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Goal-based Multi-agent Collaboration Community Formation: A Conceptual Model

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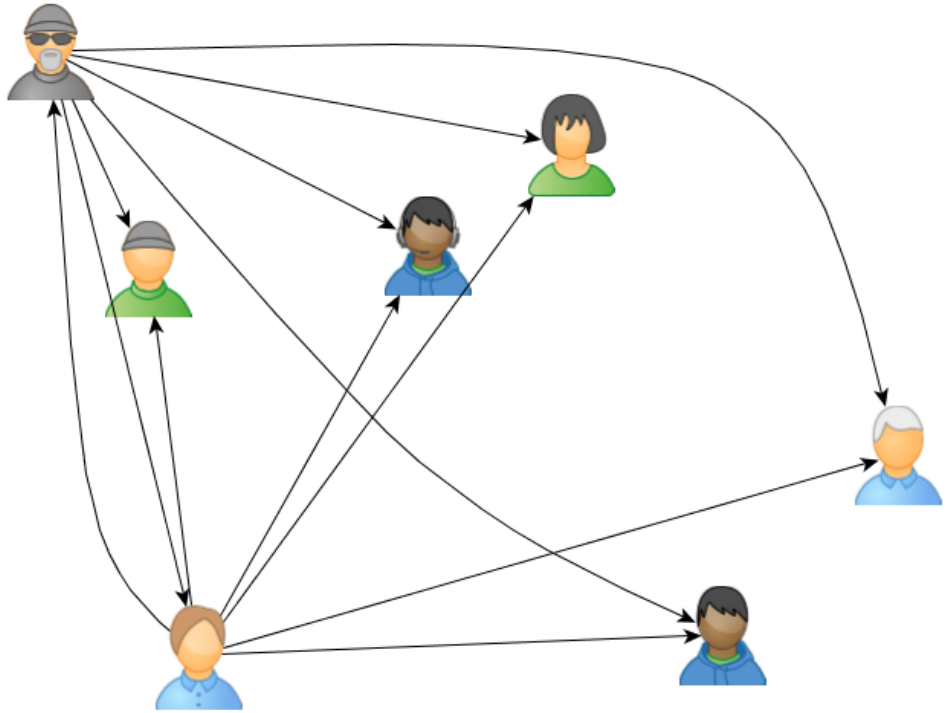
Outline

- What is the problem?
- Solution Design: A Conceptual Model
- Results

What is the problem?

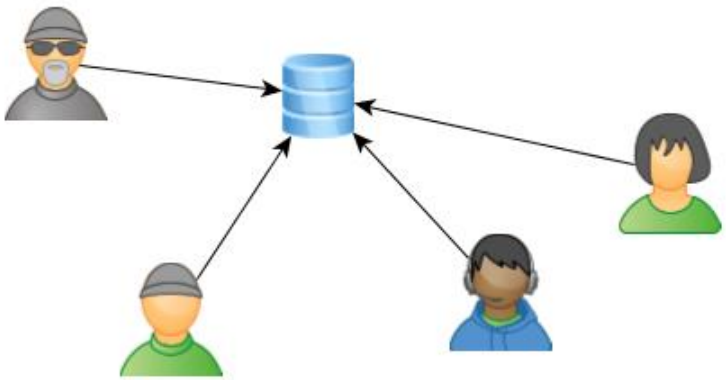
- A Network of agents
- Their aim is to form a collaboration community to achieve a shared goal
- No predefined network structure or completely connected network structure

- Large number of links between agents (Large number of possible combination)
- Computational Complexity
- Not flexible enough for dynamic open systems



