# Benefits of Vehicle Safety Communications

## CICAS-V and VSC-A

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# Presentation Overview

- Introduction to Safety Benefits
- CICAS-V Benefits
- VSC-A Benefits
- Summary and Plans

# Safety: Research Questions

- Does the safety system alter crash frequency and severity?
- Is the safety system more effective in preventing some crash scenarios?
- Are there any unintended consequences?

# Safety Benefits Basic Principle

Crashes *Avoided* = Crashes *Without* – Crashes *With*

Crashes *Avoided* = Crashes *Without* × $\left(1 - \frac{\text{Crashes } \textit{With}}{\text{Crashes } \textit{Without}}\right)$

$N_a$

***Applicable Crashes***

$N_{wo}$

***System Effectiveness***

**SE**

$$N_a = N_{wo} \times SE$$

**Process**:

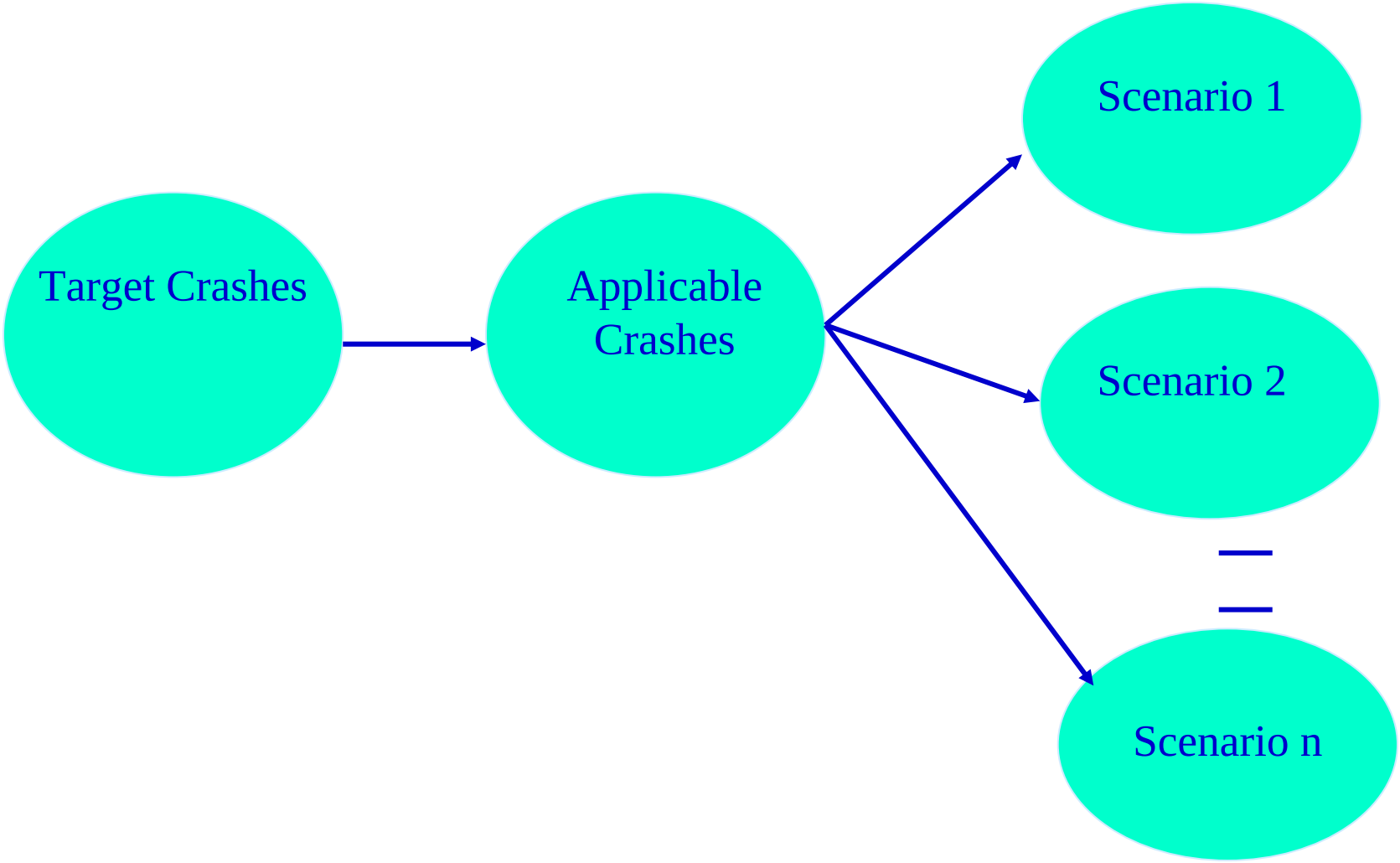
1. Break down applicable crashes to the lowest level of pre-crash scenarios where system effectiveness may vary

2. Estimate system effectiveness in each pre-crash scenario

# How CICAS-V and VSC-A Safety Benefits Differ

| CICAS-V | VSC-A |
| --- | --- |
| • Based on data collected from a Field Operational Test (FOT)<br>• Cooperative vehicle-infrastructure system | • Input data from test track and modeling<br>• Vehicle-vehicle based system |

