Multi-Objective In-Network Caching Strategies in Information-Centric Network

UNIVERSITY OF HELSINKI

Liang Wang

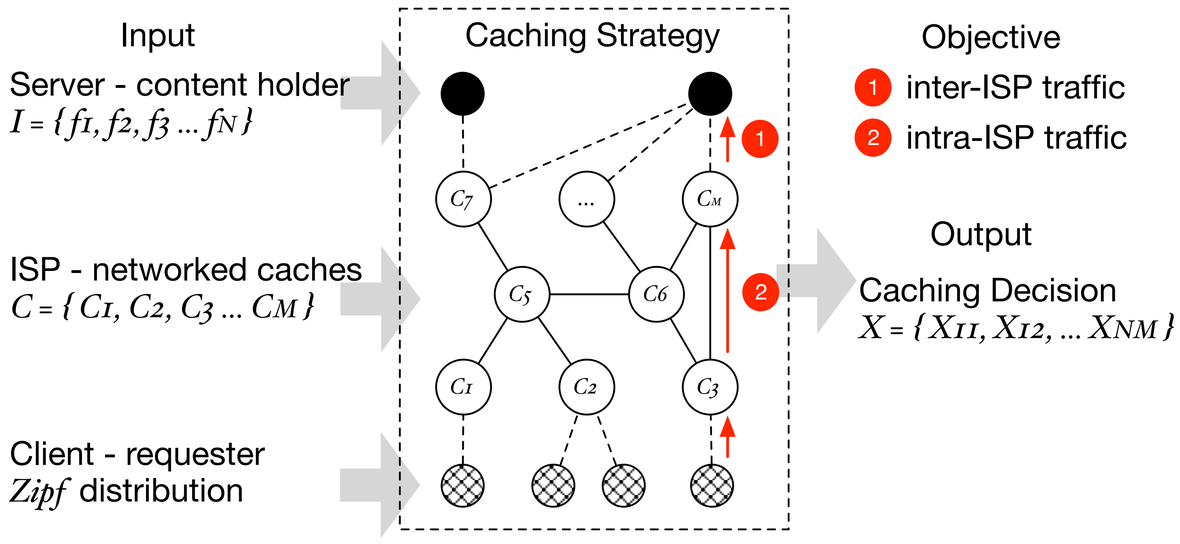
Department of Computer Science, liang.wang@cs.helsinki.fi

Migrating Caching Function into Network Infrastructure

- Motivation – Maximize the utilization of network storage.
- Rationality – Access content by name (in ICN).
- Objective – Effective management algorithm for networked caches.
- Challenges – Modelling and evaluation are difficult.

Complexity vs. Scalability

- Two optimization models: **static** placement model and **dynamic** step-by-step model. The difference is whether take user request as input.
- Optimization model provides a reference upper bound of system performance. However, it is impractical to scale up to production network due to its high complexity.
- Develop distributed heuristics to get around real-life complexity.

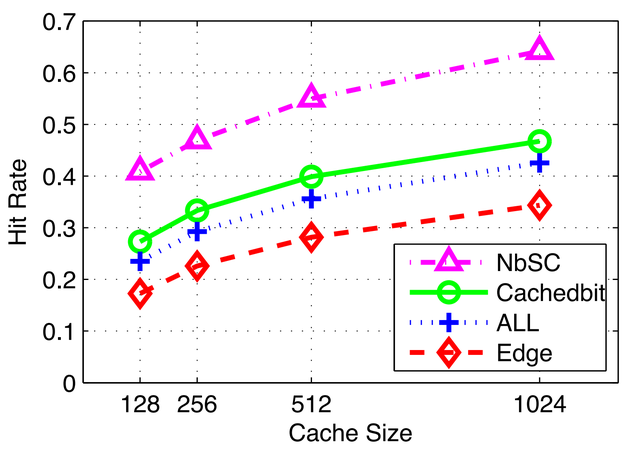


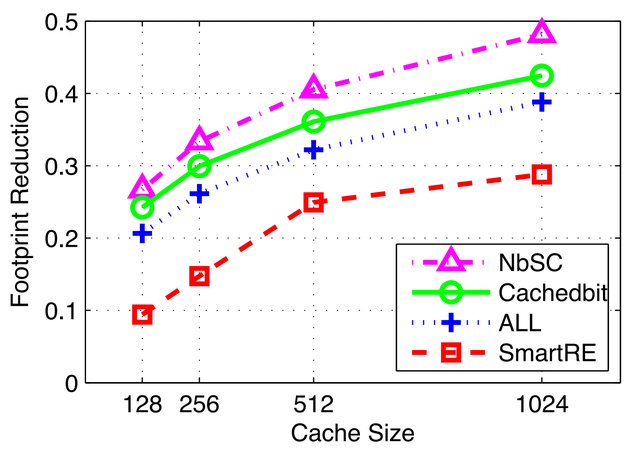
A caching strategy manages a group of networked caches. It consists of three policies:

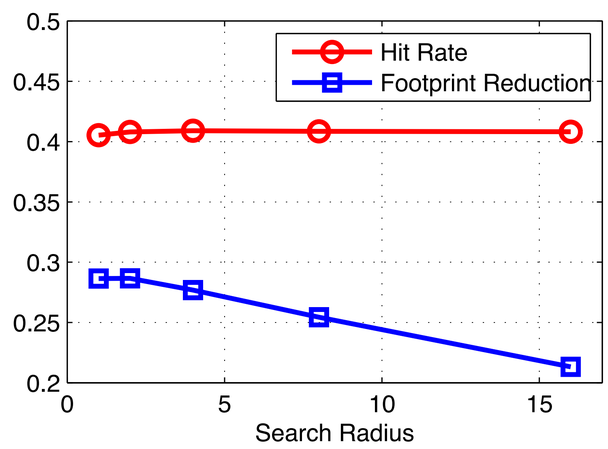
- **Admission policy**, which content to cache?
- **Replacement policy**, which content to evict?
- **Cooperation policy**, where to cache the content?

Optimization Model		Distributed Heuristic
• Line topology, k-tree topology. • Node has global knowledge of the network and content. • Formulated into MIP (mixed integer programming) problem.	**VS.**	• Test on realistic ISP network topology. • Node has only local knowledge, on-path caching. • Design takes graph structural properties into account.

Evaluate Different Strategies







Edge: Proxy solution.
SmartRE: Redundancy-Elimination technique.
ALL, **Cachedbit** and **NbSC** are distributed heuristics.

Experiments were performed on Sprint network topology.

Strategy	Admission	Replacement	Cooperation	Distributed Algo	Share across Flows
Edge	LRU	LRU	None	No	No
ALL	LRU	LRU	None	Yes	Yes
Cachedbit	Probabilistic	LRU	One bit in header	Yes	Yes
NbSC	Probabilistic	LRU	Neighbor search	Yes	Yes
SmartRE	Probabilistic	LRU	None	No	No

Future Directions

- Apply graph-theoretical approach to improve caching performance.
- Study how graph structural properties impact cooperation policy.
- Compare integral caching and partial caching.