MobySpace: Mobility Pattern Space Routing for DTNs

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Basic concept

Problem:

- **Routing is a challenge in DTNs** (Delay Tolerant Networks). Regular ad-hoc routing protocols fail because the topology suffers from connectivity disruptions.

Proposition:

- We propose to use **mobility patterns** of nodes, i.e. regularities in nodes contacts or movements, to define their position in a virtual Euclidean space used for routing. This space is called the **MobySpace**.
- Each node's position in the MobySpace (its MobyPoint) is flooded throughout the network. Other nodes use this information for routing.
- To route a bundle, a node chooses among its *physical* neighbors. It passes the bundle to the neighbor whose MobyPoint is closest to the destination's.
- The MobySpace can be defined in many ways, e.g. type/number of dimensions, distance function. This poster describes preliminary work.

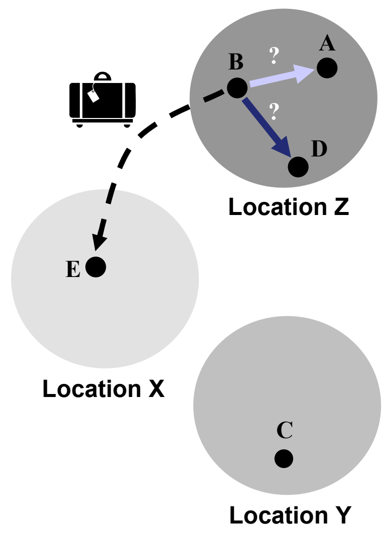

Fig. 1 : example scenario

B wants to send a bundle to E, but B and E are not at the same location.

B has 3 possibilities:

- keep the bundle.
- give it to A.
- give it to D.

B uses the MobySpace to decide what to do.

A MobySpace

- Let's consider users with power-law based mobility patterns. Their frequency of visits to locations follows a power-law distribution. This behavior has often been observed in reality.
- Each dimension in the MobySpace represents a location in the physical space. **Each coordinate corresponds to the probability of finding the node at that location.** We assume that these probabilities are known.
- Euclidean distance is used.

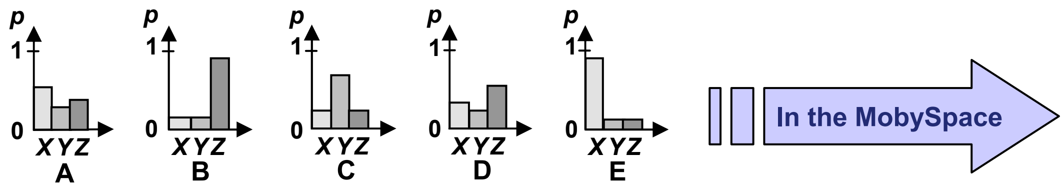

Fig. 2 : node mobility patterns

B decides to transfer the bundle to A, the closest to E in the MobySpace.

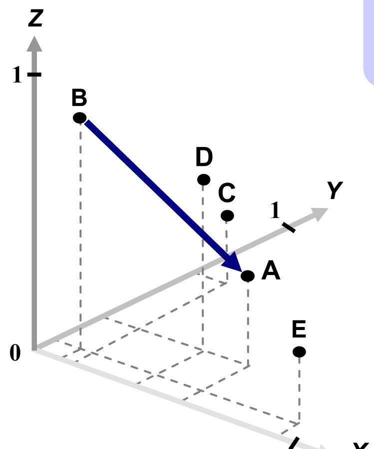

Fig. 3 : MobySpace

Simulation results

We simulated nodes with power-law based mobility patterns (*d*, the power-law exponent). We compared MobySpace routing to:

- ***Epidemic routing:*** Bundles are flooded in the network. It is the optimum in terms of delays but leads to high buffer and radio utilization.
- ***Opportunistic routing:*** A node waits to meet the destination in order to transfer its bundle. It involves only one transmission per bundle.
- ***Random routing:*** At any time, a node may transfer the bundle to a neighbor chosen at random. Loops are avoided.

Preliminary simulations have shown promising results:

- **Low delays** compared to *Random* and *Opportunistic*.
- **Low route lengths** compared to *Epidemic* and *Random*.

d	1.1	1.5	2
Epidemic	10.9	13.2	16.2
Opportunistic	123.3	287.4	550.2
Random	117.8	160	203.3
MobySpace	103	59.1	54.6

Average bundle delay (s)

d	1.1	1.5	2
Epidemic	3.7	3.7	3.8
Opportunistic	1	1	1
Random	44.5	55.9	69.8
MobySpace	3.3	3.2	3.2

Average route length (hops)

<u>*Simulation parameters:*</u>

50 mobile nodes, 25 locations, pause time at each location is uniformly distributed on [5s,15s], nodes generate bundles every 30s toward each of the others during the first 500s, simulation time is 4000s.

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THALES