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# Implementation of a Reliable Anti-Collision Technique for RFID Using 1-To-4 RFRJ Coding

K.Poojit Avinash<sup>1</sup>, R.Gurunadha<sup>2</sup>

M.Tech Student, JNTUK-UCEV, AP, India<sup>1</sup>

Assistant Professor, Dept. of ECE, JNTUK-UCEV, AP, India<sup>2</sup>

**ABSTRACT:** While transmitting secret data over Internet or by any other means our whole concern is to make it secure before transmission so that it should not be disclosed to pirates. In this paper, a novel coding based on the RANDOM FLIPPING AND RANDOM JAMMING (RFRJ), has been proposed for Secure Communication of Secret Information. In this proposed approach the secret information is transformed and then the shares of the transformed information are generated. These shares are then transmitted individually. RCEAT ARCHITECTURE is used, which consists of the preRCEAT and postRCEAT methods for the construction of information shares & reconstruction of secret information from the information shares resulting the scheme with very low computational complexity and highly secured. Experimental results show that this scheme is simple and effective.

The PreRCEAT subsystem is to detect any error in the incoming messages. Then the identification bit (ID) of the no error packet will be fed to the next subsystem.

The PostRCEAT subsystem is to identify the tag by using the proposed Fast-search Lookup Table. The proposed system is designed using Verilog HDL. Finally the RCEAT architecture is synthesized using xilinx 14.5.

**KEYWORDS:** RFID, Pseudo Random Number, Secret Sharing, Secret Communication, RFRJ, RCEAT, PreRCEAT, PostRCEAT

### I. INTRODUCTION

In recent years there is a enormous increase in the usage of multimedia data over Internet. Multimedia knowledge largely comprises the use of pics and consequently their comfy transmission over web has grow to be a relevant obstacle for the researchers. Quite a lot of approaches were proposed for comfortable conversation of snap shots. These incorporate encryption, steganography, visual cryptography, secret sharing, and some more. In encryption the info to be transmitted is modified in unrecognizable content material utilizing a secret key. This makes the information cozy but also makes it a topic of attraction for the intruders, who in flip attempt to decrypt it with the aid of employing quite a lot of cryptographic attacks. In steganography the key information is embedded into any other duvet media which avoids the attention of unlawful person. If data is tremendously secured then this procedure also might not be preferrable as it's convenient to discover the secret data from the duvet media. One an extra strategy is Secret Sharing (SS), which used to be first proposed by Blakley and Shamir independently, which encode a secret photograph into n shares. The reconstruction of secret picture can most effective be viable from any ok or extra shares. Advantage of ok-1 or fewer shares presents certainly no know-how in regards to the secret picture. Secret Sharing now not handiest ensures the safety of information, but additionally highly reduces the possibility of secret entry of snapshot because of misfortune or betrayal. As a consequence it has attracted many students' concentration. A secret sharing scheme will also be evaluated by way of its security, computational complexity, contrast (reconstruction precision), and pixel expansion (storage requirement).

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Further to boom the extent of safety, before generation of the stocks, the authors have transformed enormously mystery image based on a mystery pseudo random collection and this transformation procedure additionally has a completely low computational complexity. Thus standard computational complexity remains very low and secret photograph becomes distinctly secured even with out the use of any traditional cryptography or steganography schemes.

Cryptographic hash capabilities that are typically nonlinear capabilities have been broadly used in lots of cryptographic structures. These hash capabilities have many facts safety programs, appreciably in digital signatures, message authentication codes (MACs), and other varieties of authentication. They also can be used as ordinary hash functions, to index information in hash tables, for fingerprinting, to come across replica information or uniquely perceive files, and as checksums to come across unintentional information corruption.

## II. PRELIMINARIES

### Secret Sharing:

Secret Sharing refers to a way for dispensing a secret among a group of members. Each of whom is allocated a percentage of the name of the game. The mystery may be reconstructed best whilst a sufficient range of shares are blended collectively: Individual stocks are of no need on their very own.

### Distributed RFID Systems

In the traditional RFID system, an RF reader has two components, a transmitter (i.e., query transmission/energizingtags) and a listener (i.e., listening to a tag's reply) as shown in Fig. 1a, where a diamond represents the transmission function of a reader, a circle represents the listening function of a reader, and a rectangle represents a tag. The communication range of the backward channel is much shorter than that of the forward channel, and thus readers must be deployed based on the short-range backward channel to access all tags in the region as shown in Fig.2.1a. A recent study proposes Distributed RF Sensing model that employs two kinds of devices (a single RF transmitter and a number of RF listeners) for each function of a reader as shown in Fig 4.1b. The model contributes to cost reduction of RFID system deployment For example, in Fig.4.1b, the traditional RFID system requires nine transmitters and nine listeners, while the distributed RFID system requires one transmitter and nine listeners.

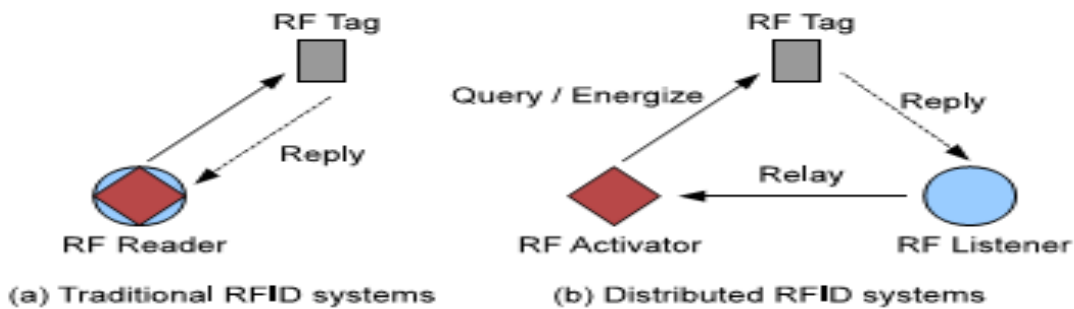


Fig.2.1 Distributed RFID systems.

