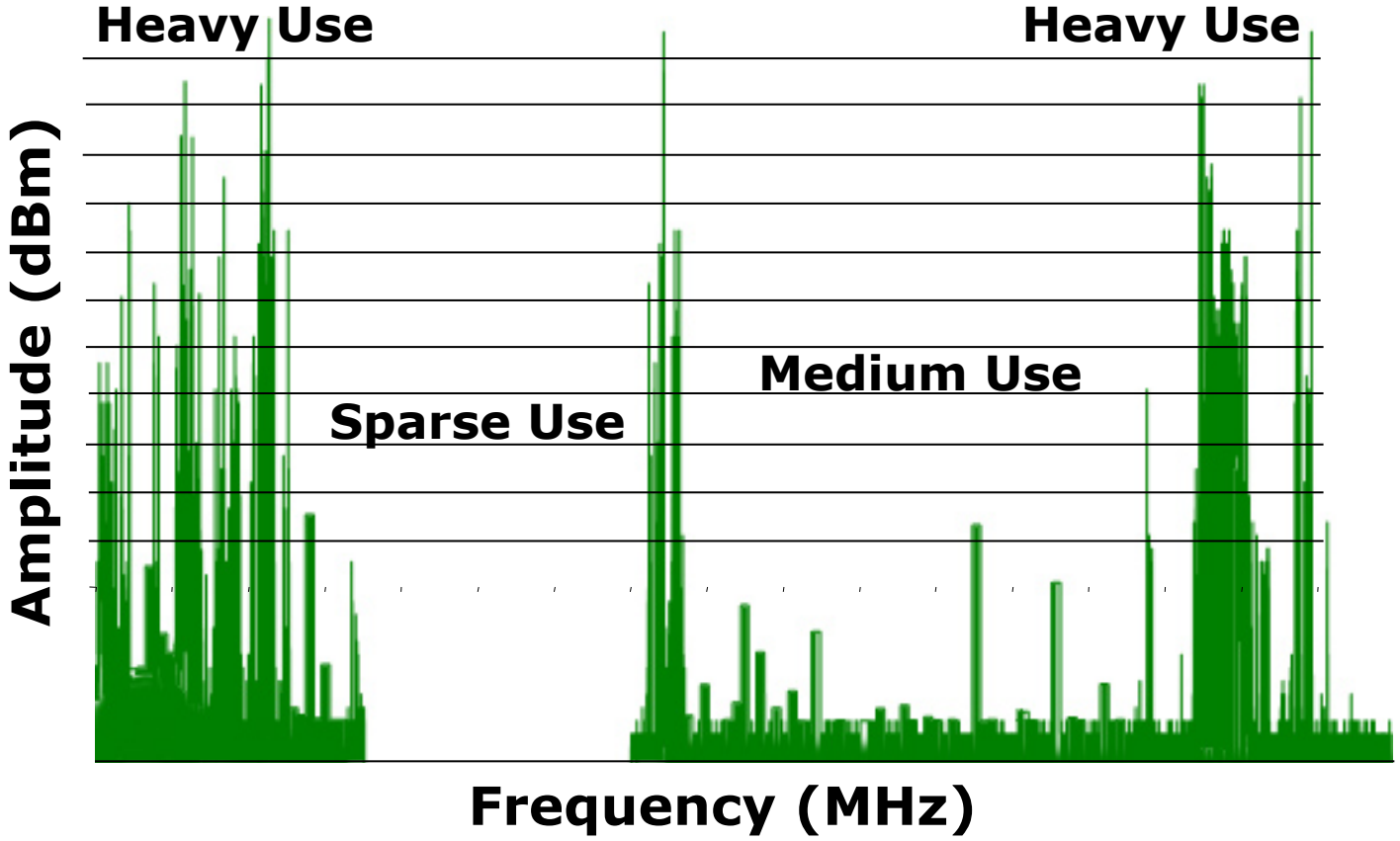
Fixed Spectrum Utilization



- A significant amount of the spectrum remains unutilized.
- According to the Federal Communication Commission, utilization of the fixed spectrum assignment is approx. 15-85% based on temporal and geographical variations.

