

# 2018 SE Commercial Vehicle Safety Summit Briefing

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## Texas A&M Transportation Institute

*Mike Lukuc*

*Program Manager & Research Scientist*

*Connected & Automated Transportation  
Technology*





***The Evolution of Transportation in TX  
through Connectivity and Automation***



# Agenda

TTI Overview

TX Freight Overview

TX Initiatives

TTI Research

# GM Futurama – 1939 Worlds Fair





## Legacy

Established 1950

State Agency

Early Focus: *roadside safety, pavements, bridges*





## Current Research Emphases

Technology

CAV

Mobility

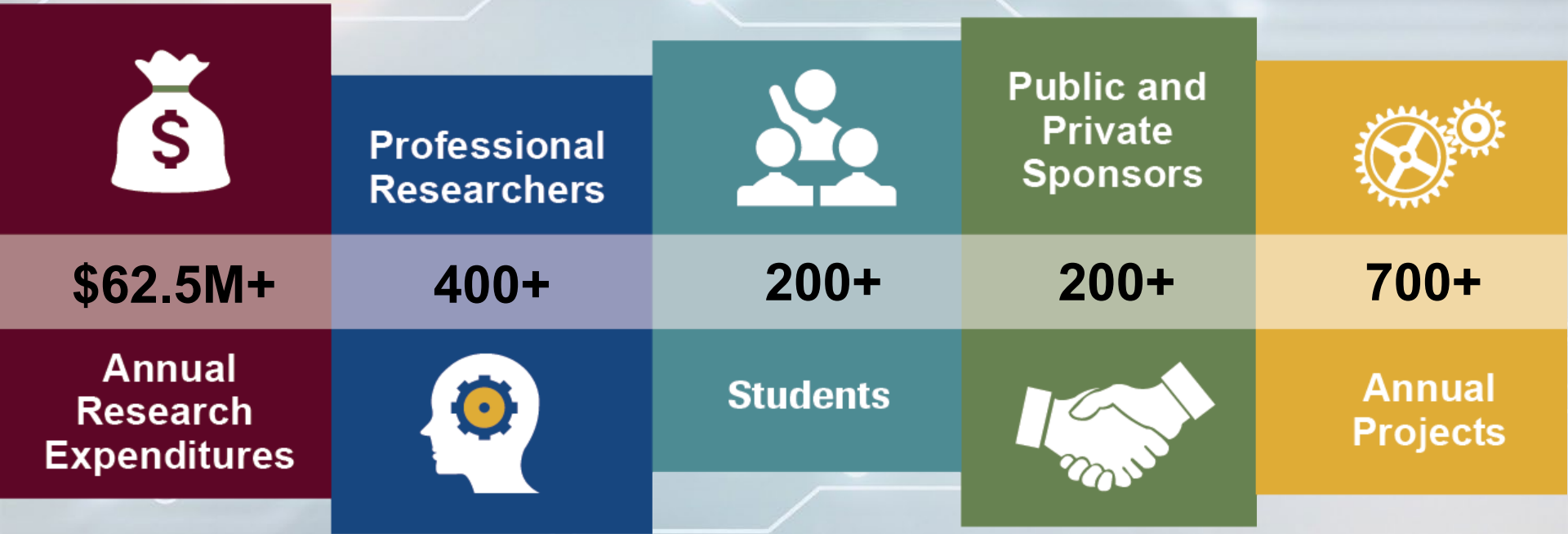
Human Behavior



# Our Research Portfolio



# TTI Facts



# Locations

**★ Headquarters**

College Station  
Bryan

**📍 Urban Offices**

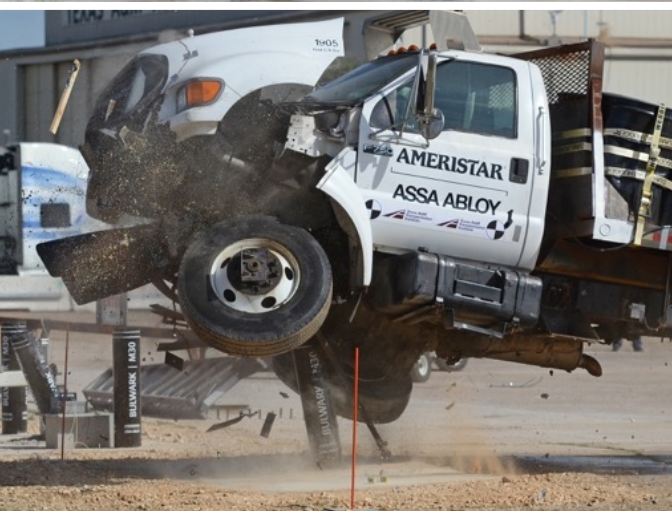
Arlington  
Austin  
Dallas  
El Paso  
Galveston  
Houston  
San Antonio  
Waco  
Washington, D.C.

