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Wireless Communications Applications in Surface Transportation

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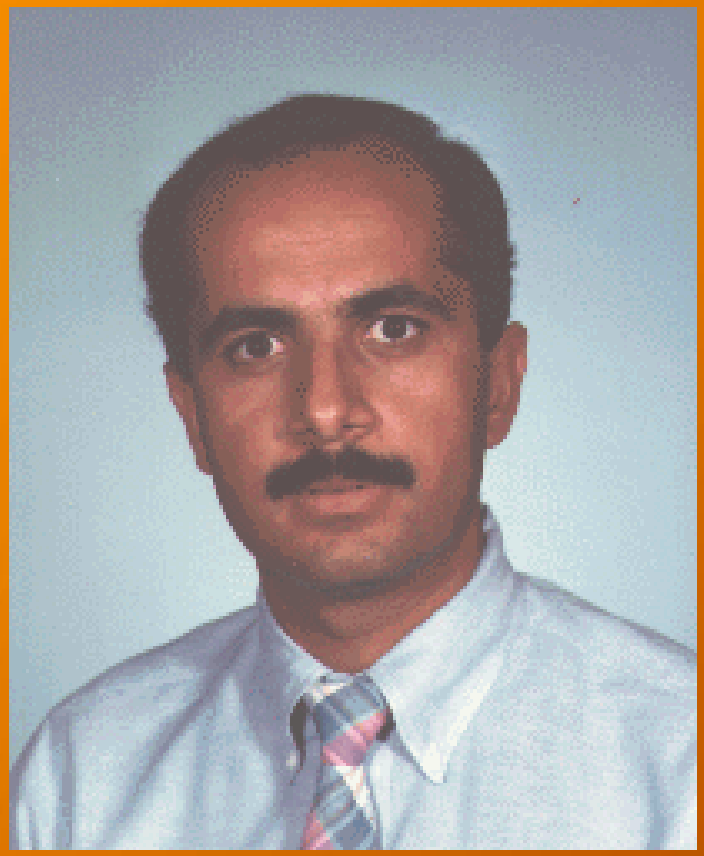
OUTLINE

