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A Secure and Efficient Real Time Service Provisioning Using Internet of Things (IoT)

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Abstract:
The Internet of Things revolution is upon us, and by the year 2020, there will be over 50 billion connected things in the world. With the world's population increasing and resources becoming more precious, this interconnection promises to supply real-world data to drive higher efficiencies and to streamline business practices. Internet of Things (IoT) has attracted much research attention from the academia and industry and is believed to enable the Internet to reach out into the physical world of Internet-connected devices. The IoT, as an emerging concept alongside this weave of technological advancements, refers to the connection of various physical objects in real life through wireless tags and sensors over network protocols similar to those used in the Internet. Thus, smart objects can become part of the existing Internet. Built on the IoT, the physical world will become an intelligent world with smart physical objects tagged wirelessly and many fiction stories and scenarios become true.

Keywords: IoT, Wireless Sensor networks(WSN), radio-frequency identification, QoS.

I. INTRODUCTION

The Internet of Things revolution is upon us, and by the year 2020, there will be over 50 billion connected things in the world. With the world's population increasing and resources becoming more precious, this interconnection promises to supply real-world data to drive higher efficiencies and to streamline business practices. Internet of Things (IoT) has attracted much research attention from the academia and industry and is believed to enable the Internet to reach out into the physical world of Internet-connected devices [15], [16]. The IoT, as an emerging concept alongside this weave of technological advancements, refers to the connection of various physical objects in real life through wireless tags and sensors over network protocols similar to those used in the Internet [17]. Thus, smart objects can become part of the existing Internet. Built on the IoT, the physical world will become an intelligent world with smart physical objects tagged wirelessly and many fiction stories and scenarios become true [18], [19]. The recent development of Google Glass and Apple's iWatch rightly catch on this new technology trend. In the future internet concept, the existing Internet will become the backbone network where major data and information will be transferred and most objects in real life will be linked together pervasively [19]. Extended from the IoT, the concepts of smart home, smart community, smart city [19], and even the smart planet promoted by IBM suddenly become foreseeable in the near future [21]. The advances in wireless networks and data processing, such as cloud computing, wireless sensor networks, and wireless communications significantly enhance the traditional Internet into an intelligent IoT, capable of interconnecting diverse "things" into the physical world [22], [23]. In reality, the inexpensive intelligent sensor networks, radio-frequency identification (RFID) tags, and wireless devices are widely used to gather or collect data, making it possible to exchange and process information among objects [24]–[25]. This further leads to changes in the operations of many existing business information systems, such as enterprise systems and decision support systems [6]. In the foreseeable future, business processes and business model will also be changed and adapt to the IoT paradigm accordingly [17], [26], [27].

There exist several challenges in current service oriented IoT [1], [2], [3].

- The IoT should be able to provide users with services for sensing information of interest, which might involve some operations of interconnected IoT edge devices. This imposes a challenge on efficient data propagation and reliable operation.
- The IoT should be able to provide distributed CDM process for service detection, classification, composition, and data processing in a timely fashion.
- Services should be able to cooperatively work to complete complicated tasks. Information consensus between services should guarantee that each service share information over the IoT that is critical to the coordination task.
- Selection of Message transmission protocols The messaging techniques are invented for IoT device communication of different requirements and use scenarios. Some methods are suitable for handling lightweight messaging under varying levels of latency due to bandwidth constraints or unreliable connections, such as MQTT, some are suitable for resource-limited internet devices like WSN nodes in IoT applications, such as CoAP. Some others focus on data format, message orientation, queuing, routing, reliability, and security like AMQP. There are techniques strong in the capability to support service discovery across network domains, such as XMPP, which are well-suited for cloud computing where virtual

machines and networks would present obstacles to alternative service discovery and presence-based solutions. In addition, some aim to simplify complex network programming for big data applications including financial trading, air-traffic control, smart grid management, etc. like DDS. There are also techniques providing easy connection, presence, and flexible development of application level functions like ZMQ. Since each solution has its strengths and particularly suited fields of applications, the selection of the alternative techniques should be based on the requirements of the practical situations of the industrial applications.

Characteristic features of WSNs

A WSN can generally be described as a network of nodes that cooperatively sense and control the environment, enabling interaction between persons or computers and the surrounding environment [4]. WSNs nowadays usually include sensor nodes, actuator nodes, gateways and clients. A large number of sensor nodes deployed randomly inside of or near the monitoring area (sensor field), form networks through self-organization. Sensor nodes monitor the collected data to transmit along to other sensor nodes by hopping. During the process of transmission, monitored data may be handled by multiple nodes to get to gateway node after multihop routing, and finally reach the management node through the internet or satellite. It is the user who configures and manages the WSN with the management node; publish monitoring missions and collection of the monitored data. As related technologies mature, the cost of WSN equipment has dropped dramatically, and their applications are gradually expanding from the military areas to industrial and commercial fields.

