Vehicle to Vehicle (V2V) Communication System

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Total Quality Project Management (INSE 6230, Summer 2019)
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Outline

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- Scope of V2V
- SWOT Analysis
- WBS (Mind Mapping approach)
- Gantt Chart
- Weighted Score Metric
- Cost Estimation
- Probability / Impact Matrix
- Risk Breakdown Structure
- Future of V2V Systems

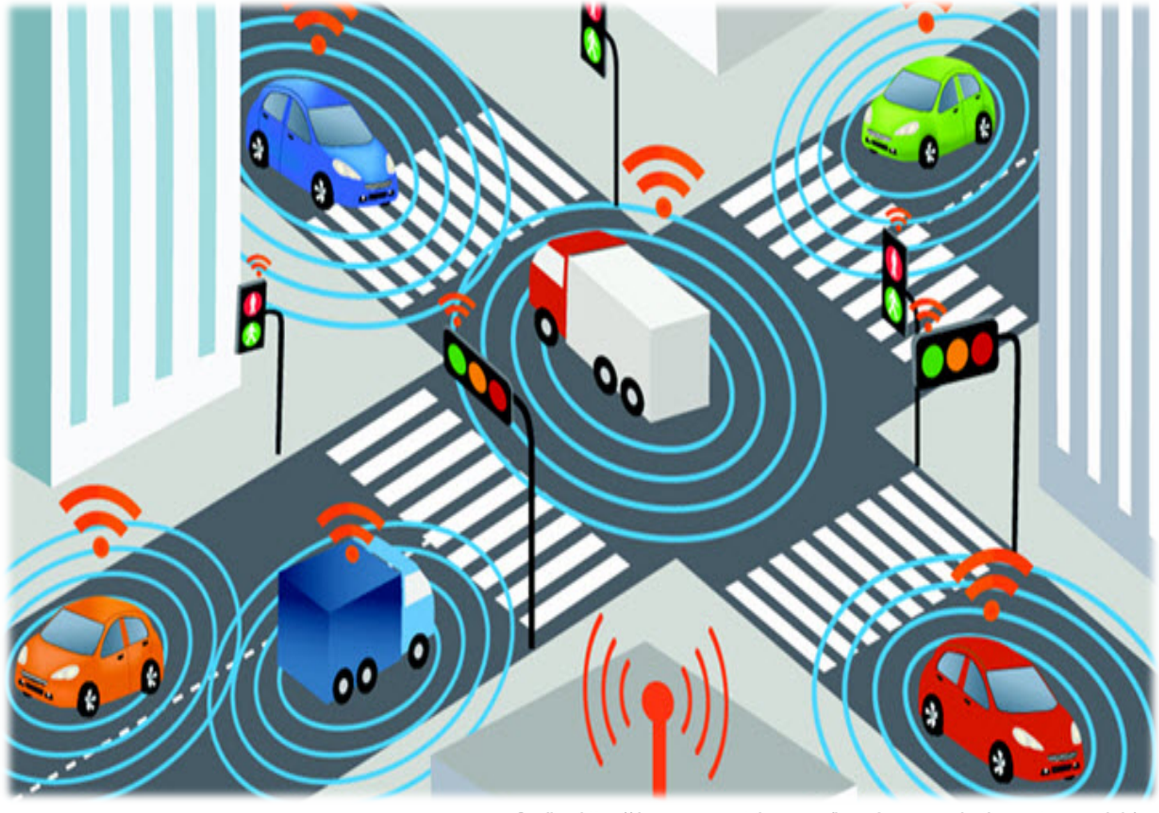
Introduction

What is V2V?

V2V is a crash avoidance technology, which relies on communication of information between nearby vehicles to potentially warn drivers about dangerous situations that could lead to a crash. For example, V2V could help warn a driver that a vehicle up ahead is braking and they need to slow down, or let a driver know that it's not safe to proceed through an intersection because another car (yet unseen by the driver) is quickly approaching.

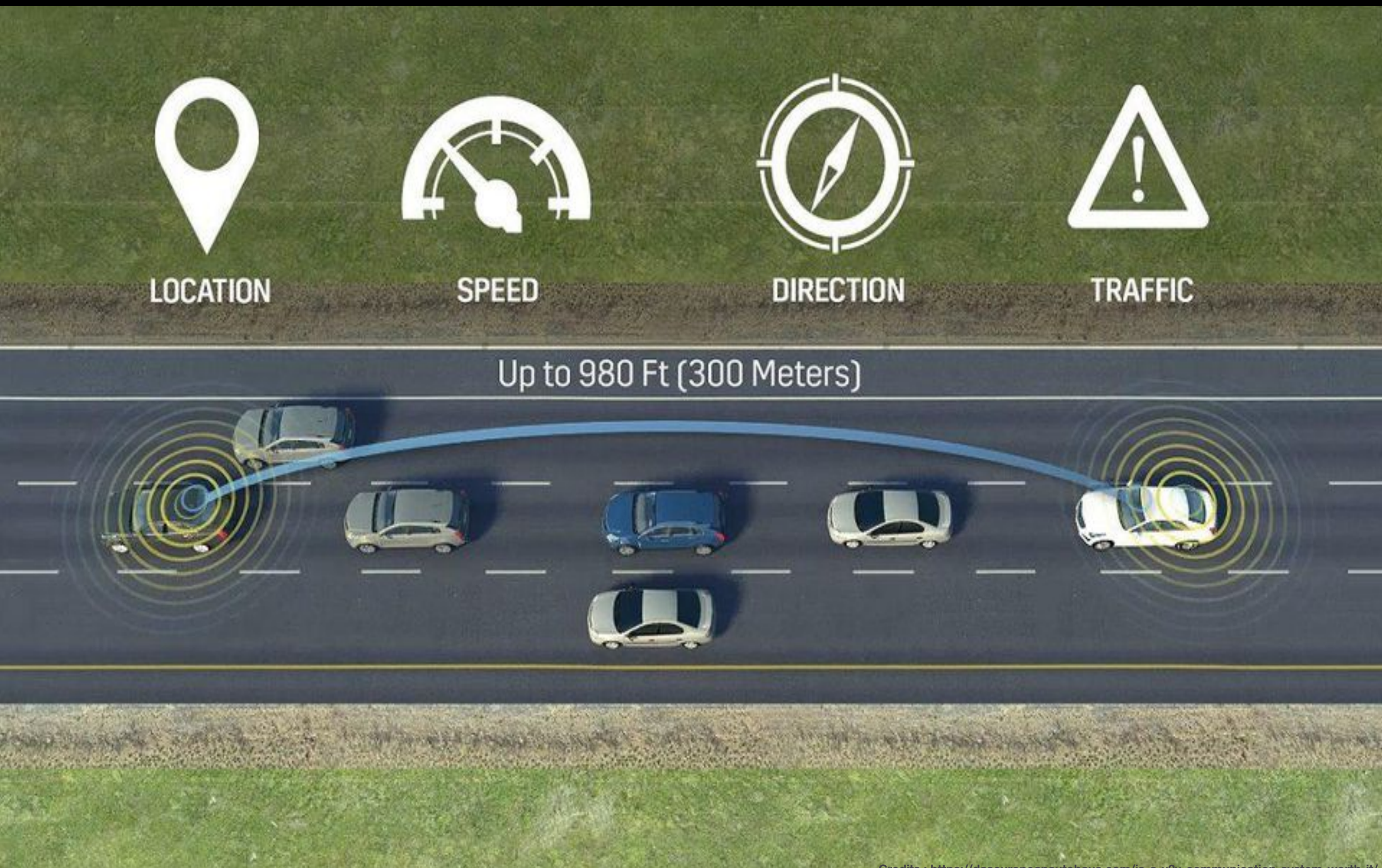
How does V2V work?

V2V communications systems are composed of devices, installed in vehicles, that use dedicated short-range radio communication (DSRC) to exchange messages containing vehicle information (e.g., vehicle's speed, heading, braking status). V2V devices use this information from other vehicles and determine if a warning to the vehicle's driver is needed, which could prevent a vehicle crash.