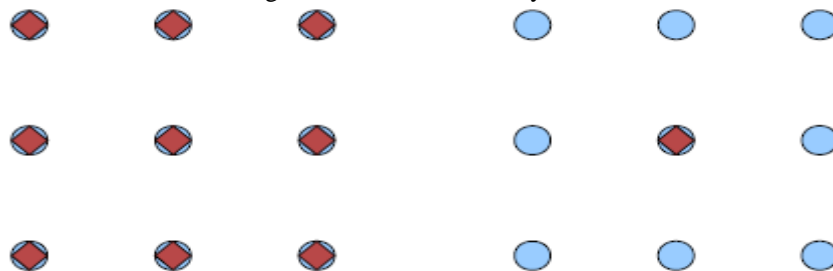


Fig.2.2. (a) Traditional RFID systems (b) Distributed RFID systems

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## TSD architecture

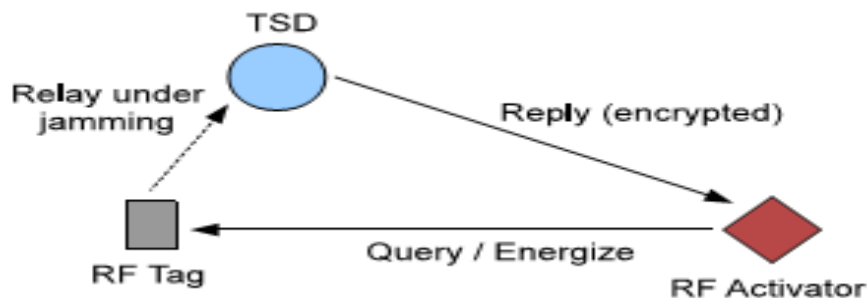


Fig. 2.3. The TSD in RFID architecture

An RF reader is divided into two components, an RF activator and a trusted shield device (TSD). In our new architecture, an RF activator queries a tag with a long-range signal (i.e., the forward channel) and energizes the tag. A TSD receives a tag's reply with a short-range signal (i.e., the backward channel), and it sends the reply to the activator via an encrypted channel, which we define as the relay channel. In typical RFID applications, a reader forwards tags data to the back-end server. For simplicity, in this paper we consider the RF activator as the final destination of a tag's data by assuming the activator forwards collected data to the back-end server. A TSD works as an RF listener and it is capable of bit level jamming during reception of a tag's reply. Therefore, our new RFID system architecture consists of three components: an RF activator, a TSD, and RF tags. In this paper, we introduce a new coding scheme, namely random flipping random jamming, for the backward channel protection. A tag will send encoded data (i.e., pseudoIDs) to a TSD under the jamming environment. This prevents adversaries from passive attacks, i.e., the random guessing attacks, correlation attacks, and eavesdropping. As we will show later, the RFRJ coding scheme ensures that adversaries cannot decode the original tag's ID from incomplete data due to jamming while the TSD successfully recovers the data from imperfect information. A TSD is conceptually similar to the trusted masking device and a medical device shield implemented, but different in the following functions. On overhearing a query from an activator to a tag, a TSD jams a bit in a codeword. As mentioned in the assumption, bit level jamming is possible. If an unauthorized reader tries to access a tag, a TSD jams against all bits of codewords so that the unauthorized reader cannot read the content of the transmitted data. A similar function is implemented, where a shield device jams the whole communication on detecting unauthorized accesses. This can be done by letting an authorized activator communicate with a TSD before a singulation process. Unlike the trusted masking device and medical shield, a TSD intermediates only the backward channel.

## III. RFRJ (RANDOM FLIPPING RANDOM JAMMING) ARCHITECTURE

In this section, we present the random flipping random jamming coding scheme. Definition: Let  $r$  be an RF activator,  $s$  be a TSD, and  $t$  be an RF tag. An activator which intends to obtain data from a tag sends a query on the forward channel. When the tag replies to the TSD, it encodes every  $l_b$  bits in the data into an  $l_c$  bits codeword with an encoding function  $E(.)$ . Note that  $l_b$  is not the length of an ID, but the unit to be encoded into a codeword. A coding scheme for private tag access is defined by the parameters,  $l_b$ ,  $l_c$ , and  $C$ . Here,  $C$  is a set of codewords that could be used for encoding. During the transmission of a pseudo ID on the backward channel, the TSD conducts bit level jamming. On receiving the tag's reply, the TSD decodes the received codeword by a decoding function  $D(.)$ , and forwards the data to the activator via the relay channel. In general, we call  $l_b$ -to- $l_c$  the RFRJ coding scheme. For instance, the coding scheme with  $l_b=1$  and  $l_c=4$  is said to be the 1-to-4 RFRJ coding scheme. The notations utilized in this paper are listed in Table 3.1.

