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Facilitating the creation of IoT applications through conditional observations in CoAP

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Abstract

With the advent of IPv6, the world is getting ready to incorporate smart objects to the current Internet to realize the idea of Internet of Things. The biggest challenge faced is the resource constraint of the smart objects to directly utilize the existing standard protocols and applications. A number of initiatives are currently witnessed to resolve this situation. One of such initiatives is the introduction of Constrained Application Protocol. This protocol is developed to fit in the resource-constrained smart object with the ability to easily translate to the prominent representational state transfer implementation, hypertext transfer protocol (and vice versa). The protocol has several optional extensions, one of them being, resource observation. With resource observation, a client may ask a server to be notified every state change of the resource. However, in many applications, all state changes are not significant enough for the clients. Therefore, the client will have to decide whether to use a value sent by a server or not. This results in wastage of the already constrained resources (bandwidth, processing power,…). In this paper, we introduced an alternative to the normal resource observation function, named Conditional Observation, where clients tell the servers the criteria for notification. We evaluated the power consumption and number of packets transmitted between clients and servers by using different network sizes and number of servers. In all cases, we found out that the existing observe option results in excessive number of packets (most of them unimportant for the client) and higher power consumption. We also made an extensive theoretical evaluation of the two approaches which give consistent result with the results we got from experimentation.

Keywords: IoT; Conditional observation; Resource observation; REST; CoAP

1 Introduction

Remarkable advances in microelectromechanical systems (MEMS) have led to the creation of tiny but crucial embedded devices such as sensors and actuators. The wireless communication capability of these devices turns them into smart objects that can interact with the virtual world. Coupled with the explosive expansion of wireless and mobile technologies, there are very good reasons to consider these objects as corner stones of the future internet rather than mere add-ons to the current communication networks. The resulting Internet is now commonly referred to as the internet of things (IoT). However, the severe limitations of these smart objects in terms of memory, processing capacity, power, and bandwidth pose great challenges in realizing this. A typical smart object may have a few kilobytes of memory (random access memory (RAM) and read-only memory (ROM)), slow microcontrollers, and limited bandwidth (around 250 kbps). On top of this, most of the smart objects are battery operated and have limited lifetime. The protocols and applications that are widely used in the current internet are too heavy for such constrained devices to be applied directly. Several initiatives exist to alleviate these prevailing problems by proposing new lightweight protocols suitable for constrained devices and networks. The internet engineering task force (IETF) is the pioneer in producing standards and protocols that fit the strict requirements of such constrained environments by establishing working groups that address different aspects of the requirements of the constrained objects and networks.

The IPv6 for low power and lossy wireless personal area network (6LoWPAN) working group of IETF has produced standards that enable IPv6 to be used in the most constrained devices [1]. Montenegro et al. [2] introduce the 6LoWPAN adaptation layer which resides

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