

Intro to DSRC

- Definition
- Standards effort
- FCC rules
- Deployment of DSRC systems and infrastructure
- Focus - Rural Applications

Dedicated Short Range Communications

"... a short to medium range (1000 meters) communications service that supports both public safety and private operations in roadside-to-vehicle and vehicle-to-vehicle communication environments by providing very high data transfer rates where minimizing latency in the communication link and isolating relatively small communication zones is important."

Technical Characteristics

- 5.850 to 5.925 GHz
- Bandwidth = 75 MHz
- Shared, but Transportation is primary
- State DOT License Holder
- FCC Part 90

Current Applications

- Use 902-928 MHz
- Unlicensed
- Toll Collection
- Garage door openers
- CVO (commercial vehicle operations)
- Telephones

Comparison

Parameters	902–928 MHz	5850-5925 MHz
Spectrum	12 MHz	75 MHz
Data Rate	500 Kbps	6 – 27 Mbps
Protection	None	Primary
Interference	900 MHz Phone; Spread Spectrum Radio; Radar	Some Radar & Satellite Uplinks
Max . Allow. Range	300 Ft.	3000 Ft. (1000 m)
Min. Separation	1500 Ft.	50 Ft.
Channel Capacity	1 to 2	7
Power (Downlink)	<10 watts	<2 watts
Power (Uplink)	<4 mW	<2 watts

Standards

Standards - World Wide

- **ISO** - TC204. WG15 - OSI Layer 7, WG16 -air interface.
- **CEN** - Layer 1, Layer 2, Layer 7.
- **Japan** - Developed DSRC standards published as ARIB T55.
- **Complication** - Japanese have a standard based on infrared technology – used in major cities and controlled by the National Police Agency.
- **Korea - Brazil**

Standards - North American

- The overall goal of the DSRC standard program is to develop a set of DSRC standards that will support full interoperability throughout North America while satisfying all of the application requirements. The emphasis is on public safety applications, but many others are considered and allowed.
- 802.11a

Standards - North American

- ASTM
- IEEE
- ISO
- SAE
- AASHTO
- ITS America

Stakeholders

- 3-M
- AASHTO
- ACUNIA
- AMTECH
- ARINC
- ARMSTRONG CONSULTING
- ATHEROS
- CALTRANS
- DIAMLER-CHRYSLER
- DENSO
- GM
- GTRI
- HIGHWAY ELECTRONICS
- HITACHI
- IDMICRO
- IMEC
- INTERSIL
- ITS-A
- JHU/APL
- KING COUNTY METRO
- MARK IV
- MICOM
- MICHIGAN DOT
- MITRETEK
- MOTOROLA
- NISSAN
- NY THRUWAY AUTHORITY
- OKI ELECTRIC
- PATH NY/NJ
- RAYTHEON

Stakeholders

- SIRIT
- SUMITOMO ELECTRIC
- TECHNOCOM
- TOSHIBA
- TRANSCORE
- VISTEON
- WASHINGTON DOT
- WI-LAN

FCC

- “Intelligent Transportation Services”
- Part 90 – PLMRS
- Frequency Coordination

5.8 DSRC Applications

- Over 1000 Applications Suggested
- List is still growing
- Large User Group Interest

Who?

- Automobile manufacturers
- Public Safety
- Parking Lot
- Retail Establishments
- Gas Stations
- Mass Transit
- Railroads
- etc.

What?

- Vehicle-to-vehicle Comm
- Traffic Flow (Speed & Volume)
- Lane Occupancy
- Priority Signal Preemption
- Toll Collection
- Freight Tracking
- Roadway Conditions

Vehicle Safety Communications Consortium



Consortium

DAIMLERCHRYSLER



- Facilitate the advancement of vehicle safety through communication technologies.
- Identify and evaluate the safety benefits of vehicle safety applications enabled or enhanced by communications.
- Assess associated communication requirements including vehicle-vehicle and vehicle-infrastructure communications.
- Contribute to 5.9GHz DSRC standards and ensure they effectively support safety.

