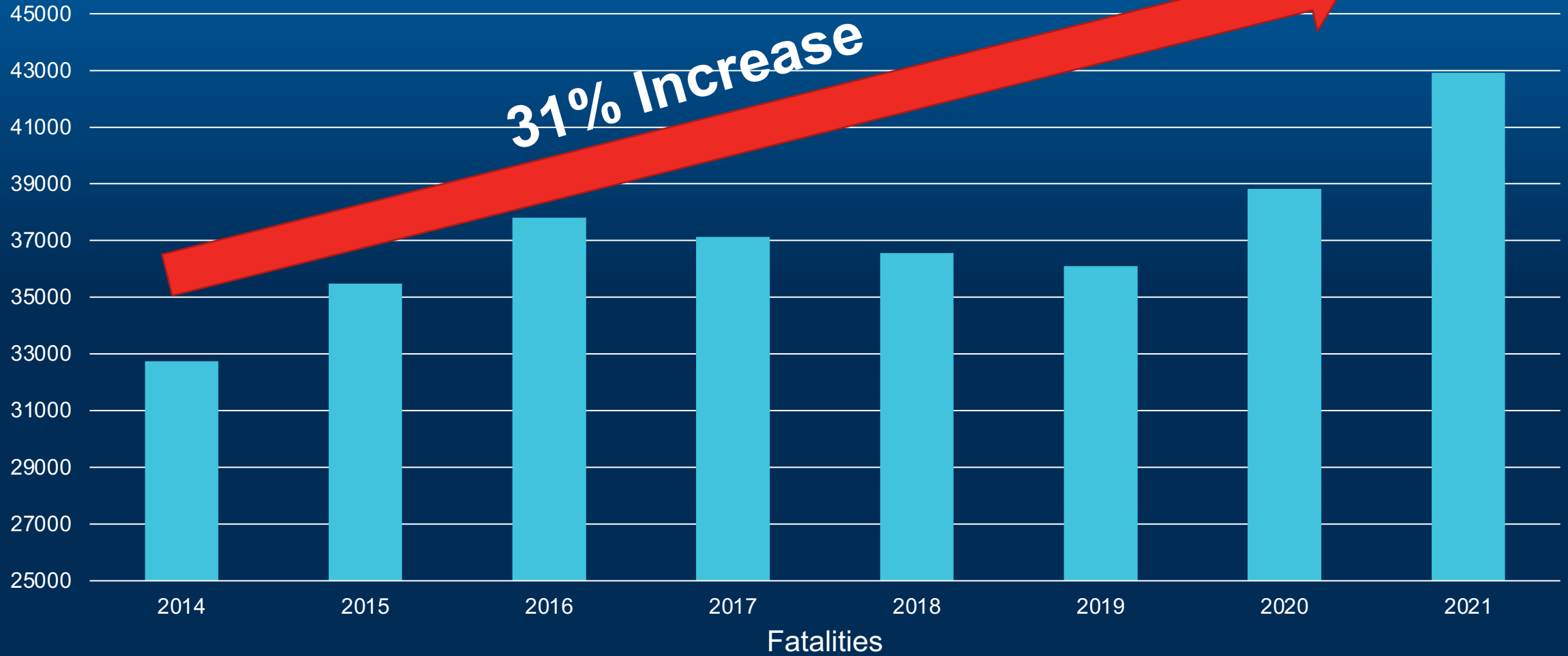


The Safety Promise of V2X

Member Michael Graham

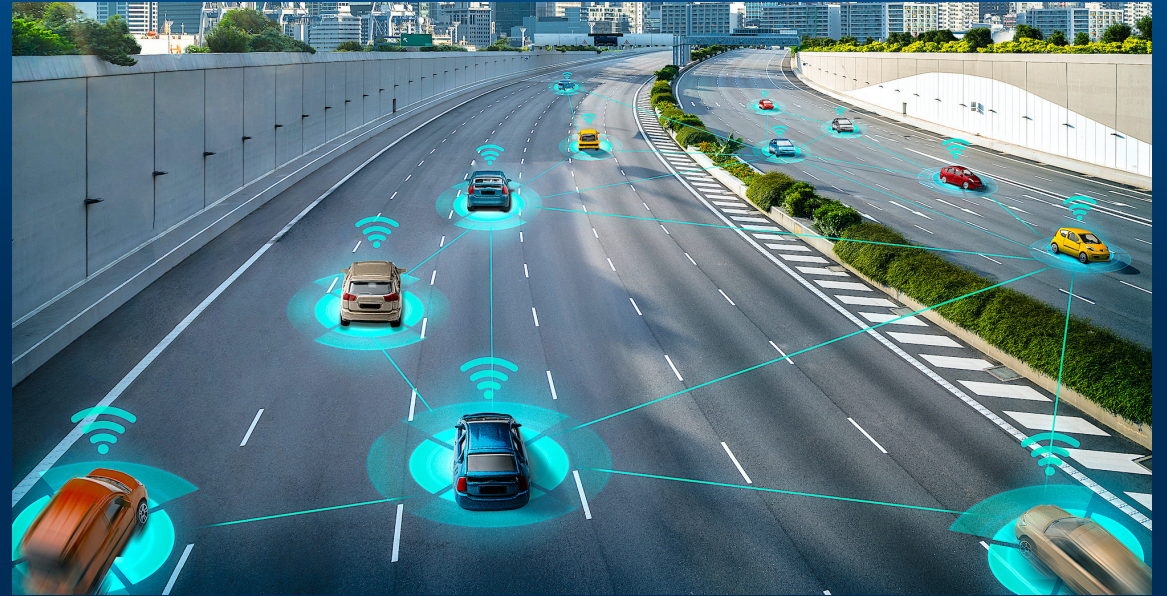
March 16, 2023

United States Roadway Fatalities



Safety Promise of V2X

- V2X is one of the most promising life-saving technologies available today
- V2X harnesses actionable, predictive data to improve safety on our roadways
- NHTSA estimates V2X could eliminate or mitigate the severity of up to 81% of all non-impaired crashes

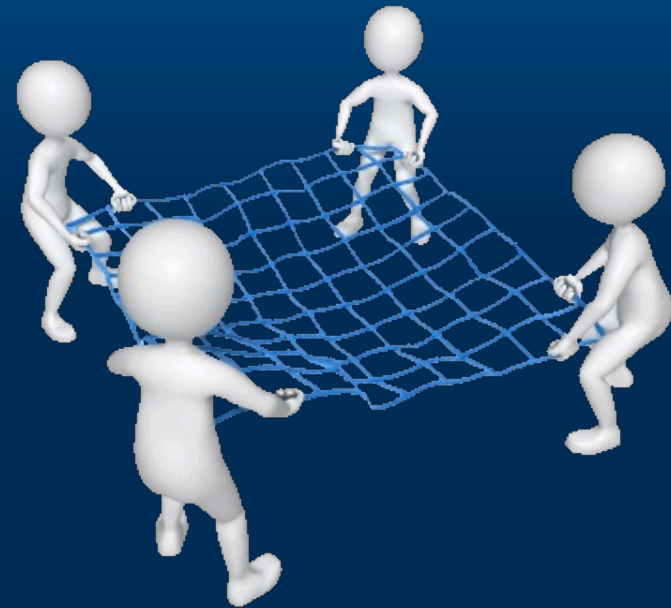




- Require and Verify the Effectiveness of Safety Management Systems in all Revenue Passenger-Carrying Aviation Operations
- Install Crash-Resistant Recorders and Establish Flight Data Monitoring Programs
- Implement a Comprehensive Strategy to Eliminate Speeding-Related Crashes
- Protect Vulnerable Road Users through a Safe System Approach
- Prevent Alcohol- and Other Drug-Impaired Driving
- **Require Collision-Avoidance and Connected Vehicle Technologies on all Vehicles**
- Eliminate Distracted Driving
- Improve Passenger and Fishing Vessel Safety
- Improve Pipeline Leak Detection and Mitigation
- Improve Rail Worker Safety

