



# 81%

Connected vehicles and new crash avoidance technologies could potentially address 81% of crashes involving unimpaired drivers.

Beyond Traffic







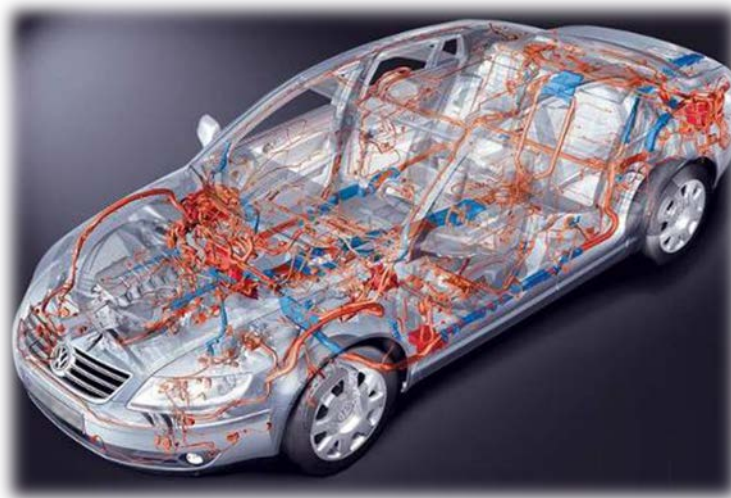


# Connectivity and the Attack Surface

Satellite Cellular WiFi Radio DSRC

Blue Tooth  
& RF

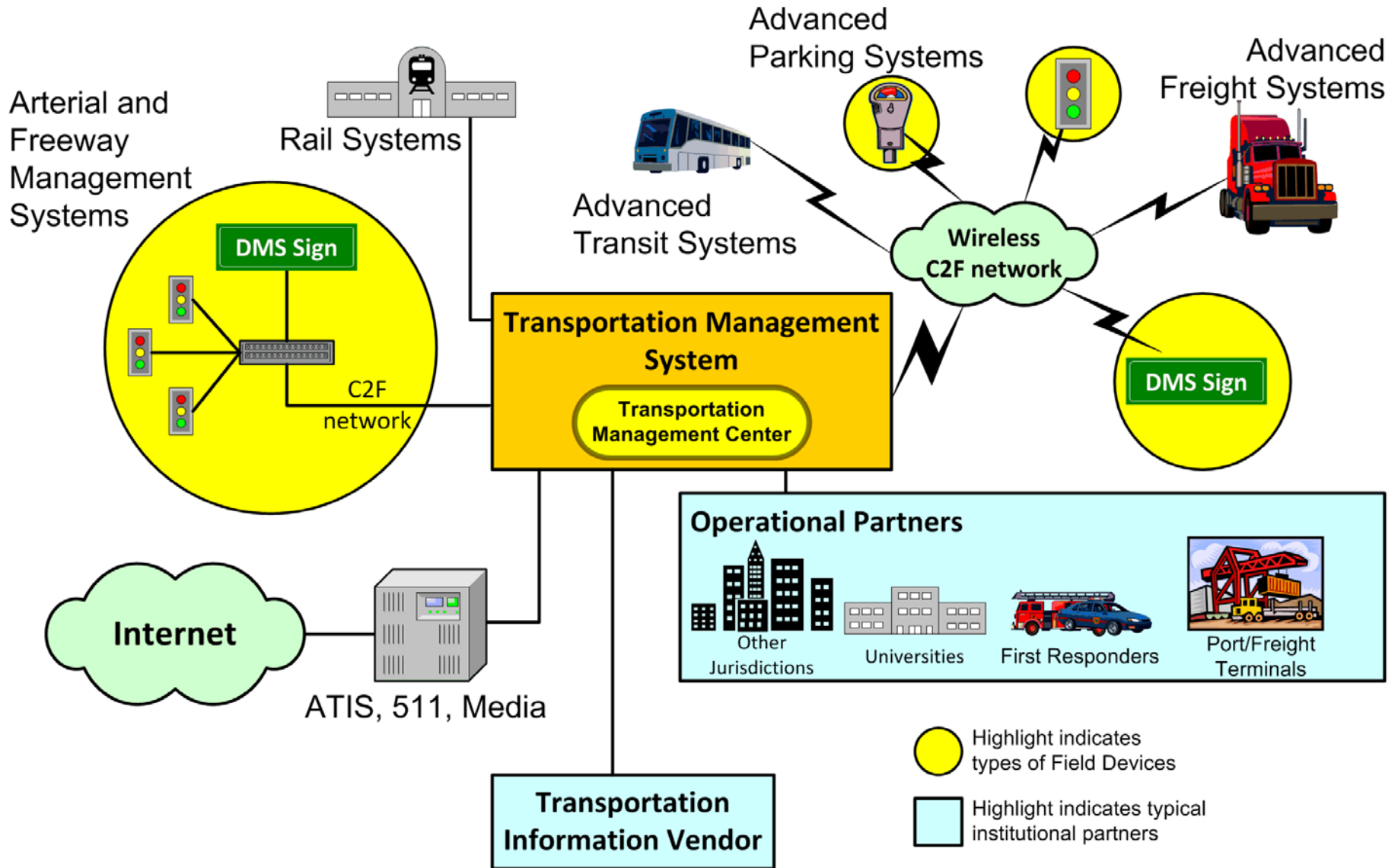
