Cooperation Policies for Efficient In-Network Caching

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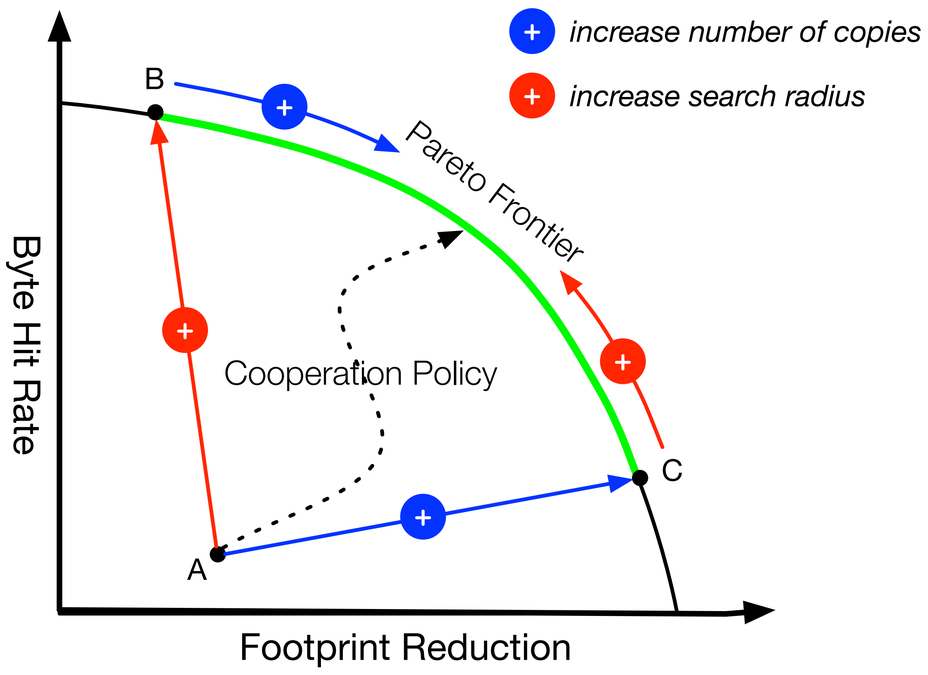
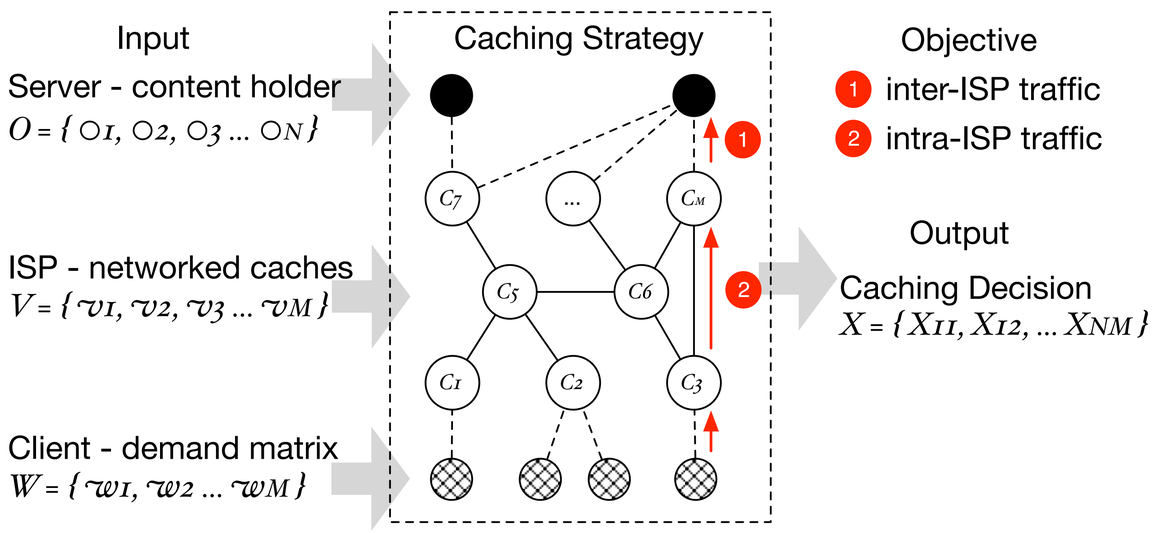
From Simple En-Route Caching To Effective Cooperative Caching

- **Motivation** – Network storage is underutilized due to the limit of simple en-route caching, leading to many duplicates in the network.
- **Rationality** – Before reaching the Pareto Frontier, effective cooperation policy improves both byte hit rate and footprint reduction.
- **Objective** – Effectively reduce the duplicates by taking advantage of network topological properties.





A caching strategy manages a group of networked caches. It consists of three components:

- **Admission policy**, which content to cache?
- **Replacement policy**, which content to evict?
- **Cooperation policy**, where to cache the content?

Challenges

- A proper way to model the cooperation policy.
- A suitable model which takes topological properties into account.
- Method to explore and utilize the topological structure.
- An efficient strategy with low complexity to avoid overheads.

