DIGITAL ELECTRONICS

TERM PAPER

RFID BASED ACCESS CONTROL

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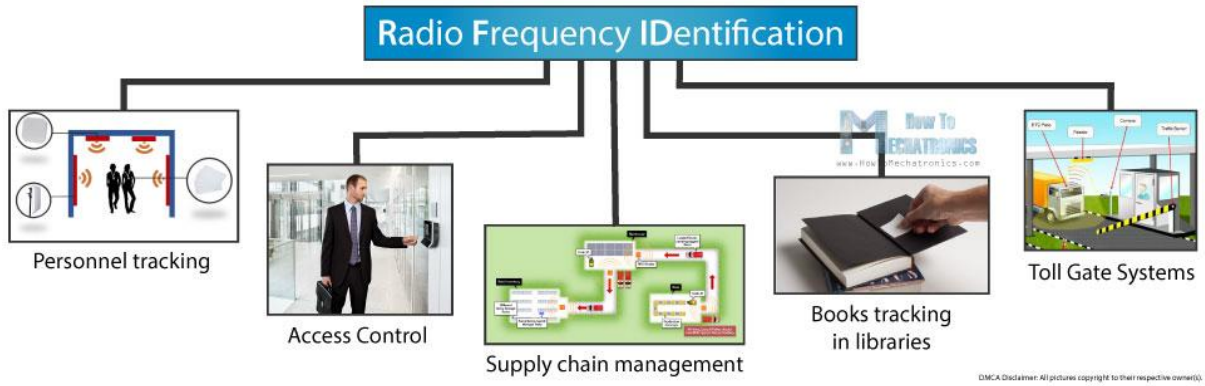
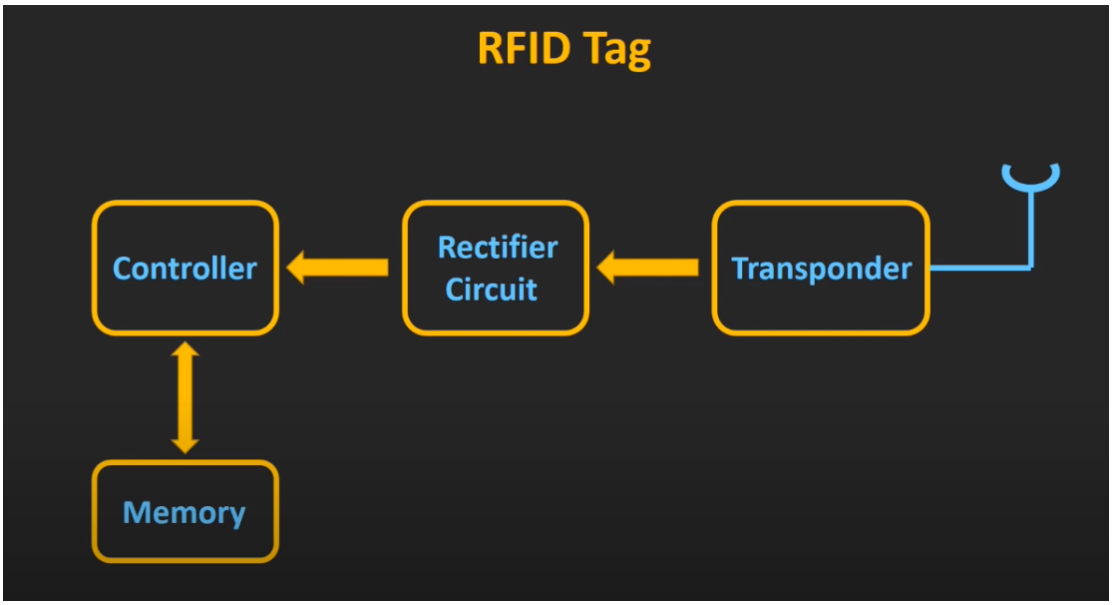
Introduction

In this term paper we will go through the following topics related to Radio Frequency Identification based access control:

- RFID tags.
- RFID readers.
- Near field coupling.
- Far field coupling.
- Applications.



