

Interoperability: connecting the dots in a fragmented digital energy landscape

IEA 4E EDNA Annex

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Why is interoperability important?



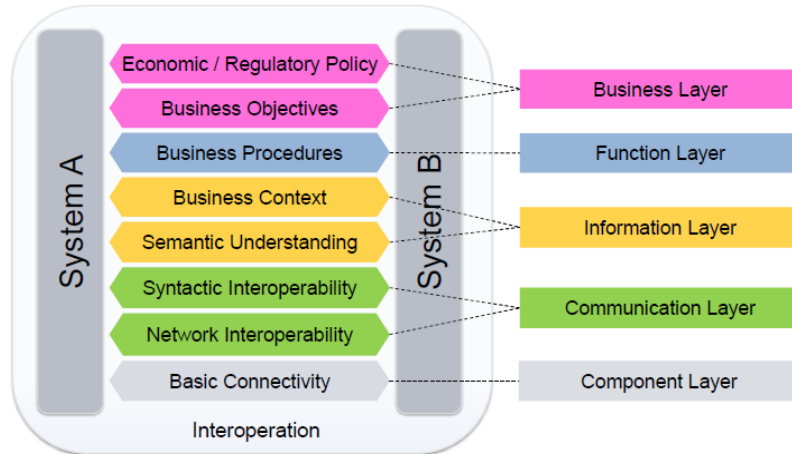
- **Intelligent Efficiency (IE):** the deployment of network-connected ICT technologies to facilitate efficient operation of energy-using equipment, leading to energy savings.
- Intelligent efficiency (Smart home): sensors, equipment and network
- Need to share a full common understanding
 - Example: smart air conditioning system from a manufacturer that interacts with the occupancy detectors of a smart lighting system from another manufacturer
- **IoT systems to work co-ordinately and provide a full IE service: untapped potential on energy savings**

- **Demand flexibility:** the capability of an electricity system to respond to upward or downward changes in the supply/demand balance in a cost-effective manner over a timescale ranging from a few minutes to several hours
- Crucial for demand flexibility where two systems interact: **smart home system and the electricity supply system must share interoperability procedures**

A definition for interoperability

*“**capability** of a product or system within the smart home landscape, to **interact** with other products or systems, by means of exchange of the necessary **information** and its **common understanding**, in order to **maximise energy savings** and to enable **electricity system to respond** to upward or downward changes in the supply/demand balance in a cost-effective manner.”*

Interoperability layers

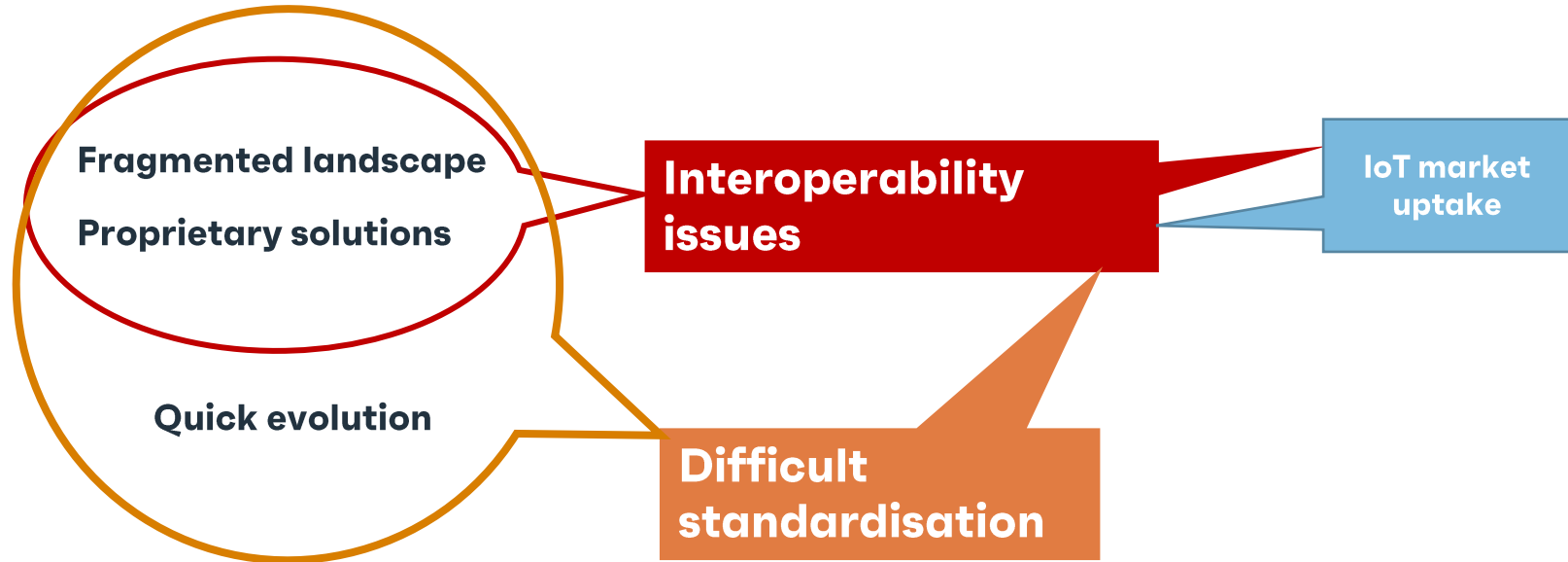


GridWise Architecture IF categories and Smart Grid Architecture Model (SGAM)

