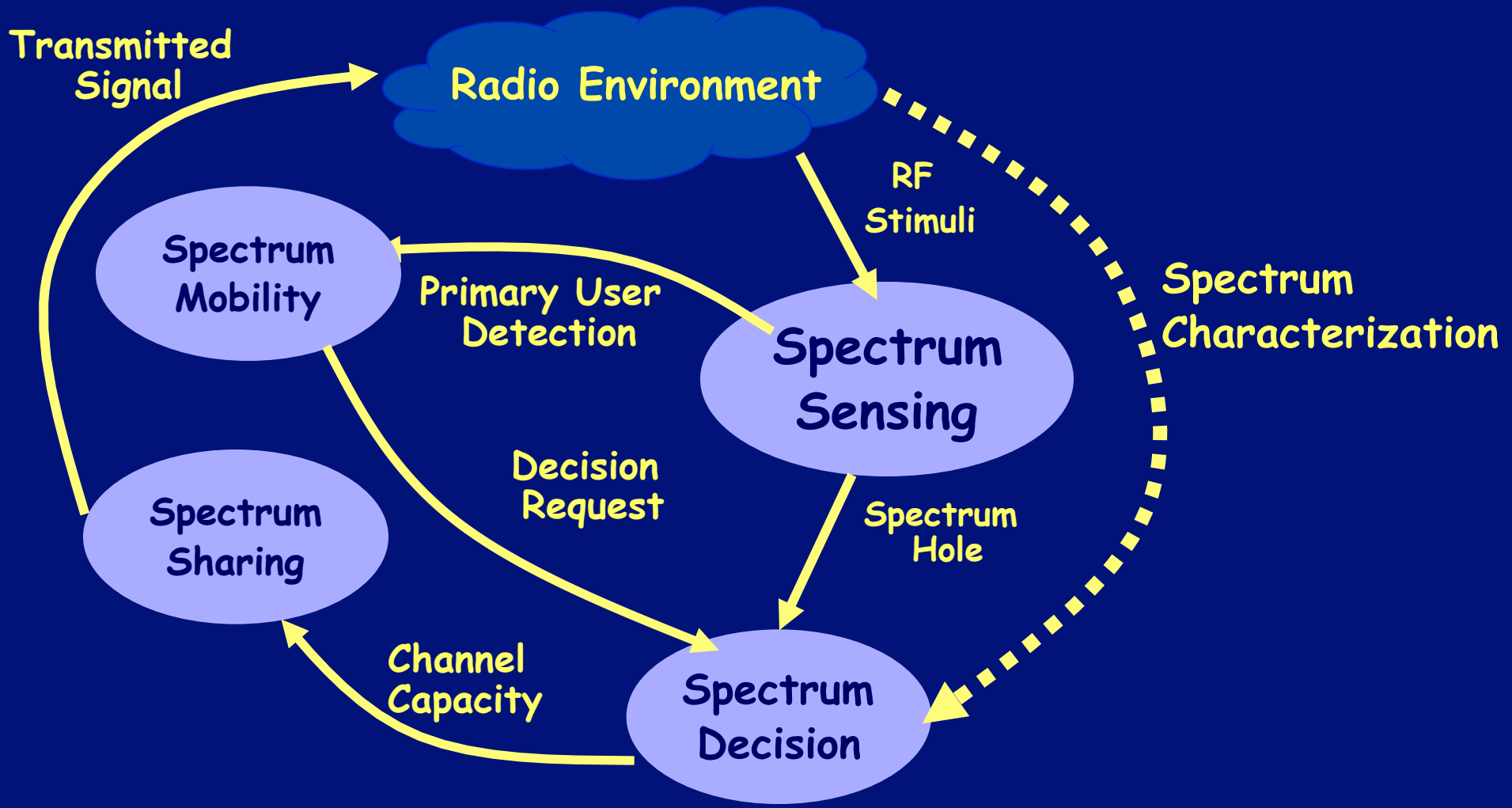
CHAPTER 4.
COGNITIVE CYCLE

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.