V2X – Additional Layer of Protection

- NTSB strongly supports AEB/FCW
- V2X is not intended to replace current or future onboard sensors
- V2X overcomes current limitations of onboard sensors
- Merging onboard sensors with V2X creates redundancy and allows for greater confidence when an imminent crash prevention scenario occurs

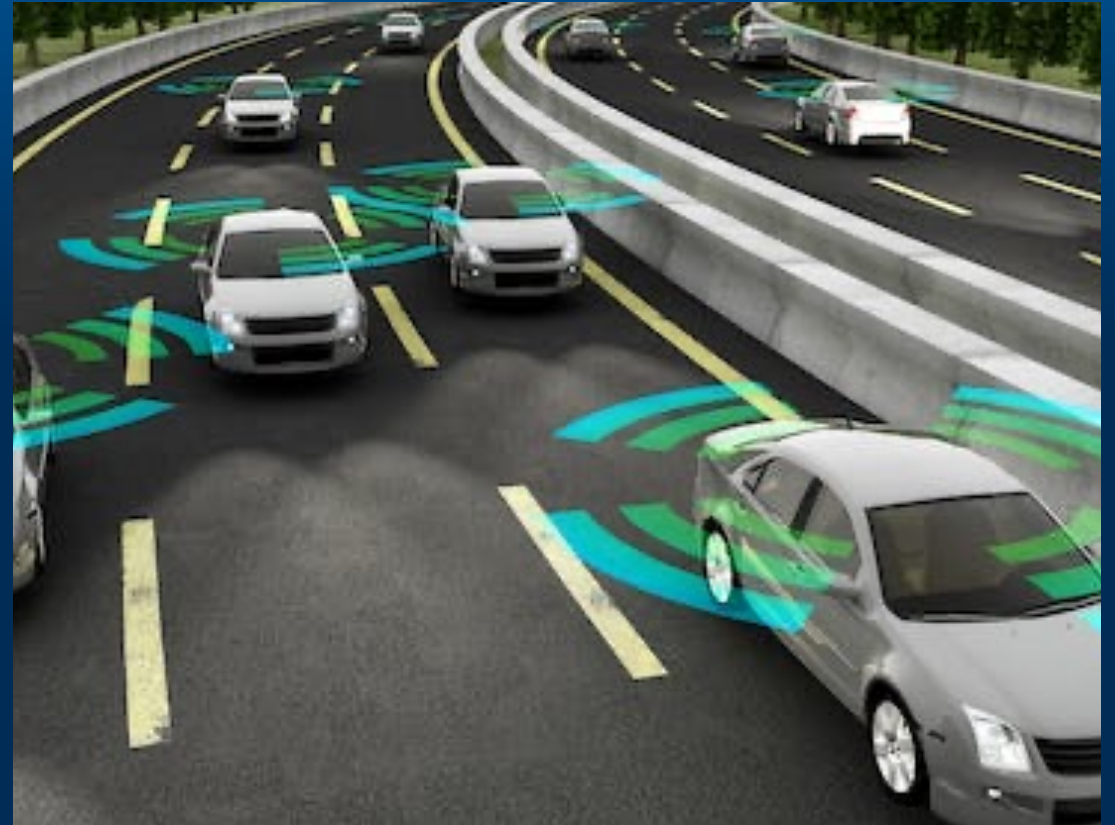


V2X Safety Applications – Safe System Approach



Imminent Crash Prevention

- NTSB strongly supports V2X because of its ability to save lives
- 2014 V2V NHTSA Readiness Report:
 - 22 of 37 pre-crash scenarios could be addressed by V2V thereby eliminating or mitigating **81% of all light vehicle crashes**
 - V2V + V2I combined could eliminate **81% of all non-impaired crashes**
- 2015 Volpe Study:
 - One of the largest naturalistic V2X driving studies: 2,800 V2X equipped vehicles
 - Out of 400 rear-end crash scenarios observed, V2X technology alerted the driver in all of them
- High reliability, low latency



