A Preliminary Evaluation of Backup Servers for Longer Gaming Sessions in MANETs

C. E. Palazzi*, A. Kaiser, K. Boussetta** and N. Achir****

***Università degli Studi di Padova - ITALY,**

****University Paris-Nord – France.**

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Context

- **Multiplayer video gaming are usually using wired communication infrastructure**
  - Home, “*office !!!*”,
  - LAN, Internet
- **Radio interface is now integrated to portable terminals**
  - Consoles, PDA etc. => integrate WiFi, Bluetooth, wireless technologies.
  - The player can then **extend their favorite games** with **the possibility to playing it outdoor**
- **Unfortunately, for current mobile consoles and games only one single hop is supported**
- **We believe that multiplayer videos games should support ad hoc networks**

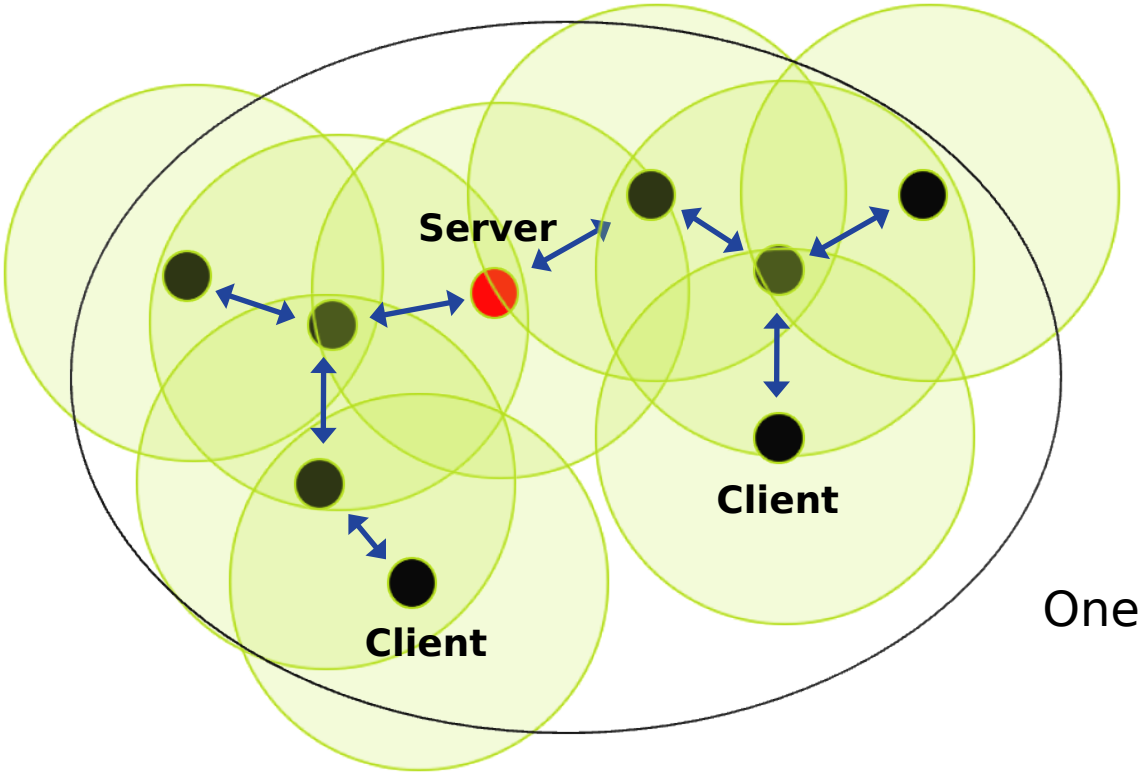
Issues

- **For multiplayer games, the game play is sensitive to network resource availability**
  - Not really in term of bandwidth (few Kbps are sufficient), but in term of:
    - ***Connectivity***
    - ***packet losses***,
    - ***end to end delays*** and
    - ***Jitter***

- **Problems in MANET**
  - Users are mobile
    1. **Risk of disconnection**
       - Some players (clients) isolated for the server
       - Server isolated from the players
    - **Energy consumption**
    - Possible impact **on delays, jitter & packet losses** due to **misfit ad-hoc routing protocols**

Connectivity

- **The classical gaming model today is client-server**
  - Client run by the player's PC
  - Server can be located locally or remotely in the internet
- **If considering Ad Hoc environment**



One Game session

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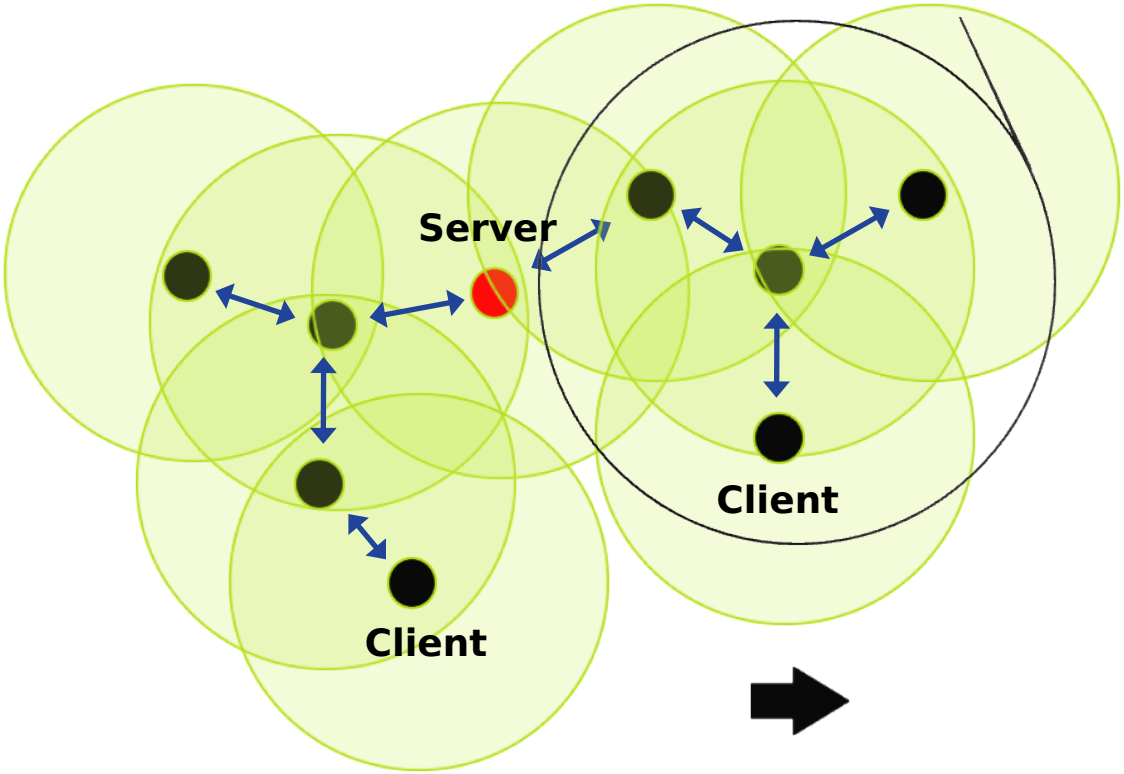

