Privacy Preserving for Health Care Services Monitor Cloud Computing

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Abstract:- **This paper presents a privacy preserving for health care services monitor cloud computing . Many works exploit sensor networks to monitor patient's health status and movements to provide health care services to them. It requires sensor data to be fast transmitted and processed so that doctors, hospitals, and other caregivers can access properly via Internet. Most existing health care systems rely on their own data center to store and process sensor data. It brings a elevated cost to maintain the system, yet the performance is not consistent and a limited number of services can be provided. Our infrastructure drives success by improving resources expenditure and increasing their scalability while maintaining more privacy and security necessary in health care. ontology machine can provide cost efficient model for automating hospitals and other health care agencies, organization corresponding data from various sensors professionally disseminating information to clients, support privacy and strong authentication from cloud, reducing IT complexity and at the same time introducing innovative solutions and updates.**

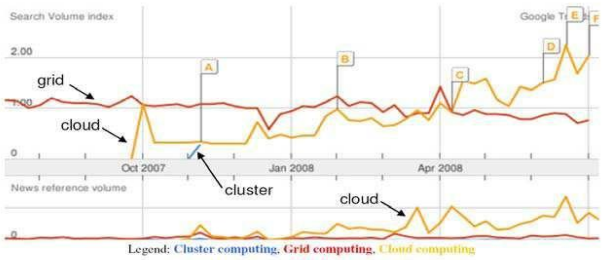
Index Terms: Korea u-Care System for a Solitary Senior Citizen (SSC),More mobility, Securities for WSN, Cloud computing to support u-Life care etc.

I. INTRODUCTION

1.1. What is Cloud Computing?

The Cloud computing, coined in late of 2007, currently emerges as a hot topic due to its ability to offer stretchy dynamic IT infrastructures, QoS guaranteed computing environments and configurable software services. Cloud computing can be defined as follows: "A Cloud is a type of parallel and distributed system consisting of a *collection of interconnected and virtualized computers* that are *dynamically provisioned* and presented as one or more *unified computing resources* based on service-level agreements established through negotiation between the service provider and customers and can be ubiquitously accessed from any connected devices over the internet" Cloud computing started quietly from several seeding technologies such as grid computing, virtualization, SalesForce.com innovative subscription-based business model or Amazon's effort to scale their e-commerce platform. However, it differs from traditional ones in that: (1) it is **massively scalable**, (2) can be encapsulated as an **abstract entity** that delivers different levels of services to customers anywhere, anytime, and (3) it is driven by economies of scale that is the services can be dynamically. Configured (via virtualization or other approaches) and delivered " **on-demand**".

The Web search popularity, as measured by the Google search trends during the last 12 months, for terms "Cluste r computing", "Grid computing", and "Cloud computing" is shown in Figure 1. From the Google trends, it can be observed that cluster computing was a popular term during 1990s, from early 2000 Grid computing become popular, and recently Cloud computing started gaining popularity. Meanwhile, market-research firm IDC expects IT Cloud-services spending to grow from about $16 billion in 2008 to about $42 billion by 2012 as Figure 2 shows. IDC also predicts Cloud computing spending will account for 25 percent of annual IT expenditure growth by 2012 and nearly a third of the growth the following year.



Cloud Computing has many benefits that the public sector and government IT organizations are certain to want to take advantage of. In very brief summary form they are as follows:

Reduced cost, higher gains: Cloud technology is paid incrementally, saving organizations money.

Increased storage: Organizations can store more data than on private computer systems.

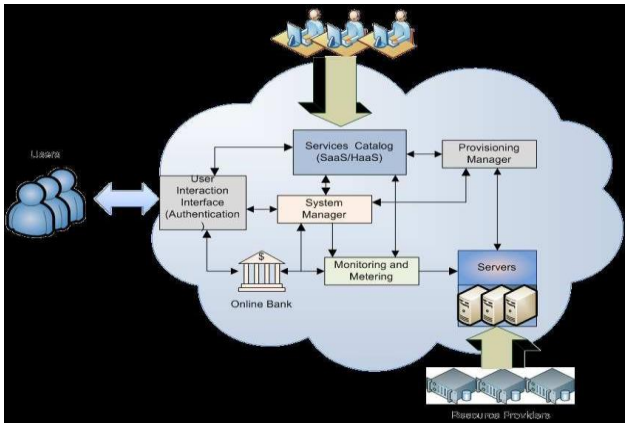
Highly automated: No longer do IT personnel need to worry about keeping software up to date.