Common Solution

Solution: Defining Neighborhoods



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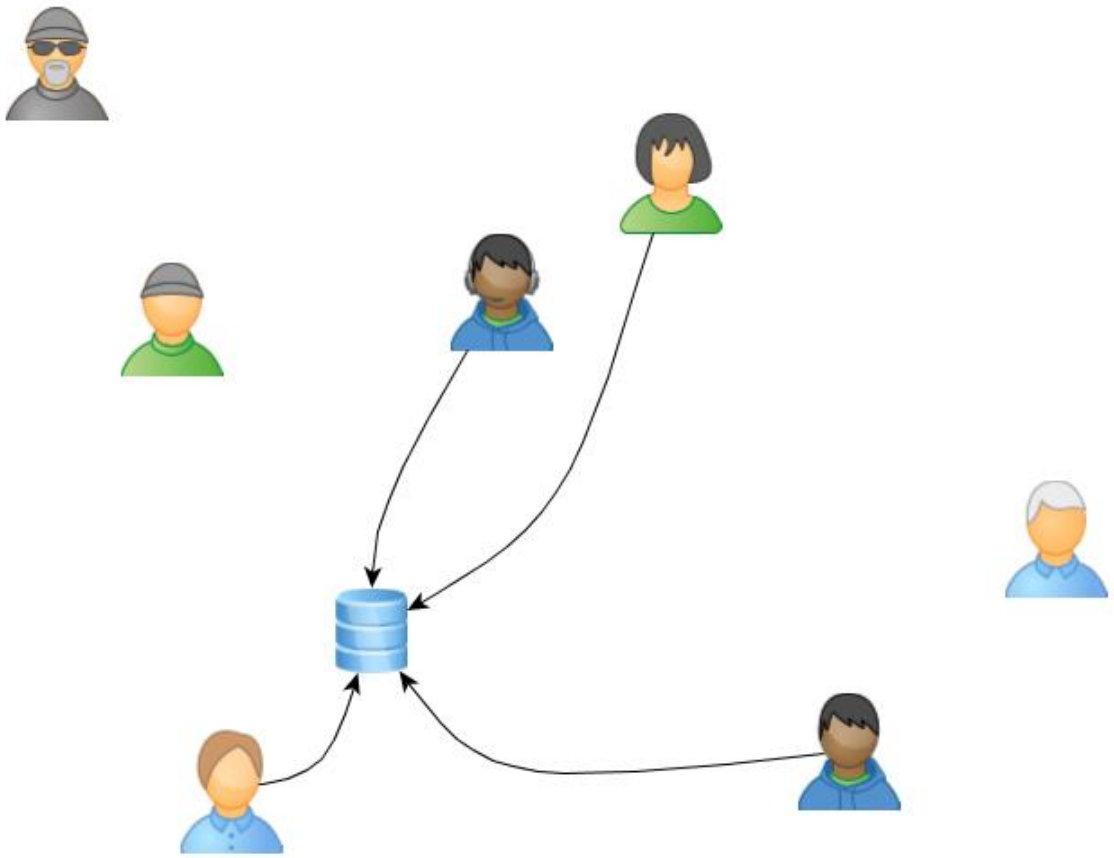