Wireless  
Sensors



CD & MP3

Mechanics'  
Diagnostic  
Tools

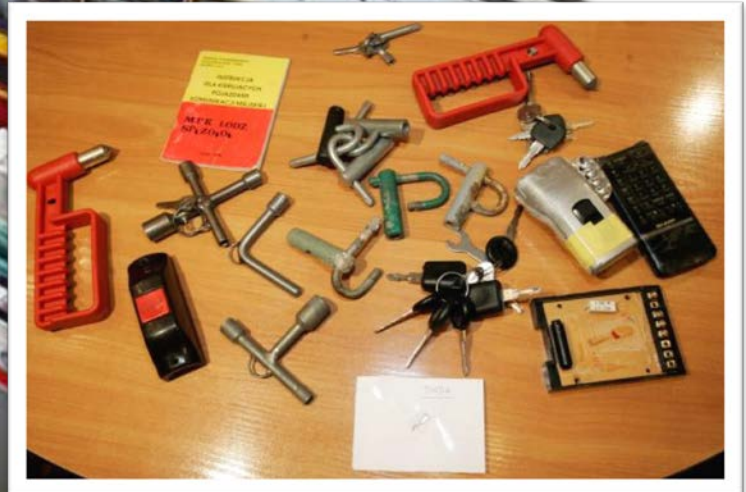








**Green** lights forever?



# Nation state attacks



eLoran  
System

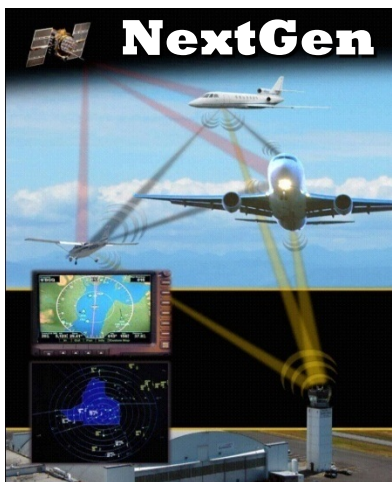
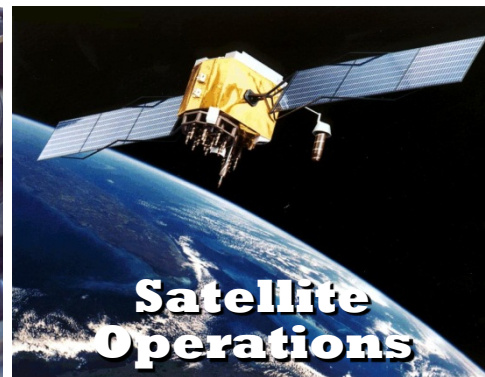
Alternative  
navigation &  
timing

