A Reconfigurable Antenna Subsystem for the RFID Applications by Using Phased Array Antennas

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The popularity of Radio Frequency IDentification (RFID) in realistic applications has produced a variety of interference problems. Typical ones are the existences of metal structures in the neighborhood of reader or tag antennas, which cause strong electromagnetic (EM) scattering fields. To overcome these types of interferences, an antenna subsystem is proposed and developed for the RFID reader antenna applications at 2.45GHz in the near-zone tag detection. The term "near-zone" indicates that the application region can be relatively arbitrary and can be close to the aperture of a phased array antenna. The potential applications can be illustrated by the scenario of indoor product transportation system in the department stores, where the I/O management system is performed at a designated spot (or the detection zone). In this case, the tags on the commercial products will move on the transportation belt through a detection zone.

To resolve the above mentioned limitations, the near-field focused antennas (NFAs) and their extensions have been also proposed, where the beam spots are created within the target zone through a beam forming network (BFN). It may provide a certain degree of interference suppression at the cost of sophisticated BFN design especially when the sidelobe level (SLL) suppression is involved. However, it does not provide sufficient flexibility in the realistic implementation because the environment for RFID system may not be well known and justified.

A programmable antenna subsystem is thus proposed and presented in this paper. This subsystem is consisted of a phased array of antenna elements and a set of phase shifters as well as a control processor as those in the smart antennas. The unique feature of this subsystem is that the NFA spot beams can be produced arbitrarily through a computer program embedded in the processor. The spot area can be arbitrarily designated according to the system requirement and environment structures. Thus the RFID system can be implemented in a relatively arbitrary environment by simply performing a system configuration to create the desired spot beam. Also in the computer a sequence of spot beam can be produced in advance, and the antenna beam can be adaptively formed according to the mechanism in the computer program. As a result, not only the EM interferences can be relatively suppressed, the scan area can be widened in a sequential beam steering order over the detection zone. In this paper the system architecture will be presented, and an antenna prototype will be examined to validate the feasibility of the concept.