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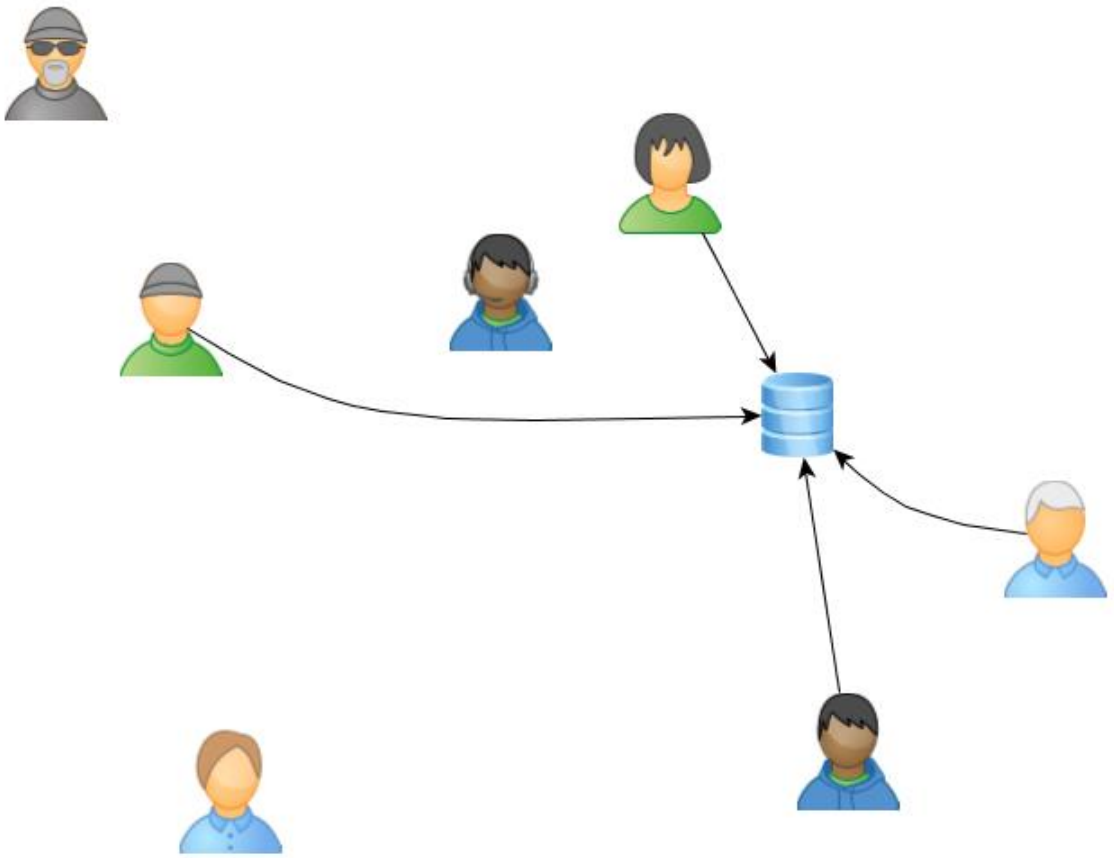