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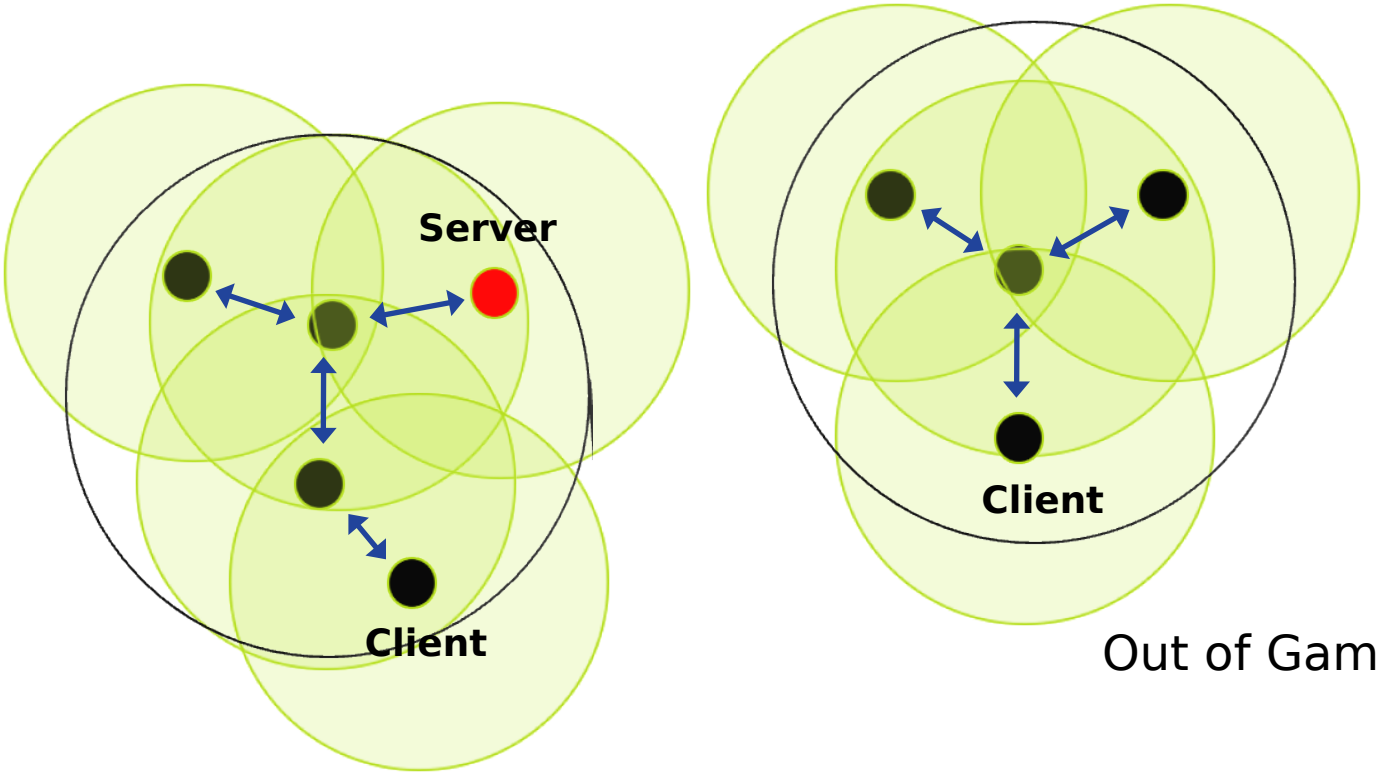


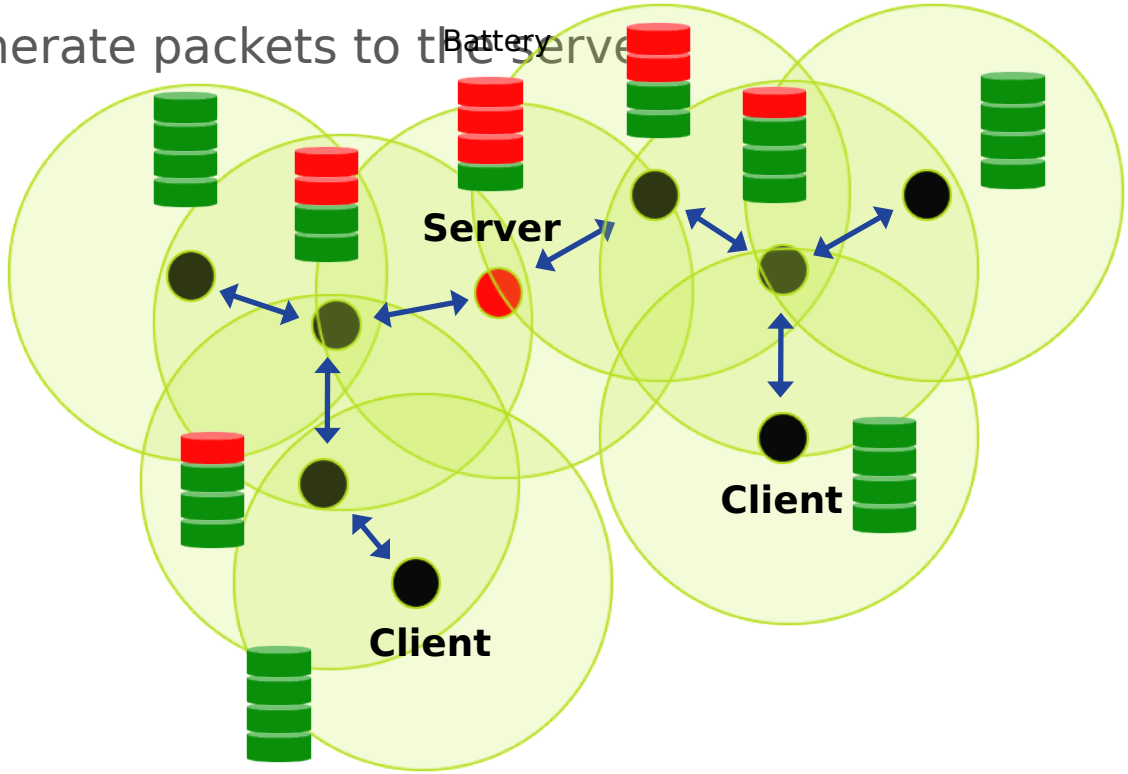
Out of Game session

Energy

- **Energy consumption is not an issue for home players**
  - Players can play for a very long time
- **If considering Ad Hoc environment**
  - Energy consumption is a major concern in case of Ad Hoc environment
    - Mobile consoles are **battery powered**,
    - …with **limited capacity**
    - Support:
      - game-related computation,
      - Visualization,
      - Communication
- **Battery go down very fast**

Energy

- **Player's device will experience a much faster decrease of it's energy reserve as it be a central node of a the MANET network**
  - Forward packets from some clients to the server
  - Forward packets from the server to some clients
  - Generate packets to the server



