RAGE 2022 @ DAC 2022
Real-time And intelliGent Edge computing workshop

July 10th, 2022, San Francisco, CA

Reliable Distributed Systems

Industrial use-cases for real-time edge-computing

Arne Hamann
Bosch Research

BOSCH

Outline

Centralized E/E Architectures

Software-Defined Vehicles

Reliable Distributed Systems

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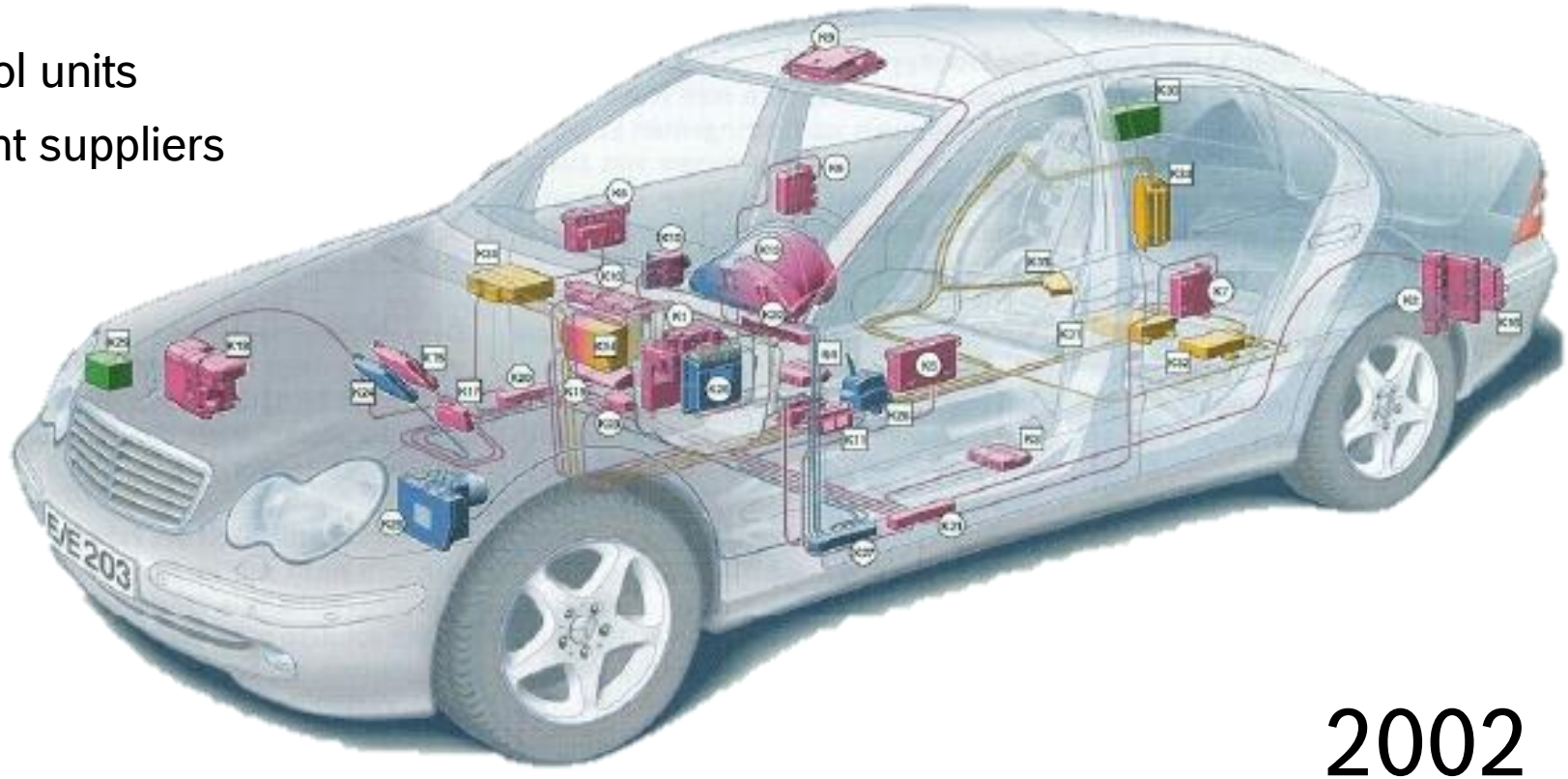
Centralized E/E Architectures