Flexibility: Cloud computing offers much more flexibility than past computing methods.

More mobility: Employees can access information wherever they are, rather than having to remain at their desks.

In Cloud computing, customers do not own the infrastructure they are using; they basically rent it, or pay as they use it. One of the major selling points of cloud computing is **lower costs**. Companies will have lower technology-based capital expenditures, which should enable companies to focus their money on delivering the goods and services that they specialize in. There will be more device and location independence, enabling users to access systems no matter where they are located or what kind of device they are using.

The sharing of costs and resources amongst so many users will also allow for efficiencies and cost savings around things like performance, load balancing, and even locations (locating data centers and infrastructure in areas with lower real estate costs, for example). The general architecture of Cloud computing is shown in Figure 3



1.2.Why Cloud Computing in u-Life care?

As the standard of living rises, people are more interested in their health and desire well-being life. Today due to aging of population, rising cost of workforce and high quality treatment, threat of new panepidemies and diseases, the cost of life care or healthcare system is increasing worldwide. According to OECD (Organization of Economic Cooperation and Development) Health data 2008 (shown in Figure 4), total health spending accounted for 15.3% of GDP in the United States in 2006, the highest share in the OECD, and more than six percentage points higher than the average of 8.9% in OECD countries. Korea was 6.4% of GDP to health in 2006. The United States also ranks far ahead of other OECD countries in terms of total health spending per capita, with spending of 6,714 USD (adjusted for purchasing power party (PPP)), more than twice the OECD average of 2,824 USD in 2006. For Korea it was 1480 USD.

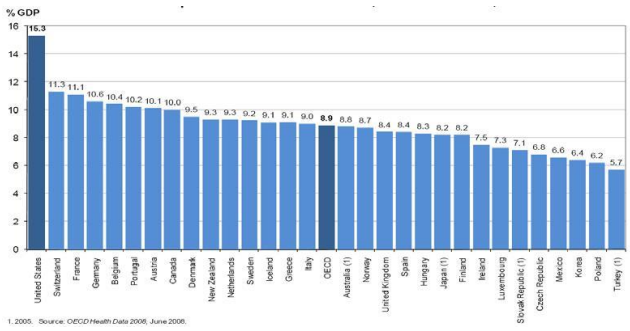


Figure 4-Health expenditure as a share of GDP, OECD countries,2006

1.3. Problems of Existing Cloud computing to support u-Life care

Poor Security and Privacy Support

Data for life care services normally composes of personal information, contextual information (e.g. location, user activity information), medical data (e.g. medical history, drug information, medical health record), etc. Such information is **highly sensitive** and people do not want to disclose them to the public. For example, a patient with HIV positive test may not want to expose his result to the other, even to their family.

Storing data in Cloud leads to **more security and privacy problems than traditional computing** systems such as distributed systems or grid computing systems. Sensitive data processed outside the enterprise brings with it an **inherent level of risk**, because outsourced services bypass the "physical, logical and personnel controls" IT shops exert over in-house programs. More dangers and vulnerabilities may cause disrupts of services, theft of information, loss of privacy, damage of information. On the other hand, because any one can access to Clouds, it brings more chances for malicious users to launch their hostile programs. Hostile people can also give instructions to good programs, or bad guys corrupting or eavesdropping on communications.

No Existing Infrastructure for Integration of WSN to Cloud:

In the past few years, wireless sensor networks (WSNs) have been gaining increasing attention to create decision making capabilities and alert mechanisms, in many Life care application areas including Life care monitoring for patients, environmental monitoring, pollution control, disaster recovery, military surveillance etc. For example, MIT wireless sensor ring as shown in Figure 7can measure heart rate, heart rate variability, Oxygen saturation and blood pressure for the person wearing the ring.

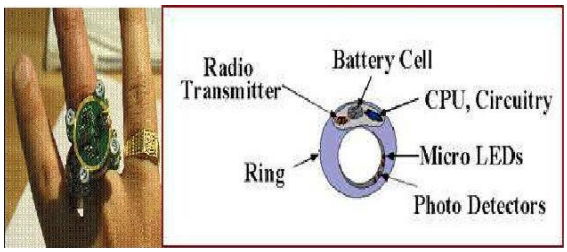


Figure MIT wireless sensor ring and its internal architecture

Collection, analysis (knowledge processing, ontology reasoning etc.), storing and disseminating of these sensor data is a great challenge since sensor nodes constituting a WSN have limited sensing capability, processing power, and communication bandwidth. There is a lack of uniform operations and standard *representation for sensor data.*

1.4. Practical Usage

Our proposed SC3 can be deployed for various u-Life care services, including but not limited to:

Safety monitoring services for home users o SC3's WSN can monitor home user's movement, location by using various sensors. The sensor data is then disseminated to the Clouds, from that SC3's Life care services such as emergenc y caregivers can monitor and has immediate response in case of emergent situations like heart attack.

