

# Intelligent Road Intersections: A Case for Digital Twins

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Víctor M. G. Martínez<sup>1</sup>, Moisés R. N. Ribeiro<sup>1</sup>, Divanilson R. Campelo<sup>2</sup>

<sup>1</sup> Universidade Federal do Espírito Santo (UFES)

<sup>2</sup> Universidade Federal de Pernambuco (UFPE)

42º Congresso da Sociedade Brasileira de Computação  
III Workshop Brasileiro de Cidades Inteligentes  
2022

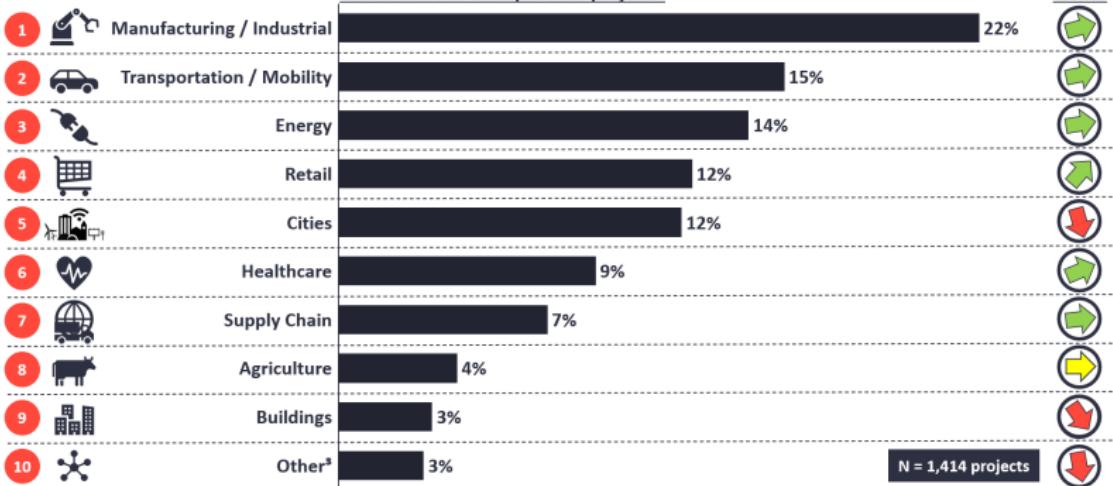




Insights that empower you to understand IoT markets

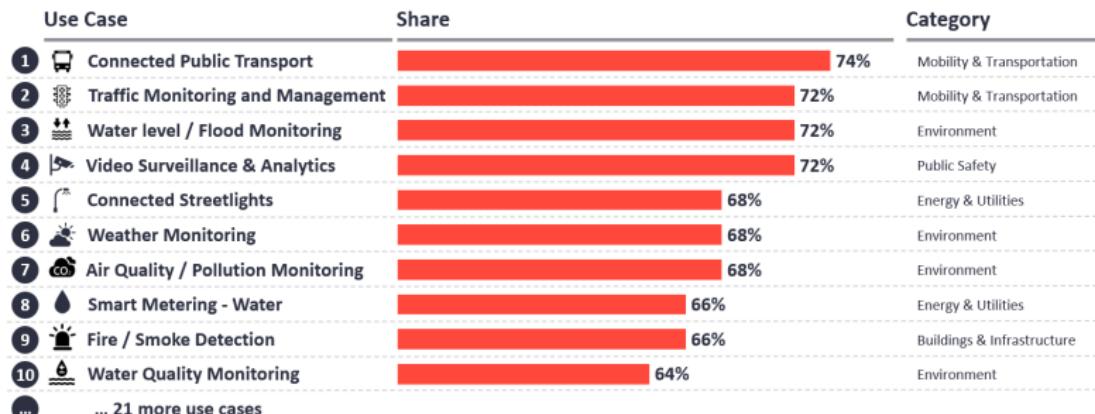
## Top 10 IoT Application areas 2020

Global share of Enterprise IoT projects<sup>1</sup>



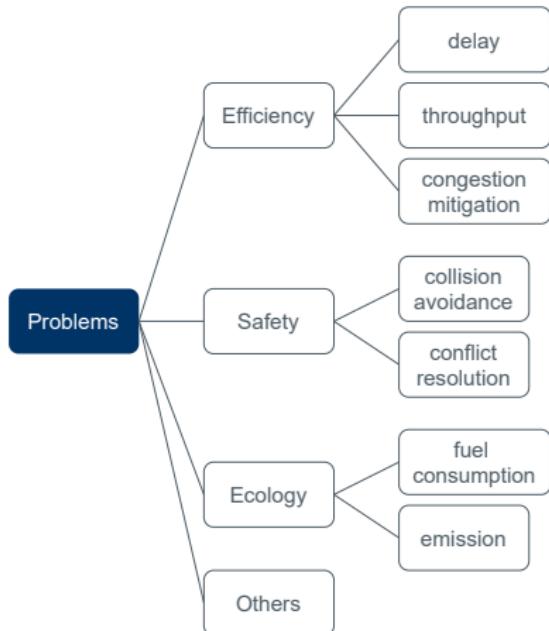
Note: 1. Based on 1,414 publicly known IoT projects (not including consumer IoT projects eg smart home, wearables, etc.) 2. Trend based on relative comparison with % of projects in the 2018 IoT Analytics IoT project list e.g., a downward arrow means the relative share of all projects has declined, not the overall number of projects. 3. Other includes IoT projects from Enterprise & Finance sectors. Source: IoT Analytics Research - July 2020

