

An Architecture Framework for RFID

*Steffen Schaefer, IBM Global Services
Technical Thought Leader EMEA Wireless Pervasive solutions
(steffen.schaefer@de.ibm.com)*

Business Background

The goal of Radio Frequency Identification (RFID) is to allow computers to Monitor, Decide, and Take Action without human intervention. RFID technology is proven technology and is widely deployed in such diverse application areas as transportation and fleet management, asset and document tracking and livestock identification. Much of the high volume container shipping and customer clearance procedures depend on the use of RFID to increase efficiency and security.

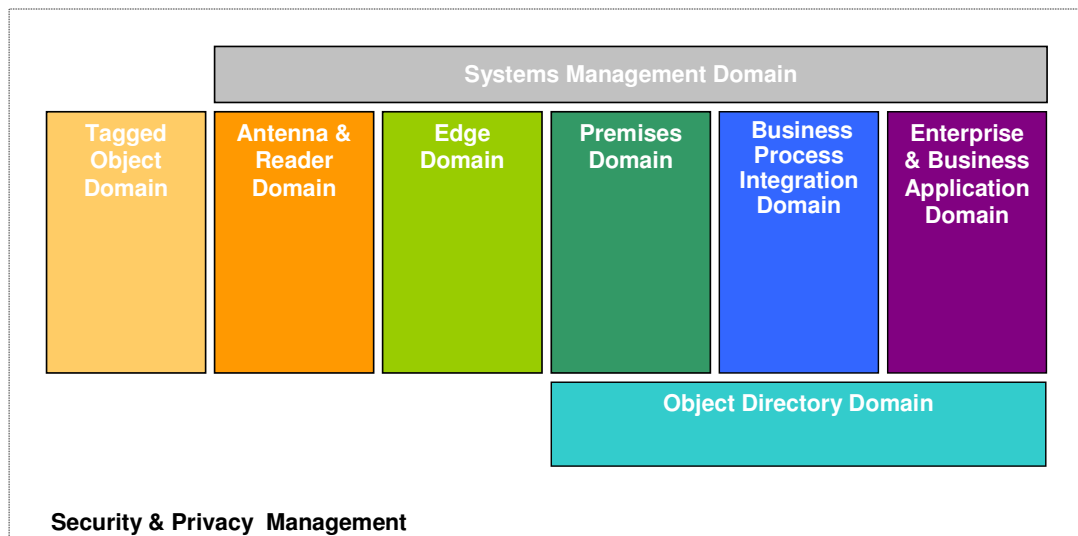
The idea is to enable computers to automatically sense product movement in the real world and to automatically make appropriate decisions about which enterprise applications need to be informed and which transactions need to be generated, for example to keep trading partners up to date. In an RFID-enabled world, humans can spend less time telling computers what is happening in a supply chain because computers can automatically sense product movement.

The role of the RFID Architecture Framework outlined below is to organize and manage RFID Infrastructure throughout the enterprise in order to capture data, create a “real-time” model in computer memory, and if necessary react to it.

Architecture Overview

RFID technology allows an object to be automatically recognized by attaching a radio transmitter to the product. RFID Infrastructure can detect the presence of these radio tags and can take appropriate actions.

The RFID Infrastructure can be broken down into distinct domains. A *domain* is a grouping of related hardware and software components. The following figure provides a graphical representation of the domains contained in the RFID Architecture Framework.



The **Tagged Object Domain** contains the tagged products in a supply chain; or any other assets or locations that are intended to be tracked or monitored, including the use of sensors on tags. Since object and tag are physically attached they are considered as components of the same domain.

In contrast to other domains, most of the artefacts in the Tagged Object Domain are mobile, i.e. can move across different RFID Infrastructures. This imposes strict interoperability requirements on those artefacts which would ideally be addressed through open standards.

The **Antenna & Reader Domain** is the interface between the world of physics (objects, tags, radio frequencies, etc.) and the world of IT. The Domain may include various technologies and frequencies, such as UHF, 13.56, Barcode, Gate or Pallet Readers. This Domain can also include writers, printers, sensors on readers, stand-alone sensors and actuators.

The Antenna & Reader Domain includes mobile devices that are connected over a wireless network. Those mobile devices always connect to the same Edge Domain, and thus to the same RFID Infrastructure, but security and discovery aspects need to be addressed.

The **Edge Domain** includes the functionality of filtering and aggregating volumes of data provided by the readers, supporting the analysis of data and applying local decision making and intelligence. This activity is at the edge of the network prior to forwarding data to the Premises Domain.

The Edge Domain is typically a low cost appliance just upstream of the readers and uses pervasive technology to establish a software stack on the outer edge of the RFID Infrastructure. One appliance controls multiple readers. It is organized hierarchically and provides assured message delivery into the Premises Domain, as well as automatic reader discovery and authentication.

The **Premises Domain** is the intermediary between enterprise applications and the Edge Domain. It compiles business sense of RFID read information and enables automatic decision making.

It further filters and aggregates, monitors and escalates RFID events to detect critical business operations, or tracks the location of physical objects. It also logs all important information on products and locations and manages 'downstream' components in other domains, such as readers or RFID controllers.

Premises are most typically hierarchical, in a sense that a head office coordinates subordinate premises. Business logic can be specific for a premise. As an example, a distribution centre for food could have different business logic from a distribution centre for hardware, although they belong to the same retail chain and are part of the same hierarchy.

The **Business Process Integration Domain** is a means to connect between enterprise applications and the RFID Infrastructure. While other domains provide a reasonable level of functionality 'out-of-the-box', Business Process Integration will typically require some customization to match a given enterprise environment to fulfil its function. It can therefore be described as a toolbox for business integration.

Another key feature of the Business Process Integration Domain is the ability to act as a business to business hub for transactions between trading partners.

The **Enterprise & Business Application Domain** contains the existing 'back end' (sometimes called 'legacy') components that require information about product movement that will be captured by the RFID Infrastructure.

Such capabilities correspond to an organization's unique mixture of supply chain management and business support systems. The Domain includes systems that help ordering, managing or supplying goods and that will be interested in the product movement information. Examples are ERP, Warehouse Management Systems, Inventory Management, Data Warehouse, Merchandise Management, Store Systems, and so on.

The **Object Directory Domain** contains components that provide information about the physical object using the ID as the lookup key. It can retrieve information about a product and allows companies to securely share product level information. Information can be on three levels of precision:

- on product / stock keeping unit (SKU) level
- on instance level, as known at time of manufacturing
- on instance level with track and trace history

The Object Directory Domain is a dynamic area, with various standards (i.e. EPC) and products evolving. A simple, and therefore initially a frequent, instantiation of the Object Directory Domain is a database lookup in an existing internal database of an enterprise.

A more sophisticated implementation will be required to enable secure, distributed track and trace across multiple trading partners.

The **Systems Management Domain** allows customers to remotely monitor, configure, and update software and firmware of deployed assets such as antennas, readers, and servers. It includes the capability to manage and deploy applications remotely in a distributed environment.

It also includes a central 'dashboard' through which it is possible to receive alerts when reader, antennas, and servers break down which will increase reliability and reduce operations costs.

Security & Privacy Management allows customers to extend the existing security infrastructure of an enterprise all the way down to readers. For the core security functionality, the infrastructure must protect both stored data and data that is in transit. The infrastructure will ensure that stored data is only accessed and modified by authenticated and authorized components and people, and that transmitted data will be sent with integrity and confidentiality controls to allow for detection of tampering, and to prevent eavesdropping.

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