Multi-Agent System Design: Treasure Hunt

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Changes in the architecture

- **New system architecture**: There is no longer a hierarchy. Previously: low level agents, cooordinators and managers
- **New communication methods**: Coordination between agents has been simplified. There are no longer auctions and voting

Architecture evolution

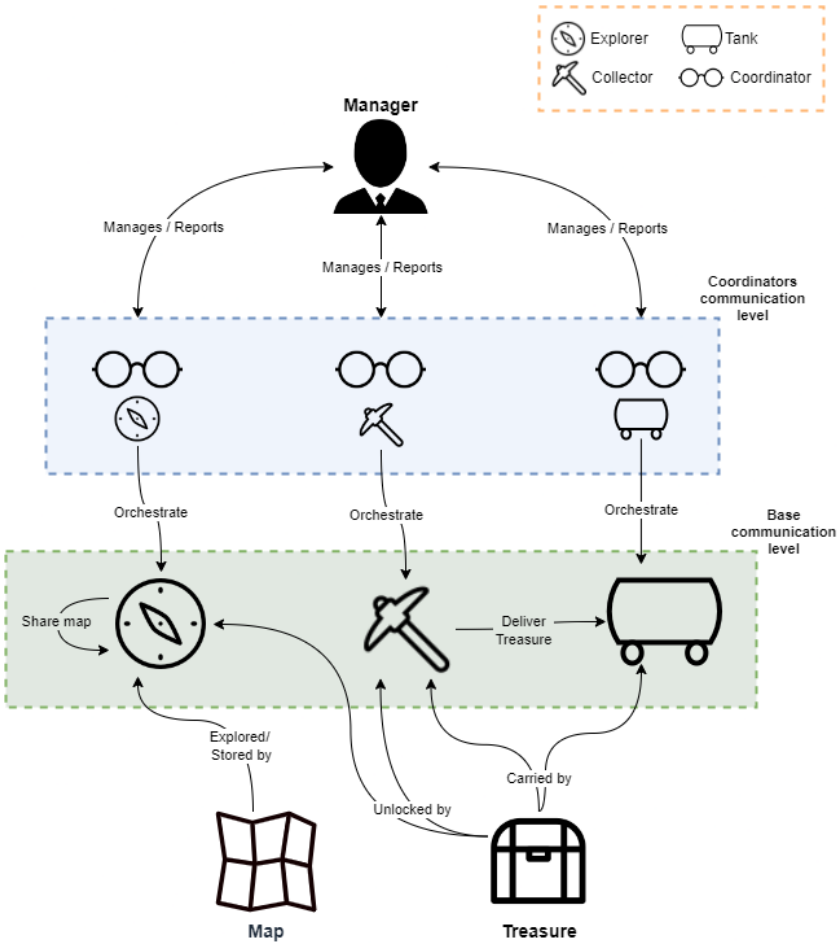


Fig. 1: Previous Architecture

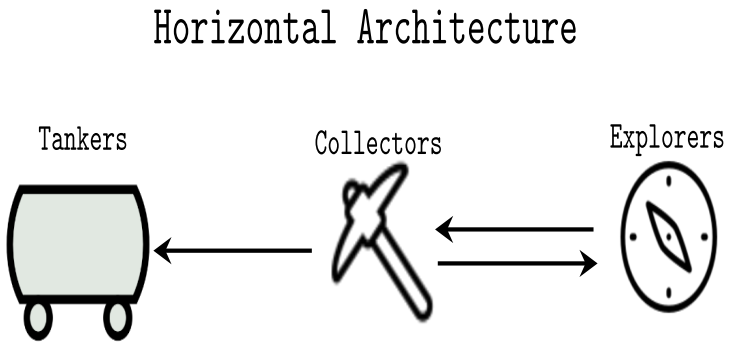


Fig. 2: New architecture system

New architecture

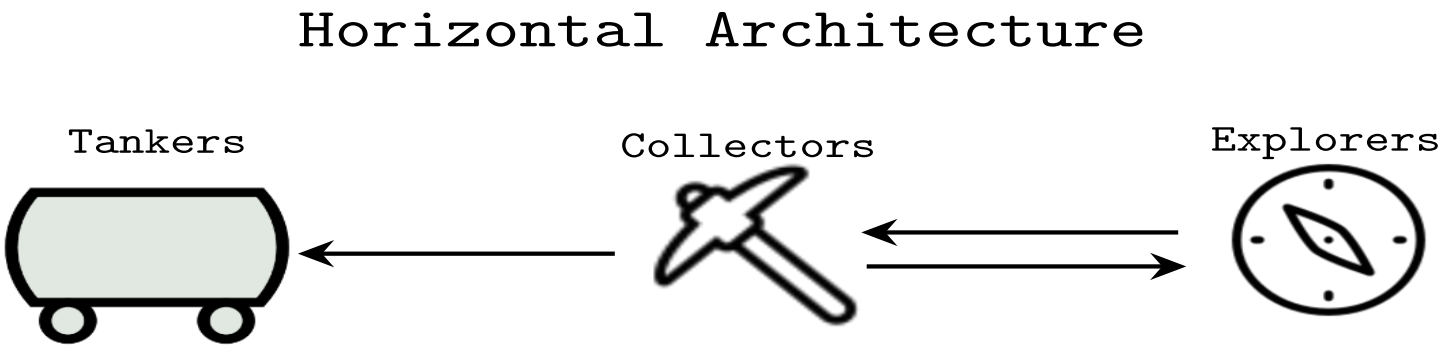
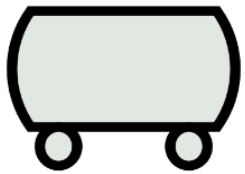


Fig. 3: New architecture system

Overview

- **ExploCoopBehaviour**
  - action()
    - tmpRandomMovement(L_Obs)
      - moveToNextNodeRandom