Credits : https://daseuropeanautohaus.com/is-a-v2v-communication-system-worth-it/

Introduction



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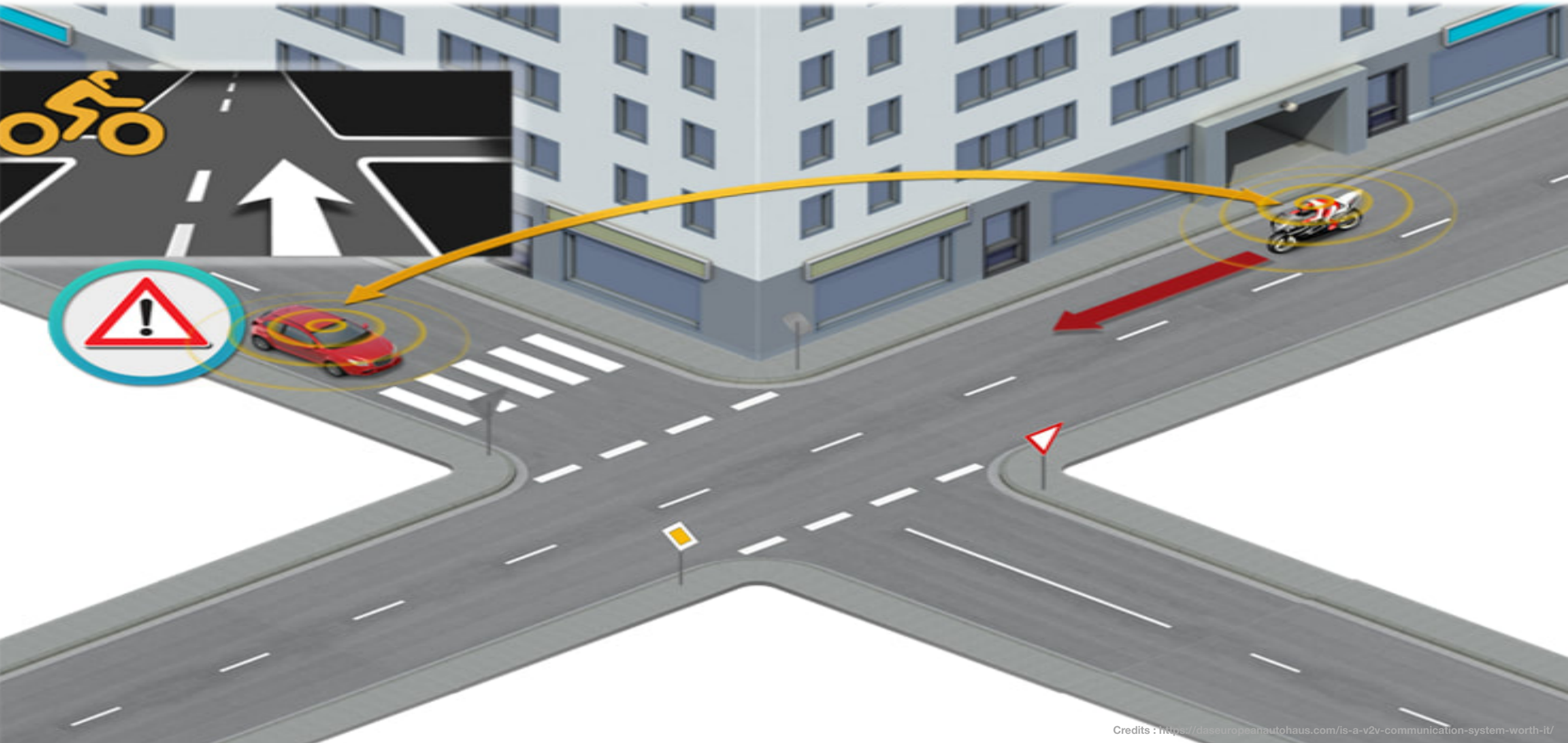
Scope of V2V

Intersection Movement Assist

IMA warns the driver when it’s not safe to enter an inter- section because of an increased potential for colliding with one or more vehicles.



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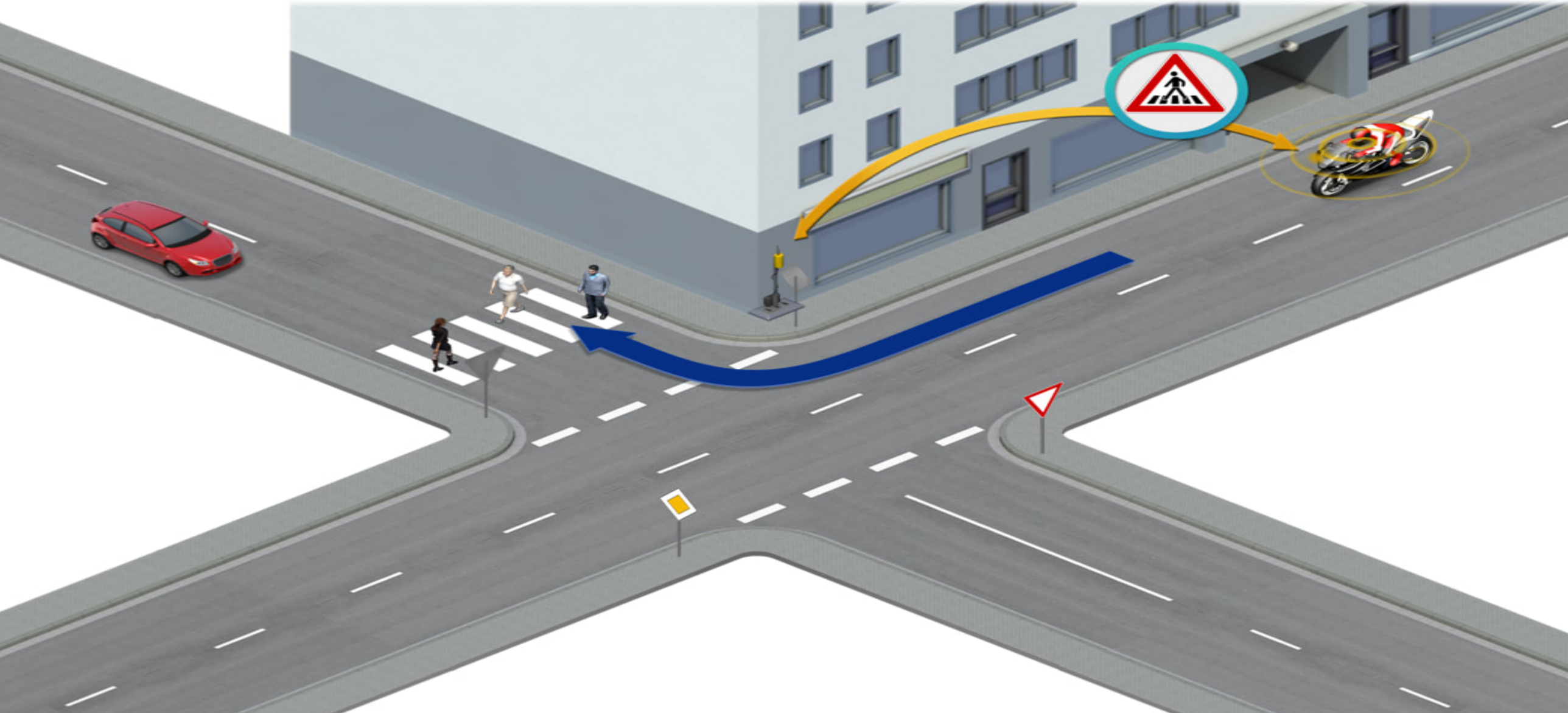
Scope of V2V