## The top 10 Smart City use cases



Share = Percentage of cities that have fully or partially deployed the use case as part of their Smart City initiative; n= 50 cities across the globe

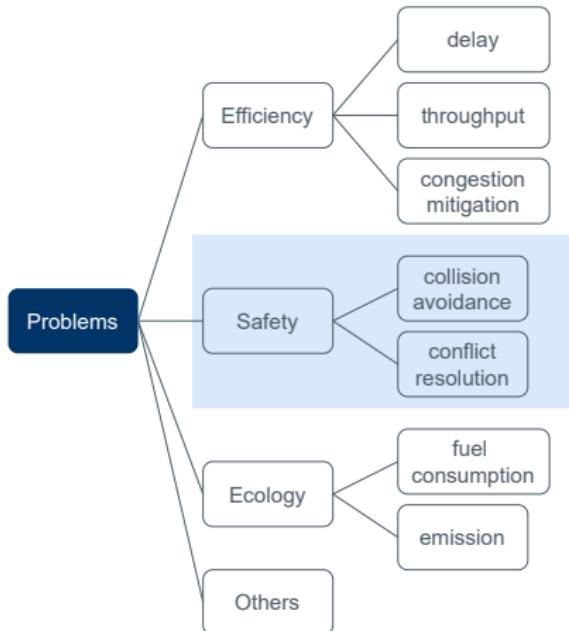
Source: IoT Analytics Research – August 2020 (For more information, refer to: Smart City Use Cases & Technology Adoption Report 2020)



## Complex systems

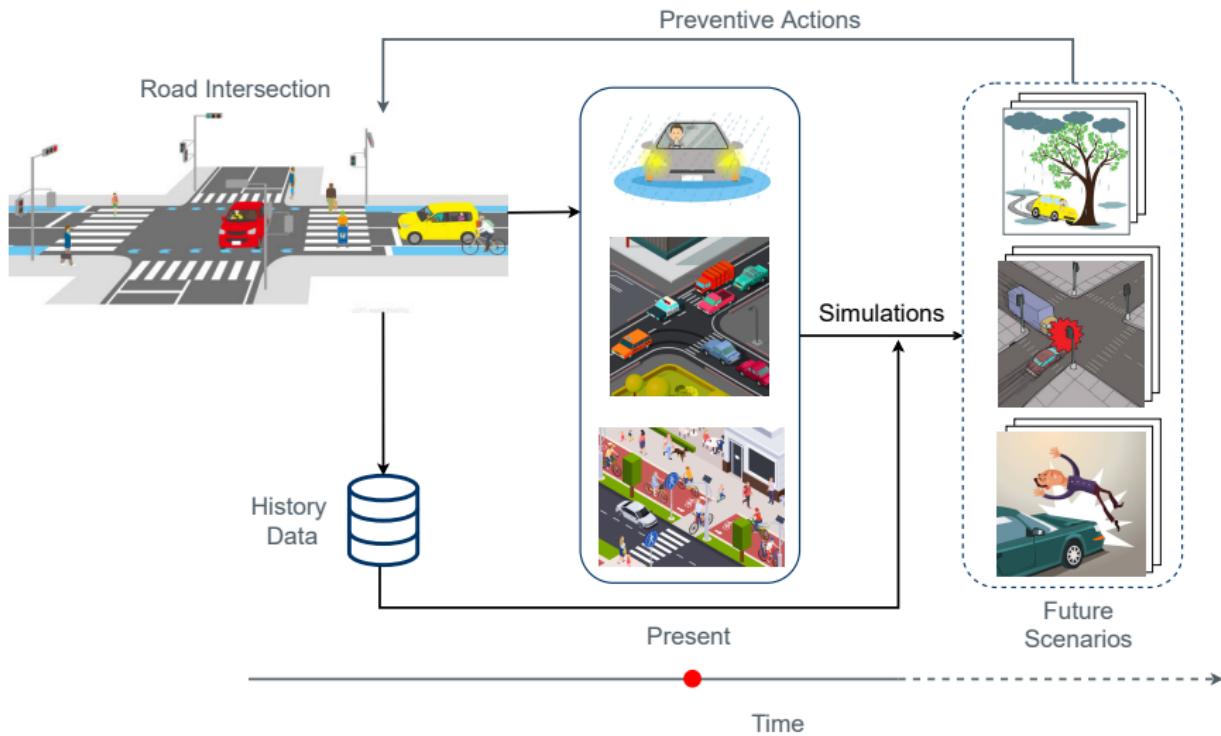
**It is not easy to analyze all specific states and scenarios** during the system's design, operation, and management stages.