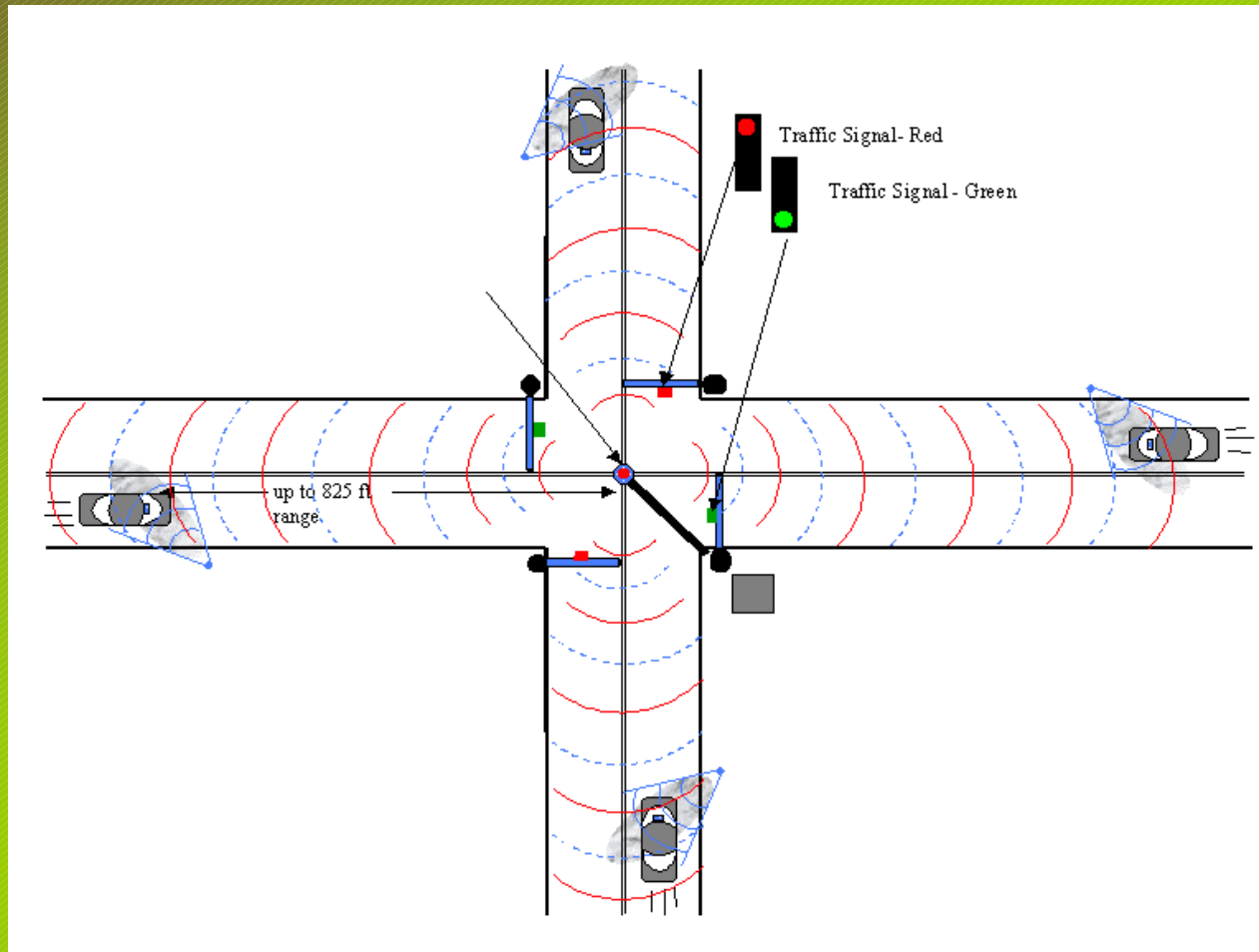


TOYOTA

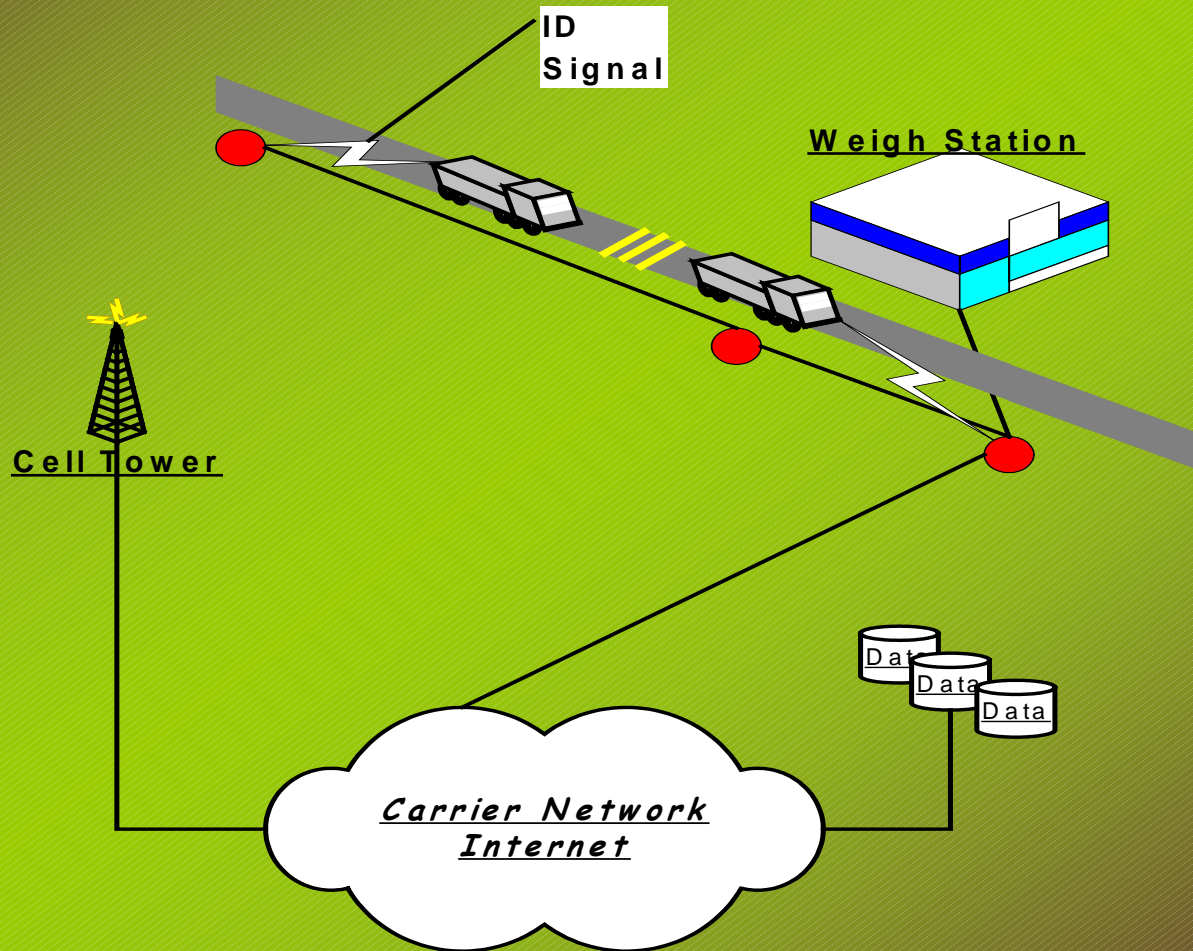


Application Examples

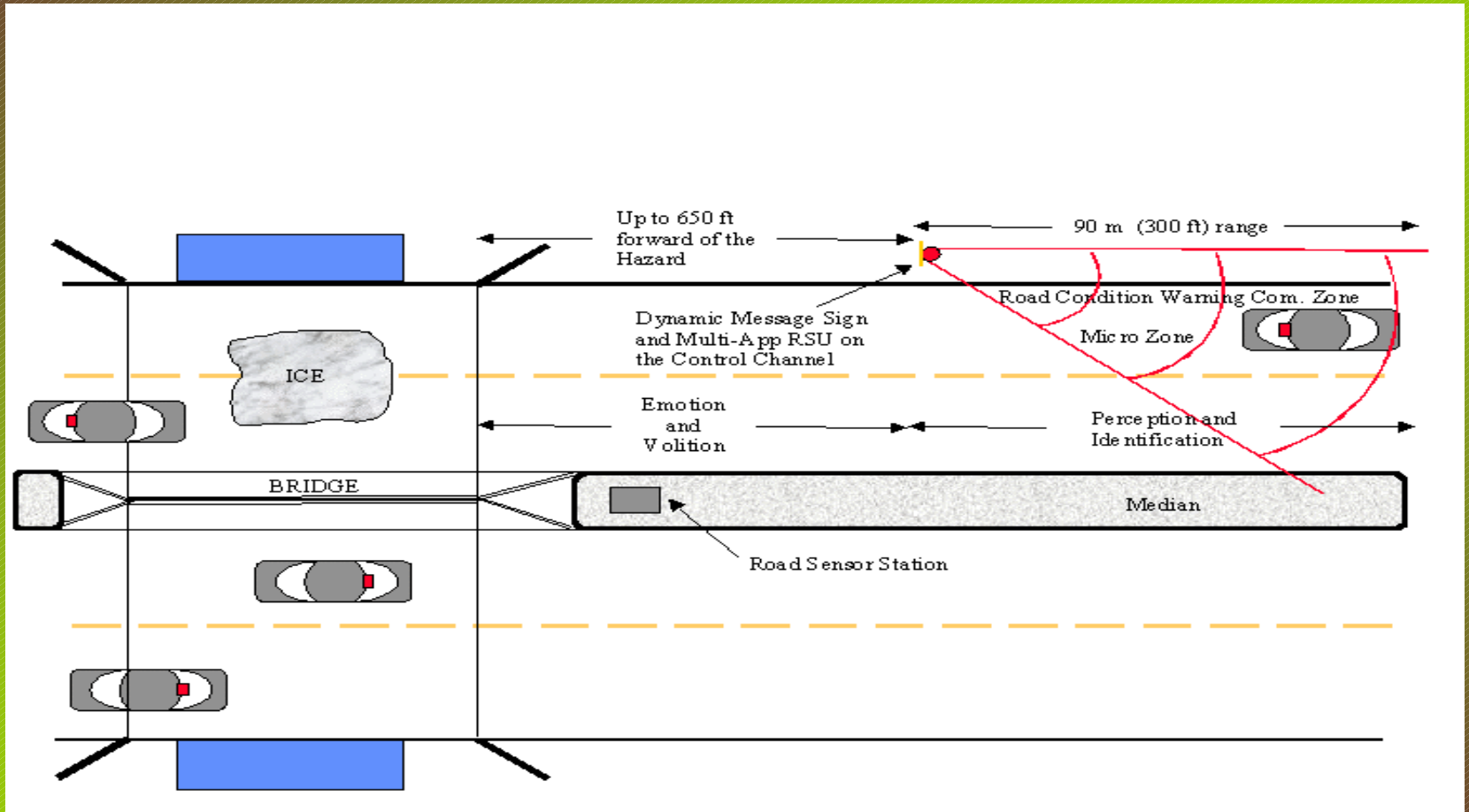
Assisted Collision Avoidance



CVO



Roadway Conditions



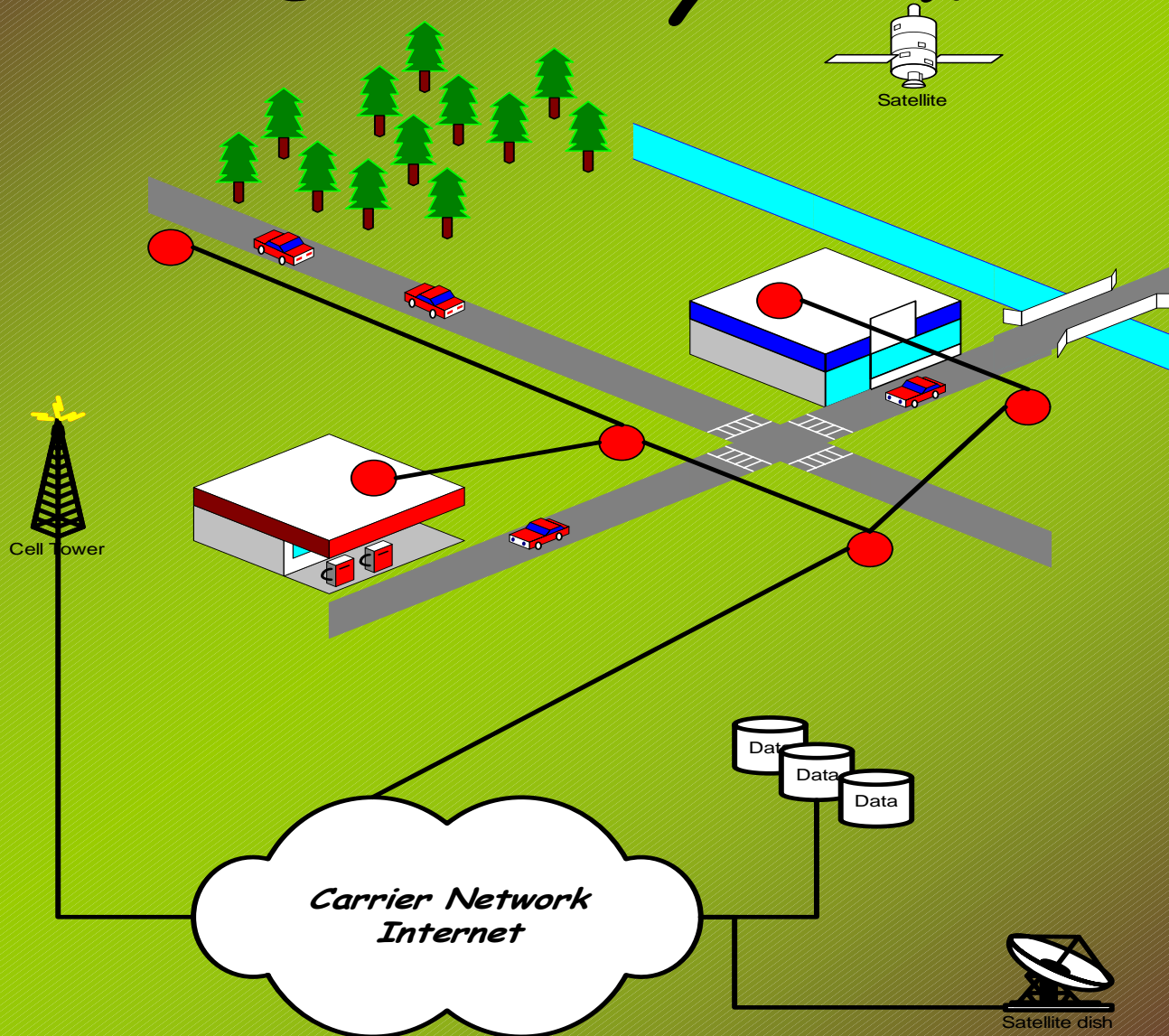
DSRC Deployment

- Rural
 - Lots of space