1. Wireless Communication Options
2. WiMAX Study
3. Connected Vehicle System-Applications

Tenure: What it Does to you

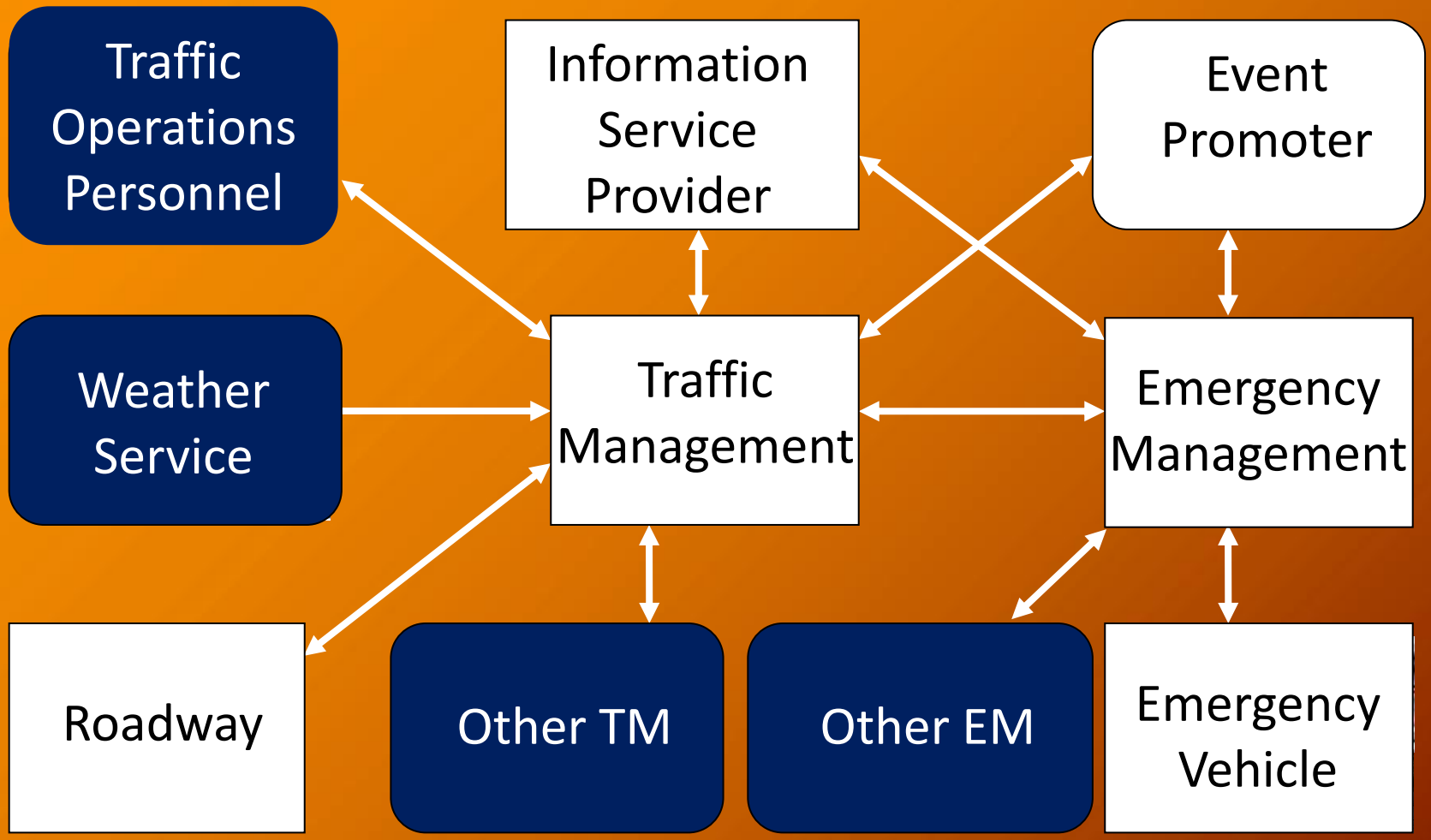


Before Tenure

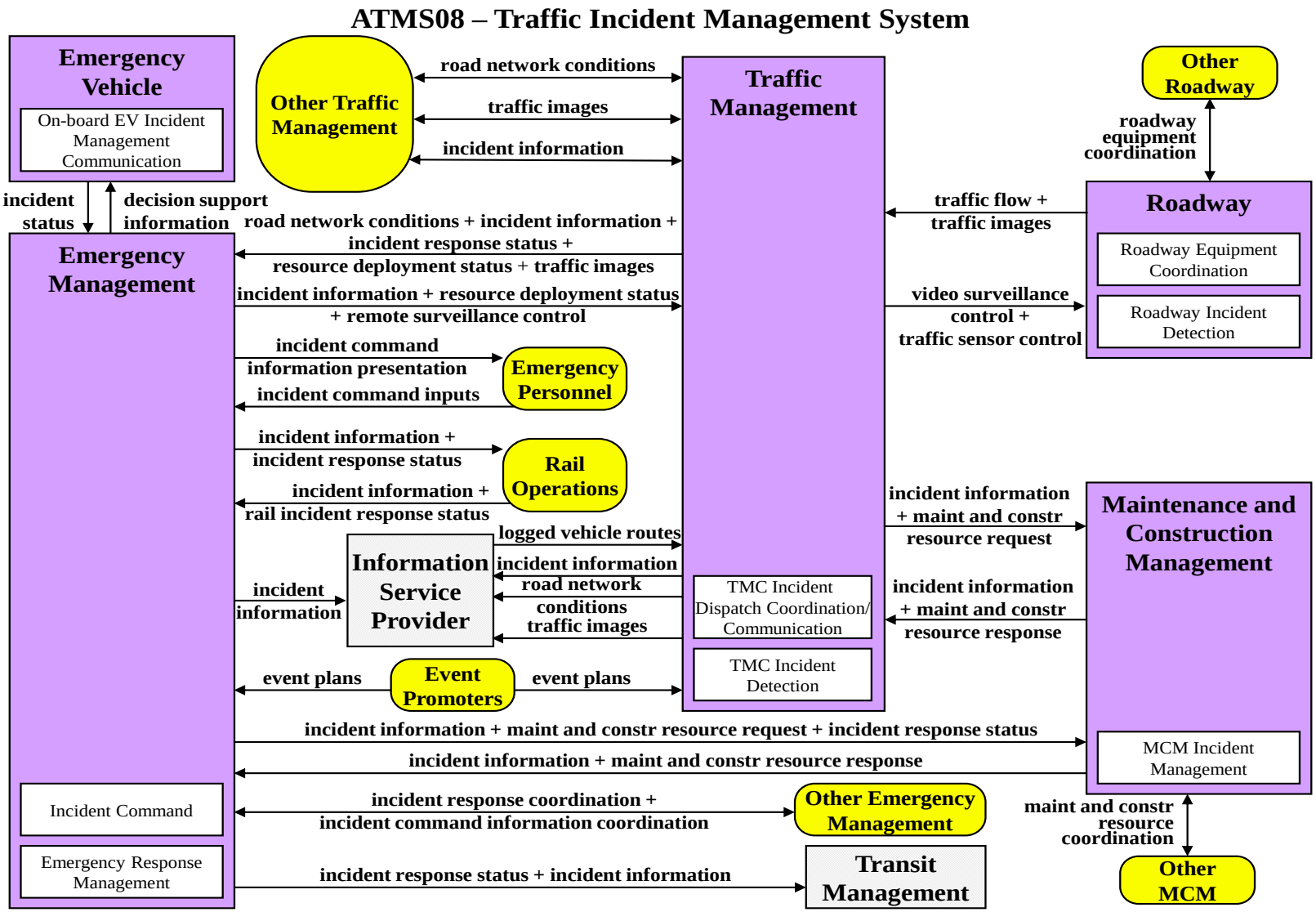
Tenure: What it Does to you

After Tenure

Incident Mgmt: Interactions with Real-World Systems



Traffic Incident Management System Information Flows



Introduction-ITS Communications

- On-line highway traffic management needs
  - Faster
  - More efficient and
  - Reliable communication technologies

- Wired communication has been the most popular choice

- It is changing with
  - Advancement in wireless technologies
  - Needs

Issues with Wireless?

- Reliability
- Cost

Selection of Communication Technologies

- Agencies' needs, future plan and resources available?
- Each communication alternative varies
  - Bandwidth
  - Transmission Range
  - Data Rate
  - Reliability
  - Cost

Wireless Options-Short Range

- WiFi
  - Wireless Fidelity
  - IEEE 802.11a/b/g/n

- WAVE/DSRC: IEEE P1556
  - WAVE
    - Wireless Access in Vehicular Environments
    - IEEE P1609
  - DSRC
    - Dedicated Short-Range Communications
    - IEEE 802.11p

Wireless Options-Long Range

- WiMAX
  - Worldwide Interoperability for Microwave Access
  - IEEE 802.16

- 3GPP
  - 3rd Generation Partnership Project
  - Cellular/mobile

Why WiMax

A globally rising wireless communication technology

- High-speed broadband access
- Easy extension to suburban and rural areas
- Broad coverage

Field Performance Study of a Regional WiMAX Network for Roadway Traffic Control and Management

In collaboration with

West Virginia High Technology Consortium Foundation

WiMAX Field Study Tasks

- Field performance evaluation of a regional WiMAX network
- Feasibility of WiMAX for a wireless sensor based traffic surveillance system