GNSSnews.com

**GPS Jamming**



# Dependencies on GPS throughout transportation and other sectors





# Multimodal disruption of GPS

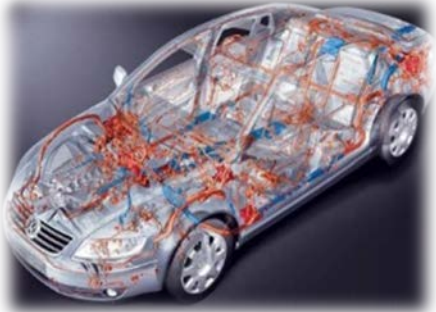


Jammer

**June 19, 2014:** The FCC issues its largest fine in history (**\$34.9M**) to a company selling signal jammers.



# All modes are connected & vulnerable

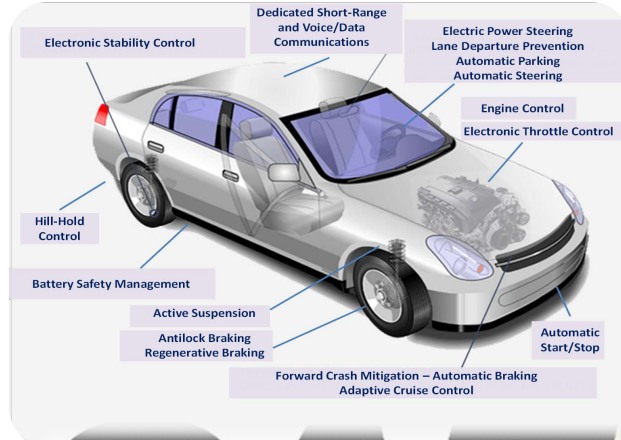


# Designed-in security



**RTCA**

THE GOLD STANDARD FOR AVIATION SINCE 1935



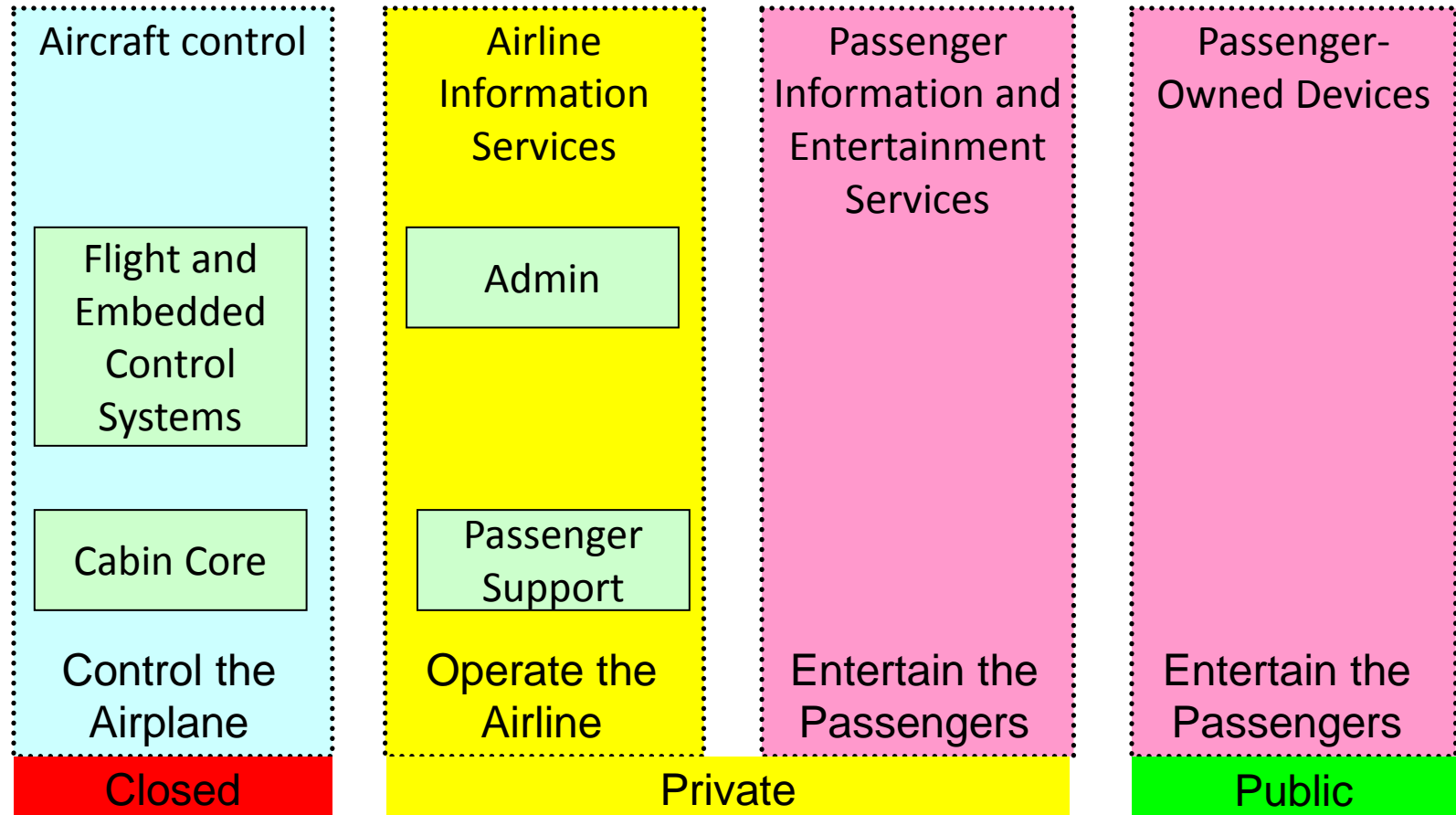
**SAE**



**AMERICAN  
PUBLIC  
TRANSPORTATION  
ASSOCIATION**

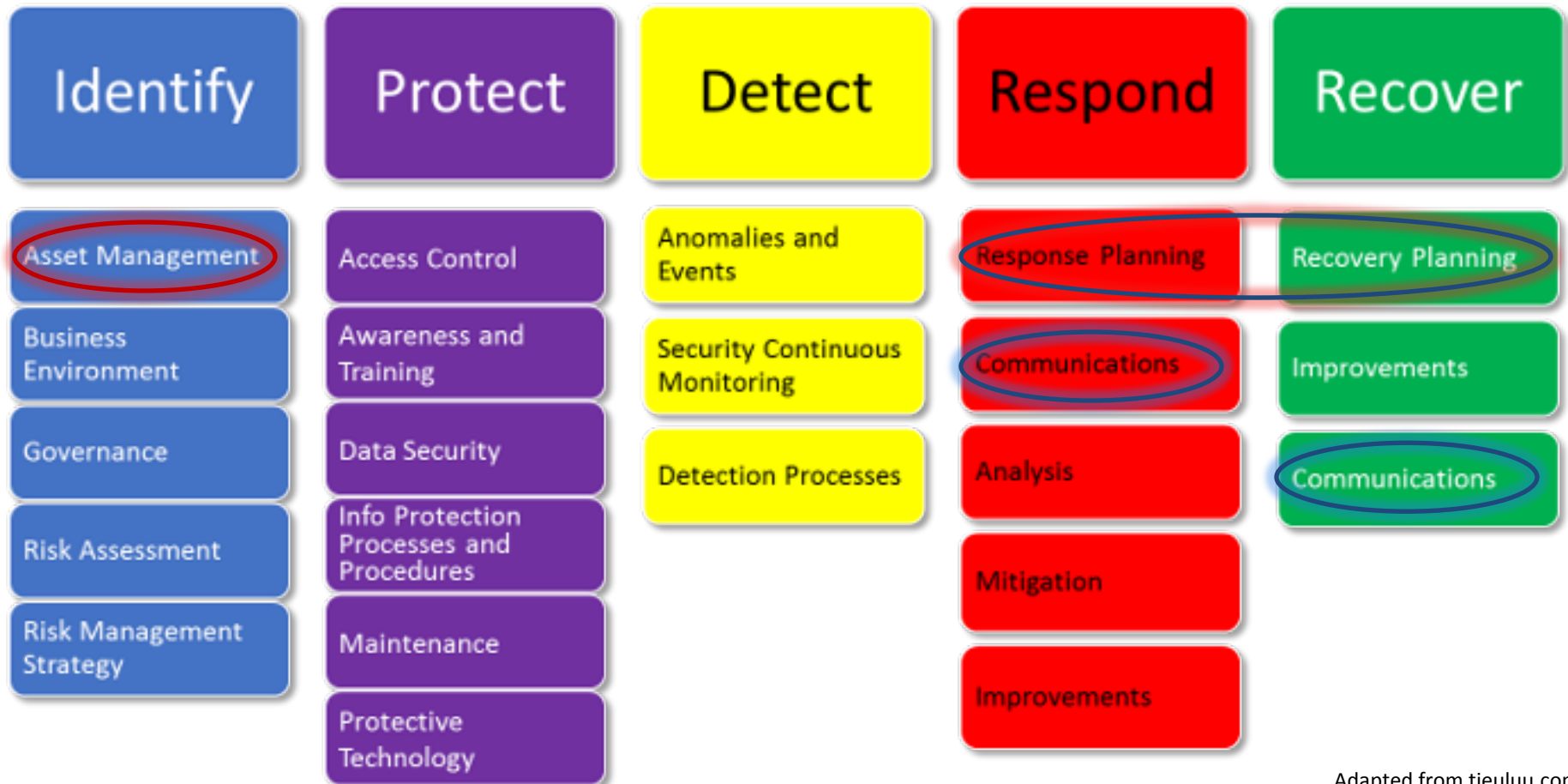
Recommended practices for cyber security & resilience

