

Additional Topics: Location and Context-Aware Computing

Dr Robert Harle

CST Part II

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Additional Topics

- The tripods is good for teaching you established, core principles of CS but in three years we don't get to touch much on real world applications
- Goal of this course: expose you to topical issues and trends in CS and the technology underpinning them

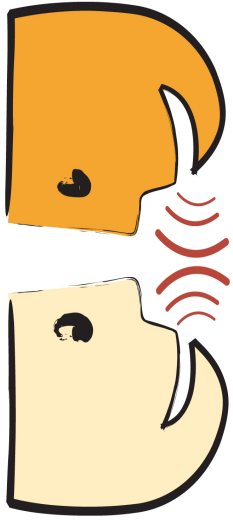
Lectures

- MWF 1200-1300 LT2
- This year we have lots of guest lecturers from industry

| | |
|-----------------|--|
| Friday 23/04 | Location-Aware Computing I (Dr Robert Harle) |
| Monday 26/04 | Location-Aware Computing II (Dr Robert Harle) |
| Wednesday 28/04 | RFID (Dr Robert Harle) |
| Friday 30/04 | Mobile RealVNC Development (Dr Andy Harter, RealVNC) |
| Monday 03/05 | Computing for the Future of the Planet (Professor Andy Hopper) |
| Wednesday 05/05 | The GPS System (Dr Alan Jones, Cotares) |
| Friday 07/05 | Coding in Industry (Dr David Berry, Qualcomm) |
| Monday 10/05 | Developing Commercial Software (James Moore, Redgate) |
| Wednesday 12/05 | Affective Computing (Professor Peter Robinson) |
| Friday 14/05 | TBC |
| Monday 17/05 | Building and Deploying Google Voice Search (David Singleton, Google) |
| Wednesday 19/05 | Advances in Search, Information Retrieval and Extraction (Professor Ted Briscoe) |

- Today: Context-aware Computing

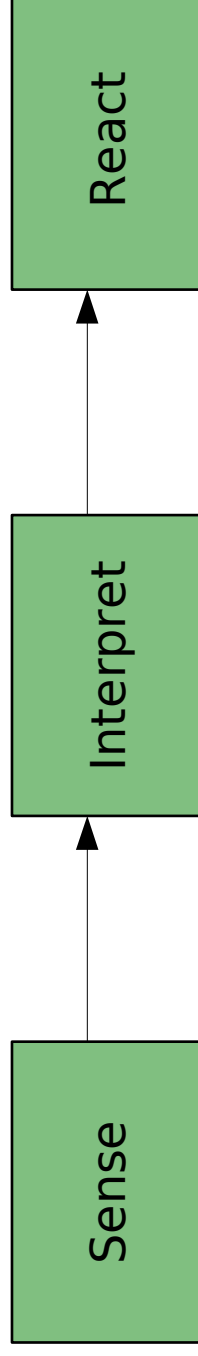
Context Aware Computing



- Our communication is based on:
 - Verbal Language
 - Shared understanding
 - Gestures
- A lot of what we say relies on the other person making implicit assumptions
- When we communicate with computers, however, we have only a limited language and this is often frustrating

Context-Aware Computing

- C-A Computing is about giving computers more context about their situation in order to improve their behaviour
- Context is *"any information that can be used to characterise the situation of entities"* (Dey)
- The challenge is to collect contextual information



Where do we start?

- Making technology *sentient* is a tall order. We need to start with context that undergoes big changes
- With growing mobility, this has turned out to be *where* you are

Some Examples

- Active Bat
. Motivated by phones
- Tour Guides
- Automatic Reminders
- Environmental Controls



Location-awareness

- Commercially, location-awareness is likely to become a major trend in the near future
 - Mobiles now expose location hooks
 - We already have personal navigation to tell us where we are (think sat-nav)
 - The next step will be for us to start sharing this information with trusted entities
- Right now, the key is in understanding the limitations of the tracking technologies, which we will look at in this lecture and next