 - Utilities Sparse
 - Roads Less Traveled
- Urban
 - Little space
 - Utilities Plentiful
 - Congested Roads

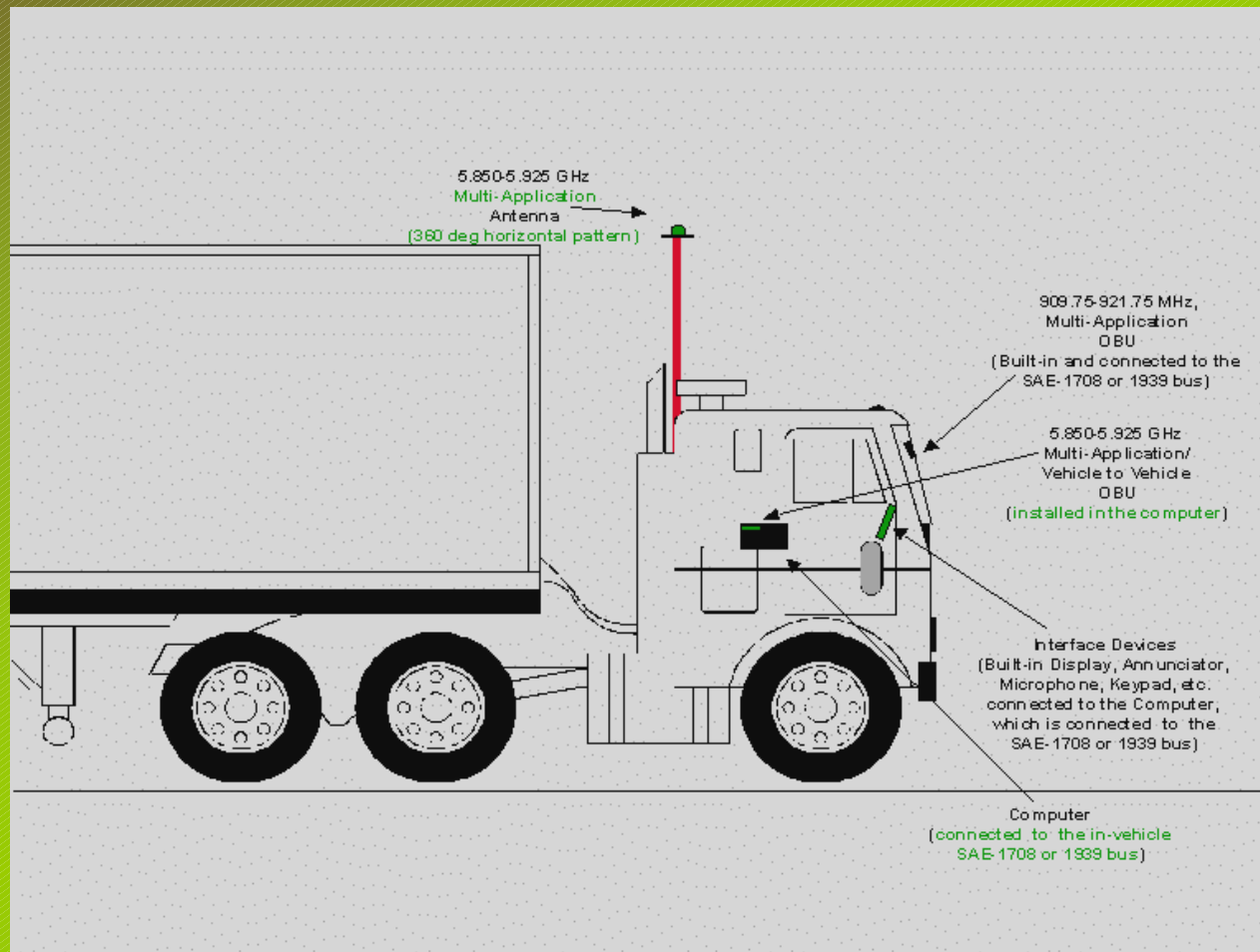
DSRC Infrastructure

- On-board Vehicular Radio System
- Roadway Backbone Communications System
- Connectivity
 - Internet
 - Database Networks (SAN)
 - TMC