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**TABLE-3.1 Definition of the notations.**

Symbols	Definition
R	The RF Activator r
S	The TSD s
T	The RF tag t
B	The bit b
B	The source bits $\{b_1, b_2, \dots\}$
C	The codeword c
C	A domain of codewords $C = \{c_0, c_1, \dots\}$
$l_c$	The length of a codeword $ c $
$l_b$	The length of source bits $ B $
I	The index of a bit in a codeword
$E(\cdot)$	The function $E: \{0,1\}^{l_b} \rightarrow \{0,1\}^{l_c}$
$D(\cdot)$	The function $D: \{0,1\}^{l_c} \rightarrow \{0,1\}^{l_b}$
$H(b, b')$	The Hamming distance between b and b'
$H(b, b', i)$	The Hamming distance between b and b' after removing the $i^{th}$ bit of b and b'
$P_j$	The probability that a jammed bits is flipped

## Private Tag Access Protocol

The proposed private tag access protocol works as follows. Suppose an RF activator r plans to read an RF tag t without disclosing the tag's ID to an eavesdropper. In this section, we first consider the length of the encoding unit  $l_b$  to be 1. Our idea can be applied to arbitrary values of  $l_b$  and  $l_c$ , where  $l_b < l_c$ . On receiving a request, the tag text ends bit into an  $l_c$ -bit codeword, where  $l_c \leq 4$  must hold. When the tag transmits data over the backward channel, it randomly selects a bit in a codeword and intentionally flips it. Note that this process is done before the tag sends out the codeword, so the data sent by the tag always contains a one-bit error. On the other hand, the TSD, which is an RF listener with jamming capability, jams a single bit in the codeword. The jamming causes the selected bit to flip. Let  $p_j$  ( $0 \leq p_j \leq 1$ ) be the probability that the bit jammed by the TSD is flipped. We denote  $i_s$  and  $i_t$  as the indexes of the selected bits by the TSD and the tag, respectively. The TSD randomly selects any bit in the first half of the  $l_c$  bits codeword, i.e.,  $1 \leq i_s \leq \lfloor l_c/2 \rfloor$ , while a tag randomly selects a bit in the second half of the codeword, i.e.,  $\lfloor l_c/2 \rfloor + 1 \leq i_t \leq l_c$ . By doing this, we can guarantee that the TSD and the tag do not select the same bit. Thus, the codeword received by the TSD or an eavesdropper contains a two-bit error when jamming flips the  $i_s$ -th bit and a one-bit error when jamming fails. For instance, in Fig. 3.2, a source bit is encoded into a 4-bit codeword. The tag flips the third bit in the codeword, which is colored gray, and the TSD selects the first bit for jamming, which is crossed off. Assume the original codeword is 1010. Since the tag flips the third bit, it will send 1000 over the backward channel. Meanwhile, the TSD jams the first bit. Hence, the TSD and the eavesdropper will receive X000, where X could be decoded to either 0 or 1. The TSD knows  $i_s$ , and thus it knows one of the three bits may contain an error after excluding the jammed bit. However, the eavesdropper does not know which bit the TSD jammed or which bit the tag flipped. For the eavesdropper, two out of the 4 bits may contain errors. Thus, the TSD and the eavesdropper have a different amount of information to decode the original codeword. In general, for 1-to- $l_c$ , TSD knows that there is a 1-bit error out of  $\lfloor l_c/2 \rfloor$  bits while the eavesdropper knows there is a two-bit error out of  $l_c$  bits at best.

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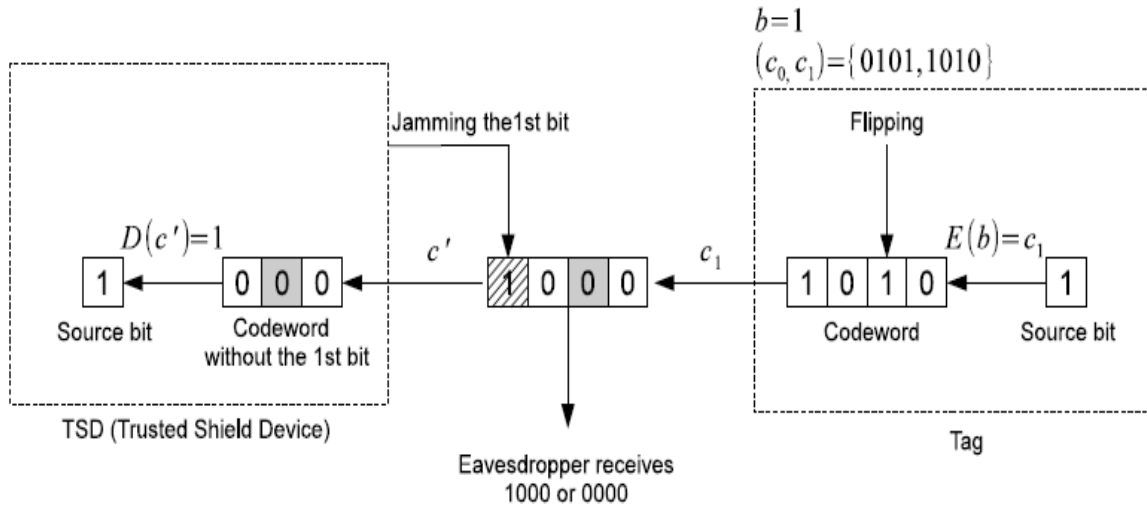


Fig.3. 2. The system model and basic idea

## The Single Bit RFRJ Coding Scheme

The RFRJ coding scheme with the parameter  $l_b = 1$  and  $l_c = 4$ . Note that  $l_c = 3$  does not work and  $l_c = 4$  is the most efficient in terms of communication cost, which will be shown later. Let  $b$  be a source bit and  $c$  be a codeword. The encoding function  $E(\cdot): \{0,1\} \rightarrow \{0,1\}^4$  is defined by  $E(b) = c_0$  if  $b = 0$  and  $E(b) = c_1$  if  $b = 1$ . The encoding function  $E(\cdot)$  must ensure that the Hamming distance between  $c_0$  and  $c_1$ , denoted by  $H(c_0; c_1)$ , is four. There are 16 such  $(c_0; c_1)$  pairs that can be used for private tag access. We call them valid 4-bit codeword pairs.

