An Architecture for Seamless Mobility in Spontaneous Wireless Mesh Networks

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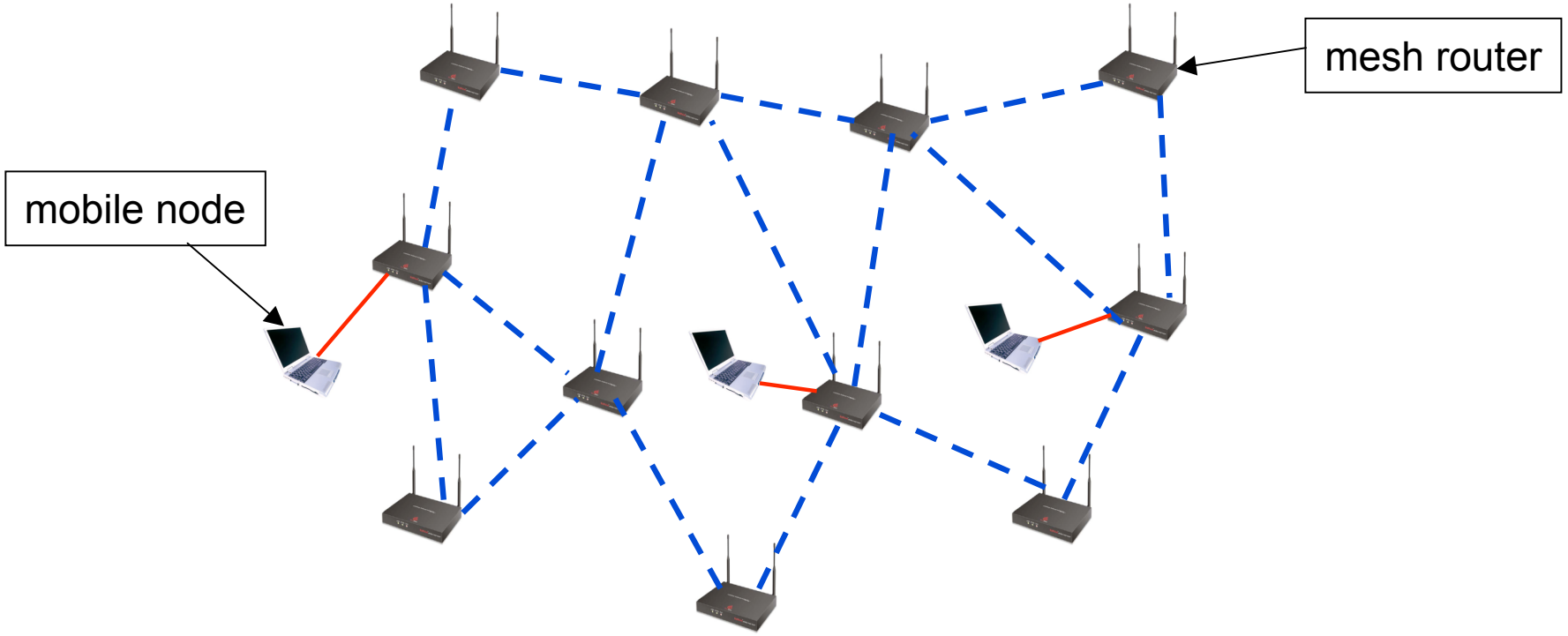
Overview

- Spontaneous wireless mesh networks
- Principles of seamless mobility
- Pseudo-geographical addressing space
- Geographical Ballistic Routing
- Joining the mesh and handoff
- Conclusions

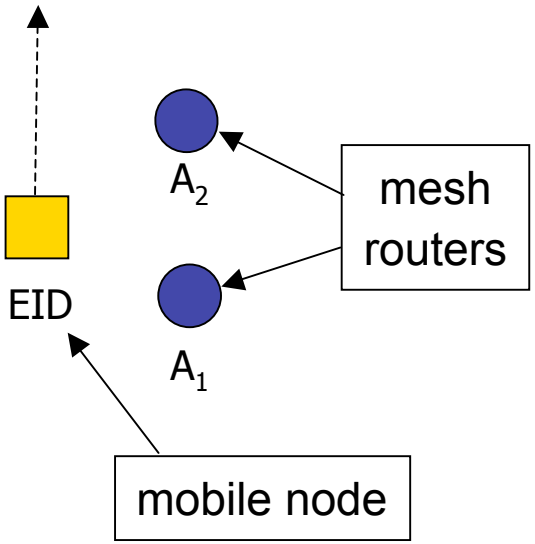
Spontaneous mesh



- Self-forming - follow human structures
- Autonomic - no (or limited) administration
- Dense, large scale, not only for Internet access