# Design best practices: Separate information domains



Plus: encryption, authentication, intrusion detection

# NIST Cyber Security Framework



Adapted from tieuluu.com

# Goal: System resilience

**Robust**  
**Redundant**  
**Adaptive**



September 26, 2014

# 91,000 square mile "ATC Zero"

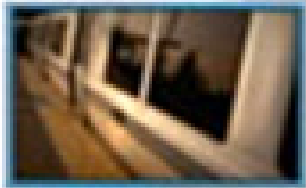
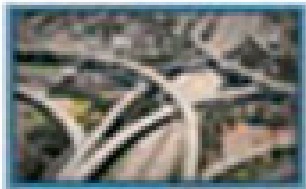


NextGEN

Cyber  
Physical  
Personnel



# Challenge: Multimodal Resilience

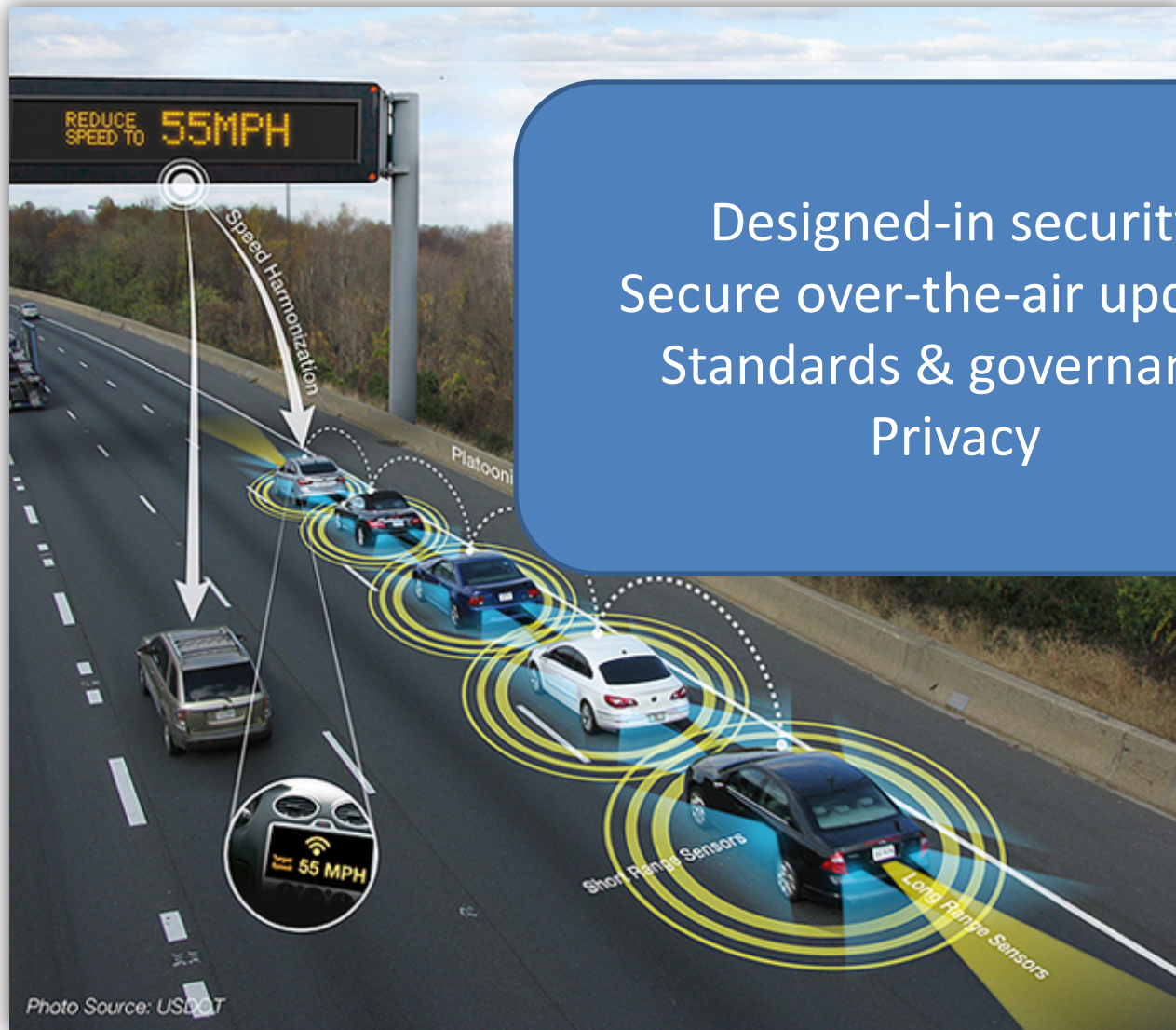


Operational impacts  
Cyber resiliency plans  
Response & recovery

**Rail  
Systems**

**Bus  
Systems**