DSRC System

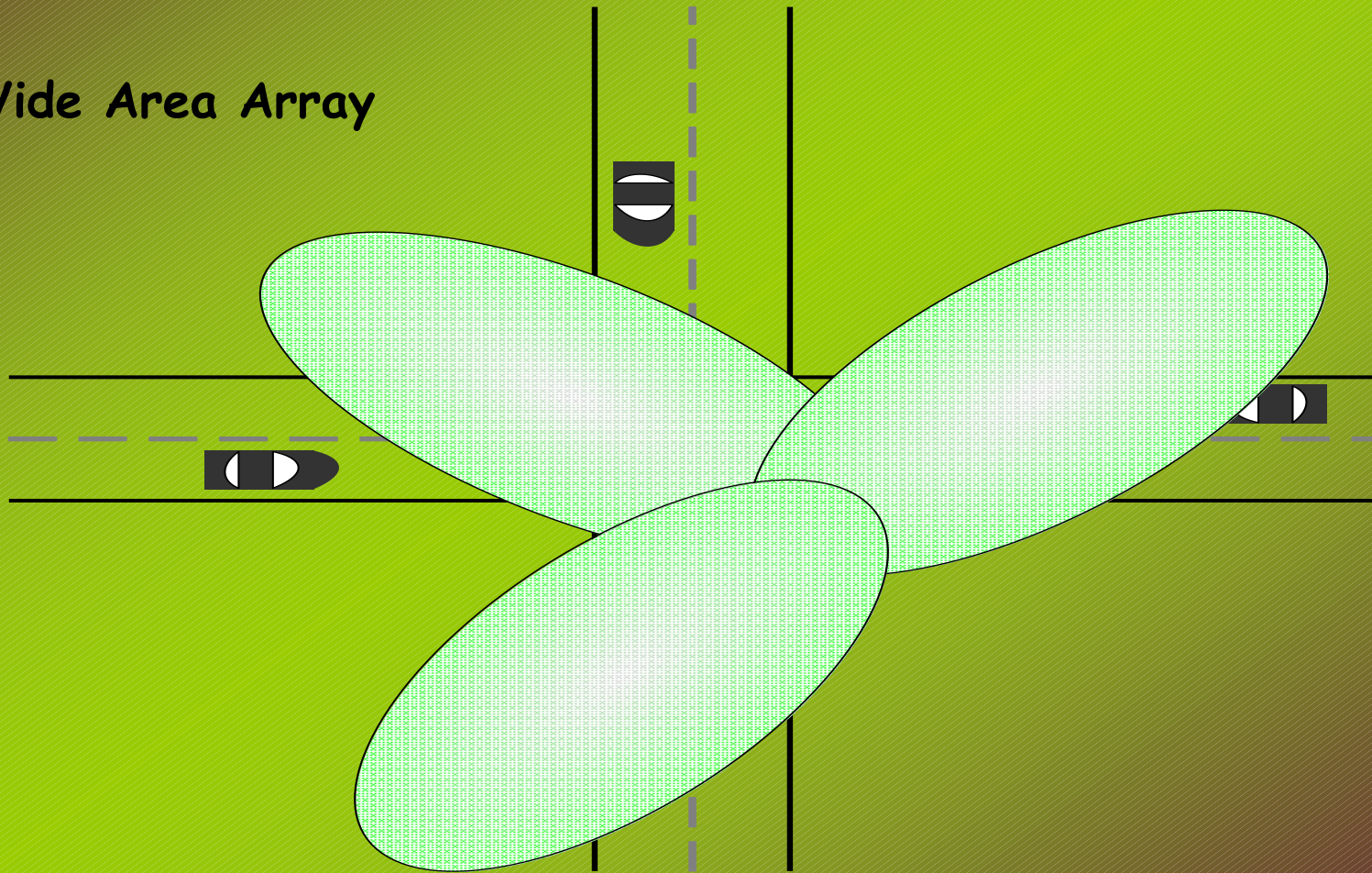


DSRC Vehicular Radio



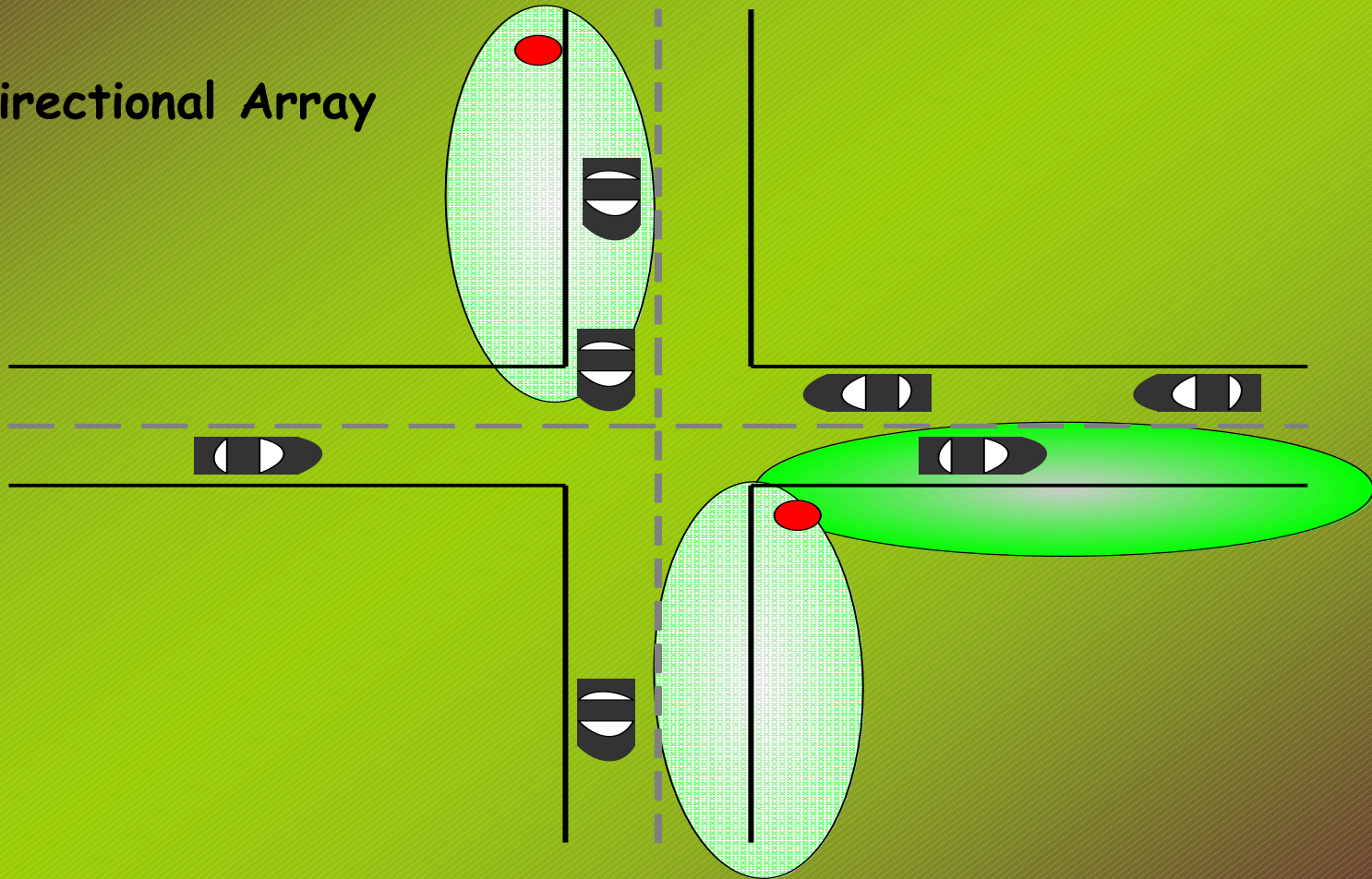
DSRC Roadside Antenna Array

Wide Area Array

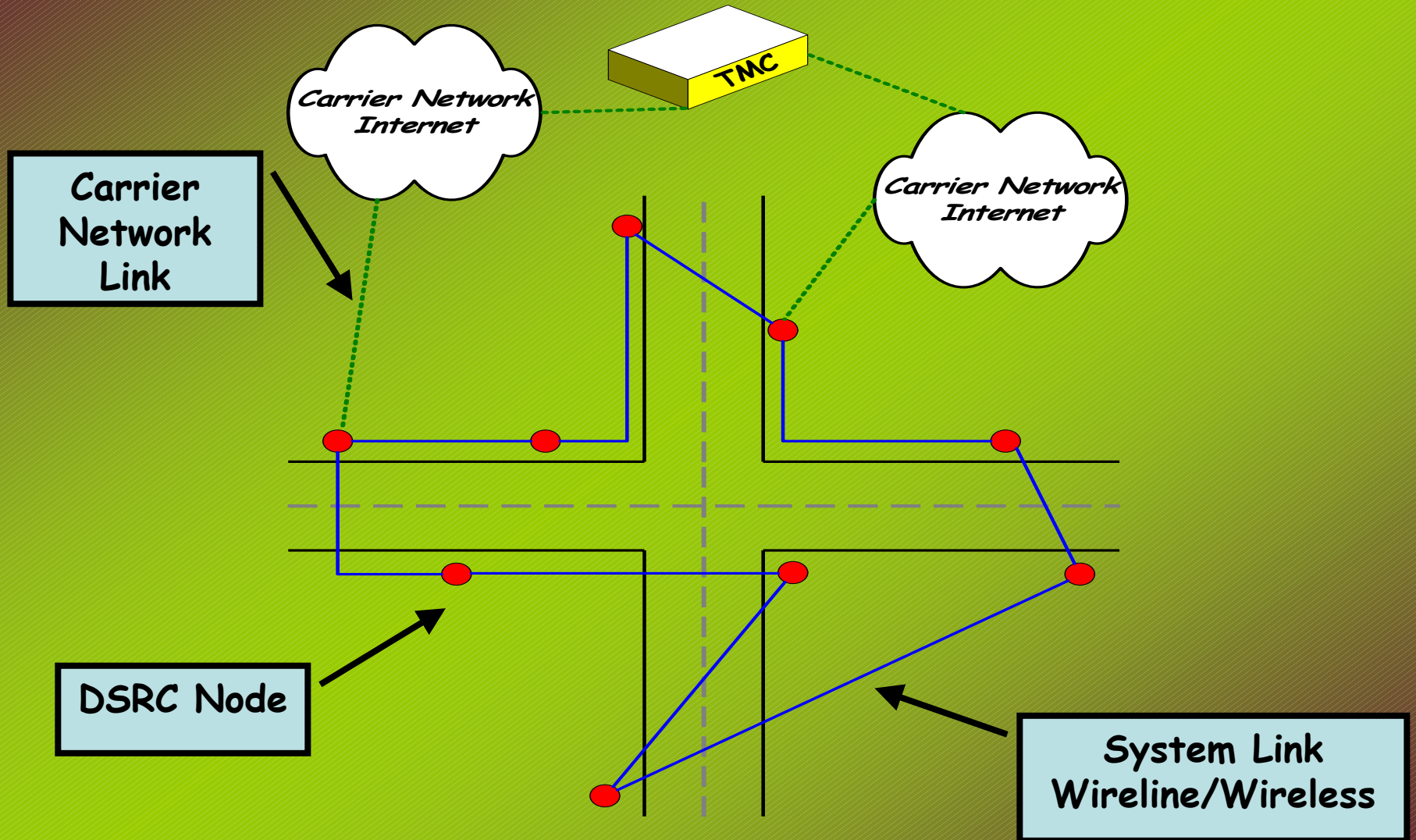


DSRC Roadside Antenna Array

Directional Array

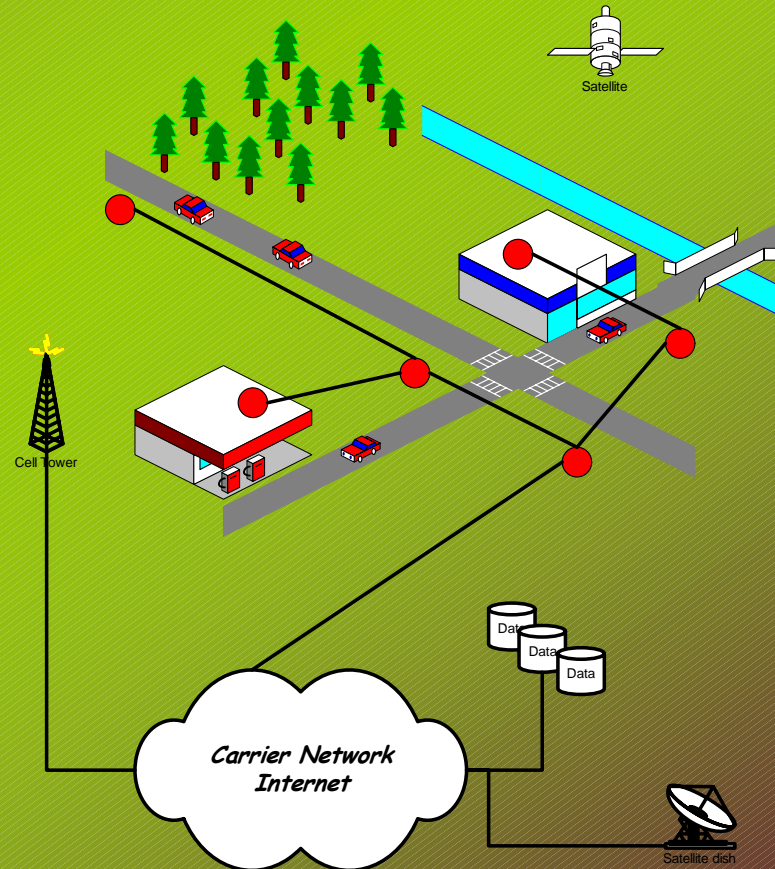


DSRC Wireless Infrastructure



DSRC Flows

- Vehicle-to-Vehicle
- Vehicle-to-Roadside
- Roadside-to-World

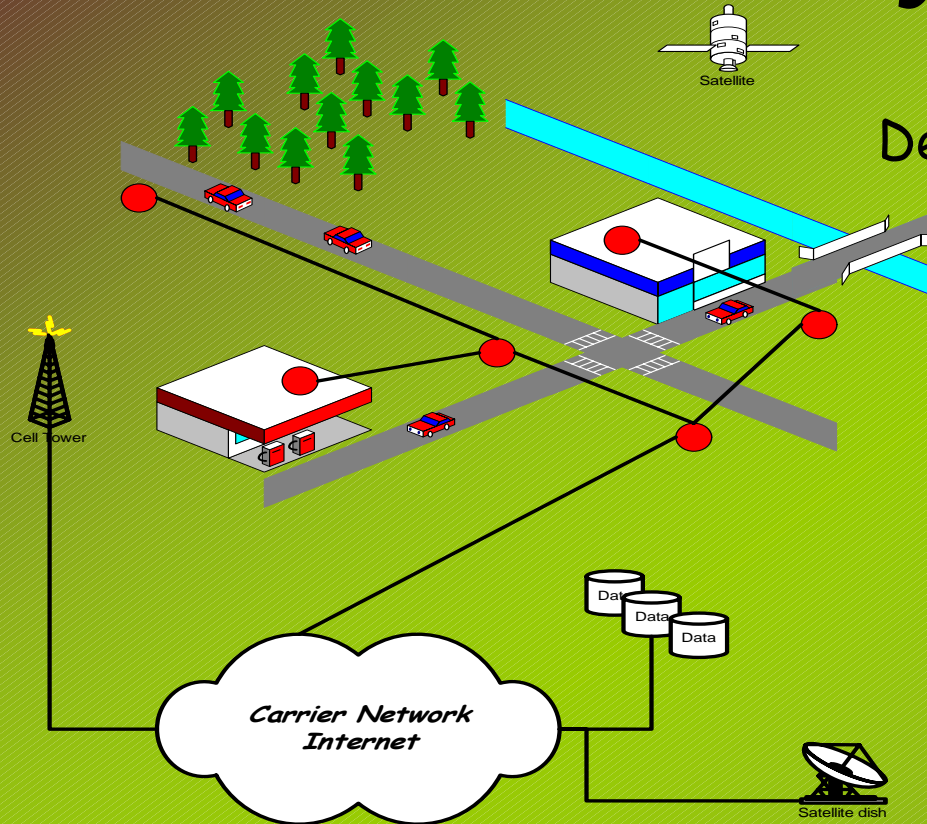


Rural Deployment

Rural Deployment

- **Obstacles**
 - Lack of Power
 - Lack of Telecommunications Facilities
 - High Cost DSRC Deployment
 - Infrastructure : \$\$\$\$\$/Vehicle
 - Total Cost Infrastructure ÷ Vehicle Population = \$ per Vehicle

DSRC System



Deployment of a large scale system in a rural setting will cost about 60% of an urban system. However, cost per potential user vehicles is substantially higher for rural applications.