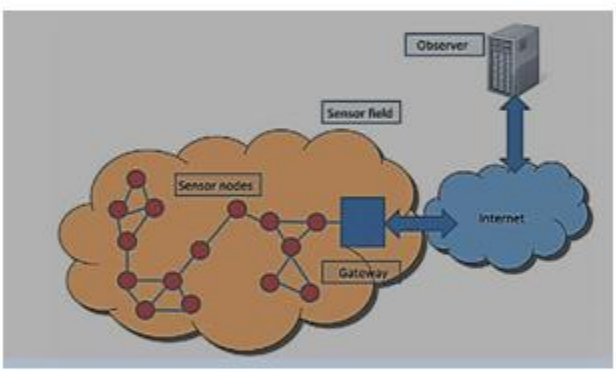

Figure.1. Internet of Thing based wireless sensor network

Challenges for wireless sensor network in an Internet of Things

In common wsn without internet access, the sensor nodes may already play an important role to ensure data confidentiality, integrity, availability and authentication depending on the application sensitivity. However, the current identified attack scenarios require a physical presence near the targeted WSN in order to jam, capture or introduce malicious nodes for example. By opening WSNs to Internet, such location proximity will no more be required and attackers would be able to threaten WSNs from everywhere. WSNs may have to address new threats like malware introduced by the Internet connection and evolving with the attacker creativity. Most current WSNs connected to the Internet are protected by a central and unique powerful gateway ensuring efficient protection. However, a direct reuse of such existing security mechanisms is made impossible by the scarce energy, memory, and computational resources of the sensor nodes. Many services on the Internet make use of cryptography with large key lengths such as RSA-1024, which are not currently supported by sensor nodes. Consequently, innovative security mechanisms must be developed according to the resource constraints to protect WSNs from novel attacks originating from the Internet. Improving the QoS, such collaborative work is consequently promising for mechanisms requiring high amount of resources like security mechanisms. Nevertheless, the existing approaches ensuring QoS in the Internet are not applicable in WSNs, as sudden changes in the link characteristics can lead to significant reconfiguration of the WSN topology. It is therefore mandatory to find novel approaches towards ensuring delay and loss guarantees. In addition to security and QoS management, sensor nodes can also be required to control the WSN configuration, which includes covering different tasks, such as address administration to ensure scalable network constructions and ensuring self-healing capabilities by detecting and eliminating faulty nodes or managing their own configuration. However, self-configuration of participating nodes is not a common feature in the Internet. Instead, the user is expected to install applications and recover the system from crashes. In contrast, the unattended operation of autonomous sensor nodes requires novel means of network configuration and management.

II. LITERATURE SURVEY

2012

Paper 1

In the internet of things (IoT) environment, the dynamic service is the use of resource allocation, service composition and service methods such as internal adjustment of the system to achieve an important mechanism for QoS management, in the device layer; dynamic service provides flexible self-adaptive applications for RFID. However, smart devices such as mobile reader of resources are scarce in the internet of things, in addition, the wireless sensor devices form more intelligent environment interface, so the more interface access to fewer resources, which greatly reduce the network objects together intelligence, it is necessary to call the interface of IoT dynamic allocation of resources, composition, adjustment, thereby enhancing the IoT network and intelligent applications. In this work, in the complex networked environment a self-adaptive dynamic service was introduced, a novel adaptive method proposed, the method for a control decision-making system to reduce the consumption of devices resources, and the effect measure adjustment based QoS dynamic service.

REF: J. Liu, "Adaptive service framework based on grey decision-making in the Internet of things," in Proc. 6th Int. Conf. Wireless Commun. Netw. Mobile Comput., pp 1–4,

2012.

Paper 2

In wireless sensor networks, distributed consensus algorithms can be employed for distributed detection. Each sensor node can compute its log-likelihood ratio (LLR) from local observations for a target event and using an iterative distributed algorithm, the average of sensors' LLRs can be available to all the sensor nodes. While the average of sensors' LLRs allows each sensor node to make a final decision as a decision statistic for an overall detection problem with all sensors' LLRs, it may be desirable if all sensors' LLRs or local observations, which form a full information vector and denoted by x, could be available to each sensor for other purposes more than the detection of a target event In this paper, They showed that each sensor can have not only the average of local observations, but also full information vector, x, (or its estimate) using a well-known iterative distributed algorithm. Then they extended their approach to estimate x when x is sparse based on the notion of compressed sensing.