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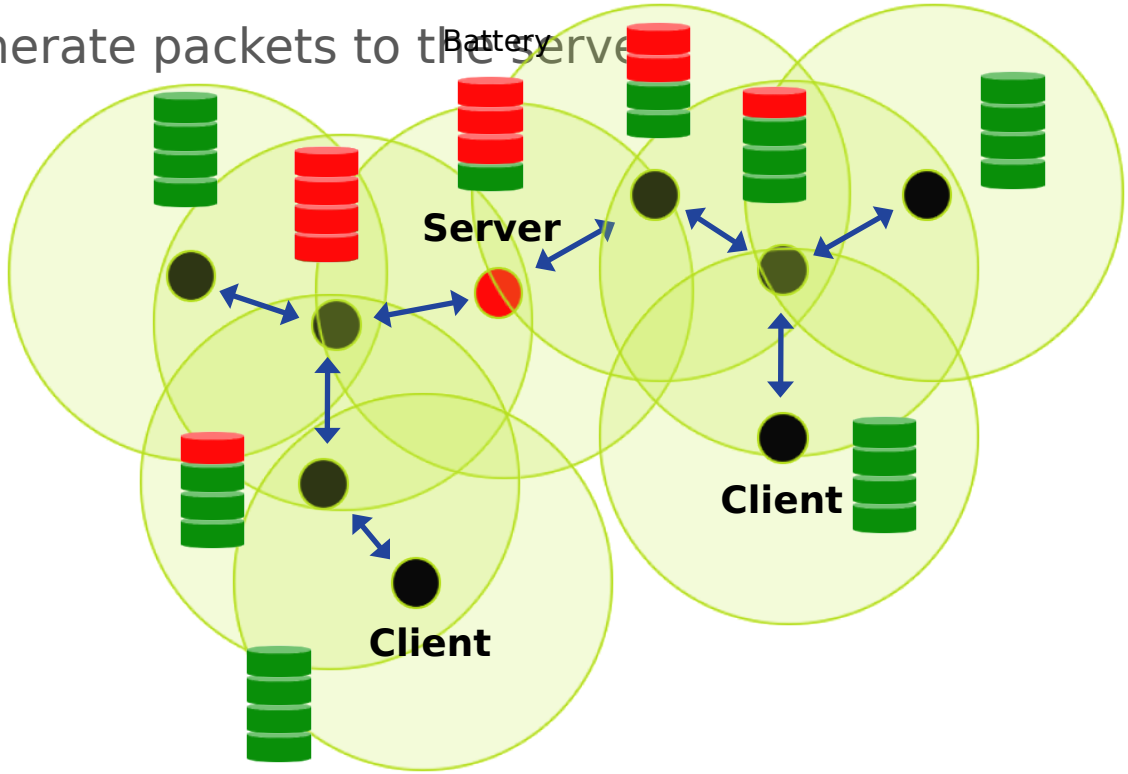

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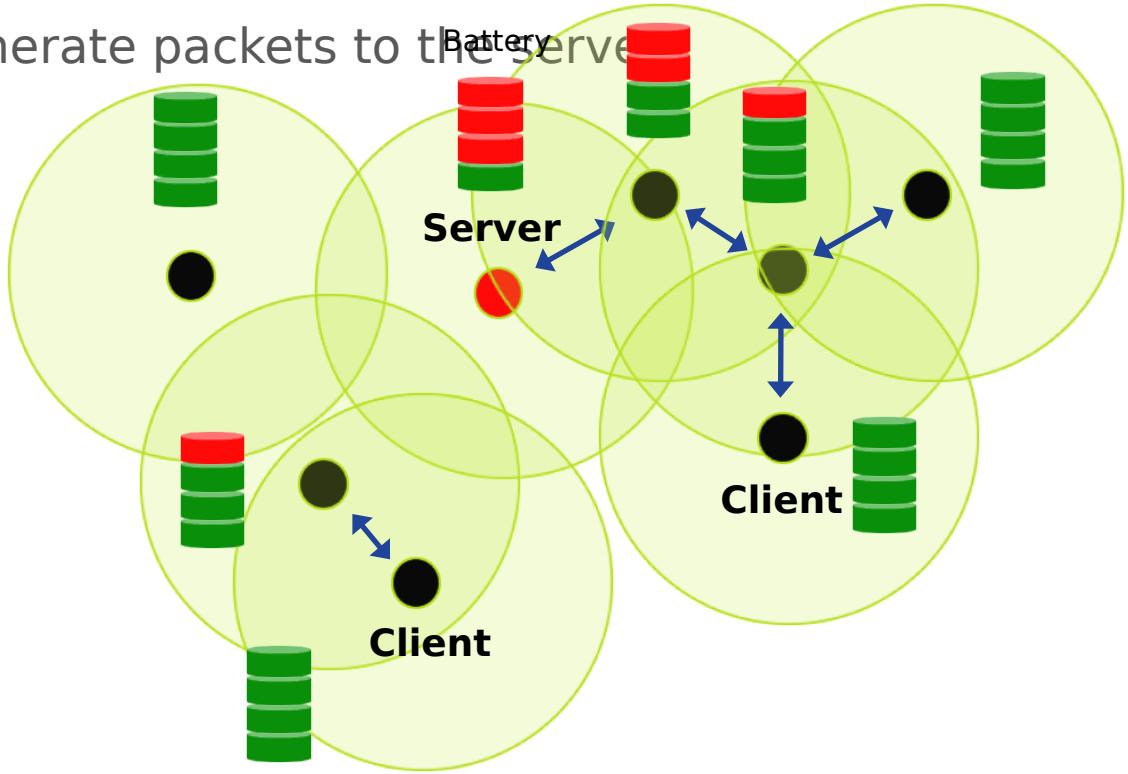
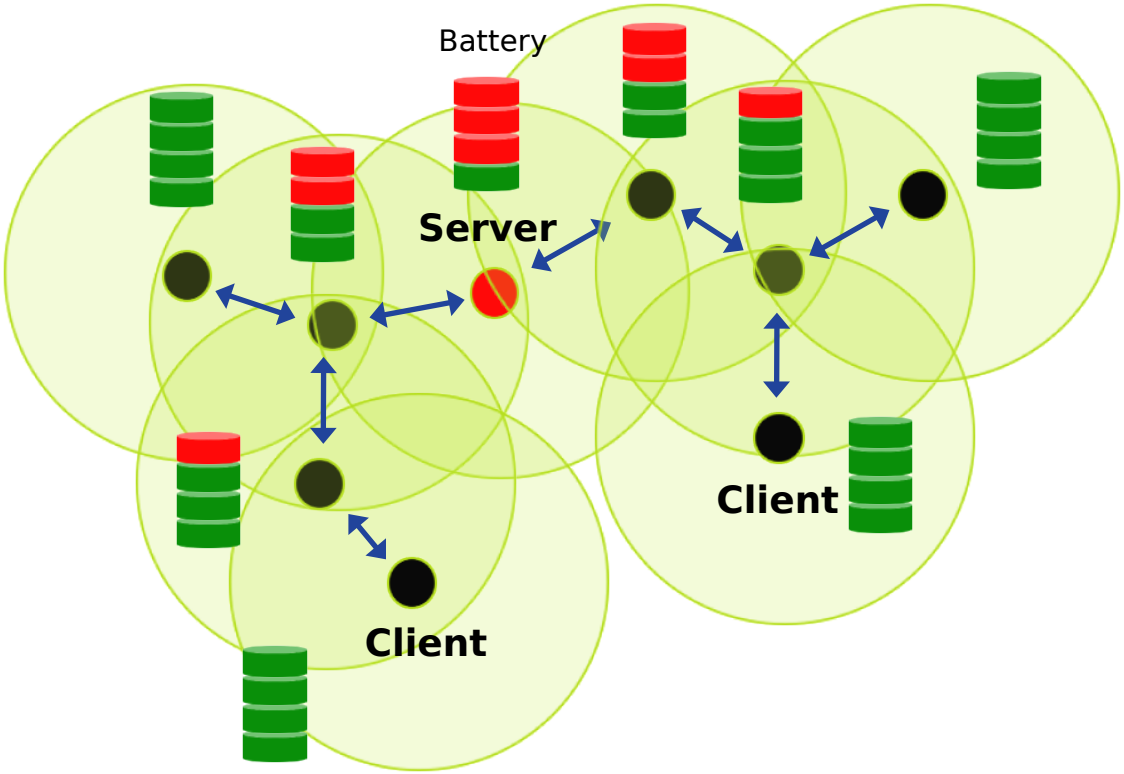