DSRC Rural

- *How can cost of deployment be reduced?*

Ad Hoc Communication Networks

Ad Hoc Communication Networks

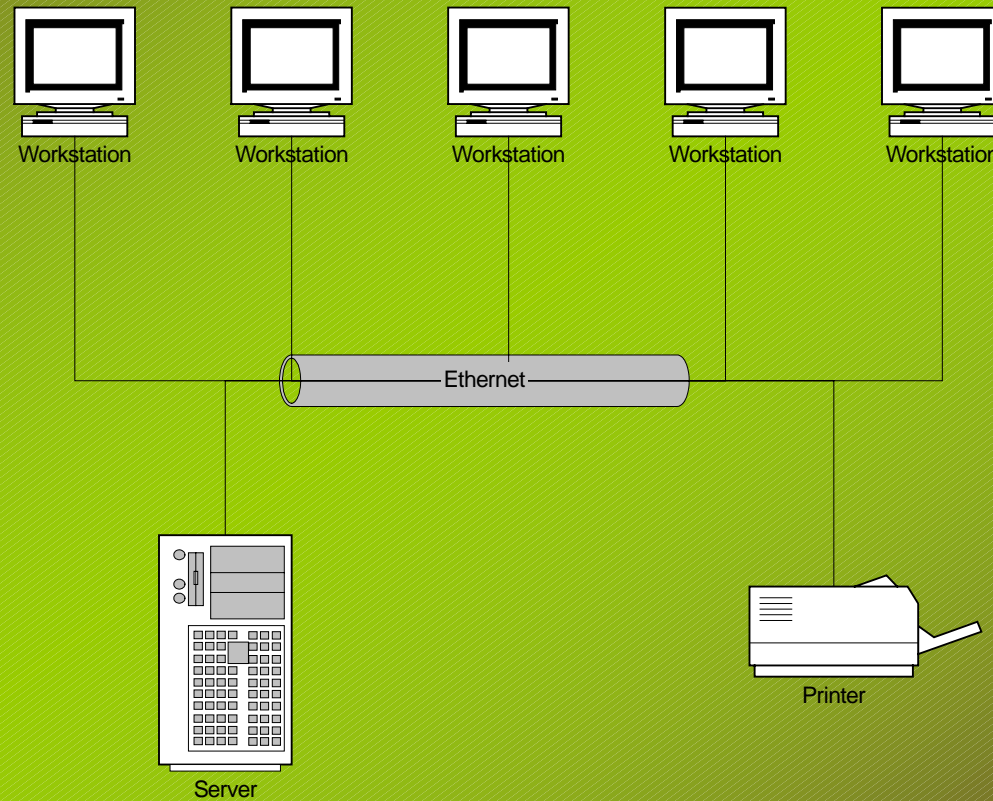
- Randomly occurring communications networks that activate when two - or more - entities need to pass information between themselves.
- The network exists as long as the need for communication exists.
- The networks is usually supported by underlying infrastructure

Ad Hoc Communication Networks

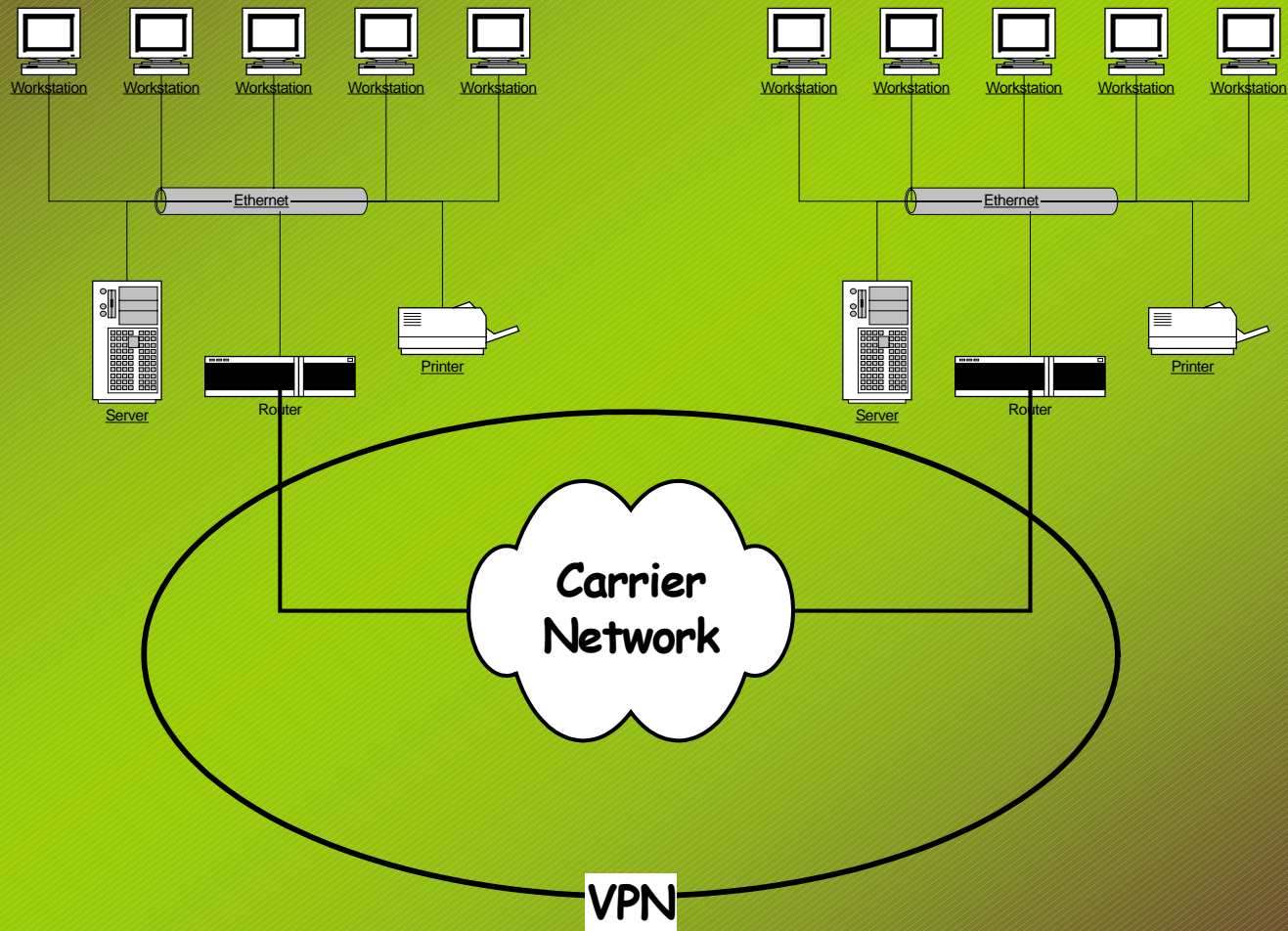
- *Examples*
 - *Newspaper*
 - *Letter*
 - *Conference Call*
 - *World Wide Web*
 - *This Discussion Group*

