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Potential Uses of IR-UWB Technology on Next Generation RFID Tag Systems

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Presentation Outline

- Current RFID Tag Technology
- Our expectation of Next Generation RFID Tags
- IR-UWB Transmitters
- System Design
- Localization

Current RFID Tag Technology

- RFID – One of the most important technology in twenty-first century.
- Mainly divided into two main catalogs:
  - Active
  - Passive

Active RFID Tags

- Powered by a battery – Increased production cost and tag size
- Narrowband – Destructive interference
- Narrowband Circuits require large static current to ensure accuracy

Passive RFID Tags

- Require an external power source. For example, inductive coupling
- Limited distance to the power source
- Also means limited number of users

Our expectations

- Green to environment – energy harvesting with no battery
- Low cost – small die size, no battery and low packaging cost
- High flexibility – small size and reasonable transmission distance
- Accurate Localization without extra cost

IR-UWB Pulse Generator

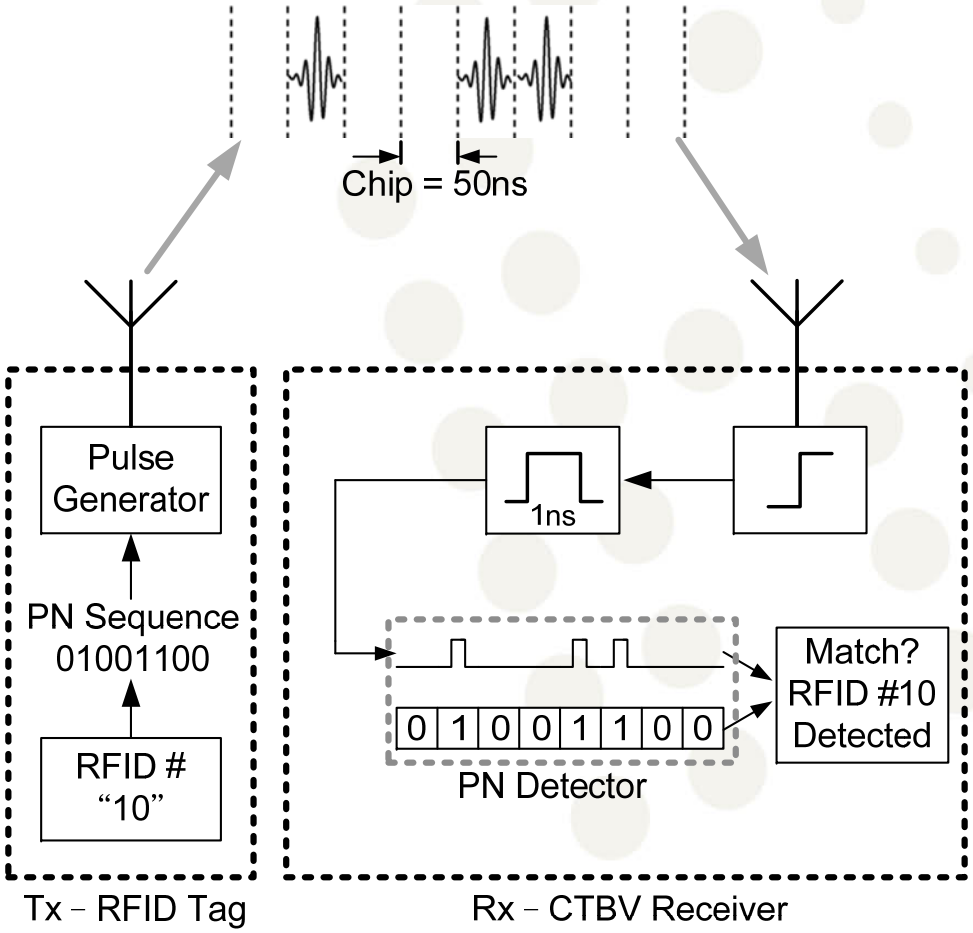
- Can be turned off completely between transmissions
- Does not require power-hungry precise carrier generators
- Very power efficient!
- Short pulse width – Insensitive to multipath fading
- Reported in [1], 5.6 pJ to generate one IR-UWB pulse

[1] X. Wang et al., “FCC-EIRP-aware UWB pulse generator design approach,” in *IEEE International Conference on Ultra-Wideband*, 2009, pp. 592–596.