GPS



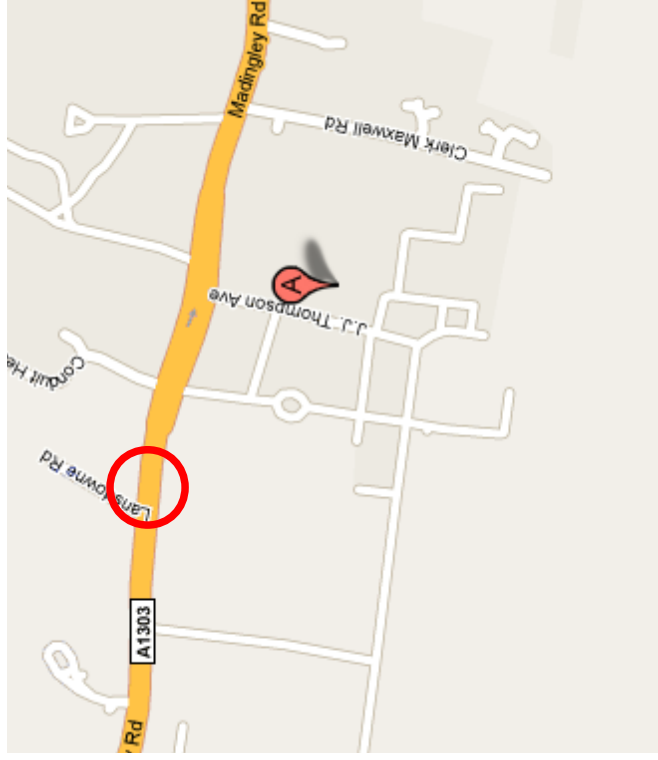
- The outdoor solution as you know
- Now so important to our computing infrastructure that it warrants a lecture of its own later in this course

⇒ Position

⇒ Global time

Limitations of GPS

- The main limitation is that it doesn't work indoors.
- Even if it could be made to, the 10m accuracy is achieved is pretty much useless indoors
- Doesn't even get you the room!



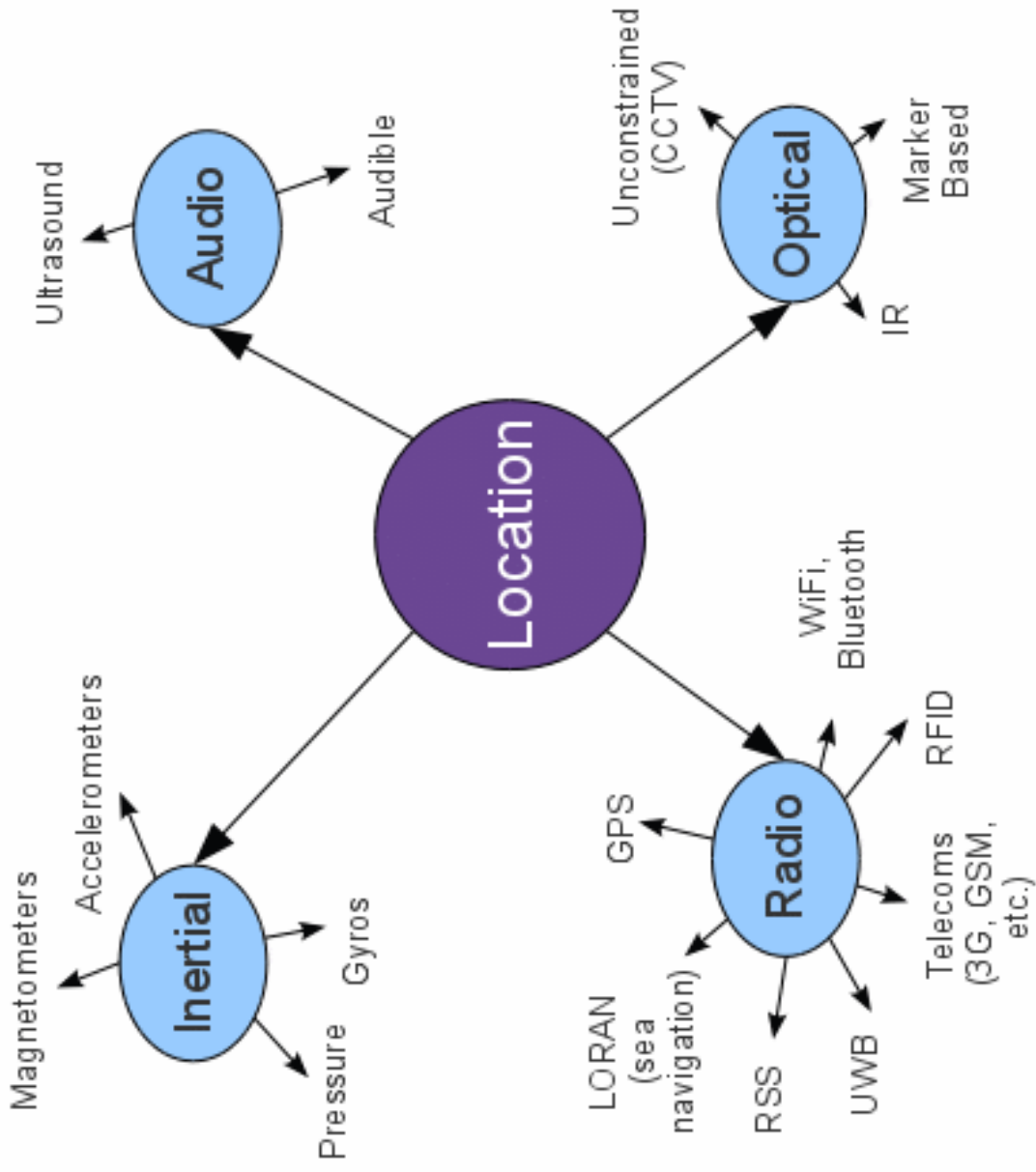
So how do we do it?