**📍 International**

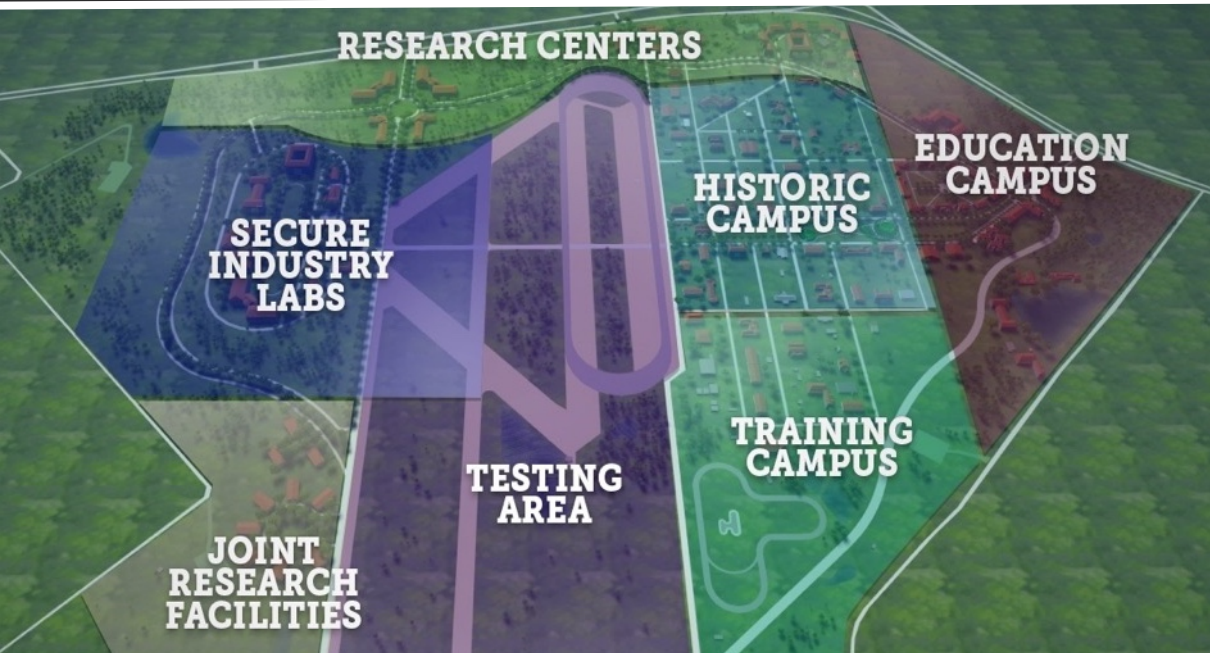
Mexico City, Mexico  
Doha, Qatar











**RELLIS**

THE TEXAS A&M  
UNIVERSITY SYSTEM

- 2,000 Acres
- TTI Facilities
- Workforce Development
- Industry Collaboration





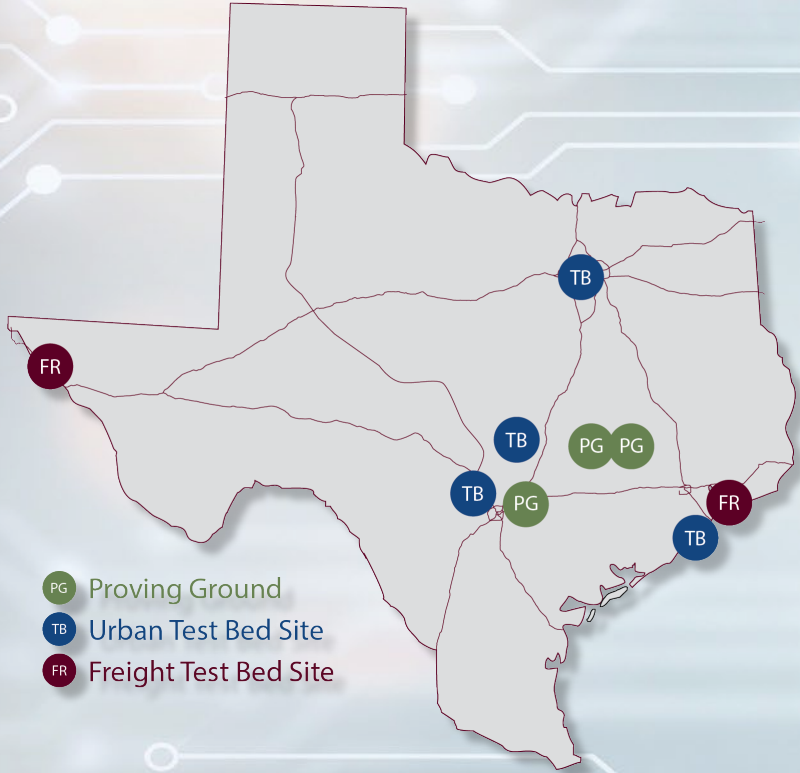
# Texas Freight Situation

- Annual projected changes between 2014 and 2040 in TX:
  - Freight tonnage moved will increase by 46%, from 2.6 billion to nearly 3.8 billion
  - Freight tonnage moved by trucks will double, from over 1 billion to over 2.2 billion
    - **Translates to 89% increase in VMT**
  - Truck trips increase from 589,000 to over 1 million
- In 2013, Texas had over \$1 billion in congestion cost to the trucking industry, ranking only behind California.
  - Dallas ranked 4th with over \$406 million
  - Houston ranked 6th with over \$373 million
- I-35 through Austin experienced over 116,000 hours of trucking delays in 2013
  - #1 in TX

# Texas AV Proving Ground Partnership



[www.texasprovinggrounds.org](http://www.texasprovinggrounds.org)



- PG Proving Ground
- TB Urban Test Bed Site
- FR Freight Test Bed Site





# TX AV Proving Ground Expertise

## TTI

Infrastructure, connected automation, operations, human factors, freight, UAVs, deployments

