Trends in Wireless Communications For Automobiles
Leading to SDR and Implications for Antennas

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Wireless Automotive Services

• Several automotive companies have shown prototypes / concept cars with “Internet Dashboards” which provide users with direct attachment to the net and a variety of displays including
  – Voice synthesis
  – Color graphics
  – Motion Video

• This is just a sign of the rapidly growing number of wireless services users wish to access from their vehicles such as:
  – Cellular telephony
  – GPS
  – Navigation Services
  – Electronic tolls
  – Highway information
  – Traffic information
  – Parking payment / information / reservation
  – Platooning of cars
  – Video of accident scene
  – Medical information
Wireless Automotive Networks

• Coverage
  – WAN’s
    • Analog / Digital Broadcast, cellular, Internet, etc.
  – Vehicle to Roadside
    • Toll collection, highway information, traffic information, vehicle guidance
  – Vehicle to Vehicle
    • Platooning, intercom, etc.
  – Intra vehicle
    • Information distribution to different occupants

• Authority / Economics
  – Fee for Service - Licensed
  – Unlicensed
  – Government Bands

• Vehicular, Handheld, or combination packaging
The Promise of SDR

- Ability to support a wide range of services with a single hardware platform
  - Minimizes volume & weight
  - Flexible to accommodate
    - Different geographic / government regions
    - Different network topologies
    - Different economic / authority network structures
    - Dynamic requirements
  - Minimizes cost
  - Maximizes convenience to users
  - Provides future proofing for relatively long life vehicles
    - Software downloads can add new capabilities required by services introduced after initial vehicle manufacture
- SDR vendors capable of delivering are beginning to appear
- SDR capability will continue to grow
Intersection of SDR

• Requirements
  – Capabilities between handset and base station
  – Flexible bandwidth
  – Cognitive capability
    • Sense what wireless resources are available
    • Accept user input on economic / QOS trade offs
  – Able to be partitioned based on
    • Criticality of service
    • Criticality of latency
  – Ability to function in automotive environment
    • Shock
    • Heat
    • Etc.
Many solutions propose an antenna for each service

One antenna for each service makes the vehicle look like a porcupine

Multiple projecting antennas create a variety of problems on vehicles
  - Aesthetic
  - Aerodynamic
    • Fuel consumption, top speed, etc.
  - Wind noise
  - Reliability
Desired Antenna Solution

- Reduced number of antennas
  - Single antenna system for all information and Vehicle to Roadside Services
    - Covers desired frequency range
    - Provides diversity:
      - Space
      - Polarization
    - Conformal to the car
  
- Single antenna for sensing
  - Proximity of other vehicles
  - Other critical environmental sensing
  
- Minimizes exposure of vehicle occupants to RF radiation
Conclusion

• SDR / ITS drivers
  – Proliferation of ITS wireless systems and services
  – Dynamic nature of some service requirements
  – Rapid and continuous evolution
  – Relatively long life of vehicles
  – Desire to minimize costs, size and weight

• Partitioning of SDR / ITS systems
  – Information / payment
  – Guidance and critical environment sensing