- In order to understand the location systems that exist and the limitations they each carry, we need to delve deeper into the techniques researchers have developed to locate people or their devices...

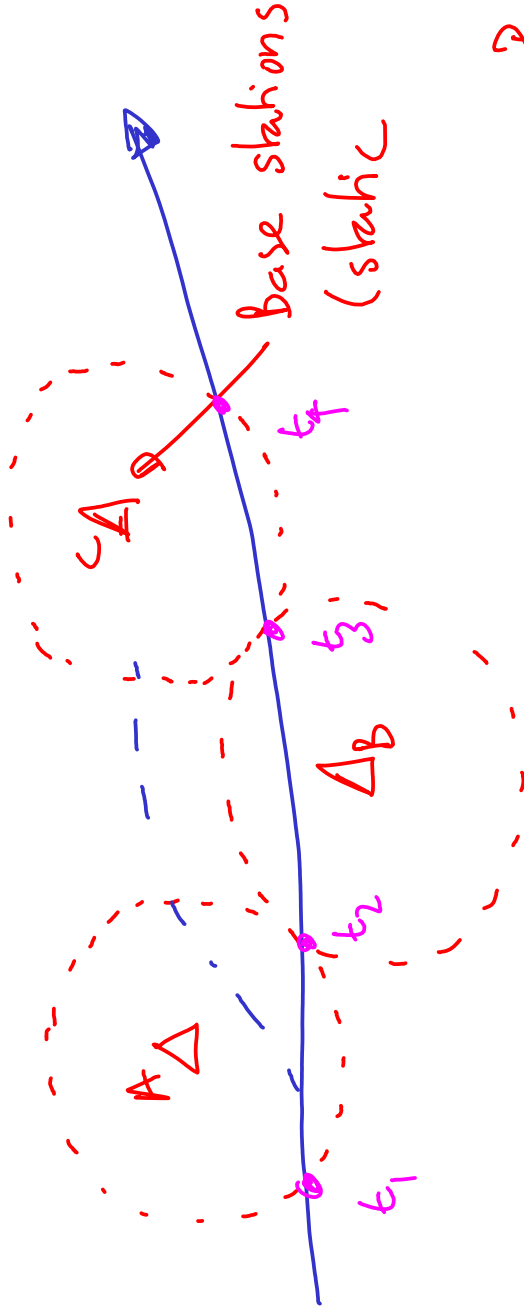


Location Techniques

Medium



Proximity Systems



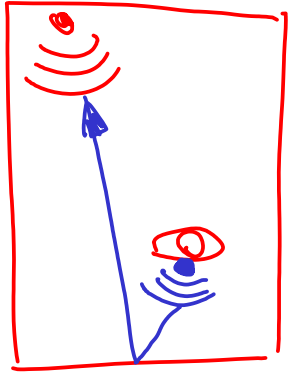
Problems

- incomplete coverage
- How do you handle overlap?
- Can't often specify the range
- Smaller ranges to get better accuracy

Location



Proximity: Active Badge



Transmit IR (same as TV remote)