# Breakdown of CICAS-V Applicable Crashes



# Estimation of CICAS-V System Effectiveness

$$\text{Crashes } \textit{Avoided} = \text{Crashes } \textit{Without} \times \left(1 - \frac{\text{Crashes } \textit{With}}{\text{Crashes } \textit{Without}}\right)$$

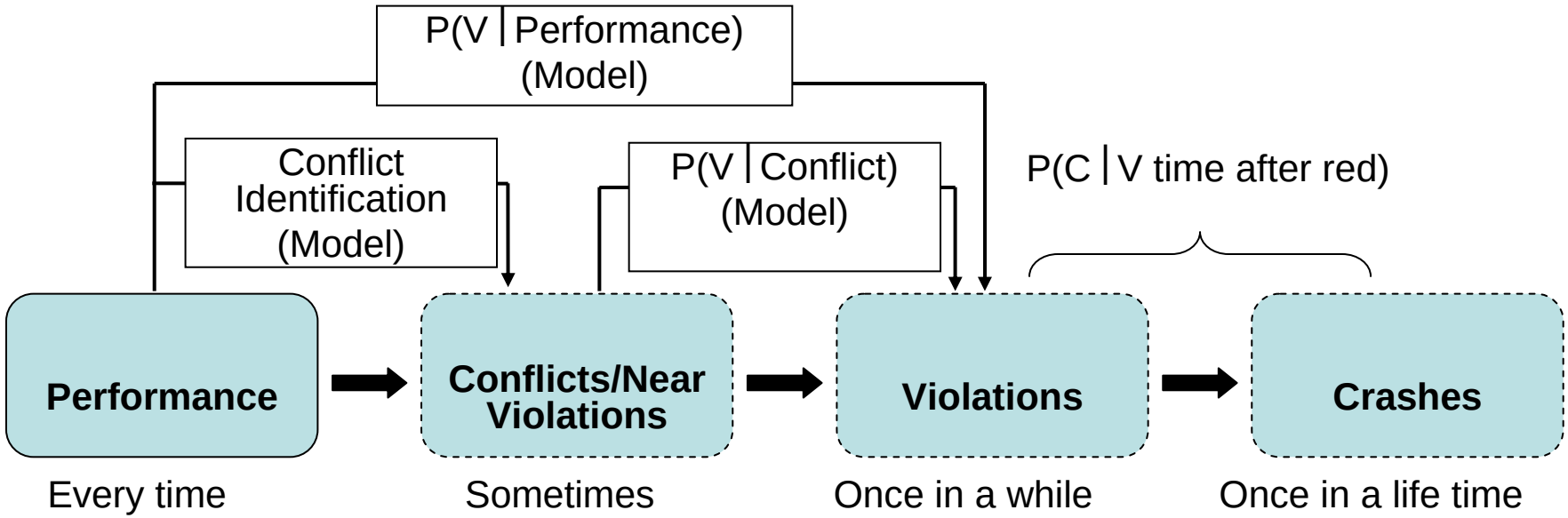
***System Effectiveness* SE**

Determine Crashes *With* and Crashes *Without* from:

$$\text{Crashes} = \text{Violations} \times \text{Probability}(\text{Crash} \mid \text{Violation}_{\text{time after red}})$$

***Exposure Factor*** ***Prevention Factor***

# Data Flow for CICAS-V Safety Benefits Estimation




| Sample Measures | | |
|---|---|---|
| Brake reaction time to desired signal<br><br>Average deceleration | Number of near violations per total number of crossings | Number of violators |

# VSC-A Safety Benefits Approach

OEMs will:

- Equip 10 vehicles with DSRC
- Develop vehicle relative positioning algorithms
- Develop warning algorithms
- Test vehicles and algorithms (no FOT!)

US DOT will:

- Help plan tests
- Receive and analyze test data
- Estimate safety benefits

# Safety Benefits Model – VSC-A

$$B = \sum_i N_{\mathrm{woi}} \times \mathrm{D(MP)}_i \times \left( 1 - \frac{\sum_j p_j x_{i,j}}{x_{i,()}} \right),$$

Parameterizing the model is the key to estimating the VSC-A safety benefit

**B** = number of crashes avoided

**$N_{woi}$** = Number of crashes in each scenario (from crash statistics)

**$D(MP)_i$** = Deployment effectiveness (higher is better, max = 1)

**$P_j$** = probability of a specific driver response

**$X_{i,j}$** = probability of a crash with specific driver response

# Summary and Plans

Discussed safety benefits estimation for two DSRC-enabled systems: CICAS-V and VSC-A

Safety benefits begins with a model, which must be parameterized

CICAS-V parameterization will use FOT and additional data

- Acquire additional data to link violations and severity to crashes
- Identify violations, near violations and performance events in FOT data
- Analyze driver response to situation and CICAS-V alert

VSC-A parameterization will use test data

- Analyze test data
- Develop representative set of crash initial conditions
- Simulate driver/vehicle response to alert following these initial conditions

# Questions/Comments?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