Principles of seamless mobility

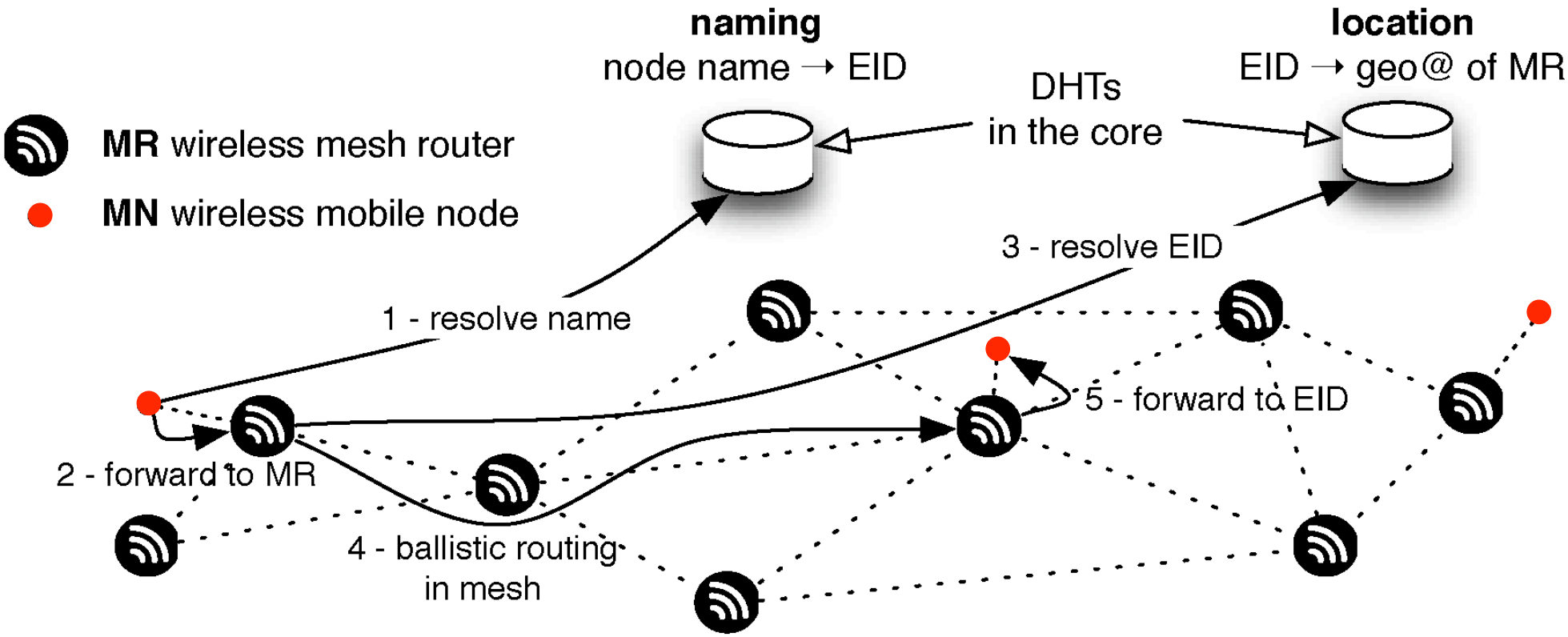
- Separation between Identities and Addresses
  - node identified by stable end-point identifier EID
  - address reflects current position
  - EID-ADDR binding stored in a distributed Location Service
- Optimized for local mobility
  - the most common case - movement in a closed vicinity
  - lazy location update - do not notify about small position changes