### Definition 1 (Valid 4-bit codeword pairs).

When  $l_c = 4$ , a codeword pair  $(c_0; c_1)$ , corresponding to a source bit pair  $(0; 1)$ , is said to be valid when the Hamming distance between  $c_0$  and  $c_1$  is four, i.e.  $(0000, 1111)$ ,  $(0001, 1110)$ ,  $(0010, 1101)$ ,  $(0100, 1011)$ ,  $(1000, 0111)$ ,  $(0011, 1100)$ ,  $(0110, 1001)$ ,  $(0101, 1010)$ ,  $(C_1, C_0)$ .

## The 1-to-4 RFRJ Coding Scheme

We have illustrated how the RFRJ coding scheme encodes a single source bit to a 4-bit codeword. In general, an RF tag has data with arbitrary length or a constant length ID (e.g., 96-bit defined in EPC Class1 Gen2). In this section, we elaborate on the complete 1-to-4 RFRJ coding scheme. In real RFID applications, a tag is likely to transmit the same data, such as its ID, to a TSD several times. Should an eavesdropper continuously listen, it can recover the content of the tag response by the help of the previous interrogations (the correlation attack). To avoid the attack, we incorporate dependency by using different valid codeword pairs to each source bit. Let  $b_k$  be the  $k^{\text{th}}$  source bit that a tag intends to encode. To encode  $b_k$ , our coding scheme employs the previous source bits,  $b_{k-1}$ ,  $b_{k-2}$ ,  $b_{k-3}$ , and  $b_{k-4}$ . To be specific, we use the coding table in Table 3.3, where  $b_k = 0$  if  $k \leq 0$ . For example, the source bits with length four, 1010, will be encoded into four codewords with each having 4 bits, i.e., 1111 0011 1110 1001. The decoding process is basically the same, but uses different codeword pairs for each source bit. The corresponding codeword for the  $b_k^{\text{th}}$  source bit is obtained by Table 3.3. The decoding function  $D(\cdot)$  is applied to the received codeword  $c_0$ , computes  $H(c_0, c_1, I_s)$  and  $H(c_1, c_0, I_s)$ , and then outputs 0 or 1.

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**TABLE-3.3 Coding Rule for the 1-to-4 RFRJ Coding Scheme**

$b_{k-4}b_{k-3}b_{k-2}b_{k-1}$	$b_k=0$ c	$b_k=1$ c'
0000	0000	1111
0001	0011	1100
0010	0001	1110
0100	0101	1010
0101	1001	0110
0110	1000	0111
0111	1011	0100
1000	1111	0000
1001	1100	0011
1010	1110	0001
1011	0010	1101
1100	1010	0101
1101	0110	1001
1110	0111	1000
1111	0100	1011

## SECURITY ANALYSIS

In this section, we provide security analysis for the proposed coding scheme. Every source bit is assumed to be 0 or 1 with the same probability 0.5.

### The 1-to-4 Coding Security

Let  $X$  be a random variable that represents the number of flipped bits in a codeword. The  $I_r$ <sup>th</sup> bit selected by a tag is always flipped with the probability 1, since this is done before the data is transmitted. On the other hand, the bit selected by a reader is flipped with the probability  $p_j$ , since the jamming does not guarantee that a target bit is flipped. In RFRJ, 1 or 2 bits in a codeword could be flipped depending on  $p_j$ . The probability that the events  $X=1$  and  $X=2$  occur is obtained by

$$P[X = 1] = 1 - P_j \tag{3.1}$$

$$P[X = 2] = P_j \tag{3.2}$$

Since  $X$  is either 1 or 2,  $P[X=1] + P[X=2] = 1$ . In our 1-to-4 RFRJ coding scheme, an eavesdropper cannot decode when 2 bits are flipped. Thus, the eavesdropper cannot decode the source bit with the probability  $p_j$ . This rule is only applied to the first source bit, but not to the  $k$ <sup>th</sup> bit for  $k > 1$  because it is encoded with a dependency. Let  $X_k$  be a random variable that represents the number of flipped bits in the codeword corresponding to the  $k$ <sup>th</sup> source bit. Again  $X_k$  could be 1 or 2. Since a valid codeword pair used for the  $k$ <sup>th</sup> source bit is defined by the previous source bits, an eavesdropper must decode the  $[k-1]$ <sup>th</sup> source bit to successfully decode the  $k$ <sup>th</sup> source bit. Thus, the probability that the eavesdropper can decode the  $k$ <sup>th</sup> source bit is  $P[X_k=1 | X_{k-1}=1]$  with the base  $P[X_0=1]=1$ . Although the selection of a valid codeword pair is dependent,  $X_k=1, 2$  and  $X_{k-1}=1, 2$  are independent events.

$$\begin{aligned} P[X_k = 1 | X_{k-1} = 1] &= P[X = 1] \cdot P[X_{k-1} = 1] \\ &= P[X = 1]^k \\ &= (1 - p_j)^k \end{aligned} \tag{3.3}$$

Hence, an eavesdropper has a very small chance to successfully decode the  $k$ <sup>th</sup> source bit when  $k$  is large.

