

Thing'in

The Web of Things

White Paper

May 2018

The Thing'in research platform

Graphing the web of things, together!

orange™

Why the Thing'in platform?

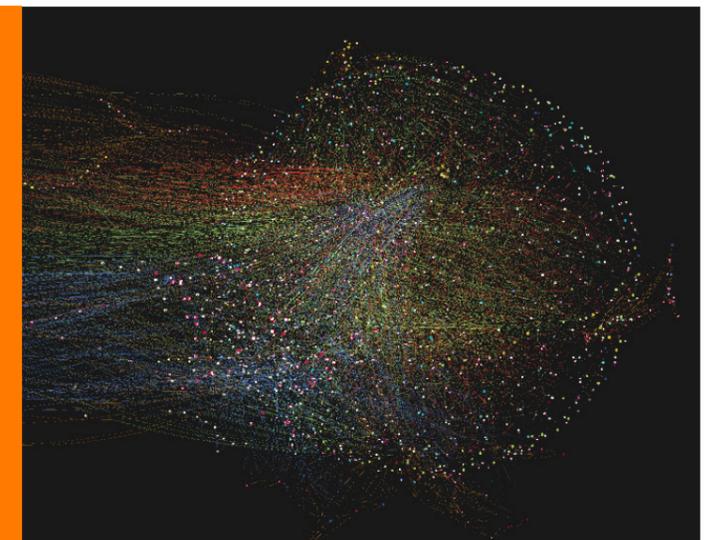
The **Internet of Things** (IoT) opens up a new world of applications, which we do not have yet full awareness, that will be built on the interconnection and sharing of billions of things/objects¹, of the information about the physical world they will capture and upload as (digital) data, and then on the retroactions they will perform on th physical world, thanks to decisions based on the analysis of this data.

The ultimate vision of the IoT is the extension of the digital world (the Internet as we know it today) to the physical world, and even the fusion of the two worlds. This implies the interaction between things/objects from very different universes: objects from house, buildings, enterprises and cities, from cars, trains, and transports, from the agriculture and the industry, etc. The bad news is that the IoT has not developed in the direction so far. It is today very fragmented in numerous sectorial, vertical, ecosystems of technologies, services and actors, which are so many islands.

In 1989, Tim Berners-Lee, then at the CERN, invented the Web as a system of digital contents interconnected by hypertext links. From 1990 to 1993, a prototype implementing the concept was developed and experimented by teams of scientists. The Thing'in platform proposes to relive today a similar experience: contribute to the emergence of the web of things.

Thing'in is an open platform launched by Orange as a catalyst for the emergence of a graph-centric vision of the web of things.

Just like the Web made it possible to go beyond the mere interconnection of computers that exchange data (the technical vision of the Internet in sense of the IP protocol) to allow humans and service to search, navigate and exchange higher-level digital information that makes sense to them; the web of things will allow tomorrow humans and services to explore and leverage the relationships between things, and between things and their environment, to exchange knowledge about (and act on) the physical world at a very large scale, beyond the current silos.



¹The terms «thing» and «object» as in «the Internet of Things» or «l'Internet des Objets» in French, are used interchangeably in this document.

What's in the Thing'in platform?

The overall ambition of the Thing'in platform is to build an open, secure, and historicized, graph shaped index² of object avatars³, i.e. digital representations of physical world objects, and their relationships.

It is worth remembering here that the core platform does not only allow for the description and manipulation of a graph of objects avatars and relations: it also allows for interactions with the actual physical objects accessible from their avatars in Thing'in.

The Thing'in platform is made of 2 distinct constituents: Core Platform and Enablers.

Core Platform

The Core Platform allows essentially for the management of the index that takes the form of a graph⁴ of avatars of objects of the physical world with:

- Their **properties** such as their function (e.g. a camera, a chair, a tree), model, serial number, state (e.g. on/off, connected/unconnected, localisation) - described by types using ontologies as in the semantic web,
- Their **relationships** with other objects and more generally their physical environment: objects can be parts of other objects (e.g. a bicycle is made of a frame, 2 wheels, etc.), they can be contained in other objects (e.g. a chair is contained in a room that is contained in an apartment, that is contained in a building...), they can be sensors (e.g. a camera can see objects in an area) or actuators (a connected electric plug can switch on/off a light) for other objects - or any other arbitrary semantics of relationships that can be thought of,
- Some **access modalities**, i.e. technical chains that can be set up for the actual access to physical objects (sensors and actuators) and their data (sensors) in order to monitor and control the physical environment. Access modalities between one avatar and the physical object it represents can possibly take different shape (e.g. manage configuration, security, price, etc.) depending on the contracts set up between the provider of an object and its users.