NTSB Recommendation History

To FCC: Expedite rulemaking action on the allocation of frequencies that would enhance the development possibilities of collision warning systems. (H-95-46) – Menifee, AR



1995

1995 – Menifee, AR

- January 9, 1995, 1:50am
- Interstate 40
- Dense fog
- Lead vehicle slowed from 65mph to 35mph and was struck in the rear
- Subsequent collisions
- 9 total vehicles
- 5 fatal
- To FCC: Expedite rulemaking action on the allocation of frequencies that would enhance the development possibilities of collision warning systems. (H-95-46)

**MULTIPLE VEHICLE COLLISION WITH FIRE
DURING FOG NEAR MILEPOST 118
ON INTERSTATE 40, MENIFEE, ARKANSAS
JANUARY 9, 1995**

and

**SPECIAL INVESTIGATION
OF COLLISION WARNING TECHNOLOGY**

HIGHWAY ACCIDENT REPORT

**Adopted: December 4, 1995
Notation 6530A**

**National
Transportation
Safety Board**

Washington, DC 20594

NTSB Recommendation History

To FCC: Expedite rulemaking action on the allocation of frequencies that would enhance the development possibilities of collision warning systems. (H-95-46) – Menifee, AR

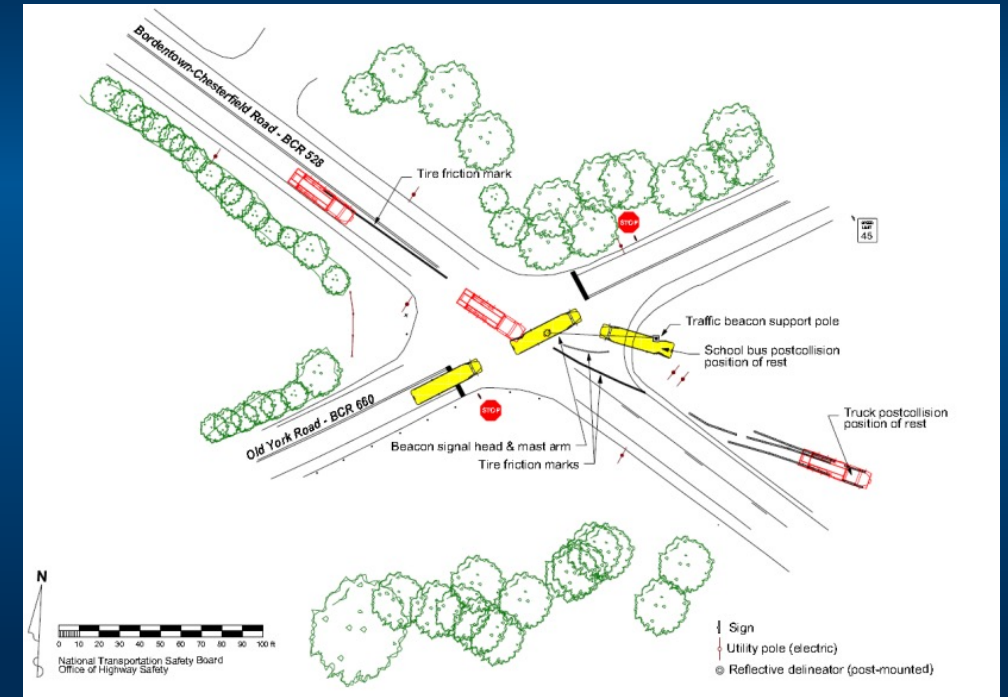
To NHTSA: Once minimum performance standards for connected vehicle technology are developed, require this technology to be installed on all newly manufactured highway vehicles (H-13-30/31) – Chesterfield, NJ



FCC allocates 75mhz for intelligent transportation services as part of the US DOT's ITS national program

