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Comparative Study of Types of ALOHA Protocol for RFID used in IOT

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Abstract - Internet of Things or IOT is now a smart platform which requires the devices like RFID tags and readers to uniquely identify the devices and have communication among them over the Internet. For reliable and secure transmission of data RFID processes have to follow some of the protocols like ALOHA. The working principle of this Protocol is explained here with its two types and compared with all their advantages and disadvantages.

***Key Words*:** Internet of things (IOT), RFID, RFID tags, RFID Reader, Protocol, Pure ALOHA, Slotted ALOHA

1. INTRODUCTION

Internet of thing (IOT) is nothing but the interconnection and interaction of uniquely identified devices within the existing internet connectivity. IOT offers connectivity of devices and services which does not require machine to machine connectivity. In the process it uses variety of protocols, domains and applications.

Things in IOT can refer to wide variety of devices in our day to day life such as smart appliances, agricultural equipment, healthcare monitors, manufacturing devices, surveillance camera, security systems, smart homes and connected smart cities.

2. IOT with RFID and ALOHA Protocol:

IOT is about interaction between things and users with the help of electronic device like sensors. Both things and user have to be uniquely identified in order to have a communication between them. Various other entities are involved in the process of their interaction and they are part of an IOT system and identification also plays an important role relevant to them. And identifier is a pattern which uniquely identifies an entity or entities within specific contexts. One of the identification schemes is radio frequency identification (RFID).

RFID Technology:

The most popular identification procedure in IOT in today's trend is radio frequency identification (RFID) which overcomes most of the issues of traditional IOT systems identifiers.

RFID is the wireless identification process which is used to bind devices with unique serial number encoded within a tag. RFID system consists of the RFID tag. RFID tags are nothing but the devices called as transponder. The transponder remains with the object which has to be identified.

RFID tags can be recognized using the readers even when they are not visible in direct line of sight. The communication between special tag and the Reader happens with the help of radio frequency.

RFID are attached physically to the device which requires an identification in the process.

Principle of RFID communication:

RFID works on the principle of wireless communication technology. RFID uses radio frequency for communication between the RFID tag attached on a device and RFID reader that identifies the unique RFID tag which can be used for identifying and tracking the attached object.

RFIDs are attached physically to the device to which unique identification is required. The tag saves a unique serial number that identifies the object and some additional data which can also be kept on the device along with the serial number for more detailing, if required.

RFID signals are used by the tag to communicate the message to the Reader. The two logical states represents state 1 and 0 (ON and OFF) are used for this purpose.

With the help of load modulation, the communication between the tag and the Reader takes place.

The microchip located at the tag stores the unique identity of the chip. The processor is used for reading the load modulation and operation of the switch.

RFID provides contact less identification of devices at low cost. When the device comes within the range of RFID reader, readers read this data on the tag using radio frequency even without the actual contact.

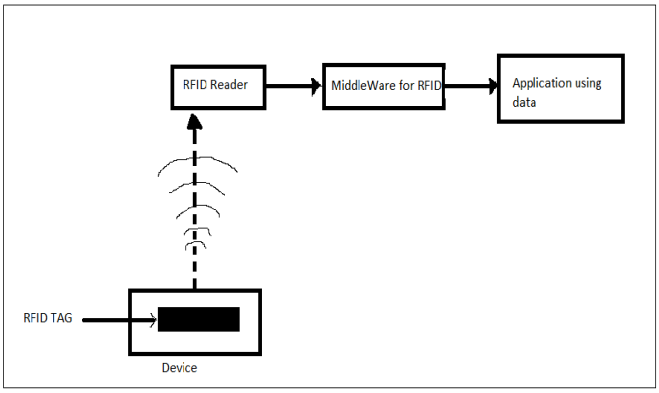

Figure -1: RFID Communication

Protocols in RFID:

RFID tags and readers must follow the mutually agreed communication protocols so as to achieve secure and reliable data transfers.

In networking, stations may communicate using either point to point links or broadcast links. Out of which, broadcast link is a common link to which multiple stations are connected. The link is shared among several stations. Access control is needed in such cases to deal with the collision.

There are various access control methods such as Time Division Multiplexing (TDM), Polling, CSMA/CD, Token passing and ALOHA.

Protocol ALOHA:

ALOHA is a Hawaiian word which was used for the name of Protocol developed in University of Hawaii in early 1970s for the computer networks.
The ALOHA algorithm is used for collision resolution which is based on Time Division Multiple Access (TDMA). There are two basic types of the ALOHA Protocol: Pure ALOHA and Slotted ALOHA.

Pure ALOHA:

It allows the central stations to transmit frames at any time as per the requirement. After transmitting the data frame, central station waits for some time which is considered as back off time.

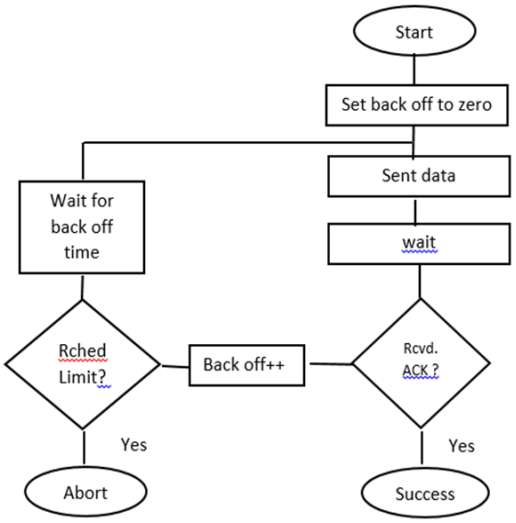

Figure 2: Flowchart showing Pure ALOHA Working

The back off time is initially set to zero, but it is assumed to have certain value in the entire process of communication. There can be two cases in pure ALOHA as follows:

1) When back off time is zero and the data frame is sent, it waits for the acknowledgment to be received. Once received, it works as a successful transmission.

