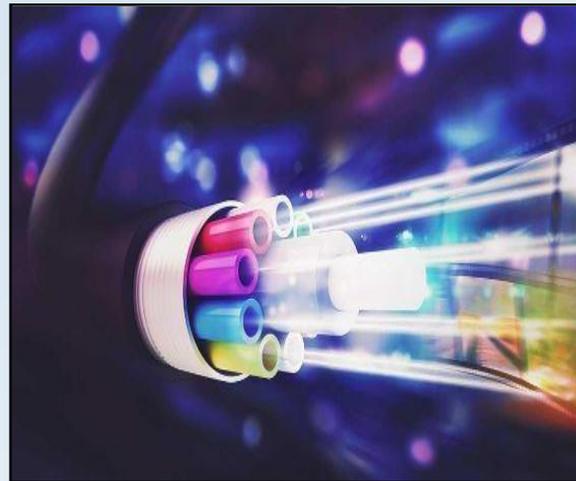


ITS (Intelligent Transportation Systems)

ASCE Richmond, Va.



What is ITS

The integrated application of advanced computer, electronics, and communications technologies to increase the safety and efficiency of transportation is known as Intelligent Transportation Systems (**ITS**)

- **ITS** Includes communications, sensors, information processing, controls, and other technology-based strategies to facilitate the movement of people, goods, and information to save time, lives and money.
- **ITS** strategies are used for toll roads, the movement of freight (trucking, railroads, marine, and air), public transportation, intermodal, 'smarter' CV/AV vehicles on the roadway, weather and traffic information, emergency medical services, electronic payment systems, internet applications, cellular phone systems, and just about anything else you can imagine that can involve transportation.



© ETSI 2012

ITS Roadway Sub-Systems (DMS, Detectors, CCTV's, Control/Data Centers ATMS and much, much more)



ITS Intersection Sub-Systems Traffic Signals, Pedestrian, Bicycle detectors, CCTV-360 and VDC



ITS Transit Sub-Systems

(AVL, Real-time Passenger Information, Transit Signal Priority/Conditional Priority, Security, Fare Collection Automatic Stop Annunciation, Automatic Passenger Counts and much, much more)



Other ITS Sub-Systems and much, much more...

Rail

Freight

Port (Marine)