REF:J. Choi, S. Li, X. Wang, and J. Ha, "A general distributed consensus algorithm for wireless sensor networks," Wireless Adv. (WiAd), pp. 16–21, 2012.

2013

Paper 1

The emerging compressed sensing (CS) theory can significantly reduce the number of sampling points that directly corresponds to the volume of data collected, which means that part of the redundant data is never acquired. It makes it possible to create standalone and net-centric applications with fewer resources required in Internet of Things (IoT). CS-based signal and information acquisition/compression paradigm combines the non-linear reconstruction algorithm and random sampling on a sparse basis that provides a promising approach to compress signal and data in information systems. Here they investigate how CS can provide new insights into data sampling and acquisition in wireless sensor networks and IoT. First, they briefly introduced the CS theory with respect to the sampling and transmission coordination during the network lifetime through providing a compressed sampling process with low computation costs. Then, a CS-based framework is proposed for IoT, in which the end nodes measure, transmit, and store the sampled data in the framework. Then, an efficient cluster-sparse reconstruction algorithm is proposed for in-net-work compression aiming at more accurate data reconstruction and lower energy efficiency. Performance is evaluated with respect to network size using datasets acquired by a real-life deployment.

Paper 2

The emerging compressed sensing (CS) holds considerable promise for continuously acquiring biomedical signals in body sensor networks (BSNs), which enables nodes to employ a much lower sampling rate than Nyquist while still able to accurately reconstruct signals. CS-based BSNs are expected to significantly enhance the quality of healthcare and improve the ability of prevention, early diagnosis, and treatment of chronic diseases. However, existing BSNs are still unable to support long-term monitoring in healthcare, as well as providing an energy-efficient low communication burden and inexpensive scheme. Capitalizing on the sparsity of biomedical signals in transfer domains, this paper develops a continuous biomedical signal acquisition system, which explores a sparsification model to find the sparse representation of biomedical signals. The sparsified measurements of signals are wirelessly transmitted to a fusion center through BSNs. Meanwhile, a weighted group sparse reconstruction algorithm is proposed to accurately reconstruct the signals at the fusion center. Simulation results show that, on random sampling over BSN, their proposed group sparse algorithm shows good efficiency, strong stability, and robustness.

REF:S. Li, L. Xu, and X. Wang, "A continuous biomedical signal acquisition system based on compressed sensing in body sensor networks," IEEE Trans. Ind. Informat., vol. 9, no. 3, pp. 1764–1772,

2013.

Paper 3

The Internet of Things (IoT) is expected to substantially support sustainable development of future smart cities. This article identifies the main issues that may prevent IoT from playing this crucial role, such as the heterogeneity among connected objects and the unreliable nature of associated services. To solve these issues, a cognitive management framework for IoT is proposed, in which dynamically changing real-world objects are represented in a virtualized environment, and where cognition and proximity are used to select the most relevant objects for the purpose of an application in an intelligent and autonomic way. Part of the framework is instantiated in terms of building blocks and demonstrated through a smart city scenario that horizontally spans several application domains. This preliminary proof of concept reveals the high potential that self-reconfigurable IoT can achieve in the context of smart cities.

REF:G. Poulios et al., "Enabling smart cities through a cognitive management framework for the internet of things," IEEE Commun. Mag., vol. 51, no. 6,

2013.

Paper 4

The Internet of Things is going to create a seamless integration of physical objects and information network. Ubiquitous sensors are deployed to support the vision of IoT. In this work, based on an agricultural IoT platform, they proposed a clustering algorithm to cluster multi-type sensor data streams to provide future prediction for batches data of a certain farm product.

REF:Mingze Wu; Yitong Wang; Zhicheng Liao, "A New Clustering Algorithm for Sensor Data Streams in an Agricultural IoT," in High Performance Computing and Communications &IEEE International Conference on , vol. 13, no15., pp.2373-2378, Nov. 2013.

2014

Paper 1

Many industrial enterprises acquire disparate systems and applications over the years. The need to integrate these different systems and applications is often prominent for satisfying business requirements and needs. In an effort to help researchers in industrial informatics understand the state-of-the-art of the enterprise application integration, they examined the architectures and technologies for integrating distributed enterprise applications, illustrated their strengths and weaknesses, and identified research trends and opportunities in this increasingly important area.

