

# INTELLIGENT COLLISION WARNING SYSTEMS FOR TRAMS

TORONTO JUNE 23-26 2019



**Bosch Engineering North America**  
Florian Waldenmaier

# Bosch - Four business sectors

## Key Figures 2018

Bosch Group

€ 77.9 billion euros  
in sales

 410,000  
associates



Mobility Solutions

▶ One of the world’s largest suppliers of mobility solutions



Industrial Technology

▶ Leading in drive and control technology, packaging,  
and process technology



Energy and Building  
Technology

▶ One of the leading manufacturers of security and communication technology  
▶ Leading manufacturer of energy-efficient heating products  
and hot-water solutions



Consumer Goods

▶ Leading supplier of power tools and accessories  
▶ Leading supplier of household appliances

60%



Share  
of sales

40%

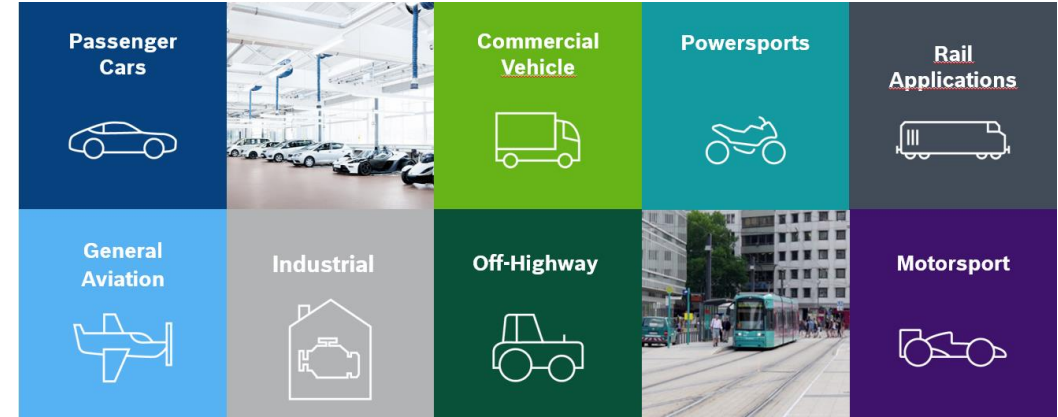


Rounded figures as of 12.17

# Rail transport @ Bosch

## Bosch Engineering GmbH

- System-Development Partner for sophisticated application based on Bosch product portfolio
- 100-percent subsidiary of Robert Bosch GmbH
- Founded in 1999
- >2750 associates at 15 sites in 9 countries



## Competence Center for Railway specific Bosch components



### Business strategy of Bosch Rail Organization:

Make Bosch technology available for the railway industry under consideration of the rail specific requirements: **standards and volumes**

# Tram forward collision warning (TFCW)

## Overview

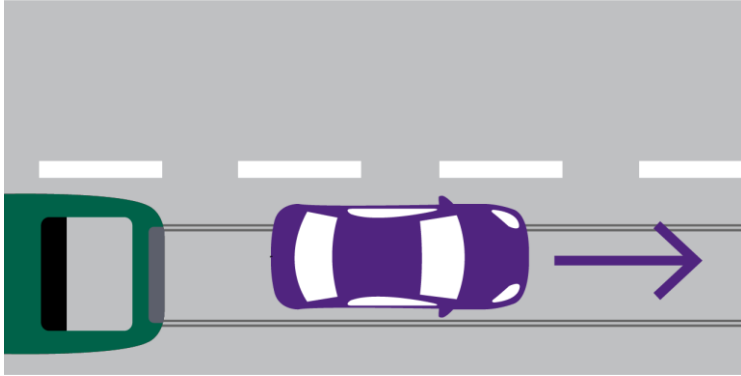


- ▶ Based on automotive components
- ▶ In productive operation since 2017
- ▶ Compliant and certified to tram standards and homologated in several EU applications
- ▶ Continued function and performance optimization
- ▶ Basis for higher automation

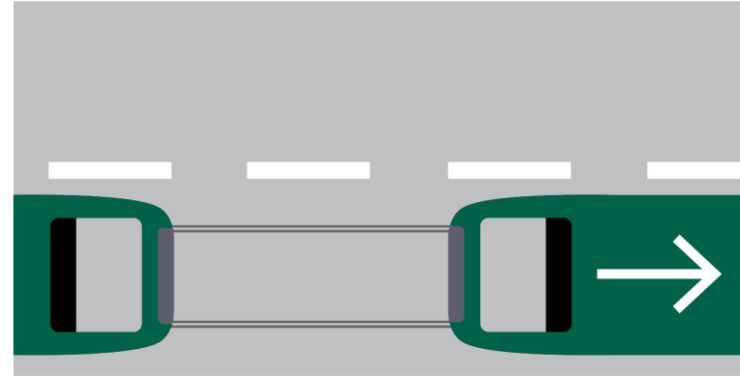
# Tram forward collision warning (TFCW)