Left Turn Assist

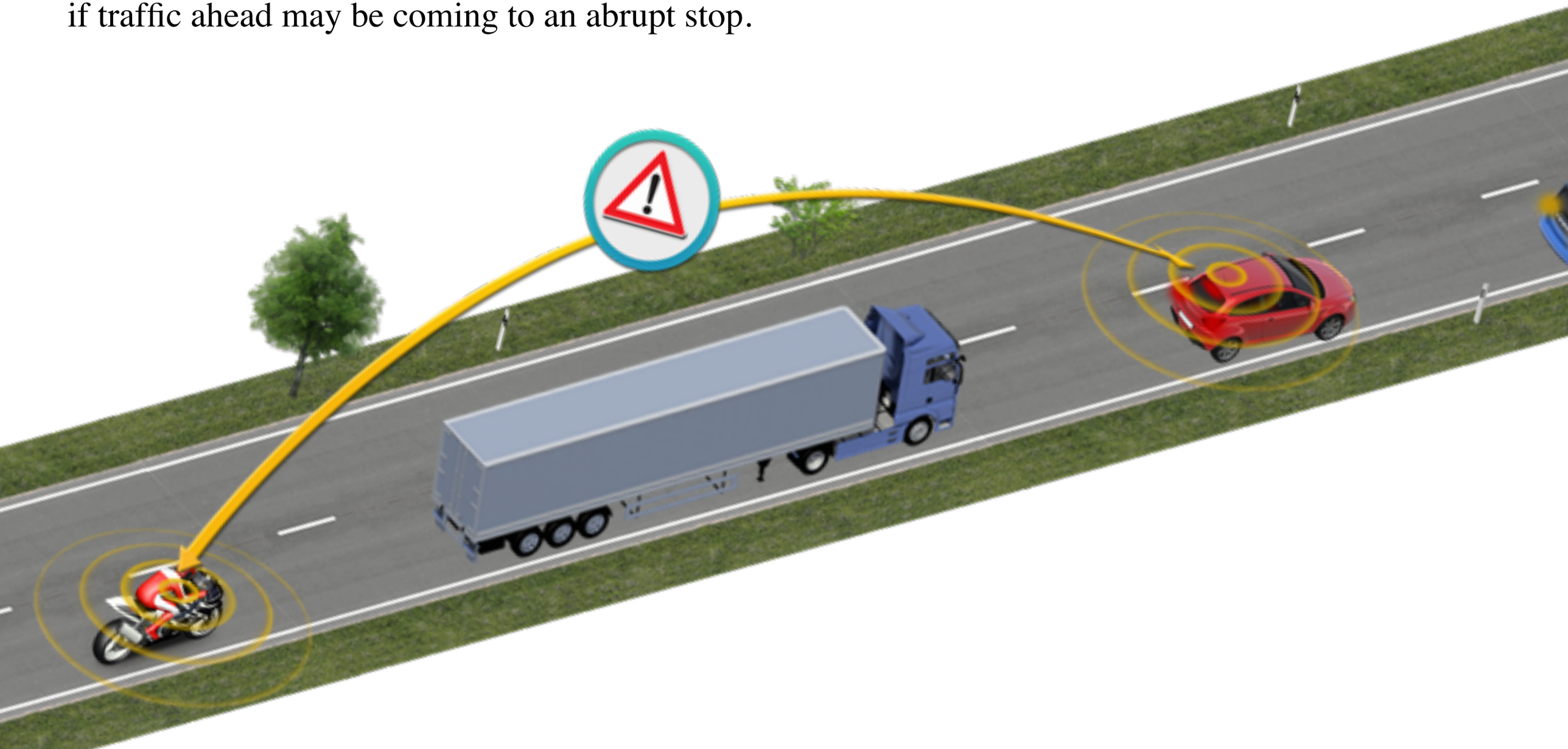
LTA warns the driver when there is strong probability they will collide with an oncoming vehicle when making a left turn. This is especially critical when the driver’s line-of- sight is blocked by a vehicle also making a left turn from the opposite direction.



Scope of V2V

Emergency Electronic Brake Light

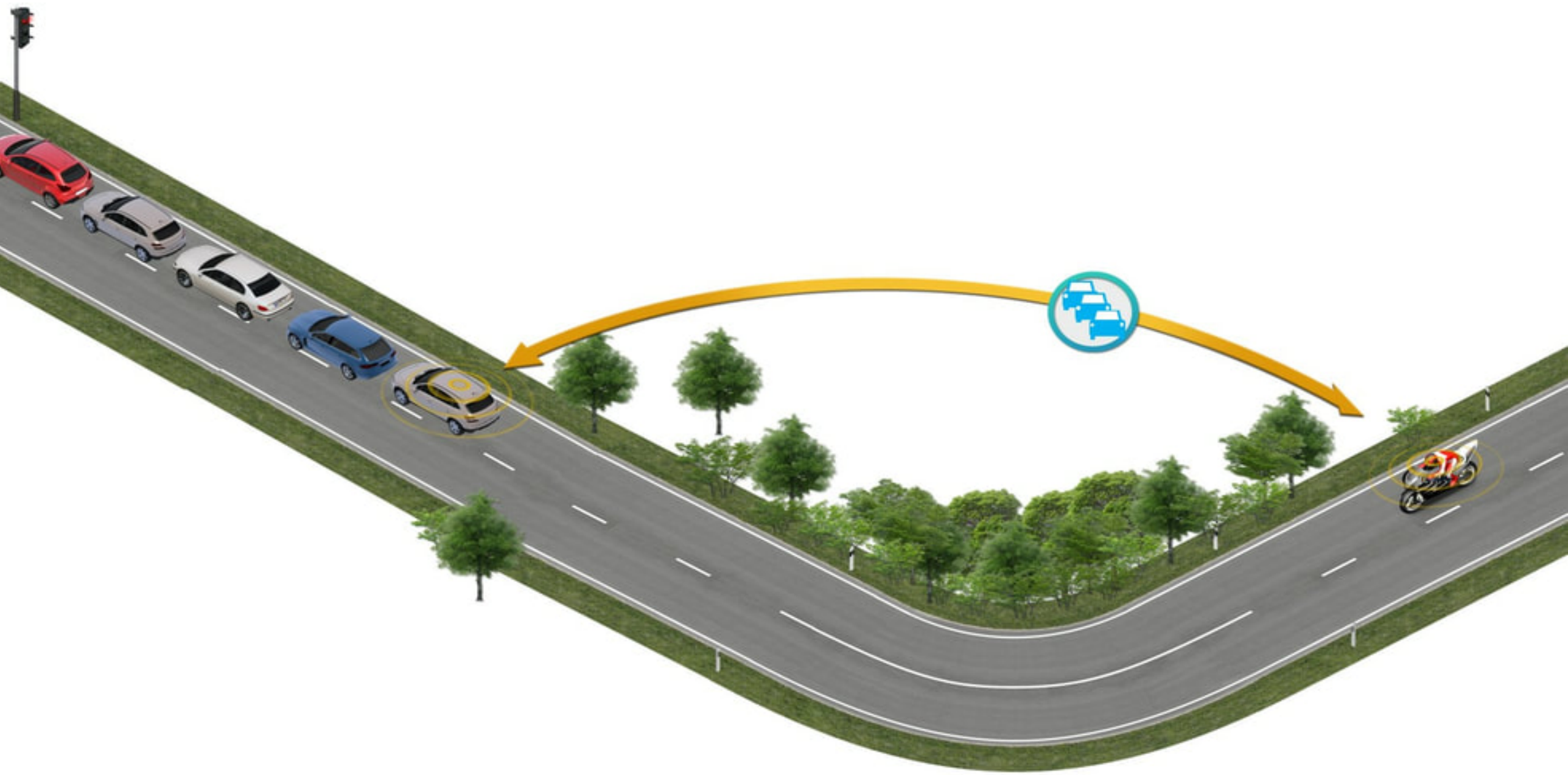
Emergency Electronic Brake Light (EEBL) warns the driver to be prepared to take action when a V2V-equipped vehicle traveling in the same direction but not in the driver's line-of-sight decelerates quickly. V2V would allow the driver to "see through" vehicles or poor weather conditions and know if traffic ahead may be coming to an abrupt stop.