# Road Intersections Safety



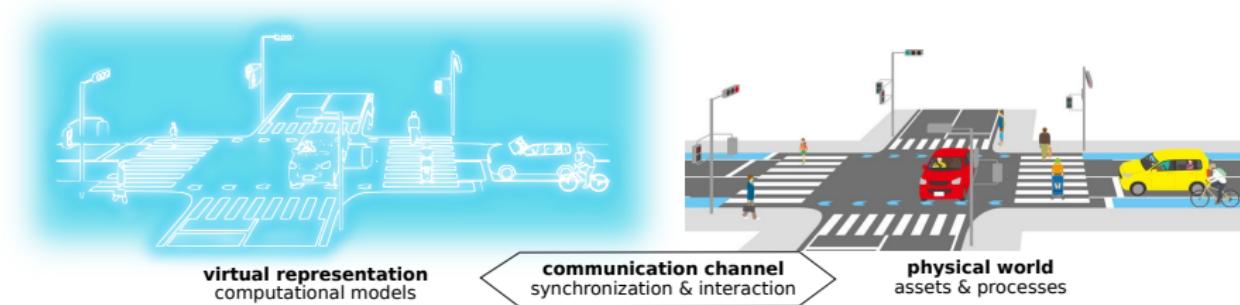
How to interact with the road intersection to apply proactive actions that help in the safety of the intersection and the agents of this system?