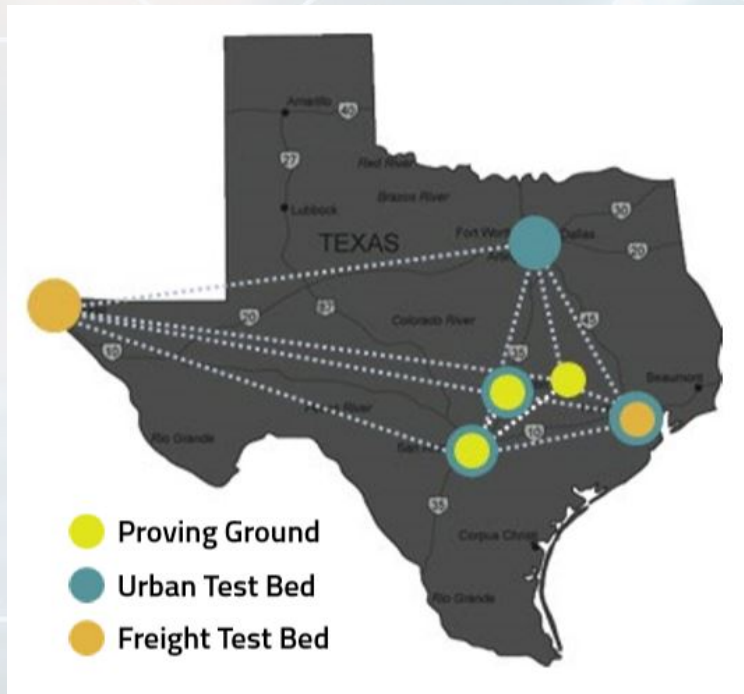
## UT/CTR

Travel behavior, GPS and wireless sensing, cybersecurity, policy and regulation

## SwRI

Localization, perception, cybersecurity, connected automation, UAVs

# TX AV Proving Ground Urban and Freight Test Bed Locations

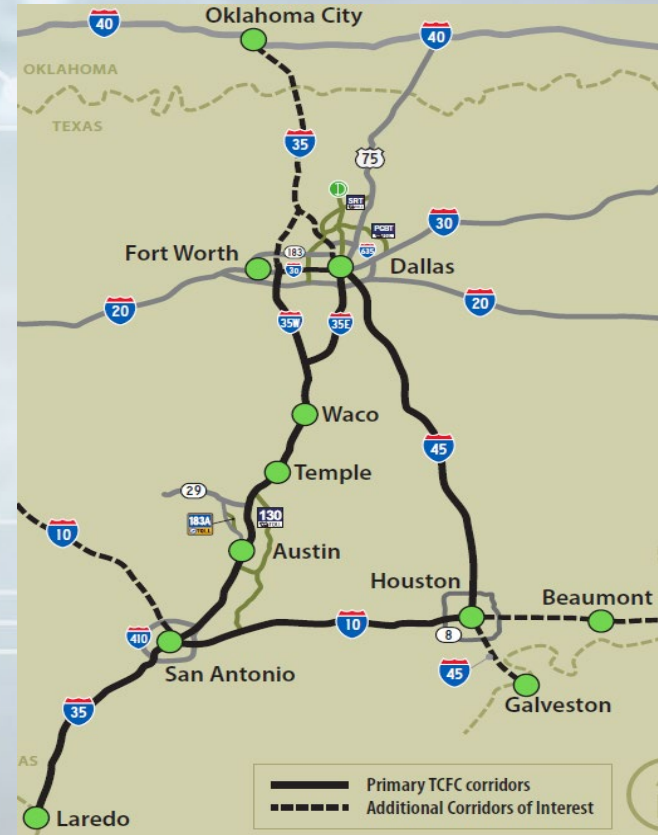


- Austin Area — Austin- Bergstrom International Airport and Riverside Drive corridor
- Houston Area — Texas Medical Center, Houston METRO HOV lanes and Port of Houston.
- Dallas/Fort Worth/Arlington Area — UTA campus, Arlington streets, I-30 freeway and managed lanes.
- San Antonio Area — Fredericksburg Road/Medical Drive corridor and bus rapid transit system.
