Mobile Networks

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Emerging networks

Universidade do Minho

Adriano J. C. Moreira

Dept. de Sistemas de Informação

Universidade do Minho

adriano.moreira@dsi.uminho.pt

Emerging networks

1. Opportunistic Networks
2. Delay Tolerant Networks (DTNs)
3. Vehicular Networks
4. Mobility Models
5. Routing

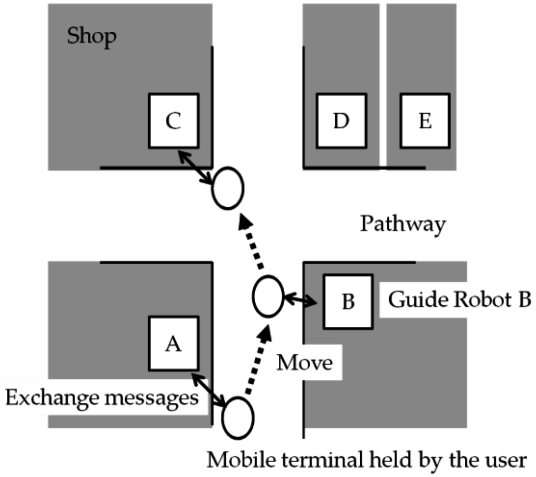
Note: These slides are intended to support a discussion about some aspects of emerging networks, and do not constitute a single source of information about the addressed topics.

Connected networks

- most of the existing communication networks assume permanent end-to-end connectivity
- in packet switched networks, data is carried from source to destination across a certain path
- data is carried in packets that are forward through intermediate nodes (e.g. routers): store-and-forward
- routing protocols keep updating routing tables, usually to minimize end-to-end delay
- end nodes are fixed, or mobile, permanently connected
- assume the existence of infrastructure

Opportunistic networks

- infrastructure-less, or hybrid
- exploit proximity between nodes
- messages (packets) are exchanged whenever there is an opportunity
- packets are forward through intermediate nodes: store-carry-and-forward
- end-to-end connectivity is not assumed
- nodes can be fixed or mobile



source: [2]

Delay Tolerant Networks

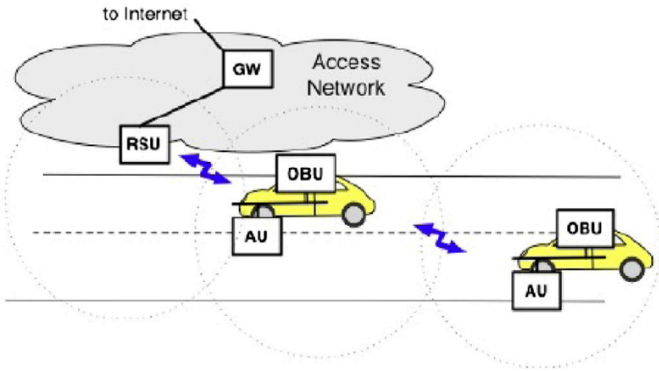
- opportunistic networks:
  - no end-to-end path between source and destination
  - intermittent connectivity
  - possibility of very large delays
- can be used to support services that are tolerant to delay -> DTNs
- nodes can be of various types:
  - cars / buses / trucks / …
  - robots / drones / …
  - devices carried by people: Pocket Switched Networks