WiMax Technology

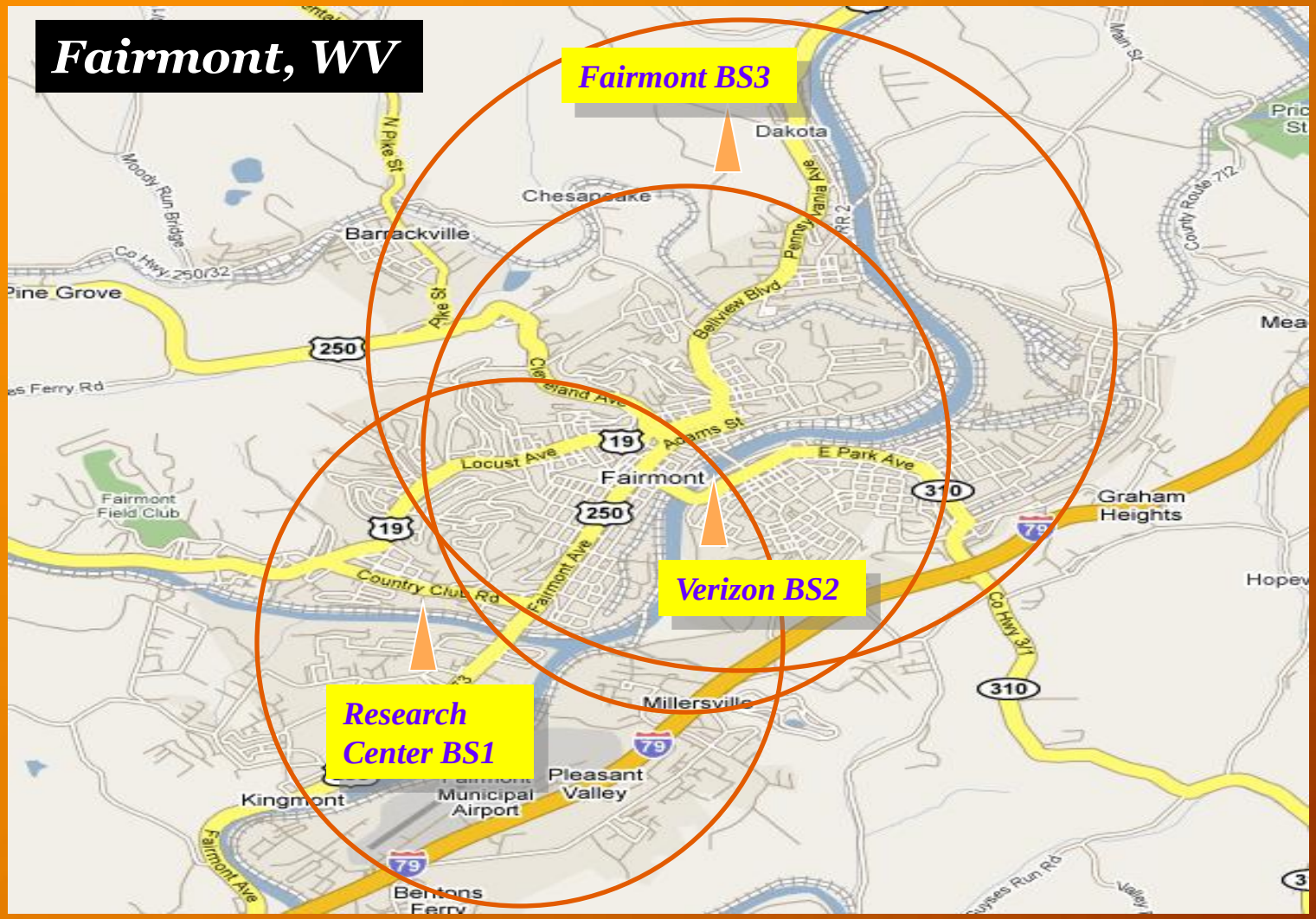
- A typical WiMAX network consists of two parts
  - Base station
  - Client radio
- Complex environmental factors can affect the network performance
- Impact of environmental factors on WiMAX have not been systematically studied

WiMAX Characteristics

- Theoretical performance
  - Max link rate is up to 70 Mbps
  - Coverage range > 10 miles

- Cost information:
  - Base station: $ 11,000 to $ 125, 000
  - Client radio: $ 2,200

WiMax Testbed



Experimental Setup

- Fixed Operation Test
  - Stationary Locations
  - Client radio: Airspan EasyST

- Moving Car: Mobile Operation Test (very low speed)
  - 25 mph
  - Client radio: M-A/COM

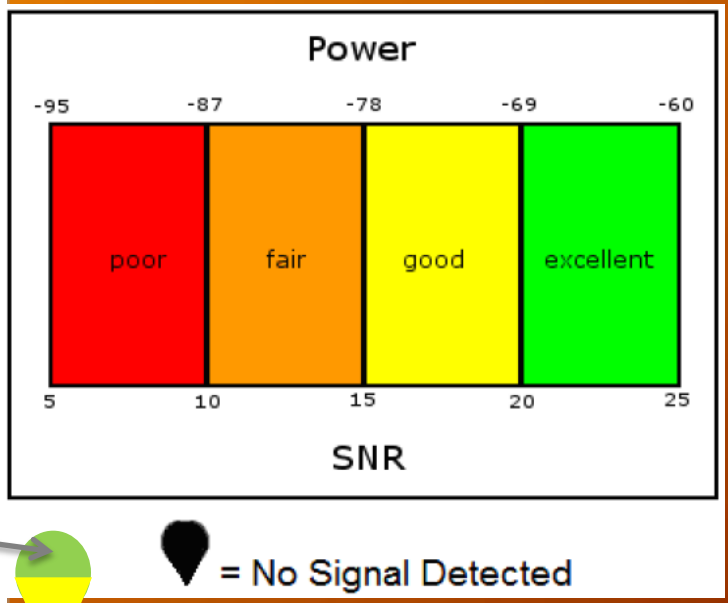
- Network Testing Tool: Iperf for throughput measurement