RFID Tags



There are three components of RFID tags: a microchip (an integrated circuit that stores and processes the information and modulates and demodulates

radio frequency (RF) signals), a signal receiving and transmitting antenna and a substrate. The tag information is contained in a non-volatile memory.

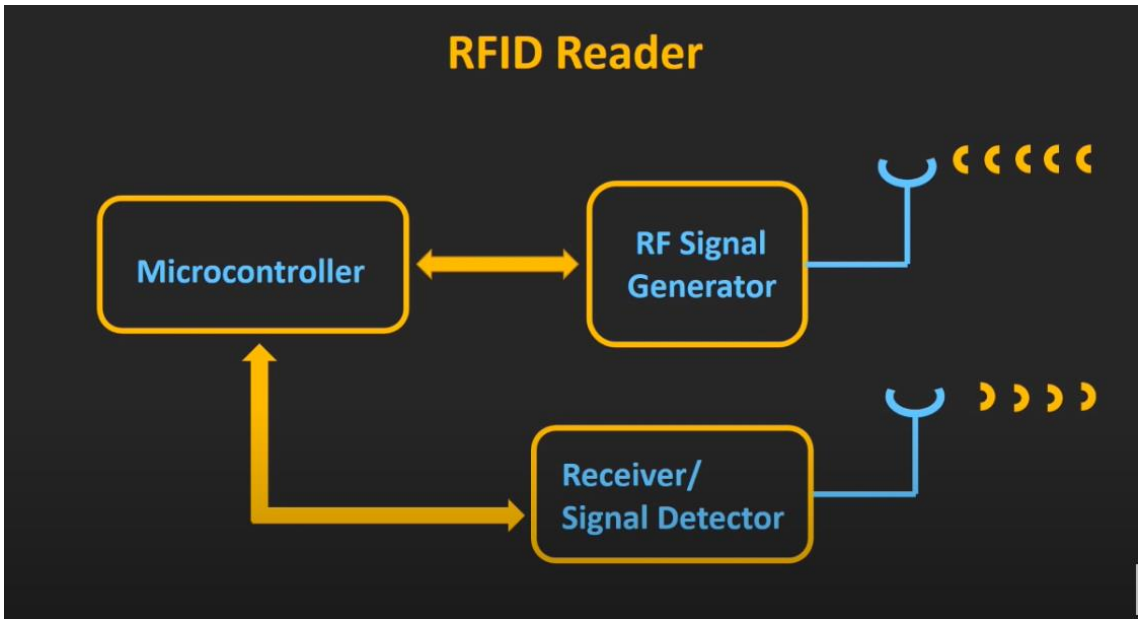
The RFID tag comprises either fixed or programmable

logic for the transmitting and sensor data processing, respectively.

RFID tags are categorised as passive, active or passive, battery-assisted passive. An active tag features an on-board battery and transmits the ID signal regularly. A passive battery-assisted system has a small battery on board which is enabled when an RFID reader is present. Since a passive tag does not have a battery it is lighter and has low cost, instead, the tag uses the radio energy the reader transmits.

It must, however, be illuminated with a power level approximately a thousand times higher than an active signal transmitting tag in order to work a passive tag.

RFID Reader



A Passive Reader Active Tag (PRAT) device has a passive reader that only receives radio signals (battery powered, transmitting only) from active tags.