2013 – Chesterfield, NJ

- February 16, 2012; 8:15am
- School bus carrying 25 elementary school children traveling north stopped at STOP sign
- 2004 Mack dump truck traveling east
- Obstructed intersection and limited line of sight
- School bus driver failed to see the dump truck and proceeded across intersection
- One fatal, 16 injured
- NHTB Finding: Connected vehicle technology could have provided active warnings to the school bus driver of the approaching truck and possibly prevented the crash
- To NHTSA: Once minimum performance standards for connected vehicle technology are developed, require this technology to be installed on all newly manufactured highway vehicles (H-13-30/31)



NTSB Recommendation History

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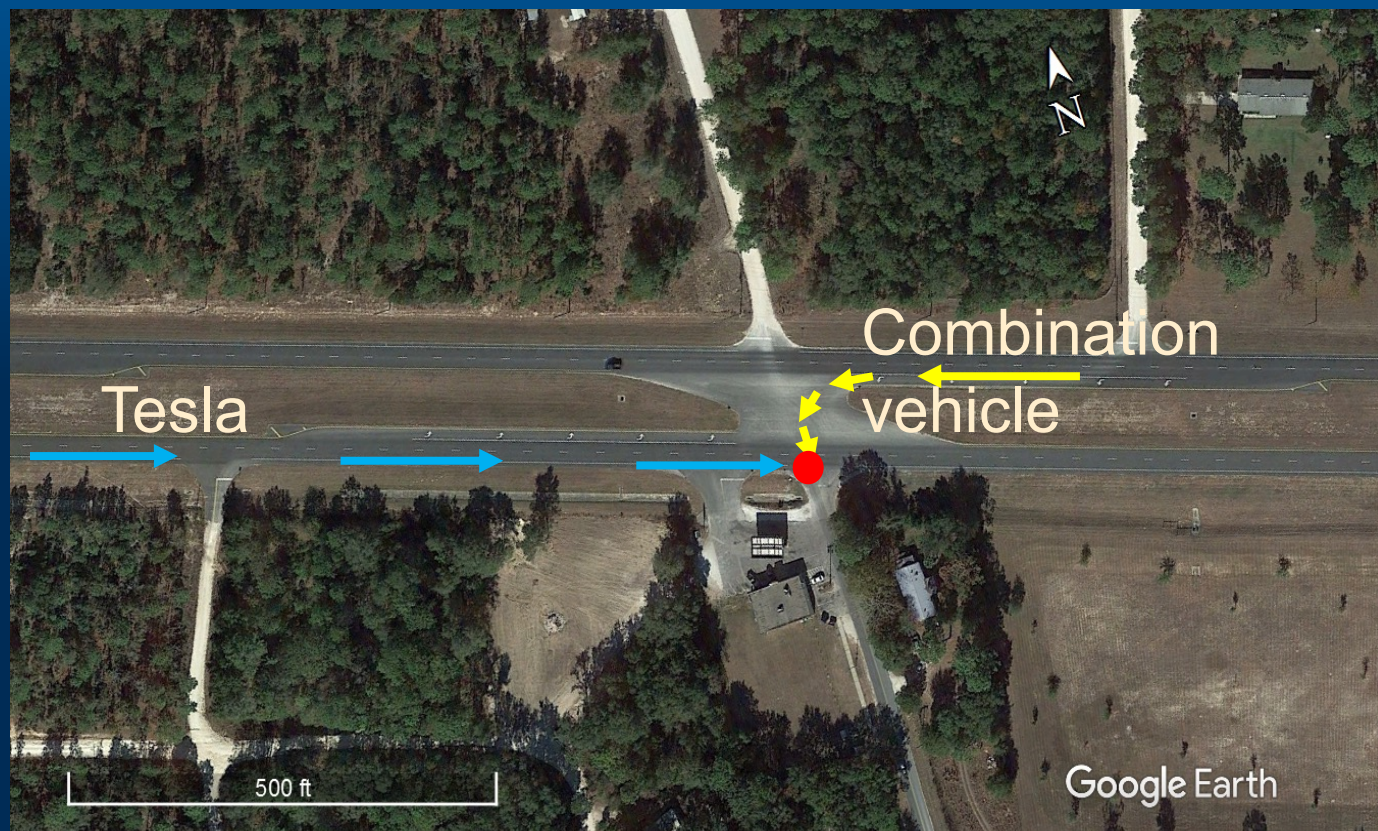