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## 4.5 Random Guessing Attacks

When the eavesdropper cannot decode, they may guess the source bit to be either 0 or 1 with even probability (i.e., the random guessing attacks). In this subsection, we consider the security of our coding scheme against an eavesdropper with random guessing capability. When a bit flipping by jamming fails, the eavesdropper decodes with the probability 1. Otherwise, it can successfully decode with the probability 0.5 by random guessing. Let  $b^j$  be the bit decoded by the eavesdropper. Thus, the probability that the eavesdropper successfully decodes the source bit is given by:

$$P[b = b'] = P[X = 1] + \frac{1}{2} P[X = 2]. \quad (3.4)$$

Let  $b_k$  and  $b_k^j$  be the  $k^{\text{th}}$  source bit and a bit decoded by the eavesdropper, respectively. We can obtain the probability that the random guessing succeeds at the  $k^{\text{th}}$  source bit as follows:

$$\begin{aligned} P[b_k = b_k^j] &= P[X_k = 1 | b_{k-1} = b_{k-1}^j] + \frac{1}{2} P[X_k = 2 | b_{k-1} = b_{k-1}^j] \\ &= (P[X = 1] + \frac{1}{2} P[X = 2]) \cdot P[b_{k-1} = b_{k-1}^j] \\ &= (P[X = 1] + \frac{1}{2} P[X = 2])^k \\ &= (1 - \frac{1}{2} p_j)^k \end{aligned} \quad (3.5)$$

## IV. ANTI-COLLISION TECHNIQUE FOR RFID UHF TAG

We are implementing Reliable and Cost Effective Anti-collision technique (RCEAT). In our RCEAT the body consists of slots and each slot (column) is split into 4 minislots (rows). Therefore in each slot, 4 tags are allowed for contending the minislots. The RCEAT will discover these four tags the use of the proposed Lookup desk. The strong point of this proposed method is reducing the tag identity time in the Binary Tree. The present tags are divided into 4 in every Read cycle to lessen the desired iterations and for that reason quicker the tag identity. This proposed technique does no longer require the tag to recollect the commands from the reader for the duration of the identification technique. Thus the tag is treated as an address wearing device best and reminiscence-less tag may be designed which calls for very low strength. In RCEAT, bidirectional communications are concerned, from the reader to the tag (Downlink) and from the tag to the reader (Uplink). When the reader detects there are tags exist in its interrogation sector, it's going to strength these tags. Then the reader sends the Select-institution command primarily based on the tag Prefix or Object Class (OC). The selected tags institution will flow to the Ready country. Next the Reader transmits Reset alerts and its body. After that the body is transmitted back to the reader, column by means of column beginning with the first column. This compensates the time required for transmitting the packet to the reader. Therefore for each Read cycle, there are constantly available packets on the reader watching for identity.

At the reader, the incoming packets for each hyperlink sequentially enter the RCEAT machine. To keep away from the four incoming packets from colliding with each other, those packets (IDs) are recognized using the Binary Tree based totally technique with most four leaves. The reader selects those IDs the use of the proposed Fast-search Lookup desk, and then the chosen ID may be identified. Based on this proposed Lookup desk, the four IDs will be identified from the smallest fee to the largest one in one Read Cycle. Then the tag that has effectively recognized may be acknowledged through sending the Kill-tag.

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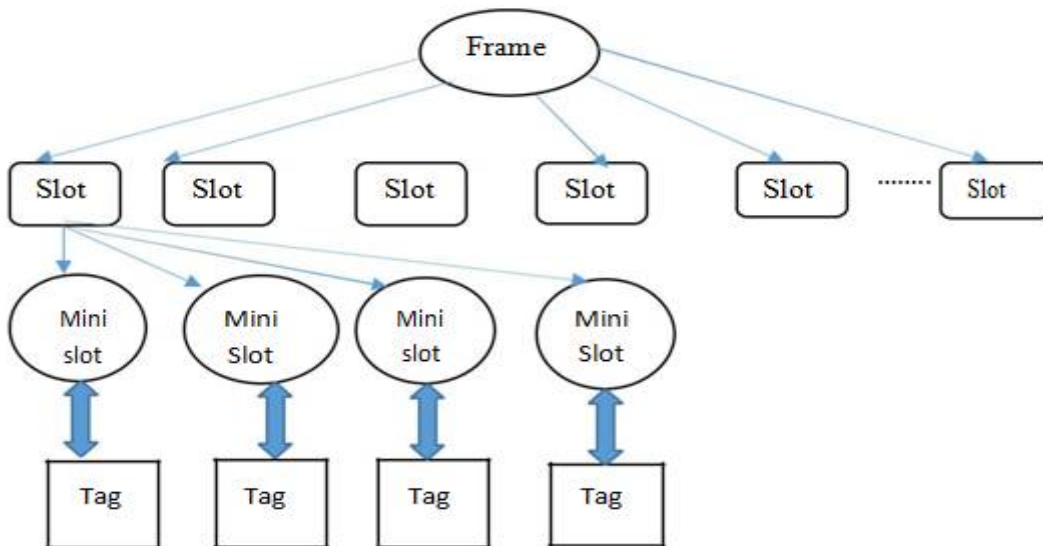


Fig.4.1 Individual tags linked with the frame.