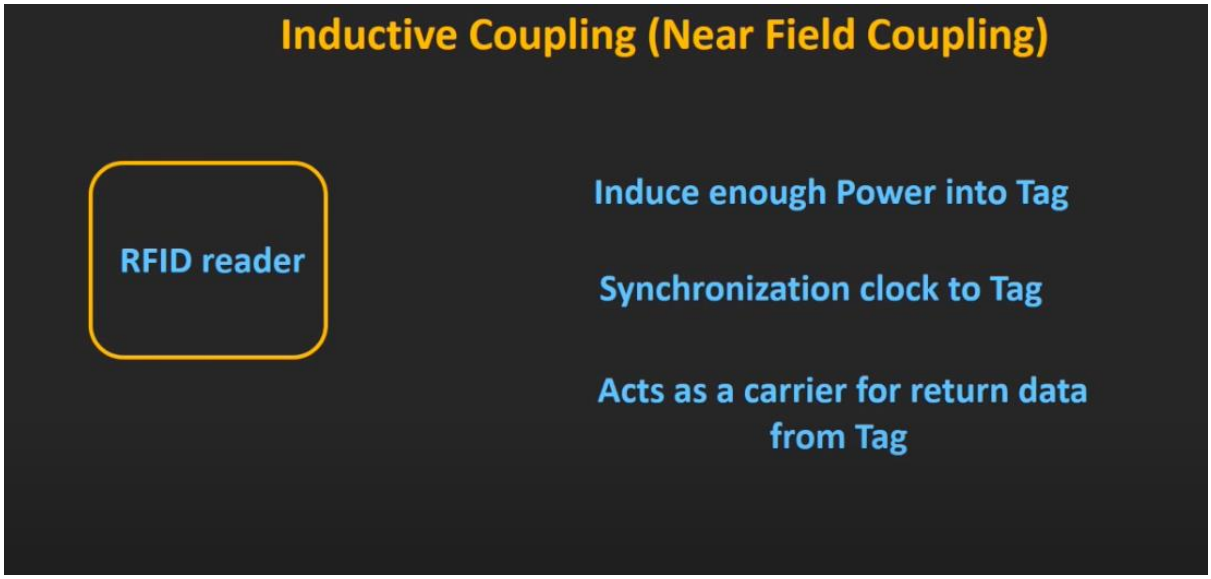
An Active Reader Passive Tag (ARPT) device has an active reader that transmits interrogator signals and receives passive tag authentication responses as well.

An Active Reader Active Tag (ARAT) device uses active tags that are awakened by an active reader interrogator signal. A Battery-Assisted Passive (BAP) tag that functions like a passive tag but has a small battery to control the return

reporting signal of the tag may also be used for a variant of this device.

The RFID reader can also perform some other technical procedures like acting as a power supply for the tag, helps derive synchronization clock for the tag circuit (i.e. the controller) and acts as a carrier for return data from tag.

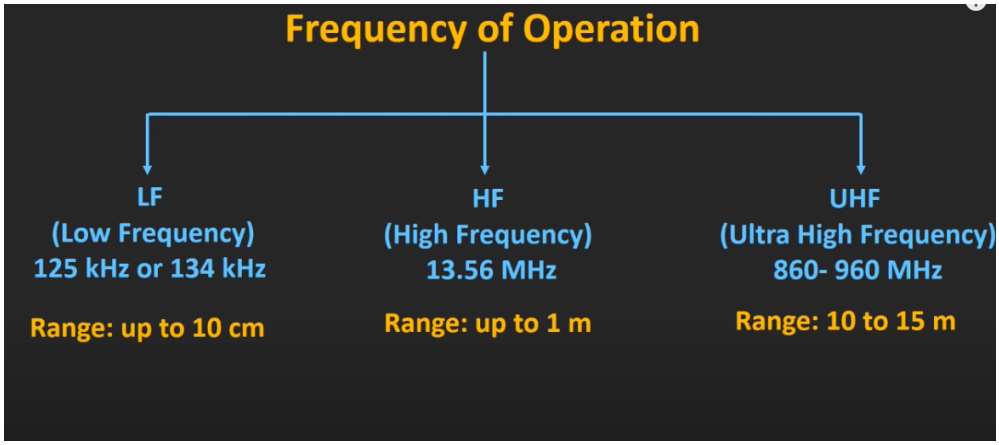
Usually these days we use active reader passive tag.