- El Paso Area — Tornillo/Guadalupe Port of Entry.

# Texas Connected Freight Corridors

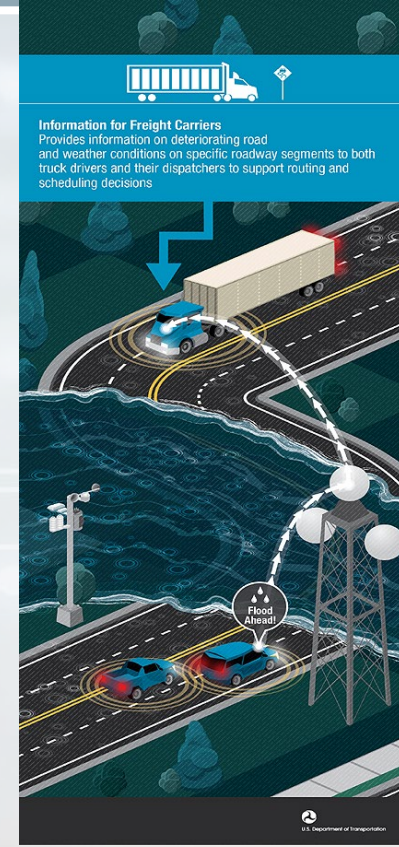
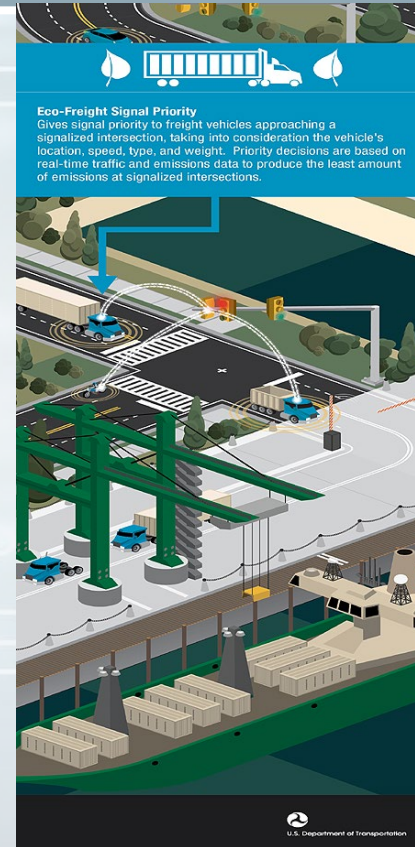
## 2017 USDOT ATCMTD Program Award

- **Vision:** to create a sustainable CV environment covering the 865-mile Texas Triangle (including extension to Laredo) to support V2V and V2I safety and mobility applications
- **On-going success** and support will be achieved by:
  - **Promoting economic efficiency and safety**
  - **Creating Day One benefits**
  - **Minimizing infrastructure costs** to state and local agencies



