# Application of Radio Frequency Identification (RFID) Technology in Goat Dairy Traceability

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**Keywords:** Radio frequency identification technology; Dairy goat breeding; Dairy traceability; Network architecture

**Abstract.** The goat milk wins its wide recognition and concern for its nutritional value, which overpasses milk and human milk. However, frequent food safety incidents, especially those of dairy products closely related to the health of infants and young children, affect tens of thousands of parents. To study and establish a dairy traceability system is an important measure to solve the dairy safety problem. Firstly, the needs of goat dairy traceability system are analyzed in detail. And then the model is established based on radio frequency identification technology, thereafter, a three-tier network architecture is established. The model and network structure can be used as reference for the practical engineering of goat dairy traceability system.

## Introduction

With the "school milk", "green milk" policy promotion, China dairy industry growth rate is as high as 25% to 30%, far more than the speed of development in other countries，which will undoubtedly create a miracle in the history of the development of dairy industry in the world. Modern research shows that，as far as the nutritional characteristics, including dry matter content, fat and protein content, mineral content and vitamin content, goat milk is more nutritious than cow milk, and the nutritional value of goat milk has been more and more attention.

However, in recent years, food safety issues, especially in the health of infants and young children's dairy safety problems occur frequently, which has aroused widespread concern in the community. In order to reap high profits, bad traders often add melamine and other harmful substances to raw milk and dairy products, resulting in repeated outbreaks of dairy safety incidents [1-2]. It is an important measure to solve the problem of dairy safety to carry out the traceability management of dairy farming and dairy products. As a new automatic identification technology, Radio Frequency Identification (RFID) has strong technical advantages, and has been proved to be more suitable than the bar code and two-dimensional code to solve the tracking and traceability of dairy quality [3-6]. The application of radio frequency identification technology in the accurate breeding of dairy goats, the establishment of the dairy goat breeding based on the radio frequency identification technology and the goat milk traceability system has broad market prospects.

In recent years, the agricultural products traceability system based on radio frequency identification technology has attracted wide attention [7-10]. Sahin[7] analyzed the performance of RFID based traceability system, Regattieri[8] studied the blood tracing system, Bernard[9] studied the feasibility of applying radio frequency identification technology to the agricultural product tracking chain. In this paper, the radio frequency identification technology is applied to the goat dairy traceability system, the system model is designed, and the design scheme based on the EPC_Global C1 G2 standard is studied.

## Goat Dairy Traceability System Model Based on RFID

**Goat Dairy Traceability.** Goat dairy traceability system includes dairy goat breeding, dairy processing and circulation. The traceability process includes two aspects, the tracking process from the farm to the consumer and the retrospect process from the consumer to the farm. The tracking process of goat milk is from the upstream of the dairy supply chain to downstream, that is, from the

dairy goat breeding to the consumer, following a specific product running path. The whole process of tracking information can ensure the flow of goat milk can be controlled, and problem dairy products can promptly limit their circulation or recall.

**Basic Structure of RFID System.** RFID system is divided into software system and hardware system. The hardware system is composed of three parts, such as reader, tag and back-end processing system, as shown in fig. 1. The reader and the electronic label use special wireless communication to transmit information, and the reader can not only read the label information anytime, anywhere, but also can write the necessary information. This work model provides a convenient and flexible access and information embedding mechanism for product traceability.

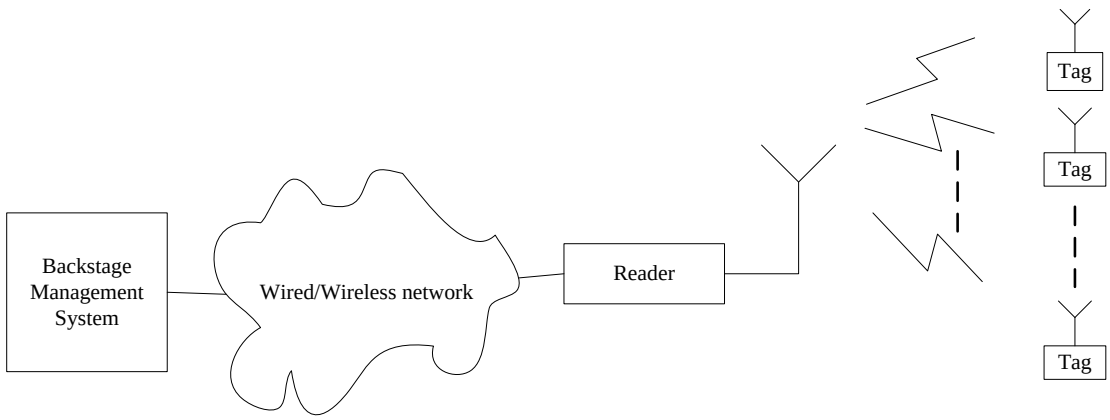


Figure 1. RFID system architecture

The special communication between the reader and the label generally uses ASK modulation, Manchester encoding (uplink) or FM0 encoding (downlink) and the necessary encryption method. The reader is composed of RF front-end, logic control unit and interface unit. The interface unit completes the exchange of information with the back-end management system. In addition to the function of transmitting and receiving signals, the RF front-end also undertakes the task of providing energy and clock for passive tags.Inductance coupling mode using the principle of the circuit, the circuit design is simple and low cost, usually used in the field of low frequency and high frequency RFID.

