

# Coexistence for Ultra-Wideband and Cognitive Radio Systems



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## Coexistence: Primary and Secondary Systems

- Traditionally spectrum usage has been organized according to **fixed frequency plans** defined through government **licences**.
- Recently more **efficient spectrum utilization** by means of **unlicensed** transmissions and **dynamic** spectrum access has been envisioned.
- **Coexistence** of primary (e.g., licensed) and secondary systems may cause **mutual interference** and entail **performance degradations**.

### Primary Systems

- Wi-Fi systems (IEEE 802.11a/b/g)
- WiMAX systems (IEEE 802.16d/e)
- Cellular systems (GSM, EDGE, UMTS, etc.)
- TV broadcasting systems

### Secondary Systems

- **Ultra-wideband (UWB)** systems (IEEE 802.15.4a, ECMA-368) operate with  $>500$  MHz bandwidth and very low power spectral density (spectral underlay).
- **Cognitive radio (CR)** systems (IEEE 802.22) analyze radio environment and dynamically access spectrum.

## Research Projects on Coexistence

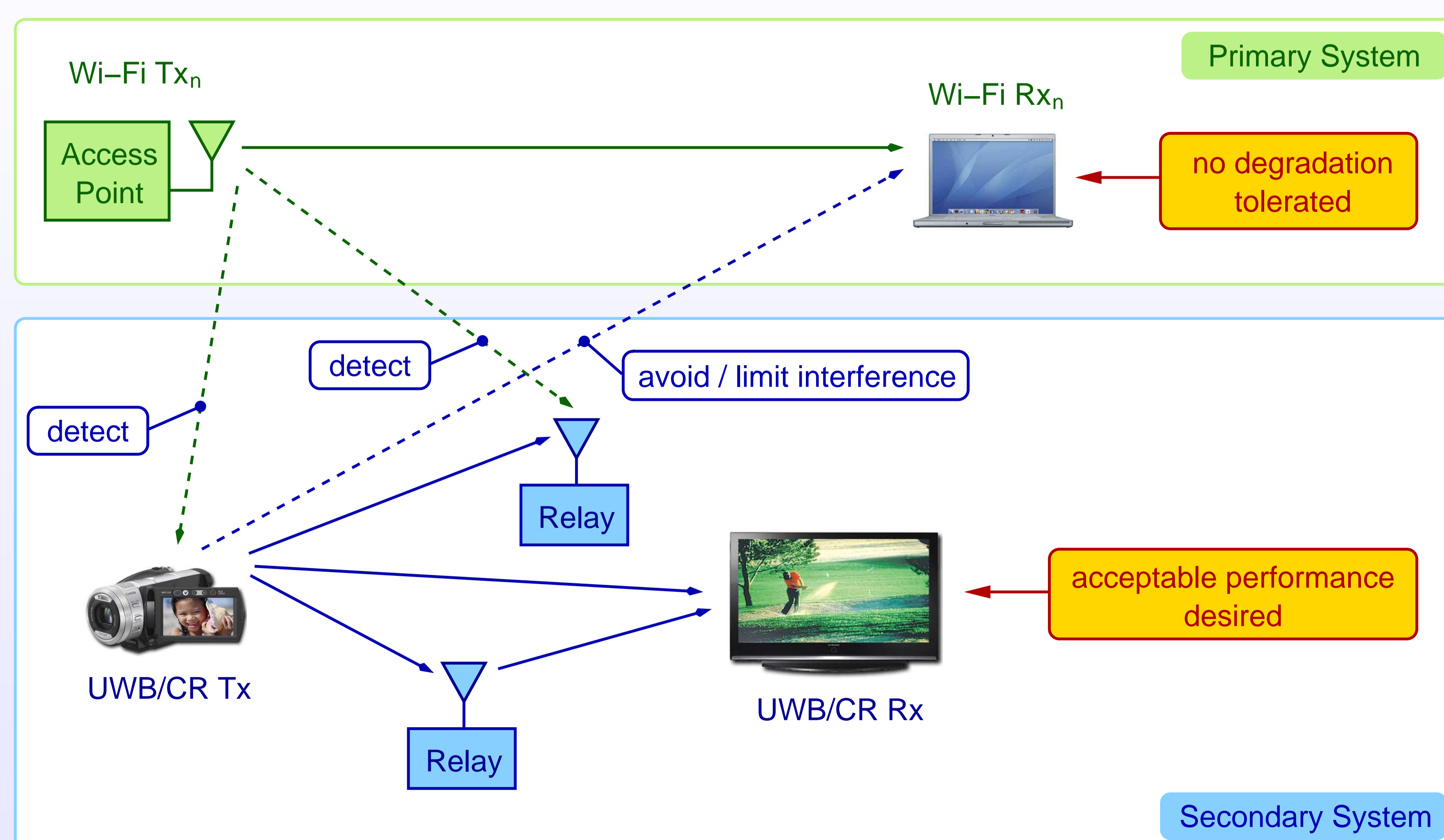
### Detection-and-Avoidance for UWB Systems

- UWB systems are underlay systems with a maximum power spectral density of  $75\text{nW/MHz}$ .
- Despite low UWB power spectral density, detect-and-avoid (DAA) techniques are mandatory in some bands due to requests from licensed users.
- In the current research, *primary user detection and operation capabilities of UWB systems* are investigated, and appropriate avoidance measures are implemented.

### Relay-Assisted Cognitive Radio Systems

- In order to limit interference experienced by primary users, CR systems will naturally operate at low transmit powers.
- Correspondingly, relaying techniques are very attractive to improve performance and coverage of CR systems.
- In the current research, *transmit power allocation schemes for relay-assisted CR systems* are investigated, which optimize CR performance while limiting interference for primary users and minimizing signaling overhead between CR nodes.

## Typical Coexistence Scenario



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