PeerTIS– A Peer-to-Peer Traffic Information System

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VANETs

- Limited network capacity ? Limited scalability, connectivity
- No immediate market penetration
- Benefits:
  - User-driven, Decentralized

Infrastructure-based Cellular Communication (i.e. UMTS)

Assumptions:

- Each car connected to cellular Internet (IP-based communication channel between cars)

TIS

- Distributed database of traffic measurements

Peer-to-Peer Internet Overlay Over Infrastructure-based networks

- Robust and efficient search and data retrieval
- Redundant storage
- Scalability
- Decentralized

The TIS Application

- Street segment IDs as keys measurements on the segment as values
- Use any DHT and apply it to TIS ?

Cellular Internet Access limitations:

- Bandwidth and Latency limitations
- Mobile stations limited storage and processing power

Reduce Communication Burden

- Non-random access operations / Exhibits locality property

Content Addressable Network (CAN)

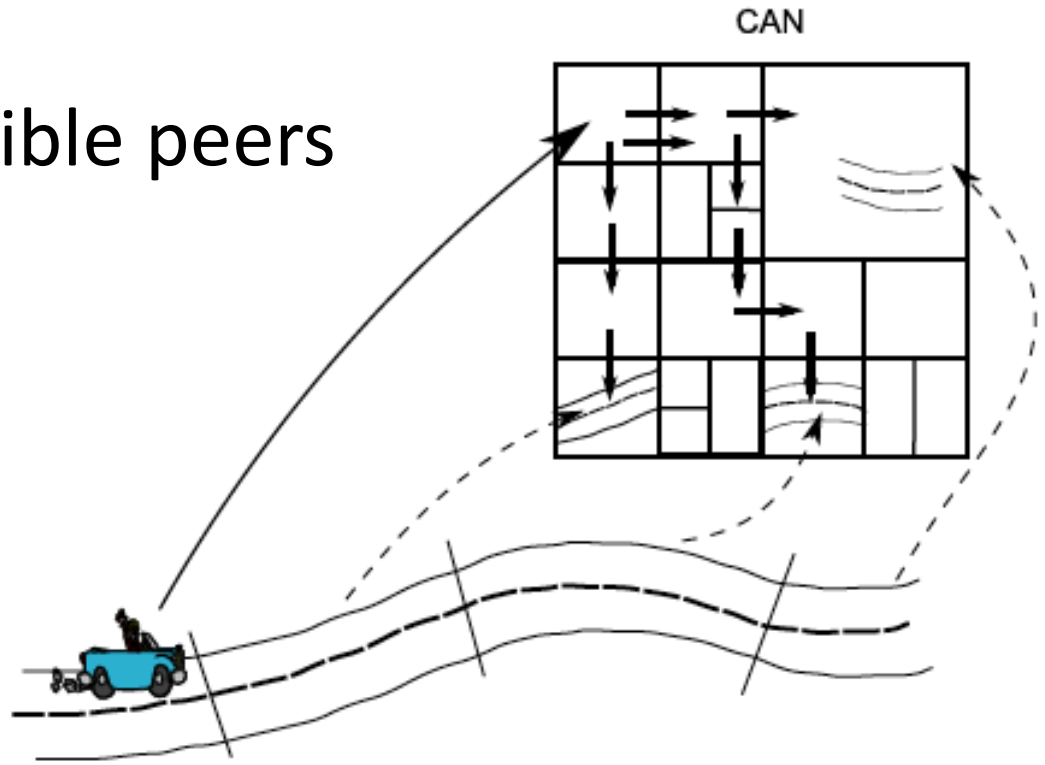
- Key-values mapped to points in d-dimensional space, key space
- One zone/peer
- Peer joins– Split
- Peer leaves– Merge

CAN continued…

- Communication Overlay formed by connecting neighbor peers in the key space.
- Routing Table
- Greedily forwarding of requests