Working Principle of Near Field Coupling:

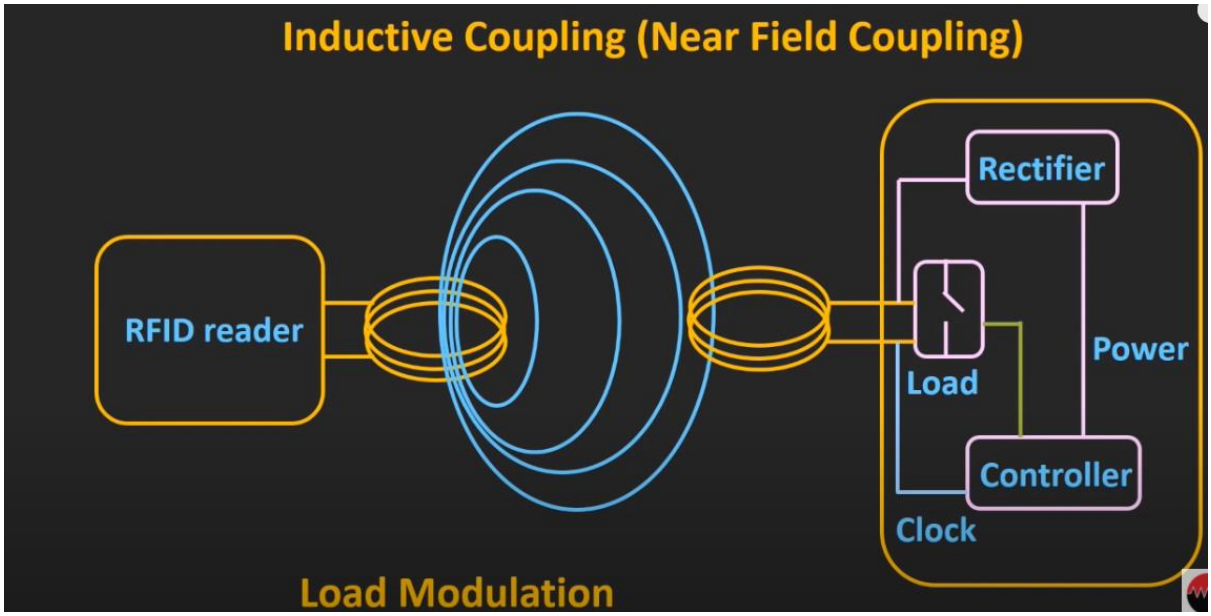
There are two types of frequencies that can be used for tags used in RFID based access control, the two types of frequencies are:

- Low Frequencies - 125KHz or 134KHz.
- High Frequencies – 13.56MHz.



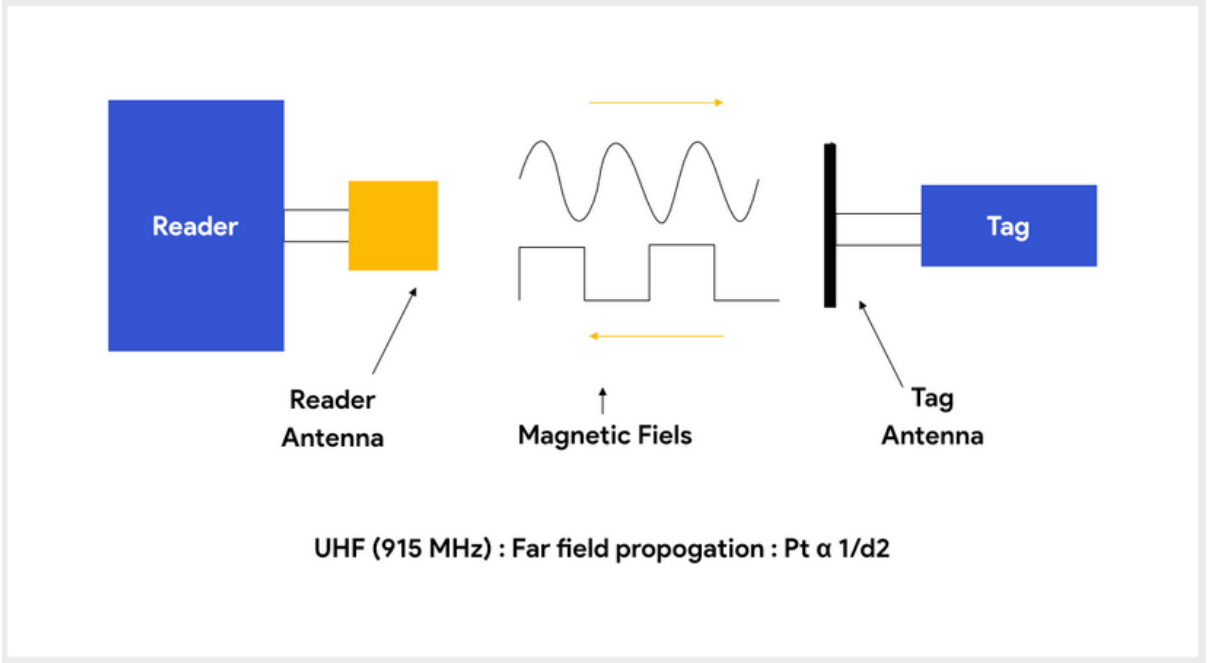
The tags using LF should be in a range of 10cm of the RFID reader and the tags using HF should be in a range of 1m of the RFID reader.