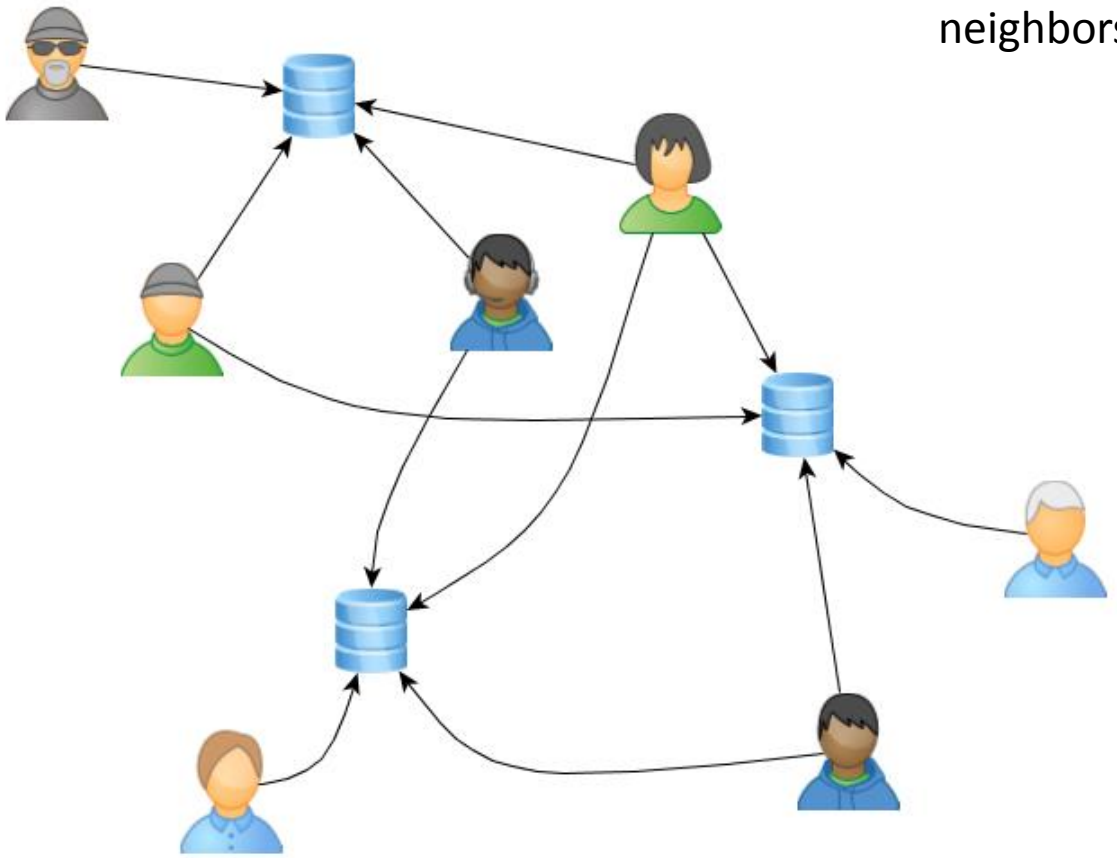
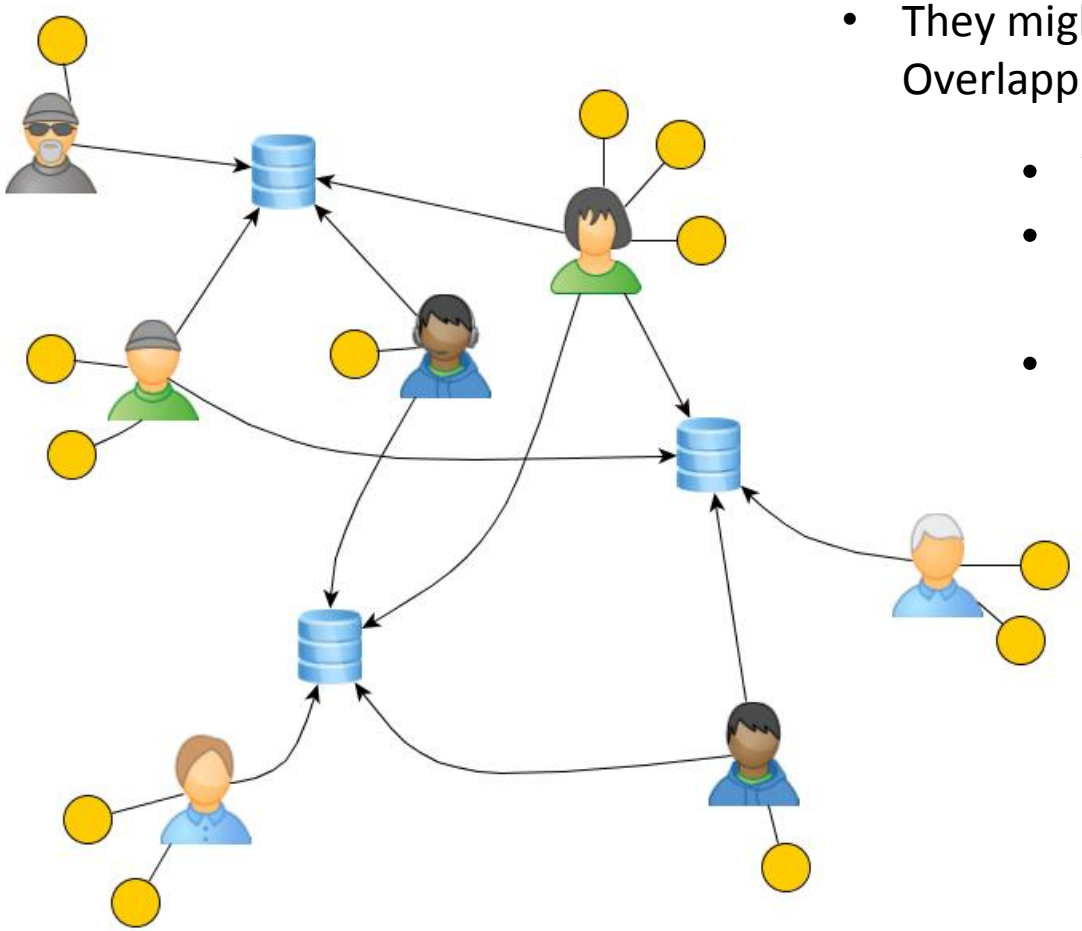