Main design choices

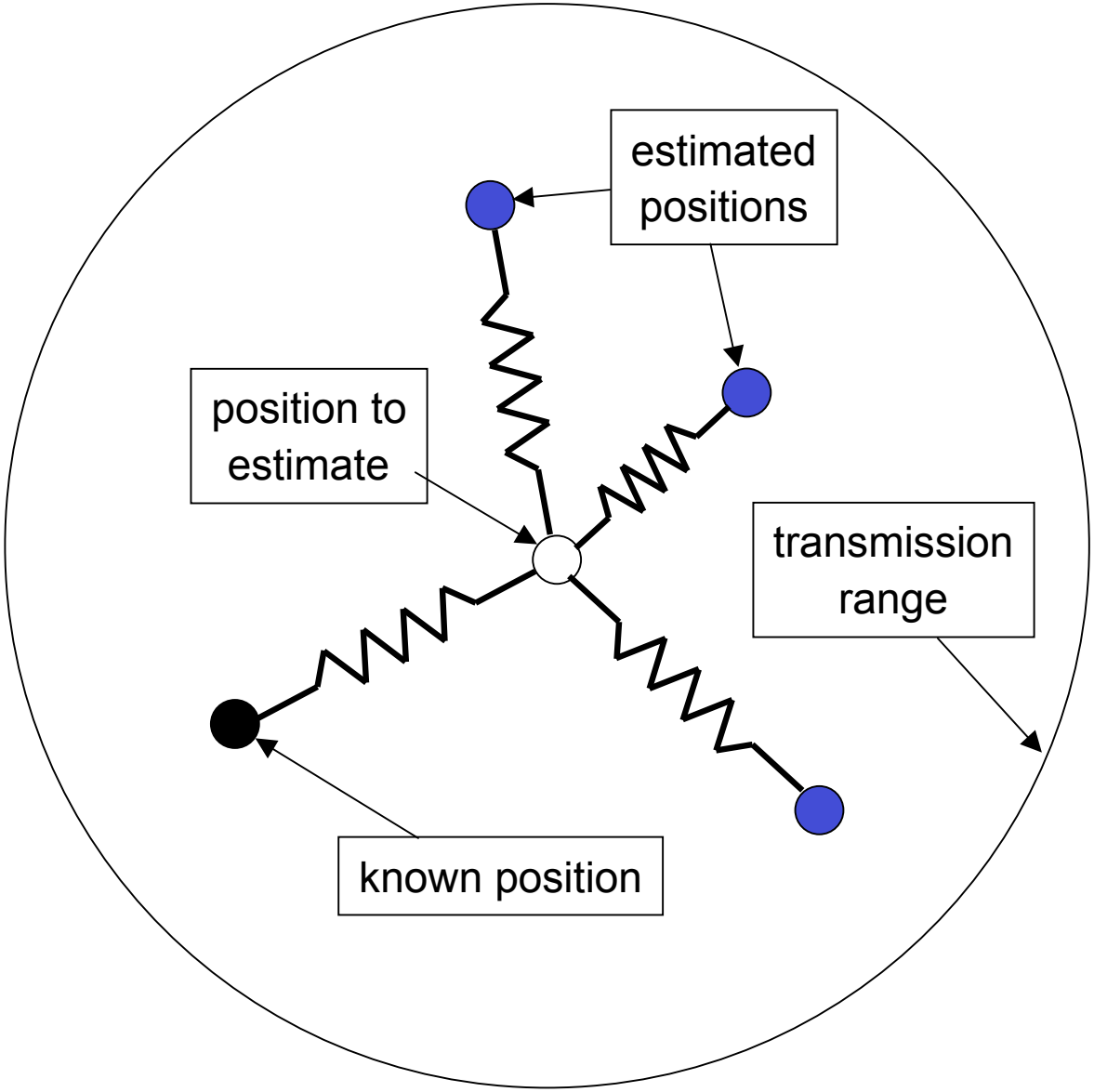
- Addresses in a coordinate space
  - virtual topological space anchored with some geographical positions - *pseudo-geographical coordinates*: $d_{virt}(A_1, A_2) \sim d_{real}(A_1, A_2)$
  - possible merging of subspaces
- Geographical routing in the coordinate space
  - take advantage of little routing information
  - avoid drawbacks of greedy geo-routing
- Local fish-eye view
  - precise knowledge of your neigborhood
  - approximate view of distant destinations