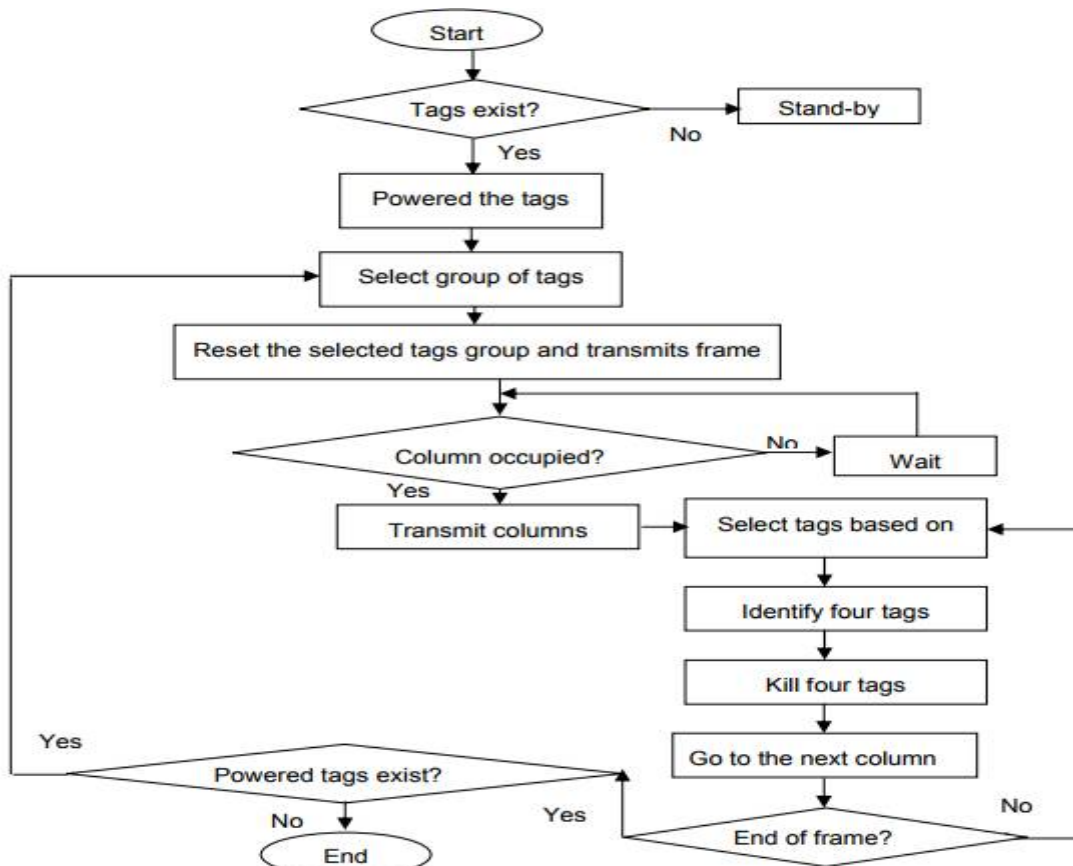


Fig 4.2 : RCEAT identification Methodology



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## Implementation

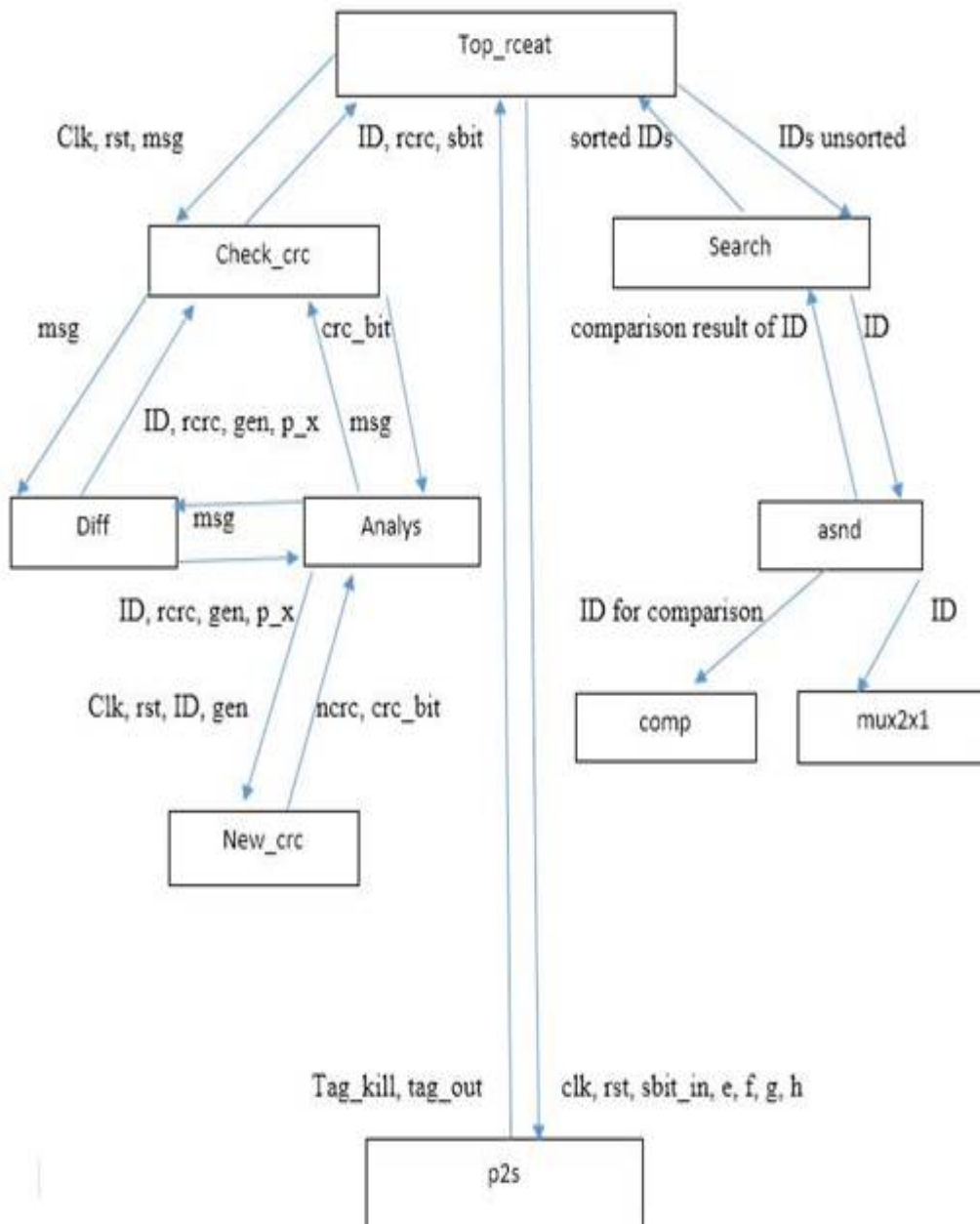


Fig 4.3 Code implementation flow chart

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## V.RESULTS

### Results of RFRJ coding:

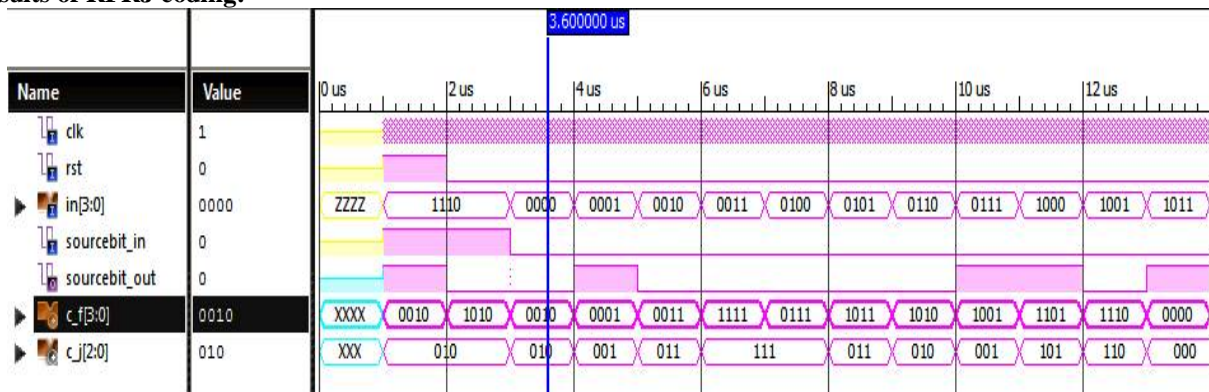


Fig 5.1 simulation results of RFRJ coding

In the above fig 5.1 shows the simulation results of RFRJ coding. It consists of clk,rst,in[3:0],sourcebit\_in,sourcebit\_out,c\_f[3:0],c\_j[2:0]. Here in[3:0] indicates the