

Analysis of Collisions Involving Transit Vehicles and Applicability of Connected Vehicle Solutions

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Transit Collisions

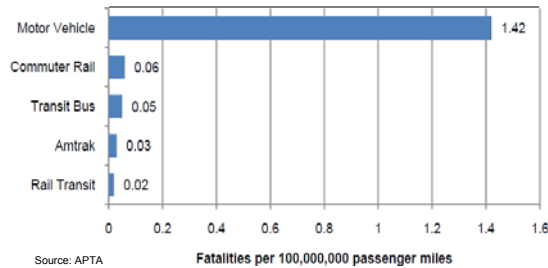
- Over \$250M in damages annually
- Over 100 fatalities with thousands of injuries annually
- Less than 1% of total traffic crash casualties, but often the front page news



Source: http://articles.nydailynews.com/2011-05-18/local/20110518_1_city-bus-art-the-worner
bigpage



Source: http://www.msmbc.man.com/id432258/noblis_news-crime_and_courts/huff-chicago-shooting-about-bus-crash/



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Connected Vehicles for Transit Safety



Connected vehicles can help mitigate collisions with transit vehicles

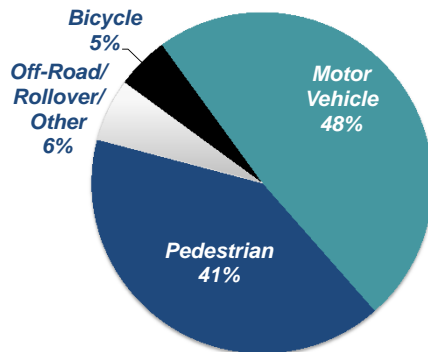


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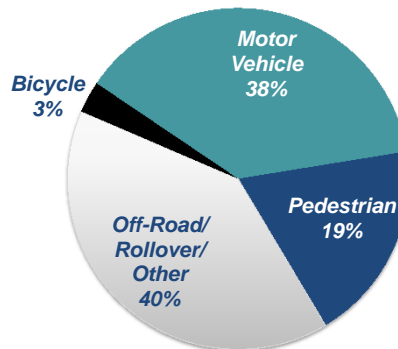
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Fatal Collision Characteristics

Fatal Transit Bus Crashes



All Fatal Crashes

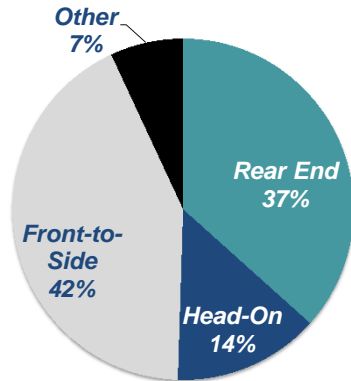


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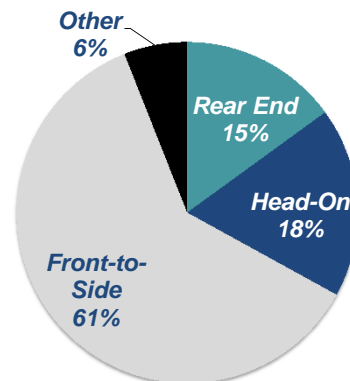
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Fatal Collision Types

Fatal Transit Bus Crashes



All Fatal Crashes



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Study Overview

- This project included a detailed analysis of transit collisions to better understand where connected vehicles have the most potential to reduce the number and severity of traffic collisions that involve transit buses.
- The study results were used to identify/prioritize candidate transit collision scenarios for near-term connected vehicle safety research.
- This study analyzed transit collision datasets from the 2010 National Transit Database (NTD)

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National Transit Database

- The NTD was established to be the nation's primary source for information and statistics on the transit systems of the United States.
- Recipients or beneficiaries of grants from the FTA under the Urbanized Area Formula Program (§5307) or Other than Urbanized Area (Rural) Formula Program (§5311) are required to submit data to the NTD.