Energy

- **The energy consumption of the server of the game session**
  - Receive packets of each client
  - Send packets to each client



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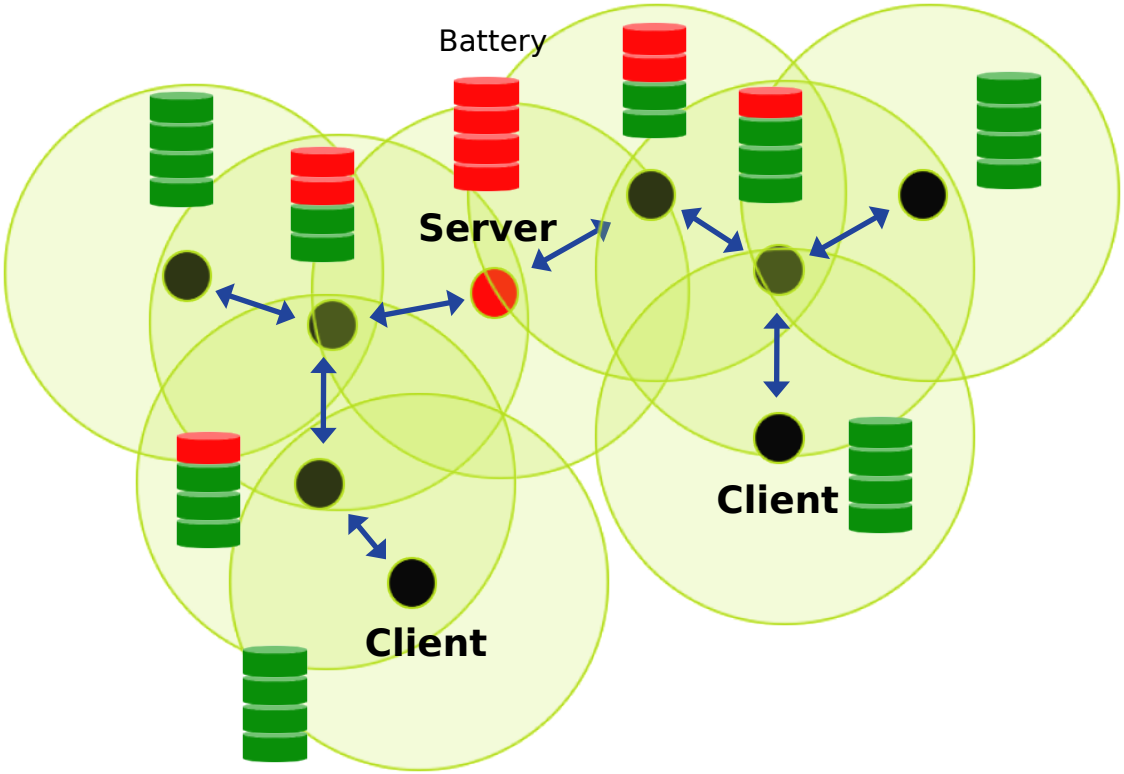

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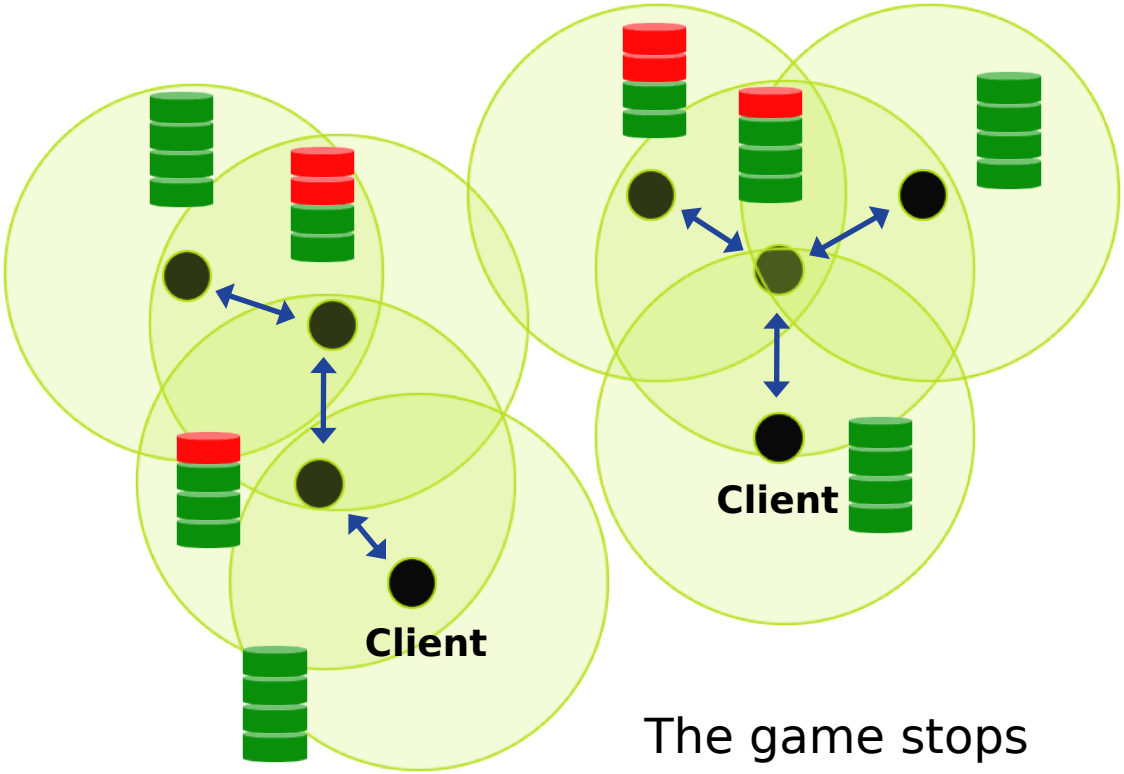

The game stops

How to adapt the multiplayer gaming to ad hoc environment ?