## Main use cases

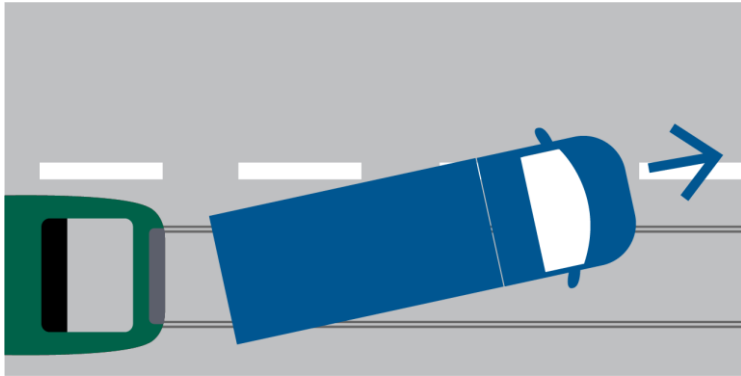
Passenger Cars



Other Trams



Busses/Trucks



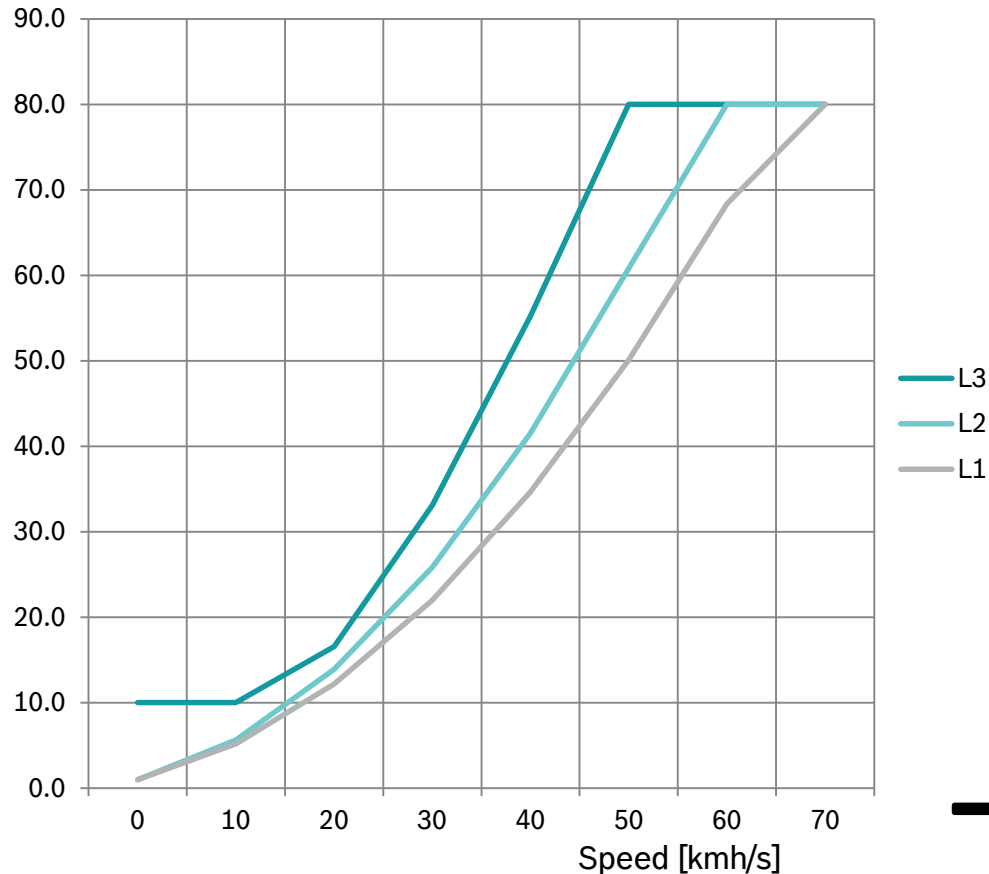
Buffer Stop



# Tram forward collision warning (TFCW)

## Warning Strategy

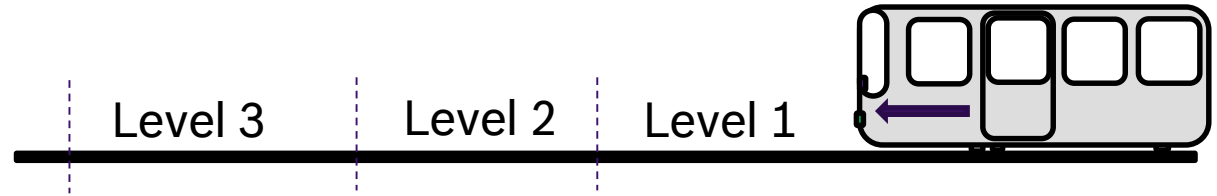
Warning distance [m]