Principles of the architecture

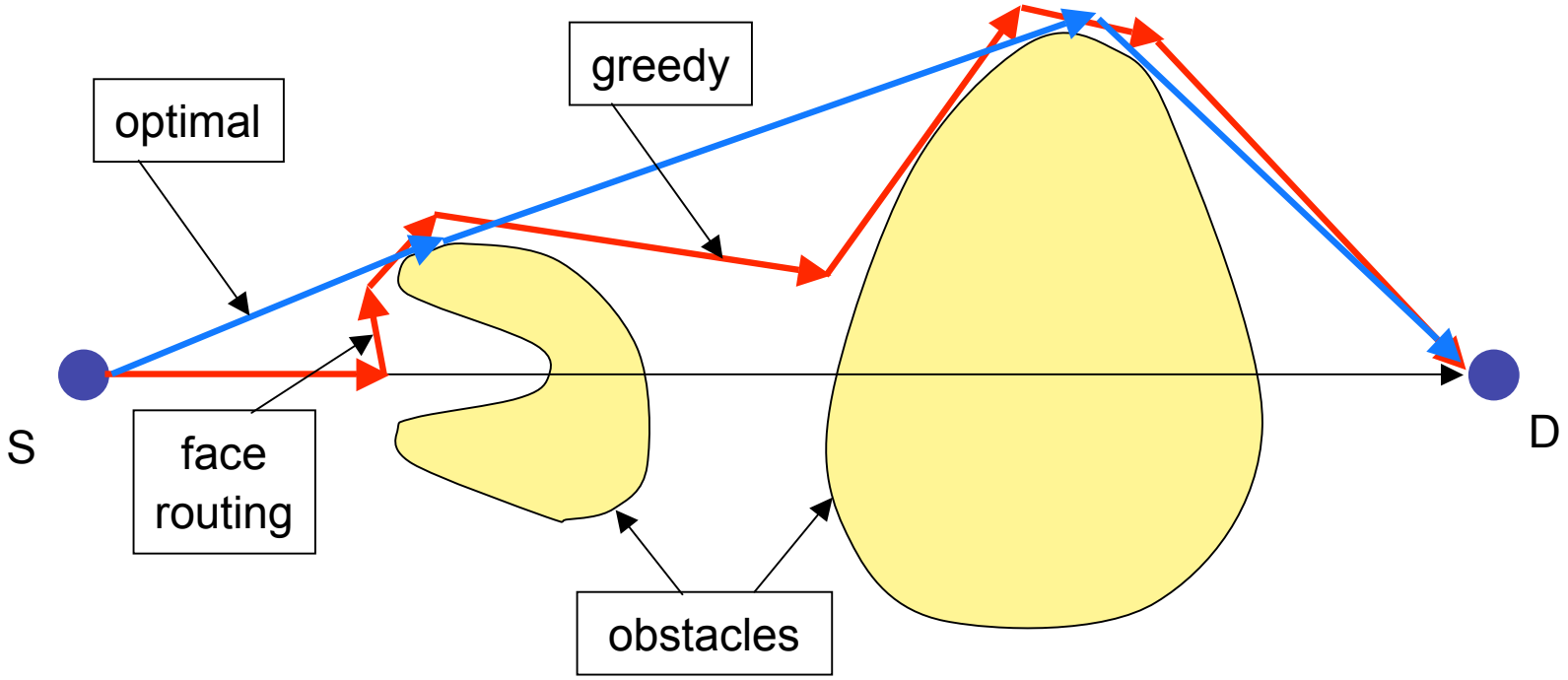


Addressing space - spring model

- Nodes
  - with exact geographical position (GPS or configured)
  - estimated position
- Spring model
  - minimize a potential function that depends on node positions