Enablers

The platform comes with a set of tools to ease/enable, application development. By definition, Thing'in enablers do interact with the core platform through its Application Programming Interfaces (API) and are easily composable. Enablers primarily target application developers. They are sort of «added-value» to the core platform.

Some typical (non exhaustive list) enablers would target:

- Graph **population** by means of injection of objects descriptions from third parties IoT platforms or direct **detection/sniffing** of objects in the physical world
- Graph **visualization** and **navigation** in 2D, 3D, Virtual Reality
- **Projection** of the graph onto geographical and generally physical representations (maps, buildings, cities, etc.)
- **Inference** and **reasoning** on the graph
- Execution or simulation of **mashups/scenarios** of objects and services

Note that distinction between an enabler and an applicative component (a component developed in the context of a specific application development) is not always straightforward. They are intrinsically not different in their nature but in their usage: an enabler is a component that can be shared, mutualised, between several applications.

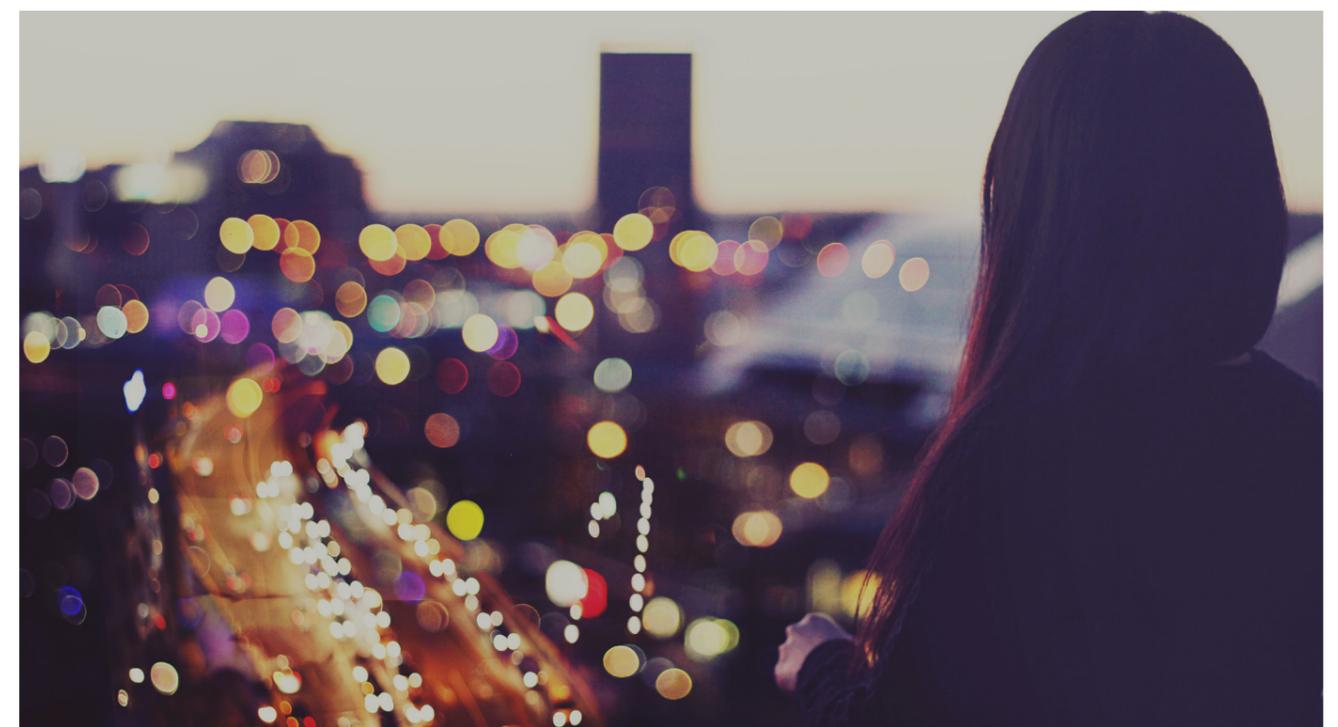
Thing'in focuses on IoT objects and relationships, not primarily on IoT devices and corresponding raw data

Something that is worth mentioning because it helps distinguishing Thing'in from the numerous IoT platforms that exist today is the fact that Thing'in focuses on the things themselves, in their environment - and not primarily on the data captured by connected IoT devices, which is the main focus of current IoT platforms.

