Context-based Messaging for Ad Hoc Networks

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Massive ad hoc information spaces:
- locations (shopping centers, boats, stadiums) with many people
- spontaneously formed ad hoc networks of mobile devices
- applications problematic due to unreliability and unpredictability
- likely to cover significant regions and comprise diverse people and devices.

Approach: allow devices to interact without explicitly knowing the names or services of others.

Solution: address devices by their "contextual situation", including available services, current status and location, etc.

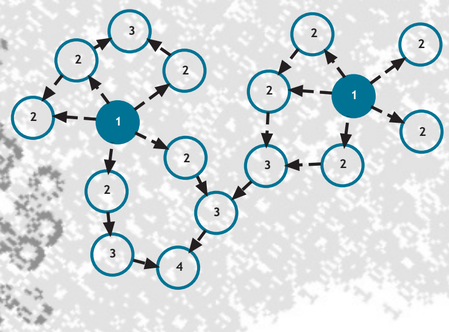
Context-based Messaging

Context-based messaging (CBM) uses the "contextual situation" of nodes to implicitly guide targeted data in a large ad hoc network. Messages are delivered from a single source node to a set of target nodes matching a specified contextual situation.

The contextual situation of a node is a description of its changing execution environment, which includes details such as its location, social situation, current applications, environmental and computing conditions. Individual pieces of context are modeled as symbols.

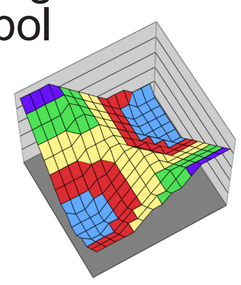
Context

Context includes, though is not limited to: spatiotemporal information (location, speed, time of day or year), identity and user models (profile, preferences and others in vicinity), environmental (noise, light), social activities (at a meeting, interview or party), computing resources (printers, fax, wireless access, network bandwidth), physiological (hearing, heart rate), schedules and agendas.



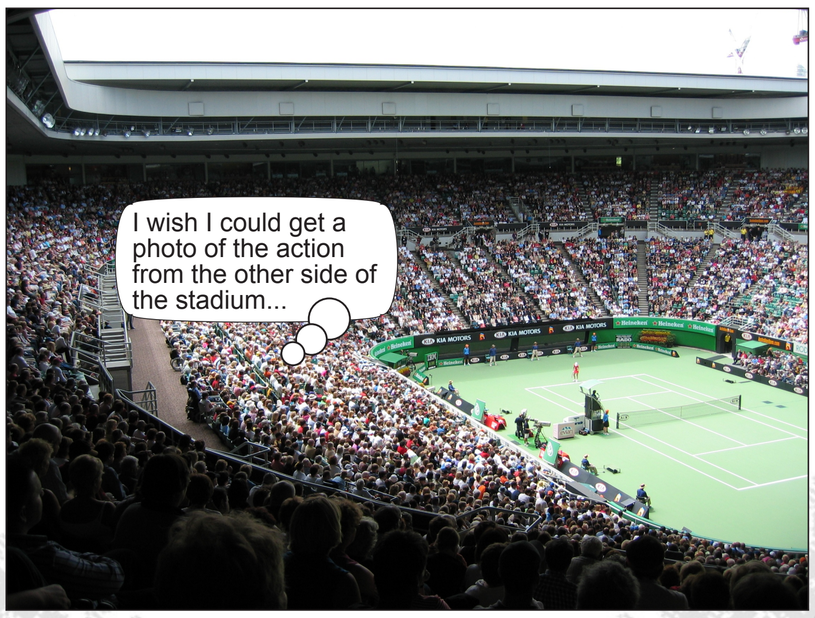
Topography algorithm

- generates a "height map landscape" over the network based on topological clusters of contextually similar neighbours
- each node has a "height" for each context symbol and periodically broadcasts it to its neighbours
- if a node has a particular context symbol, its height for that symbol is always 1. Otherwise, its height is the minimum of its neighbours plus one.



Delivery algorithm "FlavourCast"

- delivers a message from a source to as many targets as possible
- targets are nodes with the specified context symbol, so they are the minima in the generated topography towards which messages are forwarded.



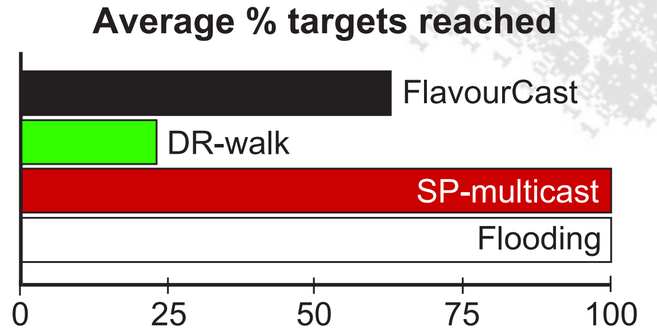
P2P networks

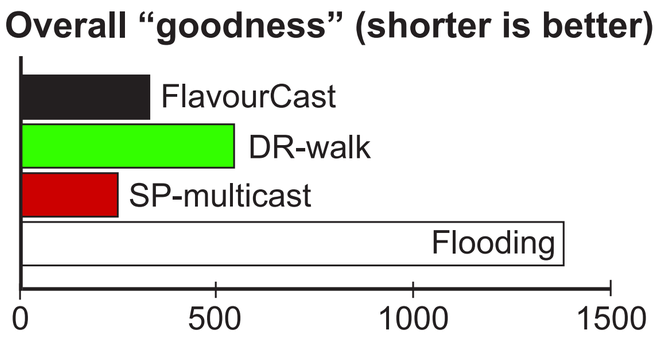
CBM is also applicable to Internet P2P networks:
- news services targeted to particular demographics
- targeted software updates
- research management tools for sending calls for papers to those with particular interests and who will be available to travel according to their calendar
- spontaneous chat forums that can be based on participants' interests and contexts.

Results

Comparison of FlavourCast to:
- flooding (worst-case)
- shortest-path multicast (best-case)
- directed-random walk.

Metrics are:
- average percentage of targets reached (a high value is preferable)
- average number of transmissions per message divided by average fraction of targets reached (gives an overall indication of how "good" an algorithm is with a low value meaning it reaches a relatively high number of targets for the number of transmissions made).





Current work

A richer context model allowing:
- support for multiple context symbols
- logical target expressions, such as "A & ((B > 20) | !C)" for publisher to specify target audience to an arbitrary degree.

Topography algorithm evaluation: graph shows how quickly the algorithm converges to stable states for 1100 node networks and how nodes joining or leaving cause ripple-on effects to other nodes.

Delivery algorithm: test different approaches including simulated annealing and other search algorithms.