- **ShareMapBehaviour**(Agent, Period, Map, Receivers)
- **ShareTreasuresLocBehaviour**(Agent, Period, Treasres, Receivers)
- **SharePath**(Agent, Map)



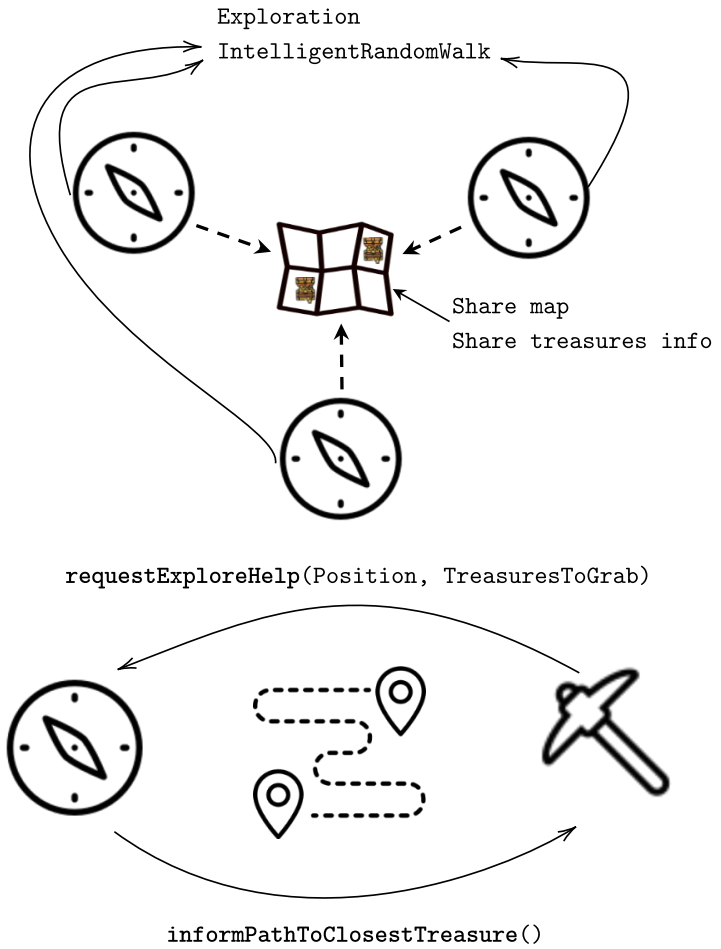
- **RandomTankerBehaviour**
  - onTick()
    - chooseNextNode(L_Obs)

- **CollectorBehaviour**
  - onTick()
    - solveBlockedPath()
      - sendBlockingInfo()
        - getRemainingPath()
      - getBlockingInfo()
        - getRemainingPath()
    - updatePotentialTreasures()
    - receiveMission()
    - getStopMessage()
    - requestExploreHelp()
    - sendTreasureRequest()
    - backOff(L_Obs)
    - moveToNode(L_Obs)
    - moveToNextNodeRandom(L_Obs)
    - shareTreasureInfo()
    - mergeTreasureInfo()

Fig. 4: Implemented functions for each type of agent.

