2009 Paper 7 Question 1

Additional Topics

(a) Briefly describe what is meant by *active* and *passive* RFID tags. [2 marks]

(b) Some RFID manufacturers now produce *semi-active* RFID tags, where a battery is used to power the microelectronics but backscattering is used for all radio communications. Give *two* advantages and *two* disadvantages of such tags. [4 marks]

(c) Consider a typical binary tree search applied to identify all RFID tags within range of a transmitter. Each request takes the form [**REQ** | **F** | **X**], where REQ is a c-bit command ID, F is the $f < K$ filter bits and X is a $(K - f)$ bit sequence of 1s. Any response then has the form [**RESP** | **F** | **I**], where RESP is a c-bit command ID, F is the first f bits of the replying tag's ID and I represents the remaining $(K - f)$ bits of that ID.

In an attempt to increase efficiency, a manufacturer proposes that the reader just send [**REQ** | **F**] and the tags immediately respond with [**I**].

(i) What addition would you have to make to the communications protocol for this to work? What would its overhead be in bits? [3 marks]

(ii) Derive an expression for the proportional reduction in search time that this new scheme would provide. Estimate the value of the ratio for a typical tag on the market today. [5 marks]

(d) In a probabilistic RFID scheme, the reader transmits the number of slots in a round, N. RFID tags choose a slot uniformly at random and transmit their ID in it. Suggest how to estimate the number of tags in range based *only on one round* at the reader.

[Hint: Consider the expected number of slots with a given property such as being empty or containing a collision.]

[6 marks]