

The Internet of Things—A survey of topics and trends

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Abstract The Internet of Things is a paradigm where everyday objects can be equipped with identifying, sensing, networking and processing capabilities that will allow them to communicate with one another and with other devices and services over the Internet to accomplish some objective. Ultimately, IoT devices will be ubiquitous, context-aware and will enable ambient intelligence. This article reports on the current state of research on the Internet of Things by examining the literature, identifying current trends, describing challenges that threaten IoT diffusion, presenting open research questions and future directions and compiling a comprehensive reference list to assist researchers.

Keywords Internet of Things · IoT · Survey · Machine to machine · Ubiquitous · Ambient · Context-aware

1 Introduction

Over the last couple of decades, the Internet has been in a constant state of evolution. The early days of the Internet were characterized by the World Wide Web, a network of linked HTML documents that resided on top of the Internet architecture. This network of static HTML pages gradually evolved in

to what is referred to as Web 2.0, in which two-way communication became common, which enabled user participation, collaboration and interaction. Web 2.0 technologies include social networking services, blogs, and wikis—technologies that have become essential to modern social interaction as well as for global business. While Web 2.0 currently dominates the Internet, scholars have been working towards another goal, commonly referred to as the Semantic Web and sometimes referred to as Web 3.0. The goal of the Semantic Web is to mark up web content in a way that makes it understandable by machines, allowing machines and search engines to behave more intelligently. Marking up web content in standardized formats would allow machines to process and share data on their own, without the need for human mediation. Alongside developments in the Internet technologies, technologies in Sensor Networks and Near Field Communication using RFID tags have also been evolving. Convergence of these two technologies, i.e. the Internet and Sensor Networks, is leading to new possibilities and visions. The possibility of a framework that would allow direct machine-to-machine communication over the Internet has led researchers to envision the benefits of bringing more machines online and allowing them to participate in the web as a vast network of autonomous, self-organizing devices. This vision has produced a paradigm being referred to as the Internet of Things (IoT).

While there is no universal definition for the IoT, the core concept is that everyday objects can be equipped with identifying, sensing, networking and processing capabilities that will allow them to communicate with one another and with other devices and services over the Internet to achieve some useful objective. The core concepts underlying the IoT are not new. For years, technologies such as RFID and sensor networks have been used in industrial and manufacturing contexts for tracking large-ticket items such as cranes and livestock. The idea of direct machine-to-

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