FCC allocates 75mhz for intelligent transportation services as part of the US DOT's ITS national program

Reiterated Recommendation (H-13-30/31) – Williston, FL

2017 – Williston, FL

- May 7, 2016
- Combination vehicle making left turn from westbound US-27A across two eastbound lanes
- Tesla, traveling east, struck right side of the combination vehicle at 74mph
- 1 fatal
- Equipped AEB/FCW on 2015 Tesla did not detect the combination vehicle and was also not designed to detect crossing path collisions
- Reiterated Recommendation H-13-30/31



NTSB Recommendation History

To FCC: Expedite rulemaking action on the allocation of frequencies that would enhance the development possibilities of collision warning systems. (H-95-46) – Menifee, AR

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Safety Reports on Motorcycle (2018) and Bicyclist (2019) safety; NTSB issued six recommendations to incorporate vulnerable road users into the development of connected vehicle technology

1999

2017

2020

1995

2013

2018/2019

FCC allocates 75mhz for intelligent transportation services as part of the US DOT's ITS national program

Reiterated Recommendation (H-13-30/31) – Williston, FL

Reiterated Recommendation (H-13-30/31) – Rochester, IN

2020 – Rochester, IN

- October 30, 2018; 7:12am
- School bus traveling north on a two-lane road (SR-25) stopped on the east side of the road to pick up 10 students from a mobile home park on the west side of the road
- Conditions were dark; no roadway lighting; roadway curve 900 feet before collision site
- 2017 pickup truck traveling south at 58mph struck four students
- Three fatal, one injured
- Reiterated Recommendation H-13-30/31



NTSB Recommendation History

To FCC: Expedite rulemaking action on the allocation of frequencies that would enhance the development possibilities of collision warning systems. (H-95-46) – Menifee, AR

To NHTSA: Once minimum performance standards for connected vehicle technology are developed, require this technology to be installed on all newly manufactured highway vehicles (H-13-30/31) – Chesterfield, NJ

Safety Reports on Motorcycle (2018) and Bicyclist (2019) safety; NTSB issued six recommendations to incorporate vulnerable road users into the development of connected vehicle technology

NTSB adds Connected Vehicle Technology to its 2021-2023 Most Wanted List

NTSB releases four-part V2X video series: Preserving the Future of CV Technology



FCC allocates 75mhz for intelligent transportation services as part of the US DOT's ITS national program

Reiterated Recommendation (H-13-30/31) – Williston, FL

Reiterated Recommendation (H-13-30/31) – Rochester, IN

FCC issues final rule reducing available spectrum by 60%

Mt. Pleasant, PA Issued recommendations to DOT and FCC, reiterated recommendation (H-13-30/31)

Multivehicle Crash Near Mt. Pleasant Township, Pennsylvania

Board Meeting February 8, 2022

Interstate 70/76 – Mt. Pleasant, PA

- January 5, 2020; 3:30am
- Slight precipitation
- Mountainous interstate curve with 55mph advisory speed
- Motorcoach entered curve at 77mph
- Excessive steering input from motorcoach
- Motorcoach overturned
- Initial position of rest blocked both lanes and shoulders



Subsequent Crashes

Vehicles Involved (in order)

- FedEx truck
- UPS truck (UPS-1)
- Car
- UPS truck (UPS-2)