Information sharing services o With SC3, patient information and data can be accessed globally and resources can be shared by a group of hospitals rather than each hospital having a separate IT infrastructure. Cloud computing would

help hospitals to achieve more efficient use of their hardware and software investments and increase profitability by improving the utilization of resources to the maximum. The SC3 can provide a flexible platform for public-health departments to upload real-time health data in a timely manner to assist state and national health officials in the early identification and tracking of disease outbreaks, environmental-related health problems, and other issues.

Emergency-connection services o SC3 can be deployed to real-time monitor home environments, including gas, fire, thief, etc. Through SC3, an alarm system connects to users, u-119, police department can give an emergency alert in case any emergent situation occurs.

Users can monitor their home, their family health anywhere, any time with any device o SC3 Clouds and WSN enable user to access their home environment, their family's health information with any kind of connected devices over Internets such as cell phone, PDA, laptop, computer.

1. CONTRIBUTION OF THIS STUDY

Our proposed SC3 can help in enhancing capabilities and provides tremendous value by achieving efficient use of software and hardware investments. Our infrastructure drives profitability by improving resources utilization and increasing their scalability while maintaining strong privacy and security essential in u-Life care. SC3 can provide cost efficient model for automating hospitals and other life care agencies, managing real-time data from various sensors, efficiently disseminating information to consumers, support privacy and strong authentication mechanism, reducing IT complexity and at the same time introducing innovative solutions and updates. Our versatile architecture makes it possible to launch web 2.0 applications quickly and also upgrade u-life care IT applications easily as and when required. Our automated secure framework of cloud computing would provide increasingly cheaper and innovative services. Technically, our SC3 infrastructure can contribute in the following ways in u-Life care:

Our architecture helps in eliminating the time and effort needed to roll a healthcare IT application in a life care centre Flexible and swift access to expert opinionIntelligent personal health monitoring system. Synergy of information from individual sensors (better insight into the physiological state and level of activity). Hospitals, silver care centers and life care agencies could share our secured infrastructure with vast number of systems linked together (i.e. secured sensor network to support real time information) for reducing cost and increasing efficiency. This means real-time availability of patient information for doctors, nursing staff and other support services not within the country but possibly across various countries as medical professionals can access patient information from any internet enabled device without installing any software.

The EMR software or the LIS software and information can be located in our Cloud and not on the users or computer. Patient information and data can be accessed globally maintaining proper privacy and security policy and resources can be shared by a group of hospitals or life care agencies rather than each hospital having a separate IT infrastructure.

2.1 Problems of Existing Works

Weak security support

o First, the customer needs to know her data is encrypted so nosey sysadmins at the cloud data center can't troll through the data for interesting tidbits. If the information is encrypted, who controls the encryption/decryption keys, the customer or the cloud vendor?

o Integrity relates to the integrity of the data, in that it changes only in response to duly authorized transactions. So we need standards to ensure that. But they don't exist -- yet.

o The last nagging security issue is availability: Will the data be there whenever you need it? The answer here is an unqualified "maybe." In February of this year, Amazon's S3 went down for almost four hours, wreaking havoc on several companies that use and depend on the S3 Cloud. Amazon ascribed the cause to an unexpected spike in customer transactions.

Weak Privacy Support

Private health data can goes public by mistake: Part of consumers' reticence to sign up for electronic personal health-care records — with or without services "in the clo ud" — has to do with a handful of recent high-profile data breaches. In April, the largest health insurer in the U.S.,

WellPoint disclosed that records on as many as 130,000 of its customers had leaked out and become publicly available over the Internet. User heath data and information uploaded into Clouds are not controlled by user

o Consumer's privacy may get loss in the cloud: Is there a law that keeps your data from being misused? Yes. It is Health Insurance Portability and Accountability Act (HIPAA), but it does not offer health-care service themselves. Right now, disclosure of health information is out of control.

