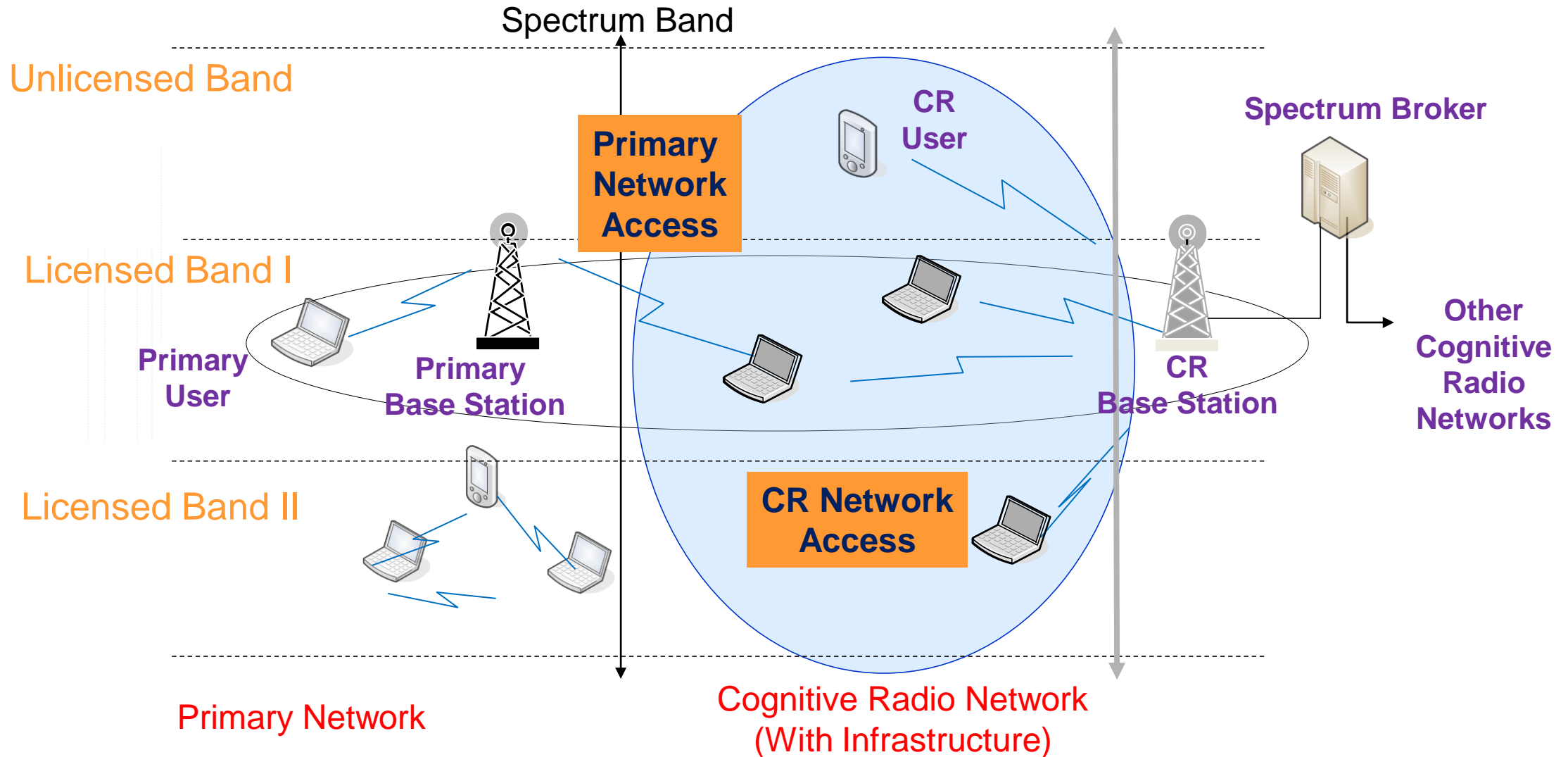
