

# An Investigation into Intra-vehicle Sensor Networks

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# Obligatory Intro/Goal/Motivation Slide

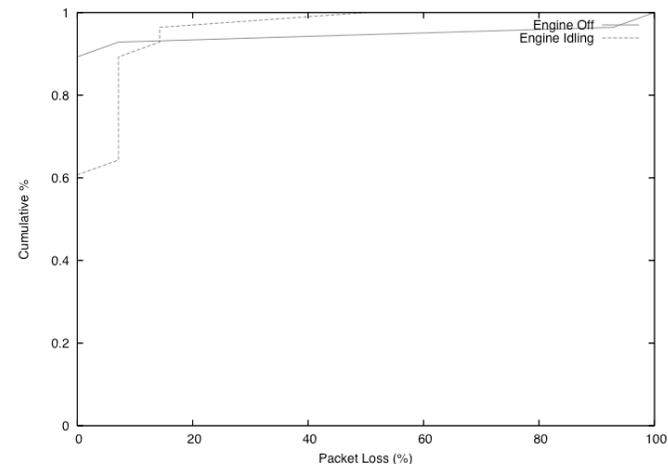
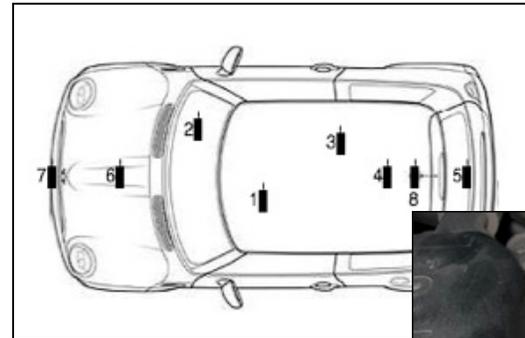
- Sensor networks
  - ‘motes’ sensing environment and talking to each other through low-power radios
- Goal
  - Construct a wireless sensor network on a car
- Motivation
  - Wireless replacement of ‘wiring harness’
  - Wireless ‘clamp-on’ diagnostics tools

# High Level Approach

- Two Experiments
  - Initial ‘Packet Loss’ Test
    - Test packet loss between many points in a car
    - Determine appropriate communication parameters
  - Full-up Build/Test
    - Build ‘final’ system
    - Baseline in a controlled environment
    - Then drive around testing it

# Packet Loss Test

- Process
  - Place a pair of motes on the car
  - Send some packets
  - Measure loss
  - Repeat *ad nauseum*
- Results
  - Generally pretty good!
  - Some loss, but not significant in light of criticality (or lack thereof)
  - Out-of-the box single-hop messaging is okay!

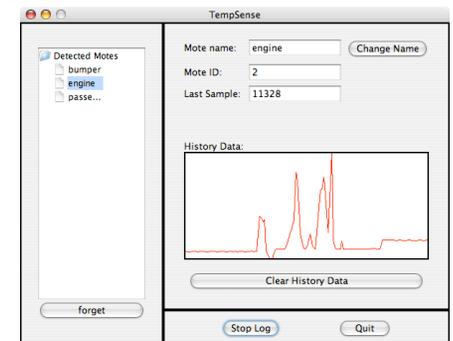


# Full-up Build (the Plan)

- Process
  - Write mote code
  - Write front-end code
  - Test Run in the lab
  - Hook it all up (3 sensor motes + 1 base station mote) to my car and drive around

# Full-up Build (the Reality)

- Process
  - Write mote code
  - Try to program mote and realize that the programming board doesn't work anymore
  - Freak out
  - Purchase Timeshare on Wei's programming board
  - Try to program mote and realize that sensorboard driver is incomplete
  - Freak out some more
  - Hack together new sensorboard driver out of spare parts
  - Try to program mote and realize that I am now reading photocell instead of thermistor
  - Call it 'good enough'
  - Write front-end (Java! Yay!)
  - Test Run in the lab
  - Hook it all up (3 sensor motes + 1 base station mote) and drive around

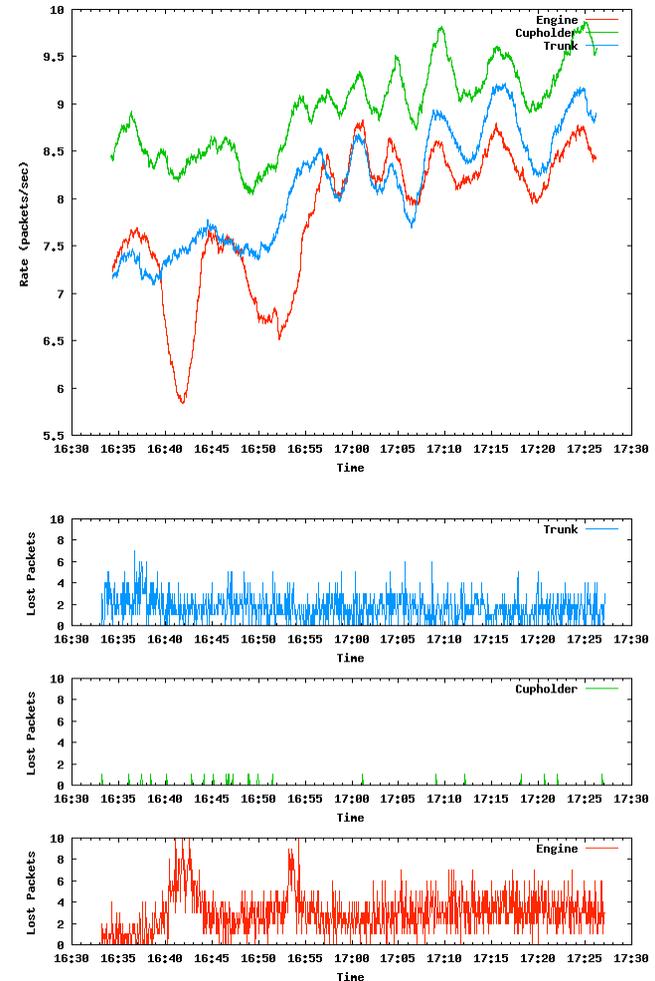


# More Pictures!



# Full-up Build Results

- Packet loss worse than desktop baseline, but similar to initial test
  - <10% for a mote tied to the top of the engine
- Average of 6-7 measurements/second is easily attainable
  - >10/s likely with a little more 'smarts'
- Main Result: 50 minutes of data showing it sensing



# Conclusions/What's Next?

- Conclusions
  - No fundamental barrier against intra-vehicle sensor networks
  - Packet loss could be reduced further, but sufficient for non-mission-critical application
- What's next?
  - Sensing motes need to be able to be retasked
  - More sensors! Custom Sensors!
  - Better mounting (i.e. less reliance on fishing line)
  - Graduation...?

# Lessons Learned

- Sensor Network programming, namely TinyOS/NesC, is harder than it probably should be
  - Though some things are trivial (retransmissions)
- Don't switch major programming platforms in the middle of a project (duh)
  - Linux to OS X; TinyOS 1.1.x to 2.0; raw RS232 to USB; sanity to madness
- “It's a hardware problem”
  - Bad programming boards, no driver support, incorrect schematics



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