Journal of Computer Science 9 (12): 1710-1714, 2013
ISSN: 1549-3636

doi:10.3844/jcssp.2013.1710.1714 Published Online 9 (12) 2013 (http://www.thescipub.com/jcs.toc)

AN IN-DEPTH ANALYSIS ON INTEGRATING CAMPUS RADIO FREQUENCY IDENTIFICATION SYSTEM ON CLOUDS FOR ENHANCING SECURITY

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Received 2013-09-08, Revised 2013-09-28; Accepted 2013-10-29

ABSTRACT

Several measures had been taken to ameliorate security technology at campuses using latest technologies available. Radio Frequency Identification (RFID) technology in campuses is mainly used for recording attendance which is further extended to activity monitoring and individual security. This research paper proposes a framework of RFID integrated solution for enhanced campus IT security including human, campus IT asset traceability, student's valuables tracking, exam papers leakage security and issue authentic certificates. In order to meet the growing requirements of campus security system, the use of RFID technology in existing campus application has to be expanded where RFID technology certain performance issues may arise. Designing RFID enabled scalable and reliable applications is difficult due to managing and handling data banks generated by RFID tags, which further requires enhancing the entire IT infrastructure, inconvenient for Small and Medium Enterprise (SME) such as academic institutions having budgetary constraints. Therefore in order to take RFID campus implementation to the next level and create internet of things based applications, campuses have to embrace the concept of using the leading edge technology of cloud computing due to its both technological and economic benefits for supporting RFID technology.

Keywords: RFID, Cloud Computing, Internet of Things

1. INTRODUCTION

Security is state of providing resistance to, or protection from any danger or threat which can be applied to any vulnerable or valuable asset. Security in academic institution is critical as it affects students and society. To prevent disciplinary actions strictly and reduce criminal activities, strong security should be provided by the system.

This study proposes a system using RFID which helps implementing security at different levels to and from students for which use of RFID technology has to be expanded. Chetna and Gupta (2010) concluded RFID technology expansion may create problems due to e-data flexibility, low efficiency, bulks of data produced. Expanded deployments result in, more infrastructure (hardware and software), cost, services and storage facilities. Secondly, Main implementation cost of RFID technology involves in professional services which includes consulting services, architecture design, platform selection, integration and installation and management.

Instead of increasing budgets for improving IT infrastructure and adopt professional services to accommodate changing needs of system in this research paper we propose an architecture framework to integrate cloud computing which will increase scalability and boost RFID system performance. With the view to improve and adapt existing campus RFID systems and design modern reliable, accurate, fast and scalable systems based on the cloud computing, security will be implemented for campus IT assets, students valuables, exam paper leakage and issuing authentic certificates.

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2. RFID TECHNOLOGY

In RFID a unique Identification code is set to the memory of each tag which is attached to each object. Multiple tags can be read simultaneously by an RFID reader with no direct contact or optical connection, read multiple tags simultaneously, write data within few milliseconds and no human intervention required. Yangi and Zhangi (2010) as Stated RFID tags can be reattached to other objects and are effective for over 10 years. However, RFID fixed readers identify objects move in/out of a fixed area for mobile reading or identification wireless RFID readers are required.

RFID has the potential to get embedded in our surroundings and create an environment that is sensitive to our presence and responsive to our requirements. As RFID is an enabling technology, combined with other technologies it allows developing robust applications. RFID technology can manage massive objects data through a sophisticated process of transmitting and gathering data from RFID tags, elaborating data through a computerized application running over a powerful background system capable of handling overflow of data.

Chetna and Gupta (2010) stated that RFID technology still in its growth face is being used in various applications such as Asset Tracking, Manufacturing, Supply chain management, Retailing, transport, health care, entertainment and Academics but is not widely accepted due to its performance issues like limited computational capacity, poor resources and inefficient data management.

3. CLOUD COMPUTING TECHNOLOGY

Cloud Computing is a type of computing that do not requires local servers or personal devices to handle applications rather it shares computing resources and services over internet. Over a cloud (Internet), computing (computational resources) are accessible, reliable and scalable. After grid computing cloud computing is a new computing model based on internet therefore stored data and applications are securely accessible in ubiquitous and pervasive manner. Cloud computing can handle applications which require increased computational power and extra storage for faster as well as secured retrieval of required information within budgetary constraints. Chetna and Gupta (2010) has broadly categorized cloud computing Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS).

SaaS includes the process of any software application being delivered over platform web typically through a browser.

PaaS is a platform, including application development, interface development, database development, storage and testing, delivered through a remotely hosted platform to subscribers. It allows creating enterprise-class applications for local or on demand use with some subscription price or free.

IaaS is what makes the basic computational resources like disk space, storage and servers available as on-demand services. It allows accessing virtual servers and to deploy custom made applications and access remotely.