Common Solution

- Defining Neighborhoods
- Agents are able to communicate with their neighbors



What is the problem, Now?

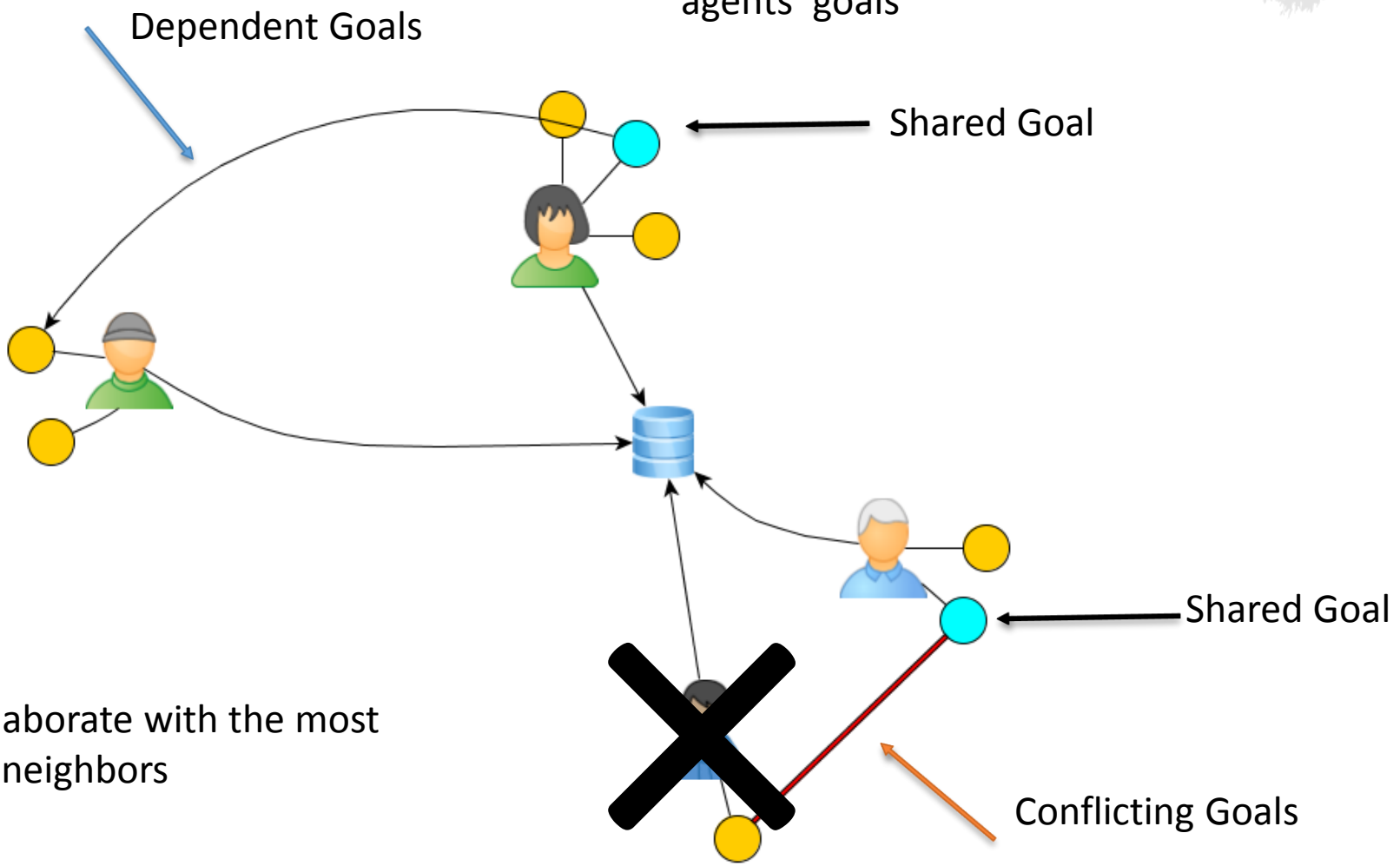


- Agents have different individual and shared goals and policies
- They might have Conflicting Goals, Overlapping Goals, ….

- **Who are the collaborators?**
- **How to nominate agents with no conflicting goals or interest ?**
- **How to balance shared goal and individual goal achievement?**