Scope of V2V

Forward Collision Warning

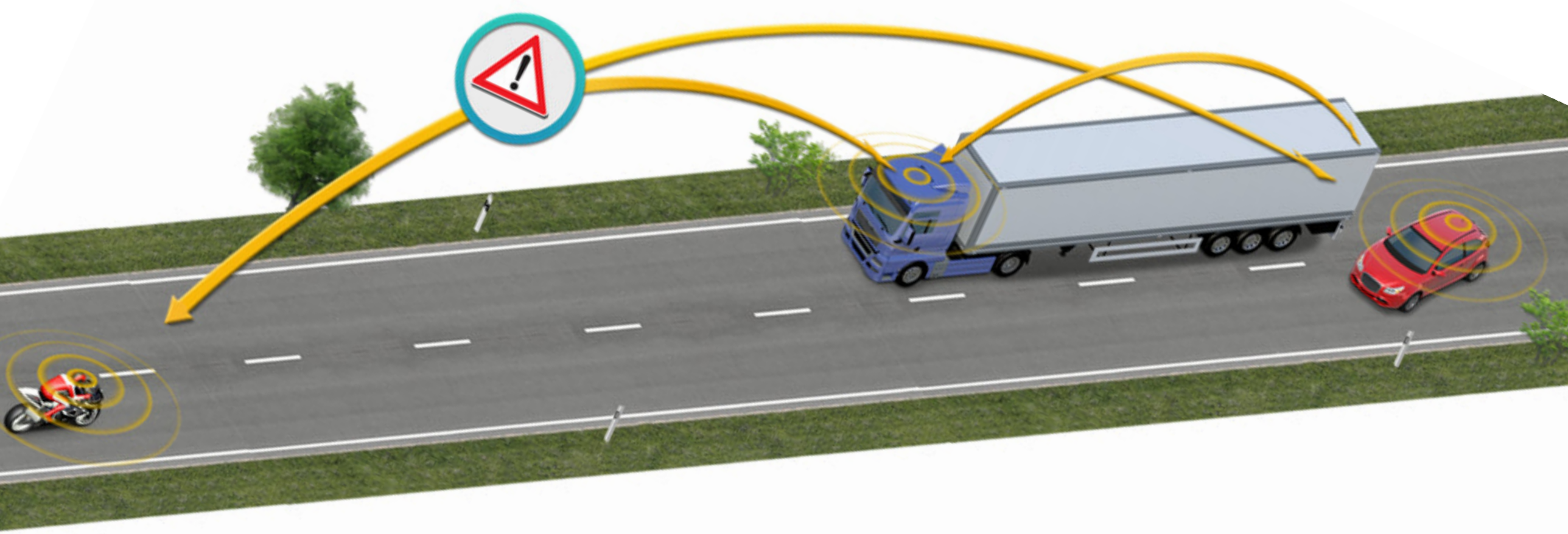
Forward Collision Warning (FCW) warns the driver of the risk of an impending rear-end collision with a vehicle ahead in traffic in the same lane and direction of travel.



Scope of V2V

Do-Not-Pass Warning

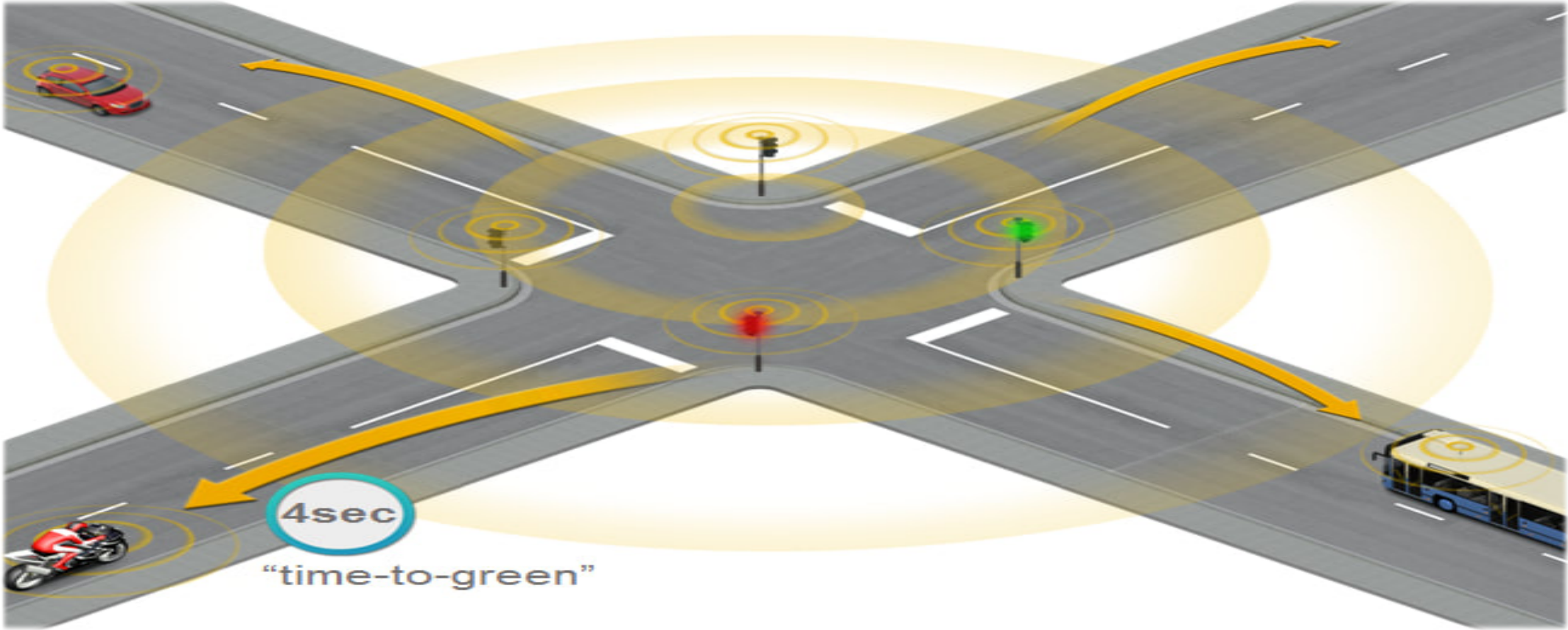
Do-Not-Pass Warning (DNPW) warns the driver that it is not safe to pass a slower-moving vehicle when vehicles are approaching from the opposite direction.



Scope of V2V

Green Light Optimised Speed Advisory

This will enable a smoother traffic flow and optimum efficiency by avoiding unnecessary braking and acceleration. The application can also display the remaining time till green in case the light is red, and so mitigates rider's stress.



SWOT Analysis

Strengths

- Provide accessibility to all drivers
- Increases safety and comfort
- Smooth traffic flow
- Potential to decrease the number of road accidents.
- Potential to decrease the number of parking spaces needed

weaknesses

- Costs
- Most of the countries do not have legislation that allows the use of autonomous vehicles on non-dedicated infrastructure. This is the reality in the Netherlands today.
- Electronic security: there may be hacking of the vehicle management system.
- Limited wireless/telecom bandwidth availability for V2V communication.
- New vehicle models needed to cope with the greater usage intensity of each vehicle.

SWOT Analysis

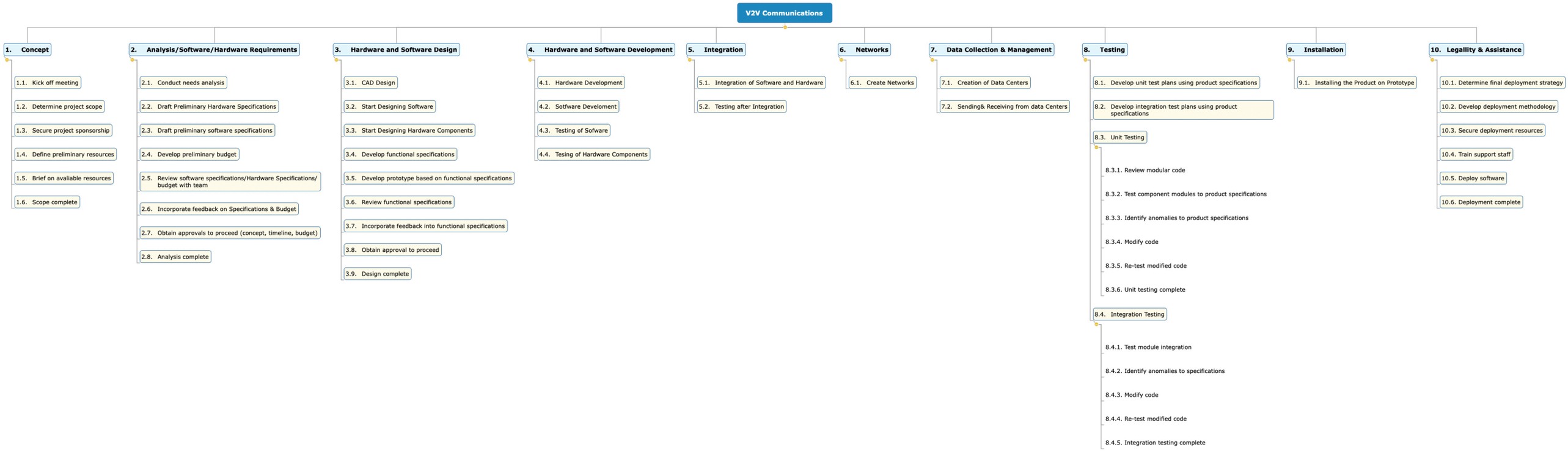
Opportunities

- Potential to increase road capacity (shorter headways) and thereby reduce congestion.
- Technology maturity may reduce system cost.
- sustainability might increase by more fuel efficient driving
- Increasing cooperation with AI-software/IT specialist and automotive industry concentrating on development of solutions for automated driving.