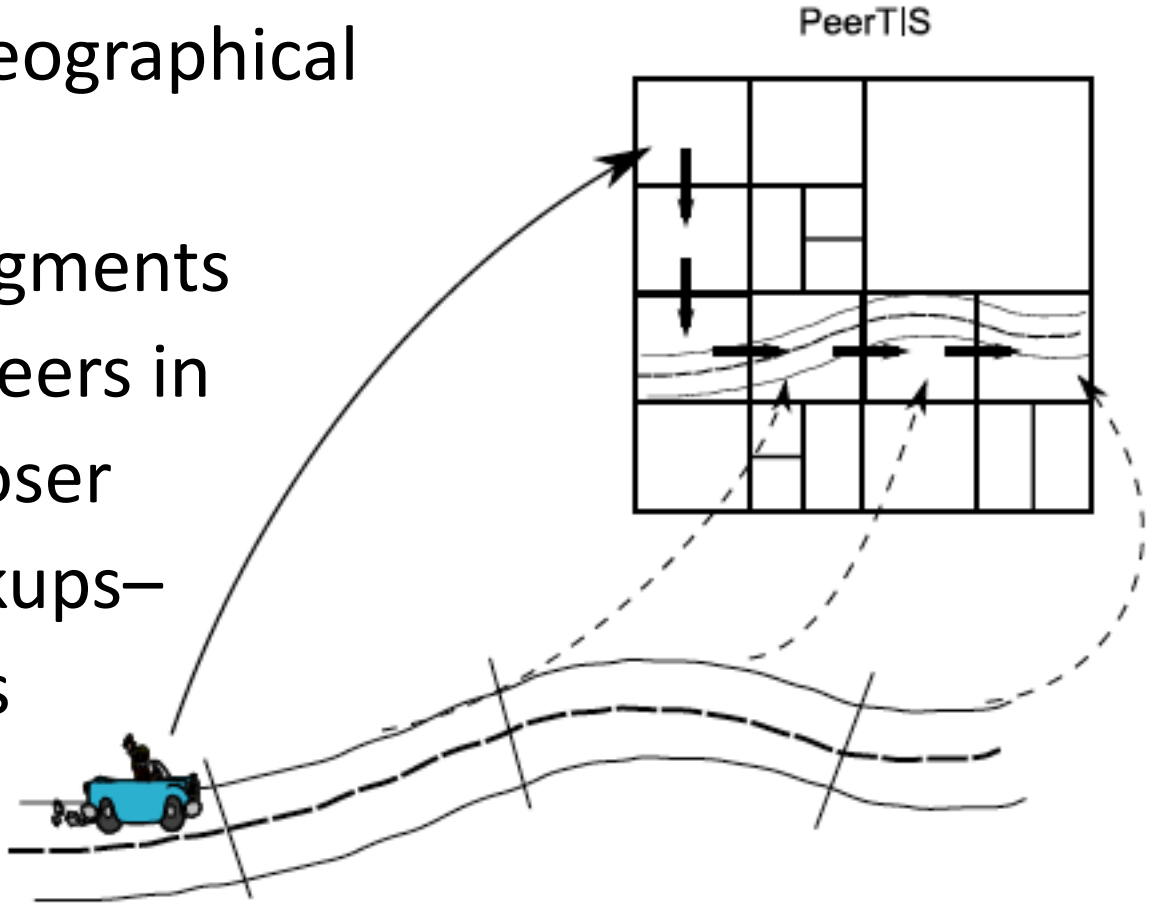
Naïve Approach (CAN)

- Identify relevant road segments
- Determine the position of the segments in the key space
- Locate responsible peers



A P2P Overlay for TIS (PeerTIS) Improving the Lookup Performance

- Keep the relationship between the road segments
- No hashing– use geographical coordinates
- Looked-up road segments are contiguous– peers in the overlay are closer
- More efficient lookups– Multi-hop lookups



Load Distribution

- No uniform distribution of segment IDs over the key space (maintain locality)
- Homogeneous zone sizes in original CAN
- Higher load for peers responsible for dense zones
- Solution: Smaller zone sizes in dense areas
- Achieved: by considering physical location of cars– not random