Overview

- **In Cognitive Radio Networks:**

  - A *primary* (or licensed) user has a license to operate in a certain spectrum band; his access is generally controlled by the Primary Operator (PO) and should not be affected by the operations of any other unlicensed user.

  - Unlicensed (*secondary*) users have no spectrum license, and they implement additional functionalities to share the licensed spectrum band without interfering with primary users.

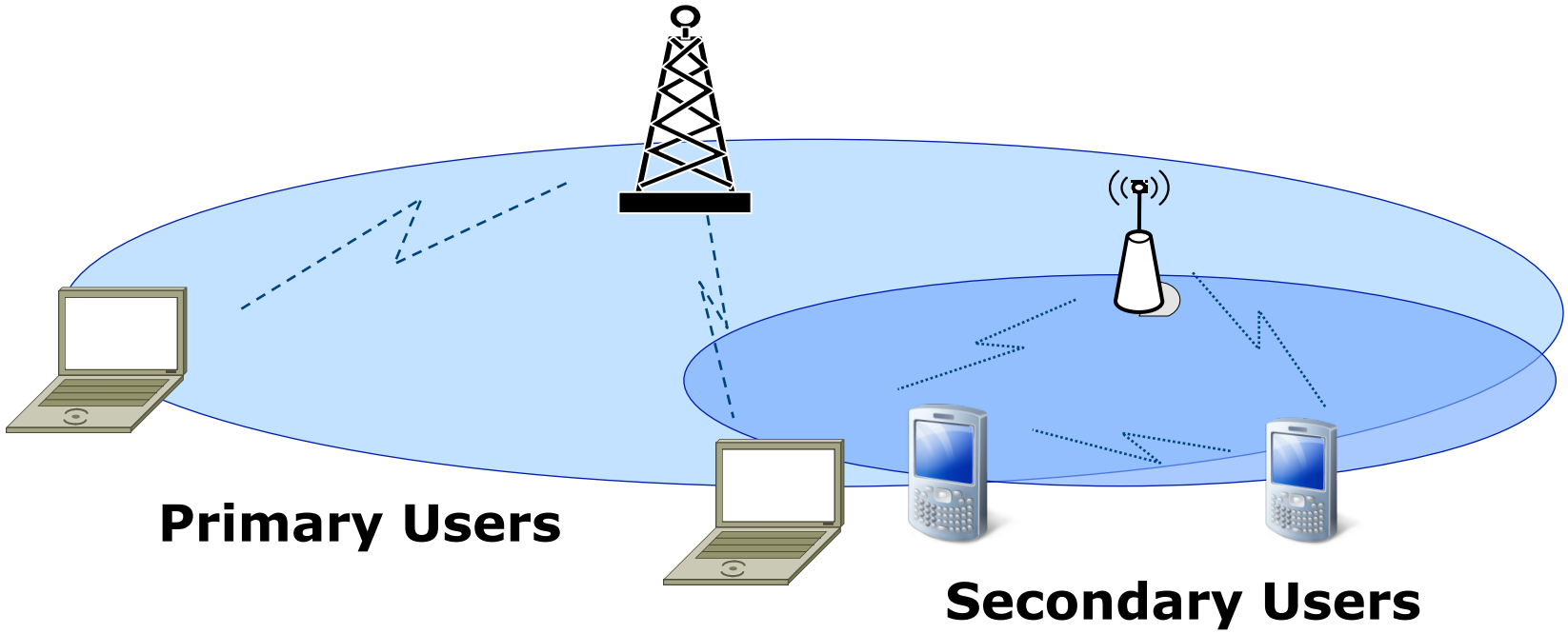
Unlicensed users

- Cognitive Radio (secondary) users are capable of transmitting over:
  - unlicensed bands, such as the ISM band;
  - licensed spectrum bands, which are shared with Primary Users.

- This can increase considerably their bandwidth availability, and hence their capability to access to remote resources, while being mobile.

