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Efficient Data Collection Using Secure Hybrid RFID and WSN

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ABSTRACT: Radio frequency identification (RFID) is mainly used for identification. RFID is a technology that uses radio waves to transfer data between RFID tags and RFID readers. RFID can be implemented on the objects to be identified, improving the efficiency of individual object tracking and management. Wireless sensor networks (WSNs) are widely used in many real life applications due to their numerous advantages. Such networks are mainly used for the applications like health monitoring, industrial automation, smart home monitoring, military applications, etc. RFID and WSNs are widely used in applications for environmental and health monitoring. In this work, a hybrid RFID and WSN system (HRW) integrates the traditional RFID system and WSN system for efficient data collection and simultaneously provides security mechanism.

KEYWORDS: Radio Frequency Identification (RFID), Wireless Sensor Network (WSN),Hybrid RFID and WSN (HRW), Security mechanism.

I. INTRODUCTION

A wireless sensor network (WSN) is a network of many low power autonomous sensor nodes which collects data about environment and used in military, civilian applications and more. As sensitive information is sent through sensor nodes, there is need for privacy in WSN. There are two main categories of privacy preservation in WSN context privacy and content privacy. Sensor networks are used in various applications because of its ease of installation, portability and cost efficient. A WSN is made up of hundreds or large number of sensor nodes. A sensor consists of four basic parts: a sensing unit, a power unit, a processing unit, and a transceiver unit. RFID have a much importance these days, its being used in a lot of industrial systems such that it's used in assembly lines to keep track of the machines, it's also being used to make easy and accurate inventory results. It also is used in hospitals to keep 24 hours a day patient monitoring, so if anything wrong happened to them, the doctors will be immediately noticed.

In WSN, the most critical problem is energy efficiency. The proposed system is a secure hybrid RFID and WSN system (HRW) which integrates WSN system and traditional RFID system so that data can be collected efficiently with security mechanism and energy efficiency. HRW has hybrid smart nodes. It combines the function of RFID tags, the reduced function of RFID readers, and wireless sensors. So, for nodes it is to read each other's sensed data in tags and all data quickly transmitted to an RFID reader through the node that first reaches it. The RFID readers transmit the collected data to the back-end servers for data processing and management. The proposed system uses the ecc algorithm which gives more security. Thus, the system will provide the energy efficient data collection with security mechanism.

II. RELATED WORK

Lei Zhang and Zhi Wang [2] presented the architectures, opportunities and challenging problems in integrating RFID and WSN technologies. There are four integration classes presented in [3] as: integrating tags with sensors, integrating readers with WSN node and wireless devices, mix of RFID and WSN and integrating tags with WSN nodes and wireless devices D. Simplot-Ryl, I. Stojmenovic, A. Micic, and A. Nayak [5] Proposes a new protocol which combines the two partitioning algorithm into one which is very efficient. In the presence of many objects at the same time identification of multiple objects is a challenging task. Only one tag responds to the request and receiver will get just

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one message, but if there are more tag's responses then messages will colloid and will not receive correctly to receiver. Only reader can detect the collision.

X. Chen, K. Makki, K. Yen, and N. Pissinou [6] presented a survey on security issues and defense methods; it also explained advantages and disadvantages of the current security schemes.

M. Li, Y. Liu, J. Wang, and Z. Yang [7] presented a road map system in sensor network without location information. The design of an efficient and effective navigation protocol without any advance knowledge of a user and sensor network is a very challenging task.

Hybrid RFID and WSN systems fig.1 presented in [1-2-3] consists of hybrid smart nodes. Smart node has components are: Reduced Function Sensor is a sensor without having transmission function. It just collects or gathers the data. RFID Tag is normal RFID tag and RFRR (reduced function RFID reader) is used to transmit data between smart nodes.

HRW uses multi-hop transmission mode and hence it avoids the data packet loss and ensure that data forwarded to the receiver. Smart node has two modes: Active mode and Sleep mode. In sleep mode smart node do nothing. In active mode sensor presented in smart node collects information.

In HRW it uses two types that are: Proactive data transmission and Cluster based data transmission.

Proactive data transmission: In this type, it has timestamp with node ID. Thus it will check that if the timestamp is greater than the previous stored timestamp then it will replicate the data and if timestamp is less than previous timestamp then it will ignore that information. In this way data duplication or data excess can be avoided.

Cluster-based data transmission: Clustering is used to manage data exchange between interacting nodes. Weight based clustering technique is used to select cluster head. Weight is calculated based on: Frequency from different reader for each node. Threats due to compromised smart nodes: Data Manipulation and Data Selective Forwarding.