The working principle used in tags using LF or HF is inductive/near field coupling. Here we use inductive coupling since the distance between the tag and the reader is very less.



In inductive coupling, the field generated by the RFID reader will get coupled with the antenna of the tag. This mutual coupling will result in an induction of some voltage across the coil of the tag. Some amount of the induced voltage will be rectified to be used as a power supply for the controller and some memory elements. The voltage induced in the tag due to inductive coupling will be of a certain frequency, and this induced voltage is used to derive a synchronization clock for the controller. This controller is responsible for switching the load on and off. The current induced in the tag circuit will pass through the load, when the load switched on and off in a synchronized manner, i.e. according to the data stored in the tag, then the reader will be able to read the data stored in the tag in the form of voltage. This process is known as load modulation since the load will modulate the carrier frequency switching on and off.

Far-Field Coupling



UHF-The distance between RFID reader and Tag is up to a few meters

The coupling between reader and coil will be far field coupling. The RFID reader continuously propagates radio wave of ultra-high frequencies towards the tag and in response this tag sends weak signal to RFID reader. This weak signal is called backscattered signal. The intensity of the signal depends on load matching. If the load is matched exactly the intensity is high.

An electromagnetic field transmits outward from reader's antenna out of which a small proportion enters the tag's antenna. The energy is supplied to the antenna connections as high-frequency voltage, and after rectification by diodes,

it can be used to power the tag or activate or deactivate the tag.

The antenna reflects some proportion of the incoming RF energy and reradiates it outwards into free space. . This weak signal that is reflected back is called backscattered signal. The intensity of the signal depends on load matching. If the load is matched exactly the intensity reflected back is high.

The performance of antenna in terms of coupling depends on the amount of power reflected RFID tags that use backscatter to respond to their readers have antennas that are designed to resonate well with the carrier signal emitted by the reader.

By altering the load attached to the antenna, the reflection properties of the antenna, its efficient cross-section, can be affected. A load resistor linked in parallel with the antenna is turned on and off in time for the data stream to be transmitted in order to relay data from the tag to the reader.

The tag makes itself a strong or weak reflector by adjusting its antenna 's resonant properties. The frequency of the signal reflected from the tag varies, producing a pattern that is detected as data by the reader. This approach is known as modulated backscatter.

Signal goes through forward loss and backward path loss, multiple modes of interference in both directions, and absorption by the tag to power it before the backscattered signal arrives at the reader’s antenna.

The reflected signal also passes from the initial signal in the opposite direction through the reader's antenna link.

Using a directional coupler, it is decoupled and passed to the reader's receiver input. The transmitter's forward signal is suppressed by the directional coupler to a significant degree.

Application of RFID based Access System

1. Securing student accommodation
2. Airport security
3. Access control in hospitals
4. RFID Tags: Securing the Internet of Things
5. Easy-to-integrate wireless access control tech inside a stylish door handle

References

- https://www.ifsecglobal.com/global/rfid-access-control-explained/
- www.research.com

Acknowledgement

We would like to humbly express our gratitude towards our teacher Prof. Pimal Khanpara and Prof. Preksha Pareek for giving us this amazing opportunity to explore and learn. We would also like to mutually acknowledge the efforts of each other in putting together this project and would like to thank each other for the same.