How it always was…

- Up to 100 electronic control units
- ECUs delivered by different suppliers
- Some SW sharing
- Mainly integration on network level



2002

OEMs: “ We will reduce the number of ECUs significantly”

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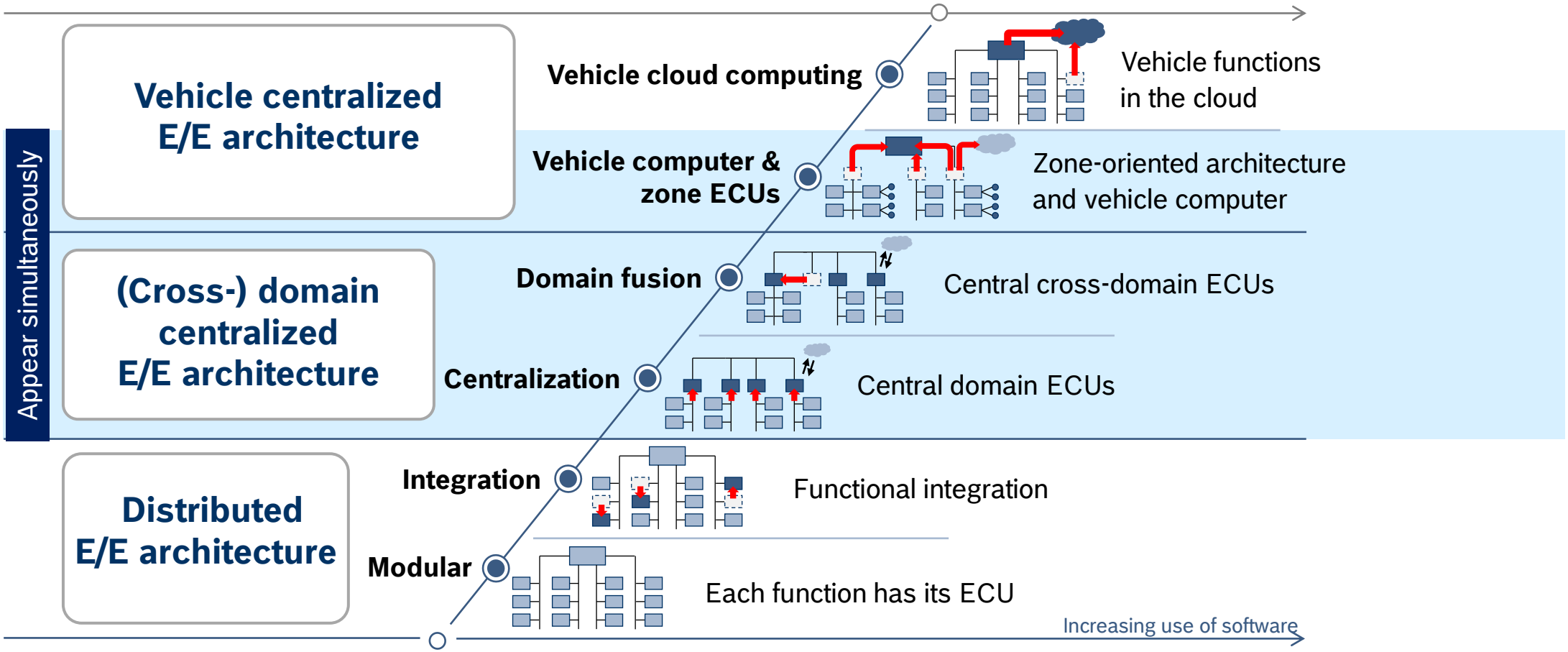
Centralized E/E Architectures
...but today not anymore