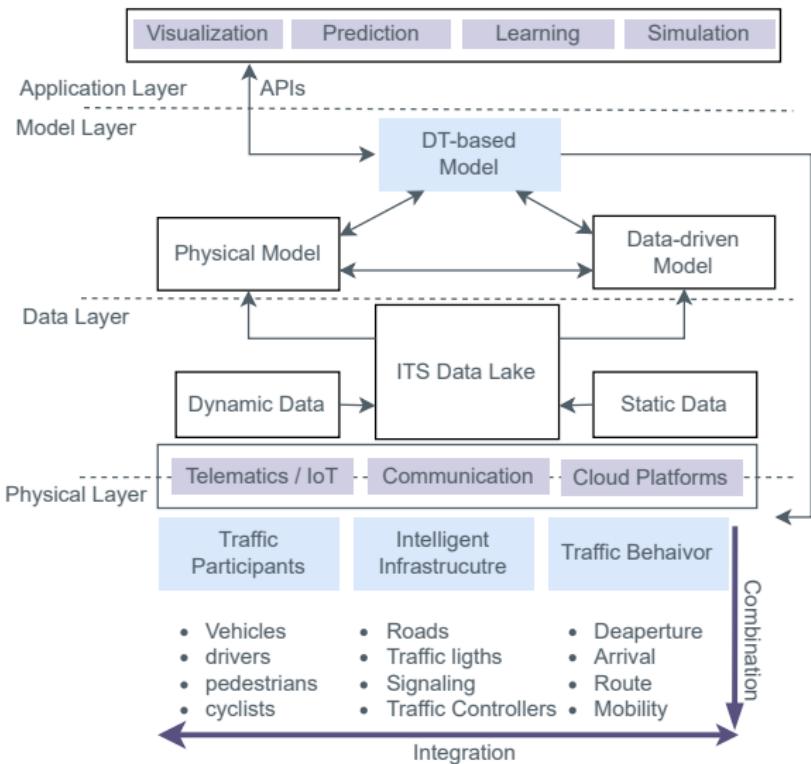
# Intelligent Road Intersections



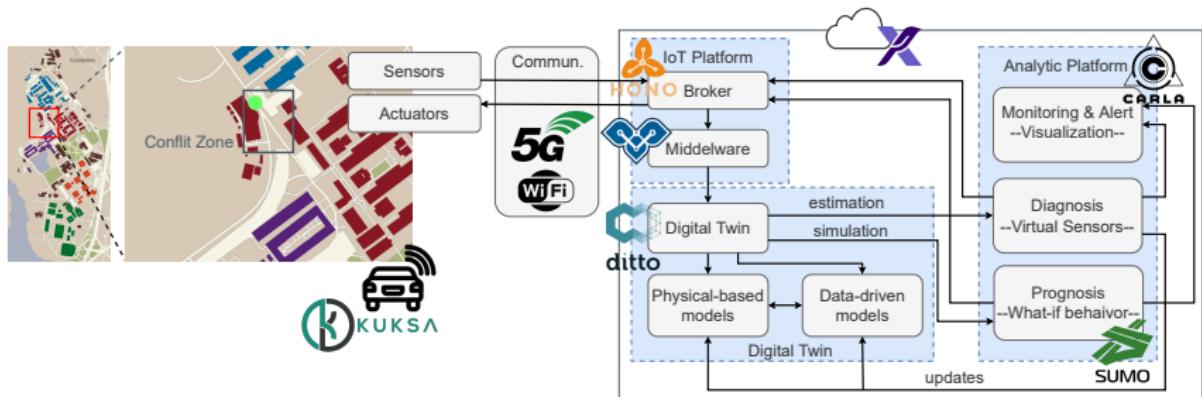


*"A digital twin is a **virtual representation of real-world entities and processes**, synchronized at a specified frequency and fidelity."*



