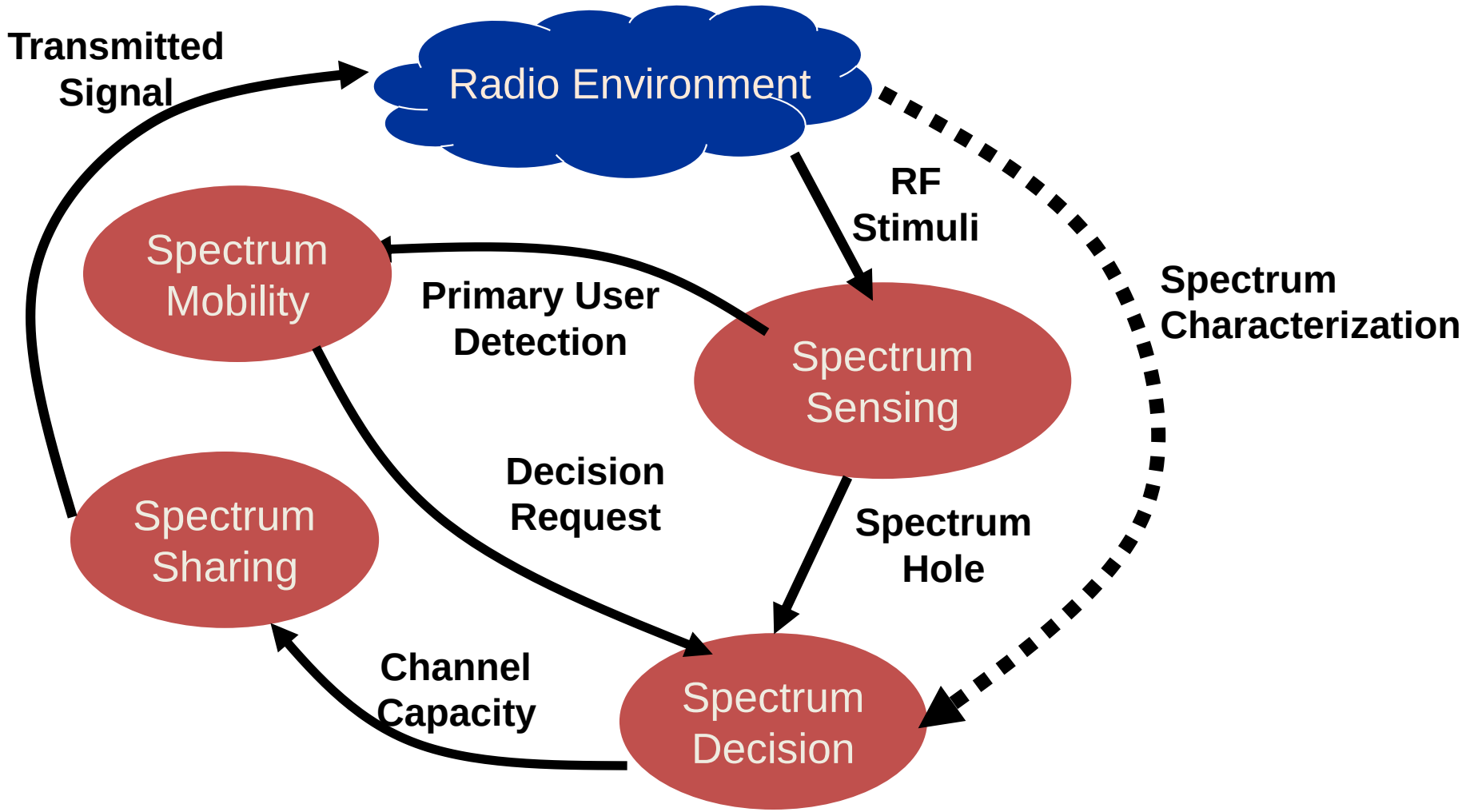
CHAPTER 4.
COGNITIVE CYCLE

Cognitive Cycle

A CR determines appropriate communication parameters and adapts to the dynamic radio environment

Tasks required for adaptive operation in open spectrum referred as **COGNITIVE CYCLE**.

Spectrum Sensing



Spectrum Sensing

A CR monitors the available spectrum bands, captures their information, and then detects the spectrum holes.

Spectrum Decision

- Based on the spectrum availability, CR users can determine a channel.
- This operation not only depends on spectrum availability, but it is also determined based on internal (and possibly external) policies.

Spectrum Sharing

- Multiple CR users try to access the spectrum
- CR network access should be coordinated in order to prevent multiple users colliding in overlapping portions of the spectrum.

Spectrum Mobility

- CR users are regarded as "visitors" to the spectrum.
- If PUs need a specific portion of the spectrum then the CR users must continue in another vacant portion of the spectrum.

Reconfigurability

- **Capability of adjusting operating parameters for the transmission on-the-fly without any modifications on the hardware components.**

- **This capability enables CR to adapt easily to the dynamic radio environment.**

Reconfigurable Parameters

i) Operating Frequency

ii) Modulation

iii) Transmission Power

iv) Communication Technology

Operating Frequency

- **A CR is capable of changing the operating frequency.**
- **Based on the information about the radio environment, the most suitable operating frequency can be determined and**
- **the communication can be dynamically performed on this appropriate operating frequency.**

Modulation

- **A CR should reconfigure the modulation scheme adaptive to the user requirements and channel conditions.**

Example: Delay Sensitive Applications → data rate important

→ Modulation scheme enabling higher spectral efficiency!!

Example: Loss-Sensitive Applications → error rate important !

→ Modulation scheme with low bit error rate..

Transmission Power

- **Transmission power can be reconfigured within the power constraints.**

- **If higher power operation is not necessary, CR reduces the transmitter power to a lower level to allow more users to share the spectrum and to decrease the interference.**

Communication Technology

A CR can be used to provide interoperability among different communication systems.

Reconfigurable Parameters

- **Not only at the beginning of a transmission but also during the transmission.**

- **Parameters can be reconfigured such that**
  - CR is switched to a different spectrum band
  - Tx and Rx parameters are reconfigured
  - Appropriate communication protocol parameters and modulation schemes are used.