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.

The Porcupine Problem

- 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 weitght
- Partitioning of SDR / ITS systems
  - Information / payment
  - Guidance and critical environment sensing