Thing'in does allow for accessing objects and their data (through technical chains built from the description of access modalities) as other IoT great deal of describing objects per se: what they are, where they are, in which state they are, how they relate to other objects and their environment in general. One or several ontologies may be associated to each object so as to allow for reasoning and inference at a semantic level.

Thing'in stores and manages data about the objects in the form of a knowledge graph that captures their properties and relationships, but it does not store and manage data from the objects. To take a trivial example, Thing'in would manage data about thermometers; it would NOT manage temperatures data. In this respect, Thing'in is more concerned by IoT metadata than IoT data really.

Hence, Thing'in provides a great help in finding, locating, the right objects, with the right properties - in particular by leveraging relationships between objects and between objects and their environment.



²The terms «index» should be taken here in its very broad meaning. It can be understood at this stage as a «database», a «databank», a «repository», a «library», a «collection».

³The terms «avatar» can be understood here as (digital) «twin» or «shadow». Subtle distinctions between these different terms are out of the scope of this White Paper.

⁴In its mathematical meaning, i.e. a set of nodes and links

What specific added value the Thing'in platform brings in?

Bridging the digital world and the physical world thanks to digital avatars

Thing'in is not concerned with connected objects only, but possibly by all physical objects really: devices and things (connected or not), spatial entities, physical systems and their subsystems at all scales (e.g. a chair, a wall, a room, an apartment, a building, a city, etc.).

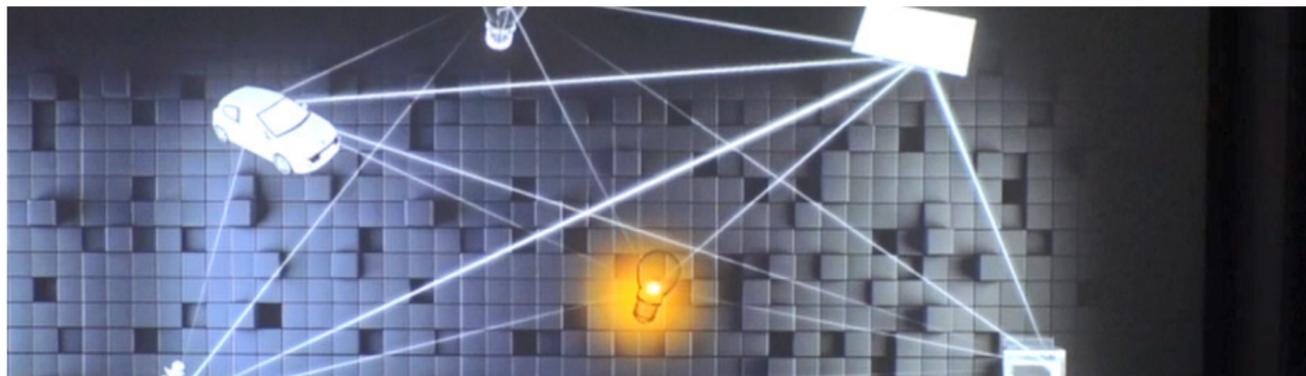
Thing'in is fundamentally a gateway, a medium that manages the connection between physical objects and their digital counterparts: avatars. Avatars represent, manifest, physical objects in the digital world. Physical objects embody, incarnate, avatars in the physical world. Avatars and physical objects they represent are (ideally) causally connected: an action on a physical object is reflected in the state of its avatar - and vice versa.

Thing'in can be seen, in a somehow restrictive way, as an «index», a «search engine», or even a «marketplace» for objects. The ultimate goal of Thing'in however is much more about capturing, recording, the physical world, with all the intricate relationships between things that makes it, into the digital world, and even augmenting it thanks to a global semantic knowledge graph.

