Lesson Title: Singulation

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Rationale
Why is this lesson important? Why does the student need this lesson? How does this lesson fit in the larger module?

A reader needs to communicate with a single tag in the presence of multiple tags. This process is called singulation in an RFID system. The student needs to understand the two major techniques used in RFID to share the communication medium because it affects the performance of the system as well as the security.

Objective(s)
What will the student know, be able to do, and value at the end of this lesson? This is smaller amounts of information than the module objectives.

The student will be able to list the two major anti-collision techniques used in RFID to share the media, evaluate the efficiency of the framed slotted Aloha algorithm, and describe the Q-protocol used in EPCglobal UHF Gen2.

Exploration
Explicit concepts related to the Module goal are explored. It is at this point that the student will be provided basic information about the topic and the chance to explore some basic concepts about the topic. This is where the instructor imparts information.

- Define singulation: Singulation is the process that a reader performs to identify and/or communicate with a particular tag in the presence of multiple tags that are in range of the reader.
- Define anti-collision algorithm/protocol: An anti-collision protocol is the protocol used to prevent two or more devices from interfering with each other in a common communication channel to share the medium. They are also called medium access control (MAC) protocols.
- Access methods
  - Permanent assignments
    - TDM
    - FDM
    - CDMA
  - On-demand
    - Polling
  - Random access
- Pure Aloha
- Slotted Aloha
- Framed slotted
- Query tree
- Q-protocol used by EPCglobal UHF Class-1 Generation-2 (Gen2)
Reflection
Several questions are posed to the student to answer and then often discuss as a class. This is an attempt to determine whether the student "gets" the basic concepts delivered above. If they do get it, move on to engagement. If they do not get it, go back to exploration above. It could be as simple as asking a few probing questions or as complex as asking the student to write a paper.

- Which is more efficient, pure or slotted Aloha?
- What is the difference between slotted Aloha and framed slotted Aloha?
- What is the difference between the query tree and framed slotted Aloha anti-collision algorithms?
- Name the different phases of the Q-protocol used in Gen2.
- When is it advantageous to use the query tree algorithm?
- When is it advantageous to use the framed slotted Aloha algorithm?

Engagement
Concepts learned in the Exploration are further developed by conducting experiments, designing and building solutions, and solving problems. This is an attempt to cause the student to apply the new knowledge. By applying the new knowledge, the student is much more likely to retain this information. This engagement could be accomplished through a debate, an experiment, a problem solving activity, or anything else that would cause the student to demonstrate understanding and competence.

- Homework assignment
  - Plot pure Aloha, slotted Aloha, and framed slotted Aloha for varying offered traffic.
  - Manually demonstrate a simple query tree algorithm for a given set of tags that are in range of a reader.
  - What does the reader do if there are too many collisions when using the Q-protocol?

Expansion
Provide opportunities for students to expand the concepts to more general or global situations including connection to the Module goal. Expand back to the big ideas of the module and prepare for the next lesson.

- Can you explain a real-world situation that explains why Gen2 supports both a query tree and framed slotted Aloha protocol? Think about dynamic changes in tag populations.
- If you know the number of tags that will typically be in the range of a reader, how many slots should there be?
- Can you think of a threat that would confuse the Q-protocol?

Lesson Assessment
Assess student understanding of the lesson content. This does not have to be a full-blown examination. It could be a graded homework assignment, a quiz, a performance examination, a graded problem solving activity, or something similar.

- Homework assignment

Equipment
- None
Software

- None

References

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