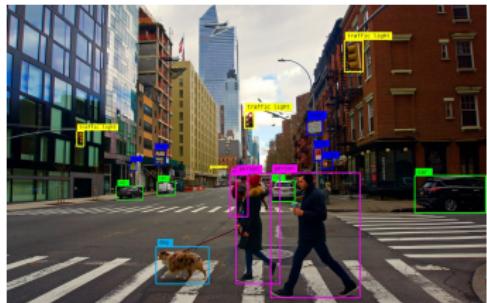


# Testbed

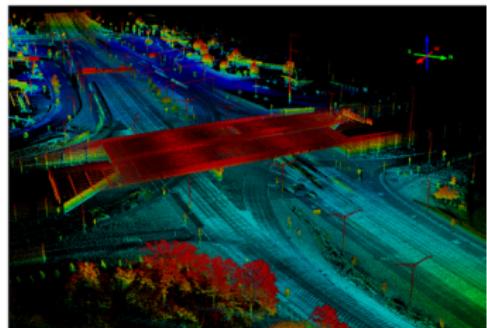


# Testbed - Sensors

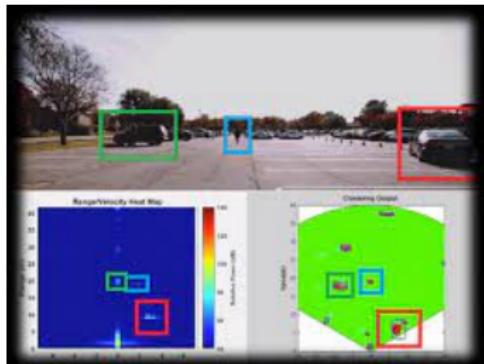
## Computer Vision



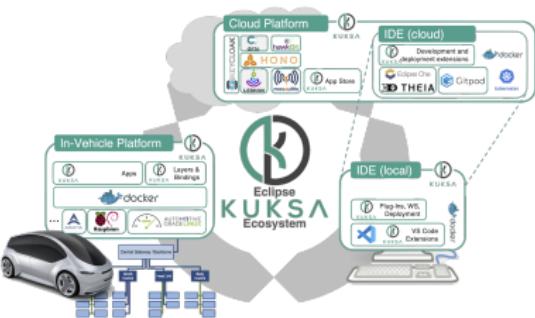
## LIDAR



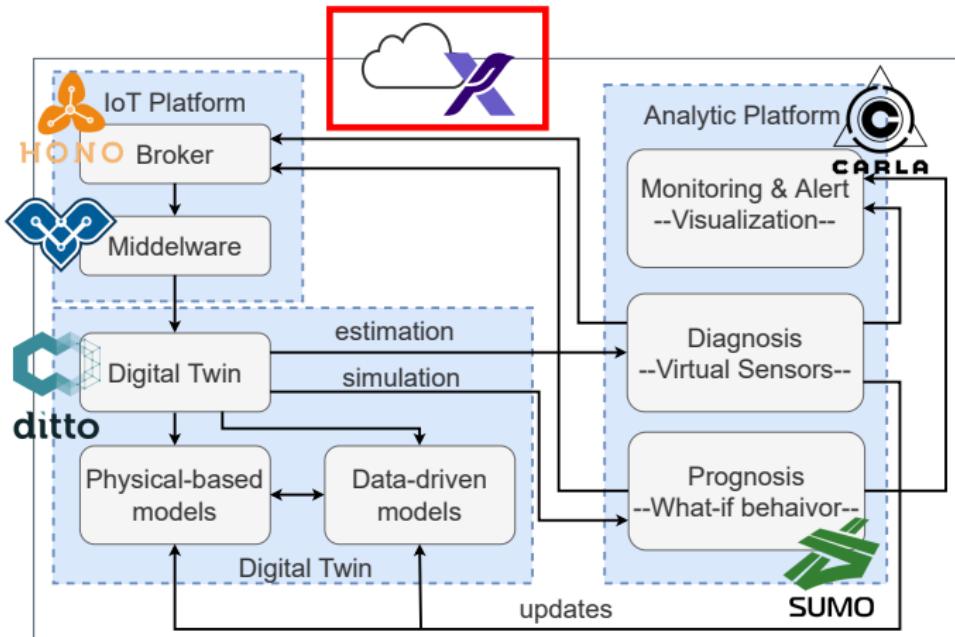
## mmWave RADAR



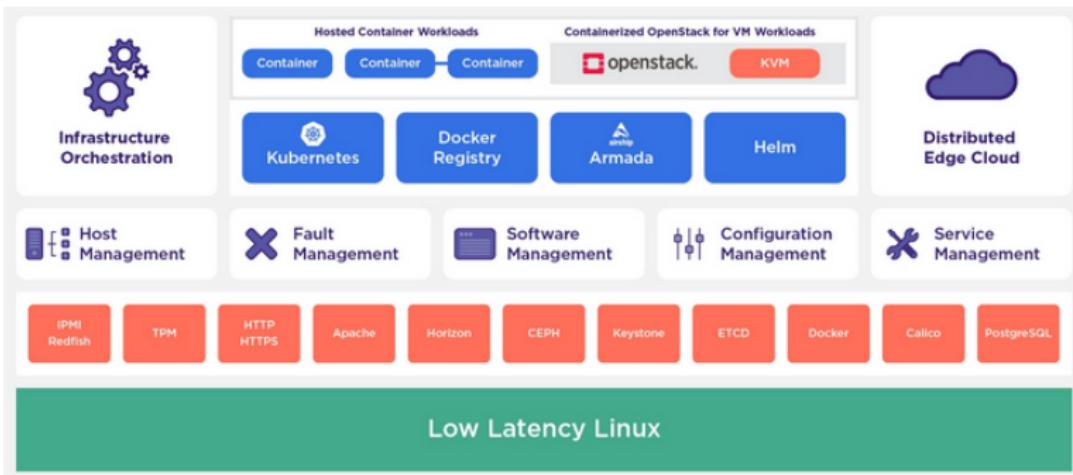
## Eclipse Kuksa



# Testbed - Edge Cloud

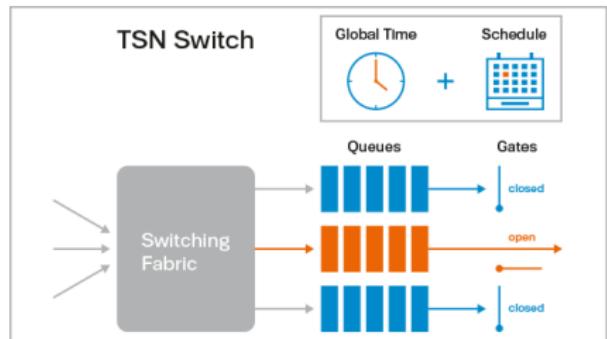
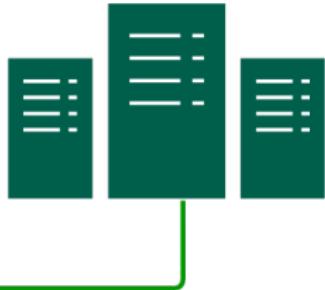


# Testbed - Edge Cloud



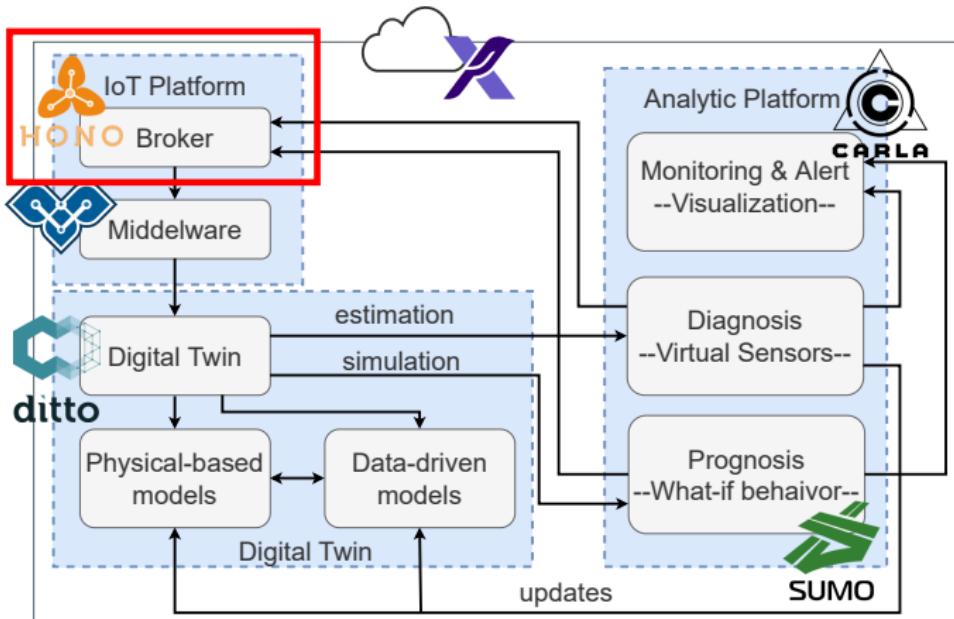
- Reliability
- Environments with severe resource constraints
- Deterministic