Cognitive Radio Network architecture

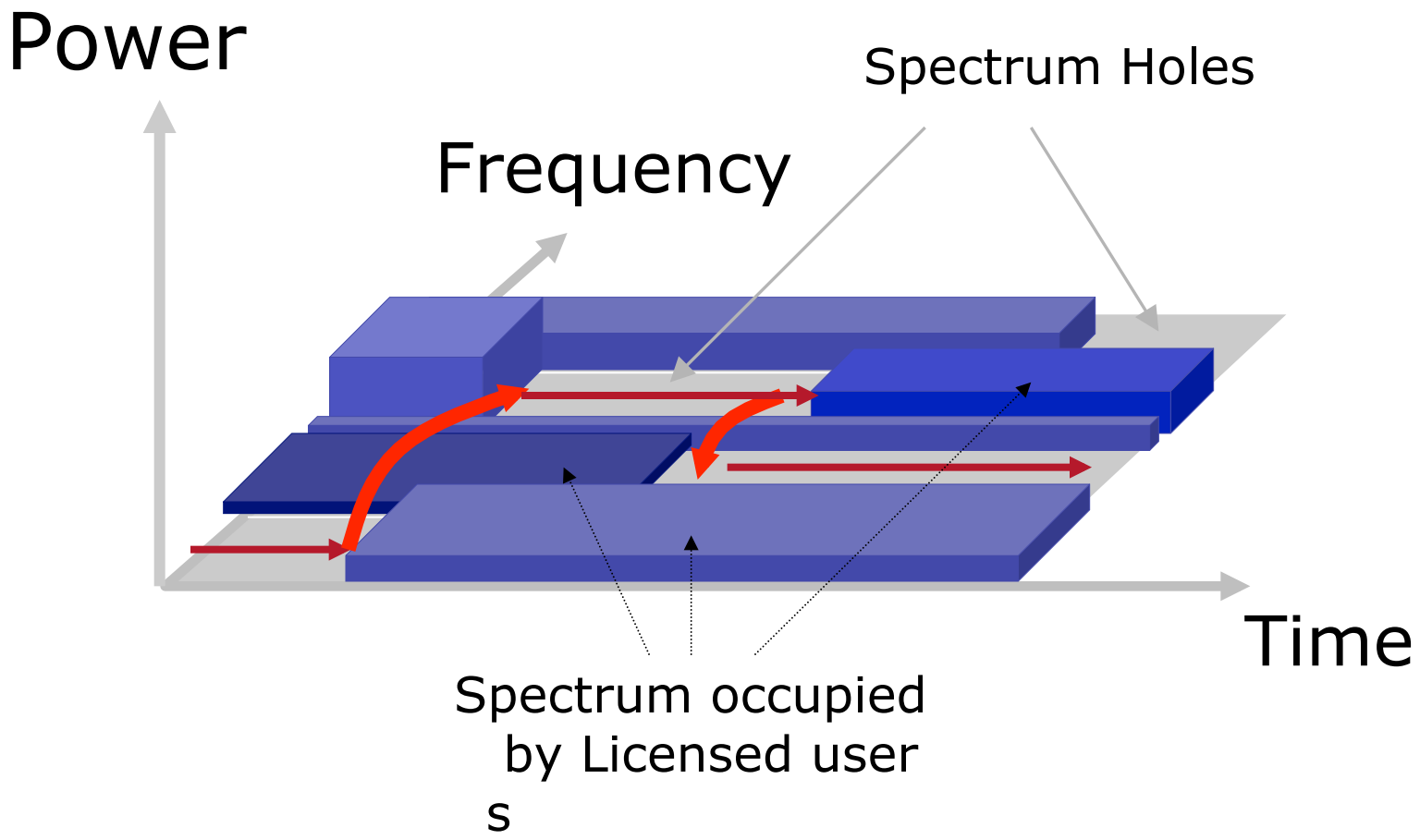
- In this figure, a secondary Cognitive Radio Network coexists with the Primary (licensed) Network at the same location and on the same spectrum band.



Spectrum Holes

- Unused spectrum holes exist in the licensed spectrum band.
- Secondary (unlicensed) users can exploit these spectrum holes to communicate between themselves or to a secondary base station, to access the Internet.
- Cognitive radio communication techniques must be used to limit the interference:
  - towards the Primary Users;
  - between SUs themselves.

Spectrum Holes



Limiting Interference towards PUs

- The most important issue is avoiding any interference towards Primary Users.
- For this reason, Secondary Users must always *sense* the occupied spectrum.
- If a primary user is detected, the SU must switch immediately to a new available spectrum (if any)
  → *spectrum handoff*.