REF: W. He and L. Xu, "Integration of distributed enterprise applications: A survey," IEEE Trans. Ind. Informat., vol. 10, no. 1, pp. 35–42,

2014.

Paper 2

In real-life applications of wireless sensor networks (WSNs), optimization of the network operation is required to extend its lifetime. A framework was proposed that enables practical development of centralized cluster-based protocols supported by optimization methods for the WSNs. Based on this framework, a protocol using harmony search algorithm (HSA), a music-based meta-heuristic optimization method, is designed and implemented in real time for the WSNs. It is expected to minimize the intra-cluster distances between the cluster members and their cluster heads (CHs) and optimize the energy distribution of the WSNs. The study of HSA cluster-based protocol is carried out in a real case where the WSNs equipped with the proposed protocol are deployed in an indoor environment to monitor the ambient temperature for fire detection. A comparison is made with the well-known cluster-based protocols developed for WSNs such as low-energy adaptive clustering hierarchy-centralized (LEACH-C) and a cluster-based protocol using Fuzzy C-Means (FCM) clustering algorithm. Experimental results demonstrate that the proposed protocol using HSA can be realized in centralized cluster-based WSNs for safety and surveillance applications in building environments. From the obtained experimental test results, it can be seen that the WSNs lifetime has been extended using the proposed HSA protocol in comparison with that of LEACH-C and FCM.

REF:D. C. Hoang, P. Yadav, R. Kumar, and S. K. Panda, “Real-time implementation of a harmony search algorithm-based clustering protocol for energy efficient wireless sensor networks,” IEEE Trans. Ind. Informat, vol. 10, no. 1, pp. 774–783,

2014.
Paper 3
In modern commerce, both frequent changes of custom demands and the specialization of the business process require the capacity of modeling business processes for enterprises effectively and efficiently. Traditional methods for improving business process modeling, such as workflow mining and process retrieval, still require much manual work. To address this, based on the structure of a business process, a method called workflow recommendation technique is proposed in this paper to provide process designers with support for automatically constructing the new business process that is under consideration. In this work, with the help of the minimum depth-first search (DFS) codes of business process graphs, we propose an efficient method for calculating the distance between process fragments and select candidate node sets for recommendation purpose. In addition, a recommendation system for improving the modeling efficiency and accuracy was implemented and its implementation details are discussed. At last, based on both synthetic and real-world datasets, we have conducted experiments to compare the proposed method with other methods and the experiment results proved its effectiveness for practical applications.

REF: Y. Li, B. Cao, L. Xu, and J. Yin, “An efficient recommendation method for improving business process modeling,” IEEE Trans. Ind. Informat., vol. 10, no. 1, pp. 502–513, 2014.

2015
Paper 1
The concept of sensing-as-a-service is proposed to enable a unified way of accessing and controlling sensing devices for many Internet of Things based applications. Existing techniques for Web service computing are not sufficient for this class of services that are exposed by resource-constrained devices. The vast number of distributed and redundantly deployed sensors necessitates specialized techniques for their discovery and ranking. Current research in this line mostly focuses on discovery, e.g., designing efficient searching methods by exploiting the geographical properties of sensing devices. The problem of ranking, which aims to prioritize semantically equivalent sensor services returned by the discovery process, has not been adequately studied. Existing methods mostly leverage the information directly associated with sensor services, such as detailed service descriptions or quality of service information. However, assuming the availability of such information for sensor services is often unrealistic. Here they proposed a ranking strategy by estimating the cost of accessing sensor services. The computation is based on properties of the sensor nodes as well as the relevant contextual information extracted from the service access process. The evaluation results demonstrate not only the superior performance of their method in terms of ranking quality measure, but also the potential for preserving the energy of the sensor nodes.

REF:Wei Wang a, Fang Yao b, Suparna De b, Klaus Moessner b, Zhili Sun b, “A ranking method for sensor services based on estimation of service access cost,” 2015.

2016
Paper 1
An innovative iterative process is proposed to acquire the dynamic process of multichannel slotted ALOHA(S-ALOHA). It reveals the direct relation between the number of contending devices that perform their j-th random access (RA)attempt at the i-th RA slot and the newly arrived devices before the i-th RA slot. These results allow engineers to analytically derive the probability density function of RA delay of multichannel S-ALOHA, as well as its cumulative density function and average value. Under stable RA attempts assumption, simplified form of the above analysis is given, with which we prove the number of preamble transmissions follows truncated geometric distribution. Taking the two traffic models for machine type communications as examples, numerical results are presented to verify the effectiveness of the proposed iterative process and the accuracy of its simplified form, and illustrate the delay characteristics of simplified LTE random access channel.