Bridging the silos in the Internet of Things

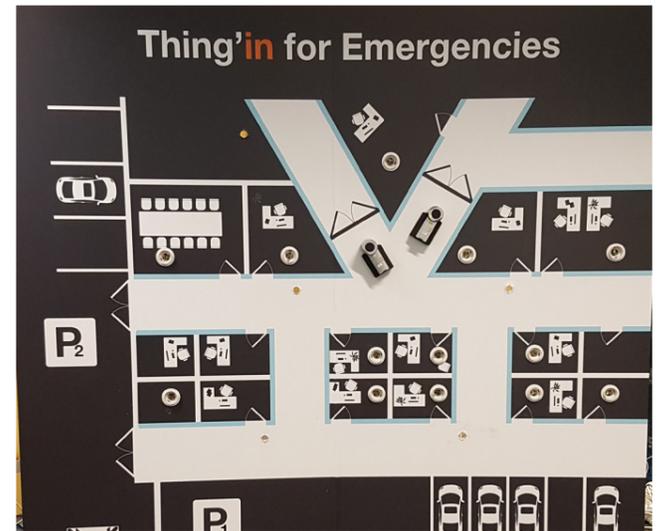
Thing'in positions itself as a universal, transversal gateway that connects objects coming from different (business) universes: personal objects (e.g. wearables), objects from the home, building, city and agriculture, transportation, leisure and industry - basically all the «smart something» one can possibly think of (smart home, smart city, smart car...).

The intent is to go beyond sectorial, vertical, usages by enabling the emergence of new usages; to go beyond the current low level and siloed Internet of Things and address the future Web of Things.



Use case example #1 Product lifecycle management

Imagine one wants to develop a service that follows objects (e.g. bicycles) - or parts of objects (e.g. frames, wheels, handlebar, saddles...) - throughout their entire lifecycle from production, transport and distribution, purchase, recycling or destruction of objects (or parts in some situations) so that specific services could be added (e.g. advertisement, sale, leasing). This use case would be very difficult to implement in today's Internet of Things for it involves different actors in different verticals/businesses that would manage data about considered objects at different time frames, in different formats, in different platforms that would make sharing and exchanging of information hardly feasible. Thing'in, in contrast, would easily allow for reconciliation of the different views of the considered objects and «hand-over» between successive owners/platforms.



Use case example #2 Prevention of hazardous situations

Consider now that the objects of interest are chemical product containers, which could create hazardous situations when co-located in a given perimeter. Preventing and detecting such situations before accidents happen by asset monitoring and geo-fencing would be hardly feasible today because information about the chemical products and their localisation not only as to be known or shared by a specific actor or a set of actors inside a business vertical (the chemical industry here); but it has to be shared across a entire chain of actors from different domains e.g. transport, logistics, public sector. Thing'in could help sharing information between specific actors in specific points in time (no need for all actors to have all information about chemical products movement but only when relevant in the scenario).



Use case example #3 Emergency interventions

In case of emergency - for instance a major fire in an industrial site in a city due to the explosion of chemical products - rescue teams (the fighters, ambulances, etc.) could benefit from road lights and train barriers control put to green and opened on their move, from control of gas, water and electricity equipment at their arrival on site, from localisation and temporary control of locks and doors, fire extinguishers, lights and screens, and other equipment, inside the buildings, either to help evacuating the occupants, or to help the intervention of rescue teams and to control the progression of the fire. This use case would be almost impossible to implement without Thing'in, which can index and links all the objects concerned in the scenario, and which can allow objects owners to give temporary control of their objects to other actors.

Fostering the in-place re-use of objects in a collaborative economy

If you have a thermometer or a moisture sensor in your garden you use for watering your crops from your smartphone when you are away for the week-end, there is pretty good chance your neighbour can use your sensors for taking care of her garden situated a few meters away. Data collected from these same objects would be of good use as well for a (collaborative) weather service, or for the fire brigade to assess the progression of a surrounding fire...

If there are security cameras installed in your building, perhaps by pivoting a camera from your smartphone, you would be able to check the health of the plants on your balcony when you are away on vacations, or to check a fire alert, or perhaps to check if there are enough chairs in a meeting room you have booked for a meeting your are organizing...

As illustrated by these examples and the use case #3 above, thanks to Thing'in, **physical objects can be localised and solicited to contribute to use cases for which they were not initially installed**, leading the way to new usages, services and business models. This is really core and distinctive feature of the Thing'in platform - emphasizing its focus on the control of the individual things themselves, and not only the data from the things as other IoT platforms.

Leveraging latent interactions between objects

The value described above: fostering in-place reuse of physical objects between different business areas is enabled, backed up, by another one: leveraging latent interactions between objects.