# Challenges: Connected Vehicles

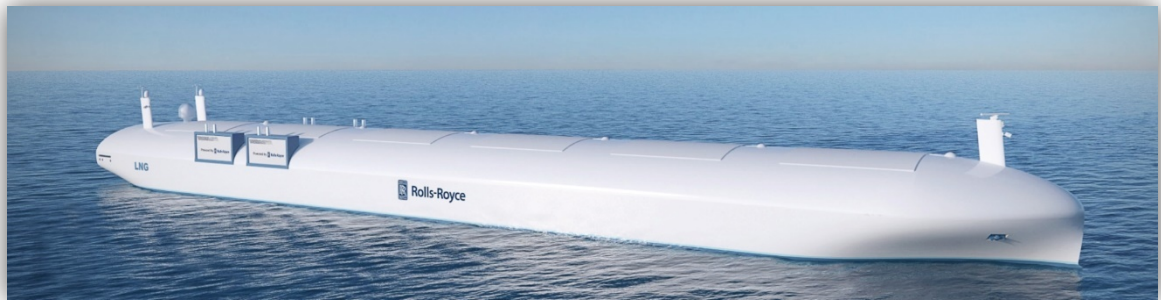


Designed-in security  
Secure over-the-air updates  
Standards & governance  
Privacy

# Challenges: Automated Vehicles



Optimize safety, security & reliability  
Cyber/physical attack scenarios  
Regulation and governance



# Challenges: Smart Cities



Interdependencies & risks  
Architectures & standards  
Framework for cyber resilience



# Opportunities for leadership

- Multi-disciplinary, multi-sector research
- Collaborative outreach with industry





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