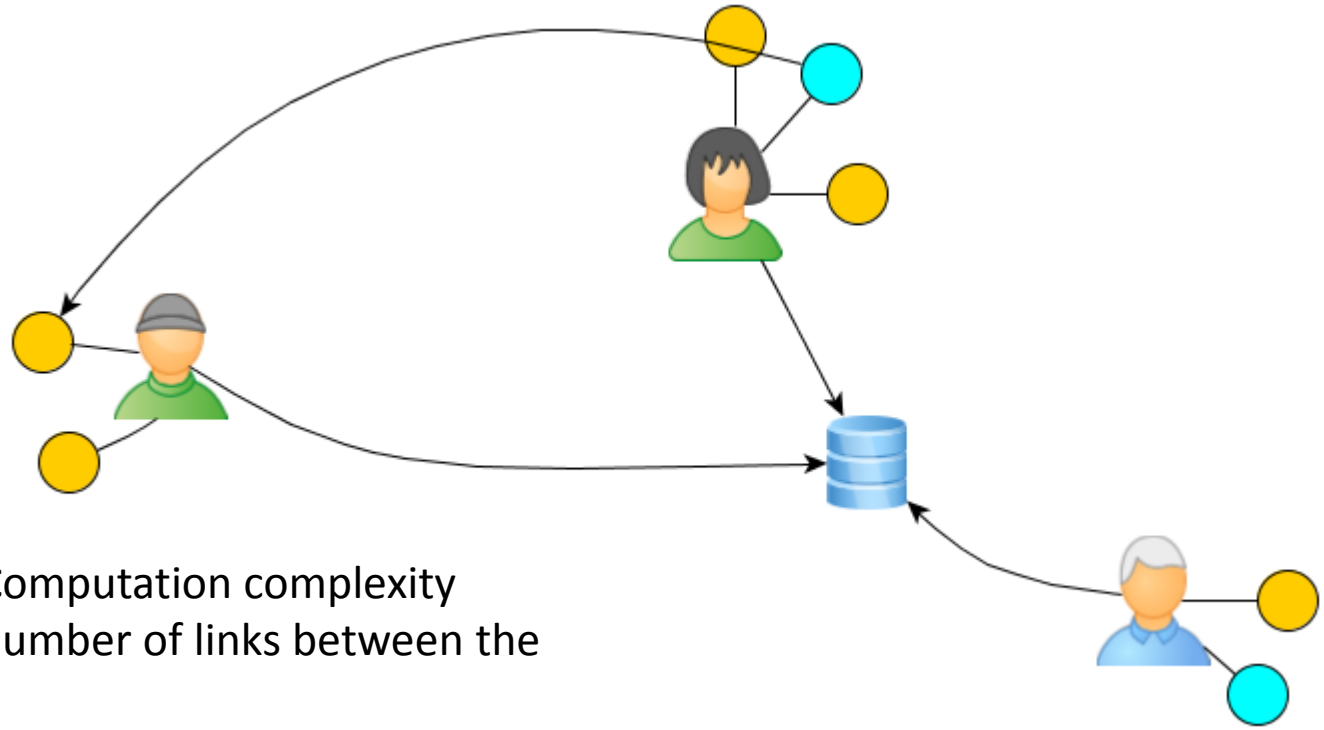
Our Solution

- Agents' Goal Relation Type Model
- Different dependencies between agents' goals



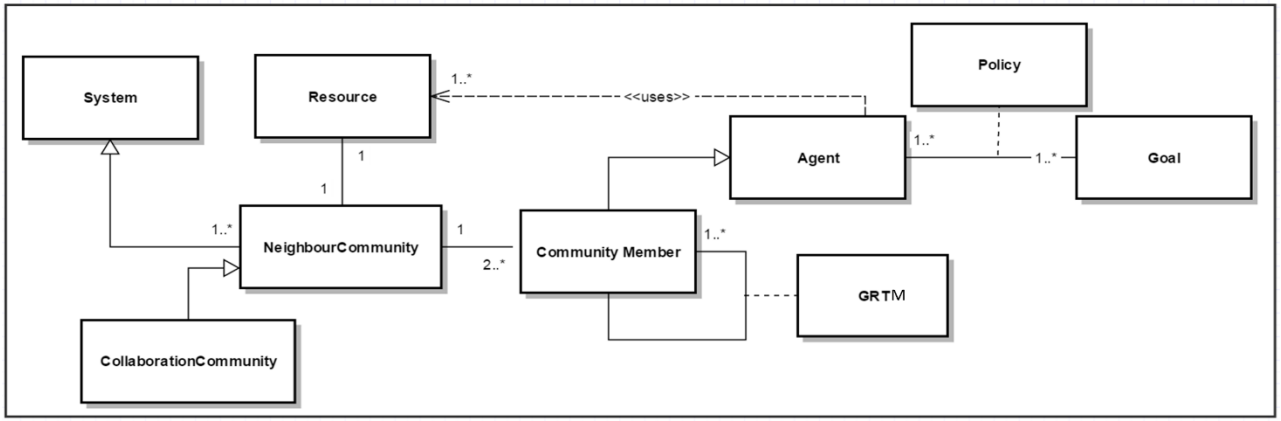
- They collaborate with the most relevant neighbors