With cloud computing, existing campus RFID application can be expanded for implementing campus security system as now data generated by RFID tags applied on each IT asset, student valuables, question papers can be processed and stored more efficiently. RFID systems melded with the cloud computing allows designing modern scalable, reliable and efficient systems. Cloud computing reduces system development, operation and administration costs.

4. PROPOSED ARCHITECTURE

This paper proposes architecture of merging cloud computing to existing RFID technology in **Fig. 1** and develop an application scalable enough to be integrated in to our surroundings and efficient to be responsive to our requirements i.e. providing security in various areas. Cloud computing combined with RFID allows creating internet of things. RFID tags reading will generate abundance of data for which more computational power is required provided by cloud computing. The existing architecture of campus RFID system is revised and combined with cloud computing in a way that new architecture is scalable, more efficient and reliable. Browser is the only software required on client system to access various applications and alleviate or reduce the implementation cost which is prevalent barrier in global acceptance of RFID systems.

Proposed Architecture consists of two main sections Front End and Back End, which further consists of following components.

4.1. RFID Components

Two major components of RFID technology are RFID tags and RFID readers. Reader sends and receives radio frequency data to and from the tags via coiled antennas. The tag is made of a microchip that stores data, an antenna and a carrier to which the chip and coiled antenna are

mounted. Daniel and Rajni (2010) mentioned coiled antenna of tag and reader are coupled to form a magnetic field and used to power up the tag's microchip which then reflects back its own signals to transfer data information.

4.2. RFID Middleware

RFID middleware is a software layer located between reader devices and business applications on cloud. RFID middleware is generally installed in Computers connected to Internet for accessing applications on cloud. Such applications can orchestrate on the higher layer through a communication channel requesting and receiving RFID events generated by RFID middleware. RFID middleware is composed of three main modules that also facilitate the process of applications development.

4.2.1. Application Interface

Application interface provides necessary means that enable applications to request data and execute the operations, in one or more reader devices.

4.2.2. Event Layer

Event layer is in charge of managing and write event cycles that come from the reader. Event layers must enable the data dissemination that can be synchronous or asynchronous having different latency for sending reports. After the huge volume of tags is filtered and aggregated the data is passed to the higher layer of the architecture where this information is consumed.

4.2.3. Device Management

The device management is responsible for coordination and configuration activities of reader devices as well as for verifying reader status and reporting any errors occurred. Through devices management, it can also build the logical structure according to business applications needs.

4.3. Cloud Computing

RFID data is filtered, processed and stored according to the requirements of the developed business software. In proposed architecture, cloud computing services will be used as below.

4.3.1. Software-as-a-Service (SaaS)

Business software, hosted on the cloud access via web browser. Application sets its instructions to filter process and store the RFID data. This business application can be worldwide accessed and is easily scalable as well as highly reliable. This data is then handled on clouds on application relative platform and stored on a specific server.

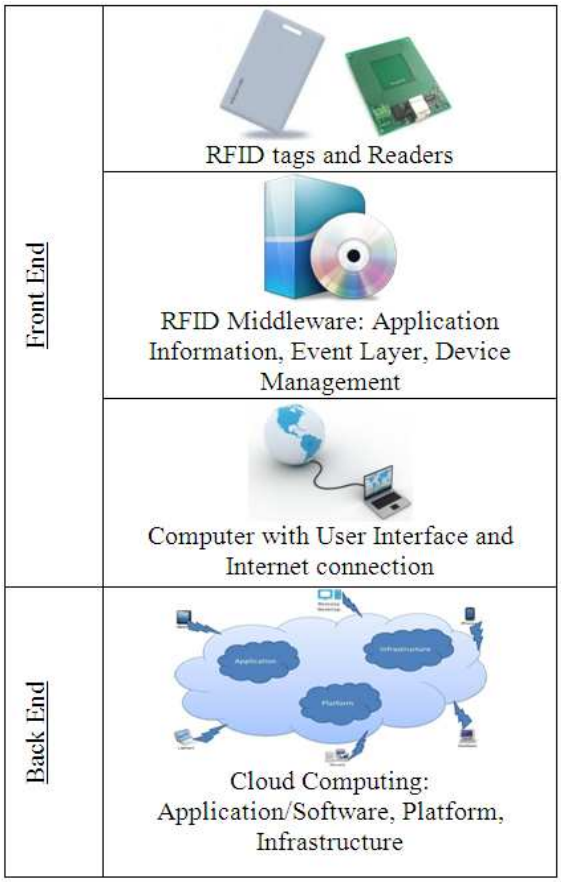

Fig. 1. RFID and cloud computing proposed architecture

4.3.2. Platform-as-a-Service (PaaS)

All the tools, libraries and underlying software and hardware are provided over the web, allowing development and deployment of business application on the cloud. It provides all the benefits such as team collaboration, web service integration, database integration, security, scalability, storage, state management and developer community facilitation.