Methodology

Optimization Model

- Optimization model calculates the Pareto Frontier.
- Node has global knowledge of the network and content.
- Formulated into MIP (mixed integer programming) problem.

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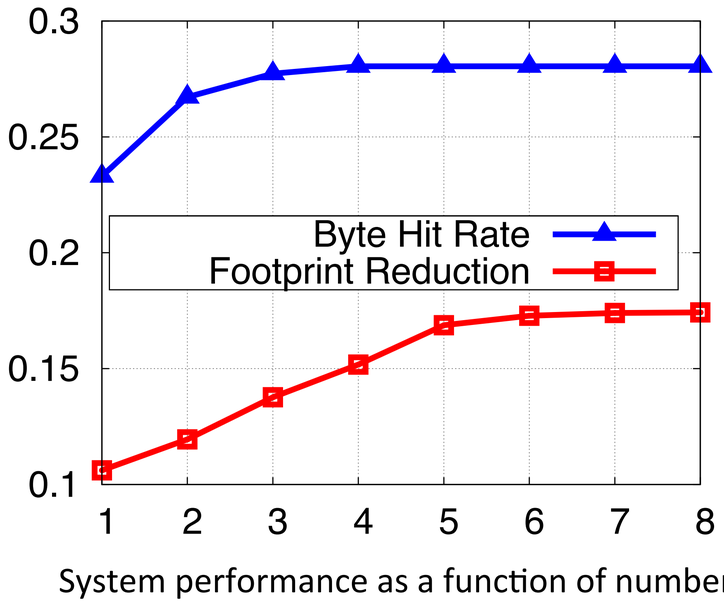
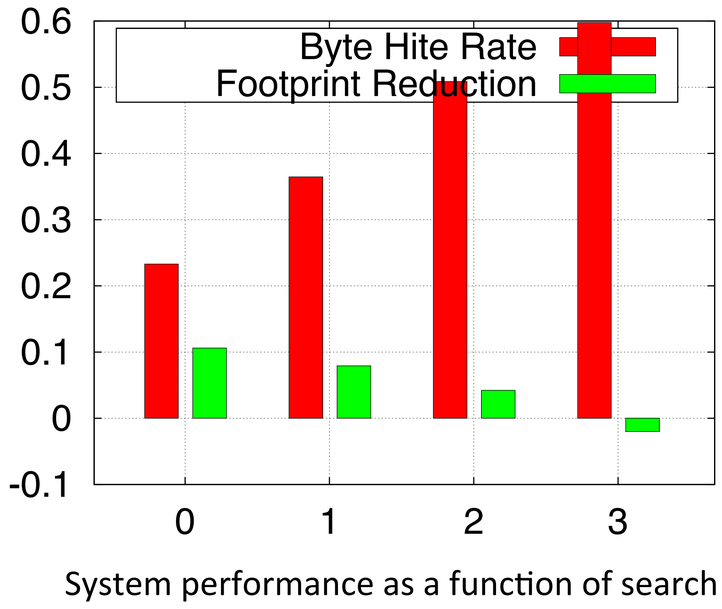
Game Theoretical Framework

- Cooperation policy is modeled as a caching game on graph.
- Node has only local knowledge, interacts with neighbors.
- Protocol design takes graph structural properties into account.

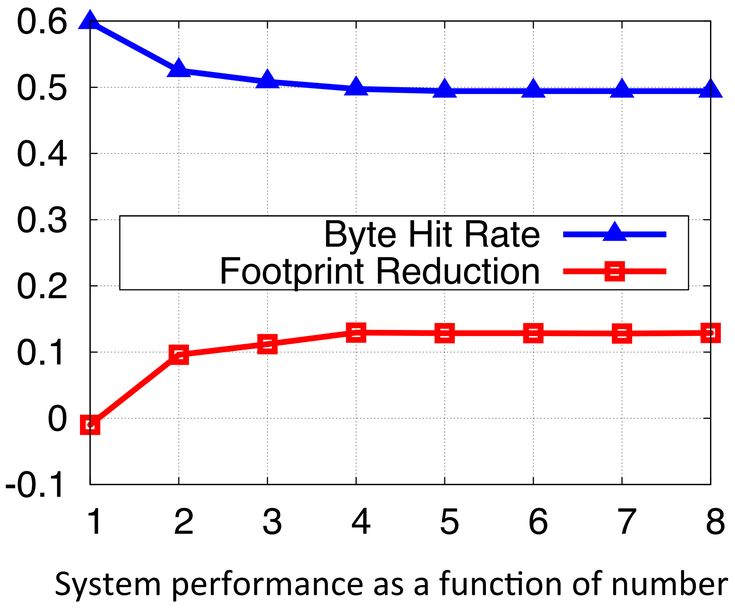
Preliminary Evaluation



System performance as a function of number of copies, search radius = 0. Performance moves from A to Pareto frontier BC.



System performance as a function of search radius, number of copies = 1. Performance moves from B to C on Pareto frontier.



System performance as a function of number of copies, search radius = 0. Performance moves from C to B on Pareto frontier.

References:
Jacobson, Van, et al. "Networking named content." In *ACM CoNEXT 2009*. ACM, 2009.