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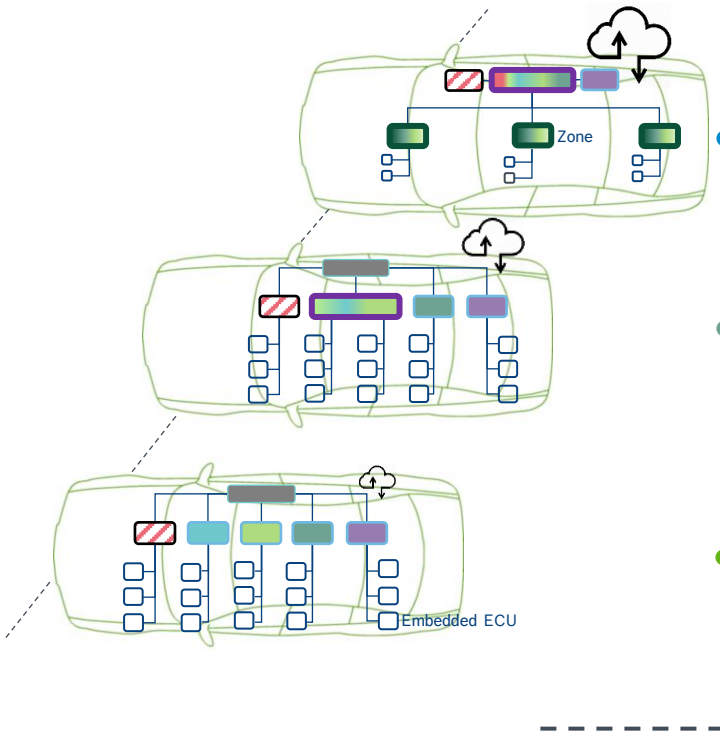
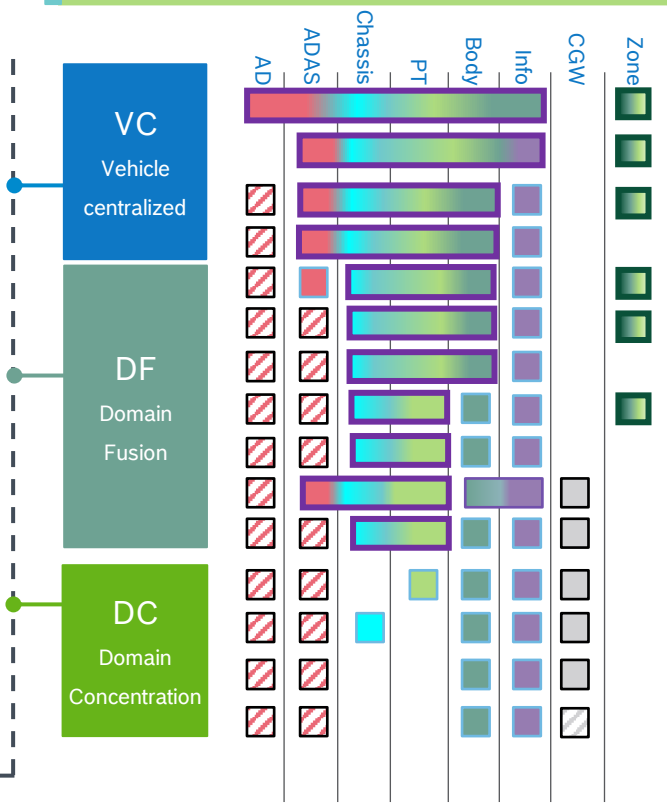
Centralized E/E Architectures
Many OEMs, Even More E/E Architectures…