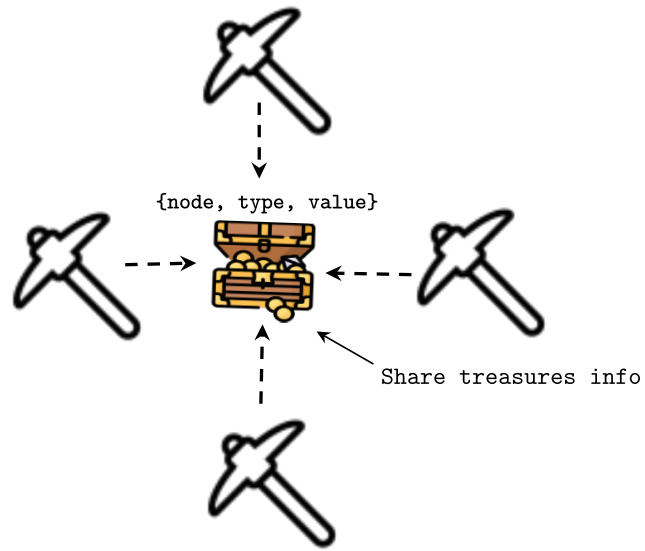
Explorers

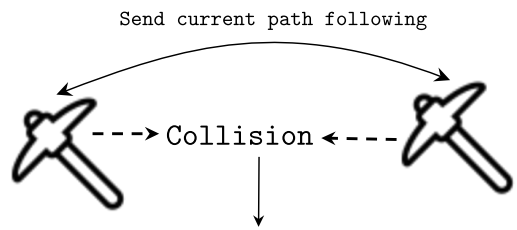
- **Generation of map knowledge**: At the start of simulation, visit the nodes of the maps until gathered the information from the whole map
- **Communication with other Explorers**: Exchange map information when being in communication range.
- **Communication with Collectors**: Explorers provide Collectors with the shortest path to the treasure they are able to collect
- **Communication with Tankers**: Explorers provide Tankers with the path to a location near to a treasure, where they fill remain fixed and waiting for Collector's treasures



Collectors

- **Basic behaviour**: On every clock tick try to 1. collect treasures if they are able to 2. deliver treasures to Tankers.
- **Solving path collision**: When two Collectors collide, compute priority of each agent's mission and the agent with most priority will continue its path.
- **Communication with other Collectors**: Share map with information about treasure types and location.
- **Communication with Explorers**: Receive information about shortest path to treasure.

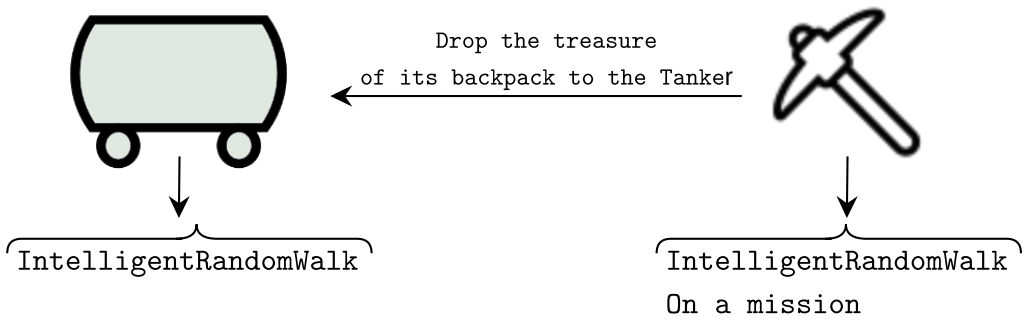




The one with the longest path moves back until he can get out of the way and then continues. If there is a tie, it is decided by name.

Tankers

- **Basic behaviour**: Do a intelligent random walk remembering and avoiding the recent nodes it has been already, trying to cover large areas in the map.
- **Interaction with collector**: When it pass near a collector it receives the treasures.