Mobile Operation Test

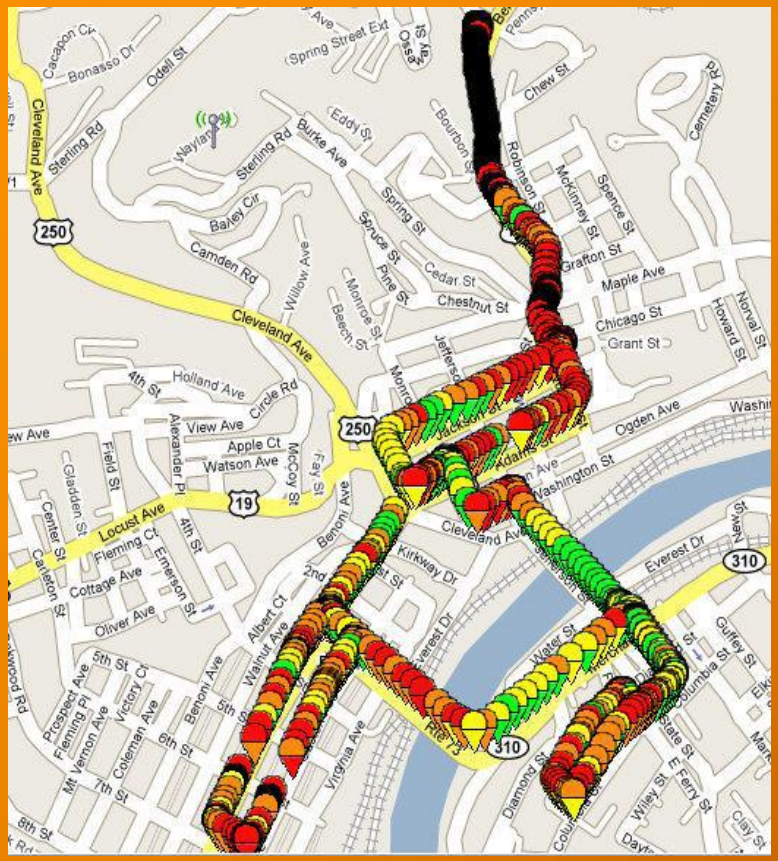
- Developed Coverage Measurement and Visualization Tool

  Visualization tool included:

  - Time/DateGPS Location
  - Vehicle Speed
  - Signal-to-Noise Ratio (SNR)
  - Received Signal Strength Indication (RSSI)