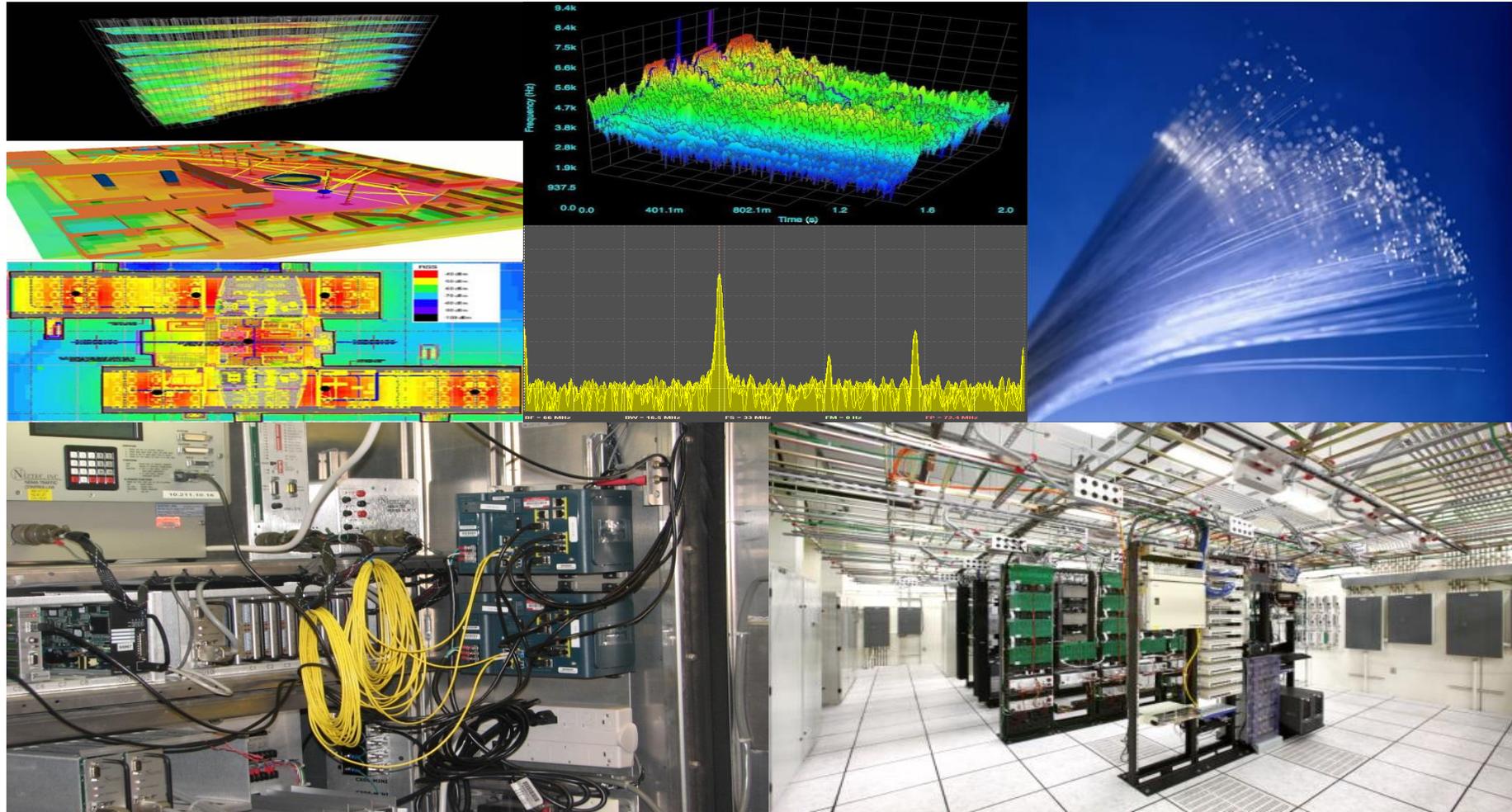
Aviation

Bus Rapid Transit

Smart Cities

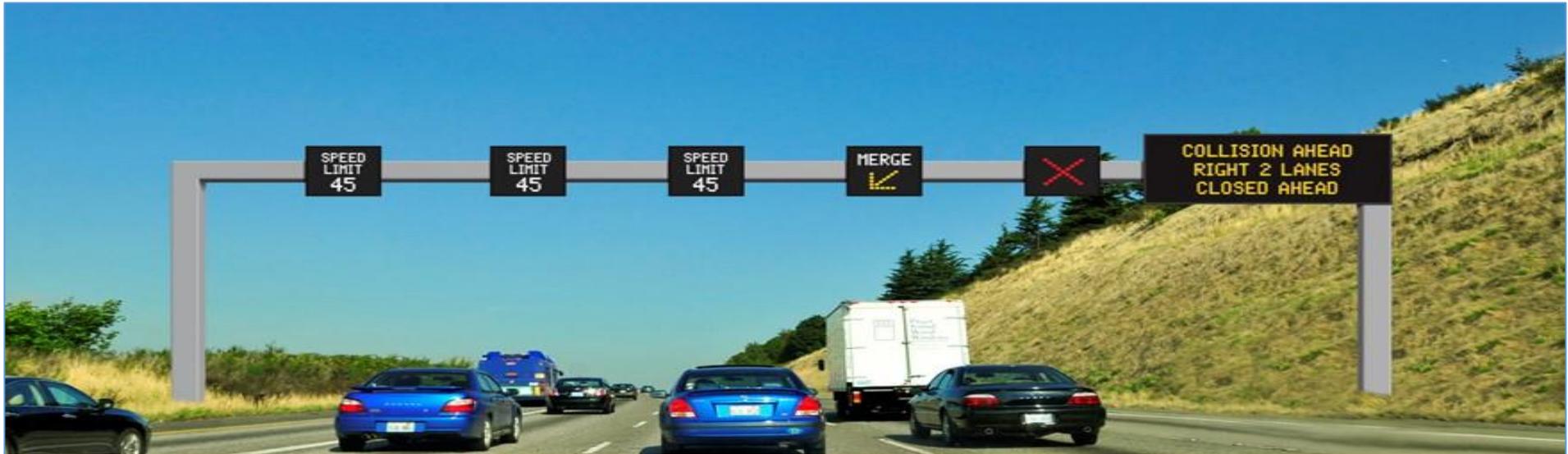
Travelers Information (511, Waze, Google etc.)

Telecommunications/Network Wired or Wireless



Active Traffic Management

FHWA definition: *"The ability to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions. Focusing on trip reliability, it maximizes the effectiveness and efficiency of the facility. It increases throughput and safety through the use of integrated systems with new technology."*

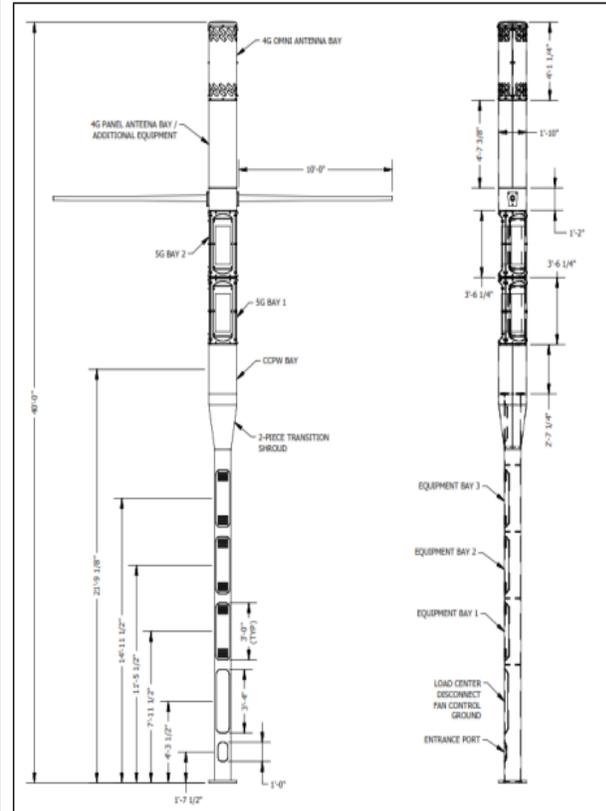


Smart Poles/Integrated Applications



- 
Energy-efficient LED Luminaire
- 
4G Telecom upgradable as per user's choice (options available)
- 
Panic Button for any emergency situation or distress call
- 
Interactive Screen for specific applications
- 
Smart Billboard, Signage, Advertising, Traffic signalling, etc. (on demand)

- 
Wi-Fi Access Points providing broadband wireless network coverage
- 
Weather proof, IP Network Camera for Traffic & Safety surveillance
- 
Air Quality Monitoring (as an option)
- 
Car or EV Charging (as an option)
- 
PA System for BGM & communication from city control room




- 
Sensors
- Monitoring cities' environment
- Noise sensor
- Air pollution detector
- Temperature / Humidity sensor
- Brightness sensor
- Monitoring municipal buildings
- 
Video Monitoring
- Security monitoring
- Vehicle monitoring
- 
RFID
- Special populations Monitoring
- Manhole Monitoring
- Community security monitoring
- Municipal facilities monitoring
- 
Emergency call
- Field contact with the monitoring center
- Active broadcast from the monitoring center to field