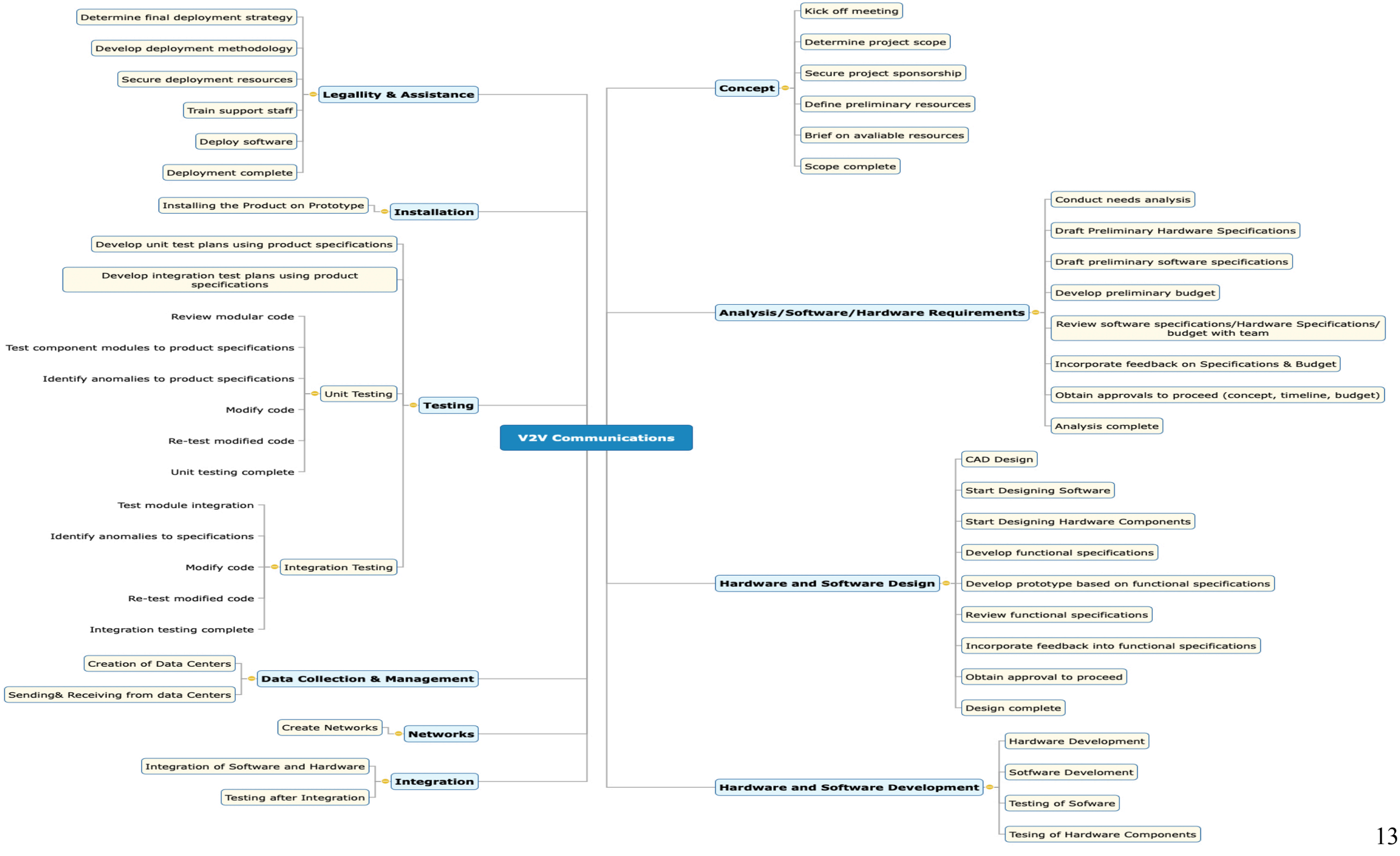
Threats

- Technology investments needed for supporting the use of the automated vehicle may not be possible due to lack of funds.
- Fusion of image and non image data cannot be solved accurately
- Uncertainty regarding bandwidth and electromagnetic interference
- Lack of sufficient training data

Work Breakdown Structure

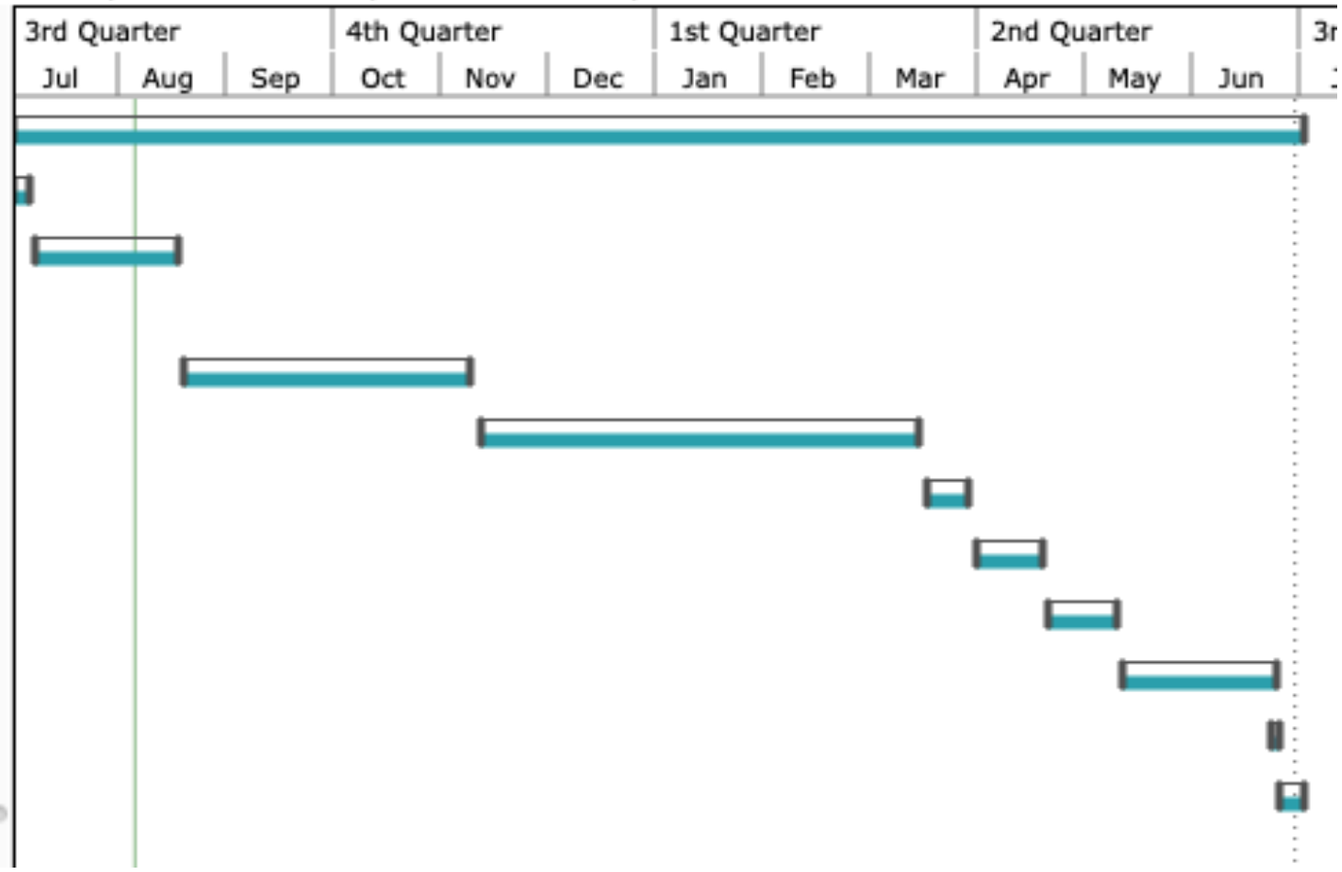


Mind Map


V2V Communications
Concept
Kick off meeting
Determine project scope
Secure project sponsorship
Define preliminary resources
Brief on avaliable resources
Scope complete
Analysis/Software/Hardware Requirements
Conduct needs analysis
Draft Preliminary Hardware Specifications
Draft preliminary software specifications
Develop preliminary budget
Review software specifications/Hardware Specifications/ budget with team
Incorporate feedback on Specifications & Budget
Obtain approvals to proceed (concept, timeline, budget)
Analysis complete
Hardware and Software Design
CAD Design
Start Designing Software
Start Designing Hardware Components
Develop functional specifications
Develop prototype based on functional specifications
Review functional specifications
Incorporate feedback into functional specifications
Obtain approval to proceed
Design complete
Hardware and Software Development
Hardware Development
Sotfware Develoment
Testing of Sofware
Tesing of Hardware Components
Testing
Develop unit test plans using product specifications
Develop integration test plans using product specifications
Unit Testing
Review modular code
Test component modules to product specifications
Identify anomalies to product specifications
Modify code
Re-test modified code
Unit testing complete
Integration Testing
Test module integration
Identify anomalies to specifications
Modify code
Re-test modified code
Integration testing complete
Legallity & Assistance
Determine final deployment strategy
Develop deployment methodology
Secure deployment resources
Train support staff
Deploy software
Deployment complete
Installation
Installing the Product on Prototype
Data Collection & Management
Creation of Data Centers
Sending& Receiving from data Centers
Networks
Create Networks
Integration
Integration of Software and Hardware
Testing after Integration