AD Hoc Data Network

Basic

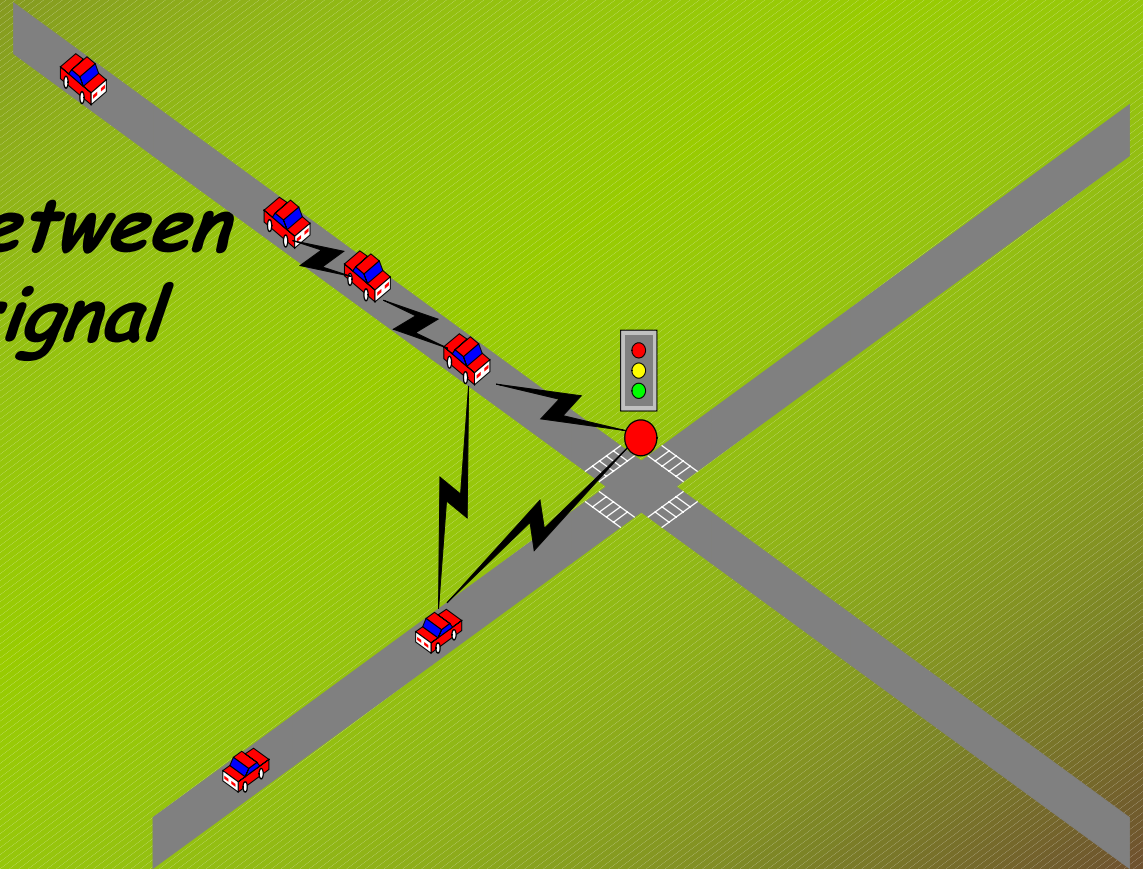


AD Hoc Data Network



AD Hoc Vehicle Network

- *Network established between vehicles and signal device*



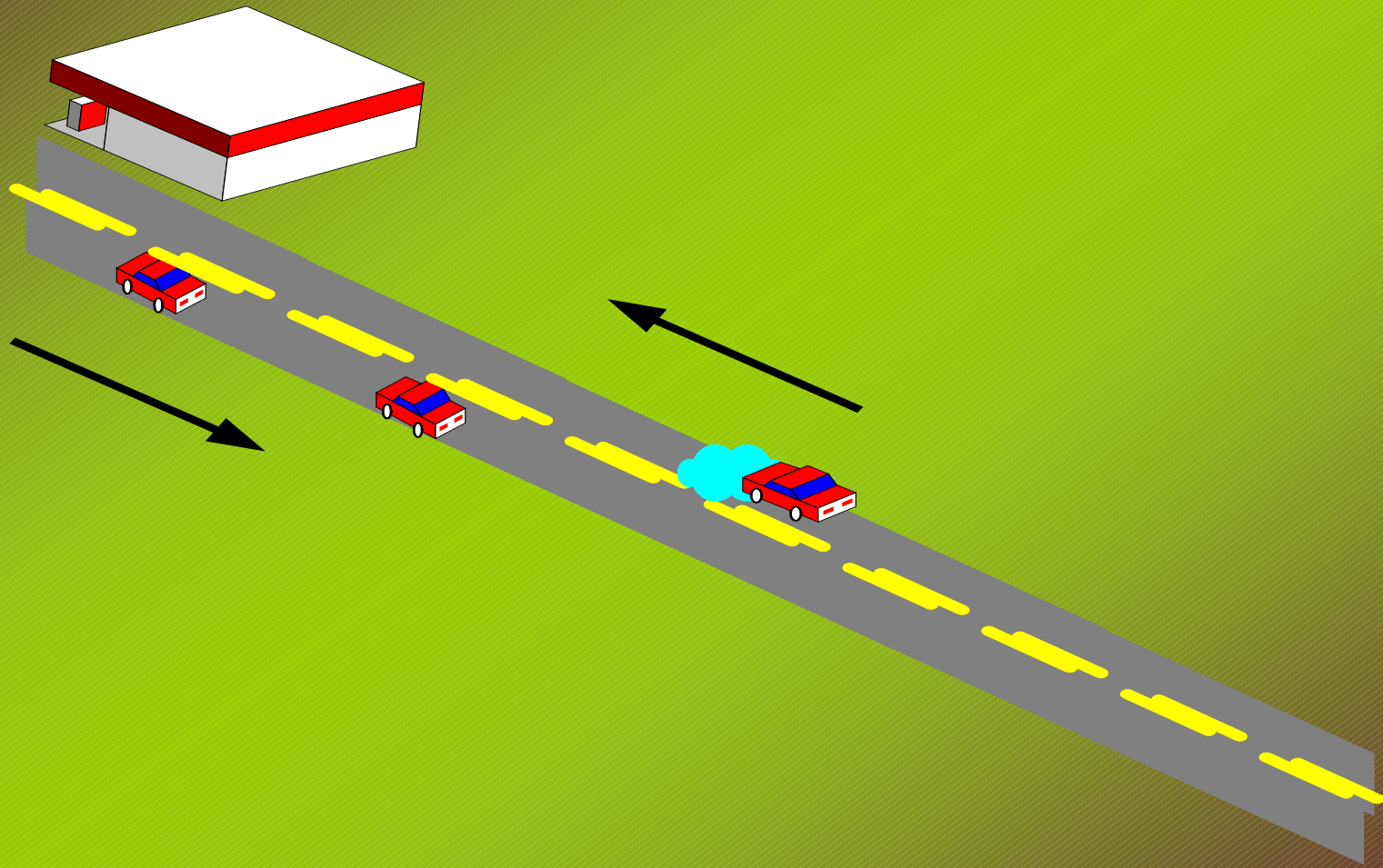
Rural Telematics Application

- *Road Hazards*
 - *Ice*
 - *Flood*
 - *Accident*
- *Need to get information to DOT*
- *Need to get information to other vehicles*

Urban-Rural

- *25 Vehicles per lane mile*
- *One network node per 1000 feet*
- *Available Carrier Network*
- *Cellular Available*
- *Sparse Network Node Population*
- *Once every 5 miles*
- *4 Vehicles per lane mile*
- *Carrier Network un-Available*
- *Lack of Cellular*