Resulting Injuries

- 5 fatal
- 50 injured



Source: Pennsylvania State Police – NTSB overlay

Collision Avoidance Systems



Source: FedEx forward-facing video, annotated by NTSB

- FedEx-1, UPS-1, and UPS-2 all equipped with Collision Avoidance System –including AEB
- FedEx driver described overturned motorcoach as a “black wall”
- NTSB Finding: Circumstances of the impact for each of the three trucks were likely outside the capabilities of the collision avoidance system on the vehicles

Limitations of Onboard Sensors

Identified limitations of current onboard line-of-sight sensors in this crash:

- Seeing around a curve or obstacle
- Inclement weather
- Orientation or profile of overturned motorcoach

NTSB Finding: Connected vehicle technology, if installed on the vehicles involved in the crash, could have provided information about the overturned motorcoach in the roadway to the FedEx truck, UPS-1, UPS-2, and the car, so that the drivers could be alerted to the hazard they were approaching, and the automated vehicle systems might have prevented the crashes involving those vehicles

V2X – Harmful Interference

Harmful interference impairs the integrity of crash imminent applications

- High degree of confidence is necessary to ensure signal is accurate, protected, and secure

NTSB Finding: Recent regulatory action by the FCC that decreases the size of the intelligent transportation system communication spectrum and allows harmful interference from unlicensed devices, such as those that use wi-fi, threatens the future deployment of connected vehicle technology

NTSB Recommendation: To the FCC: Implement appropriate safeguards to protect vehicle-to-everything communications from harmful interference from unlicensed devices, such as those that use wi-fi

V2X – Regulatory Uncertainty

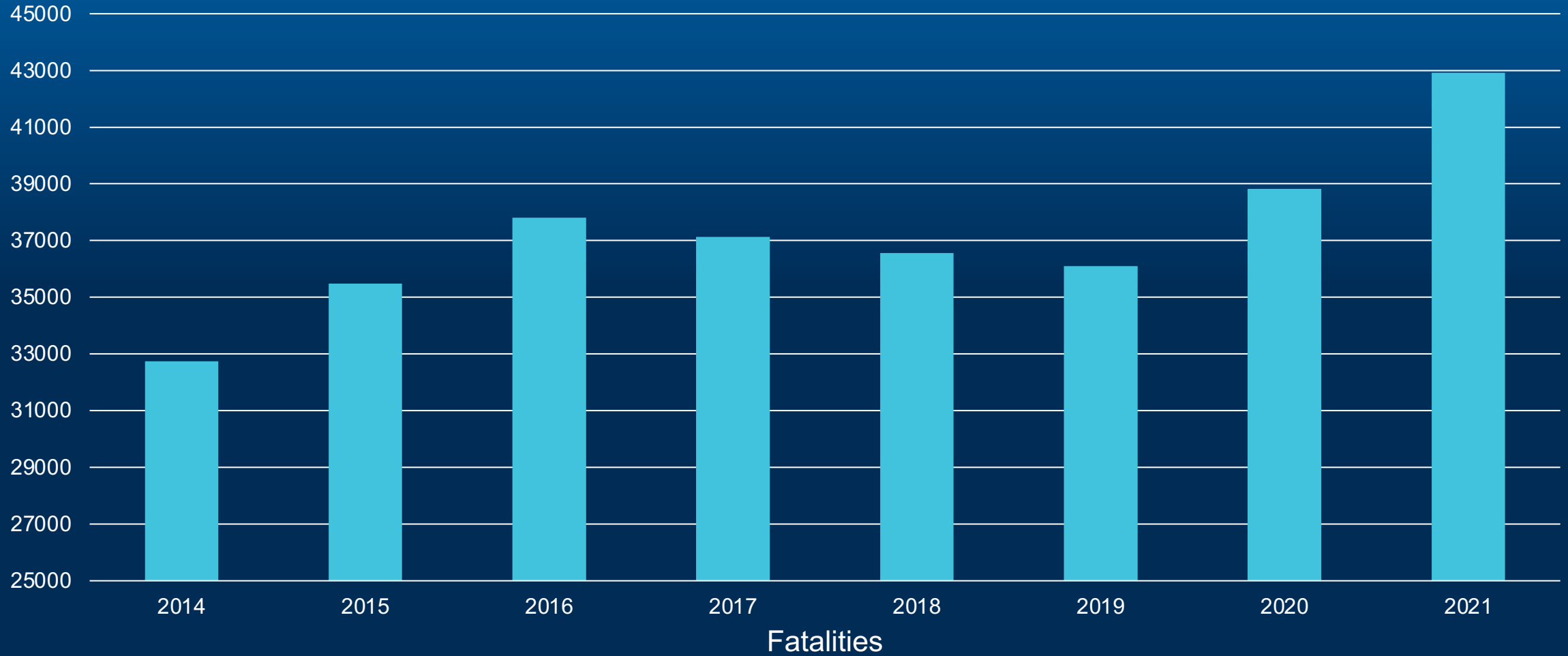
NTSB Finding: Leadership by the US Department of Transportation is needed to establish regulatory certainty and resolve critical issues related to vehicle-to-everything communication protocols; interference from unlicensed devices, such as those that use wi-fi; and sufficiency of communication spectrum needed for advanced connected vehicle applications