Greedy geographical routing

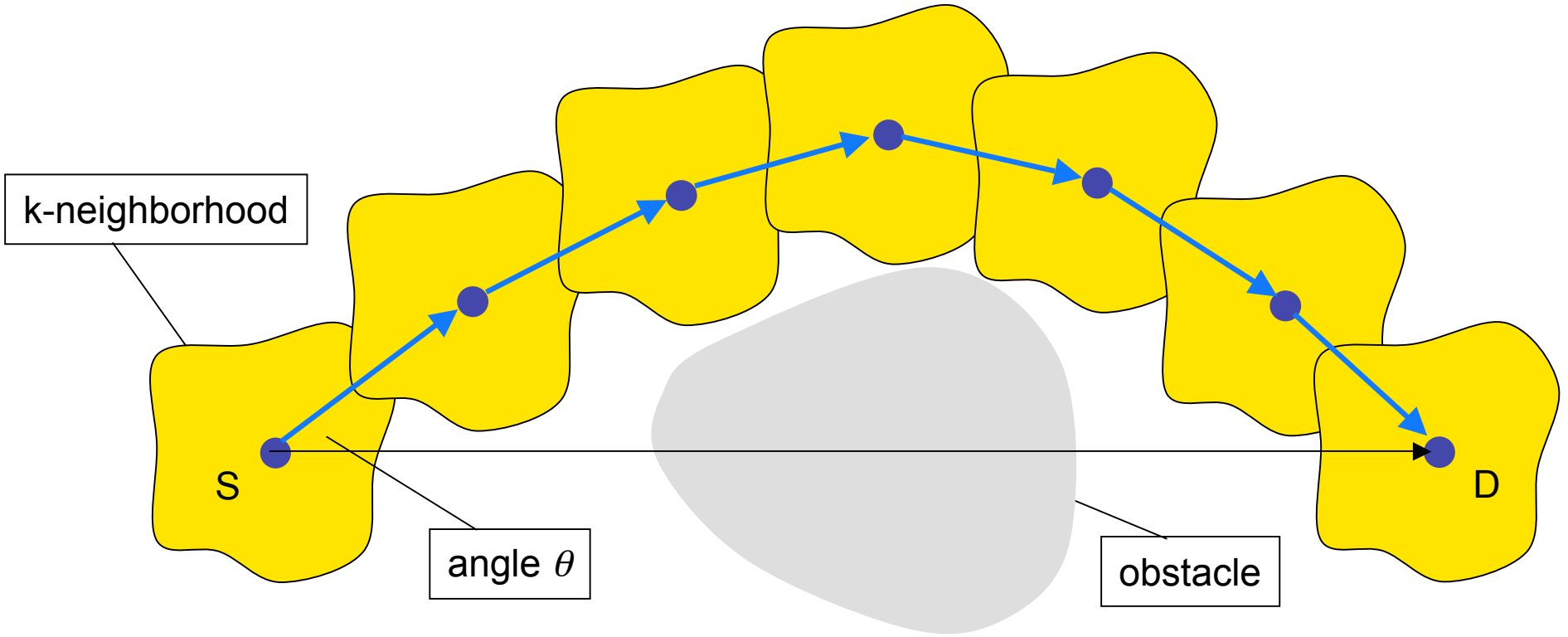


- Greedy routing
  - forward to a neighbor closer to the destination
  - problems: voids or obstacles
  - recover from local minima: face routing (right-hand rule and face changing), still may be not optimal

Geographical Ballistic Routing

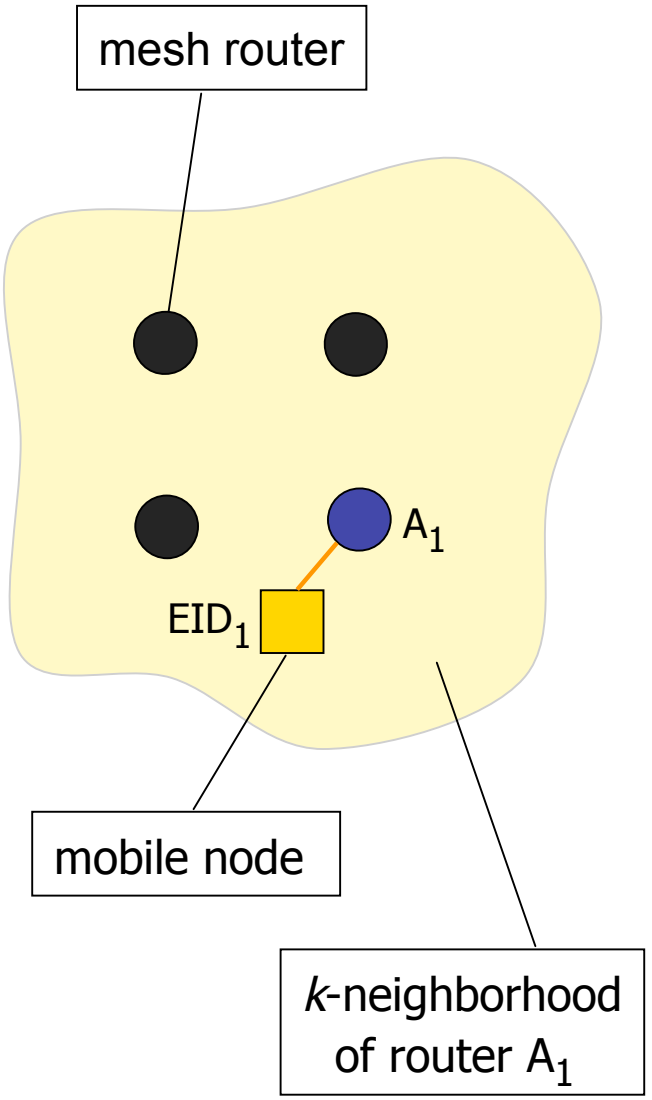
- Build upon topologically consistent address space
- Combine two approaches
  - long distance geographical routing
  - short distance topological routing
- Long distance - *geo-routing*
  - known direction
  - route is known globally, implicitly (rough direction to destination)
- Short distance - *topo-routing*
  - known topology of the *k*-neighborhood
  - route is known locally, explicitly (k-hop neighbors)