Incident Reporting in NTD

- The Reportable Incident Report form (S&S-40) was designed to capture detailed information on the most severe safety and security incidents occurring in the transit environment.
- A reportable incident is an event that involves a transit vehicle or occurs on transit-controlled property and meets one or more of the following conditions:
 - A fatality (including a suicide or deaths resulting from Other Safety Occurrences),
 - Injuries requiring immediate medical attention away from the scene for one or more persons,
 - Property damage equal to or exceeding \$25,000, and/or
 - An evacuation for life safety reasons.

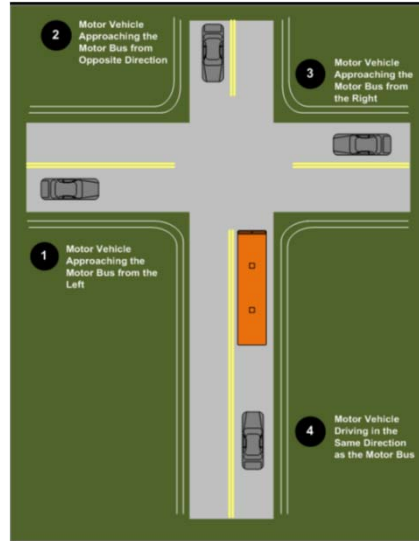
2010 National Transit Database

Mode	Crashes		Injuries		Fatalities	
	Count	Percentage	Count	Percentage	Count	Percentage
Demand Responsive	549	13.4%	1,651	6.5%	10	4.5%
Heavy Rail	116	2.8%	7,518	29.8%	96	43.4%
Light Rail	177	4.3%	914	3.6%	24	10.9%
Motor Bus	3,224	78.4%	14,803	58.7%	84	38.0%
Other	42	1.1%	337	1.3%	7	3.2%
TOTAL	4,108	100%	25,223	100%	221	100%

Additional Data Desired

- **Transit Vehicle's Turning Movement.** The NTD included a data field for the transit vehicle's action as 'making a turn'; however it did not differentiate whether the transit vehicle was making a left turn or a right turn.
- **Motor Vehicle's Action.** The NTD did not include a data field for a motor vehicle's movement (e.g., going straight, turning left, or turning right).
- **Vehicle Geographic Relationship.** The NTD did not define a data field describing the geographic relationship between two vehicles that were involved in a collision. For example, it was not possible to determine if the motor vehicle was approaching the transit vehicle at an intersection from the left, from the right, driving in the same direction, or approaching the transit vehicle from the opposite direction.

Motor Vehicle Approaches at Intersections



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Incident Description from the NTD

Bus moving straight through intersection. Auto turning left opposite direction left of bus. R/F of Auto struck L/F of bus. One customer claimed injury, as did the motorist of Auto.

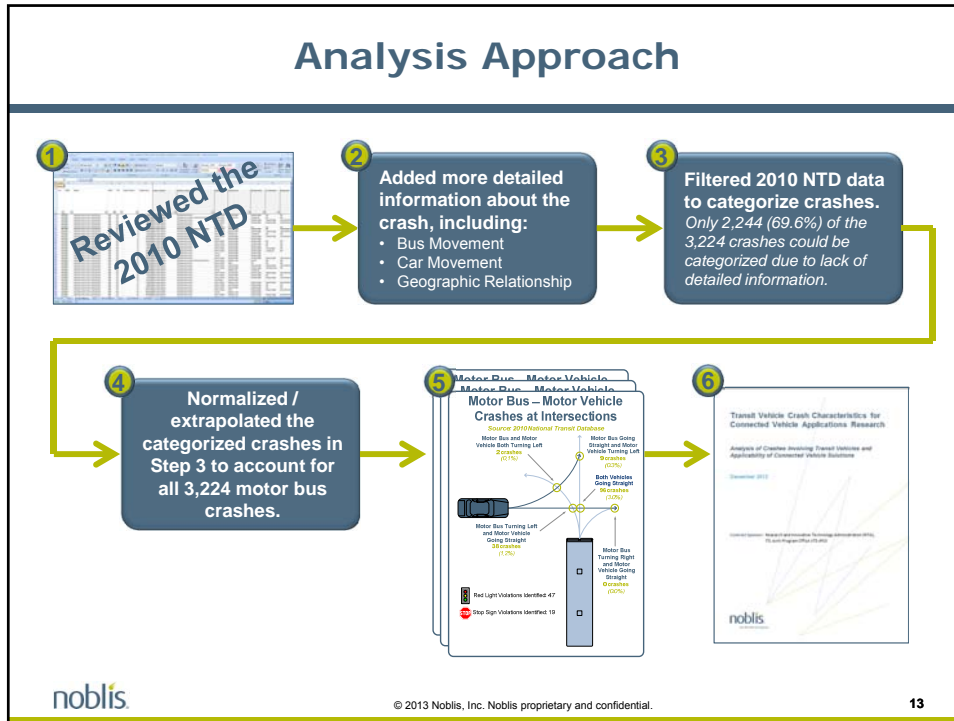
POV was traveling eastbound on NE Vancouver Mall Dr just past NE 77th Ave. POV driver state that she sprayed her windshield with water by pressing her windshield wiper control. POV driver said her windshield immediately froze and she was unable to see outside. POV collided into the rear of bus that was stopped at the marked bus stop.