NTSB Recommendation: Implement a plan for nationwide connected vehicle technology deployment that (1) resolves issues related to interference from unlicensed devices, such as those that use wi-fi; (2) ensures sufficient spectrum necessary for advanced connected vehicle applications; and (3) defines communication protocols to be used in future connected vehicle deployment.

Path Forward

- Developing and deploying V2X in a way that is secure and interoperable is a complex problem requiring collaboration among regulators, infrastructure owner operators, and private industry
- Regulators must provide industry and infrastructure owner operators with regulatory certainty
- Regulatory certainty immediately incentivizes V2X investment and deployment
- Infrastructure owner operators should develop a V2X readiness plan and deploy V2X connected infrastructure in coordination with target from regulators and automakers
- Industry must act
- Safety promise of V2X is only realized when we reach a critical mass of vehicles on our roadways

United States Roadway Fatalities



NTSB's V2X Resource Page

- [NTSB.gov/V2X](https://www.ntsb.gov/V2X)
- Overview of V2X
- V2X Video Series
- Guest Bios
- Referenced Research
- Related NTSB Investigations and Recommendations

NTSB National Transportation Safety Board

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Home > Advocacy > Safety Topics > V2X: Preserving the Future of ...

V2X: Preserving the Future of Connected Vehicle Technology

Watch the entire series on the NTSB YouTube Channel

Series Episodes

- [Episode 1](#)
- [Episode 2](#)
- [Episode 3](#)
- [Episode 4](#)

Related Information

- [Related Investigations](#)
- [Our Recommendations](#)
- [Rulemaking and NTSB Responses](#)

Resources

- [MWL Safety Item: Require Collision-Avoidance and Connected-Vehicle Technologies on all Vehicles](#)

NTSB MOST WANTED LIST VIDEO SERIES

Hosted by Board Member Michael E. Graham

V2X Preserving the Future of Connected-Vehicle Technology

What is Connected-Vehicle Technology?

Connected-vehicle technology enables commercial and passenger vehicles to communicate with each other, with the infrastructure, and with other road vehicles, such as motorcycles. It is also described as vehicle to everything (V2X), an umbrella term covering the various elements with which vehicles can communicate.

Connected-vehicle technology (V2X): Where are we today and what does the future look like?

In our four-part Most Wanted List (MWL) Interview video series, Board Member Michael Graham talks with experts from government, industry, and academia about the safety benefits and the maturity level of V2X technology, the reasons for its scarce deployment, and the impact of the Federal Communications Commission's (FCC) recent actions to limit the spectrum available for transportation safety.

- The basic viability of V2X is being threatened.
- The FCC's regulatory actions substantially limit the spectrum available for transportation safety and allow for harmful interference from unlicensed Wi-Fi devices.
- Regulatory uncertainty is the primary reason for the lack of V2X deployment.

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