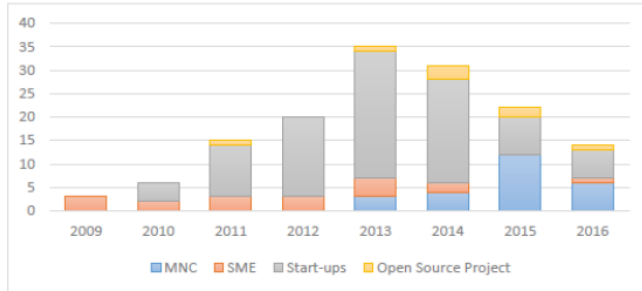
- Basic connectivity: the devices are aware of each other and ready to communicate
- Network Int.: devices agree to communicate upon a specific way
- Syntactic Int.: they agree on which message format they will use
- Semantic Int.: they agree on which language
- Business Int: they will agree on the procedures and develop end-user services → IoT platforms

Causes of interoperability issues

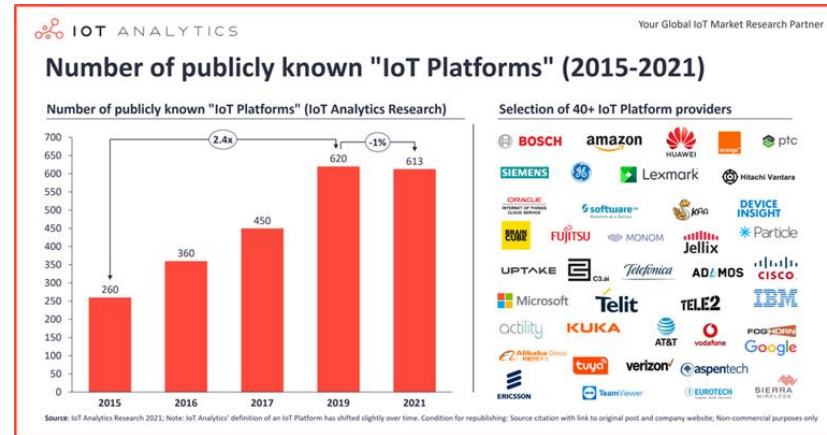
They are interlinked



Fragmented landscape, quick evolution



Number of IoT platforms launched on the market per year worldwide (Source: UNIFY-IoT, IoT Analytics)



Number of publicly known IoT platforms worldwide (Source: IoT Analytics)

More than 600 IoT platforms in the market,
Apple, Google Cloud, Cisco IoT Cloud Connect,
IBM Watson IoT, Amazon AWS IoT Core

Each platform develops and promotes **its own**
IoT infrastructure, protocols and interfaces, in
standards, formats and semantics

Basic connectivity of devices

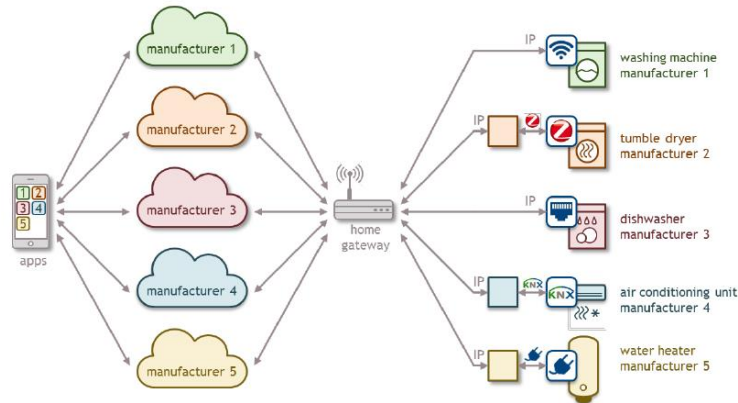
- Wi-Fi technologies and 3G/4G cellular communications: Smart TV, printers, air conditioners
- Bluetooth SMART and NFC: wearable devices
- Z-Wave, ZigBee, KNX: sensors
- LoRa, SIGFOX
- Thread

Standardisation

Basic connectivity

Current situation

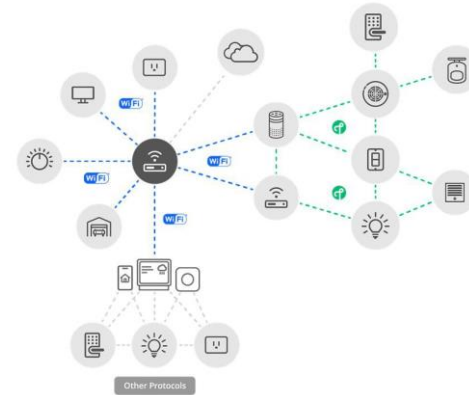
- Different connectivity protocols
- Need hubs or bridges to interconnect



Connectivity of different appliances with different technologies and standard protocols (Source: Preparatory study on Smart Appliances)

Possible solutions

- Common protocol
- Thread and Matter?: IP-based solution



Matter network map. (Source: Image: Z-Wave Alliance, The Verge)

Standardisation

Semantic interoperability

Current situation

- Each platform develops and promotes **its own** IoT infrastructure, protocols and interfaces, in **standards, formats and semantics**
- **Vertical** applications ≠ unique standard for **cross-domain** interoperability
- Need for (standardised) **entities or reference/abstract ontologies** able to perform the **mapping between the different existing ontologies**
- Several initiatives are addressing reference models such as oneM2M Base ontology and ETSI SAREF ontology.