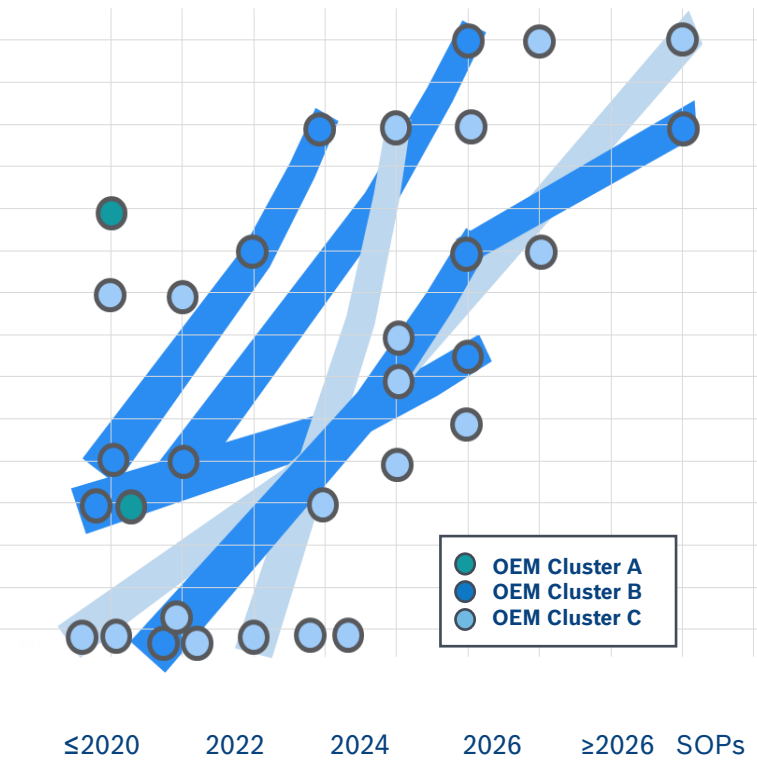
E/E Evolution



E/E Patterns



OEM Evolution / Revolution hikes



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Centralized E/E Architectures
Advantages

Up to 20%
fewer control units

Up to 10%
Cost savings

Up to 10%
material and weight savings
in the wiring harness

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Outline

Centralized E/E Architectures

Software-Defined Vehicles

Reliable Distributed Systems

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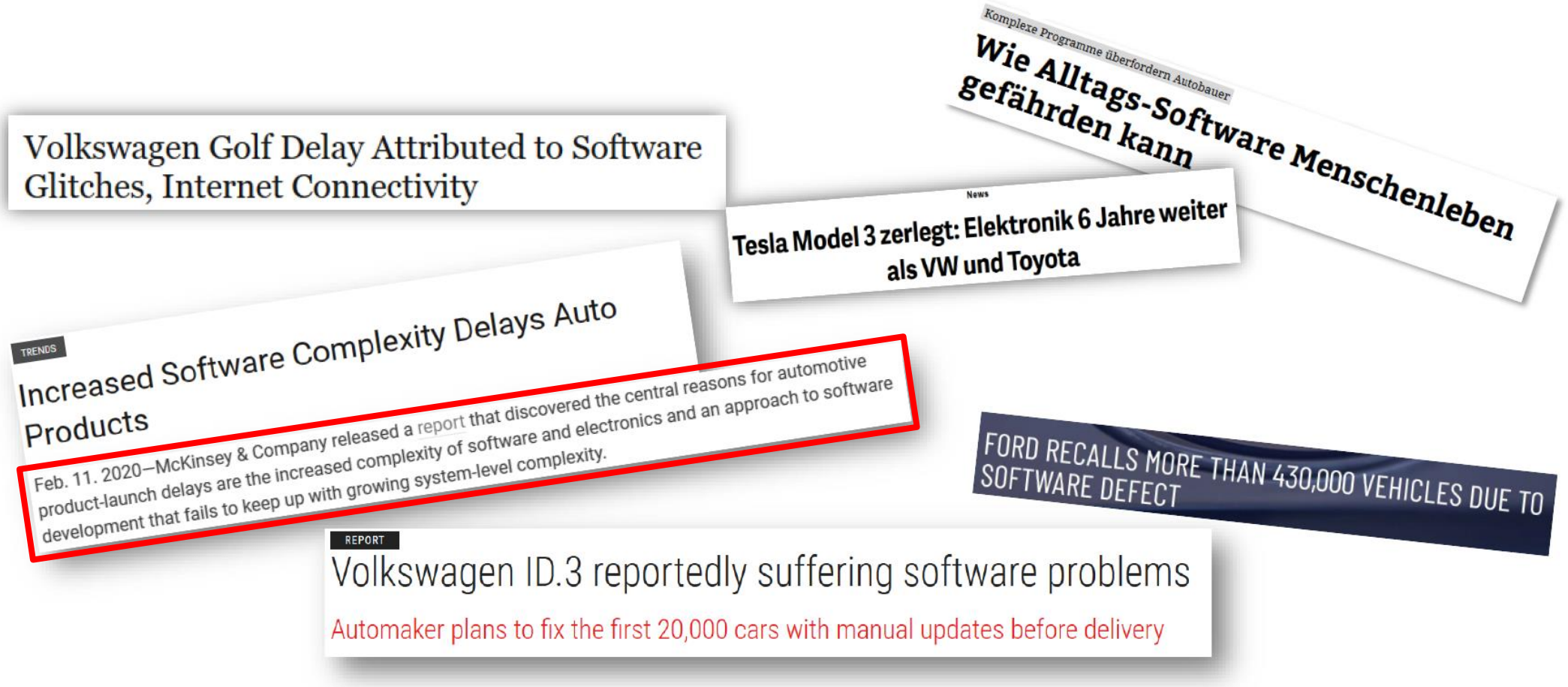
Software is eating the world – and cars are next on the menu!