III. PROPOSED SYSTEM

In traditional RFID monitoring applications [2], such as baggage checking in Delta Airlines and supply chain management, an RFID reader should quickly process several tagsat different distances. An RFID reader can only read tags in its range. Background noise, limited communication bandwidth, channel accessing contention between tags and multipath fading would severely deteriorate the performance of the data collection. These problems can be avoided by using multi-hop data transmission mode in WSNs. In HRW [7] smart nodes are introduced. Smart nodes actively transmit data to readers in a multi-hop manner. Smart nodes read tag data between each other. Thus, instead of reading every tag one by one when they move into the reading range, RFID reader can receivetheinformationofagroupoftagsbyreadingonlyonefirst-encounterednode. As a result, the noise interference and channel contention during the data transmission can be significantly reduced. In HRW, a node can read data from the RFID tag of another node even if it is in sleep mode, which greatly increases transmission efficiency.

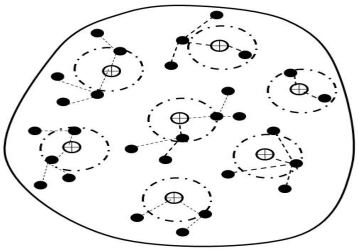

Figure 1.HRW Architecture

Cluster nodes replicate their data to each other to one specified cluster head that has high encountering frequency with cluster nodes and RFID readers to improve information collection efficiency. And a tag clean-up algorithm to remove delivered data from tags to reduce transmission overhead.

Several approaches to encryption/decryption using elliptic curves have been analysed in the literature. This one is an analog of the ElGamal public-key encryption algorithm. The sender must first encode any message m as a point on the elliptic curve Pm (there are relatively straightforward techniques for this). Note that the cipher text is a pair of points on the elliptic curve. The sender m asks the message using random k, but also sends along a clue all owing the receiver who know the private-key to recover k and hence the message. For an attacker to recover the message, the attacker would have to compute k given G and kG, which is assumed hard.

IV. PSEUDO CODE

The process of replication executed by smart node i.

```
ifthis.state = activethen
    Collect the sensed data of its host D_i
    //Store D_i into itstag_i
    forevery node j in its transmission rangedo
        Store Di,tag_i
        ifthis.linkAvailable(j)then
            Read data D_j with timestamp >t_ij fromtag_j
            // Store data D_j in itstag_i
            Store D_i,tag_i
            Update timestampt_ij with current type
        endif
    endfor
endif
```

The process of information reading executed by RFID reader i.

```
forevery node j in its transmission rangedo
    ifthis.linkAvailable(j)then
        Read data D_j from tag_j in node j
        //Store data D_j in storage S_i in the RFID reader
        Store D_j,S_i
        // Erase D_j fromtag_ij in node j
    endif
endfor
```

Base point selection algorithm of ECC

Constants a and b, Prime number p as input and effective base point G on curve with order n.
Step 1: Select x randomly between 0 and p.
Step 2: Calculate a=(x3+ax+b) mod p
Step 3: If a belongs to the quadratic residue of mod p, then y value is obtained As G(x,y) and move to step 4,
else go to step1.
Step 4: Calculate hG according to the value of G and verify whether the point G meets y2=x3+ax+b and also make sure that G is not an infinite point. If everything is satisfied go to step 5,
else go to step 1.
Step 5: Return G(x,y)

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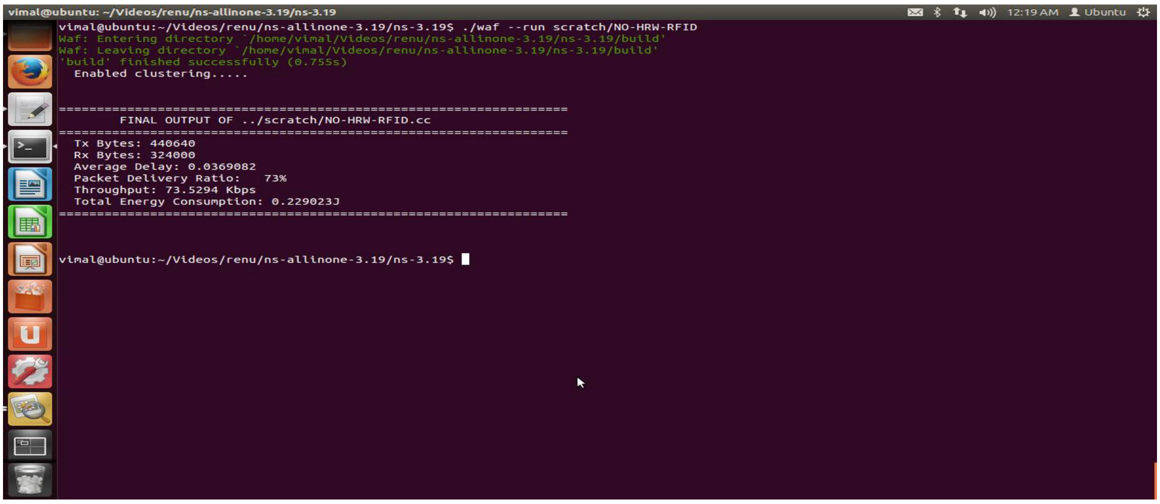
V. SIMULATION RESULTS