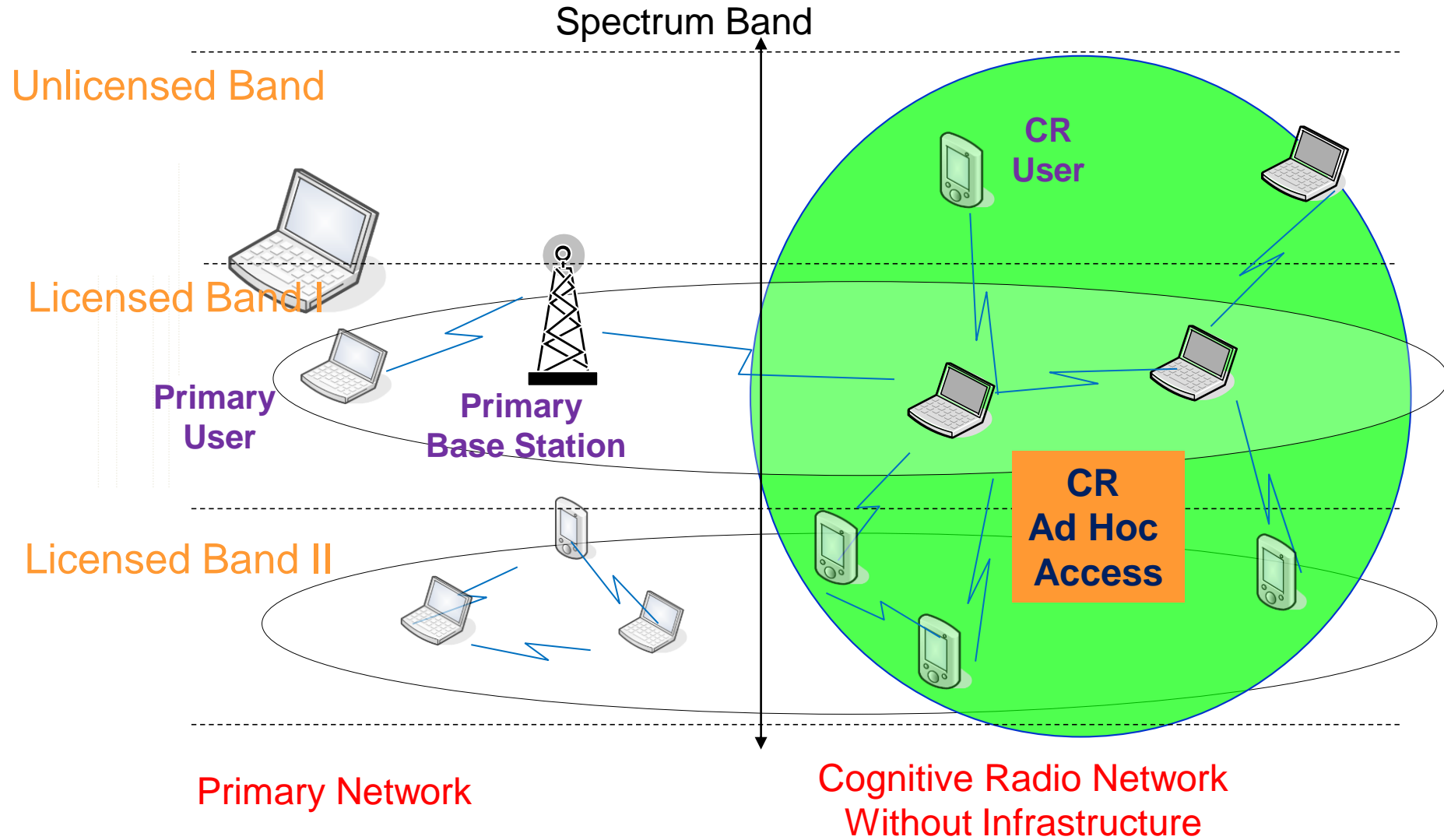