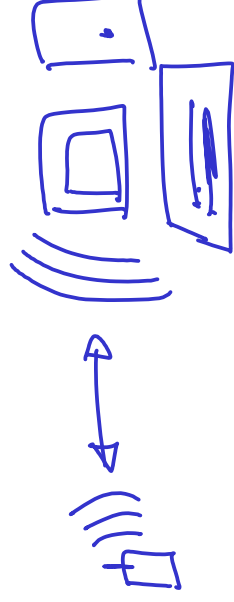
+ Signal bounced (no need for line of sight)

+ Cheap and simple

- Clothing could obscure
- Bright sunlight could overpower the sensor.

Proximity: Bluetooth

- Class 1 ~100m
- Class 2 ~10m
- Class 3 ~3m



- Base station looks for phone. if it finds it, it must be in range \Rightarrow proximity detection.

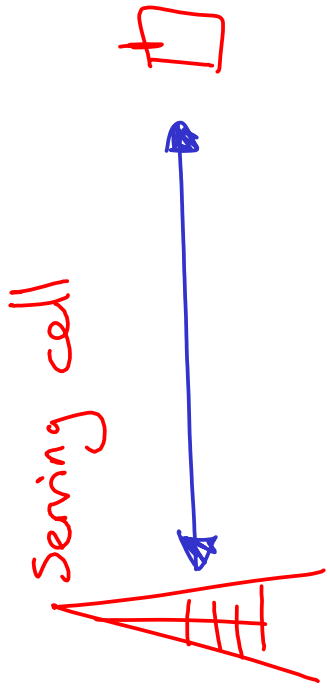
- Bluetooth scanning is slow (10.24s in spec)

\Rightarrow Anful update rate

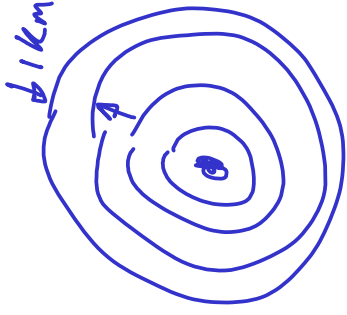
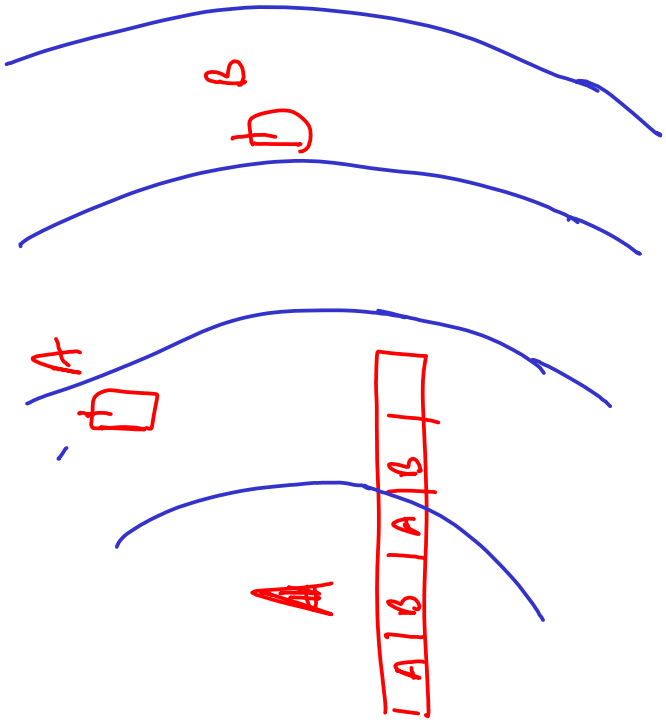
\Rightarrow Discoverable means security risk.

- Advantage is everyone carries a phone now!

