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)
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