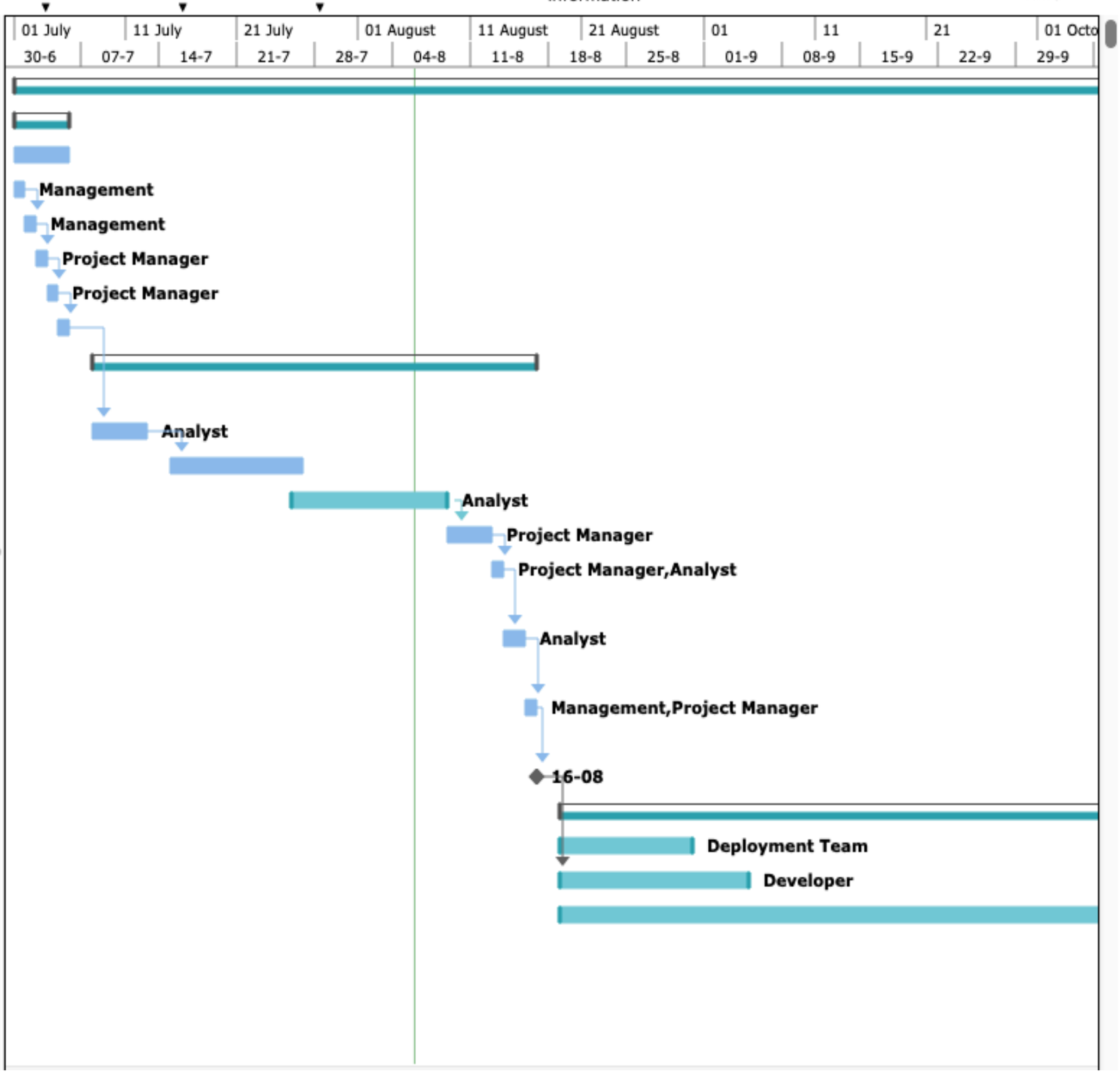
Gantt Chart

		Task Mode	Task Name
1			**V2V Communications**
2			**Concept**
9			**Analysis/Software/Hardware Requirements**
18			**Hardware and Software Design**
28			**Hardware and Software**
33			**Integration**
36			**Networks**
38			**Data Collection & Management**
41			**Testing**
57			**Installation**
59			**Legallity & Assistance**