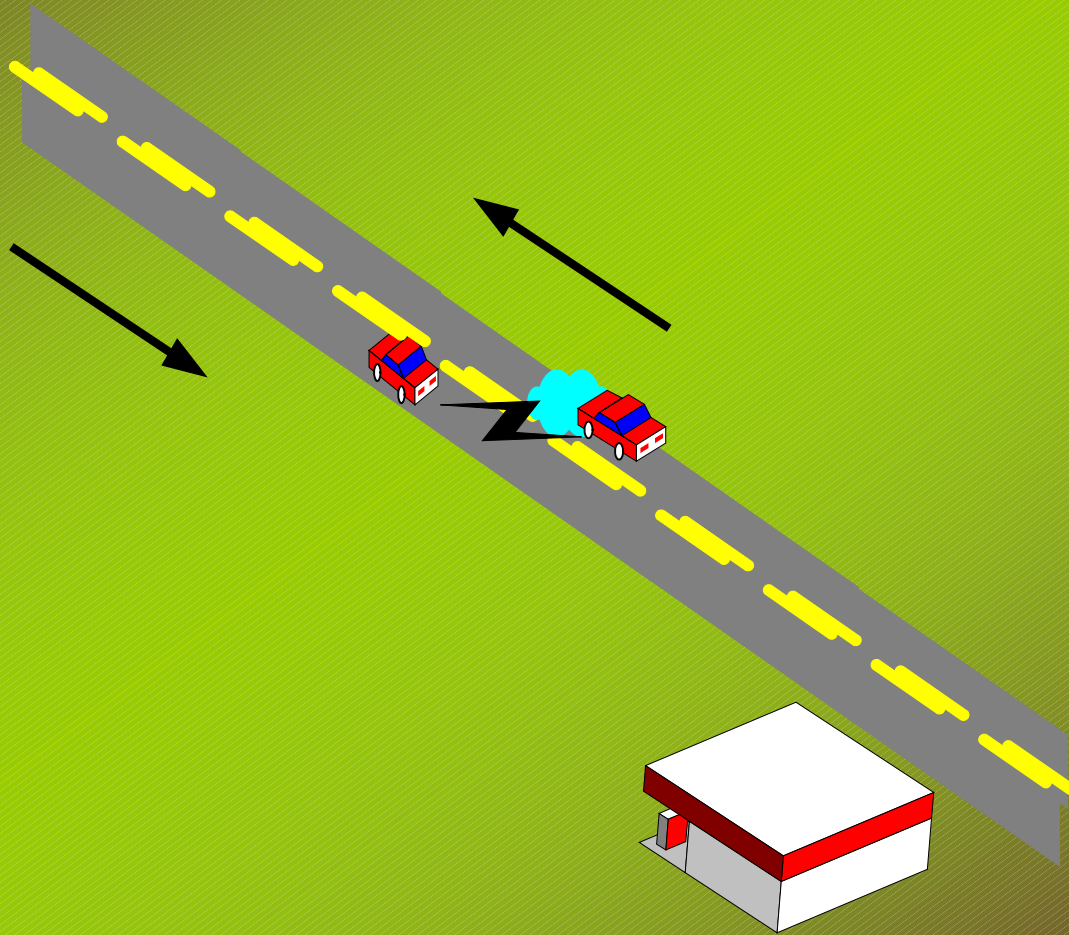
Rural Hazard



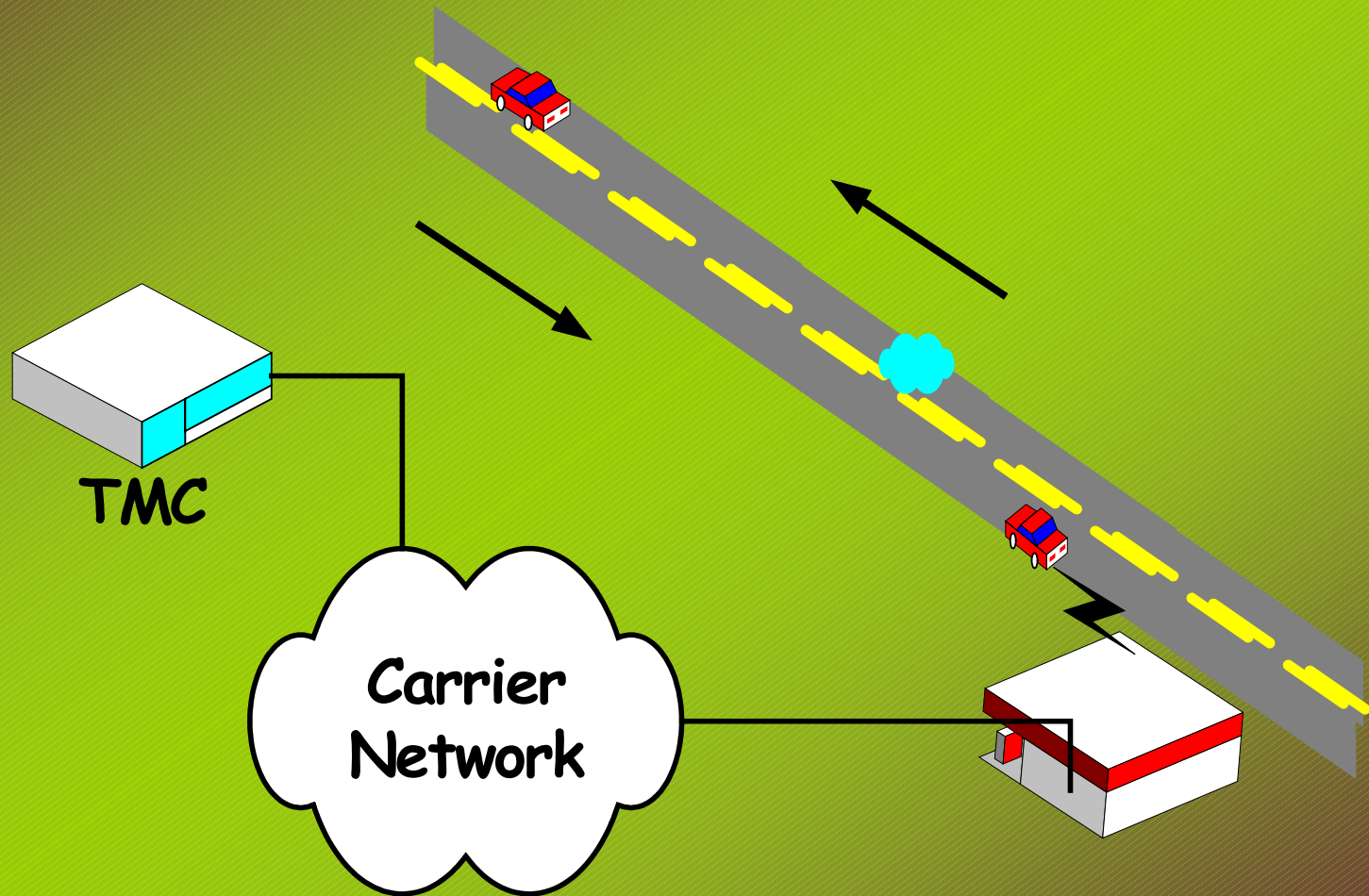
Rural Telematics Hazard

- *Any Information Is Better Than No Information*
- *Use of Ad Hoc for "Store & Forward"*

Store & Forward



Store & Forward



Lesson

- *All Information is Valuable*
- *"Think Outside the Box"*
- *Take Advantage of What is Available*

DSRC Resources

- *James Arnold - FHWA -
james.a.arnold@fhwa.dot.gov*
- *Lee Armstrong - Armstrong Consulting
- lra@tiac.net*
- *Broadly Cash - AIRINC -
bcash@airinc.com*
- *Shel Leader - ITS/Communications -
shel@sleader.com*

DSRC Resources - WWW

ASTM E17.51	http://www.astm.org/cgi-bin/SoftCart.exe/COMMIT/COMMITTEE/E17.htm?L+mystore+nzc a5160+1004745838
IEEE SCC32	http://grouper.ieee.org/groups/scc32/index.html
IEEE standards	http://standards.ieee.org/
SAE Discussion Forums	http://www.sae.org/jsp/forumsindex.jsp
ITS America	http://www.itsa.org/standards
DOT ITS	http://www.its.dot.gov/ , http://itsarch.iteris.com/itsarch/html/standard/standard.htm
OFDM Forum	http://www.ofdm-forum.com/index.asp?ID=92
Transit Standards Consortium	http://www.tsconsortium.org/
IPV6 Forum	http://www.ipv6forum.com/