Challenges

- **Default Random Movement**: Useful in grid like maps only. Challenge in long straight paths. Added a buffer to keep track of visited nodes.
- **Explorers getting stuck**: When going to a node and cross path with another explorer in opposite direction. Added temporal random walk behaviour until unblocked.
- **Cannot rely on randomness**: It would take ages. We added mission mechanisms for collectors.
- **Collectors getting stuck in missions**: When crossing paths with another collector on a mission, one has to back off.

Demo

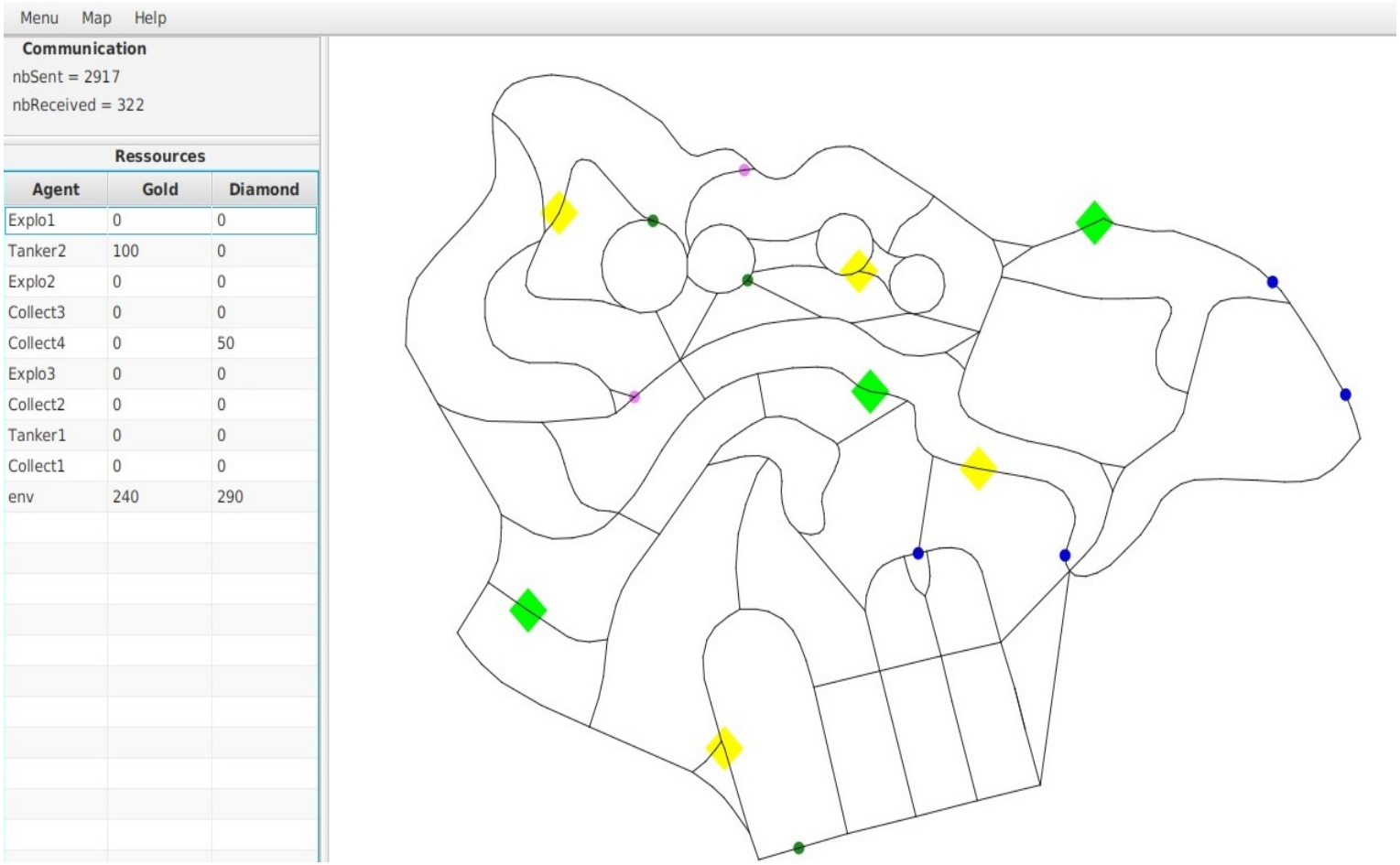


Fig. 5: Final implementation Rio map