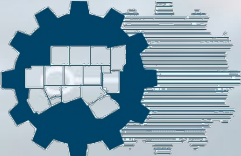
# Texas Connected Freight Corridors Project

- Proposal: Equip “Texas Triangle” with connected infrastructure technology (IH10, IH30, IH35 & IH45)
  - Equip 1,000 trucks and TxDOT fleet vehicles with on-board technology
- HEB is the flagship partner, approaching others for participation
- Provide freight operators and drivers with info and warnings to improve safety and mobility:
  - Warnings for traffic queues, work zones, low bridge heights, weather (heavy rain, ice, fog), wrong-way drivers
  - Equipped truck will get braking warnings from other equipped trucks
  - Traveler info on traffic conditions, route guidance, border wait times





# Partnership



North Central Texas  
Council of Governments



THE UNIVERSITY OF TEXAS AT AUSTIN  
CENTER FOR TRANSPORTATION RESEARCH

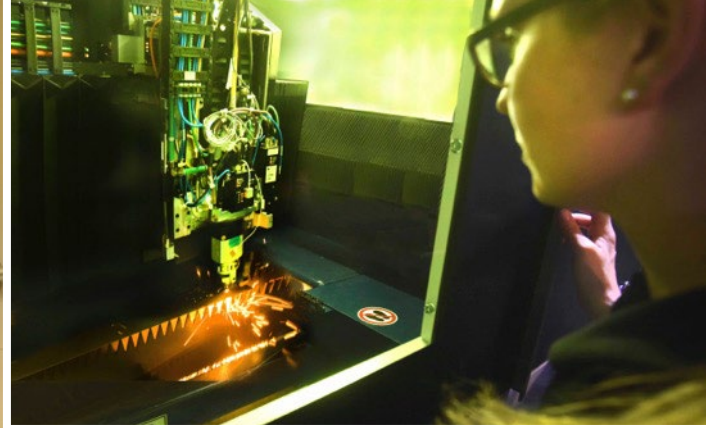
# Public Sector Stakeholders



Project provides opportunities for expansion of public sector stakeholders

















WYOMING



COLUMBUS



NEW YORK



TAMPA



## Independent Evaluator

Columbus, OH, Smart  
Cities Deployment

**CV Pilots:** New York City  
DOT, Tampa, FL, and  
Wyoming DOT





# Campus Transportation Technology Initiative



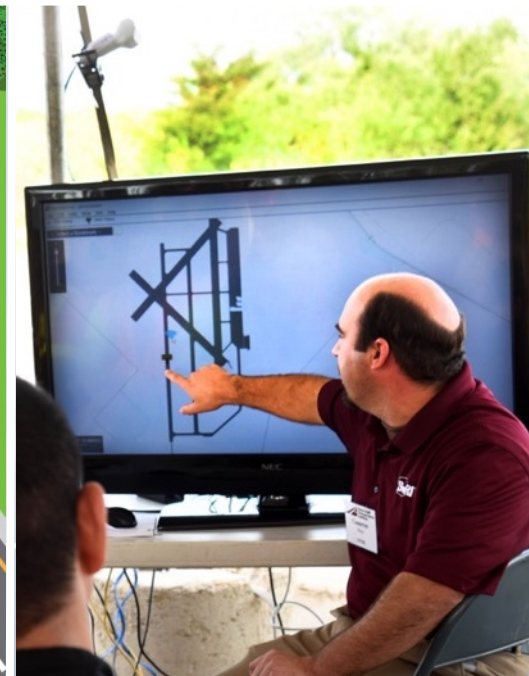
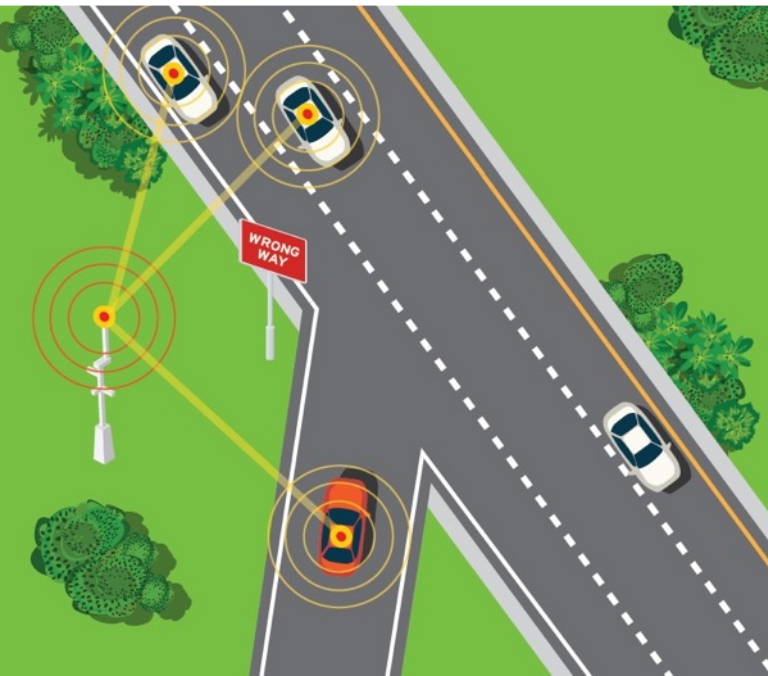
**7.5 million**  
annual transit riders



