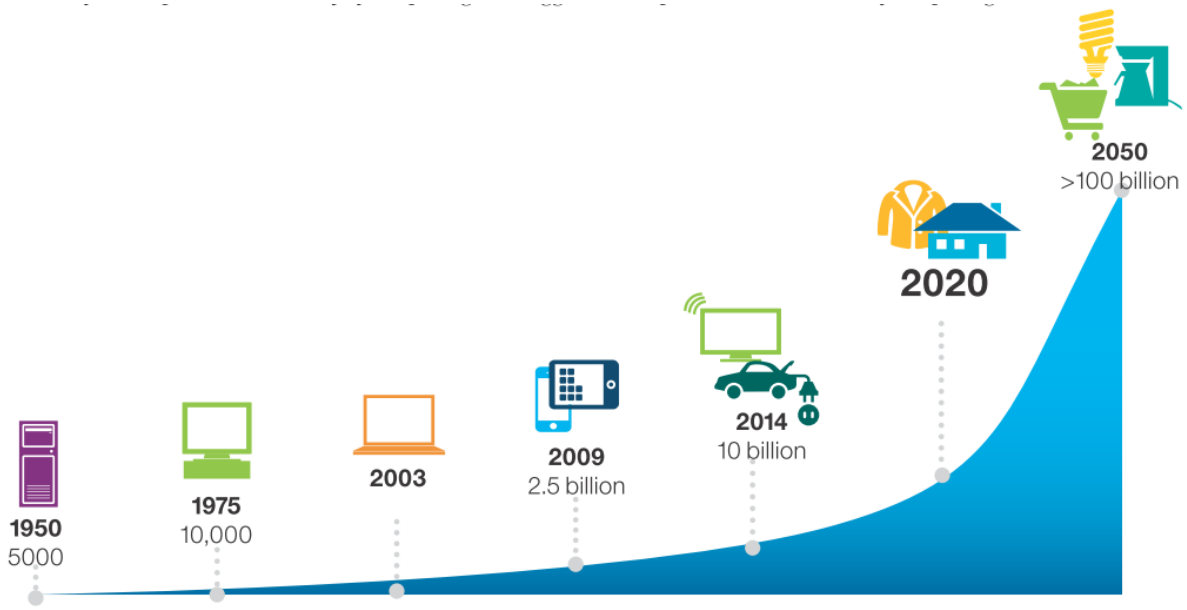
1. **Internet of Things** is defined as the connection of crowds of objects to Internet. The difference with embedded systems that have existed for decades, is the presence of the Internet as a backbone. This means:

    - Connection of huge amounts of objects
    - Collection of massive amounts of data
    - Actuation on diffuse and multiple cyber-physical systems (Web 3.0)
    - Decentralized architectures

The Internet of Things amplifies the exponential growth of the volume of data generated, stored, and available on the Internet, which makes it possible to learn AI algorithms. It also magnifies the risks of cybersecurity and threats to the protection of privacy.

Literature predicts that in 2025, IoT will cover 150 billion objects.

Each inflection point in the history of computing has triggered an explosion in the number of computing devices. Device Democracy (IBM, 2015)



To be safe, scalable and efficient, Internet of Things networks must be redesigned to gradually shift from managing billions of devices to hundreds of billions of devices. Device Democracy (IBM, 2015)

2. **IA and Big Data.** Mass data analysis and machine learning techniques will produce interesting models and behavioral algorithms for controlling objects or swarms of objects, increasing their autonomy, and securing systems using advanced supervision. This is the second element of the Machinery Economy. As a consequence, they also increase risks in the protection of personal data, and acceptability of technologies.

3. **The techniques of Distributed Computing** are less visible than IoT and AI, but fundamental. Computer architectures are moving towards greater decentralization. They leverage the development of service activities and ecosystems and provide resilience at the system level.