Latent, hidden, implicit, interactions can be made explicit, discovered, and enriched, by exploiting the **power of relationships** between objects, the power of graphs.

Consider a smart home scenario in which the rooms together with the objects they contain have been described in Thing'in: furniture, doors, stores, heaters, lights, plants, etc. Now, opening or closing a blind, moving the heating up or down can have an impact on light and heat inside a room. These latent relationships between heaters, stores, lights and plants can now be made explicit in the graph modelling the home. Some relationships can be more hidden and indirect: switching on or off a light in another room can have an impact on our plant depending on the fact the door between the two rooms is opened or closed. Again, new latent relationships between doors, lights and plants can be made explicit, and this new knowledge leveraged by user applications.



Thing'in as a multisided platform - actors play

Thing'in users, from day-to-day usage point of view, can have two distinct roles:

In fact, there is a third side the platform wish to promote and expand:

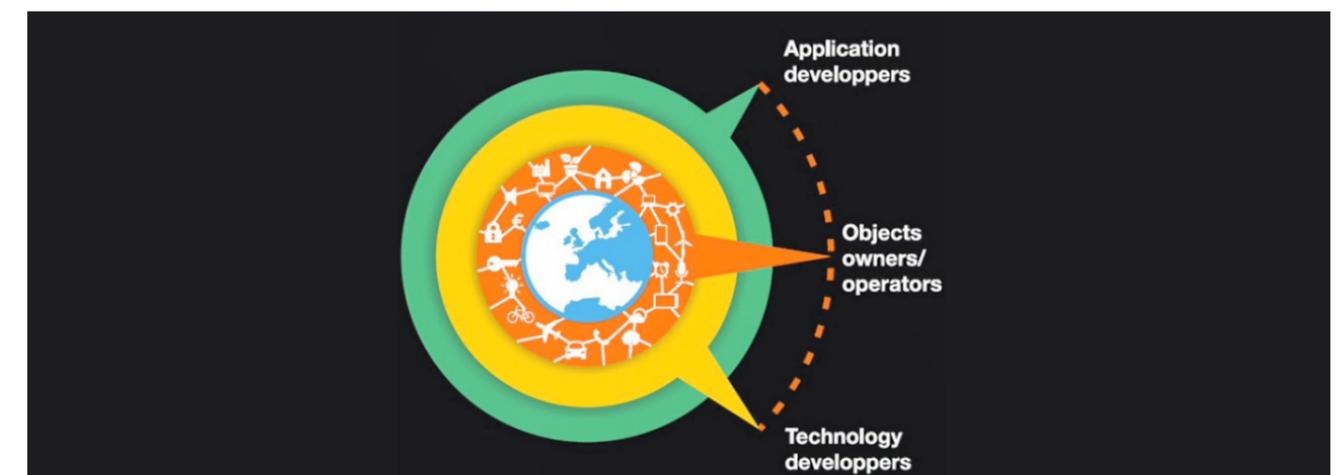
- **Producers:** objects owners/operators populate the platform with digital avatars of their physical objects,
- **Consumers:** application/service developers search and use avatars, physical objects accessed though these avatars and ultimately the overall environment in which these objects are embedded.

Technology developers develop tools and technical services which extend the functionalities of the platform, and are made for avatar producers and consumers to use. Technology developers can beneficiate from the exposure on the platform to reach new users.

Thing'in can be seen as a multi-sided platform centred on the exchange of a value unit: digital avatars of physical objects. The core interaction in the platform is the exchange of avatars between producers and consumers. The exchange is controlled by security rules and more globally by access modalities, which can be seen as contracts between producers and consumers.

Thing'in can be understood basically as an IoT object marketplace which allows for the access to objects (actuators) and their data (sensors) but concentrates on the mediation of information about object between avatars producers and consumers with the help technology developers who expose value-added services that expand and ease the use of the platform.

The essential purpose of the platform is to enable the connection between avatar producers and consumers, **to set up and maintain the most favourable conditions and rules** for the most profitable interaction between producers and consumers.



Thing'in as an integrative research platform

Thing'in is not launched by Orange as a product, but as an integrative research platform. The Thing'in initiative proposes an open (to different ecosystems), collaborative, experimental platform, whose purpose is to foster the emergence of technologies, usages and business models on the road towards the Web of Things.