2) When transmitting station is not receiving any acknowledgement, then it waits and back off time is incremented. The data frame is sent again. This repeats till the back off time elapses. When no acknowledgment is received even after the decided back off time goes beyond the limit, then the station considers it as unsuccessful and is aborted. In this case, it is assumed that the transmission is not successful.

In Pure ALOHA, if the throughput per frame time is 'S' and attempts per data frame is 'G' then $S = Ge^{-2G}$. The same is graphically depicted as follows:

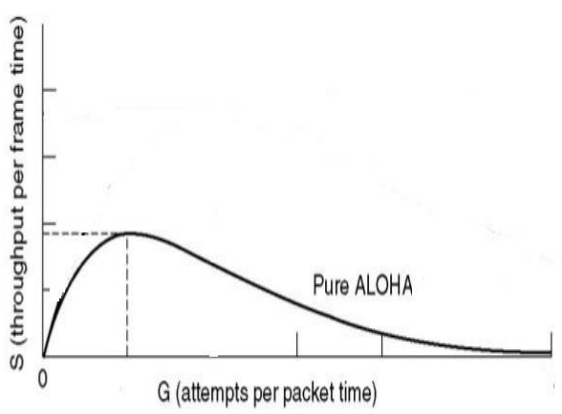

Figure 3: Throughput in Pure ALOHA

Slotted ALOHA:

In Slotted Aloha Protocol, concept of dividing the shared channel into slots is introduced. The time of transmission channel is divided into discrete slots.

When multiple stations are transmitting data frames, station can transmit its data in of the any time slot.
The rule which is followed here is that the station must start the transmission from the start of the time slots and not in between.

If the start of the time slot is missed by some data frame, then station has to wait until the next time slot begins.
In case, if two or more stations are transmitting data frame from the start of the same time slot, then there can be a state of collision in case of slotted ALOHA too.

In Slotted ALOHA, if the throughput per frame time is 'S' and attempts per data frame is 'G' then $S = Ge^{-G}$. The same is graphically depicted as follows:

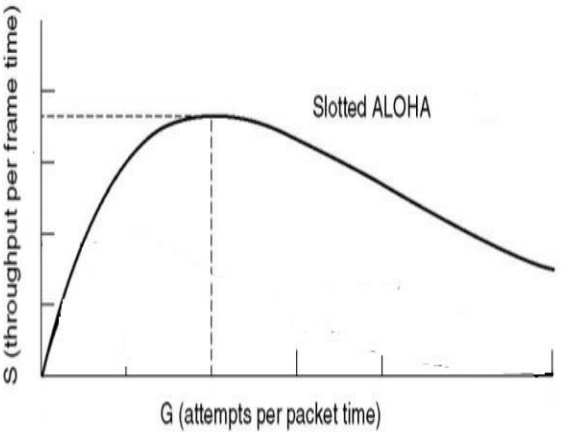

Figure 4: Throughput in Slotted ALOHA

Comparing Pure vs. Slotted ALOHA:

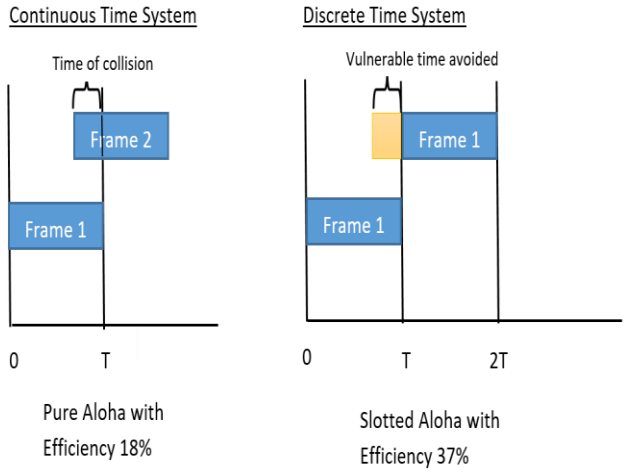

Figure 5: Pure ALOHA vs. Slotted ALOHA

1. Transmission can start at any time in Pure ALOHA where as it has to start at the beginning of a time slot in slotted ALOHA.
2. Efficiency is almost doubled in case of Slotted ALOHA over Pure ALOHA.
3. Vulnerable Time of collision is reduced to half in Slotted than in Pure ALOHA.
4. The advantageous factor in Pure ALOHA is its easy implementation than Slotted ALOHA.

3. CONCLUSIONS:

ALOHA protocol is used while multiple transmission of data frames by transmitting stations to Central system is required. When compared the two types as Pure ALOHA with Slotted ALOHA, it can be understood that, though the implementation of Slotted ALOHA is more complex as compared to Pure ALOHA, in case of Slotted ALOHA, the vulnerable time of collision is reduced to half and overall efficiency is almost doubled than Pure ALOHA.

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