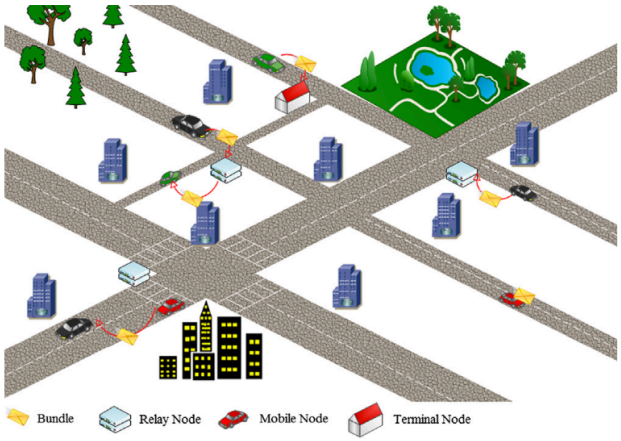
Applications

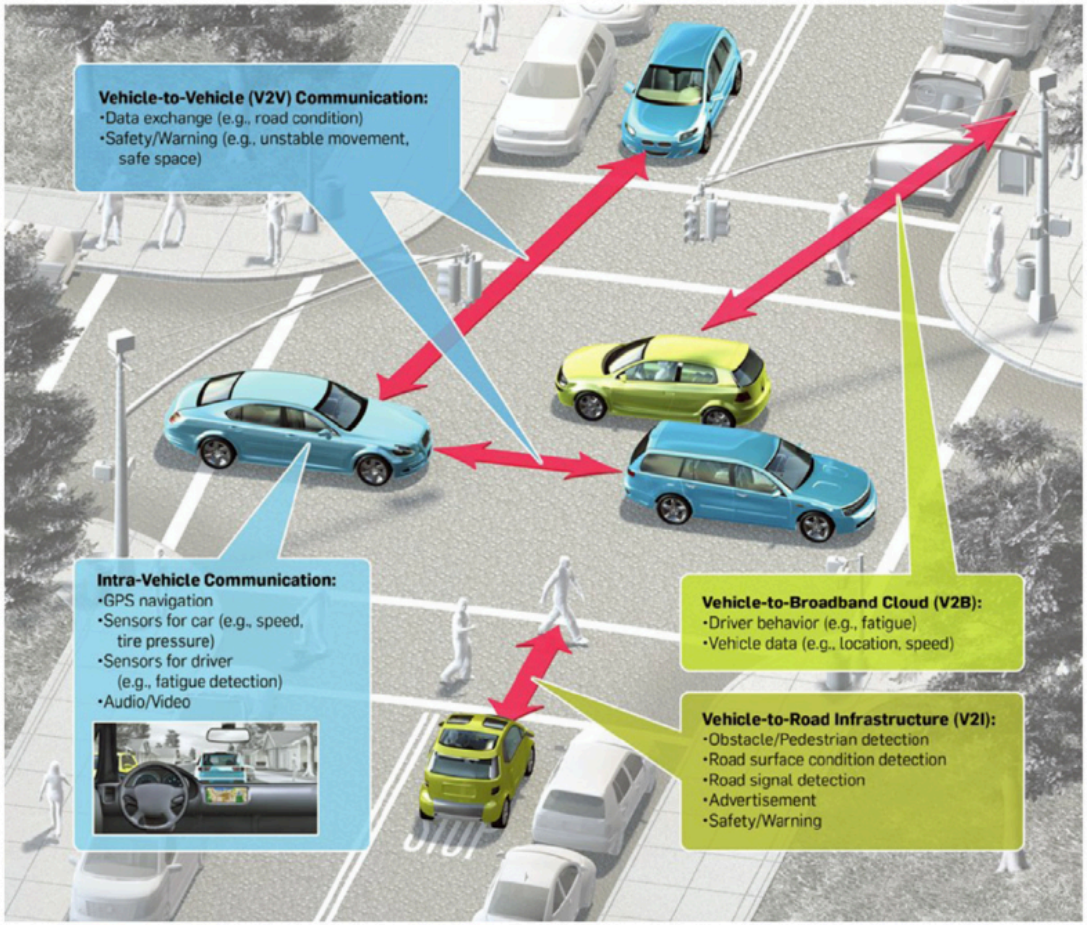
- vehicular: safety / management / infotainment
- emergency / disaster scenarios: collapsed infrastructures
- content delivery in infrastructure-less areas (e.g. delivery of cinema movies)
- wildlife monitoring
- environmental urban monitoring / smart cities
- …

Vehicular Networks

- concepts:







sources: [7,8]

Routing

- encounters
  - communication range
  - relative speed of nodes
  - data rate
- important metrics:
  - contact time
  - inter-contact time

Routing protocols (examples)