input message which is to be transmitted. The sourcebit\_in indicates that which codeword has to be generated when 0 or 1 is given. The sourcebit\_out indicates which bit is flipped in the input message after the generation of codeword. C\_f[3:0] indicates the codeword after flipping the bit. C\_j[2:0] indicates the output after jamming the first bit.

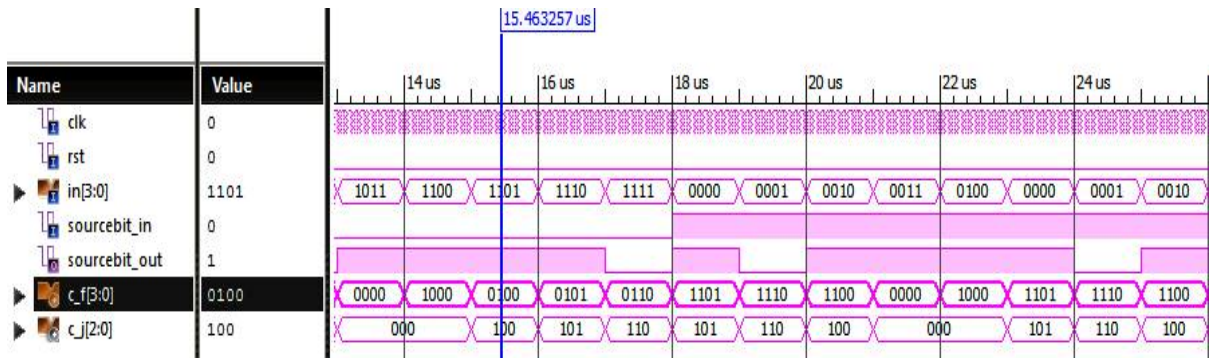


Fig 5.2 simulation results of RFRJ coding

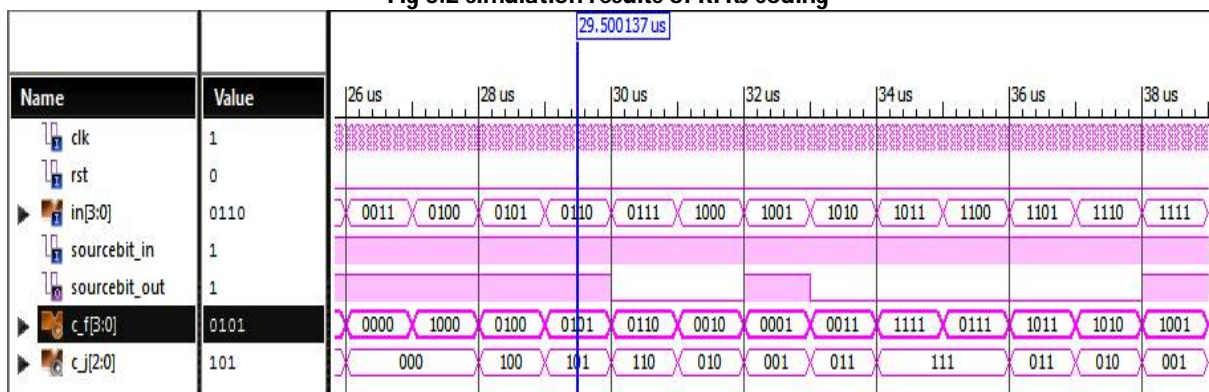


Fig 5.3 simulation results of RFRJ coding

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### Results of RCEAT:

