Decentralized decision power and information sharing in horizontal logistics collaboration

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18th of August, 2021

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4. Three systems with central authority
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Introduction

Horizontal logistics collaboration

- Central planning
- Decentralized systems
  - Auction-based
  - Non auction-based

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The network design - multicommodity flow problem

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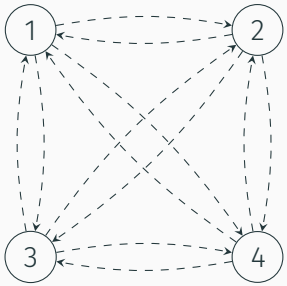
Commodities:

	$o(k)$	$t(k)$	d_k	r_k
k^1	1	2	1	10
k^2	1	4	1	10
k^3	3	1	1	10

Edges:

	q_e	c_e
$\forall e \in E$	2	5



Original network.

The network design - multicommodity flow problem

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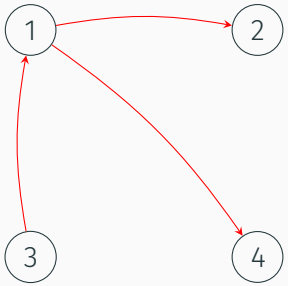

Design of the network.

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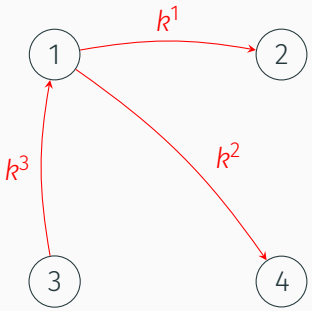

Route the commodities.

The network design - multicommodity flow problem: ILP

- We model the problem as an ILP, $\boldsymbol{P_i}\ \forall i \in N$.

$$P_i: \quad \max \sum_{k \in \Theta^i} \sum_{e \in \delta^+(t(k)) \cap E^i} f_e^k \cdot d_k \cdot r_k - \sum_{e \in E^i} u_e \cdot c_e \tag{1}$$

- Subject to different constraints

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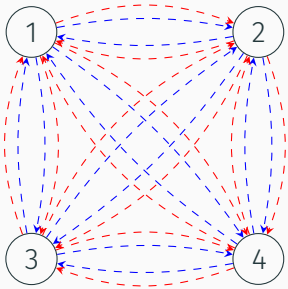

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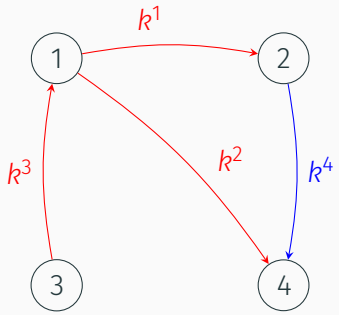

Solution without cooperation.

The network design - multicommodity flow problem

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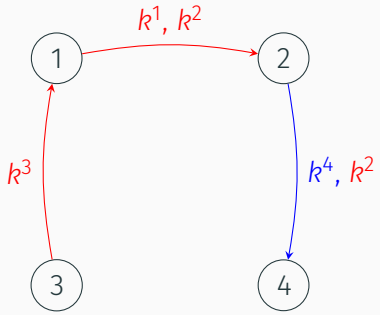


Cooperative solution.

Allocation rule

Allocation rule

1. The revenues generated by any served commodity are allocated to its owner.
2. The activation cost of any active edge is paid by its owner.
3. The price of using an unit of capacity on an edge $e \in E$ owned by agent $w(e)$ for any other member of the coalition, $i \in N \setminus \{w(e)\}$, is equal to $\frac{c_e}{q_e}$.

Three systems with central authority

Three systems with central authority

- A central authority with certain decision power.
- Agents have to share certain amount of information to cooperate.
- 3 systems:
  - Fully centralized cooperation system (FCCS),
  - Partial cooperation system (PCS),
  - Residual cooperation system (RCS).