**120,000**  
people on football  
game days  
(4th largest  
downtown in Texas)

[smartcampus.tti.tamu.edu](http://smartcampus.tti.tamu.edu)





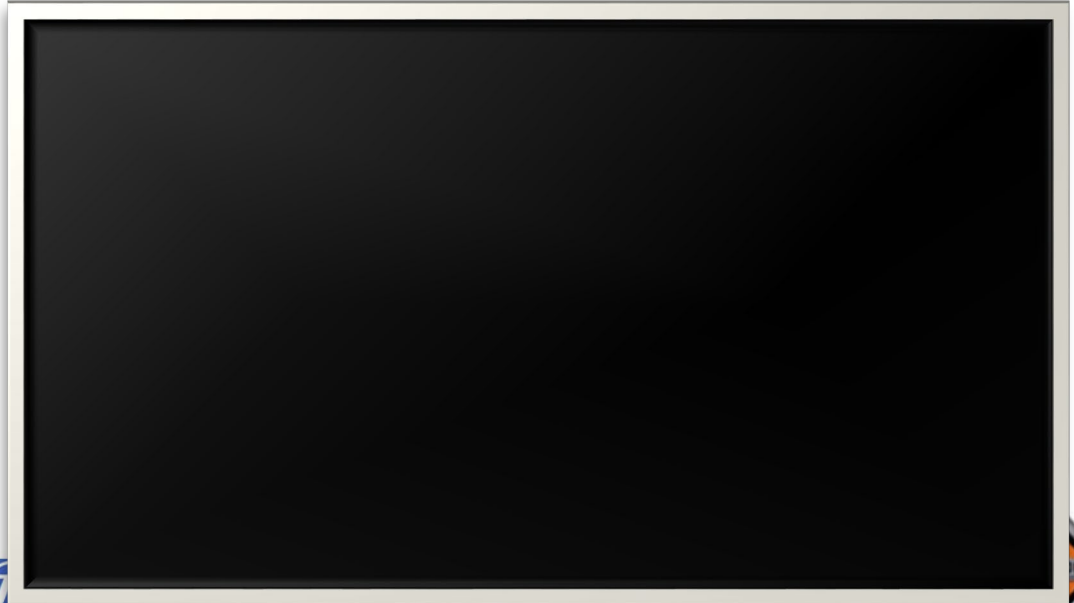
# Wrong Way Driving Mitigation





# What is Truck Level 2 Platooning?

- Extension of cooperative adaptive cruise control
- *Automated and precise lateral and longitudinal vehicle control (L2 automation)*
  - Maintain tight formation
    - Safely follow at short distances
- Lead truck: manually driven
- Following truck(s): driver engaged and monitoring environment and driving task
- Leverages ACC and collision mitigation system
  - Bendix® Wingman® Fusion™



# Why Truck Platooning?

- Fuels savings
- Emission reductions
- Safety benefits
- Traffic network benefits
- Driver benefits
- Other