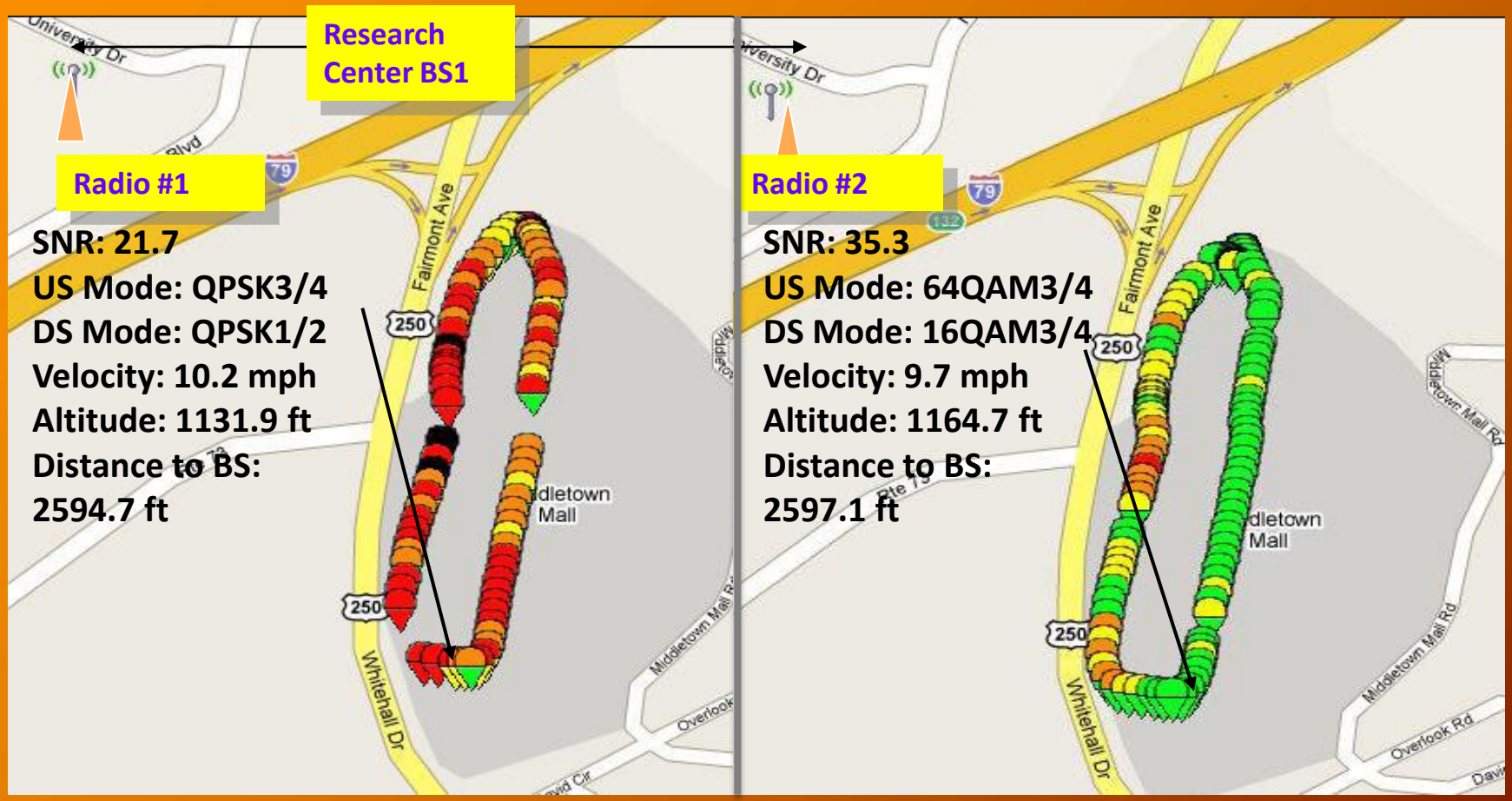
Mobile Operation Test



- Client radio subscribed to Fairmont base station
- Within a 2 mile distance

Mobile Operation Test

Client radio specifications affect network performance



WiMAX Study Conclusions

- Performance is impacted by
  - Base station location
  - Altitude of base station
  - Terrain
  - Foliage coverage
  - Client side radio specifications

WiMAX Study Conclusions

- Suitability for supporting traffic sensor network
  - Potential to support throughput requirements of ITS devices
  - Potential to support broadband communication requirements for future ITS applications

- Regional WiMAX network
  - Benefits to multi-agency resource utilization: DOTs, polices, emergency services
  - Increased benefits as more and more ITS components come on line

Clemson's Integrated Intelligent Transportation Platform (IITP)

U.S. DOT Connected Vehicle Technology Challenge Winner

Components

1. Functionality
2. Technologies
3. Business Model?

Functionality

- Safety
- Electric Vehicle (EV) recharging
- Plug-In Hybrid Electric Vehicles (PHEVs)
- Road usage fee collection
- Real time route planning
- Commercial/private industry applications

Communication Technologies

- WiFi/DSRC
- WiMAX
- 3GPP
- Wired

Business Model?

Private or public investment?

IITP Summary

- Integrates wireless communication technologies
- Identifies most suitable technology
  - Context
  - Availability
  - Cost
- Supports numerous types of applications
- Addresses infrastructure funding issues

A Recent Distinction


World's
Best
Dad

Questions?

Thank you!