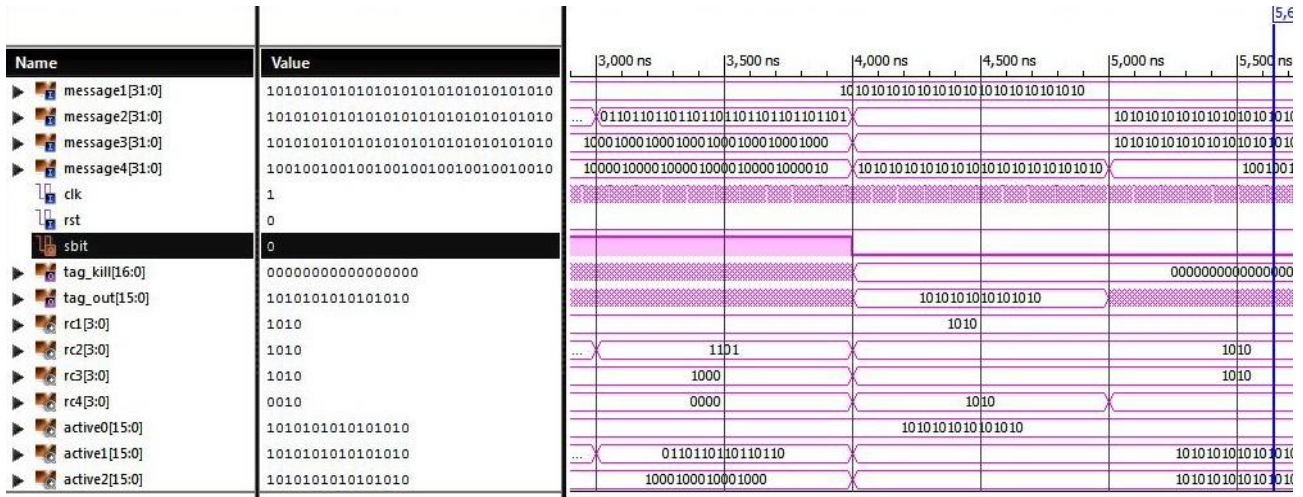


Fig 5.4 when the sbit=0

In the above fig 5.4 we can see the simulation results of the RCEAT. The input includes four 32-bit messages: message 1, message 2, message 3, and message 4. Clock (clk), and reset (rst) is also a part of input. The value of clock is clk=1, and the value of reset is rst=0. The output is tag\_kill and tag\_out. The tag\_kill is used to kill all the unwanted tags or the tags that contains any error in it. If the tag\_kill=0, then it means that the incoming message from the p2s module does not have any error in it. The tag\_out indicates which tag was identified at the given time. The four input messages are differentiated into received crc, ID, generator, and parity. The status bit sbit=0 indicates that the crc and the new\_crc are equal. Hence, there is no error in the incoming messages. Here, tag\_kill is zero, which means the unidentified tags are killed after the tag identification process. The tag\_out shows the active tags are coming out serially starting from the smallest tag to the largest tag. Here, the clock clk=1 and reset rst=0. The status bit sbit=0 indicates that the crc and the new\_crc are equal. As rrcr=ncrc, there is no error in the incoming messages and the tag reader will get the message signals serially.



Fig 5.5 when the sbit=1

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If the tag\_kill=1, then it means that the incoming message from the p2s module does have an error in it. The status bit sbit=1 indicates that the crc and the new\_crc are not equal. Hence, there is an error in the incoming messages.

## VI. CONCLUSION

The primary goal of this project is to present an efficient preventive collision technique that has a small area, is cost efficient, and has low power consumption. The preventive collision method shown here consists of two subsystems. The first subsystem is PreRCEAT that uses the cyclic redundancy check approach to find if the incoming packets have any error. The second subsystem, PostRCEAT, identifies the packets that do not contain any errors and give the serial output with the use of the parallel to serial approach. The algorithm for the preventive collision technique is synthesized using Xilinx ISE.

The device utilization summary shows that the number of slice flip-flops used is only 4% of the total available flip flops, and the four input LUTs used are only 4% of the total available LUTs. These outcomes demonstrate that the proposed architecture requires a small cell area and uses fewer gates. The time analysis results show that the minimum time needed for input is 21.849ns, and the maximum output time required is 7.244ns. As a result, the implementation and operating costs will be minimized.

## VII. FUTURE SCOPE

The active architecture can be implemented on hardware to overcome problems in real life scenarios such as in metro stations and bus transportation. In these situations, a number of passengers with unique ID cards will be able to check-in simultaneously on a single available RFID, thus saving time during the check-in process. Other improvements can be obtained through the use of high-end tools such as Cadence Virtuoso, to calculate the exact area (in nm<sup>2</sup>) required by the proposed architecture.

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