

# An adaptive Complex Event Processing-driven SIoT network formal metamodel\*

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**Abstract**—Information, objects and people are the core innovation actors of human society progress. Their inner relations can be rebounded by the Internet, the Internet of Things (IoT) and social network, respectively. The integration of social networking concepts into the IoT solutions has led to the so called Social Internet of Things (SIoT) paradigm, according to the vision of a future world populated by intelligent objects that permeate the everyday life of human beings.

In this context we propose an adaptive formal model for a SIoT network driven by a Semantic Complex Event Processing where “things” are capable of establishing social relationships with respect to their owners, according to the monitoring of sensors value, changed behavioral properties, state and/or context variables and user’s preference.

## I. INTRODUCTION

The huge amount of data flowing through Internet of Things (IoT) networks poses a big issue related to the discovery of objects that are able to provide data by executing specific services. The Smart Home is one of the focus area of the new IoT ecosystem era, both the centrality of the house in the life of every individual, with huge potential in terms of objects and distribution services, for both the bond with some of the leading sectors. Now, must be viewed as a dream where “things”, particularly all home machines and more, are intelligible, locatable, addressable or controllable through the Internet.

When Social Networks meet the Internet of Things, the resulting paradigm is called *Social Internet of Things (SIoT)*. The idea to use social networking concepts in the IoT solutions to allow objects to autonomously establish social relationships is gaining popularity in the last years. [2]

The IoT-generated data come in big amounts, are variable in terms of structure, often do not arrive at real-time, and could undermine the purpose of the services offered. Traditional DBMSs, which need to store and index data before processing it, can hardly fulfill the concepts of timeliness and flow processing coming from such domains. Recently, new approach known as Complex Event Processing (CEP) emerged. CEP allows for efficient correlation, aggregation,

and pattern matching of multiple distributed data streams on the fly [3].

In this paper we propose a Semantic CEP-driven SIoT network metamodel to communicate and interact with smart things that humans use in daily life taking into account relevant aspects adaptation: context, users habits and profiles, information detached from external sources and sensors.

The proposed approach allows modeling and reasoning on complex adaptive architecture according to changed behavioural properties or context variables [4].

## II. PROPOSED FORMAL METAMODEL

In this section we describe our proposed formal metamodel that is made up of an inference level where incoming flows of information have to be processed to timely produce new flows as outputs (Sinks). The entities that create the information flows are called Information Sources. Sources and Sinks are interpreted in the sense of the CEP metamodel definition [3]. The events to be performed are derived from high-level properties, conditions about the state, context and sensor data.

*Definition 1 (Event):* Event is a thing happening in a definite time and environment, that some social entity take part in and showing some action features. An event  $e$  can be defined as the following tuple:

$$e ::= (A, A_c, T, E, A_{ss}, L_e),$$

where  $A$  is an agent,  $A_c$  is an action,  $T$  is a time,  $E$  is an environment,  $A_{ss}$  an assertions and  $L_e$  a language expression.

Intuitively, social entity (smart object or human agent) actions are the observations of sensor data, the publishing of a post and so on.

*Definition 2 (SIoTN Ontology):*

Social Internet of Things Network (SIoTN) Ontology formally specifies the shared and event classes. It can be defined as a quadruple formally.

$$SIoTNOntology = \langle Ec, Ei, R, e \rangle$$

The elements in quadruples include the set of Entity classes, the set of Entity instances, the relationship  $R = \langle Ec_i, Ei_j \rangle$  ( $R$  includes parent-child, causal, follow and exclusion relations) and the correspondent event, respectively.

\*An extended version of this paper has been published at [1].