Exploiting Temporal Correlations

- Subsequent requests/updates by the same peer to the same geographical area (even the same road segment)
- Each peer maintain cache of contact data of peers on the planned route– can be directly contacted for update-requests and and update-uploads (own measurement)
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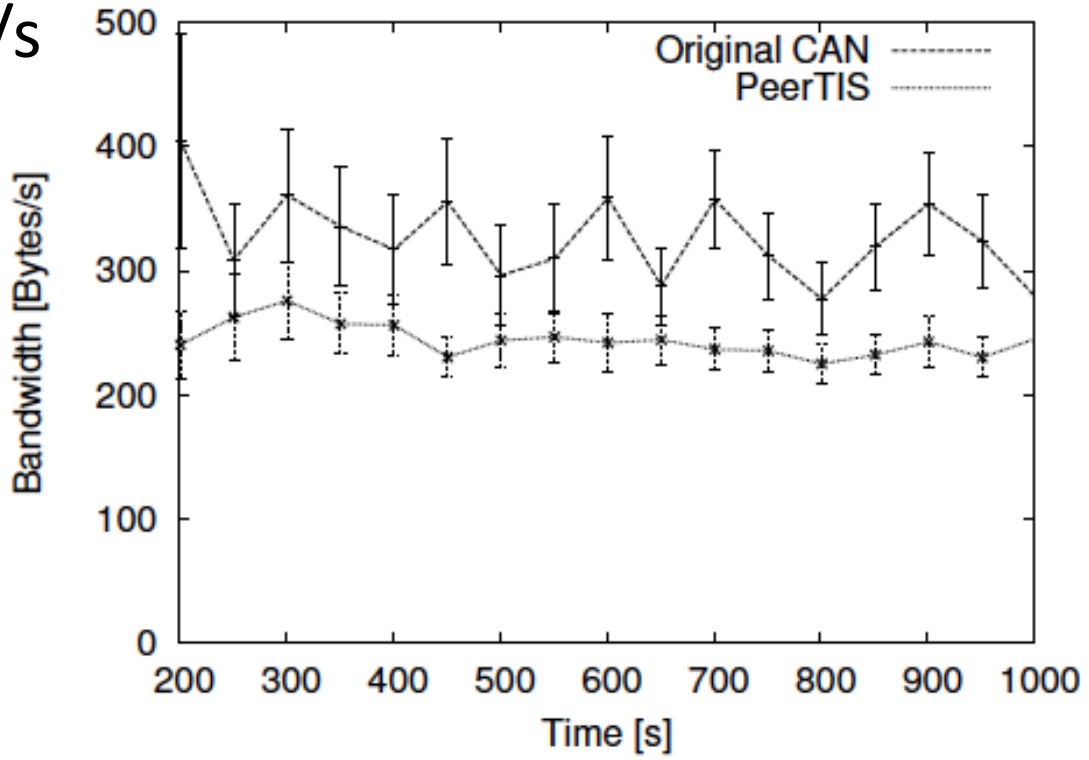
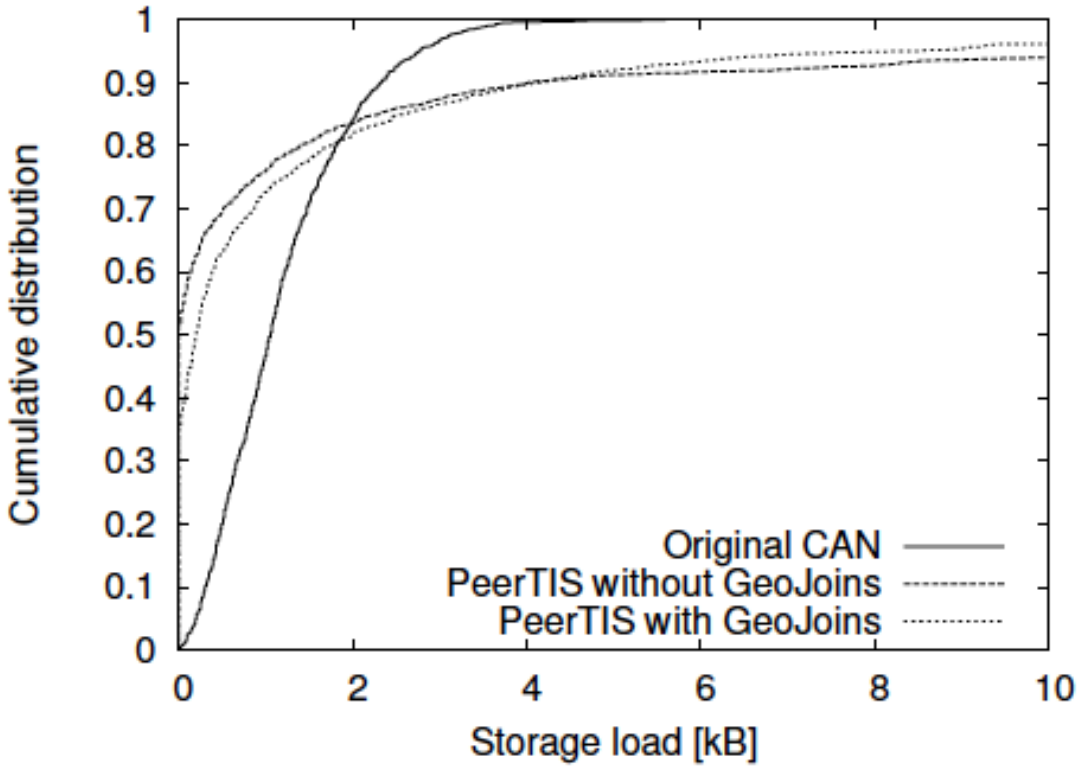
Feasibility

VISSIM microscopic traffic simulator to generate car movements, 500km roads, up to 10,000 vehicles

- Bandwidth and Latency
  - UTMS bound 384kB/s upload
  - GSM/GPRS 42kB/s



- Performance
  - Number of hops in the overlay



  - 90% of lookups require **2 hops**