- ▶ Warning depends on:
- ▶ Deceleration
- ▶ Reaction time of the driver
- ▶ Response time of braking system
- ▶ Safety offset

Example:

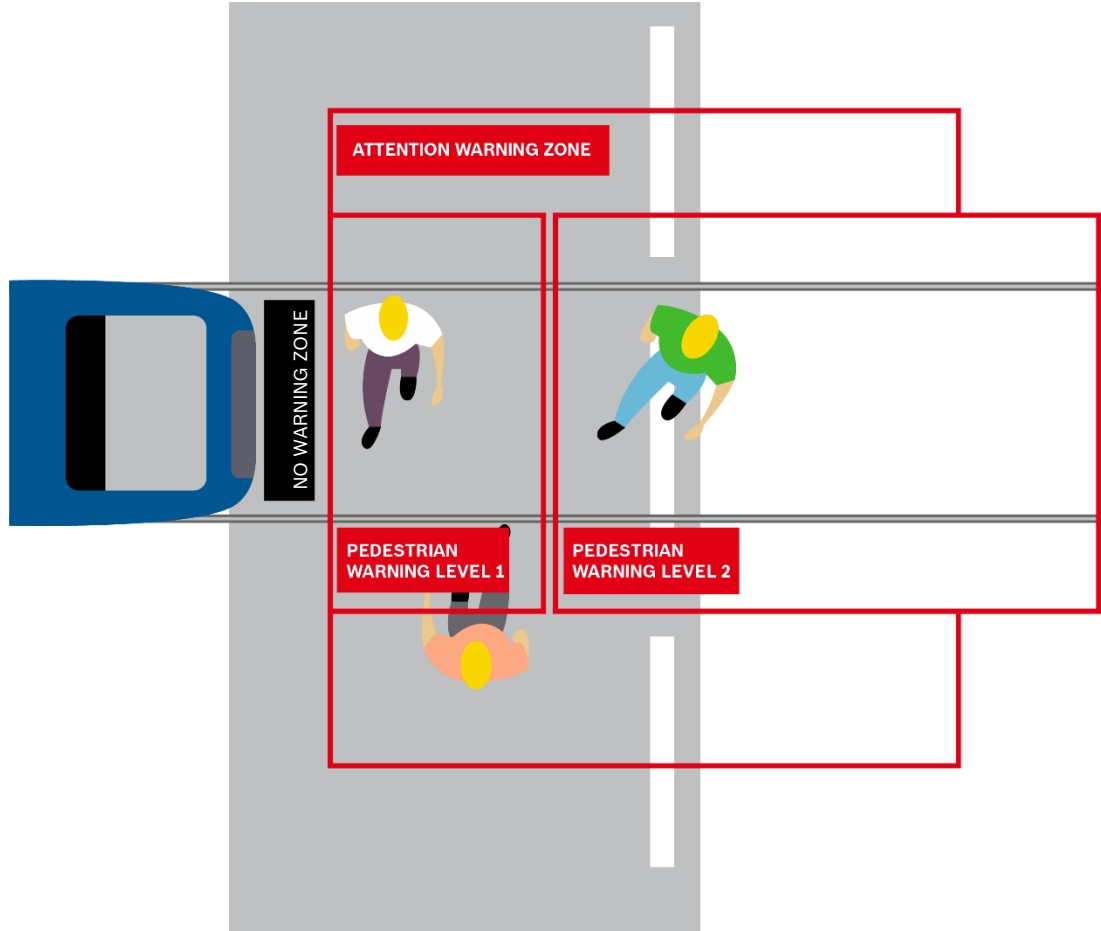
- ▶ Level 3 and 2: different optical, acoustical warning possible
- ▶ Level 1: automated brake intervention





# Tram forward collision warning (TFCW)

## Use case: pedestrian warning



- ▶ The **three warning areas** can be parametrized by the customer...
- ▶ ...with three different output signals. Possible types of warning are e.g.
  - ▶ Acoustical warning
  - ▶ Optical warning
  - ▶ Brake intervention