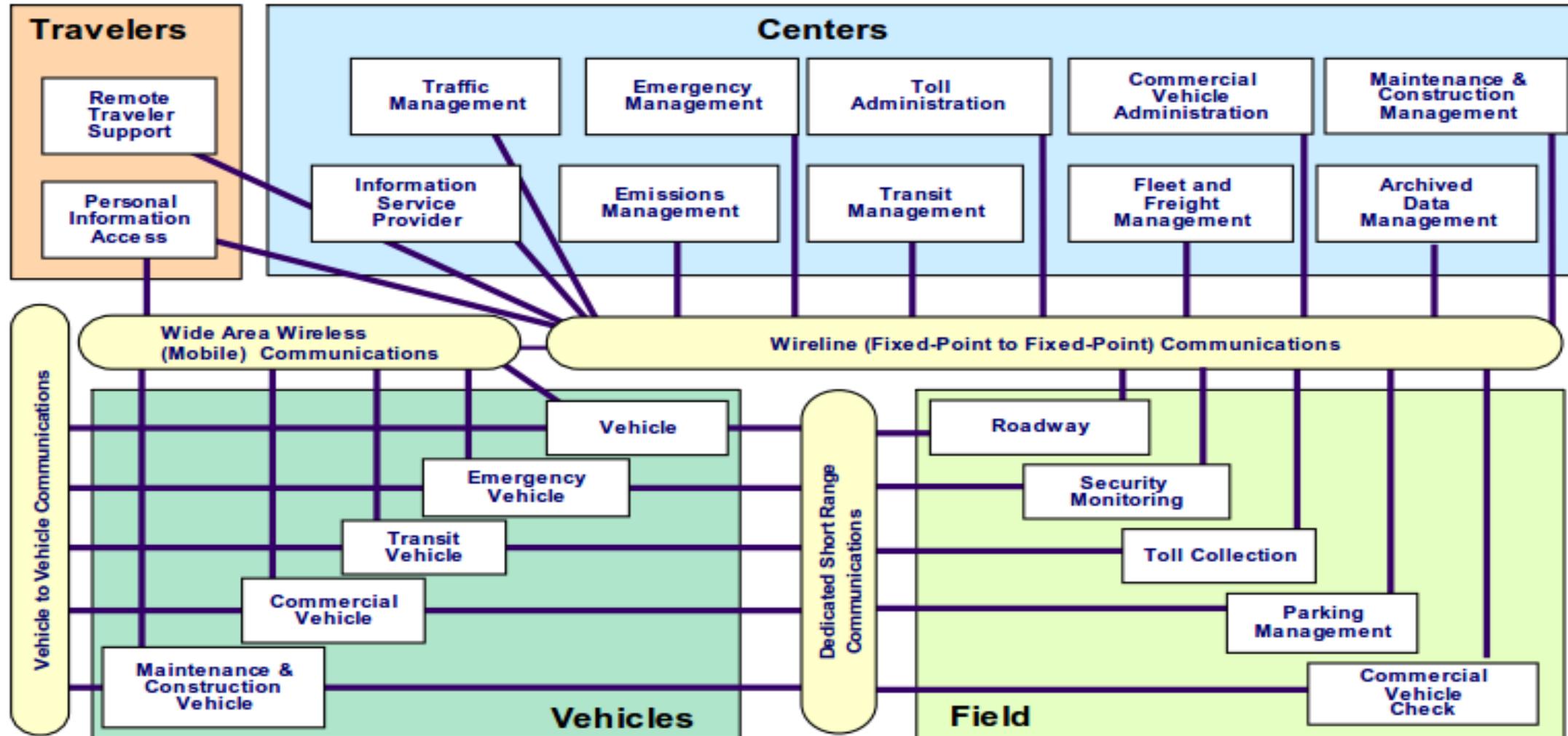
- 
Intelligent Lighting
- Cellular cooling technology
- Light distribution based on brightness
- Intelligent single lamp / centralized
- A variety of optional module design
- 
Wireless network
- WiFi hotspot
- 
Information Display
- Advertising
- Political news
- Information release
- 
Charging pile
- Electric car
- Electric bicycle