We run our experiments in Network Simulator 3 that has shown to produce realistic results. In our simulations we use AODV routing protocol. The results directory in the project folder contains .cc and xml files.

Figure 2 shows the data collection process by using traditional architecture.Fig.3. shows the process of data collection using hybrid architecture which results efficient data collection. Now after getting this efficient data ECC algorithm will be applied to get secure data.

We have compared parameters packet delivery ratio, delay, throughput and energy. All comparison shown in the given graph.



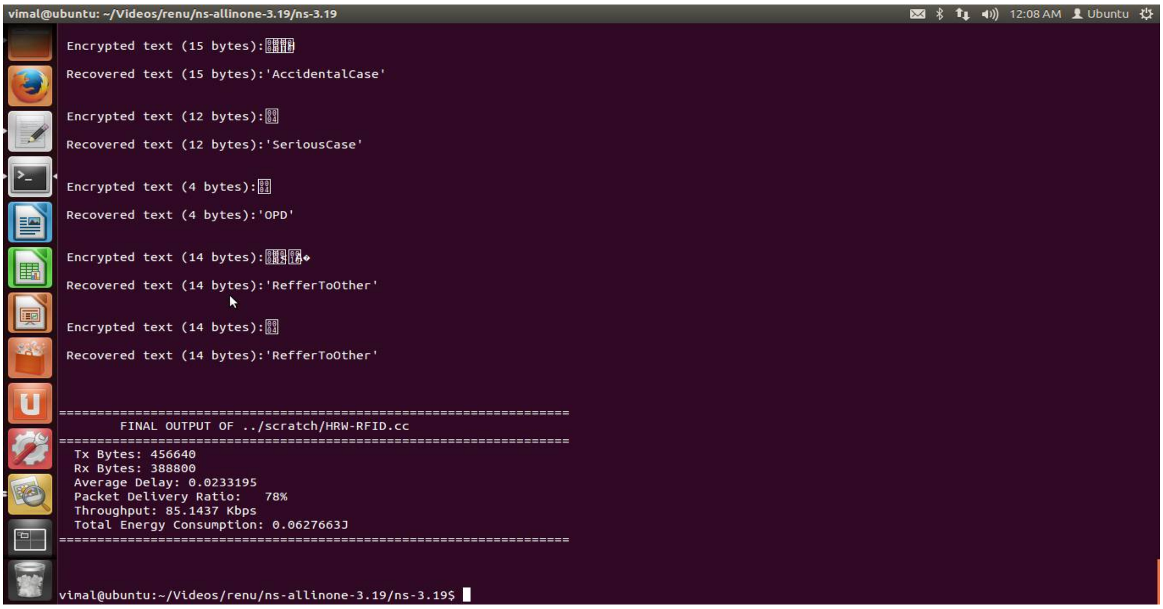
```
vimal@ubuntu: ~/Videos/renu/ns-allinone-3.19/ns-3.19
vimal@ubuntu:~/Videos/renu/ns-allinone-3.19/ns-3.19$ ./waf --run scratch/NO-HRW-RFID
Waf: Entering directory `/home/vimal/Videos/renu/ns-allinone-3.19/ns-3.19/build'
Waf: Leaving directory `/home/vimal/Videos/renu/ns-allinone-3.19/ns-3.19/build'
'build' finished successfully (0.755s)
  Enabled clustering.....


====================================================================
        FINAL OUTPUT OF ../scratch/NO-HRW-RFID.cc
====================================================================
  Tx Bytes: 440640
  Rx Bytes: 324000
  Average Delay: 0.0369082
  Packet Delivery Ratio:   73%
  Throughput: 73.5294 Kbps
  Total Energy Consumption: 0.229023J
====================================================================



vimal@ubuntu:~/Videos/renu/ns-allinone-3.19/ns-3.19$ █
```

