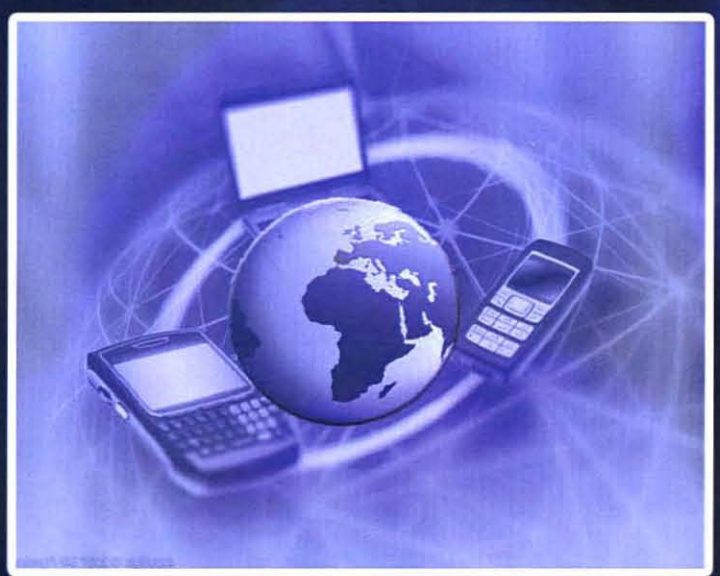
Research Issues in Wireless

Communications and Networking

Farhat Anwar
Wajdi Al-Khateeb



IIUM Press
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

Research Issues in Wireless Communications Networking

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Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Farhat Anwar & Wajdi Al-Khateeb: Research Issues in Wireless Communications Networking

ISBN: 978-967-418-149-9

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan
Tel: +6**03-6188 1542 / 44 / 45** Fax: +6**03-6188 1543**
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CHAPTER 21

Expository Analysis of the Design Requirements for Software Radio Architectures in Wireless Sensor Networks

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21.1 SOFTWARE RADIO ARCHITECTURE

In communication systems, we usually regard source codec, channel codec, and encryption/decryption as baseband, and antenna, power amplifier (PA), low noise amplifier (LNA), and ADC as radio frequency (RF) functions or front-end. Traditionally, to avoid sampling signals at very high frequency (around 2GB/s for many standards), which is over ADC's speed and resolution capability, signals usually are down-converted to intermediate frequency (IF) by a mixer before doing A/D conversion. There may be many IF stages and the typical frequencies would be 73.05 MHz, 8.83 MHz, and 455 kHz.

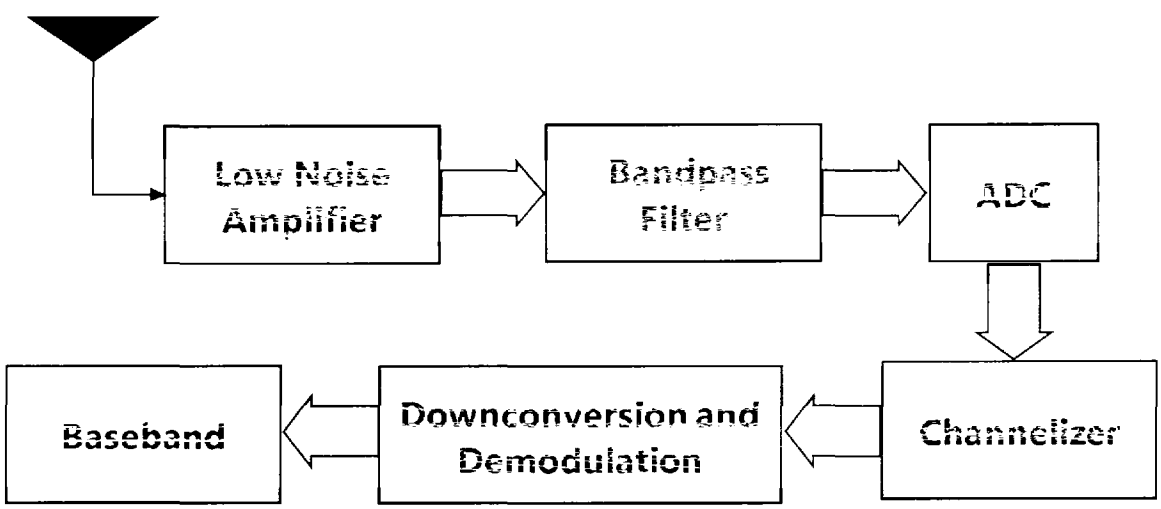

Figure 21.3: Architecture of a Generic Software Radio

Unlike today's radio functions being implemented in hardware, mostly application-specific integrated circuits (ASIC), radio functions in software radio systems are implemented in software. As shown in Figure 21.1, an ideal software radio places the ADC as close as possible to the antenna, right after the LNA and band-pass filter (BPF). Thus, after the ADC, all RF and IF functions can be performed digitally and run on a general purpose processors (GPP) like software to provide the full advantages of reconfigurability. However, ideal software radio implementation is relatively hard to fully accomplish by using today's technology. To achieve this goal, software radio needs to deal with wideband signals, meaning that the high speed processing is unavoidable. According to the Nyquist sampling criterion, the bottleneck is ADC and DSP [1, 2]. Performing high-frequency and high-data rate functions in software requires huge amounts of computation. To alleviate ADC sampling