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NATIONAL ITS ARCHITECTURE

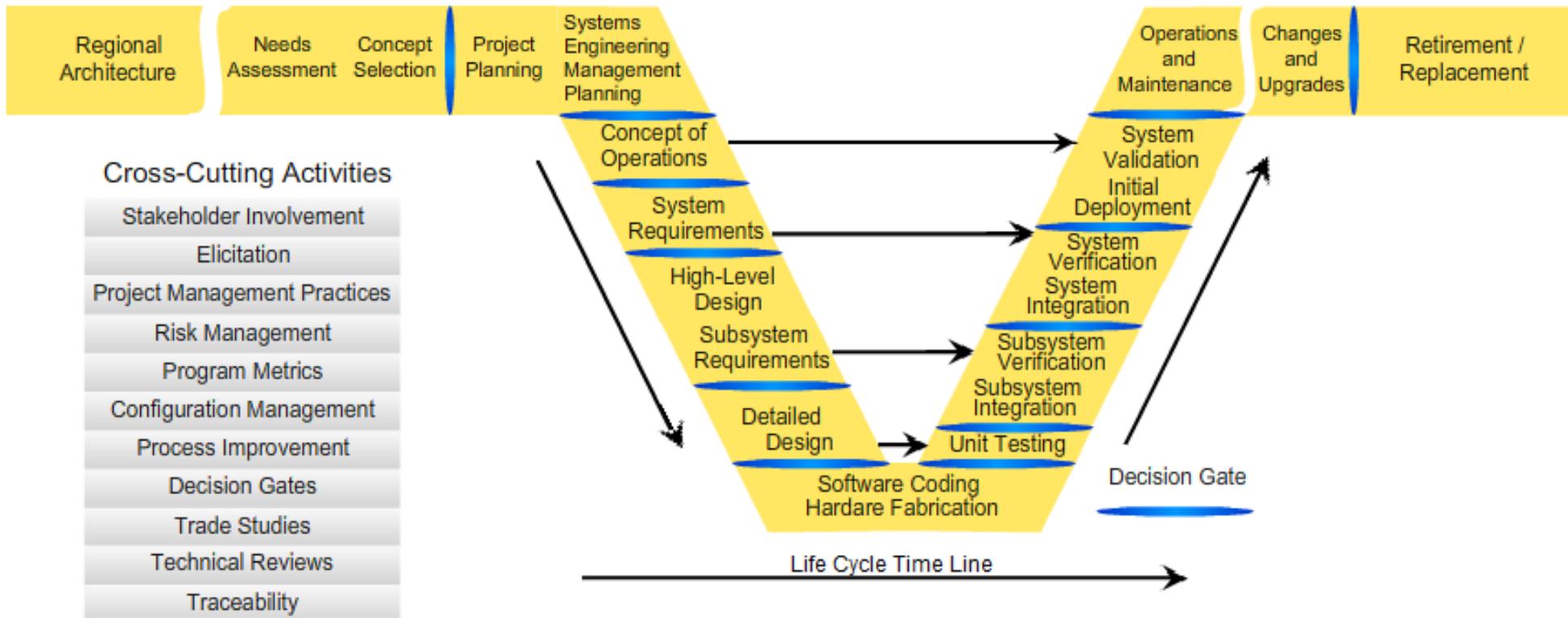
FHWA Rule 940



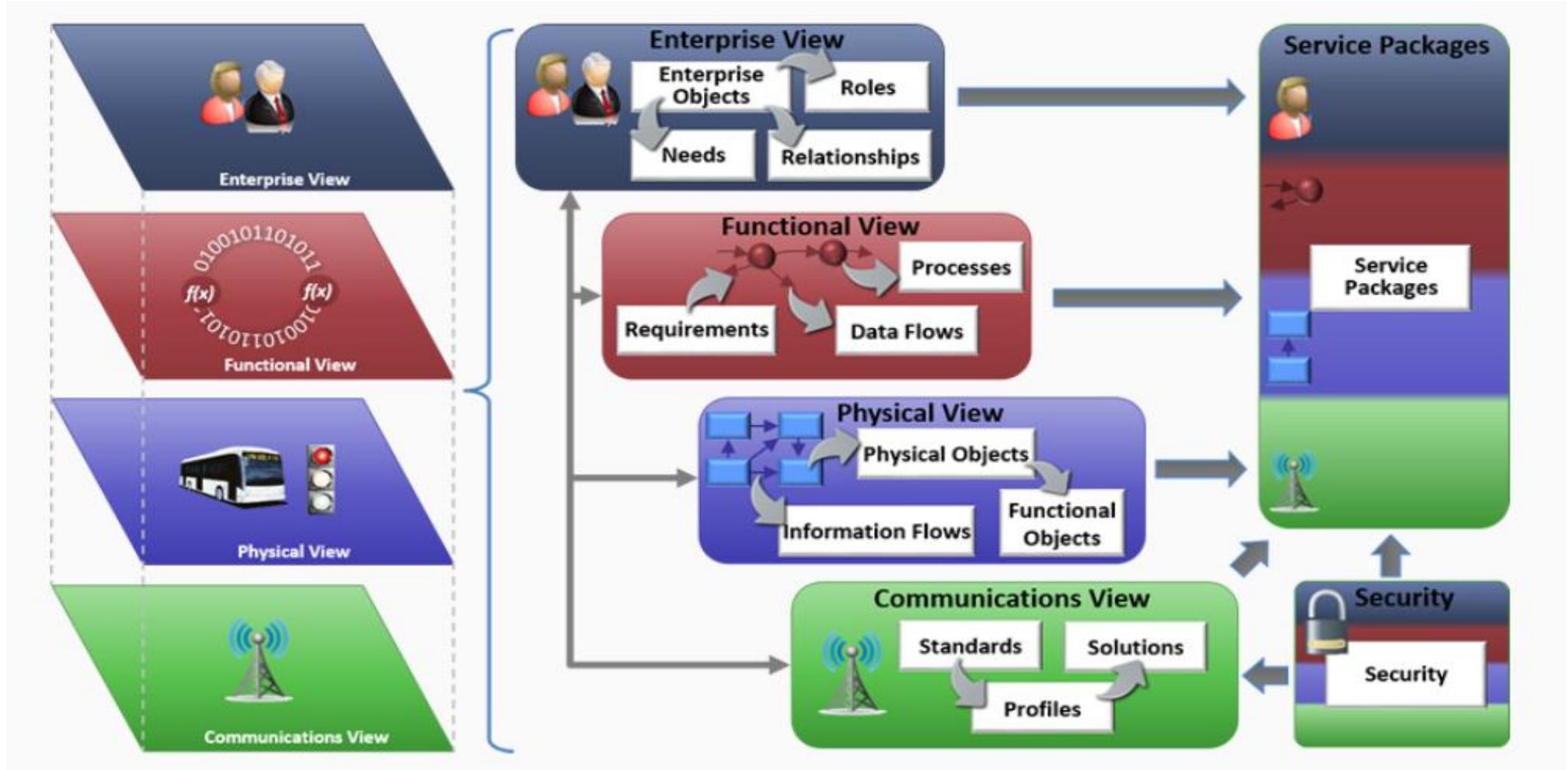
Systems Engineering for ITS

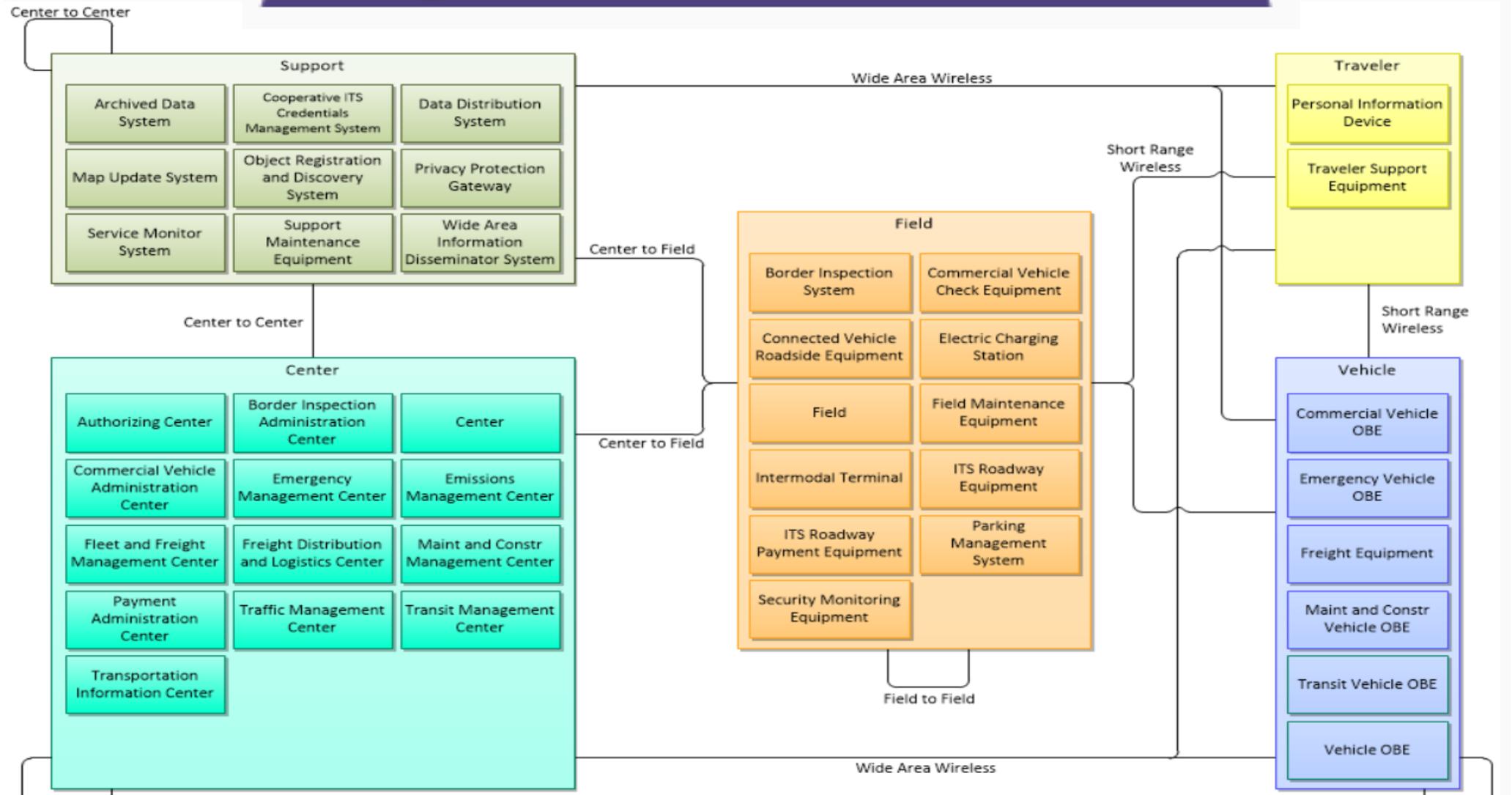
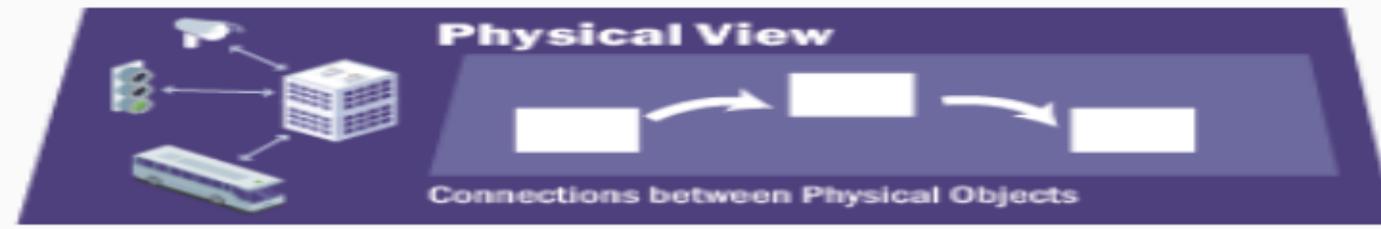
Vee Diagram