No infrastructure to support WSN integration to Cloud

The existing Cloud based Healthcare system does not integrate wireless sensor network which is necessary to get real time information of patient or environment to monitor and analysis emergency situation. Appropriate information dissemination mechanism is not explicitly addressed in the existing system to deliver sensor data or events to appropriate users of Cloud applications who subscribed. Also there is a need to match published events with subscriptions efficiently. A fast, scalable and efficient event matching algorithm is required for information dissemination system on Sensor-Cloud framework.

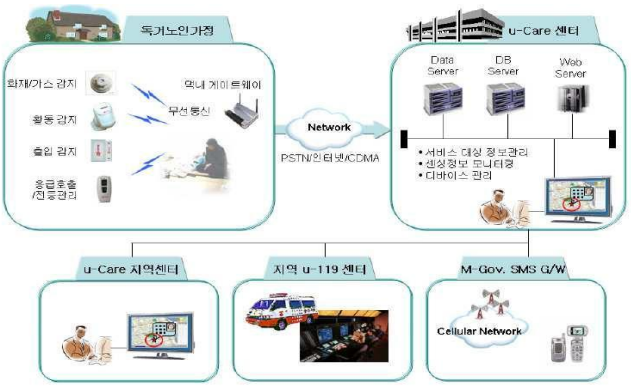
Lack of Dynamic Collaboration between Cloud providers

When the Cloud provider is unable to provide quality of service to the end-user requests, it may result in service– level agreement (SLA) violation and end up costing the provider Existing commercial Cloud services are proprietary in nature. They are owned and operated by individual companies. Each of them has created its own closed network, which is expensive to setup and maintain. Existing Cloud based solution does not consider the dynamic collaboration between Cloud providers which is obvious in near future.

Table 1 shows a comparison of the above existing work.

Existing Works / Features	Korea u-Care System	MS. HealthVault	Google Health	Amazon	VPN-Cube™	UCI
Security	x	Weak	Weak	Weak	Weak	x
Privacy Control	Weak	Weak	Weak	Weak	Weak	x
USN Integration to Cloud	x	x	x	x	x	x
Sensor data dissemination to Cloud	x	x	x	x	x	x
Collaboration btw Clouds	x	x	x	x	v	v