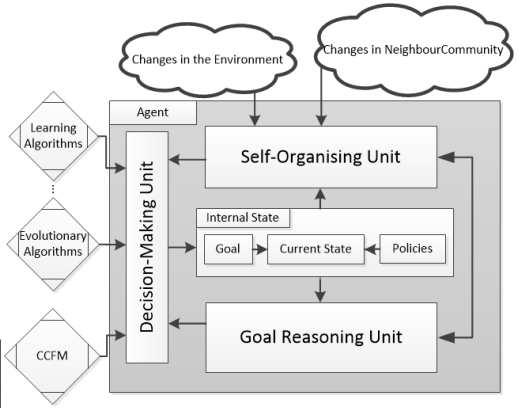
Our Solution

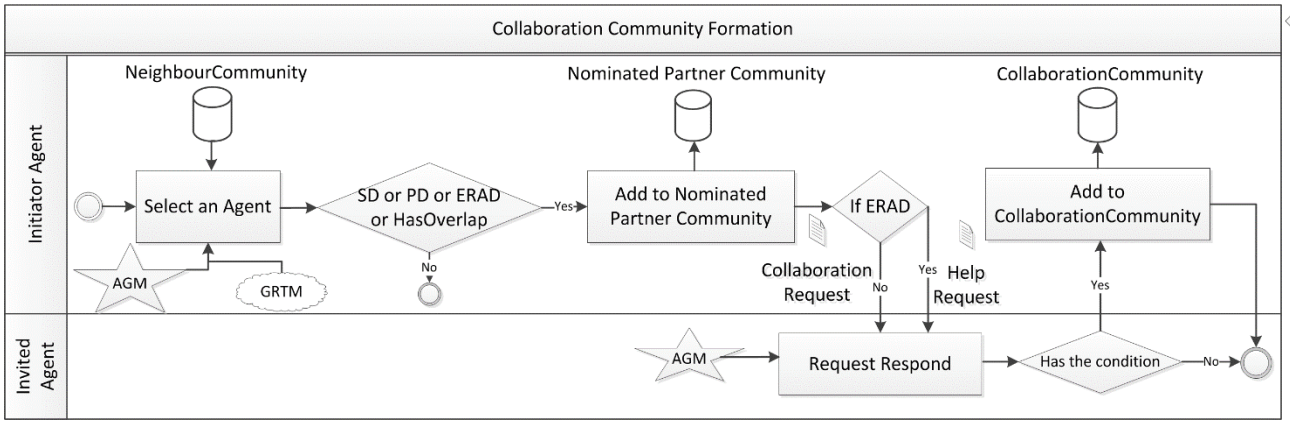


- Lower Computation complexity
- Lower number of links between the agents
- No interest conflict between the collaborating agents
- Applicable for dynamic and open multi-agent systems

Solution Design: A Conceptual Model

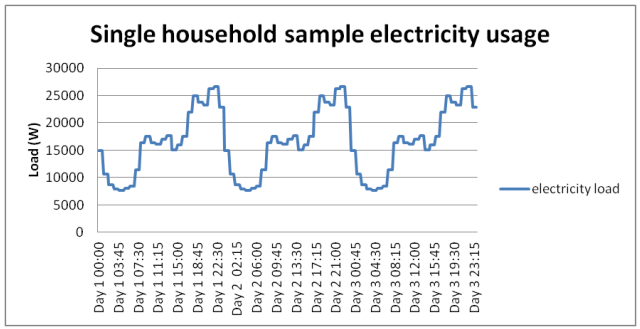


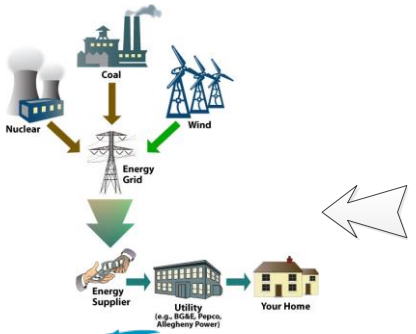


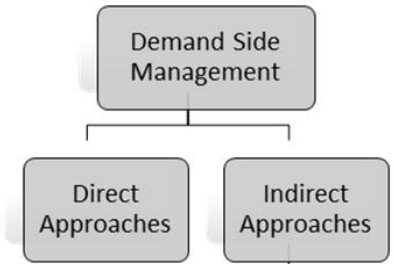


Demand Side Management

- Demand side management (DSM): modification of the consumers' electricity consumption with respect to their expected consumption.
  - Main goal: make the most of current energy capacity and avoiding new higher peaks
  - range of approaches: energy efficiency, fuel substitution, demand-response and residential/ commercial load management
    - Residential Demand side management :Energy usage not distributed evenly during the day: morning peak, large evening peak, valley during the night.
      - peak clipping, valley filling, load shifting







Smart-Grid Scenario

- 80 Electrical Vehicles(EV),10 Emergency Electrical Vehicle(EEV)
  - A Daily Plan (departure/arrival time, Distance to work)
  - Individual Goal (have enough charge to complete next journey)
  - Shared Goal (decreasing the transformer overload and utilize the off-peak available capacity of the grid)
- Each agent has its own control thread and decide the next action for the next time step
- They collaborate if their decided actions result in transformer overload.