- **Convert the Client-Server Architecture to pure Peer-to-Peer architecture**
  - Advantages
    - no dedicated clients or server terminals,
    - only equal peer nodes that can simultaneously act as a client and a server.
    - every peer can sends its local player actions to all other peers in a completely distributed manner
    - ➔ **No disconnection problem**
  - Drawbacks
    - each peer is responsible of computing the overall game state
      - **Need of efficient synchronization process between**
    - **High energy consumption at each peer**

How to adapt the multiplayer gaming to ad hoc environment ?

- **Hybrid architecture**
  - ***More than one server***,
  - At each time, ***within one gaming session***, only one server is active, while others are kept synchronized and off
  - A ***gaming session*** is considered as a ***partition***
  - Three category of participant in each game session:
    1. ***Active server***:
       - A node that holds game status
       - Communicates with nodes of its partition
       - Keeps synchronized backup servers
    1. ***Backup server:***
       - Client that plays and can be chosen as active server in the future
    1. ***Client:***
       - Node that only play to the game

How to adapt the multiplayer gaming to ad hoc environment ?

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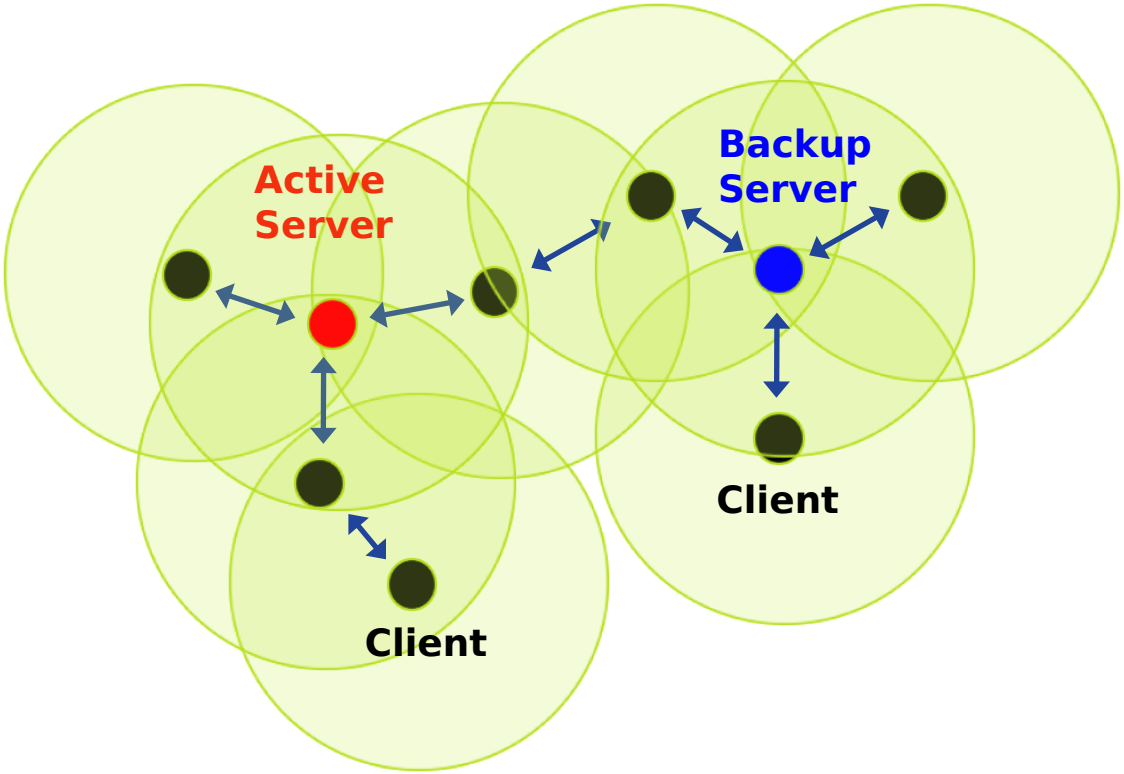
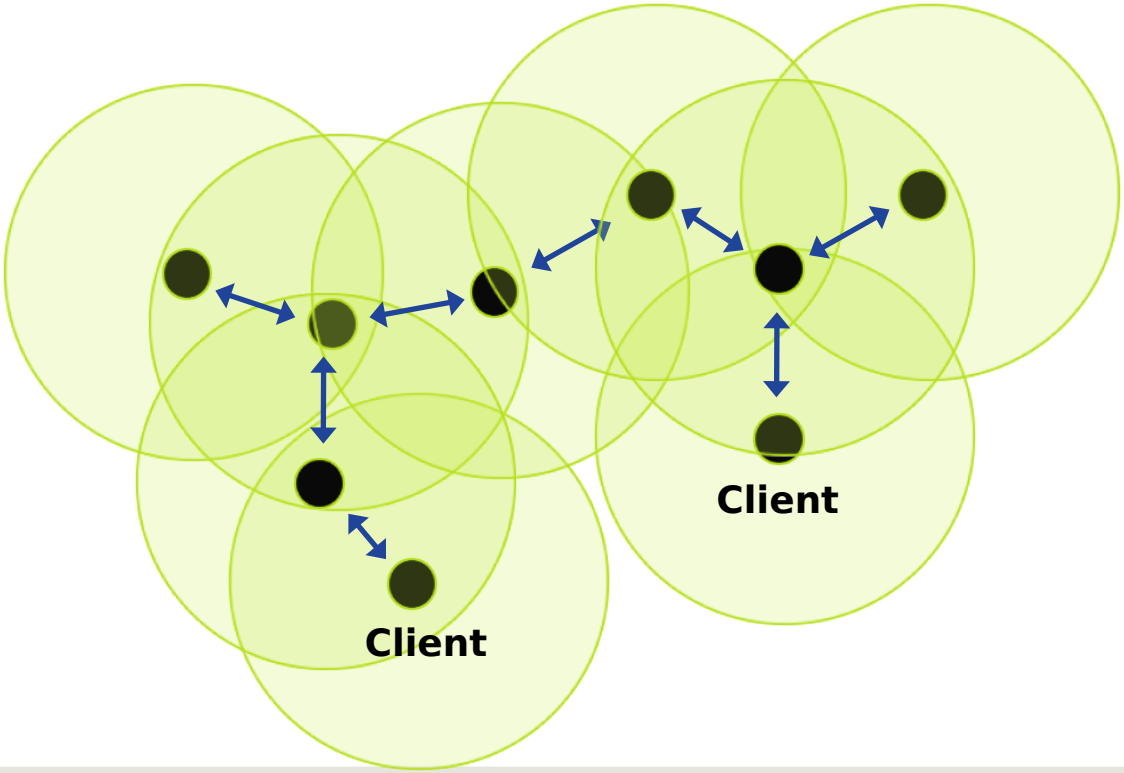


Server, backup servers & partition management

- **Election of server and backup servers**
  - **Active server election** is done in **round robin** way **among all backup servers** at the end of each quantum
  - **Backup servers election** is done using a **reachability matrix**
    - Maximizing the number of reached nodes