CHAPTER 3. Architecture

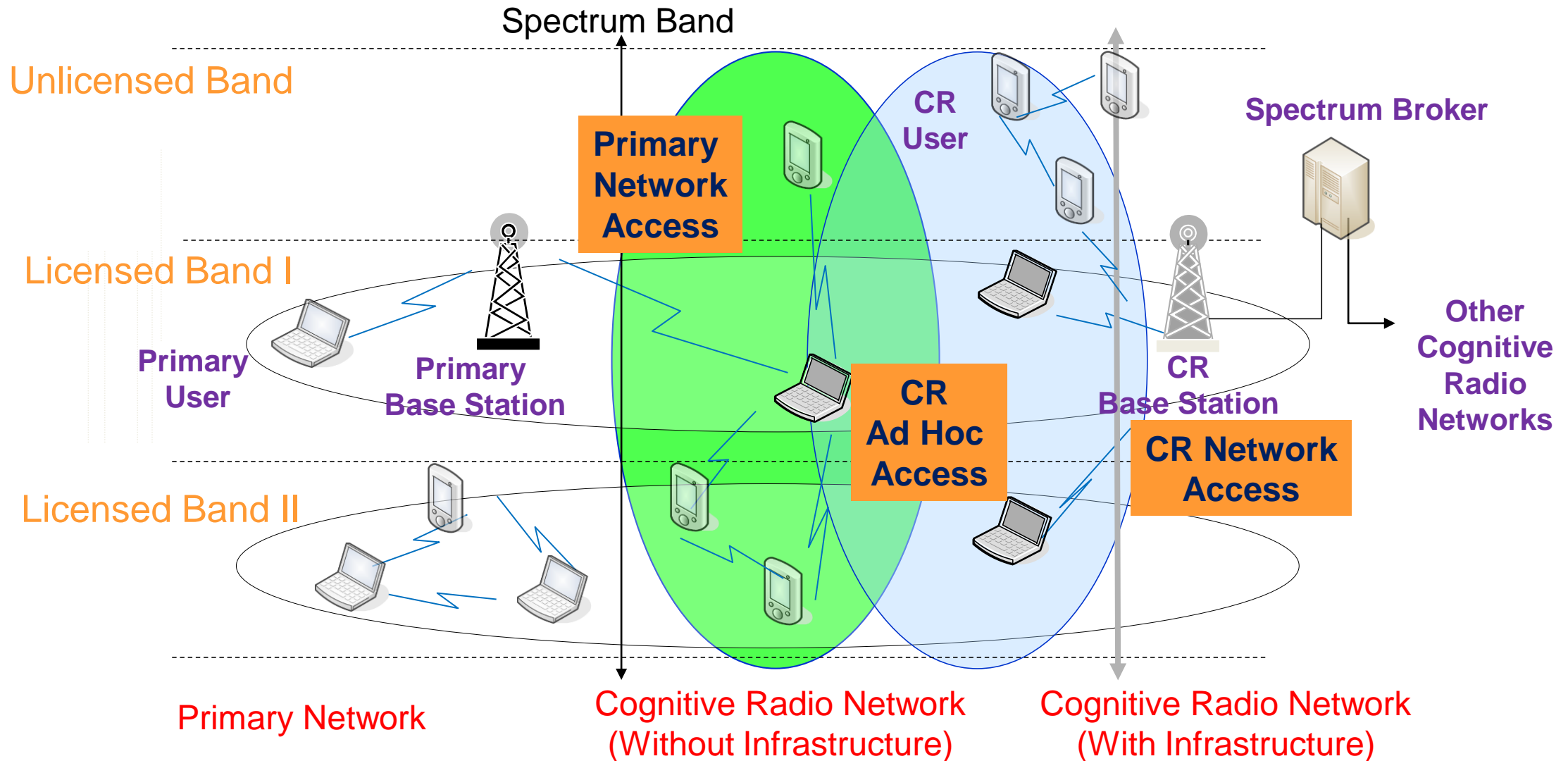
Cognitive Radio Network Architecture



CR Ad Hoc Networks Architecture



Cognitive Radio Network Architecture



Architecture

- **Primary Network**
(Primary User, Primary Base Station)
- **Cognitive Radio Network**
(CR User, CR Base Station)
- **Spectrum Broker**

Primary Network

- An existing network infrastructure (or ad hoc network) which has an access right to a certain spectrum band.

Example:

Common cellular and TV broadcast networks.

Primary User (or Licensed User)

- Has a license to operate in a certain spectrum band.
- This access can only be controlled by the primary base station and should not be affected by the operations of any other unlicensed users.

REMARK:

PUs do not need any modification or additional functions for co-existence with CR base-stations and CR users.

Primary Base Station (or Licensed Base-Station)

- A fixed infrastructure network component which has a spectrum license such as BTS in a cellular system.
- Does not have any CR capability for sharing spectrum with CR users.
- It may be requested to have both legacy and CR protocols for the *primary network* access of CR.

Cognitive Radio Network

(or Dynamic Spectrum Access Network, or Secondary Network or Unlicensed Network)

- Does not have license to operate in a desired band.
- Hence, the spectrum access is allowed only in an opportunistic manner.
- CR networks can be deployed both as an infrastructure network and an ad hoc network

Cognitive Radio User **(or Unlicensed User, Secondary User)**

→ has no spectrum license

Hence, additional functionalities are required to share the licensed spectrum band.

