

Energy-Efficient Caching in in Ad Hoc Wireless Networks

Caching is used in Many Networks

Parallel & Distributed systems

Internet (Web) Caching

Content Delivery Networks (CDN)

Multimedia caching

Caching in Ad Hoc Networks?

Necessary?

Scarcity of Communication bandwidth

Limited energy resources

Possible?

There is an internet-based server with large storage

Need wise caching decisions

Between broadcast flooding & seldom interested content, we do better to caching the content in a few nodes, which is similar to rumor routing paper and the last question in quiz 1.

Problem formulation:

An integer linear program, the same as a special case of the connected facility location problem, which is known to be NP-hard.

The authors proposed a polynomial heuristic algorithm which gives a good approximate solution, bound by factor 6 and output the optimal solution with tree topology.

$G=(V,E)$, one server in V

$Z_k = 1$ means a nodes has a copy of cache

Node k requests a copy with p_k (popularity of the copy), d_k is the distance between k and a copy

Bidirectional links and constant link cost

Insignificant storage cost

Hidden assumptions (some are not very realistic)

Calculate aggregate cost

Network always connected

Low mobility, stationary period long enough

No cost to discover the closest cache (d_k)

Access cost $K(\text{acc-energy})$ and dissemination cost $K(\text{diss-energy})$

Latency cost $K(\text{latency})$

$K(\text{total}) = K(\text{energy}) + K(\text{latency})$

Can be transferred to facility location problem

An existing facility is given (a single server), along with a set of locations at which further

facilities can be built (cache). Every location k is associated with a service demand, denoted by p_k , which must be served by one facility. $P_k * C_{kj}$.

Greedy solution – Tree Model

Basic idea: push a copy down a branch as long as it is beneficial to do so

General case: Find the most profitable neighbor nodes to add it to the cache proxy list.

Comparison with No caching (NC), Depth caching(DC) and FLOODING(FLD)

Weakness:

Insignificant storage cost in nodes?

Lack of novelty

Total cost: ad-hoc combine two parameters

Search and locate the cache cost is ignored (How to find the node with needed cache in minimum distance)

Ignore the mobility