The practical goals proposed to Thing'in users/ participants are the following:

- **Explore** the integration of future technology for the Web of Things into rich usage scenarios and meaningful user experience,
- **Understand** usages in rich, instrumented, in-vivo experiments,
- **Gather** data on technical and usage issues (e.g. technical scalability, legal issues),
- **Federate** the R&D ecosystem (public and private research, industry, startups, territories...), mutualize resources and accelerate developments and experiments.

Current status, documentation, links and contacts

The core platform and first enablers have been implemented since 2016. In 2017, an alpha version of the platform has been released internally for experimentations inside Orange, resulting in 4 demonstrations at the annual Orange research exhibition fair in December 2017.

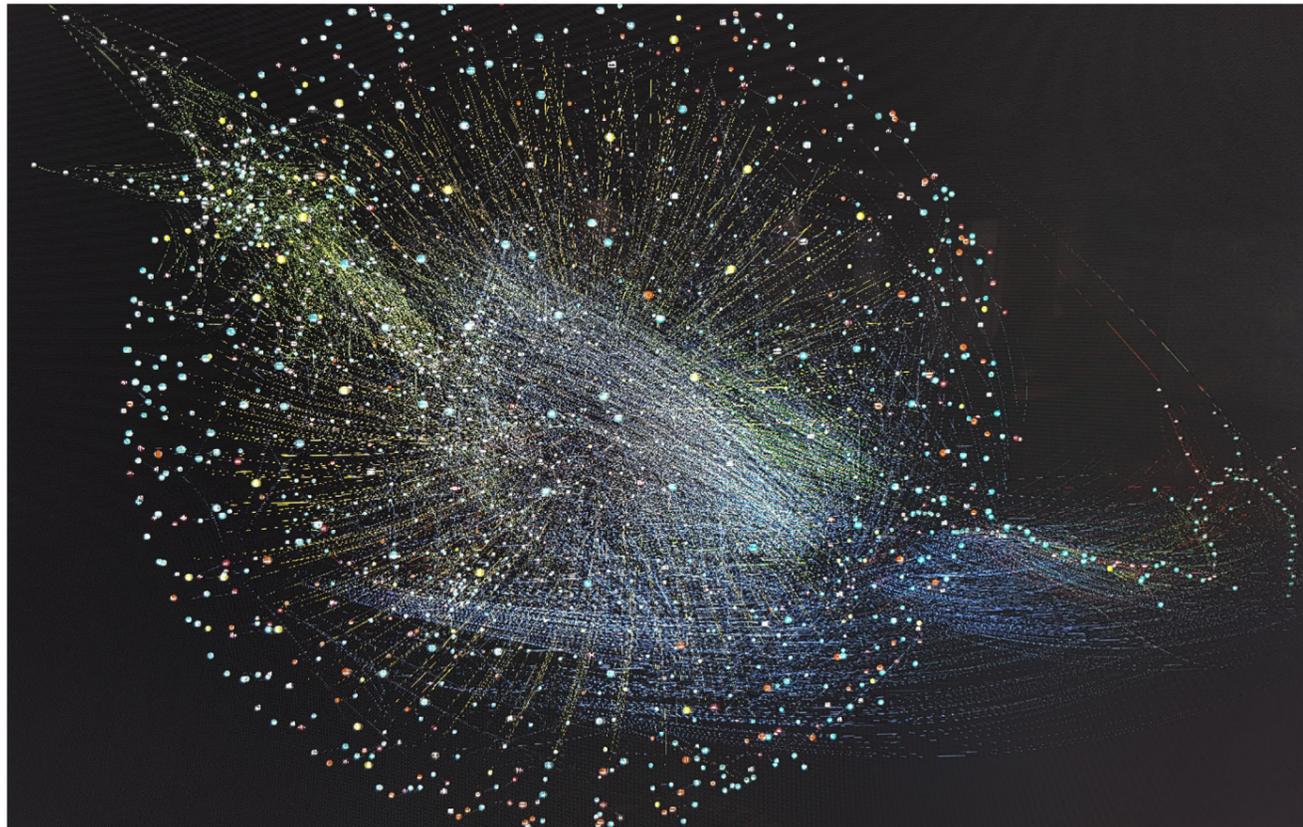
In 2018, a beta version of the platform, with new core features and enablers, is progressively opened to selected partners (large companies, SMEs, start-ups, territories, academic research)... before a larger and more public opening.

If you want to join the Thing'in initiative, experiment, collaborate, bring your own objects, develop new services or tools on top of the platform, or just know more and keep in touch, please contact us at:

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