300bn EUR market for Automotive SW & Services in 2030

60% of automotive value creation by software in the near future

Software-Defined Vehicles

Software is still often perceived as problem…



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Software-Defined Vehicles
Dealing with complexity

SW Sourcing Dev

HW Sourcing Dev SOP Series

! *No re-use of SW*

SW Sourcing Dev

HW Sourcing Dev SOP Series

! *No re-use of SW*

SW Sourcing Dev

HW Sourcing Dev SOP Series

18.02.2021 Press release | #Connected mobility

Bosch teams up with Microsoft to develop software-defined vehicle platform for seamless integration between cars and cloud

SW Sourcing Continuous Development & deployment

V1.0 V2.0

HW Sourcing Dev. SOP Series

V2.0 V2.1 V3.0

HW Sourcing Dev. SOP Series

V2.0 V3.0

HW Sourcing Dev SOP Series

Decoupling of SW and HW (and their development cycles)

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WHAT IF....

...we reimagine the vehicle as part of a digital Fabric?

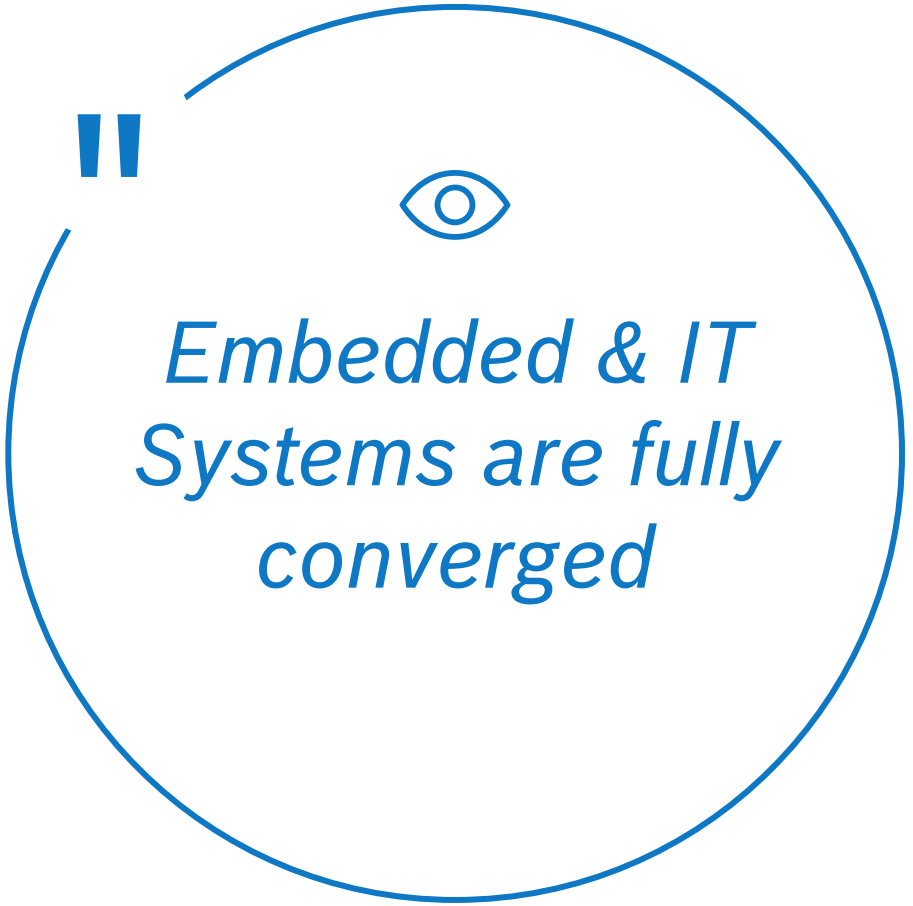
Outline

Centralized E/E Architectures

Software-Defined Vehicles

Reliable Distributed Systems

Reliable Distributed Systems: Vision



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Reliable Distributed Systems: Example

