Modeling the Web of Things from an IR Approach

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Motivation

- Nowadays, only 1% of real-world objects are connected to the Internet, but expected 50 to 100 billion by 2020.

- **Internet of Things**: technologies and research areas that enable Internet to adopt some intelligence and interconnect real world objects.

- **Web of Things**: Integration of these real world objects to the Web.

- **Consequence**: a huge amount of objects in the real world producing a vast and dynamic amount of information.

- → **Challenge for IR**.

Motivation

- **Objective**:

    – Design, development and implementation of real-time search engines

    – that allow finding things,

    – and information on variables of these things,

    – as well as the features and services provided by them.

Motivation

- But previous to that:

Design of an abstract model and

a structured representation of the Web of Things

Outline

1. Abstract Model of the WoT.

2. Conclusions and Further Research.

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1. **Abstract Model of the WoT.**

2. Conclusions and Further Research.

Abstract Model of the WoT

- Model based on an abstraction of the real world.

- Two main elements:

    - **Things** (tangible or intangible).

    - **Spaces** (where these things are contained or related to).

- Previous to the WoT model:

    - Physical infrastructure connecting these two elements with Internet.

Abstract Model of the WoT

Modeling the IoT (Devices):

- **Sensor Nodes**: Obtaining real-time information on properties of things in real time.

- **Data Nodes**: Getting connectivity to other data nodes to access Internet and joining information from other sensor nodes.

- **Gateway Nodes**: Protocol conversion and/or Internet Access.

Gateway Node
Data Node
Sensor Node
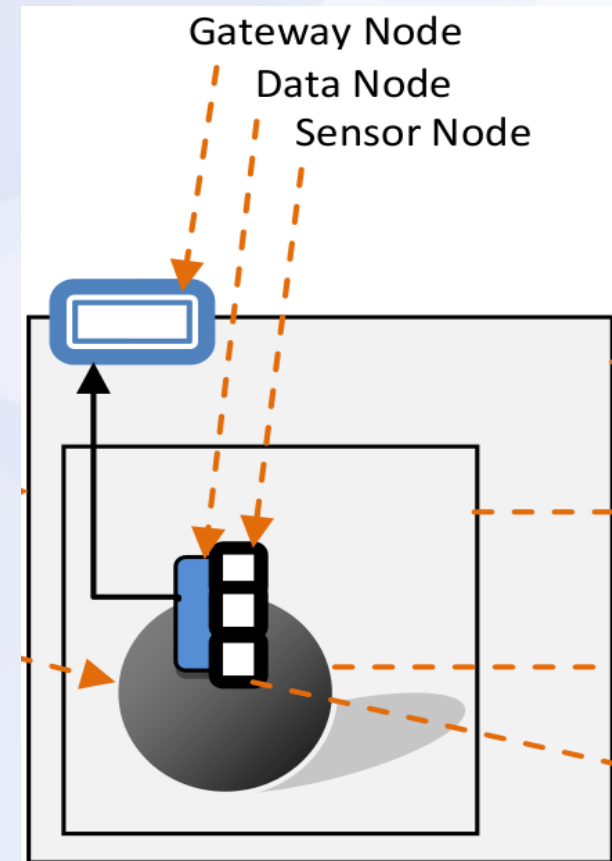
Abstract Model of the WoT

Modeling the WoT based on three main abstractions:

- **Virtual Sensors** ← Associated to Virtual Nodes.