# Testbed - Edge Communication



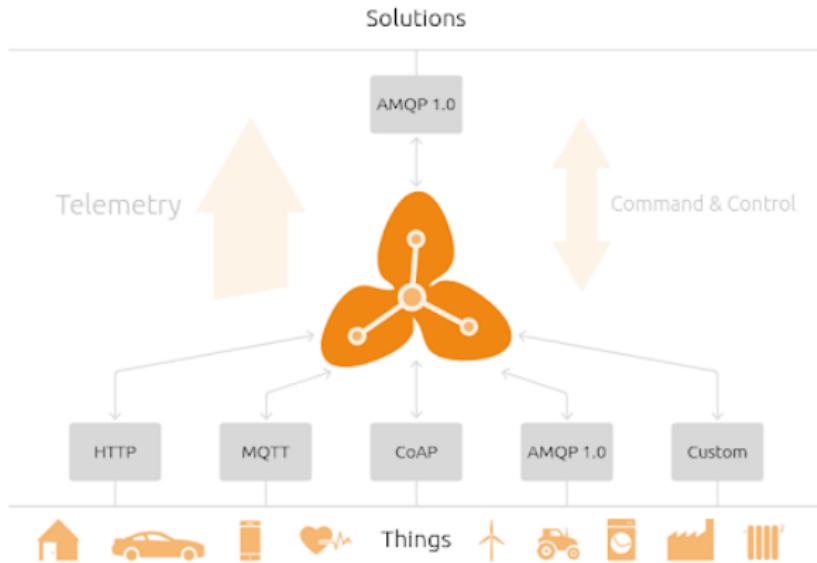
## Time Sensitive Networks

- IEEE 1588/802.1AS precision time synchronization
- IEEE 802.1Qav traffic shaper: Modelagem de tráfego usando classes de prioridade.

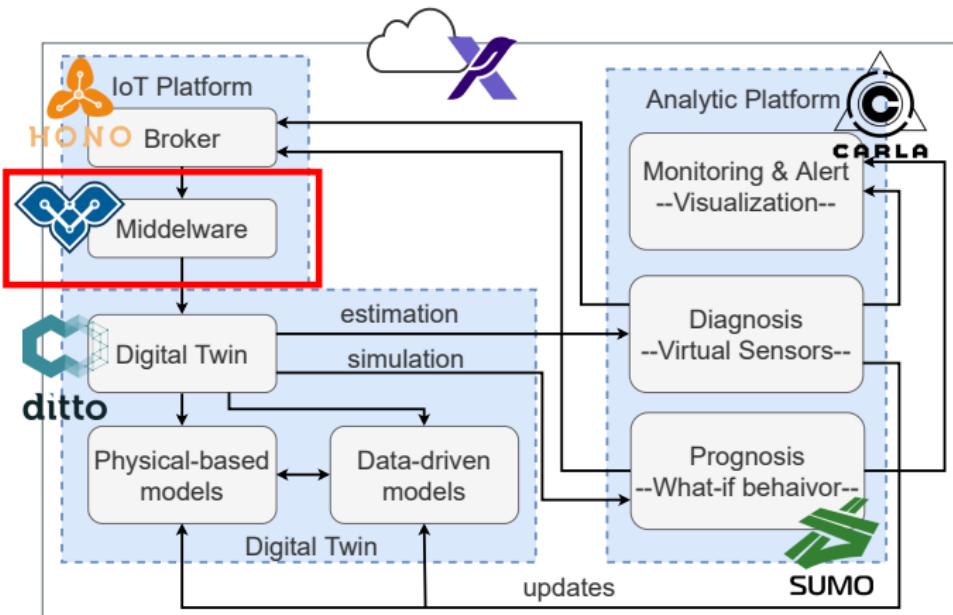


# Testbed - Broker

**Eclipse Hono** provides remote service interfaces to connect a large number of IoT devices to a backend and interact with them.