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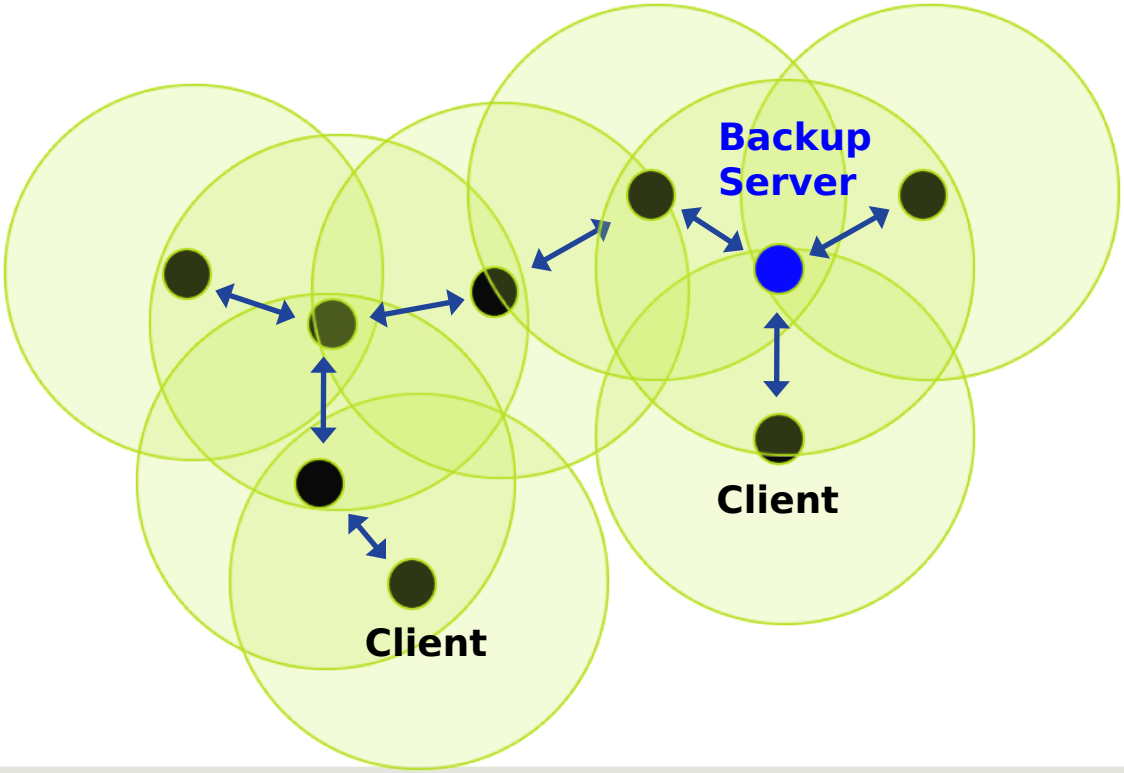

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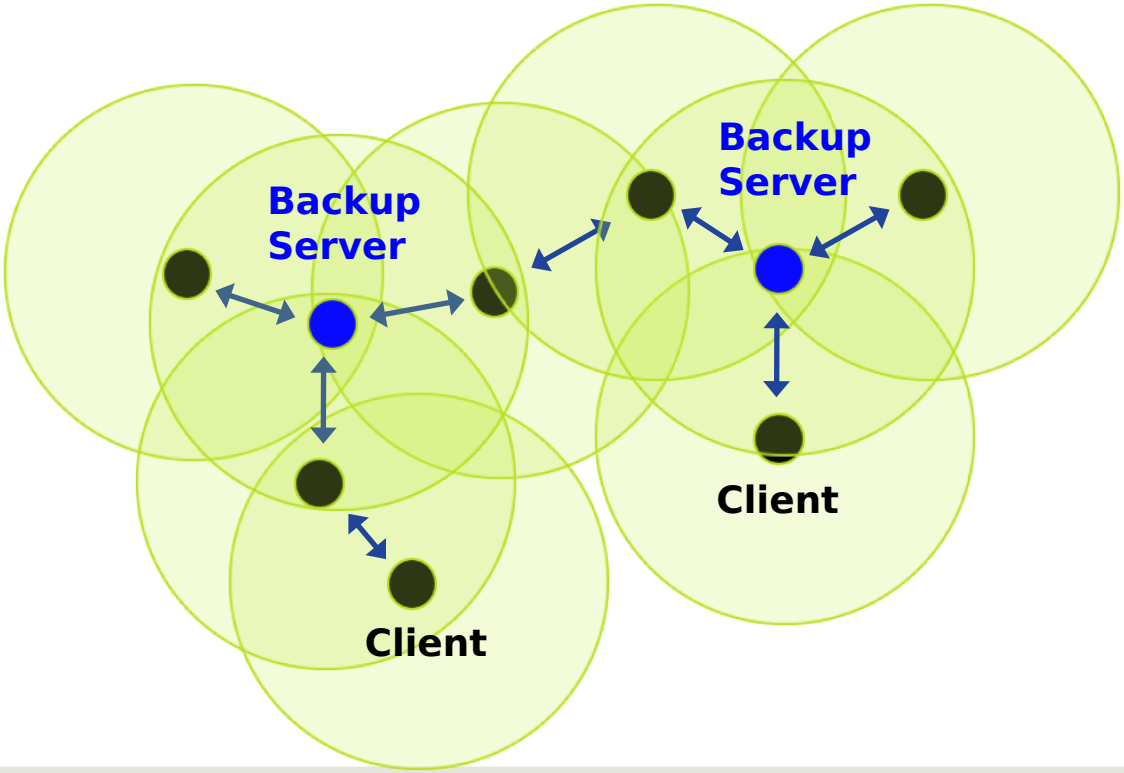