Standardisation

Platform interoperability

Current situation

- **Heterogeneity** of IoT platforms
- Each platform develops and promotes **its own** IoT infrastructure, protocols and interfaces
- **Public APIs** → are platform-specific and proprietary
- Need of developing **specific APIs** since there is not a standardised API

Possible solutions

- **Standardised approach solution:**
 - reference architecture, information and interoperability strategy, selection of Reference Points and APIs
 - Open, not controlled by any company or group
 - oneM2M

Closed ecosystems

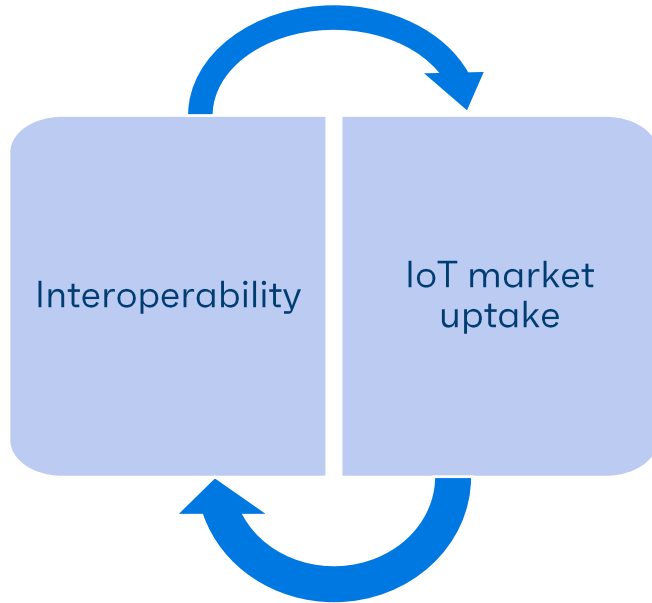
Current situation

- Vertically oriented and **mostly closed systems** → share of open-source platforms is below 5%
 - increased **functionality** and **consistency**
 - **Security** and encryption concerns
 - **Data** management
- **Public APIs** to assist developers access their services, not the best solution

Market drivers

- **Open standards and sources** are required to fully implement interoperability
- Interoperability issues ≠ **effective IoT solutions** → low uptake of smart home systems
- To steer the market **towards their solution**, making the market **dependent** upon it.
- Connectivity Standards Alliance (former ZigBee Alliance): Thread and Matter

IoT market uptake



Lack of interoperability in users:

- Poor user experience
- Misuse or underutilisation
- Perception of no value added
- Impact negatively in IoT demand

Low IoT market uptake:

- Discourage any effort to improve interoperability

Impacts of lack of interoperability

Energy consumed by IoT vs savings

- IoT devices consume energy: Intelligent Efficiency / Smart homes systems → provide energy savings that outweigh the IoT consumption

Impact of interoperability in energy consumption

- Difficult to estimate → comparing around 10% from function-specific systems to 27% of fully implemented smart home systems
- Other estimates are higher, they may include end-user uptake and behavioural aspects

Impact of interoperability in end-users

- Poor user experience
- Misuse or underutilisation

How to solve it?

Policy recommendations



- Support of **open** platforms and standards
- Stimulation of **market uptake**
- **Information to end-users** to support their purchase choice, given the proliferation of IoT devices and systems
- Support of **standardisation** for interoperability: particularly semantic and basic connectivity.
- **Organisational interoperability**: IoT platforms federations

Policy instruments?

Taking into account that:

- IoT market in terms of maturity, fragmentation and innovation.
- Enabling the **entrance of new players** can be the most appropriate at this stage of the IoT market development

Policy instruments

Mandatory minimum requirements

- Open protocols?
- Common testing methodology for interoperability?
- Standard for semantic interoperability?

- For issues and solutions available in the market, to which all players will converge
- Careful evaluation of market impact

Mandatory information to consumers

- Technical, complex information into simple information such as a rating system
- Feasible for large consumers as companies or public authorities

- Drivers to standardisation, openness and stakeholder involvement
- No market restrictions

Voluntary initiatives

- EU Code of Conduct to the energy smart appliances manufacturers
- Easier to develop than information to consumers

Incentive programmes for founding innovative projects

Standardisation and openness support

Promoting a self-regulation framework

- Improve organisational interoperability
- Enablers of an environment for innovation, standardisation, and collaboration

Thank you!

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