Cognitive Radio Base-Station

(or Unlicensed Base Station or Secondary Base Station)

- A fixed infrastructure component with CR capabilities.
- CR base-station provides single hop connection to CR users without spectrum access license.
- Through this connection, a CR user can access other networks.

Spectrum Broker (or Scheduling Server)

- A central network entity that plays a role in sharing the spectrum resources among different CR networks.
- It can be connected to each network and can serve as a spectrum information manager to enable co-existence of multiple CR networks.

Architecture

- **CR Network Access:**

CR users can access their own CR base-station both on licensed and unlicensed spectrum bands.

- **CR Ad Hoc Access:**

CR users can communicate with other CR users through ad hoc connection on both licensed and unlicensed spectrum bands.

- **Primary Network Access:**

CR users can also access the primary base-station through the licensed band.

Classifications

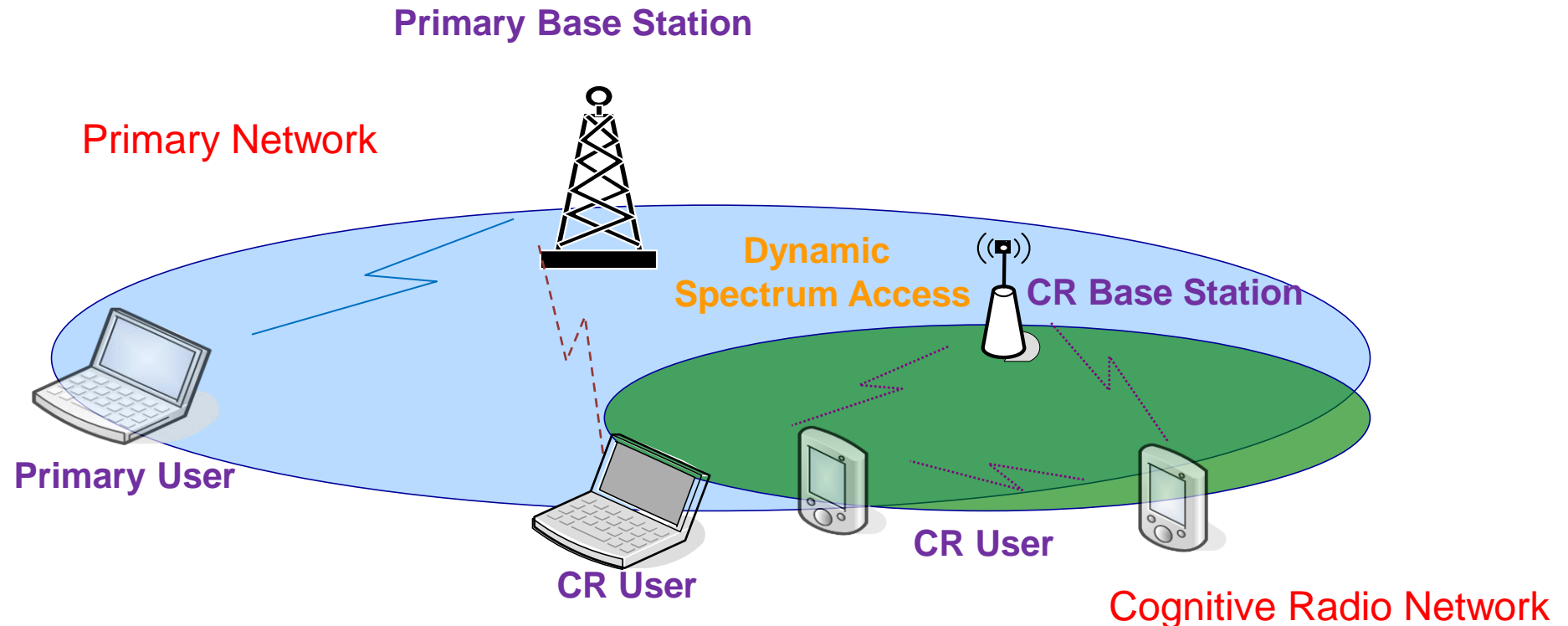
- **CR Network on Licensed Band**

CR user is capable of using bands assigned to licensed users, apart from unlicensed bands, such as ISM band.

- **CR Network on Unlicensed Band**

CR can only utilize unlicensed parts of radio frequency spectrum.