In contrast to the inductively coupled mode, the electromagnetic backscatter coupling method uses a radar model, usually used for UHF and microwave bands. In the electromagnetic backscatter operation, the electronic tag is located in the far zone of the reader. The electromagnetic wave emitted by the reader is reflected by the electronic label, and a special design is adopted to make the reflected electromagnetic wave carry the electronic product code (EPC) with the electronic label. In this RFID mode, the distance between the reader and the tag can range from 1m to 10m. The RFID software system includes all kinds of control software, application management software and middleware software.

**Goat Dairy Traceability System Model Based on RFID.** Goat milk system model based on RFID is shown in Fig. 2.

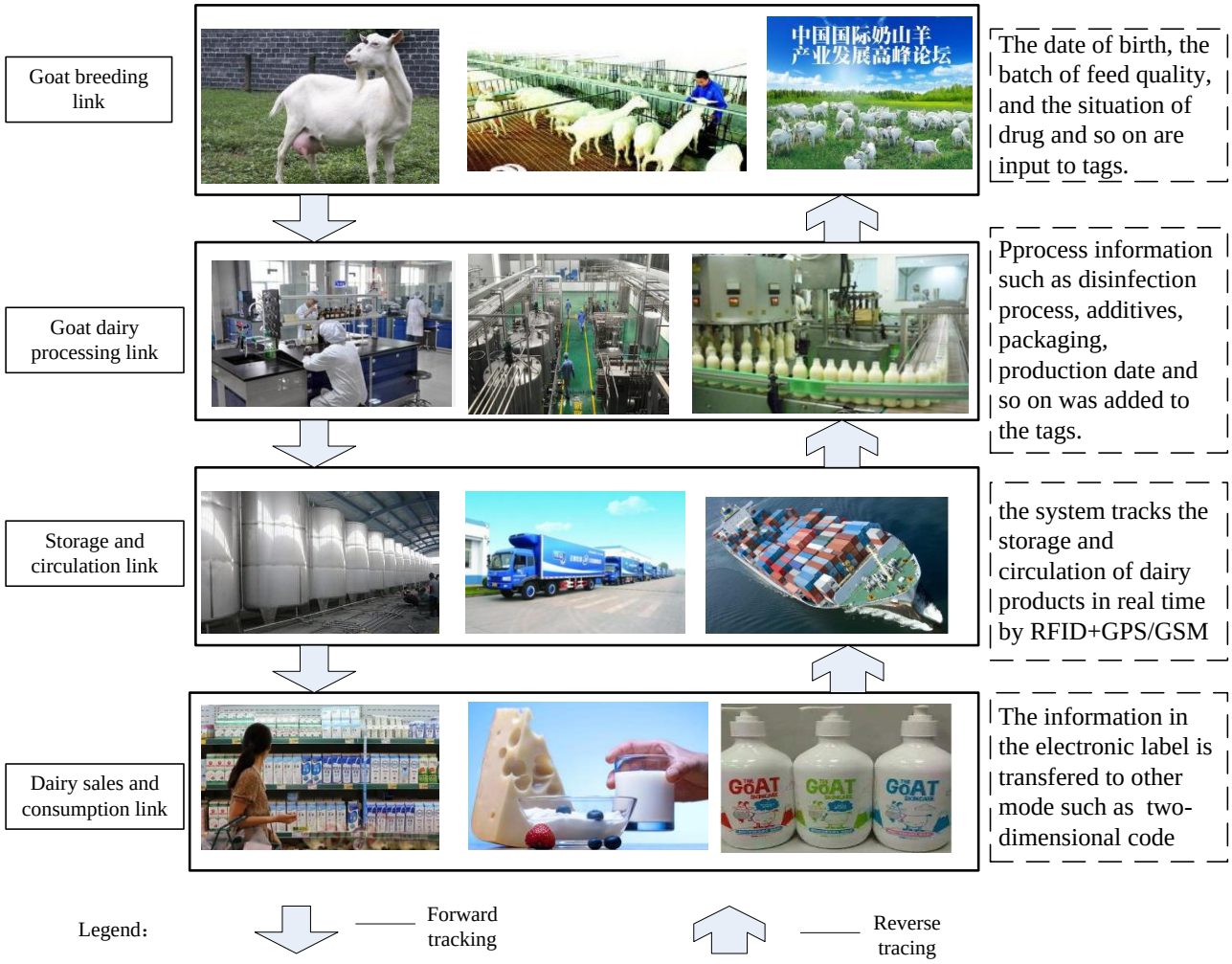


Figure 2. Goat milk system model based on RFID

The goat milk system model based on RFID mainly includes four links: goat breeding, goat dairy processing, dairy storage and transportation, circulation and goat dairy terminal sales and consumption. In the process of goat breeding, the feeding process of RFID was carried out, including the date of birth, the batch of feed quality, and the situation of drug use and so on. On the basis of feeding information, processing information was added to the tags in the goat dairy processing link, including disinfection process, additives, packaging, production date and so on. In the process of storage and circulation of goat dairy products, the system tracks the storage and circulation of dairy products in real time by RFID+GPS/GSM. In the terminal sales