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Software-Defined Radio Basics

Benny Bing, *Georgia Institute of Technology*

Software Defined Radio: Architectures, Systems and Functions
By Markus Dillinger, Kambiz Madani, and Nancy Alonistioti
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Software-defined radio is an adaptive, future-proof solution to making wireless networks highly flexible. It replaces conventional radio hardware with reconfigurable, reprogrammable radios, opening the way for new services and prolonging a mobile wireless device's lifespan. A high degree of reconfiguration requires support for different system functionalities, including multiband and multihoming systems, which support more than one frequency band or radio standard. Reconfiguration can be total, partial, static (for example, using a smart card), or transparent to the user.

Software Defined Radio: Architectures, Systems and Functions thoroughly discusses various aspects of SDR technologies, particularly Europe's extensive Information Society Technologies research programs. The first six chapters give background information on wireless and SDR concepts. Markus Dillinger, Kambiz Madani, and Nancy Alonistioti address service handoff with quality-of-service considerations for heterogeneous wireless networks. They also discuss requirements for networks that can support device reconfiguration, such as mode detection, monitoring, and filtering; handoff decision making; and software downloads. Handoffs can be disruptive; when an SDR device changes modes, the channel and service quality also change. Furthermore, in the Universal Mobile Telecommunications System, mode negotiation is underdeveloped and handoff

management is restricted to the base station.

The book also covers user requirements, network management, and adaptive protocols. The authors point out that current standards groups, such as OSA/Parlay, don't provide as much explicit reconfigurability support as needed in next-generation wireless services. They also discuss adaptive protocol stacks, including the Remote Sockets Architecture. The basic idea behind this proxy architecture is to split the legacy TCP/IP (or user datagram protocol/Internet protocol) in two, moving processing from the device to the access point and leaving the device to process only layers above TCP. The book also describes self-learning and adaptive-systems basics, key characteristics of SDR systems.

Reconfiguration

Chapter 7 is distinctive, exploring open APIs for flexible service provisioning and reconfiguration management. An open API is crucial to running software from different vendors on proprietary hardware platforms. The interface should be independent of the implementation. For example, the middleware should be an enabling software that decouples applications from discrepancies of the underlying layers, which comprise heterogeneous operating systems, hardware platforms, and communication protocols. A flexible API is also necessary for keeping pace with applications changes, as well as device and radio technology. The API must provide service discovery, negotiations, configuration control, and data. Reconfigurability therefore affects virtually all communication layers (from the physical to the application layer) and impacts both the mobile device and the radio access network. A management policy based on network, user, and mobile-device location and profiles is crucial to reducing complexity. The corresponding device, radio access network, and core network can store the profiles and policies.

The next few chapters describe communication profiles for reconfiguration systems and radio resource management and present a framework for charging and billing for reconfigurable service.

Spectrum sharing

An equally important chapter is Chapter 11, which covers spectrum-sharing methods, including additional spectrum pool sharing. These methods were investigated by Trust

(Transparently Reconfigurable Ubiquitous Terminal), the largest European IST project on SDR.

Spectrum sharing can lead to virtually unlimited wireless bandwidth when spectrum is used and reused more efficiently and cooperatively. The capacity increase and efficiency results directly from being able to switch between momentarily idle channels in different portions of radio spectrum for a short period of use. The remaining chapters discuss mode identification and monitoring, network element reconfiguration, management control and data interfaces, and adaptive baseband technologies.

Software Defined Radio covers many forward-looking, practical topics that will become more important as SDR's popularity grows. The authors explain things rather than just state the facts—a different approach from many SDR texts, which largely omit necessary practical steps. Furthermore, the book's broad scope, clear writing, and effective organization make it an invaluable reference for researchers and graduate students, as well as wireless manufacturers and operators.

Benny Bing is a research faculty member at the Georgia Institute of Technology. Contact him at bennybing@ieee.org.

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