| Phase -1 | Phase 0 | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 |
|---|---|--|------------------------------|---------------------------------------|--|---------------------------------|
| Interfacing with Planning and the Regional Architecture | Concept Exploration and Benefits Analysis | Project Planning and Concept of Operations Development | System Definition and Design | System Development and Implementation | Validation, Operations and Maintenance, Changes & Upgrades | System Retirement / Replacement |



Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)





ARC-IT Subsystem Diagram
 5 Physical View Jan 31, 2018 NAT





ITS Projects – Systems Engineering and Architecture Compliance (Rule 940) Checklist

for

Project Title:



Connected and Automated Vehicles???

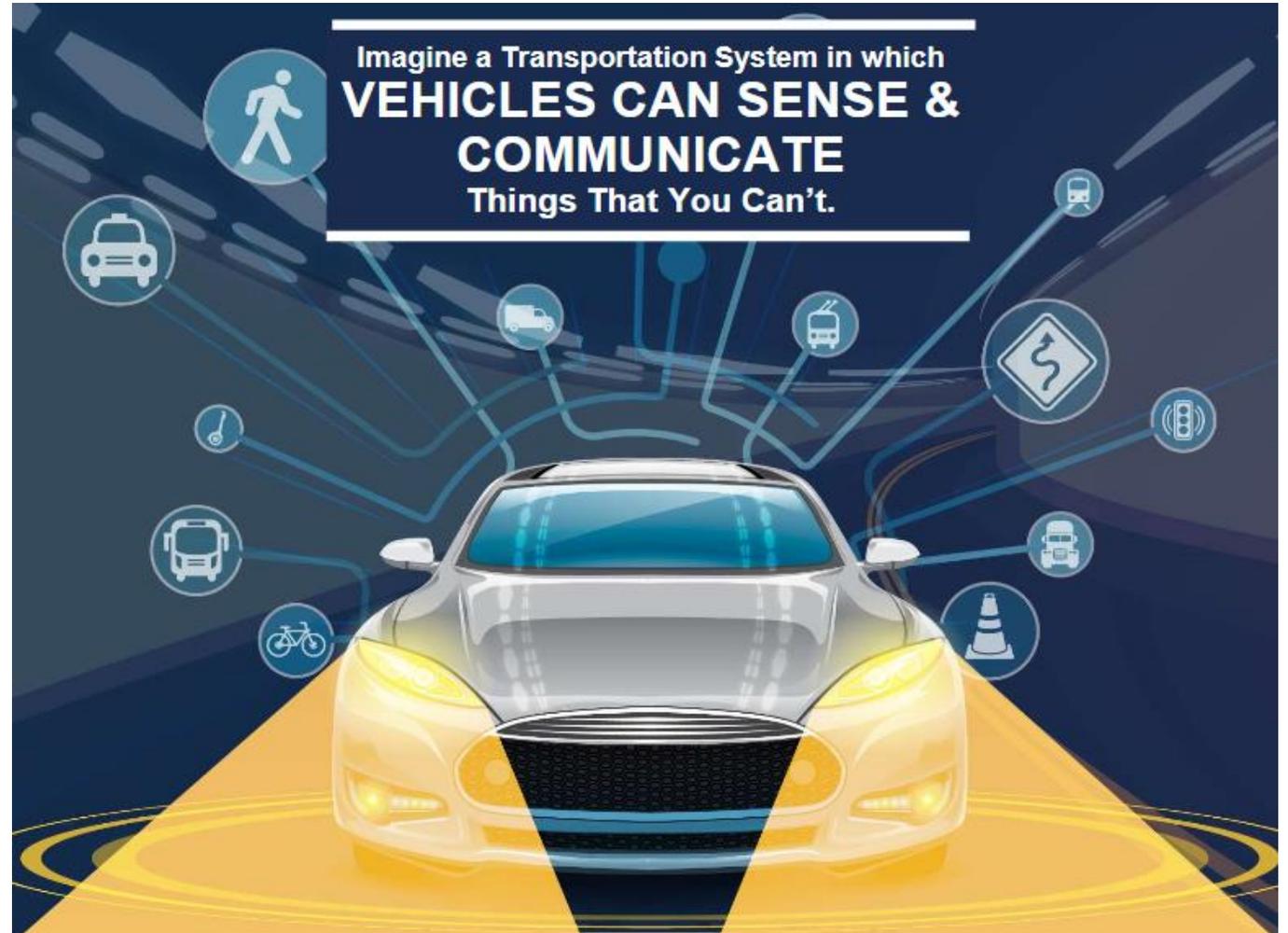
Internet of Things
(Vehicles)