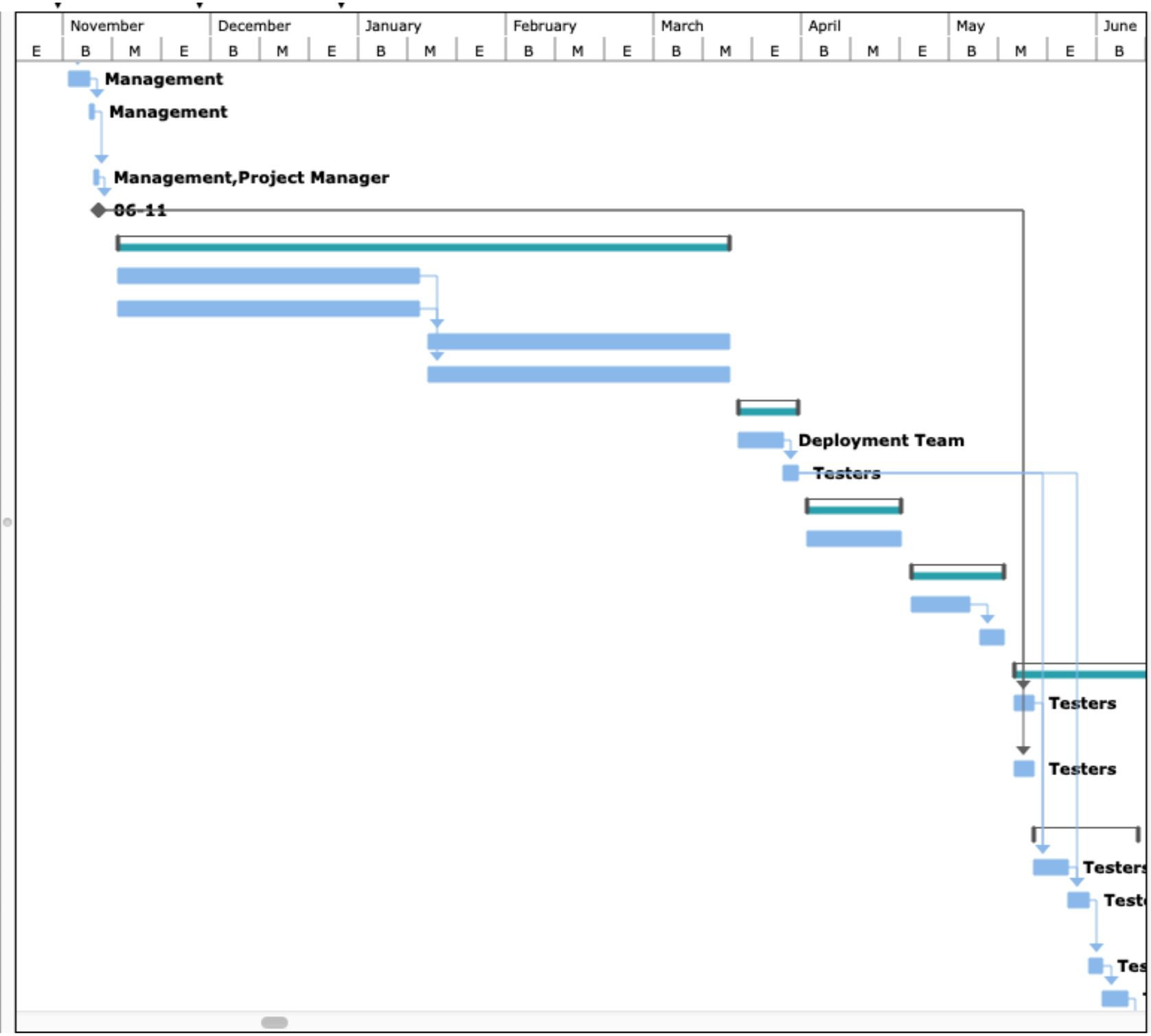
Gantt Chart

		Task Mode	Task Name
1			**V2V Communications**
2			**Concept**
3			Kick off meeting
4			Determine project scope
5			Secure project sponsorship
6			Define preliminary resources
7			Brief on avaliable resources
8			Scope complete
9			**Analysis/Software/Hardware Requirements**
10			Conduct needs analysis
11			Draft Preliminary Hardware
12			Draft preliminary software
13			Develop preliminary budget
14			Review software specifications/ Hardware Specifications/ budget
15			Incorporate feedback on Specifications & Budget
16			Obtain approvals to proceed (concept, timeline, budget)
17			Analysis complete
18			**Hardware and Software Design**
19			CAD Design
20			Start Designing Software
21			Start Designing
22			Develop functional specifications
23			Develop prototype based on functional specifications
24			Review functional specifications



Gantt Chart

	Task Mode	Task Name
24		Review functional specifications
25		Incorporate feedback into functional specifications
26		Obtain approval to proceed
27		Design complete
28		**Hardware and Software**
29		Hardware Development
30		Sotfware Develoment
31		Testing of Sofware
32		Tesing of Hardware Components
33		**Integration**
34		Integration of Software
35		Testing after Integration
36		**Networks**
37		Create Networks
38		**Data Collection & Management**
39		Creation of Data Centers
40		Sending& Receiving from
41		**Testing**
42		Develop unit test plans using product specifications
43		Develop integration test plans using product specifications
44		**Unit Testing**
45		Review modular code
46		Test component modules to product specifications
47		Identify anomalies to product
48		Modify code



Gantt Chart

49		Re-test modified code
50		Unit testing complete
51		**Integration Testing**
52		Test module integration
53		Identify anomalies to
54		Modify code
55		Re-test modified code
56		Integration testing complete
57		**Installation**
58		Installing the Product on Prototype
59		**Legality & Assistance**
60		Determine final
61		Develop deployment methodology
62		Secure deployment resources
63		Train support staff
64		Deploy software
65		Deployment complete

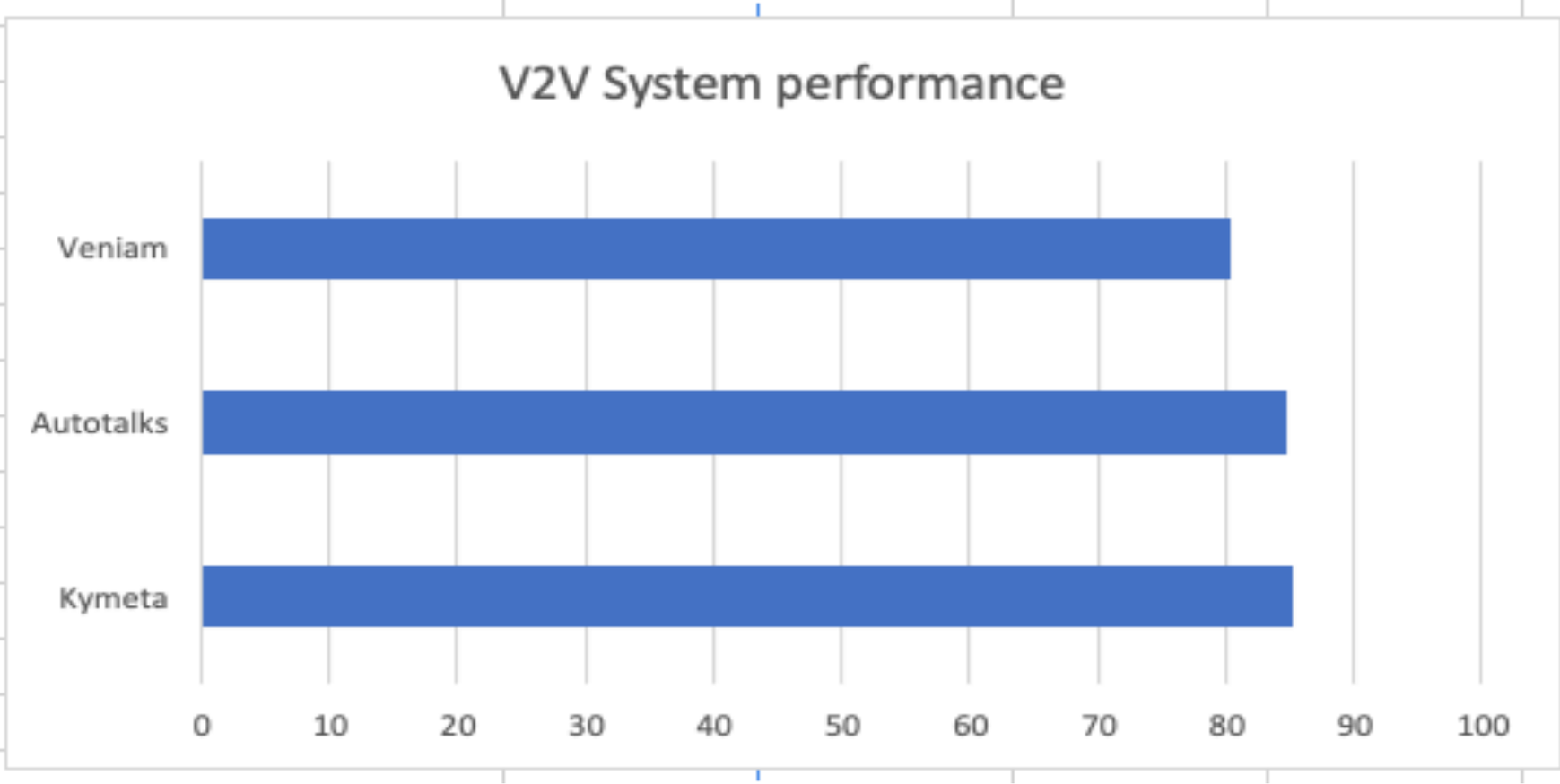
Project duration : ~ 1 year

Start Date : 01/07/2019

Closing Date : ~ 02/07/2020

Weighted Score Metric

Criteria	Weight	Kymeta	Autotalks	Veniam
Position & Motion Accuracy	40%	85	87	77
Cost (million)	5%	95	75	26.9
Vehicle safety extension	20%	100	100	95
Communication coverage	10%	90	100	90
Data exchange/message structure	25%	70	65	81
	100%	85.25	84.8	80.395

