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Effective Integration of Reliable Routing Mechanism and Energy Efficient Node Placement Technique for Low Power IoT Networks

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ABSTRACT

Internet of Things (IoT) is the emerging technology that links physical devices (sensor devices) with cyber systems and allows global sharing of information. In IoT applications, devices are operated by battery power and low power radio links, which are constrained by energy. In this paper, node placement technique and routing mechanism are effectively integrated in single network architecture to prolong the lifetime of IoT network. In proposed network architecture, sensor node and relay node are deployed, sensor nodes are responsible for collecting the environmental data and relay nodes are responsible for data aggregation and path computation. In node placement technique, densities of relay nodes are varied based on traffic area, to prevent energy hole problem. In routing technique, energy efficient and reliable path computation is done to reduce number of re transmissions. To adopt IoT scenario, we included IEEE 802.15.4 PHY/MAC radio and IPv6 packet structure in proposed network architecture. Proposed work result shows, proposed architecture prolongs network lifetime.

KEYWORDS

Energy Efficiency, Internet of Things, Network Architecture, Node Placement, Routing

1. INTRODUCTION

In IoT applications, the word “smart” is included everywhere such as, smart city, smart home, smart market, smart health, etc. Because the word “smart” refers the availability smart devices used in IoT applications, which works autonomously with its basic capabilities. IoT devices works smart but they are limited by energy (due to battery sourced devices). Thus, improving reliability with better network life time is the major challenge in IoT networks. In environmental monitoring applications, sensor devices are deployed in remote area (harsh environment). In commercial applications sensor devices are kept for constant observation. When nodes drainout its power in short span of time, it is difficult to replace the battery frequently, which severely affects the consumer as well as service provider (ITU, 2005; Lee et al., 2012; Boukerche, 2008). Hence energy is considered as the important resource in low power (energy constrained) wireless networks.

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1.1. IoT Challenges

IoT technology is used by various applications such as, health care industries, home automation, location accuracy, weather monitoring, etc. Figure 1 elaborates the features of IoT WFRM (IOTWF), which is the generic architectural model that describes the features of IoT. In Figure 1, first three layers are handled by edge devices (sensor devices) that collects and processes the event based data (real time data), last three layers are handled by higher end devices (server, PCs, etc.) that collects and processes query based data (non real time data), middle layer is responsible for data storage (IOTWF).

In Figure 1 IoT challenges are included. This says energy efficiency and reliability are the major requirement for lower layers that handles low power devices. Hence energy efficiency and reliability are considered as our major objectives in proposed network design.

1.2. Energy Limitations in IoT Network

IoT network is said as "energy constrained network or low power network" due to the usage of battery sourced device and unstable radio links in IoT network (Lee et al., 2012). Internet of things is not

Figure 1. IoT World Form Reference Model

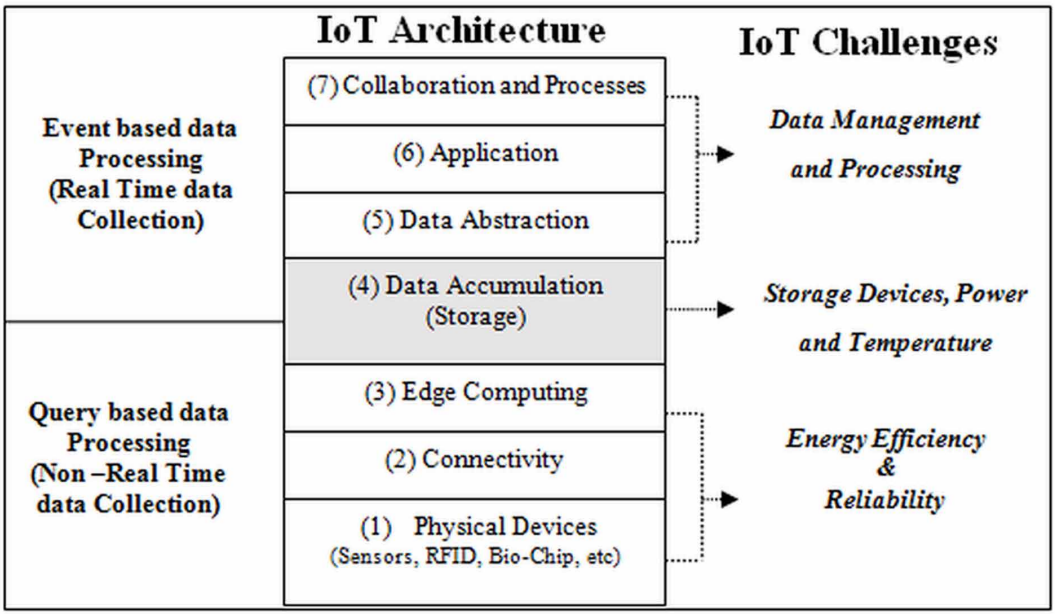

Table 1. Features of IoT and regular Internet

Features	Internet of Things	Internet
Nodes used	Sensors	Main power devices
Links	Stable links	Unstable radio links
Nature of Device	Energy Limited devices	Devices are not limited by energy
Address	IPv6	IPv6
Routing	Routing is aware of applications	Routing is not aware of applications
Power Source	Limited Source (Battery)	PLC