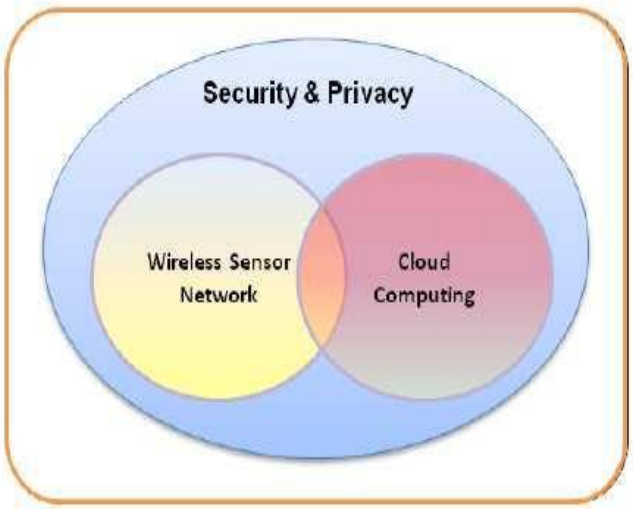
Table 1. A Comparison of Existing Works

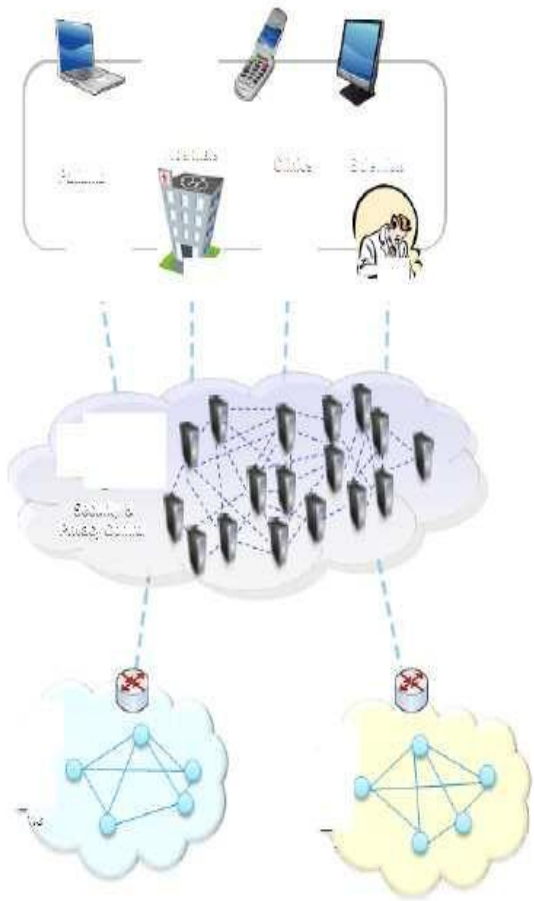


2. SECURED WSN-INTEGRATED CLOUD COMPUTING

3.1 Overview

Our research scope falls into Wireless Sensor Network, Cloud Computing, and Security & Privacy for WSN ad Cloud, as shown in Figure 9. In this section, we present an overview of our proposed solution, Secured WSN-integrated Cloud Computing for u-Life Care, called SC3.





The abstract model is shown in Figure 10. We deploy a secure wireless sensor networks in u-Home environments for a purpose of monitoring and collecting sensor data. To enable u-Lice care applications, we propose an Activity Recognition engine module for u-Life care in WSN layer. This is very important engine to detect and report current user's activities for different purpose of life care services. We provide a security and privacy control of data and applications stored in Clouds. Different Clouds can collaborate with each other by using our dynamic collaboration method. Numerous u-Life care services can access Clouds to provide better and low cost cares for end-users such as secure u-119 service, secure u-Hospital, secured u-Life care research, secure u-Clinic, etc. Figure 11 and Figure 12 shows the functional architecture and proposed architecture of the SC3. SC3 is composed of the following modules: security for WSNs (trust management), security and privacy control for Clouds (authentication and access control), integration mechanism of wireless sensor networks to Clouds, sensor data dissemination mechanism, dynamic collaboration mechanism between different Cloud providers (CLPs), and activity recognition engine for u-Life care.

3.2 Challenges

Low resource sensors Sensor nodes are very limited in term of energy, communication, and computation. Therefore, in order to make the algorithms feasible on sensor devices, they must be lightweight and energy-efficient. A huge number of users, and it increases dramatically As the number of users accessing

Clouds increase dramatically, how to support individual users to declare their privacy preferences accurately. Authentication method must be usable on various devices with wired or wireless-enable connection over the Internet. Besides, appropriate privacy policy implementation is very hard. User must agree to provide his/her sensitive information which is not always possible Data dissemination challenges In case of dissemination of information to mobile clients, the mobility can cause their access brokers to be changed, which can bring problems in dissemination of subscriptions and distribution of matching results. Dynamic collaboration challenges Finding appropriate group strategy to minimize collaboration cost in dynamic collaboration is really a major challenge.

3.3 Desired Components of SC3

In the following sections, we present SC3 in details. As shown in Figure 12, we propose SC3 with the following components: Security and Privacy Control Security for WSN including Trust Management Security and Privacy Control for Clouds including Authentication, Access Control, Privacy Control Integration of WSNs to Clouds. Sensor Data Dissemination Mechanism Cloud Dynamic Collaboration Mechanism Activity Recognition Engine for u-Life care

3. Securities for WSN

4.1 Group-based Trust Management Scheme

4.1.1 Introduction

A WSN is an essential technology for any health-care or life-care systems. Since life-care systems carries sensitive and private data, therefore security must be enforced in robust and reliable manner. Current security solutions of WSNs [5]-[9] are not capable of providing corresponding access control based on judging the quality of a sensor nodes and their services. This can only be achieved by in-cooperation of trust management scheme. The in-cooperation of trust in a security solution also provides other benefits such as: Trust solves the problem of providing reliable routing paths that does not contain any malicious, selfish or faulty node(s). Trust makes the traditional security services more robust and reliable by ensuring that all the communicating nodes are trusted during authentication, authorization or key management phases.

4.1.2 Problems of Existing Approaches

To the best of our knowledge, very few comprehensive trust management schemes (e.g. RFSN [10], ATRM [11] and PLUS [12]) have been proposed for sensor networks. Although, there are some other works available in the literature e.g. [13]-[16] etc., that discuss trust but not in much detail. Within such comprehensive works, only ATRM [7] scheme is specifically developed for the clustered WSNs. Furthermore, existing schemes have some other limitations such as dependence on specific routing scheme, like the PLUS scheme works on the top of the PLUS R routing scheme; dependence on specific platform, like the ATRM scheme requires an agent-based platform; and unrealistic assumptions, like the ATRM assumes that agents are resilient against any security threats, etc. Therefore, these works are not well suited for realistic WSN applications. Thus, a lightweight secure trust management scheme is needed to address these issues.