Proximity: Serving Cell

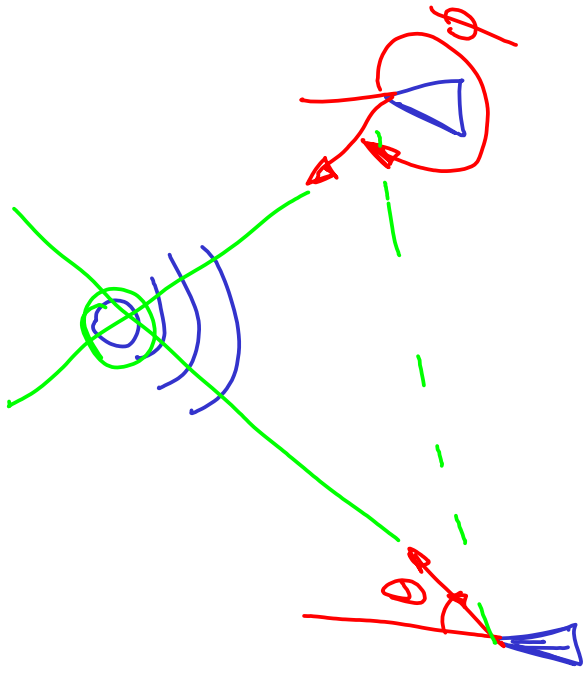


- Micro cells
- Timing advance

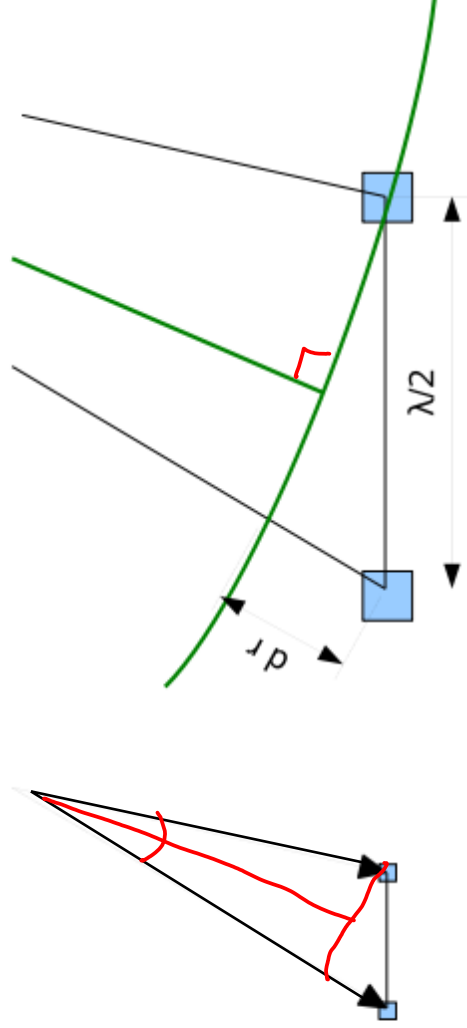


AoA Systems

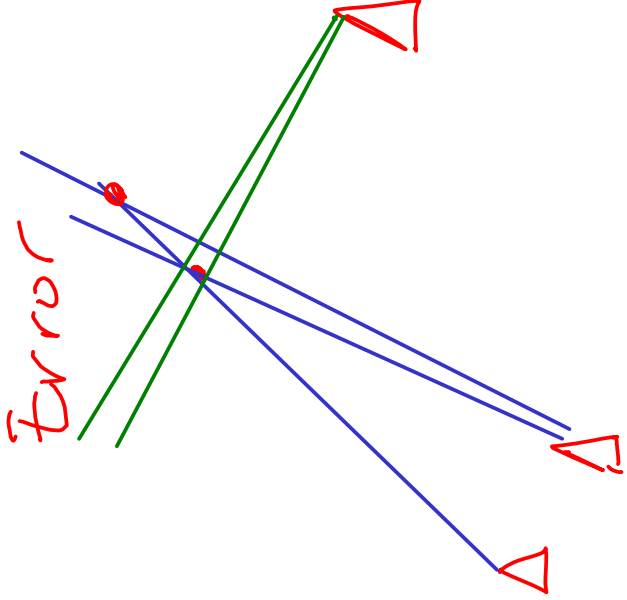
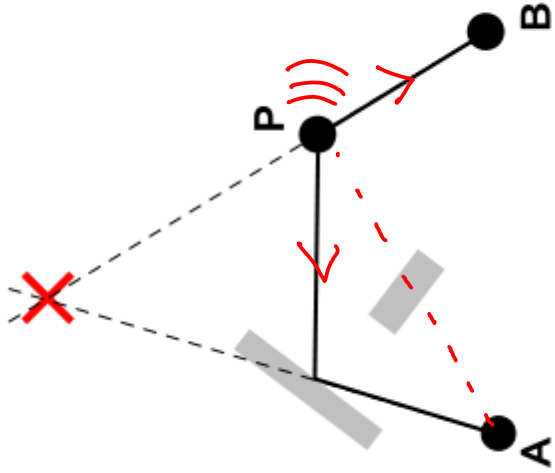
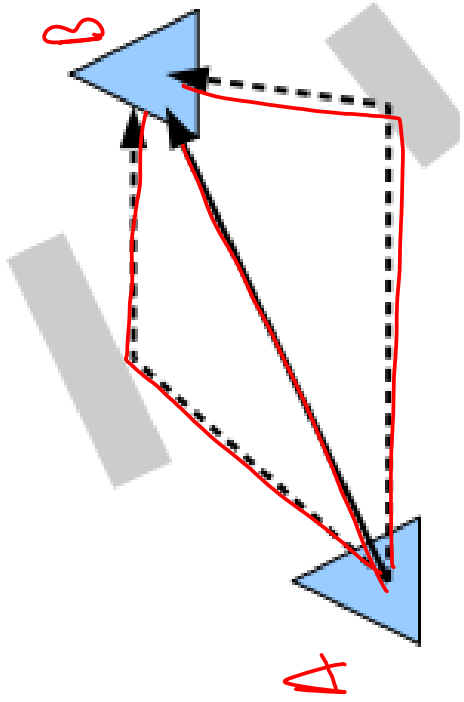
Triangulation