Figure 2 Data collection using Traditional Architecture



```
vimal@ubuntu: ~/Videos/renu/ns-allinone-3.19/ns-3.19

 Encrypted text (15 bytes):▯▯▯▯

 Recovered text (15 bytes):'AccidentalCase'


 Encrypted text (12 bytes):▯

 Recovered text (12 bytes):'SeriousCase'


 Encrypted text (4 bytes):▯

 Recovered text (4 bytes):'OPD'


 Encrypted text (14 bytes):▯▯▯▯◆

 Recovered text (14 bytes):'RefferToOther'


 Encrypted text (14 bytes):▯

 Recovered text (14 bytes):'RefferToOther'



====================================================================
        FINAL OUTPUT OF ../scratch/HRW-RFID.cc
====================================================================
  Tx Bytes: 456640
  Rx Bytes: 388800
  Average Delay: 0.0233195
  Packet Delivery Ratio:   78%
  Throughput: 85.1437 Kbps
  Total Energy Consumption: 0.0627663J
====================================================================



vimal@ubuntu:~/Videos/renu/ns-allinone-3.19/ns-3.19$ █
```

Figure 3 Data collection using HRW Architecture

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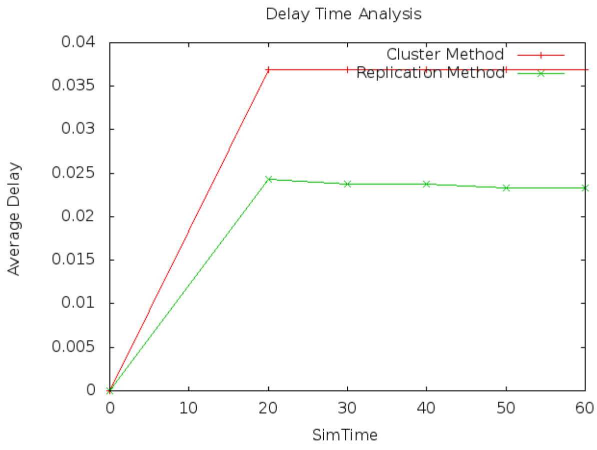

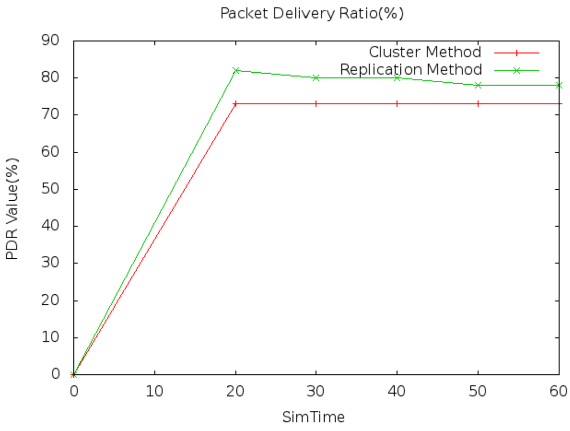

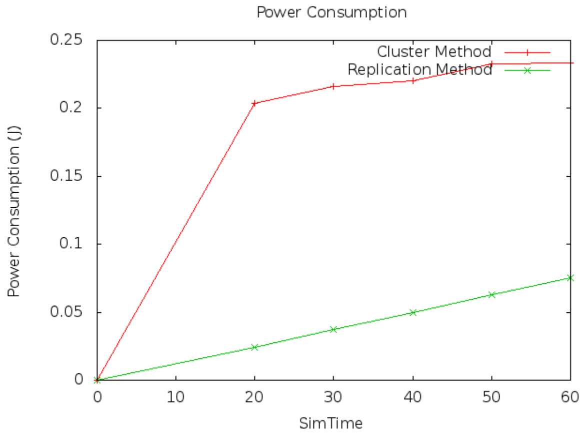

VI. CONCLUSION AND FUTURE WORK

The simulation results showed that the proposed method performs better. The proposed method provides energy efficient path for data transmission with security.The proposed Hybrid RFID and WSN System (HRW) integrates the multi-hop transmission mode of WSNs and direction transmission mode of RFID systems and improves the efficiency of data collection. Thus the system meets all the requirements like high performance, low economic cost.

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