Low Power Rendezvous and RFID Wakeup for Embedded Wireless Networks

Milan Nosovic and Terry Todd
Department of Electrical and Computer Engineering
McMaster University
Hamilton, Ontario, CANADA
todd@mcmaster.ca

Abstract

In the future, embedded wireless networking will be included in many common, everyday objects. It is expected that this added functionality will enable an enormous variety of applications and services which have yet to be achieved or envisioned. Possible examples include sensor systems, smart toys and games, smart appliances, electronic access control, and a myriad of other in-home, business, and manufacturing applications. In many of these systems the embedded nodes will operate for long periods of time under limited battery power.

A technique for reducing power consumption in this type of system is to place nodes into a low power sleep mode whenever possible, and have them occasionally awaken to communicate with other nodes. This type of action is often referred to as a *scheduled rendezvous*, and can occur in a number of different variations. Scheduled rendezvous is a very strong power-saving technique, and has been included in past wireless protocols such as IEEE 802.11 [1] and Bluetooth [2]. Unfortunately, it is expected that many embedded nodes will operate at very low utilization, and yet the applications will require high levels of responsiveness. For this reason, an embedded node's power consumption may be heavily dominated by its rendezvous activity alone.

An alternative to scheduled rendezvous is to use a low power wakeup mechanism at the embedded node. Low power wakeup relies on the use of a low power radio circuit which can be activated by the basestation when communication with the node is desired.

In this paper we study the use of radio frequency identification (RFID) technology as a low power wakeup mechanism for embedded radio. RFID has many strengths in this regard. The technology is relatively mature, and reasonable data links are possible over picocellular coverage areas. RFID radios can currently be operated at power consumptions of roughly three orders of magnitude lower than those of typical commercial radios operating in the Mbps range [3]. In addition, RFID radios are very low in cost and complexity.

We first compare the regions of operation where RFID wakeup and scheduled rendezvous are preferred. A protocol is proposed which allows the basestation to block transmissions that may interfere with the wakeup process. We also include a global node wakeup protocol for comparison purposes, and propose a hybrid low power rendezvous wakeup protocol which attains very low power consumption. We find that in low utilization situations where a high level of responsiveness is needed, this type of system can achieve much lower levels of power consumption than scheduled rendezvous. The results also suggest that adaptive schemes are possible where the mode used is selected dynamically by the basestation.

References

[1] IEEE Standards Department. *"IEEE Draft Standard - Wireless LAN"*. IEEE Press, 1996.

[2] Bluetooth Special Interest Group. Bluetooth. http://www.bluetooth.com, 1999.

[3] J.G. Evans, R.A. Shober, S. A. Wilkus, and G.A. Wright. "A Low-Cost Radio for an Electronic Price Label System". *Bell Labs Technical Journal*, Autumn 1996.