System Design

- Coding Type
- Length of code
- Tx power dissipation
- Amount of energy harvested
- Averaging – Improve SNR, hence transmission distance

System Overview



Localization

- CTBV receivers offer several ten GHz sampling
- Resolution as fine as 4.3 mm in [2]

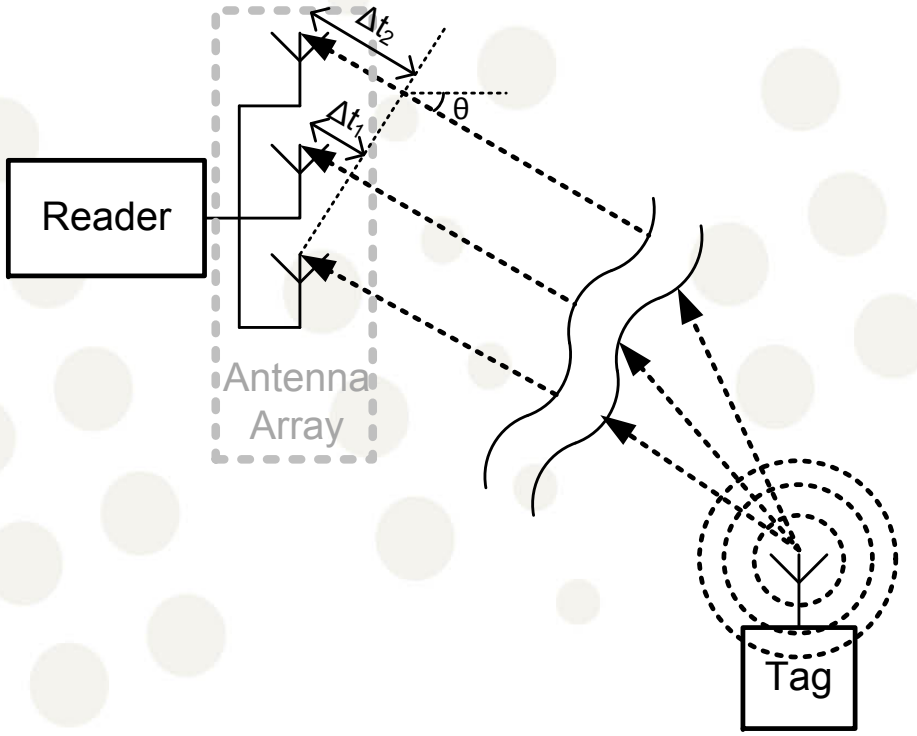
[2] H. A. Hjortland al et.“Thresholded samplers for UWB impulse radar,” in *IEEE International Symposium on Circuits and Systems*, 2007, pp. 1210–1213.

- Several possible localization approaches presented in [3]

[3] H. Wymeersch at el."Cooperative localization in wireless networks," *Proceedings of the IEEE*, vol. 97, no. 2, pp. 427–450, Feb 2009.

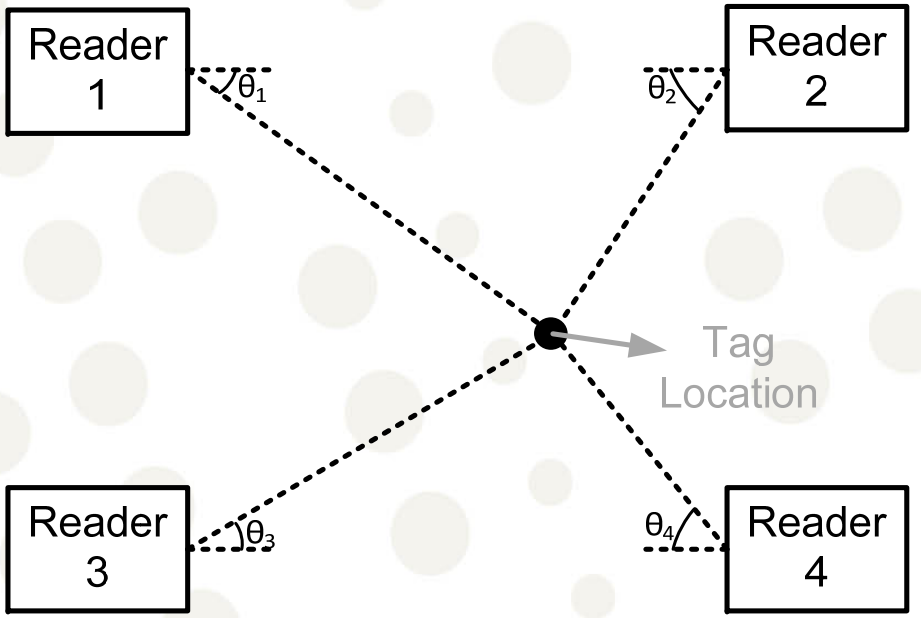
Example – Angle of Arrival

- θ is computed from the differences in arrival times (i.e. Δt_1 and Δt_2) at each of the antenna array elements



Example – Angle of Arrival (Cont')

- With multiple readers and their corresponding θ
- The tag can be localized by intersection



Continuing Works

- Ultra-low-power IR-UWB transmitter design
- High efficiency energy harvesting circuit design
- RFID system design

Questions or Comments?