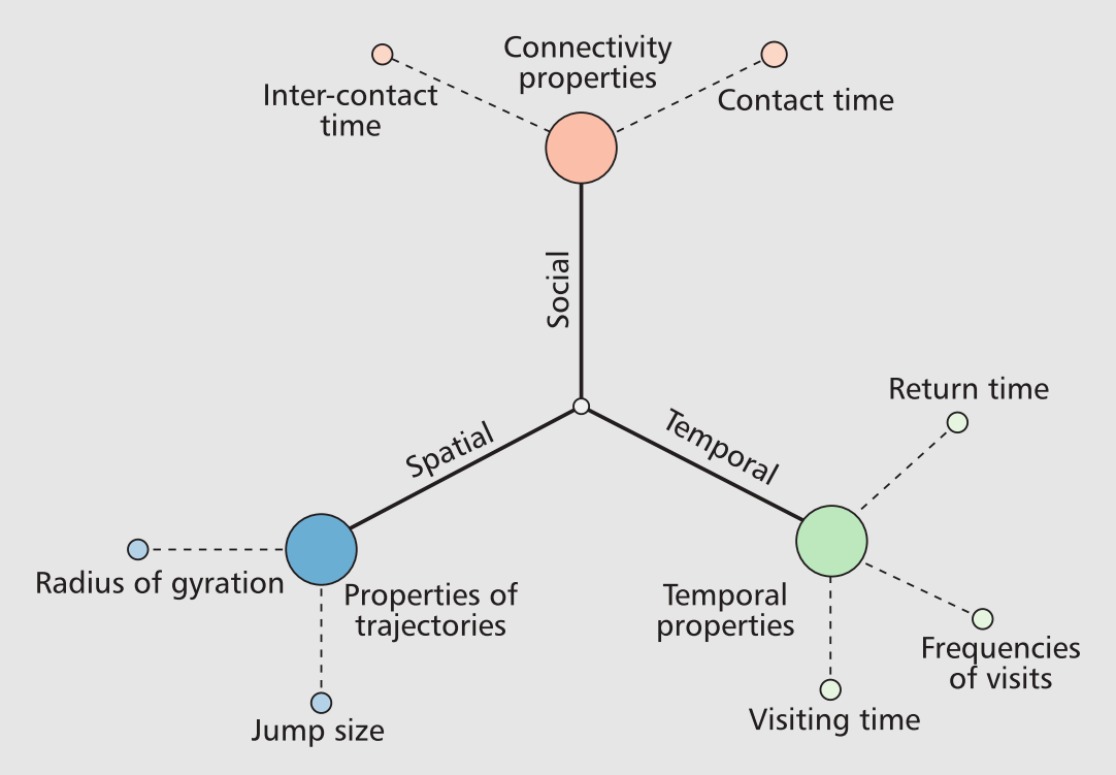
- No context:
  - Epidemic: broadcast; flooding
  - Direct Delivery: single copy
  - Spray and Wait: limited flooding
- Partial context:
  - Prophet: based on history of past encounters
  - MaxProp: “smart” dropping of packets
- Full context:
  - BubbleRap: communities; betweeness centrality

Mobility Models (examples)

- Random Walk
- Random Waypoint
- Map based:
  - random
  - random waypoint (shortest path)
  - car follower (follows car in front)
  - working day (based on social behaviour)
  - ...
- Trace based

Human mobility

- properties:



source: [3]

Challenges

- routing strategy
- security / trust
- energy efficiency
- memory requirements
- altruism / incentives
- validation in the real world -> simulation
- implementation: technologies

Sources

[1] http://www.slideshare.net/mazlan1/trends-and-challenges-in-delay-tolerant-network-dtn-or-mobile-opportunistic-network-oppnet

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[4] Mota, Vinícius F.S., Felipe D. Cunha, Daniel F. Macedo, José M.S. Nogueira, and Antonio A.F. Loureiro. 2014. “Protocols, Mobility Models and Tools in Opportunistic Networks: A Survey.” Computer Communications 48: 5–19. doi:10.1016/j.comcom.2014.03.019.

[5] Benamar, Nabil, Kamal D. Singh, Maria Benamar, Driss El Ouadghiri, and Jean Marie Bonnin. 2014. “Routing Protocols in Vehicular Delay Tolerant Networks: A Comprehensive Survey.” Computer Communications 48. Elsevier B.V.: 141–58. doi:10.1016/j.comcom.2014.03.024.

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