Additional project topics

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Topic 1

Age of information (revised)

Age of information

- Simplest case: MM1 queue (self regulating properties)
- More data ($\uparrow\lambda$) $\rightarrow$ $\uparrow$ delay $\rightarrow$ $\uparrow$AoI

- Trade-off:
  - sending not too much (congestion)
  - Not too little (unstable queue)

- Scenario:
  - 3 players: transmitter *T* (active), receiver *R* (passive), eavesdropper *E* (active)
  - Eavesdropper steals an information with a certain probability β
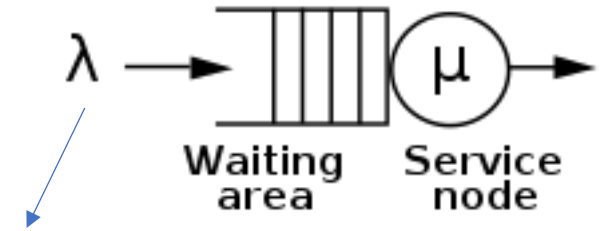
Generation rate

Theoretical results:
- min AoI if 0.5 λ = μ
- LCFS ≻FCFS

Age of information

- Transmitter (T) aims in lowering AoI at receiver. T have to decide how to update
- $u_T = AoI_E/(AoI_R)^{1+\alpha} - c\lambda$, AoI_E is function of β, while AoI_R is a function of λ
- Eavesdropper E minimizes her AoI
- $u_E = \max(AoI_E - c\beta)$

- Some intuition:
- $\downarrow\beta \rightarrow T$ transmits less
- Static game of complete information (recommended for the studens familiar with queue theory)

References

- Link to material to study [link]
  - Paper with the model

Topic 2

Micro-fluidic channel / molecular communication channel

Micro-fluidic channel

- **Application:**
  - drug synthesis and/or for detecting things in the bloodstream such as various biomarkers.
- **Example**
  - Measuring blood sugar (diabetes),
  - stroke biomarkers,
  - cancer biomarkers

Scenario 1

Framework

- few sensors are implanted in the body one of which wants to use the reading

The other sensor can

- send this command via wireless - with all related problems, it means that the sensors have batteries, transmission close to the body and so on;

- send a chemical compound in the bloodstream and when the other sensor intercepts the chemical compound, it detects the information.

Scenario 1 (jamming)

- "information" can be represented in the form of chemical compounds.

- Players:
  - Transmitter and
  - jammer (destroying data) or eavesdropper (stealing data)

- Interacting via micro-fluidic channel

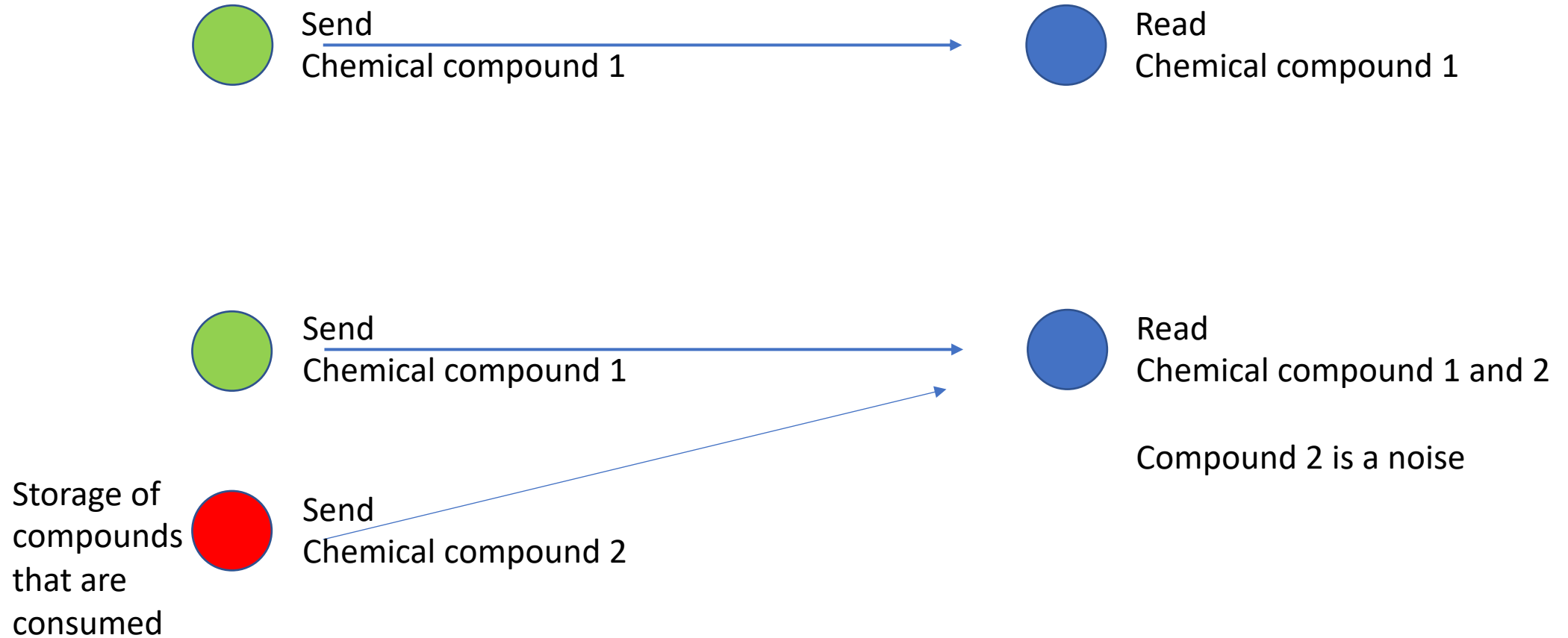- Here you have to focus on studying of jamming analysis (same formulas)

Scenario 2

- Some artificial element (malicious node) can either

- Injecting noise into signal (increase of SNR) ➝ energy consuming

Compare
2 approaches

- Emit a chemical compound ➝ compound consuming

For instance…

Send
Chemical compound 1 → Read
Chemical compound 1

Send
Chemical compound 1 → Read
Chemical compound 1 and 2

Compound 2 is a noise

Storage of compounds that are consumed

Send
Chemical compound 2

Seminar

Friday 13:00 aula Me

Card game

- Multiple players
- Each draw 12 cards which are known (12! Combinations to start this game)
- Each card is numerated
- You can:
  - Play backward induction (optimal strategy, assuming that an opponent plays optimally as well) Lecture on dynamic games
  - Randomly
  - Lowest to highest (or vice versa)

Card game

- You can
    - Simulate different strategies, many possible runs (Monte Carlo study)
    - Compare which strategy is better (pairwise comparison: random vs backwards, backwards vs lowest to highest)
    - Pick up a winner of each run
    - Draw a distribution of cards chosen by a winner at each stage of the game