

# Example: Game Sever Design

- Scenario: A game server needs to support all users with two types of actions: Type A is simple but boring to users; type B is complicated and exciting. Each type B action will occupy 100 units of CPU power for 0.1 seconds. The CPU power needed for type A is negligible.
  - To each user, the inter-arrival time of actions is exponentially distributed with the average of 5 seconds.
  - Each action can be type A (or B) with prob of 90% (10%).
- Questions:
  - Given that the server supports 100 users and its total CPU power to support all actions is 500 units, what is the probability that the game server is overloaded?
  - If the number of users is doubled and the CPU power is doubled as well, will the overload probability remain the same, be reduced, or be increased?

# Example: VANET Connectivity

- Scenario: vehicles on a highway use wireless communications to exchange emergency message.
  - The highway has two lanes in each direction.
  - On each lane, vehicles arrive as a Poisson process with the average of  $\lambda$  (equal to 10 veh/km).
  - An emergency message will be broadcasted, and each vehicle receives the message will re-broadcast it once.
  - The wireless transmission range is 150 m.
  - Assume all transmissions are successful if the receiver is within the transmission range. Ignore the width of the lane.
- Questions: For each emergency message,
  - how many other vehicles can receive it on average?
  - what is the prob that no other vehicle behind the sending vehicle receives it?
  - how far it can be propagated in each direction on average?

# Example: Cellular Network Planning

- Scenario: a base-station serves the users in a cell.
  - The call arrivals in the cell can be viewed as a Poisson process with the average rate of 0.1 per second.
  - 50% of the users are smart phone users. A smart phone call will be a video one with probability 0.2.
  - For non-video call, each requires a 100kbps channel; for video call, each requires a 1Mbps channel.
  - The time each call last follows the exponential distribution with the average of 50 seconds.
- Question:
  - Find the prob. of no video call arriving in a second.
  - If the cell is allocated with the bandwidth of 2Mbps, what is the blocking probabilities for video and non-video calls, respectively?