

Project from DKE Group:

Shortest Path Convergence Problem for RFID Tagged Objects – an RFID Network Simulation Project

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RFID Network is believed to be becoming an internet in the real world, where Readers and tagged objects are interactive to each other in a way similar to the Routers and Datagrams in the Internet. The study on the RFID network behaviours is still in its early stage.

This project is to use computer simulation techniques to simulate the behaviours of RFID networks with ability of re-configuration in large or small scales.

Particularly this project will create a prototype to resolve the following problem: Given a network of RFID Readers and a set of RFID tagged objects sequentially delivered (produced) to the network with their individual intended end-to-end travelling locations, how to direct each RFID to the next hop in the network in order to travel to the destination at a shortest distance and within a shortest time? We assume that a network structure is represented by a graph. The distances between Readers are marked on the directed edges and the readers are represented as nodes in graph. Each node has a limited capacity for its storage and each edge has a maximum capacity for its transportation. The functions of RFID Network Management and RFID Data Management are considered at a minimum level.

The above problem can be sensible in following applications:

- **Airliner Luggage Handling** – The tagged luggage can be switched to different flights to continue their journey. Every piece of luggage has predefined end-to-end travel plan and with the limited time to travel. The flight has the maximum capacity associated with the number of tagged luggage.
- **Supply Chains Streamline** – The tagged product need to be transported to different locations, similar to the luggage handling problem. Different RFID tagged parts will be assembled and redistributed in the network and their transportation should be streamlined.
- **Automatic traffic control** – If every vehicle is tagged, then the problem is also an end-to-end shortest path finding problem with time and capacity constraints. The traffic lights can then be automatically controlled for resolution of traffic jams. The shortest path problem in a traffic jammed situation then will need to be resolved with the consideration of time constraints and the road capacity.

The main challenges can be summarised as follows:

- Discovery of the shortest path within the time constraints in one scan of data.
- The early prediction, detection and prevention of the traffic jam.
- Automatically balance of the traffic.

Assumptions:

- The movements of RFID tagged objects are coordinated with or controlled by the RFID data management systems.

The Basic Requirement of the Simulation Prototype

- The system should be scalable for the large or small number of RFID tags.
- The system is dynamically re-configurable for the different types of readers and different types of topologies.
- The system should be able to visualise the dynamics of simulated RFID network. All relevant data will be available for online query.
- The user interface should allow drag-and-drop activities to design an RFID network.

The preferred background knowledge for doing this project is: Data Structures and Algorithms, Programming skills, Discrete Mathematics.