4.1.3 Proposed Solution

Our proposed Group-based Trust Management Scheme (GTMS) scheme calculates the trust value based on direct or indirect observations. Direct observations represent the number of successful and unsuccessful interactions and indirect observations represent the recommendations of trusted peers about a specific node. Figure 13 shows our Trust Management component in general sensor node architecture.

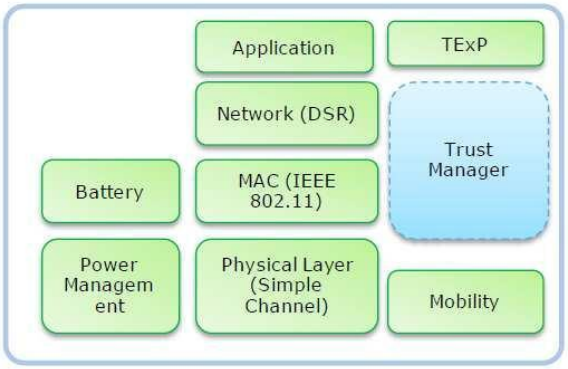


Figure- Sensor Node Architecture with our Trust Management Component

Achieved on reception of the link layer acknowledgment (ACK). IEEE 802.11 is a standard link layer protocol, which keeps packets in its cache until the sender received ACK. whenever receiver node successfully received the packet he will send back ACK to the sender. If sender node did not received ACK during timeout then sender will retransmit that packet.

Second requirement is achieved with the help of using enhanced passive acknowledgments (PACK) by overhearing the transmission of a next hop on the route, since they are within radio range . If the sender node does not overhear the retransmission of the packet within a timeout from its neighboring node or overheard packet is found to be illegally fabricated (by comparing the payload that is attached to the packet) then the sender node will consider that interaction as an unsuccessful one. The proposed trust model works with two topologies. One is the intra-group topology where distributed trust management is used. For the intra-group network, each sensor that is a member of the group, calculates individual trust values for all group members. Once this information reaches the base station, it assigns one of the three possible states to the whole group. On request, the base station will forward the current state of a specific group to the CHs. Our group based trust model works in three phases: 1) Trust calculation at the node level, 2) Trust calculation at the cluster head level, and 3) Trust calculation at the base station level.

4. SCENARIO DESIGN–SC3 SUPPORTSALZHEIMER'S DISEASE

Our general system deployment is shown in Figure 63. The patient's house includes a kitchen, a bed-room, and a living room. Several sensors and cameras are deployed in the patient's house to collect sensory data and images. We deploy a cloud gateway in the living room to collect data from all sensors and cameras. It connects to the Cloud via Internet high speed router. Doctors, nurses, and patient's relatives (e.g. his daughter) can access easily via Web2.0 interface.

The following figures show how we collect data from sensors and cameras and deploy to the Cloud.

Location Tracking

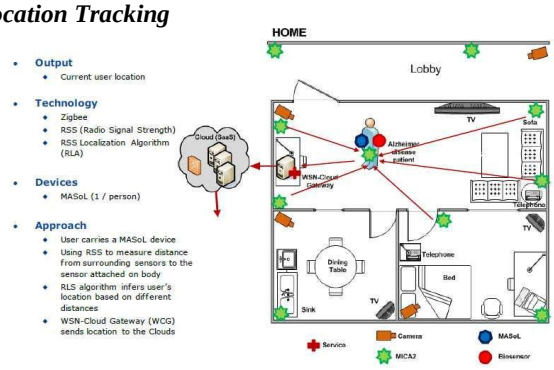


Figure -6.4 Location Tracking Deployments

CONCLUSION AND FUTURE WORK

This paper introduces Secured WSN-integrated Cloud Computing for u-Life Care, called SC3. It provides a number of featured components, including security and privacy control, WSN-Cloud integration mechanism, dynamic collaboration between Clouds, and an activity recognition engine to enable many u-Life care services. We also present our primary result of development, and then discuss about its potentialities and benefits.

There are still many works ahead. The first future work that we plan to work on is to provide more services to different kinds of patient's disease such as stroke, Parkinson disease, etc. The number of activities will be increased to support more services. A number of wireless medical sensors are under developed. They will be used to collect health data of patient seamlessly. We also will focus more on security and privacy for Cloud Computing. Currently, most users do not want to store their personal health data on Clouds because it is not safe and reliable. Another work is to extend our development into various such as manufacturing, military services.

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