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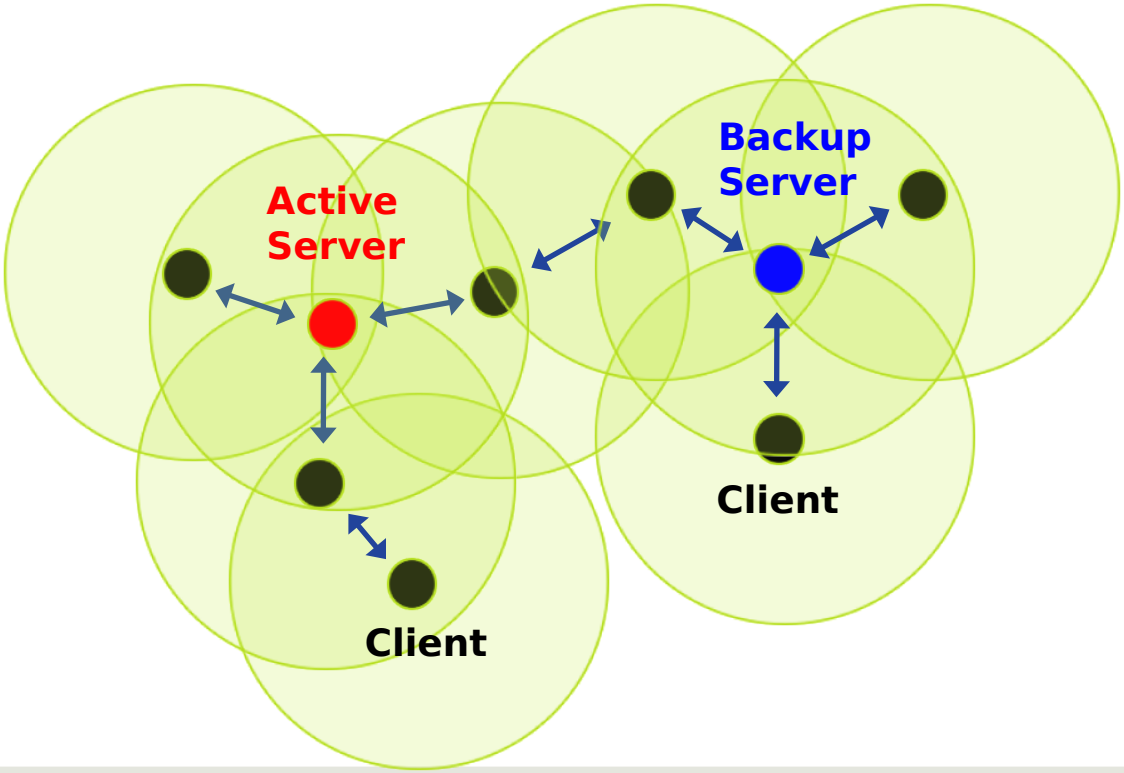

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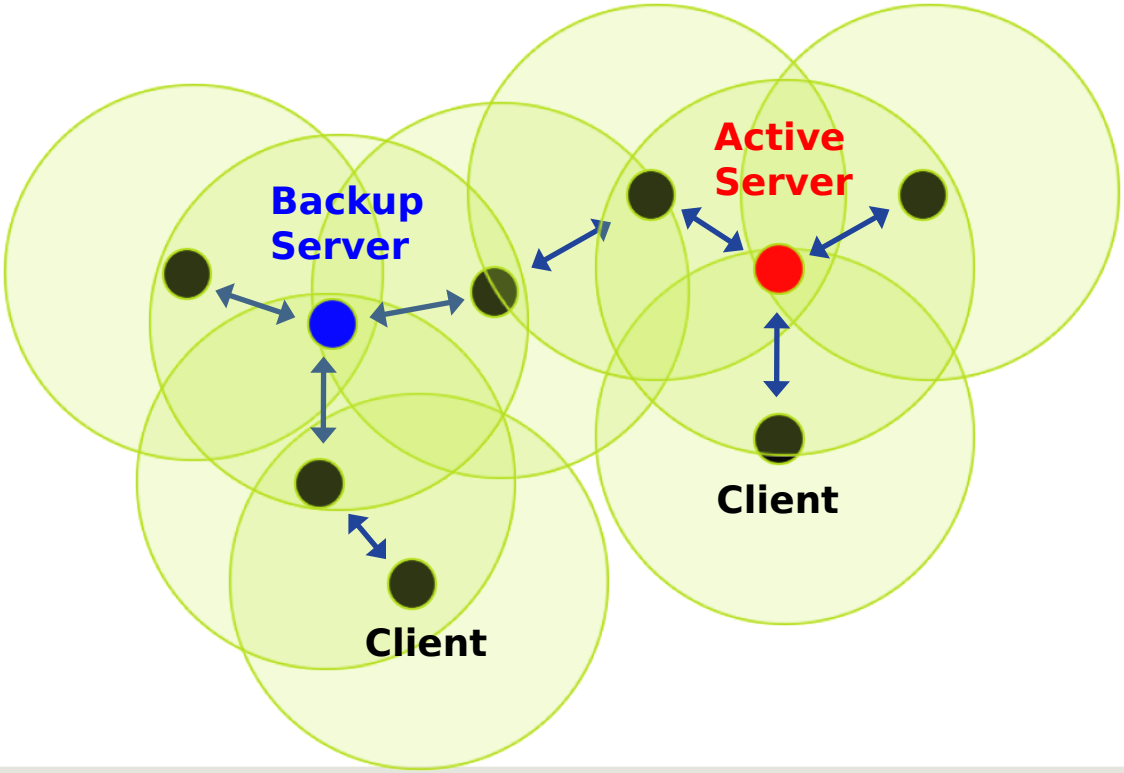
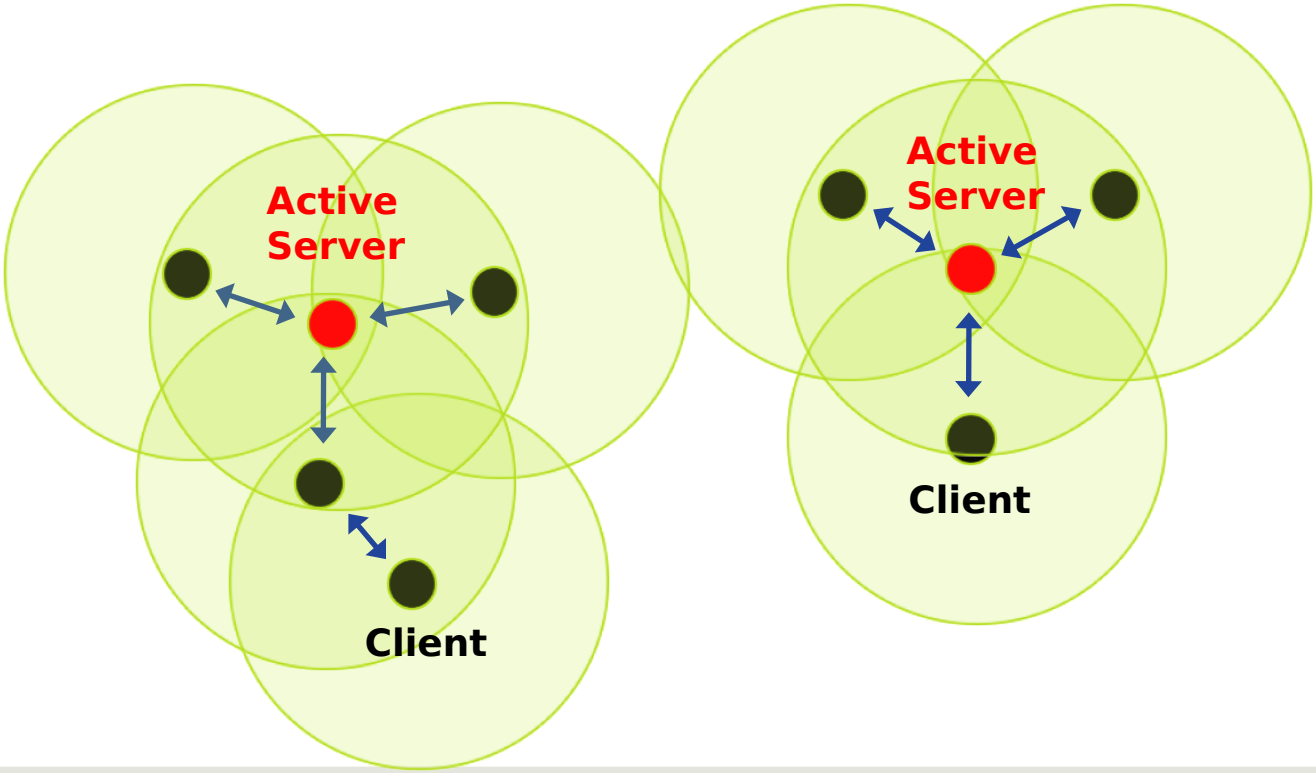


