Vehicular Sensor Networks

Characteristics and challenges

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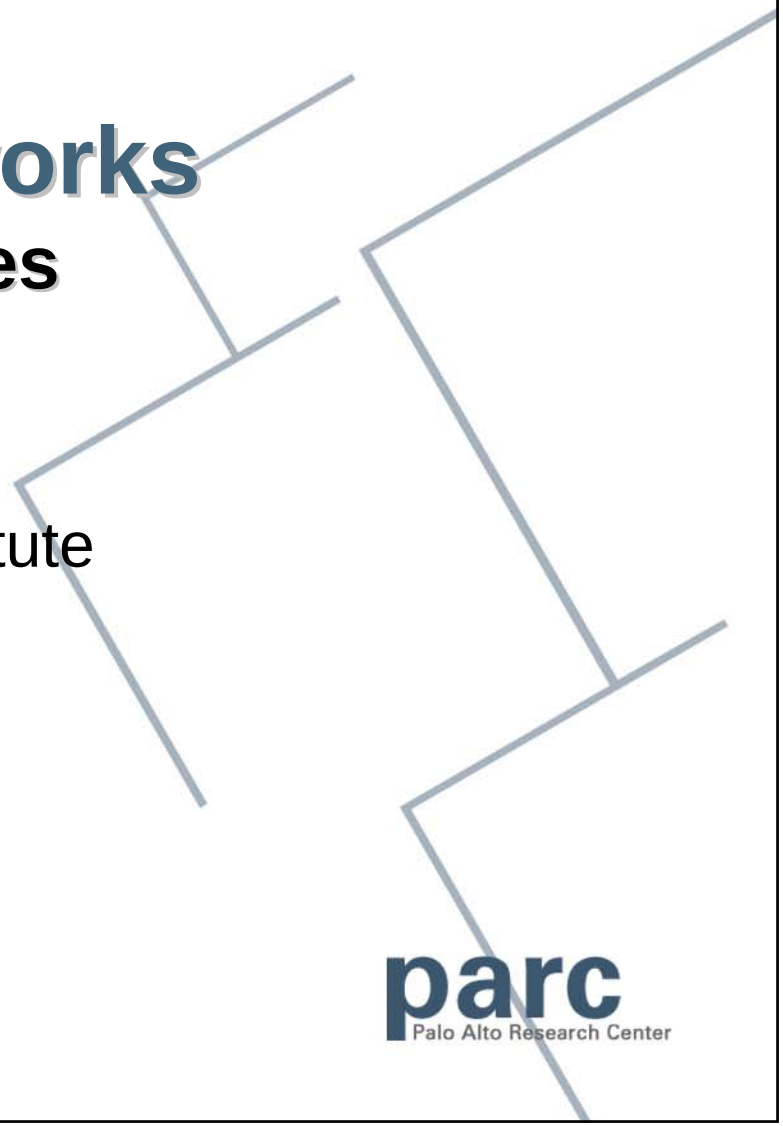

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Vehicular Sensor Networks

- Driving is a data-intensive task
  - Most dangerous thing most people do every day
  - Traffic is one of US society's greatest time-wasters
- Large quantity of spectrum allocated for free for cars to communicate with each other and with infrastructure
  - DSRC, 802.11p, ARIB standards
  - Share among many applications
  - Safety apps are the official reason for free allocation
    - » But many developers afraid of these, would rather use bandwidth to download DVDs or something…
- Communicating cars and roadside infrastructure collectively form a sensor network

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Some applications

- Collision avoidance in intersections (including pedestrians, bicyclists)
- Collision avoidance between intersections and in rural areas
- In-car signage
- Situational awareness
- Traffic light status/cycle information
- Traffic congestion information
- (Cooperative) vehicle routing
- Detailed accident information for first responders
- Casual carpooling
- Ambulance approach warnings and routing
- Parking lot information
- Parking meter information and reservations
- Advertising of roadside businesses
- Car-to-car messaging or voice
- Drunk driver detection
- Telematics – tracking trucks, taxi fleets, etc.
- Tolls (including urban tolling zones or road usage based tolling
- On-road gaming (passengers, of course)
- Trickle updating of GPS maps
- Local area information
- Vehicle population diagnostics

