Raven: Redundancy Aided Vehicular Networking

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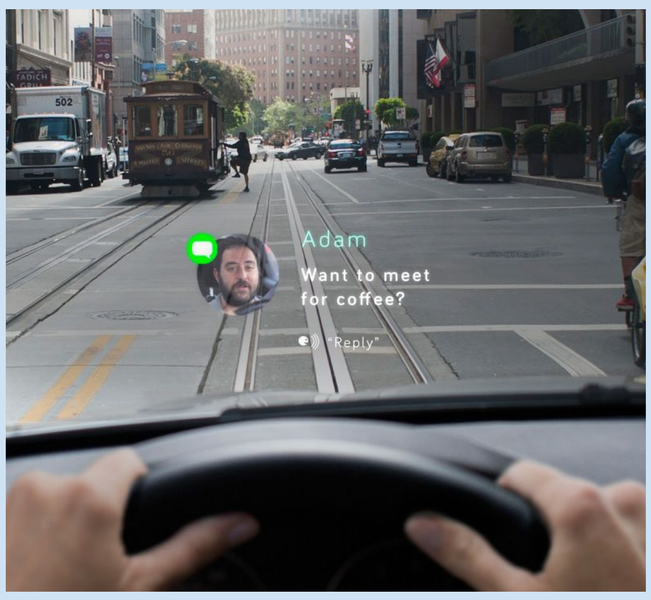
Motivation

- Emerging vehicular applications are increasingly connected to cloud services
- Many vehicular apps are latency-critical
- Multiple networks available in vehicle
  - Wifi
  - Multiple cellular via tethering

Problem

- Network communication is substantial part of user-perceived latency in vehicular apps
- Vehicular networks change rapidly due to
  - Geographical variation in coverage
  - Radio shadows
  - Differing traffic density



Solution & Implementation

- Latency estimator, quickly adapt to network latency changes
  - Calculate the expected latency distribution
  - Maintain latency prediction interval w/ confidence interval
  - Quantifies uncertainty in network latency
- Redundantly transmit small data over multiple networks
  - When error bounds for expected transmission time overlap
  - Energy considerations are minimal in vehicular platforms

Raven is composed of libDCM, DCM Module, and scheduler

- **libDCM** allows apps to talk to kernel via APIs w/ abstractions
  - Policy: how to schedule packets
  - Label: apps to explicitly describe about data property
  - Constraint: which network to include/exclude
- **MPTCP-DCM Scheduler** selects appropriate scheduling algs.
  - Implements policy chosen by apps
  - Decides which data to send over which network
  - Supports redundant transmission over multiple networks

Preliminary Evaluation

- Redundancy policy reduces ~270ms compared to the state of art TCP and MPTCP
  - TCP: 2000ms (99th percentile)
  - MPTCP: 2020ms (99th percentile)
  - Redundancy: 1750ms (99th percentile)