Technologies

DSRC

5G-6G Cellular

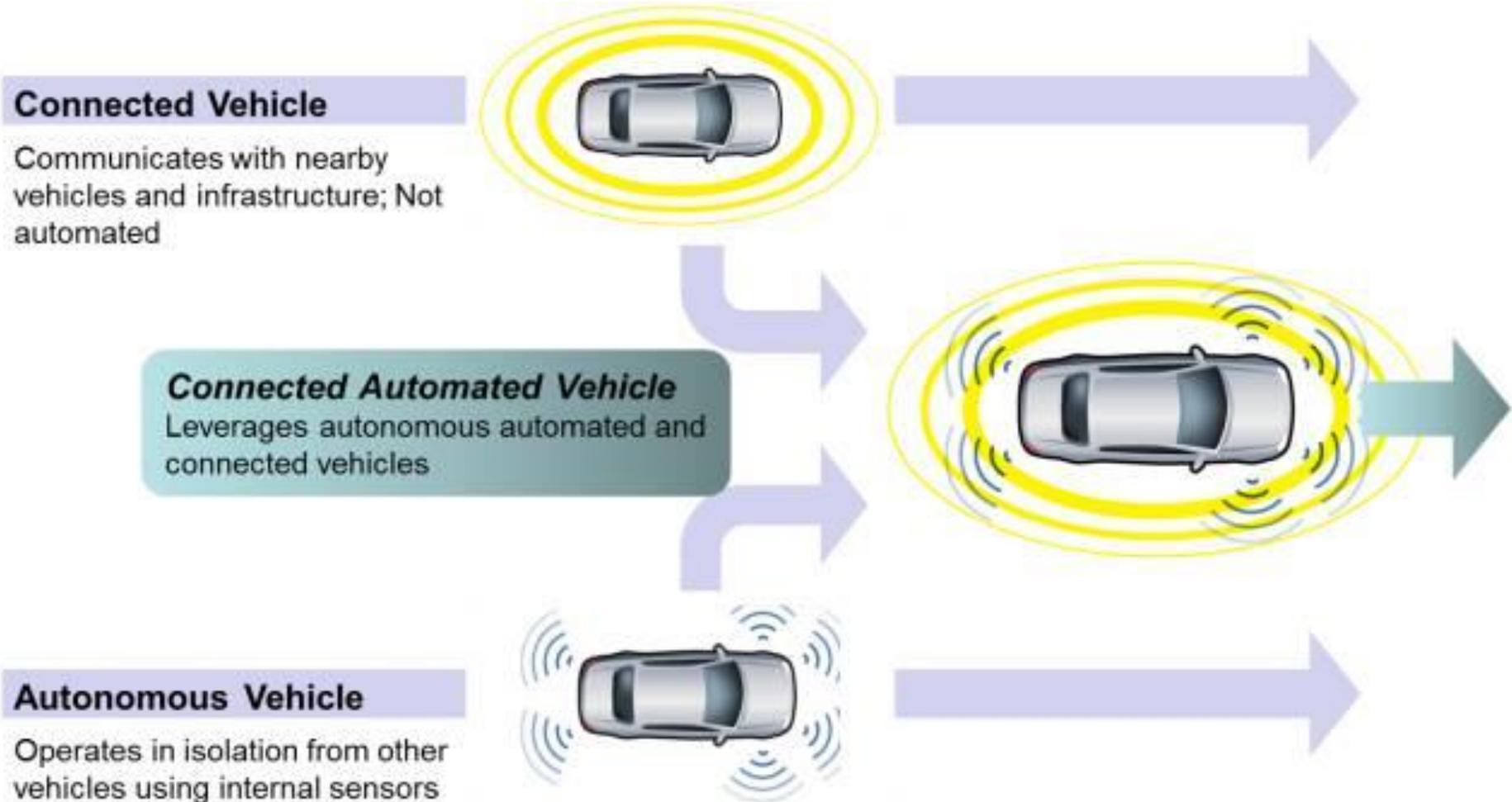
Network



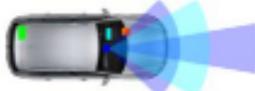
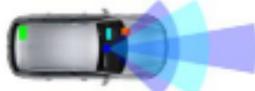
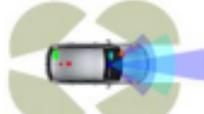
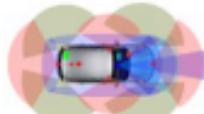
Definitions - CAV, V2V, V2I, V2X

- **Connected Automated Vehicles** – Using connectivity among systems to enhance autonomous technology.
- **Connected Vehicles** – Using communication technology vehicle-to-vehicle (V2V), vehicle to infrastructure (V2I), vehicle to anything (V2X) to enhance safety and mobility.
- **Autonomous Vehicles** – Using sensors, cameras, LIDAR, GPS, and other on-board technology to operate with reduced, limited, or no human interaction.
- **Dedicated Short Range Communications (DSRC)** – A radio band allocated by the FCC for ITS and public safety (5.9GHz). The protocol is similar to in-home WiFi, but was designed to facilitate large amounts of data transfer at very high speeds and under varying conditions.

CAV Definitions



Levels of Autonomy

| | Level 0 | Level 1 | Level 2 | Level 3 | Level 4 |
|------------|-------------|--|---|---|---|
| | Driver only | Assisted | Partial | Conditional | Full |
| Feature | | Active high beam | Traffic jam assist | Collision avoidance | Valet self-parking |
| | | Collision imminent braking | Adaptive cruise & lane keeping | Automated highway | Highway point-to-point |
| | | Cruise control | Self-parking (with driver) | Automated urban | Urban point-to-point |
| Technology | |  |  |  |  |
| | | Radar Forward sensors | Radar Forward sensors Multi-domain controller Driver state sensor V2X | LIDAR & 360° radar High accuracy GPS Multi-domain controller Forward, HD & IR cameras V2X Internal moment unit | LIDAR & 360° radar High accuracy GPS Multi-domain controller Forward, HD & IR cameras V2X Internal moment unit |
| | Today | | 2020 | 2025+ | |



| RSE Gateway | | | |
|--|---|---|---|
| OBE status --> | | | |
| Vehicle OBE | Roadside Equipment | | Service Monitor System |
| ITS Application Information Layer Undefined | Security plane IEEE 3009.2 | | ITS Application Information Layer Undefined |
| Application Layer Undefined | | | Application Layer Undefined |
| Presentation Layer ISO ASN.1 UPER | | | Presentation Layer ISO ASN.1 UPER |
| Session Layer IETF DTLS | Session Layer IETF DTLS | Session Layer IETF DTLS | Session Layer IETF DTLS |
| Transport Layer IETF UDP | Transport Layer IETF UDP | Transport Layer IETF UDP | Transport Layer IETF UDP |
| Network Layer IETF IPv6 | Network Layer IETF IPv6 | Network Layer IETF IPv6 | Network Layer IETF IPv6 |
| Data Link Layer IEEE 1609.4, IEEE 802.11 | Data Link Layer IEEE 1609.4, IEEE 802.11 | Data Link Layer LLC and MAC compatible with Physical and Network | Data Link Layer LLC and MAC compatible with Physical and Network |
| Physical Layer IEEE 802.11 | Physical Layer IEEE 802.11 | Physical Layer Backhaul PHY | Physical Layer Backhaul PHY |



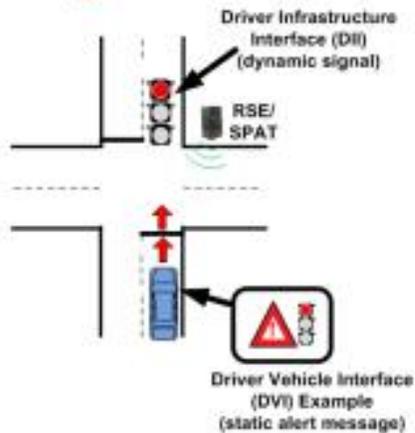
* Only 5 companies offer 5G worldwide: Huawei, ZTE, Nokia, Samsung, and Ericsson