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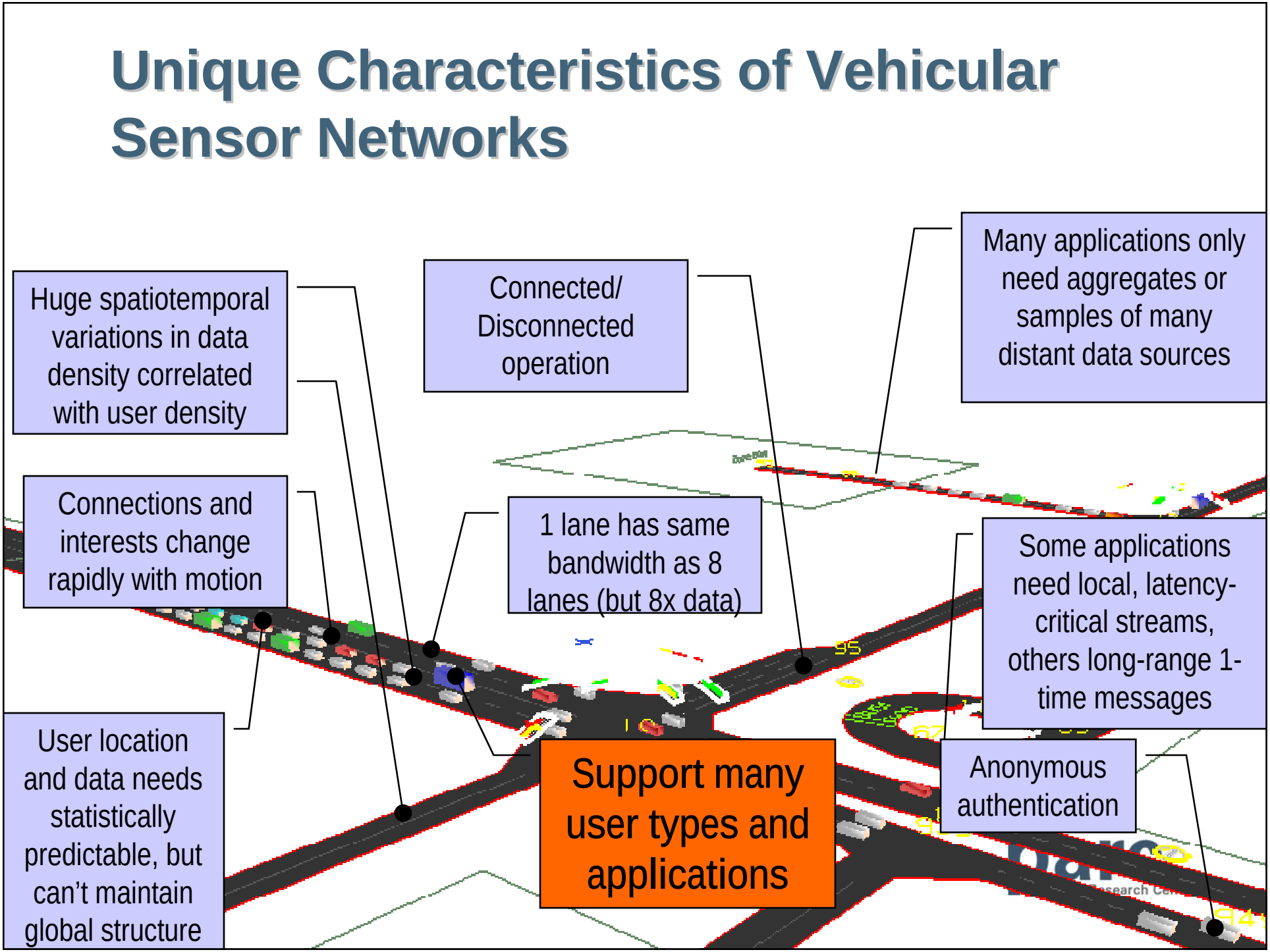
Unique Characteristics of Vehicular Sensor Networks



Lessons and Issues

- Drivers have very limited attention, cannot afford active “browsing”
  - The more the GUI knows about context and prefs, the better
  - GUI will have much more information than user can handle
  - Adjust GUI to user and context (passenger, stopped car, etc.)
- Multiple uses for data in different contexts
  - E.g. Parking lot
    - » long-range: what are the odds I’ll find a spot? Short range, which lot is closest?
- Data tends to be region-to-region, not individual-to-individual
  - Don’t want to talk to specific person, mostly data-centric
  - Pure push may be best model. Is there a common role for data requests?
  - Big leverage from user/app needs statistics
  - Have some data on likely destinations from GPS and user history
    - » But how to use – local voting? Or just data mining?
- An “eavesdrop” web?
  - Powerful GUI and storage at all nodes allows extensive caching and local filtering (no power or memory constraints!)
  - Everyone’s a data source, everyone’s a user

Lessons and Issues (2)

- Need multiple communication approaches
  - Infrastructure for long haul region-to-region data
  - FM or IR downlink for global data
  - V2I around intersections
  - V2V and data muling in between
  - Cellular or WiMax for client-server or point-to-point
- Balancing resource consumption of multiple applications/users is important and contentious
  - Think about economics not just information theory
  - How to specify temporal, spatial, data quality needs?
  - Game theoretic issues, e.g. routing, or advertiser competition
- Testing these systems is giant challenge
  - Realistic sim of vehicle density and network congestion is **key** – only way to know what will happen with widspread adoption
  - This industry has been given $4B of free bandwidth, but have no idea what will happen when users start to show up in large numbers
- Can we ever trust this for safety?

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