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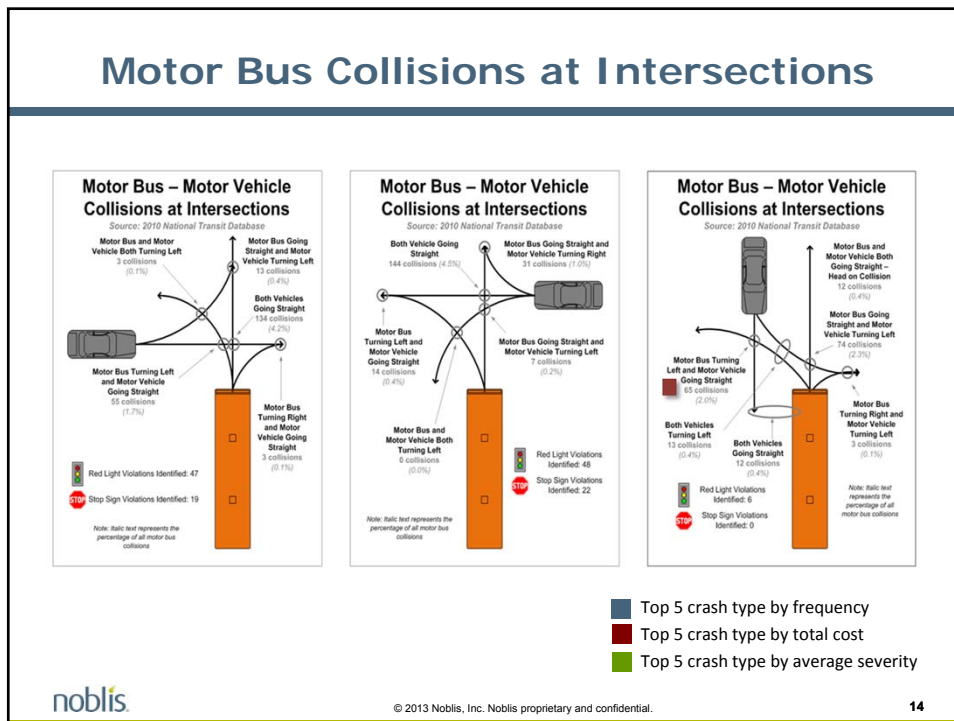
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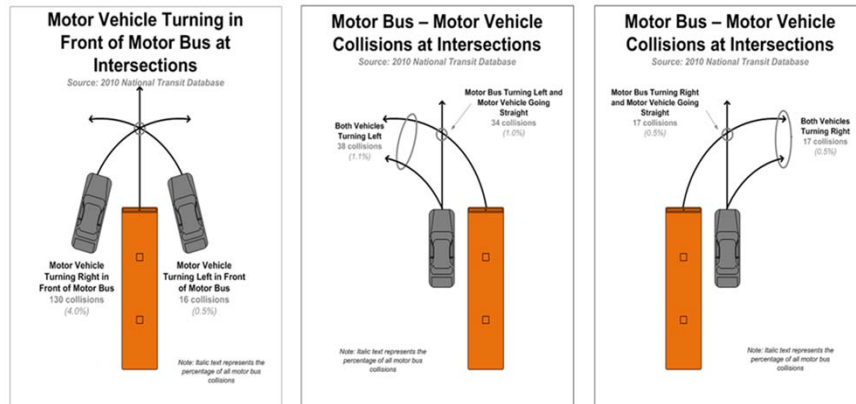
Analysis Approach