Evaluation

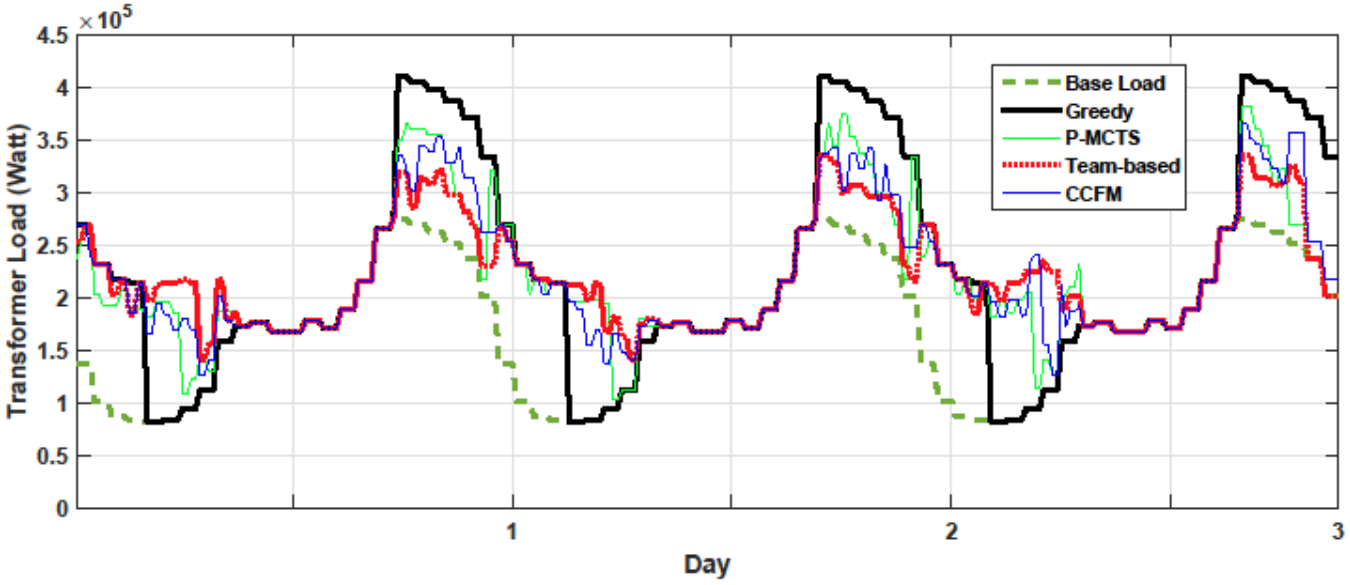
- Experimental Setup

	Number of Agents	Arrival/Departure time	Distance to work Miles (KM)	Implemented methods	Base Load
Scenario III	90	Between 6am-6pm	45 (~72 KM)	Greedy-PMCTS-MAMCTS-CPMCTS	Yes

- Performance Criteria
  - Peak To Average Ratio $= \frac{Max\ Load}{Average\ Load}$
  - Transformer Load
  - SoC (EV's State of Charge)

Results

		Statistical Analysis				
		PAR	Transformer Overload	EV SoC $\leqslant 0$	EEV SoC <100	STDEV
Day 1	P-MCTS	1.66	12	0	0	6.61
	Team-based	1.45	0	4	3	24.78
	CCFM	1.59	5	3	0	6.35
Day 2	P-MCTS	1.78	11	0	0	6.67
	Team-based	1.51	0	0	4	24.78
	CCFM	1.55	4	0	0	6.75
Day 3	P-MCTS	1.76	13	0	0	6.88
	Team-based	1.49	0	3	4	19.40
	CCFM	1.63	9	0	0	6.84



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Many Thanks!

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