and dairy consumption link, terminal vendors transfer the information in the electronic label to the corresponding system, and relate to easily method, such as two-dimensional code, which can make the consumers can trace the whole process of dairy milk through mobile phone.

## Three Layer Network Structure Based on RFID

In order to realize the traceability and tracking of goat dairy products, the architecture of RFID based three layer network system is set up as shown in Fig. 3.

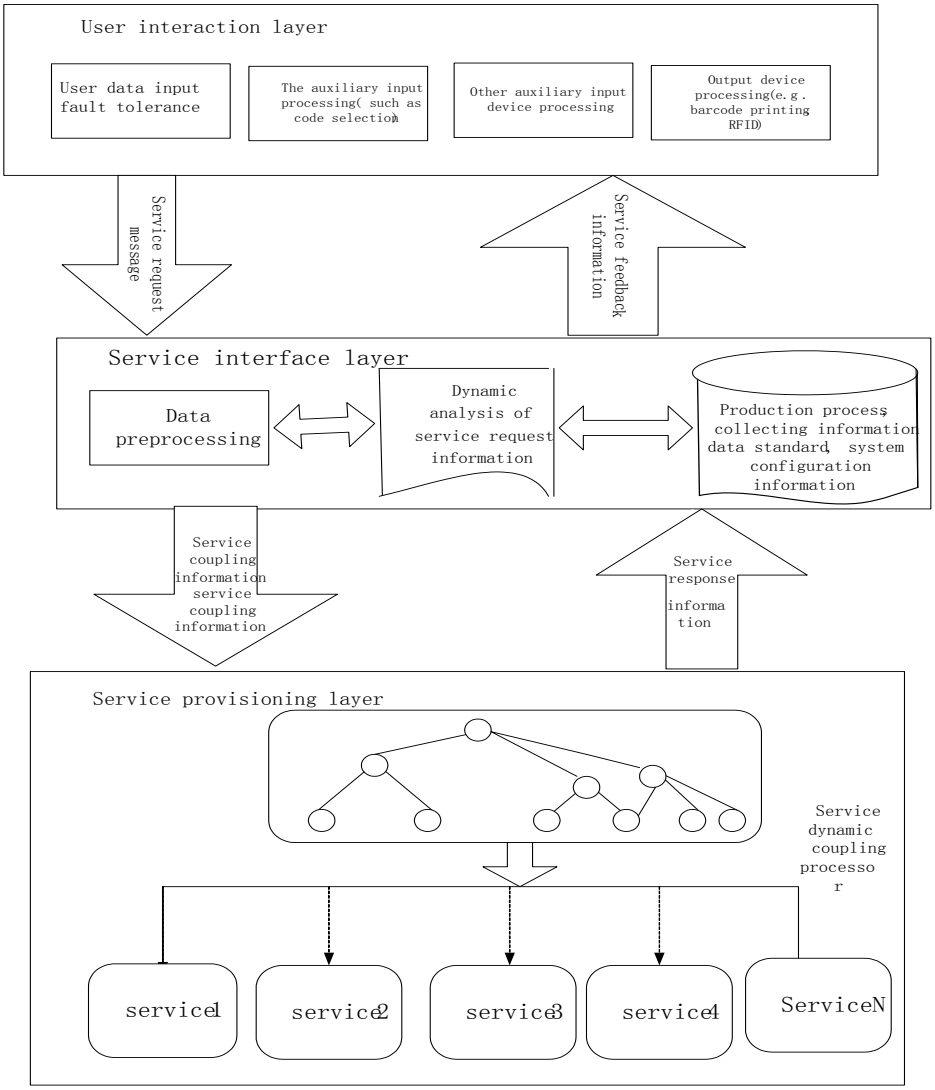


Figure 3. Three layer network structure based on RFID

Personalized service is for dairy goat breeding, acquisition, processing, distribution and marketing of all aspects of personalized information customization, which makes the traceability system can adapt to various complicated production process, information collection, processing and query statistics.

The traceability information collection system is used for the collection of the underlying information and the basic data management, including dictionary maintenance management, information collection, data upload, etc.

The data collection system is used to receive the enterprise data, summarize, data management, query analysis, generating traceability chain and data package uploading.

## Conclusion

This paper studied the goat dairy traceability system, established a traceability system model for dairy goat traceability, and puts forward the three layer structure of the network system based on RFID. The results of this paper have an important guiding role in the design of dairy goat tracking system.

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