Motor Bus Collisions at Intersections

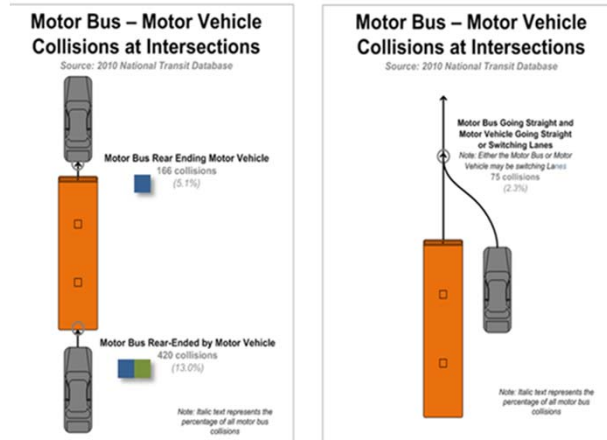


Motor Bus Collisions at Intersections (cont.)



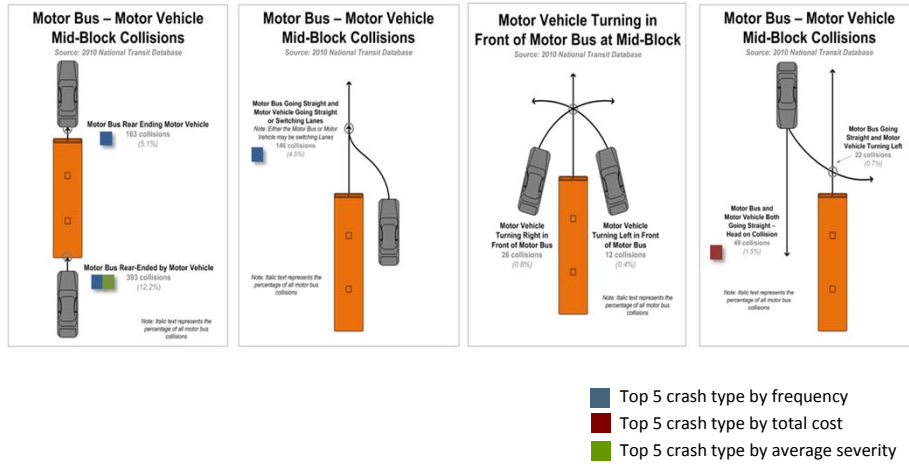
- Top 5 crash type by frequency
- Top 5 crash type by total cost
- Top 5 crash type by average severity

Motor Bus Collisions at Intersections (cont.)

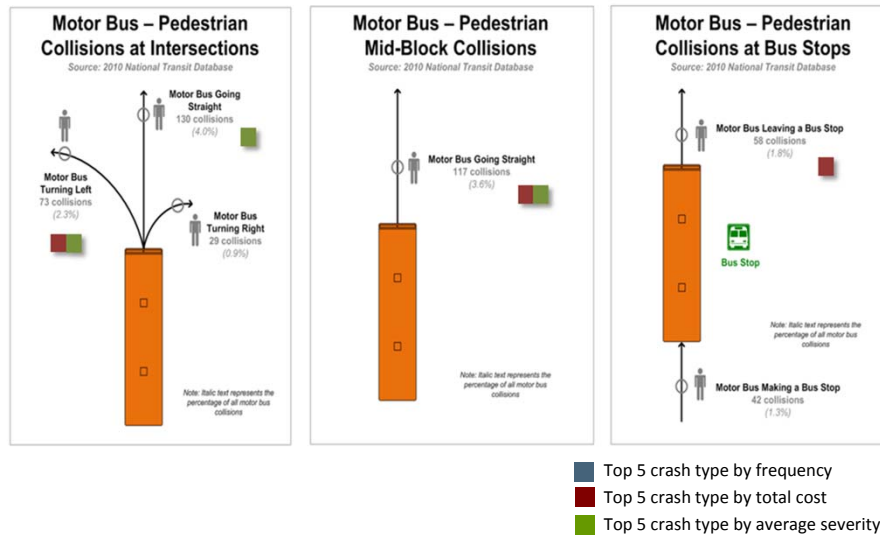


- Top 5 crash type by frequency
- Top 5 crash type by total cost
- Top 5 crash type by average severity