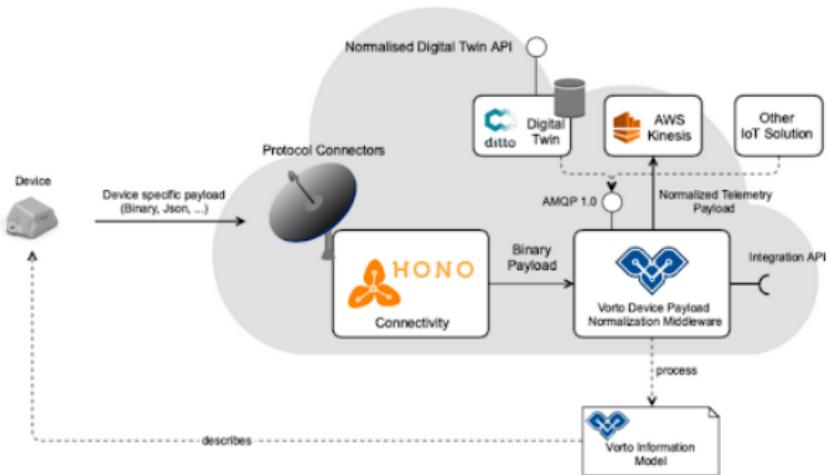
# Testbed - Middleware



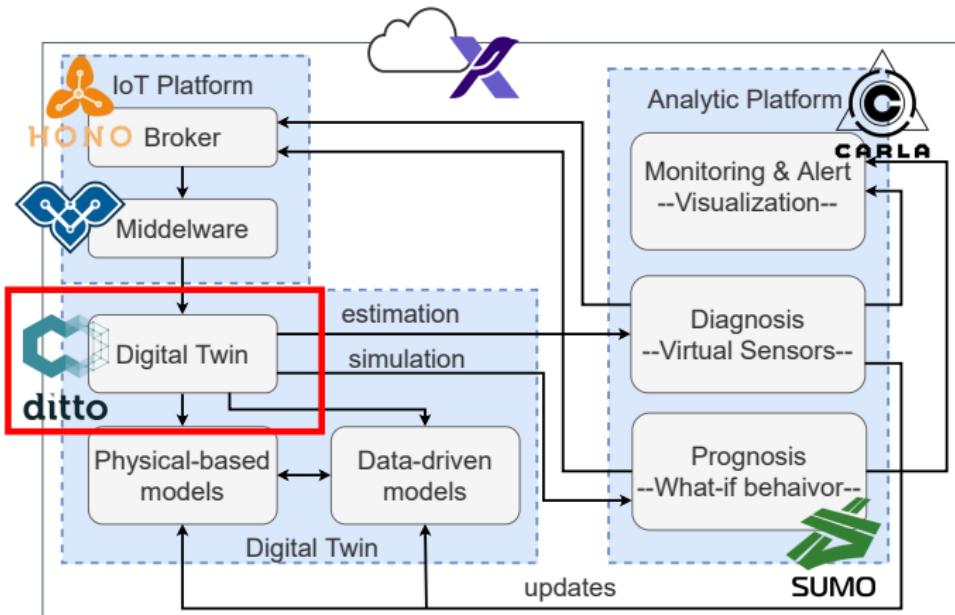
# Testbed - Middleware

Eclipse Vorto normalizes device telemetry messages to a semantic model.

**Digital Twin Vorto Language**, domain-specific language (DSL) with a very simple grammar for describing digital twin models.