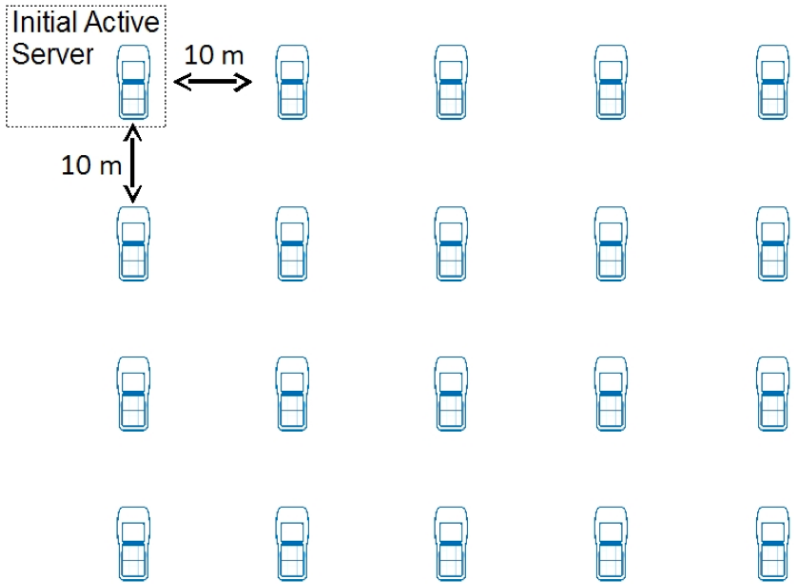
Server, backup servers & partition management

- **In case of node movement**
  - Periodically the backup servers check if they can communicate with the active server
    - If not, one of them become active server



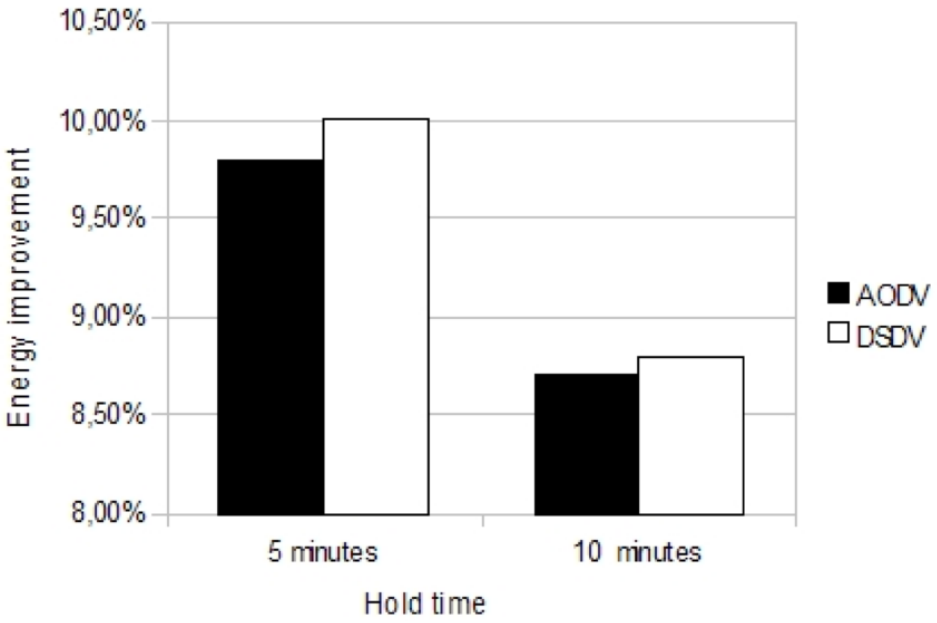
Simulation parameters

- **Area of 100 m x 50 m**
- **20 nodes**
- **8 possible servers**
- **Movement models: Grid & RPGM**
  - RPGM: Reference Point Group Mobility
- **MAC protocol: 802.11g**
- **Routing protocols: AODV, DSDV**
- **Transmission range: 20 m**
- **Server-generated flow: 200 bytes every 50 ms**
- **Client-generated flow: 40 bytes every 300ms**
- **Server hold time:**
  - no hold time (C/S architecture)
  - 5 minutes, 10 minutes
- **Simulation duration: 2 hours**

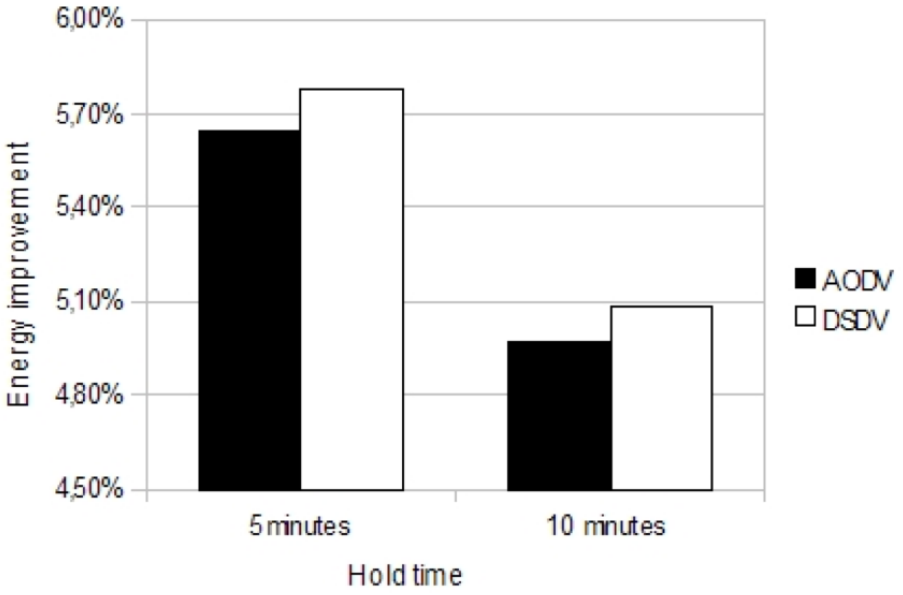


Grid topology

Preliminary Results



Energy improvement of backup server solution with respect to a traditional scheme; Grid model



Energy improvement of backup server solution with respect to a traditional scheme; RPGM model

Conclusion and future work

- **We have discussed the idea of:**
  - Hybrid architecture including one active server and a set of backup servers
  - Backup server substitute active server at the end of a certain time quantum
- **Allow player to be engaged in the game for long time, even with a limited energy and continuous mobility**
- **New efficient way for server and backup server election including:**
  - Energy,
  - Connectivity,
  - And fair delay between the server and the clients
- **Exploring MPR (Multipoint relay) of OLSR protocol**
  - We have a new solution under implementation on real testbed