Motor Bus Collisions at Mid-blocks



Motor Bus Collisions with Pedestrians



Frequency Ranking

Ranking by Frequency			
No.		Crash Type	Collision With
1	Intersection - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Motor Bus Rear Ended	Motor Vehicle
2	Mid-Block - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Motor Bus Rear Ended	Motor Vehicle
3	Intersection - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Motor Bus Rear Ending	Motor Vehicle
4	Mid-Block - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Motor Bus Rear Ending	Motor Vehicle
5	Mid-Block - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Switching Lanes	Motor Vehicle
6	Intersection - Motor Bus Going Straight	Motor Vehicle Approaching from Right - Going Straight	Motor Vehicle
7	Intersection - Motor Bus Going Straight	Motor Vehicle Approaching from Left - Going Straight	Motor Vehicle
8	Crashes at Intersections	Motor Bus Going Straight	Pedestrian
9	Intersection - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction and Turning Right in Front of Bus	Motor Vehicle
10	Mid-Block Crashes	Motor Bus Going Straight	Pedestrian

Total Collision Cost Ranking

Ranking by Cost			
No.		Crash Type	Collision With
1	Intersection - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Motor Bus Rear-Ended	Motor Vehicle
2	Mid-Block - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Motor Bus Rear-Ended	Motor Vehicle
3	Mid-Block Crashes	Motor Bus Going Straight	Pedestrian
4	Crashes at Intersections	Motor Bus Going Straight	Pedestrian
5	Crashes at Intersections	Motor Bus Turning Left	Pedestrian
6	Intersection - Motor Bus Going Straight	Motor Vehicle Approaching from Right - Going Straight	Motor Vehicle
7	Intersection - Motor Bus Going Straight	Motor Vehicle Approaching from Left - Going Straight	Motor Vehicle
8	Mid-Block - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Motor Bus Rear-Ending	Motor Vehicle
9	Intersection - Motor Bus Turning Left	Motor Vehicle Approaching the Motor Bus in the Opposite Direction - Going Straight	Motor Vehicle
10	Intersection - Motor Bus Going Straight	Motor Vehicle Driving in Same Direction – Motor Bus Rear-Ending	Motor Vehicle

Average Collision Cost Ranking

Ranking by Average Cost per Crash			
No.		Crash Type	Collision With
1	Crashes at Intersections	Motor Bus Turning Left	Pedestrian
2	Mid-Block Crashes	Motor Bus Leaving a Bus Stop	Pedestrian
3	Mid-Block Crashes	Motor Bus Going Straight	Pedestrian
4	Mid-Block - Motor Bus Going Straight	Motor Vehicle Approaching the Motor Bus in the Opposite Direction - Going Straight	Motor Vehicle
5	Intersection - Motor Bus Turning Left	Motor Vehicle Approaching the Motor Bus in the Opposite Direction - Going Straight	Motor Vehicle
6	Mid-Block - Motor Bus Going Straight	Motor Vehicle Approaching the Motor Bus in the Opposite Direction - Turning Left	Motor Vehicle
7	Crashes at Intersections	Motor Bus Turning Right	Pedestrian
8	Crashes at Intersections	Motor Bus Going Straight	Pedestrian
9	Mid-Block - Motor Bus Going Straight	Motor Vehicle Parked - Same Direction	Motor Vehicle
10	Intersection - Motor Bus Going Straight	Motor Vehicle Approaching from Left - Going Straight	Motor Vehicle

“The highest frequency collisions are rear end collisions; the highest cost collisions (and most tragic) are with pedestrians”

Potential Application Areas for Transit Safety

- Transit-Vehicle / Pedestrian Warning Applications
- Bus Stop Warning Applications
- Left Turn Assist Warning Applications
- Forward Collision Warning Applications
- Blind Spot Warning / Lane Change Warning Applications
- Angle Collisions at Intersections Warning Applications

Next Steps

Acknowledgement

ITS Joint Program Office
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