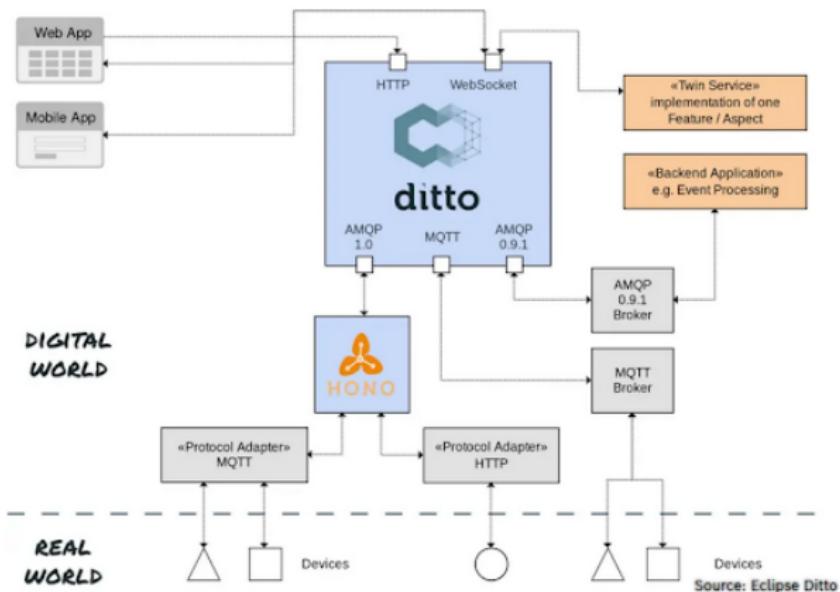


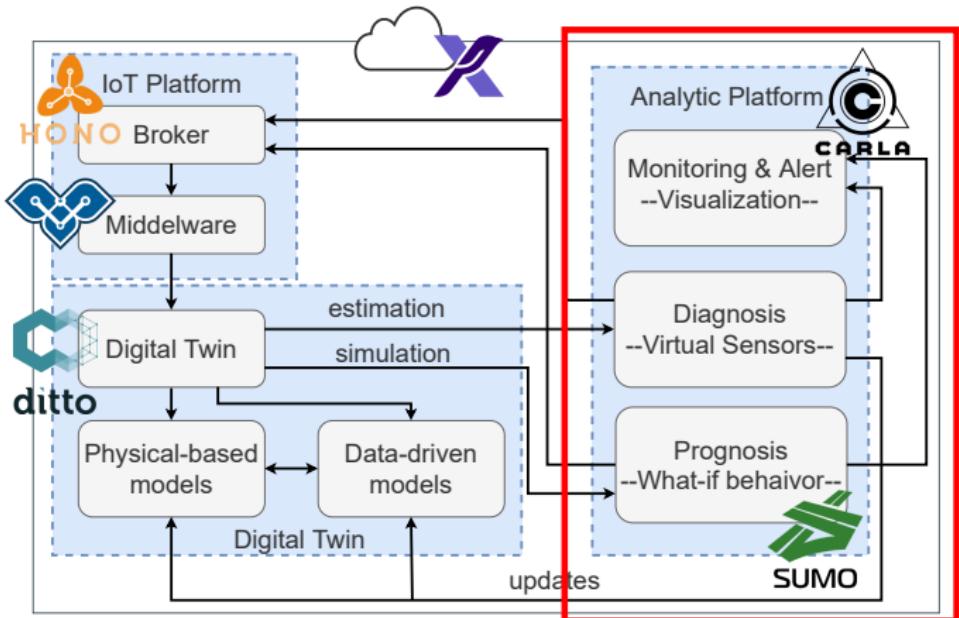
# Testbed - DT



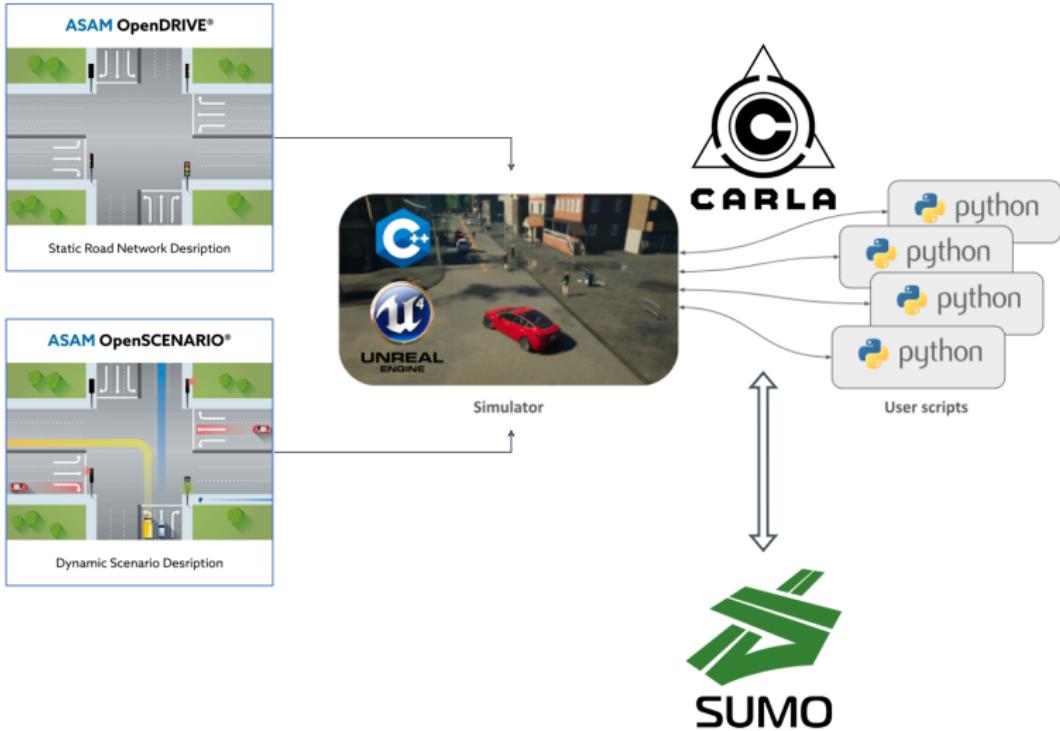
# Testbed - DT

**Eclipse Ditto** is an IoT technology that implements a software standard for digital twins.





# Testbed - Analytic



# Thank you!

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Víctor M. G. Martínez

*email : victor.martinez@edu.ufes.br*

Universidade Federal do Espírito Santo – UFES



UNIVERSIDADE  
FEDERAL  
DE PERNAMBUCO