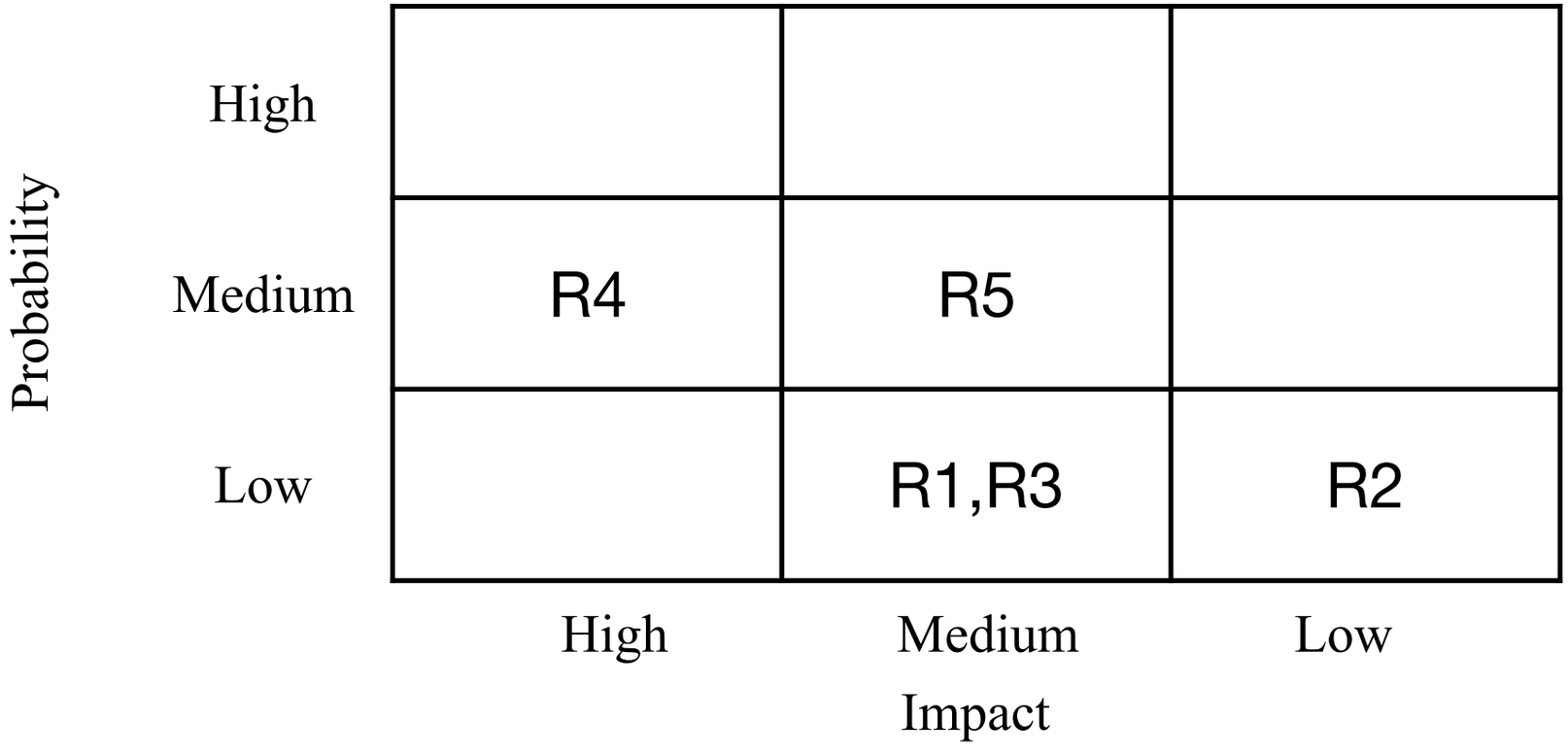


Cost Estimation

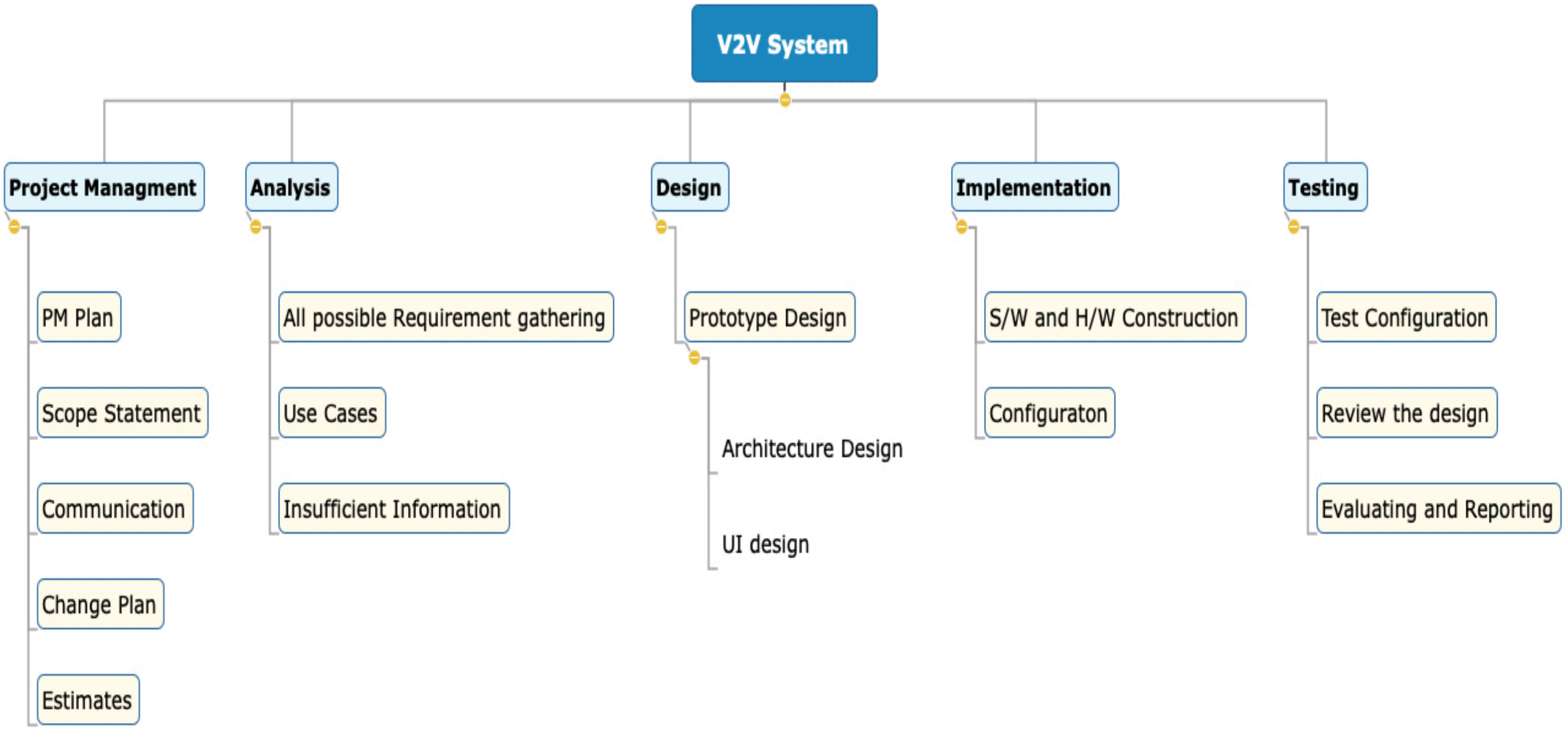
	Subtotals	WBS Level 1 Totals	% of Total
1. Project Management		**$84,380**	**48%**
1.1 Project manager	$40,000		
1.2 Project development team	$24,000		
1.3 Project testing team	$18,000		
1.4 Contractors (10% of software development and testing)	$2,380		
2. Hardware		**$23,208**	**13%**
2.1 DSRC Radios	$18,999		
2.2 DSRC Antenna	$900		
2.3 GPS systems	$800		
2.4 GPS antenna	$1,200		
2.5 Wiring	$90		
2.7 DSRC Transmitter/Receiver	$799		
2.8 Displays	$420		
3. Software		**$20,799**	**12%**
3.1 Licensed software	$799		
3.2 Software development	$20,000		
4. Network		$39,000	**22%**
4.1 Data Servers	$8,000		
4.2 Configure the server to work as Web Server	$2,000		
4.3 Secure the connection	$12,000		
4.4 Prototype Development	$17,000		
5. Testing	$7,000	**$3,000**	**2%**
6. Installation	$1,499	$999	**1%**
7. Support		**$1,899**	**1%**
7.1 Maintenance cost	$2,999		
8. Publicity/ Advertisement	$2,400	**$2,400**	**1%**
Total project cost estimate		**$1,75,685**	

Probability / Impact Matrix

No.	Risk	Probability	Impact
R1	Software Manipulation	Low	Medium
R2	Sensor Manipulation	Low	High
R3	Jamming the channel	Low	Medium
R4	Send false messages that cause true messages to be ignore	Medium	High
R5	Privacy leakage	Medium	Medium



Risk Breakdown Structure



Future of V2V Systems

Vehicle-to-Pedestrian
(V2P)

e.g. pedestrian in
walkway ahead

Vehicle-to-Network
(V2N)

e.g. traffic queue five
kilometers ahead

Vehicle-to-Vehicle
(V2V)

e.g. emergency
vehicle approaching

Vehicle-to-Infrastructure
(V2I)

e.g. traffic signal ahead
turning red

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