  Web representation of the sensor: recollection, composition and visualization of data from the sensors.
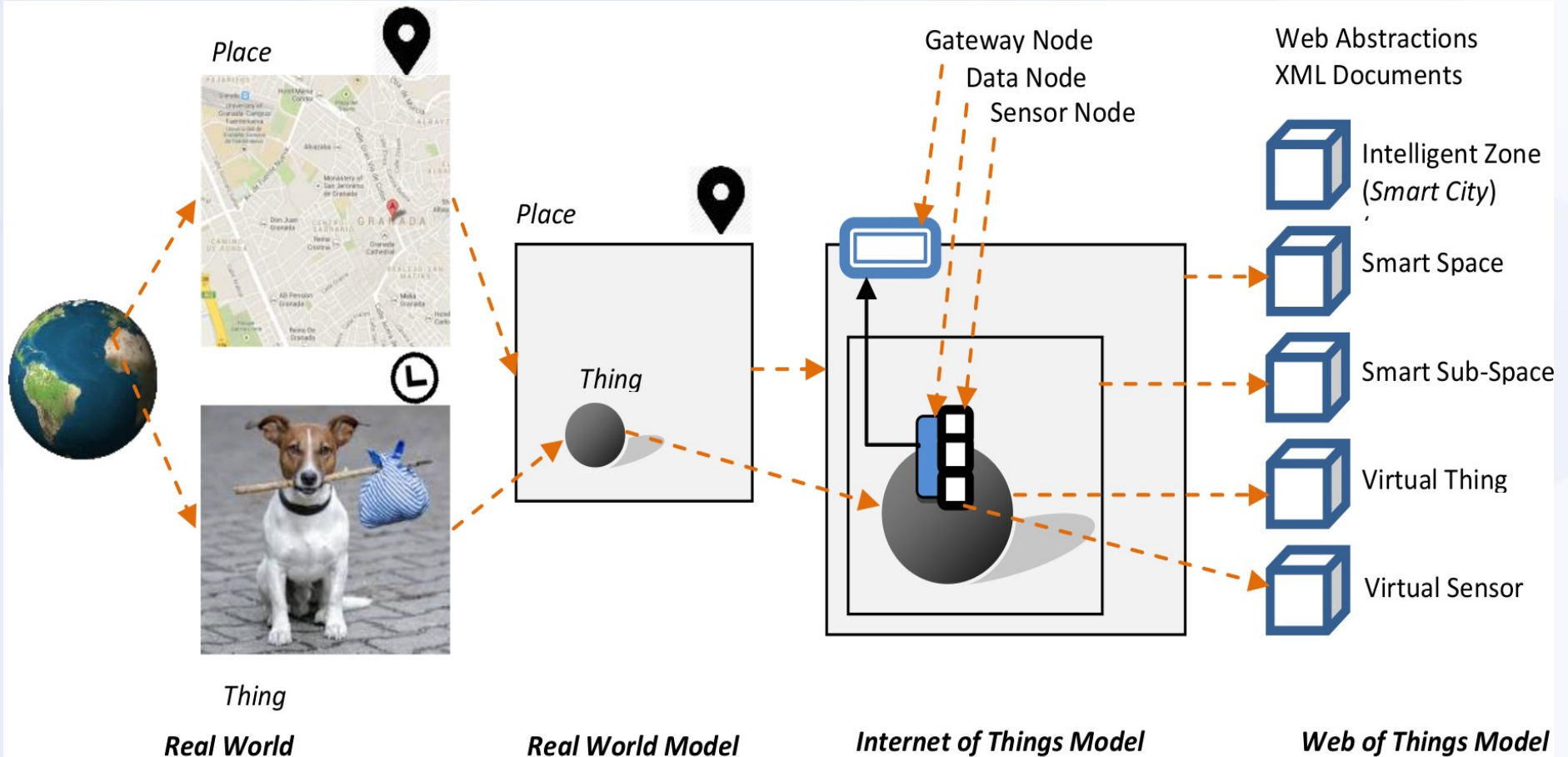
- **Virtual Things**: Web representation of real things [(un)tangible].

  Not only information from virtual sensors but also any other information or service from the real thing.

- **Smart Spaces**: Web representation of real spaces, places or environments where real things are placed or moving.

  Sub-spaces and federated spaces (Intelligent Zones).

Abstract Model of the WoT

Place

Gateway Node
Data Node
Sensor Node

Web Abstractions
XML Documents

Place

Thing

Intelligent Zone
(*Smart City*)

Smart Space

Smart Sub-Space

Virtual Thing

Virtual Sensor

Thing

Real World

Real World Model

**Internet of Things Model**

Web of Things Model

Abstract Model of the WoT

Structured representation of the WoT

- Each virtual element has associated an XML file and its URI.

    - XML file containing the its description, properties and data (dynamic XML == real time).

    - URI: identifier of the XML document.

    - Published in the Web → indexed and retrieved by search engines.