V2I Applications

Curve Speed Warning



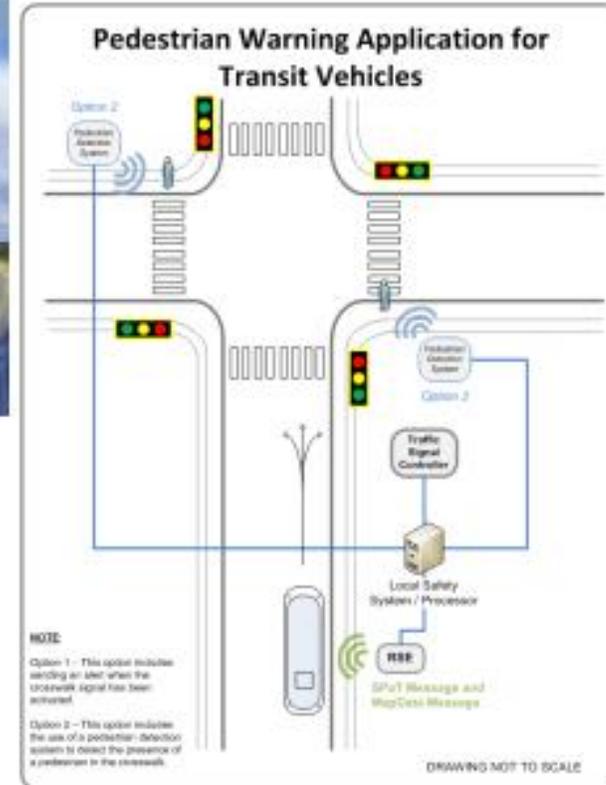
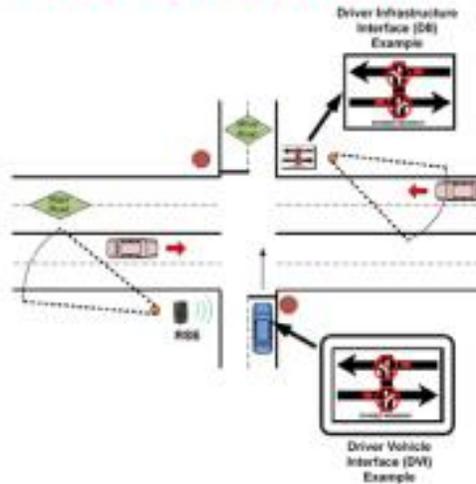
Red Light Violation Warning