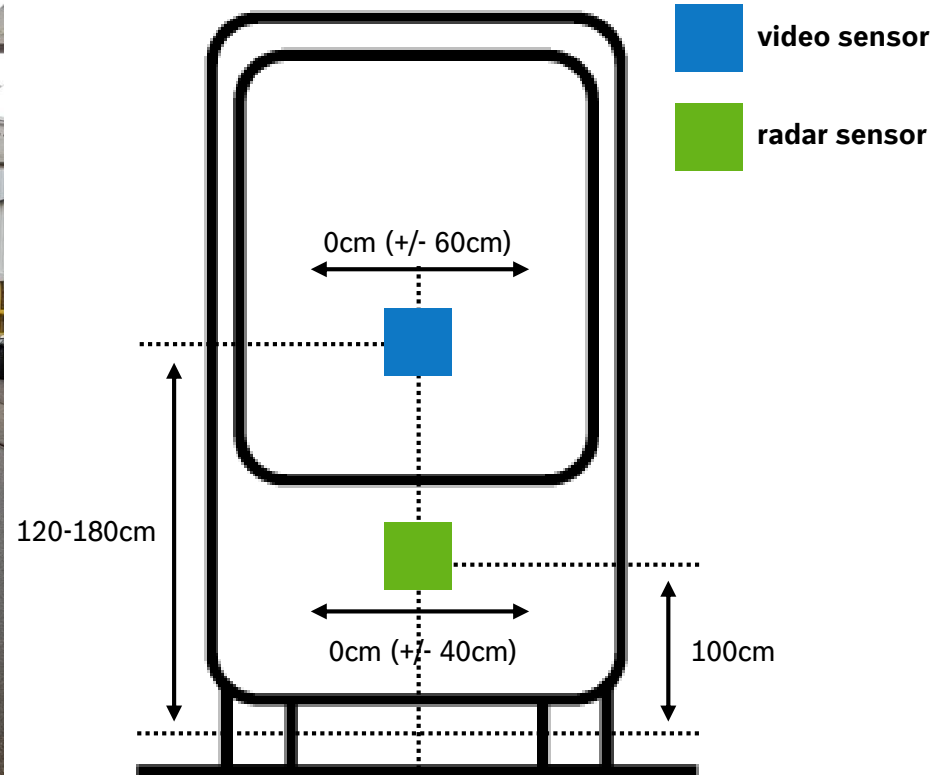
# Tram forward collision warning (TFCW)

## Examples of Integration: DVB Dresden and HTM The Haag



Demonstrator Dresden, DVB (Dresdner

Verkehrsbetriebe)



Series vehicle, The Hague (HTM)



# Tram forward collision warning (TFCW)

## System characteristics

- ▶ The System warns before **other trams, cars** and **buffer stops**  
*Optional: Pedestrian* warning can be activated
- ▶ The tram driver is **fully responsible**, his authority must not be restricted by the system
- ▶ In case of an upcoming collision, the driver receives a **warning**  
*Optional: If the tram driver does not react, the system will initiate a brake intervention*



# Tram forward collision warning (TFCW)

## Selected References, Success Stories



### FRANKFURT

- ▶ Development partnership
- ▶ 14 Systems installed and in operation in a retrofit project



### ULM

- ▶ Original equipment of 12 new trams
- ▶ Delivery starting in 2018
- ▶ Retrofit of 10 existing vehicles planned



### THE HAGUE

- ▶ Start of series equipment beginning of 2018
- ▶ 120 systems + 20 optional
- ▶ Retrofit project



### AMSTERDAM

- ▶ 126 systems + 120 optional
- ▶ Original equipment
- ▶ Delivery starting in 2018
- ▶ Passenger service beginning of 2019



### HANNOVER

- ▶ 2 tram systems with demonstrators
- ▶ Retrofit of the TW3000 fleet is planned

# Tram forward collision warning (TFCW)

## Testimonial –Frankfurt

*„The FAST is a real innovation in the rolling stock market. The Bosch technology increases the operational safety and is widely accepted within our crew. We are delighted that we developed this system to series maturity together with such a competent partner like Bosch.“*

M.Rüffer, CEO Technology and Operation VGF Frankfurt



- ▶ Development Partnership
- ▶ Preparation of 14 tram systems with Tram Forward Collision Warning
- ▶ The equipment of the whole fleet with Collision Warning Systems is planned

# Tram forward collision warning (TFCW)

## Conclusion

- ▶ TFCW is state-of-the-art technology in Europe
- ▶ Product is available for real tram operations
- ▶ Reduction of accidents → safety, availability, efficiency
- ▶ Quick break-even



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**We can save lives.**

# THANK YOU

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