   Blockchains and DLTs leverage economic systems based on distributed computing architectures. They secure the recording of distributed data, allow identification in a precise, resilient and relatively secure way through the identity of objects, integrity of codes and data exchanged. They support the creation of economic systems through functions such as notary, banking and trading.

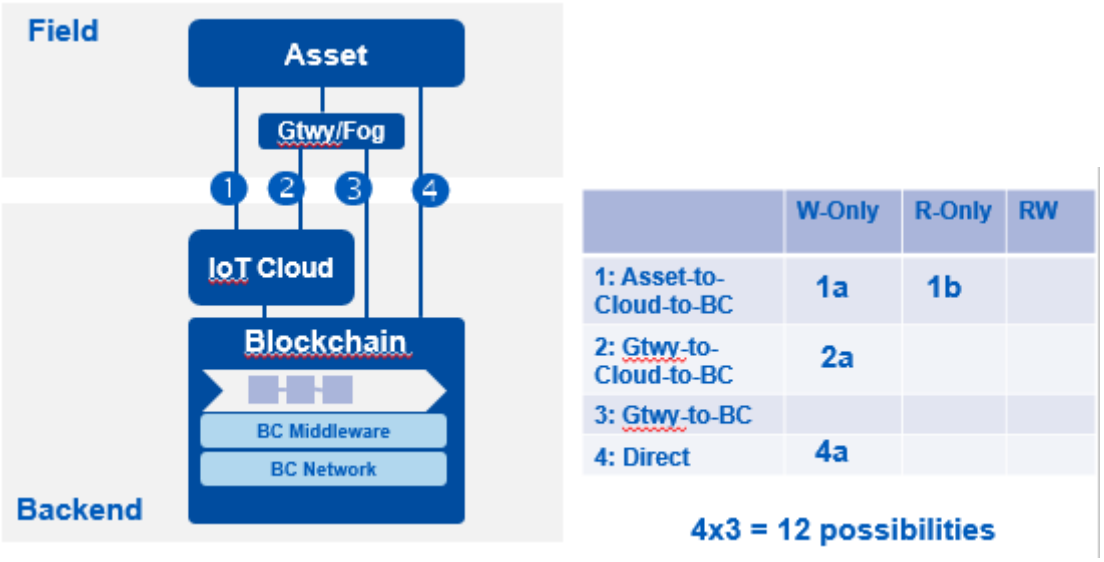
   However, improving the scalability of blockchains is a prerequisite for the generalization of these uses to create marketplaces of sufficient size and diversity to create value.

4. **Wireless Technologies** make possible the connection of billions of objects. 5G makes open fast flows and interesting adaptive capacities, such as slicing. The low latency enables the secure control of complex objects (such as robots and autonomous vehicles). A recent example has been published by DOCOMO and Toyota:

In 2018, DOCOMO and Toyota demonstrated the feasibility of the control a humanoid robot, the T-HR3 at a 10 km distance over 5G.

Other technologies (Sigfox, Lora, 4G) complement 5G to manage short distance connections between objects and boxes, and improve territorial coverage. However, here also, security issues are still open.

Connection of a Thing to a Blockchain is a prerequisite to transform as an economic agent in a semi-autonomous marketplace, and a key point for security. Therefore, we will focus on this issue in the context of this Challenge.



Four possible architecture designed to connect a Thing to a Blockchain (Bosch/Trusted IoT Alliance).

These architectures are in fact special cases of IoT solutions. They will probably be implemented on general purpose platforms from the IoT world. Wireless connections are virtually unavoidable.

Microservices architectures are also required. They allow the development of cloud-accessible IT services, referred to as XaaS and EaaS. They also favor the development of edge computing, using sparse computing capacities.

It is likely that access to sparse computing will increase rapidly with connected objects, particularly in the areas of transportation systems and decentralized energy management systems, including smartphones and boxes. Enclave technology, as software (such as an SDK developed by Intel) or as hardware (engraved in the processors), is a prerequisite for the dissemination of these use cases.