REF: -X. Jian, Y. Liu, Y. Wei, X. Zeng and X. Tan, "Random Access Delay Distribution of Multichannel Slotted ALOHA With Its Applications for Machine Type Communications," in IEEE Internet of Things Journal, vol. 4, no. 1, pp. 21-28, Feb.

2017.
Paper 2:
Here they presented Lysis, which is a cloud-based platform for the deployment of Internet of Things applications. The major features that have been followed in its design are the following: each object is an autonomous social agent; the PaaS (Platform as a Service) model is fully exploited; re-usability at different layers is considered; the data is under control of the users. The first feature has been introduced by adopting the Social IoT concept, according to which objects are capable of establishing social relationships in an autonomous way with respect to their

owners with the benefits of improving the network scalability and information discovery efficiency. The major components of PaaS services are used for an easy management and development of applications by both users and programmers. The re-usability allows the programmers to generate templates of objects and services available to the whole Lysis community. The data generated by the devices is stored at the objects owners cloud spaces. They also presented a use-case that illustrates the implementation choices and the use of the Lysis features.

REF: R. Girau, S. Martis and L. Atzori, "Lysis: A Platform for IoT Distributed Applications Over Socially Connected Objects," in IEEE Internet of Things Journal, vol. 4, no. 1, pp. 40-51, Dec. 2016.

III. OBJECTIVES

The objective of research work is to present a secure and efficient service provisioning using IOT.

- Firstly to develop energy efficient clustered based routing protocol for WSN.
- To integrate WSN with IoT for Service provisioning to remote clients.
- To adopt an efficient message transmission protocol such MQTT and ZFQ.
- To address the security issue of WSN due to integration of IoT.
- To develop a Transport layer security model considering the limited battery capacity of wireless sensor network.
- To develop a cluster based decision making mechanism for providing efficient service to end client.
- To adopt an efficient MAC protocol that address both security and energy efficiency of sensor device considering multi-channel environment.
- To achieve better throughput and improve the energy efficiency (increase lifetime) of wireless sensor network.

IV. METHODOLOGY

We first propose a three-layer service provisioning framework for service-oriented IoT deployments, which is able to represent, discover, detect, and compose services at edge nodes. The proposed decision making method for service composition enables services to make decisions based on application layer requirements. Subsequently, a distributed consensus algorithm is proposed to provide robust decision results when multiple services are involved to reach a global consensus. The network is clustered using a distance-based or energy based static clustering scheme. Each cluster selects one node as local node (cluster head (CH)) which can communicate with its neighbours within the cluster. At time instant, the nodes within a cluster distributively calculate the local consensus and measurements on each node are updated accordingly. By doing this, each CH keeps record of the local consensus calculated within its cluster. Similarly, CHs exchange local consensuses and form a global consensus, with which a global decision can be made. Each cluster contains group of nodes, these nodes cover a network area of approximately and distributively detect environmental emissions (such as co,co_2 etc…) or temperature and pressure data. There are n numbers of clusters able to cover the entire area. Each cluster executes the distributed consensus algorithm to iteratively calculate its local consensus value.

To address the energy efficiency of WSN an efficient transmission protocol such as MQTT or ZFQ will be chosen. To address security due to integration of IoT with WSN a TLS (Transport layer security) based security model will be used to offer an end-to-end secure channel. TLS offer a better security and provide wide area of security protocol over SSL (secure socket layer).

V. POSSIBLE OUTCOMES

We aim at solving the challenges by proposing an efficient distributed consensus algorithm for decision making of varied services at edge nodes in the service-oriented IoT for wireless sensor network which is summarized as follows.

- A service provision methodology is proposed by integrating IoT with wireless sensor network
- An efficient decision making method for service composition is proposed which can effectively select suitable services according to application layer (user) requirements.
- A clustering based distributed algorithm is proposed which can effectively provide robust decision results when multiple services are required to reach a global consensus.
- Information consensus between services should guarantee that each service share information securely over the IoT that is critical to the coordination task.
- An efficient IoT integrated WSN model that achieve better security, throughput and also improve the energy efficiency (increase lifetime) of wireless sensor network.

The proposed method for service composition enables services to make decisions based on application layer (user) requirements. A cluster based efficient distributed consensus algorithm is proposed to provide robust decision results when multiple services are involved to reach a global consensus. The Goal is to provide the service-oriented IoT which is secure, interactive and collaborative for the effective intelligent and global information exchange and resource allocation in dynamic environments.

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