Smart Roadside



Stop Sign Gap Assist

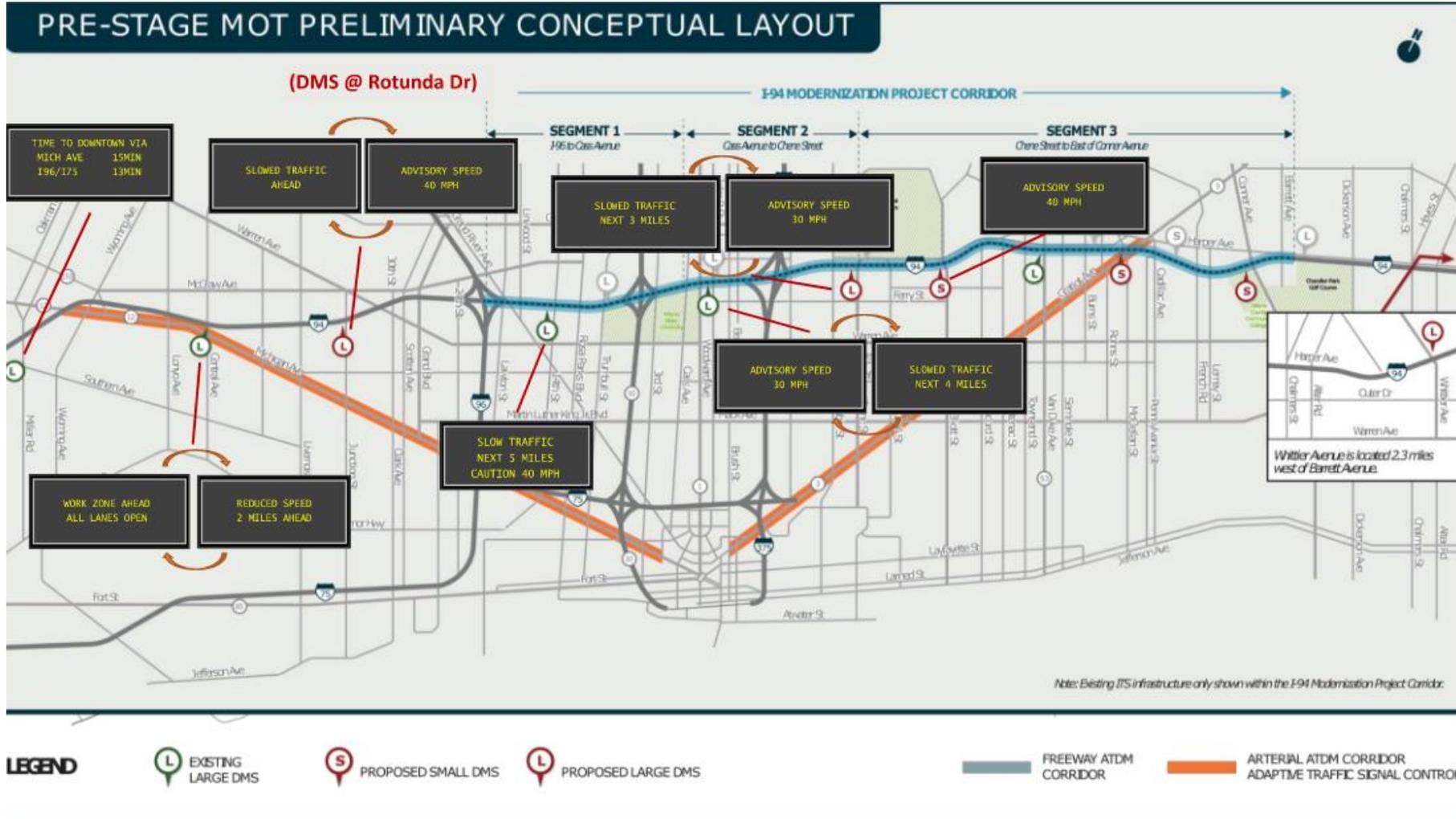




ATMS Application



ATMS for Work Zones

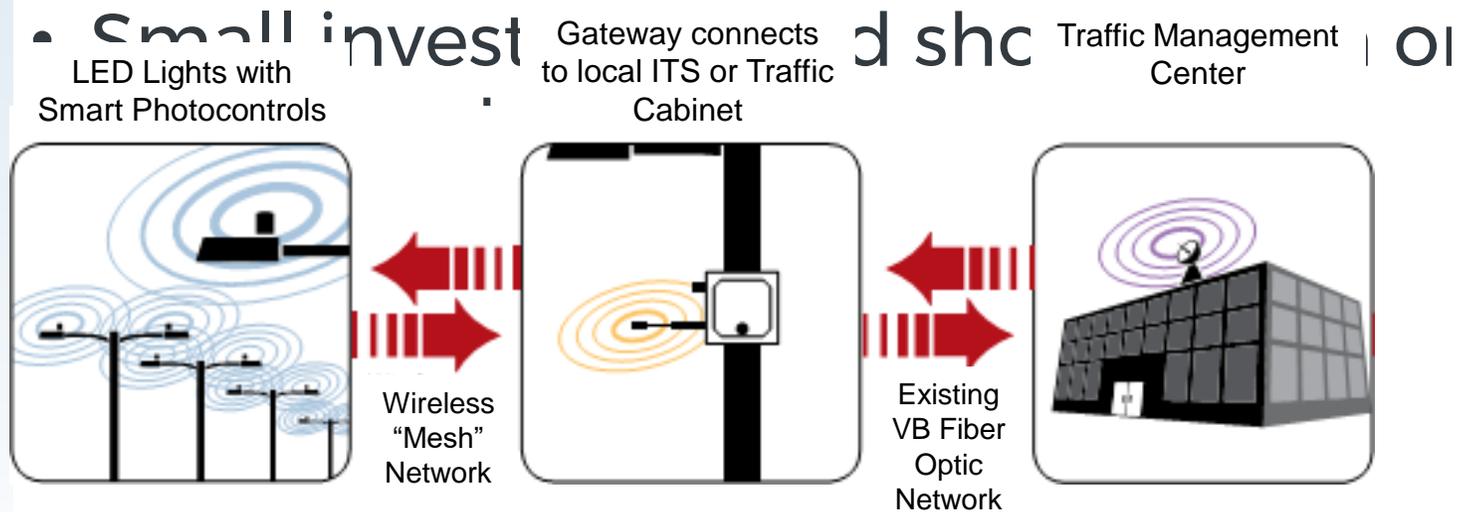


Signals- CCTV & SPaT (Signal, Phase and Timing Data)

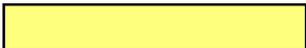
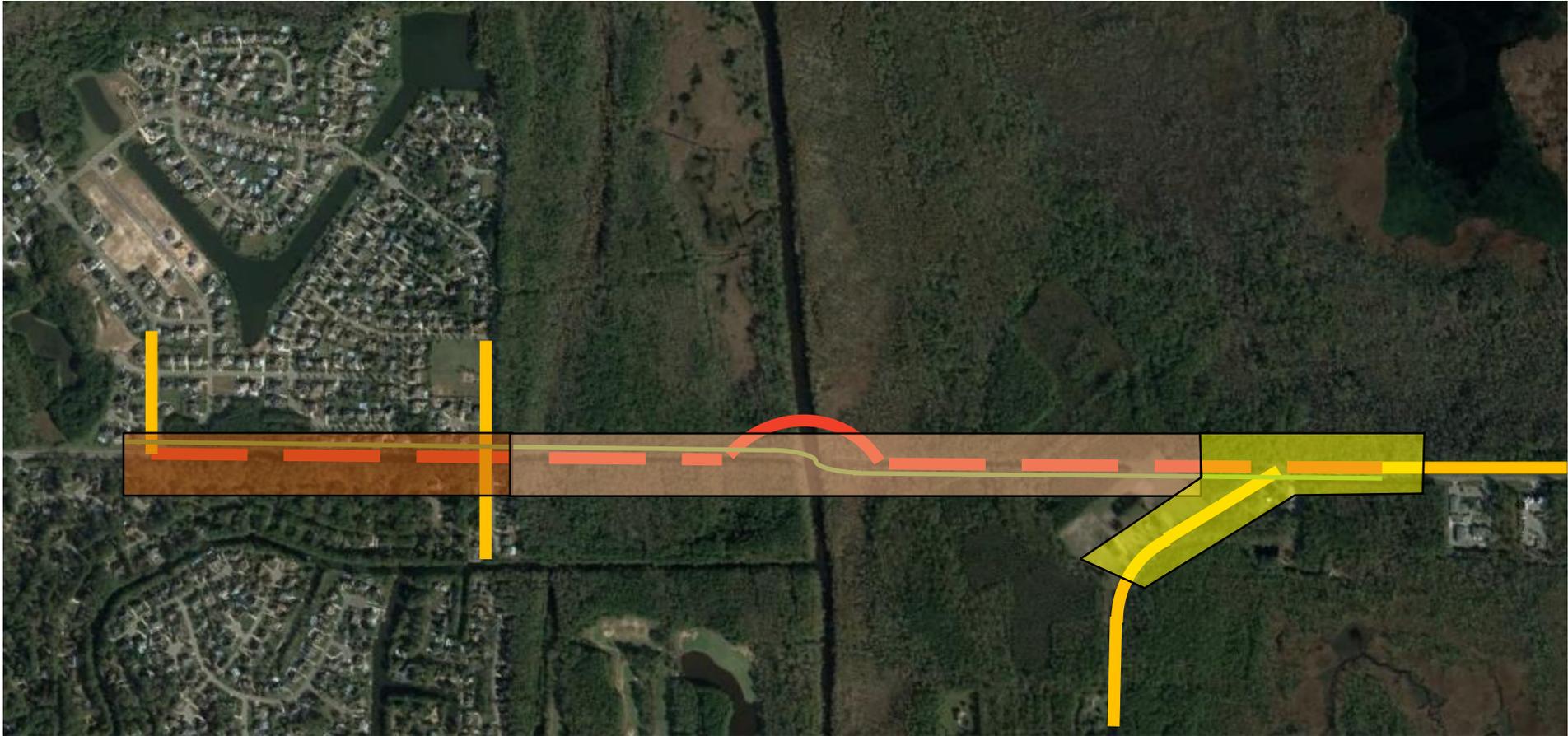


Adaptive Lighting - Technology (how it works)

- Increases energy efficiency
- Allows different lighting levels for different areas or uses
- Increases maintenance efficiency
- Allows retrofit to existing LED lights



Adaptive Lighting - Policy



Lights are always on



Schedule on/dim/off times to light the area in hours of heavy use but dim and/or turn off during the dead of night for wildlife



Lights are always on, but dim as the night goes on based on schedule times

Thank You!!!