Three systems with central authority

Fully centralized cooperative system (FCCS)

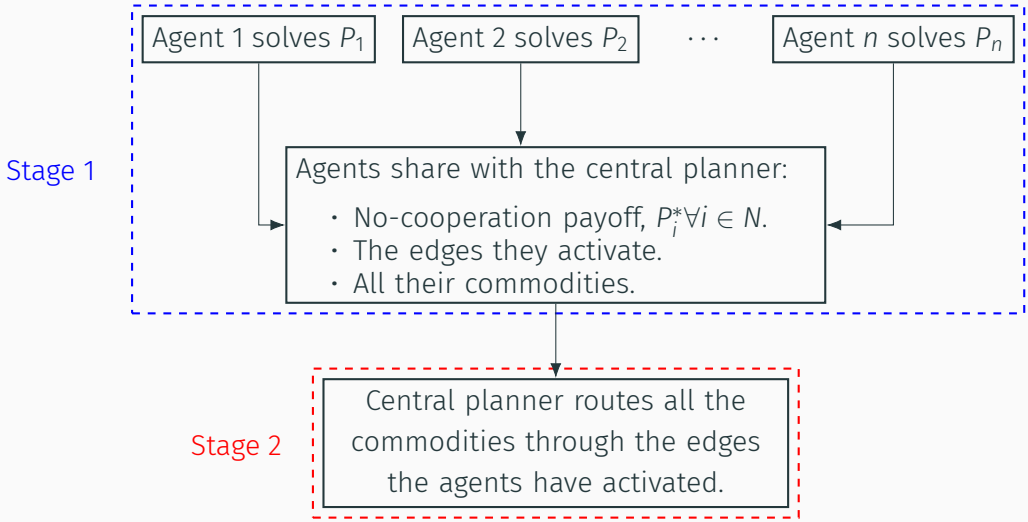
Fully centralized cooperative system (FCCS)

- A central planning system $\Longrightarrow$ Central authority with full information and all the decision power.
- Commodities and edges of all the agents are aggregated into a single bigger problem.
- Final profit allocation must be individually rational.

Three systems with central authority

Partial cooperative system (PCS)

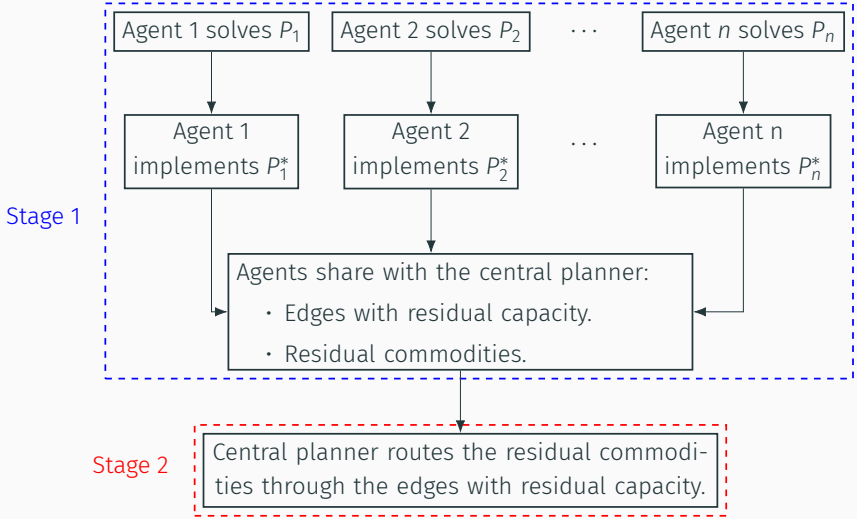
Partial cooperative system (PCS)



Three systems with central authority

Residual cooperation system (RCS)

Residual cooperation system (RCS)



Fully Decentralized Iterative Cooperative System

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Results

Discussion