Cognitive Radio Network on Licensed Band



Cognitive Radio Network on Licensed Band

- Temporally unused spectrum holes exist in the licensed spectrum band.
- CR networks can exploit these spectrum holes through cognitive communication techniques.
- In Figure, CR network coexists with the primary network at the same location and on the same spectrum band

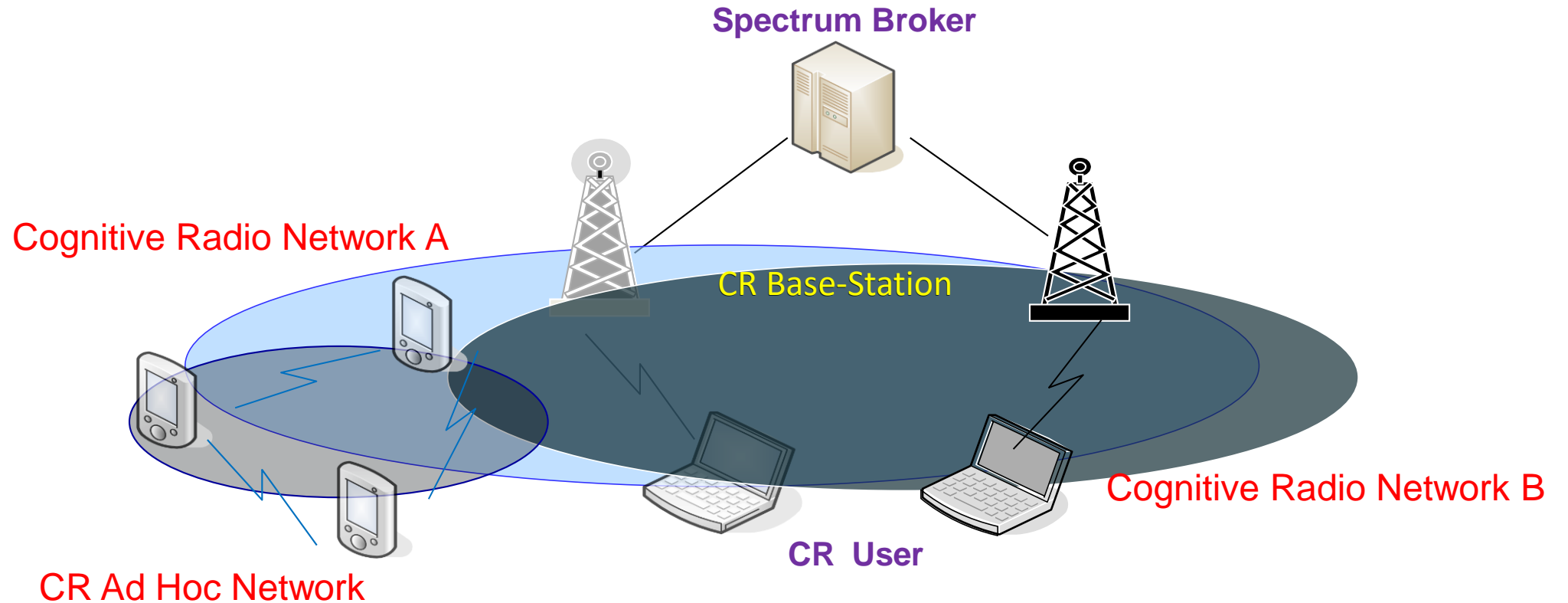
Cognitive Radio Network on Licensed Band

- **Main purpose of the CR network is to determine the best available spectrum**
- **Here in the licensed band, CR functions are aimed at the detection of the presence of PUs**
- **Channel capacity of the spectrum holes depends on the interference at the nearby PUs**

Cognitive Radio Network on Licensed Band

- Interference avoidance with PUs **is the most important issue here**
- **Also if PUs appear in the spectrum band occupied by CR users, they should vacate the current spectrum band and move to the new available spectrum immediately → *spectrum handoff*.**

Cognitive Radio Network on Unlicensed Band



CR Network on Unlicensed Band

- **Since there are no license holders, all network entities have the same right to access the spectrum bands.**
- **Multiple CR networks co-exist in the same area and communicate using the same portion of the spectrum.**
- **Intelligent spectrum sharing algorithms can improve the efficiency of spectrum usage and support high QoS.**

CR Network on Unlicensed Band

- **CR users focus on detecting the transmissions of other CR users.**
- **Since all CR users have the same right to access the spectrum, CR user should compete with each other for the same unlicensed band.**

CR Network on Unlicensed Band

REQUIREMENTS:

1. **Sophisticated spectrum sharing methods among CR users**
2. **Fair spectrum sharing among networks if multiple CR network operators reside in the same unlicensed band.**