

Chapter 4

Evaluation of RFID Tag Anti-Collision Algorithms in Supply Chain Automation

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ABSTRACT

Radio Frequency Identification (RFID) is a technology that uses radio frequency signals to identify tagged objects. RFID is an important technology used by the Internet of Things (IoT) applications. This technology enables communication between the main devices used in RFID system, the reader, and the tags. The tags share a common communication channel. Therefore, if more than one tag tries to send information at the same time, the reader will be incapable of differentiating these signals in the case of radio signals interference. This phenomenon is known as tag collision problem. The problem of tag collision is one of the major disadvantages for fast tagged-object identification in supply chain management. This chapter describes four different types of binary search algorithms for avoidance of tag collision, and then presents a performance measurement mechanism for RFID application system. Finally, simulation-based experimental results on the performance of these algorithms are presented.

INTRODUCTION

Production in modern economies is organized around supply chains, which involve business processes ranging from product design to customer delivery. In a typical supply chain, raw materials are purchased from suppliers and products are manufactured at one or more production plants (Pal, 2017) (Pal, 2018). Then, they are transported to intermediate storage facilities (e.g. warehouse, distribution centers) for packing and shipping to retailers or customers. In this way, a supply chain consists of business entities in the chain and these are the suppliers, manufacturers, distributors, retailers, and end-customers. The ultimate performance of any supply chain is governed by the business practices and corporate behaviors of the involved stakeholders, such as suppliers, manufacturers, transport service providers, technological infrastructure suppliers, and enabled by public policies and business environment.

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Moreover, all supply chains share the following characteristics: (i) the supply chain comprises all business activities in order to supply a product or service to its end-customers; (ii) any number of supply chain partner organizations can be linked in the supply chain; (iii) a customer can be a supplier to another customer within the supply chain, which means that the total network of activities can consist of a number of supplier / customer relationships; (iv) the path from supplier to customer, depending on the products and markets, can include a number of intermediaries (distributors) such as wholesalers, warehouses, and retailers. Product or service flows from supplier to customer are called downstream flows while demand information from customer to supplier is called upstream flows.

In this way, a supply chain creates a complex business network. Given process decentralization, the efficient performance of a supply chain requires a high degree of visibility – defined as the capability of sharing on time and accurate data throughout the entire supply chain, and coordination among supply chain partners. In today's global business environment, companies recognize the strategic importance of well-managed supply chains. For example, companies such as Dell, Nokia, Intel, Toyota, Wal-Mart, Zara, and Li & Fun have based their corporate strategy around achieving supply chain superiority over competitors (Copacino & Anderson, 2003). These global companies have gained competitive advantages by effectively managing the complex web of supply chain process interactions that extend across continents and across enterprises in product procurement, manufacturing and distribution. The requirements of modern supply chains are:

- **Connectivity:** With emphasis on the ability to make and maintain connection between business partners. It characterizes the ability to exchange information within supply chain partners in a way which provides inter-organizational collaboration.
- **Integration:** The ability to connect and coordinate business processes in a seamless way. It improves supply chain business processes performance by establishing collaborative connections among supply chain partners. For example, seamless integration increases information transparency among partners and allows pooling of inventories and sharing resources.
- **Visibility:** Visibility refers to the capability to access or view data or information related to logistics and the supply chains. For example, visibility is the ability of knowing where raw materials inventory for manufacturing, semi-finished products in the production line, and finished products are, at any time. But it is also actionable information that can help support customers at different interface points along the supply chain and improve business processes performance.
- **Responsiveness:** It is supply chain ability to react quickly to customer needs or specifications by delivering a product of the right quality, at the right time, at the right place at the lowest possible cost.
- **Lean and Agility:** As an aspect of lean production, lean supply chain depicts the state of business in which there is a dynamic competition and collaboration of equals in the supply chain, aimed at adding value at minimum total cost, while maximizing end customer service and product quality. Agility in contrast, refers to the ability to reconfigure supply chains with minimum effort.

The increasing interdependence of supply chain processes and the multiplicity of actors involved in them suggest that the full benefit of information and communication technology (ICT) adoption, for example in terms of end-to-end visibility, flexibility and global optimization, can only be captured if all supply chain stakeholders are aligned and coordinated in their efforts towards digitally transforming the system.

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