4.3.3. Infrastructure-as-a-Service (IaaS)

The server administers and system and traffic. Middleware and protocols allow the networked resources to communicate to each other. In this case a lot of storage space is required to store all the RFID tags data generated from users, assets, question papers and certificates. Cloud infrastructure makes the copy of all the information as a backup to retrieve data by the central server as and when required. Low priority RFID tag data which was lost earlier due to lack of storage will

be stored and backed up and later can be used with data mining techniques to draw more intense conclusions.

Cloud computing will aid in acceptance of RFID systems especially by small or mid-size companies who were left weary of the benefits and uses of the technology due to the demanding needs of incorporating new infrastructure and services. Proposed architecture now provides a way to further extend the computational capabilities of campus RFID system adding more technologies in future according to the needs and requirements.

5. PROPOSED SECURITY MODULES

Each individual is carrying an RFID card in the campus. Currently RFID readers are located all entrances and exits of campus and within campus including classrooms, cafeterias, playground and library.

5.1. Assets Security

RFID is successfully used in asset management systems for integrating accurate location tracking of asset with other business management activities. Yang and Liu (2010) stated RFID location traceability system deliver real time information of assets location and security status to administrators in case set security standards are infringe.

Each campus asset will be having an RFID tag which while moving from one place to another will be read by the RFID readers. Person moving the asset will first have to get the asset issued to his/her ID card. For example a student wants to borrow a book from library and OCR device from IT lab. The book will be issued to the students ID card by the librarian to be taken home and OCR device issued to student RFID card through Lab assistant to be used within the campus. Then student may take both objects to any part of the campus where both the student RFID card and object RFID chip will be read each time while moving in or out of any campus area. Incase student tries to move out of the campus system will alarm security in order to not let the OCR device go out of the campus building while the student can take the book along. Administrators can any time also track the movement of the campus asset within the campus building.

5.2. Students Valuables Security

As number of students valuable increase possible ways of theft have also increased which have negative effect on students and society. According to Chen *et al*. (2011) RFID technology can be very helpful for decreasing frequent campus thefts.

Proposed architecture addresses this concern that each student valuable will have a RFID tag inside the body or in a hidden area of the item. Each RFID tag of valuables will be paired with the students RFID card. When student carries valuables around the campus RFID reader will detect RFID tags of devices and RFID tag of students if they are paired then system will allow smooth movement or else alarm system will be activated. In case student forget any device in any area, student can tract it online by locating it on the campus map.

5.3. Exam Paper Security

Examination cheating has been there for as long as there have been exams. In 2007 UK based exam board Edexcelused electronic tagging system to prevent stolen exam papers and detect fraudulent activities. There were 70 security breaches out of 620000 exam papers send to various schools and universities. Before joint exam board policed the system to follow strict procedures to maintain security, but still papers were missing, stolen, sold or distributed over internet. Edexcel's managing director, Jerry Jarvis said in BBC news "Incidents involving stolen papers are extremely rare, but the potential impact is massive". Radio Frequency tags storing information about no of papers, where they come from where they are going will be attached to each bundle of exam papers, making fast checks and easier to spot tampered package.

Similar RF tagging can be done for securing exam question papers from being stolen which will be packaged and tagged at examination department and been re-checked in examination hall before opening of the package. Any detected tampering will be reported to the administration.

5.4. Authentic Certificate Security

In UAE 30 institutions and Ministry of Higher Education and Scientific research have adopted radio frequency tags technology for documents issued to students, in order to prevent document forgery and speed up issuance and attestation procedures. These RF chips store issuance date and validity information which is when read by RFID reader at attestation department verifies document authenticity without need of call to the issuing university.

These chips are 8kb memory chip with 13.56MHz frequency and ISO 14443A standards helpful for storing data pertaining to the student. This is also helpful for the provision for cancellation or issuing duplicate e-certificate. Mudraganam (2009) mentioned that all related data can be captured and stored like photograph of the students and signature of the issuing authority.

6. COMPARISON AND FUTURE WORK

As compared to Chetna and Gupta (2010) proposal, this proposal describes not only the RFID and CC architecture but also proposes additional UMS security applications based on CC including asset security, exam paper security and certificate authentication security.

Merging two technologies brings many benefits but also opens a new research area for security of RFID on cloud computing. Through cloud computing campus RFID system can be connected to country police station for direct reporting or call to police, fire brigade or ambulance in case of any emergency. E-exam box can be created which may open only when paired RFID cards are detected together.

7. CONCLUSION

RFID technology simplifies working systems and makes daily works effortless, only if its setbacks do not hinder in its acceptance. Security modules defined needs more processing power and storage, which are cost effectively provided by cloud computing.

It is conveniently achievable for midsize campuses to merge existing RFID system with Cloud computing services which will increase system scalability and reliability. Assuming no communication problem with cloud computing services most of the system processing for locating valuables or RFID tags with in campus, detecting theft and data mining of RFID tag generated data will be executed by cloud computing services therefore overall RFID system functioning.

The proposed Cloud RFID architecture framework provides direction towards more effective RFID systems melded with cloud computing allowing ubiquitous computing.

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