Geographical Ballistic Routing

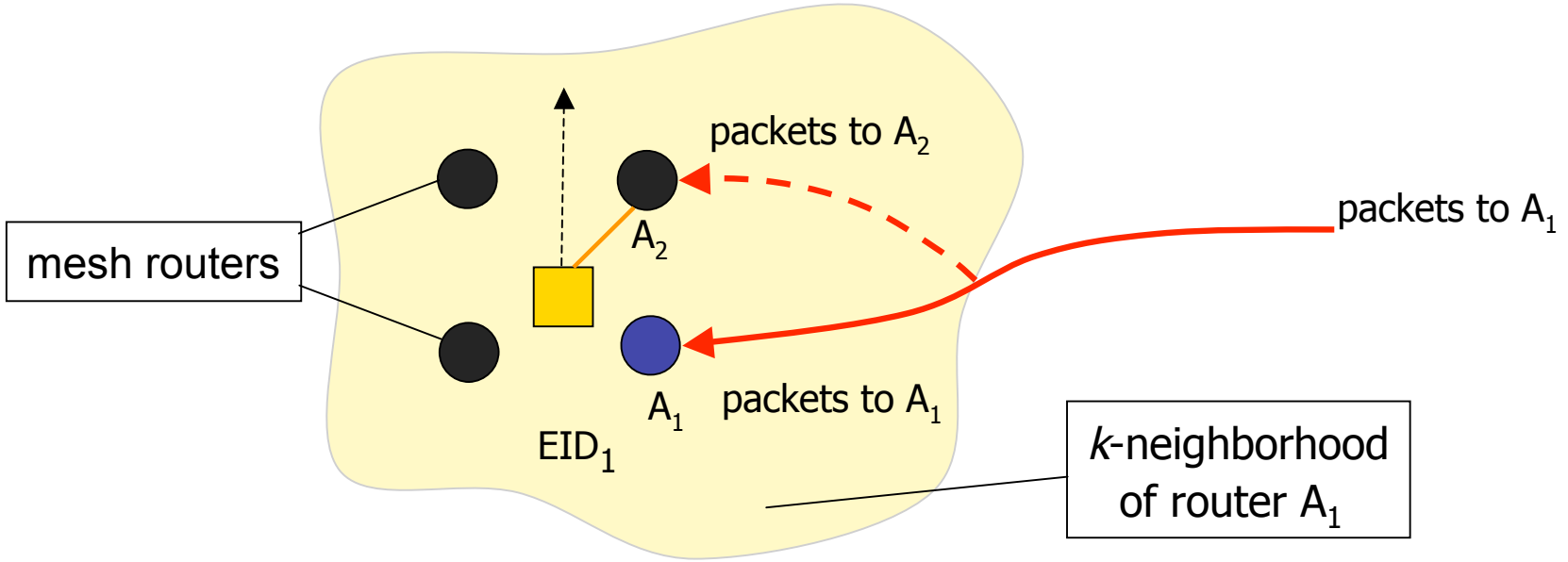


Joining the mesh

- Fast lightweight association
  - mesh routers send beacons
    - MAC addresses, channels, load indicators
- Immediate basic connectivity
  - mobile can send packets to reach a community,
  - if mobile is accepted, mesh router updates Location Service with mobile EID and router Address
  - mobile can then receive packets via mesh router



Handoff



- Fast lightweight handoff
  - choose a neighbor (A_2), send HANDOFF request to A_1
  - A_2 starts forwarding packets
  - A_2 is close - packets to EID_1 still sent to A_1, but diverted to A_2
  - lazy update of the Location Service

Conclusions

- Simple yet powerful basic principles:
  - mobility management based on separation of EIDs and addresses
  - pseudo-geographical addressing space enabling directional routing
  - fast association and handoff
  - lazy location update
- Preliminary work: simulation of the addressing scheme and geographical forwarding, first implementation on Linux
- Future work: refinement of the design, full implementation of geo-routing and mobility