Abstract Model of the WoT
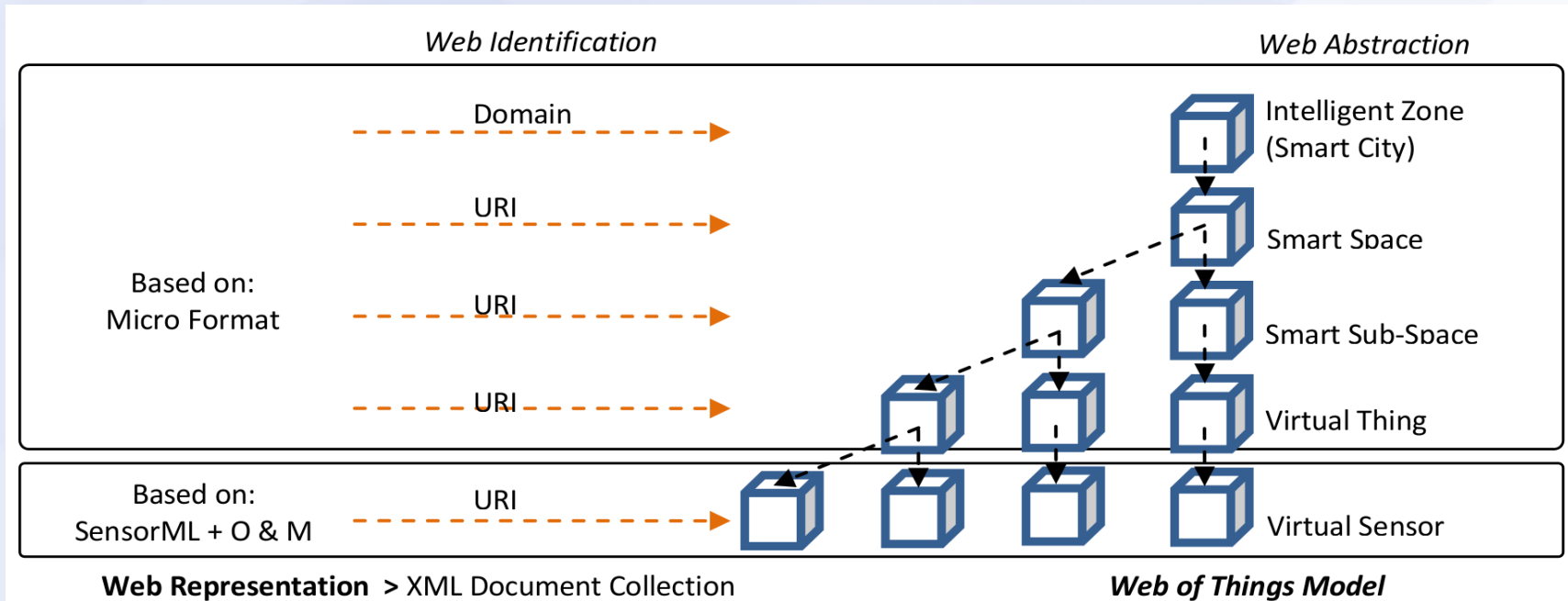
Abstract Model of the WoT

Structured WoT Representation

- Each component is represented by a XML Schema (XSD).

- For **virtual sensors**, tags representing:

    - General information (keywords, identification and classification).

    - Properties characterizing the virtual sensor.

    - Description of sensor capabilities.

    - State.

    - Sample time, measure,...

    - History.

    - Link to the virtual thing attached.

Abstract Model of the WoT

Structured WoT Representation

- For **virtual things**, tags representing:

    - General information (keywords, identification and classification).

    - Properties characterizing the virtual thing + availability.

    - History.

    - Link to the smart space attached.

    - Link to all the attached virtual sensors.

Abstract Model of the WoT

Structured WoT Representation

- For **smart spaces**, tags representing:

    - General information (keywords, identification and classification).

    - Properties characterizing the smart space.

    - History.

    - Link to the possible smart space attached.

    - Link to the possible sub-spaces that contains.

    - Link to the attached virtual things.

Abstract Model of the WoT

Structured WoT Representation

- What kind of **queries** would we like to solve?

  - *Restaurants with a terrace, located in the city center, playing ambient classic music, not crowded.*

  - *Parks with dirt tracks where there are no dogs and runners are slow.*

  - *Number plate and locations for those private cars, close to my position, going to the university campus right now and with, at least, one free seat.*

Outline

1. Abstract Model of the WoT.

2. **Conclusions and Further Research.**

Conclusions

- WoT: New challenge for IR → Dynamism and amount of data.

  – change of locations of things,

  – change of the collection when new sensors or things are included y the WoT, or removed,

  – real time data collected from sensors.

- First step in this adaptation: modeling the WoT.

- Our proposal: a model based on virtual sensors, things and smart spaces, linked among them, publishing info continuously in the Web by means of XML documents.

Conclusions

- Current research state:

  Building an simulator of the proposed WoT model.

- Further research lines:

  To measure the impact of this dynamism in search engines and propose solutions.

Thank you!!