- Arrays bulky,
expensive.



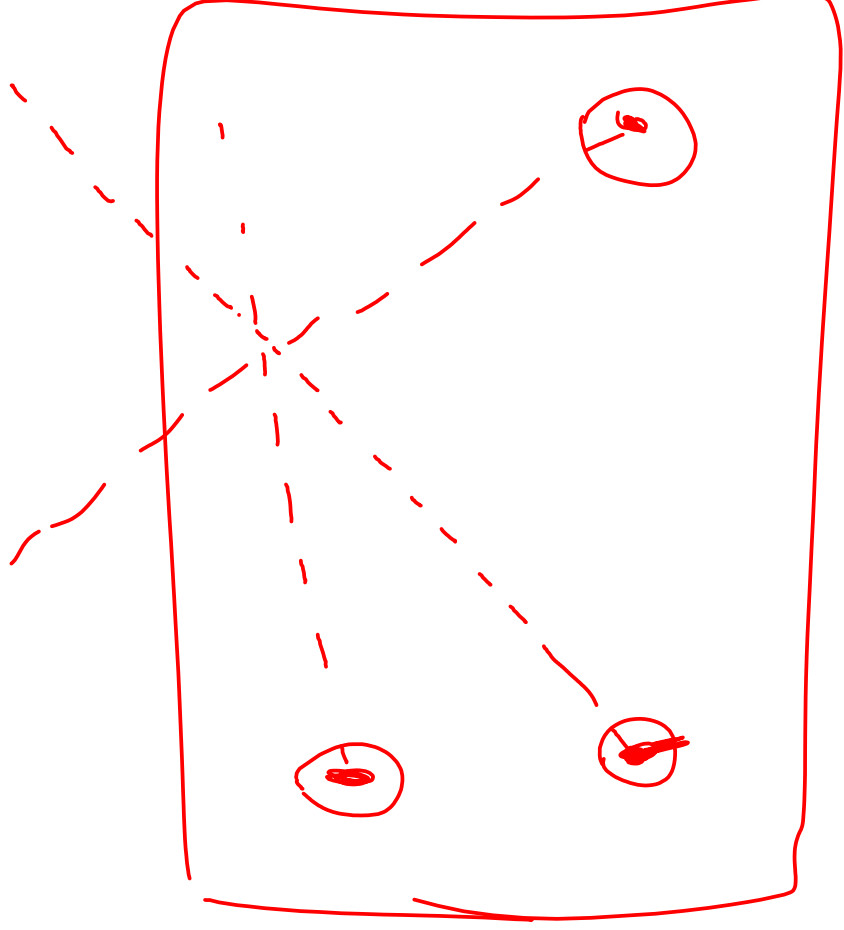
AoA: Multipath + Error



AoA: Seek and Destroy



Multiangulation



ToA Systems

- Time of Arrival (aka Time of Flight, ToF)