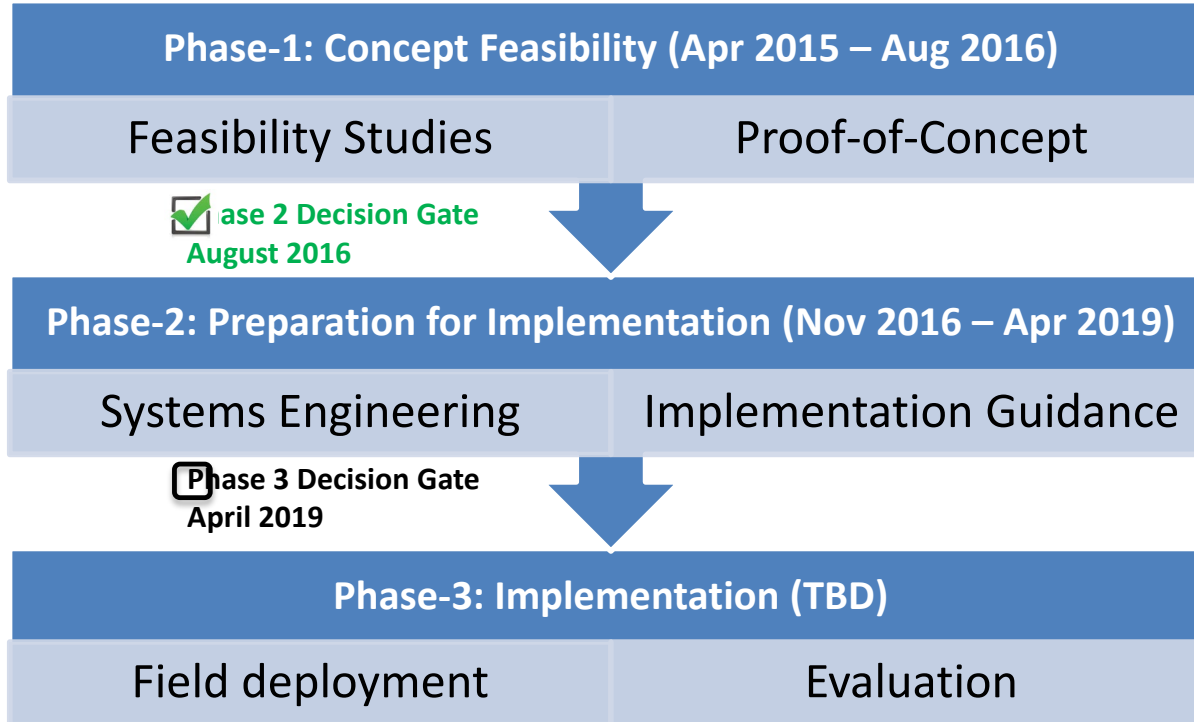




# Project Focus

- Collaboration: Bring together major partners who have committed resources in terms of in-kind matching of equipment, engineering services, and intellectual property.
- Feasibility Assessment: Assess feasibility of deploying 2-vehicle truck platoons on specific corridors in Texas in 5 to 10 years.
- Implementation: Performing systems engineering to develop the system, an implementation plan, and deployment guidance necessary for Phase III deployment
- Outreach, training and knowledge transfer

# Project Structure and Timing



# Phase 2 research





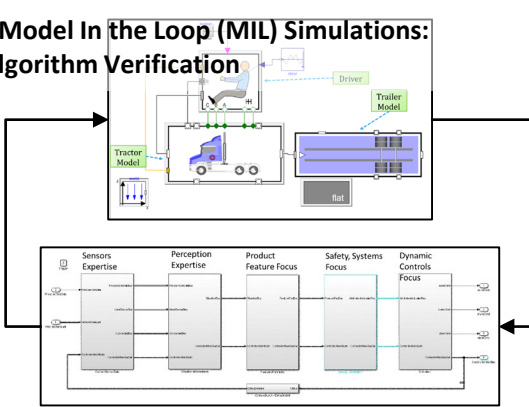


# Functional Safety for Commercial Truck Platooning

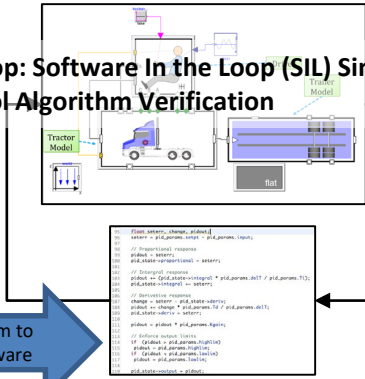
- A Highly Complex Cyber-Physical-System
- Safety achieved through:
  - Adoption of “Industry Best” development methodologies (Model Based Systems Engineering)
    - Requirements and Tests Driven, Architecture and Model Based Development, ISO 26262
  - Extensive testing for verification / some validation
    - Extensive verification (especially corner cases) using Virtual Simulations
    - Limited verification through controlled vehicle tests
    - Cautious and objective transition to naturalistic testing

# MBSE Process for Commercial Truck Platooning

Desktop: Model In the Loop (MIL) Simulations:  
Control Algorithm Verification

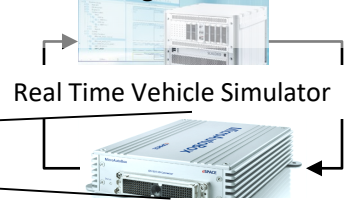


Desktop: Software In the Loop (SIL) Simulations  
Control Algorithm Verification



Control Algorithm to Embedded Software

Lab Testing: Hardware In the Loop (HIL) Simulations:  
Control Algorithm Verification



Realtime Vehicle Models; Flash to RPC

In-vehicle Testing: Control Algorithm Validation



RPC in vehicle

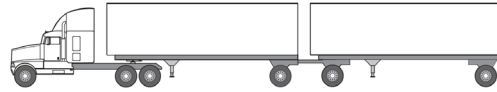
Rapid Prototyping Controller

# Implementation Planning

- Developed initial simulation-based traffic operations guidance
- Work with stakeholders to identify and address “roadblocks” that might limit Commercial Truck Platooning in Texas
  - Governance
  - Regulatory
  - Enforcement
  - Operations
  - Legal
  - Education
  - Outreach
- Impact of Recent AV Legislation



# Examples of Truck Trailer Combinations not Included in Platooning Research to Date



Double Trailer Combinations



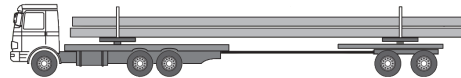
Truck with Lowboy Trailer



Commercial Truck and Stringer-Steered Semi-Trailer  
Combination Transporting Automobiles (or Boats)



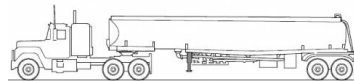
Traditional Boat or Automobile Transporter Combination



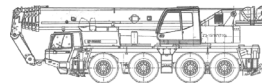
Truck and Pole Combination



Saddlemount Truck Combination



Tankers



Construction Vehicles





# TTI Freight Shuttle Video



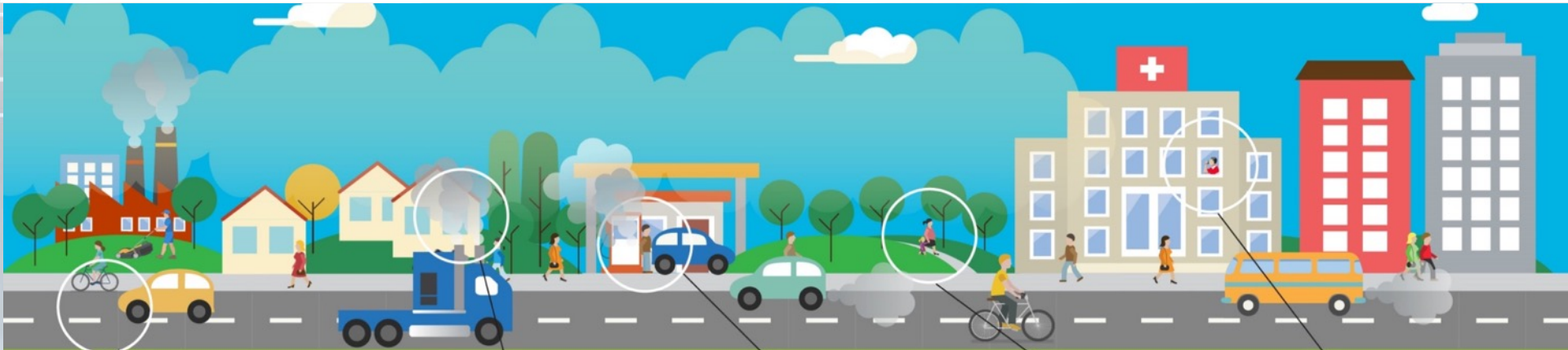


# Freight Shuttle System Facts

- Moves over 8,600 shipments per guideway per day
- At full capacity, moves more than 300,000 tons of goods per day in each direction
- Reduces energy consumption by 2/3 compared to heavy-duty diesel trucks at one-sixth of the cost
- Moves truck trailers and domestic intermodal containers up to 53 feet in length
- Utilizes elevated guideways on existing ROW for distances up to 500 miles

# CARTEEH

USDOT University Transportation Center



TRAFFIC



EMISSIONS



DISPERSION



EXPOSURE



HEALTH IMPACTS

# SAFE-D

USDOT University Transportation Center





# Connected Transportation is Our Future



# Questions?



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