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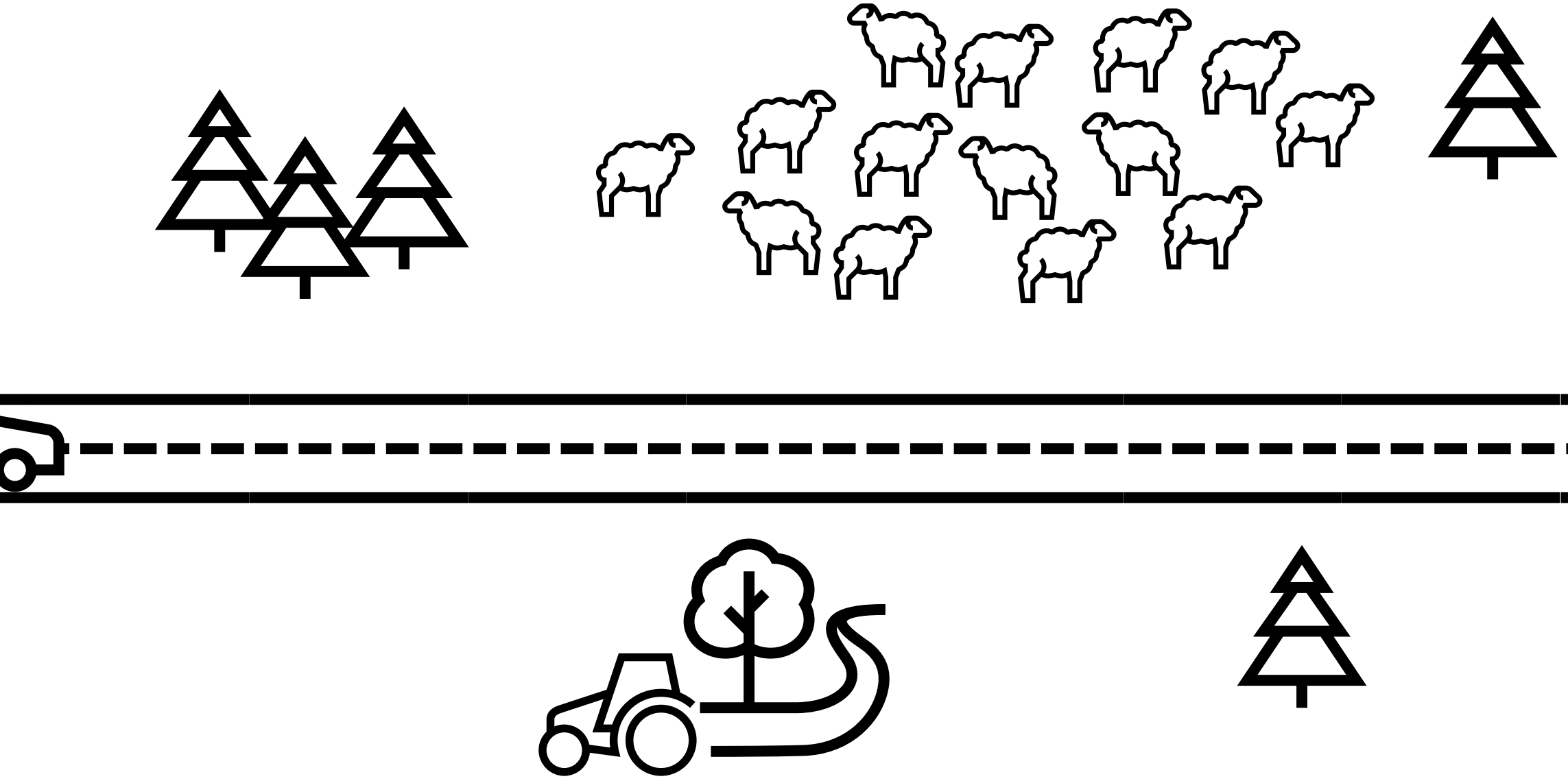

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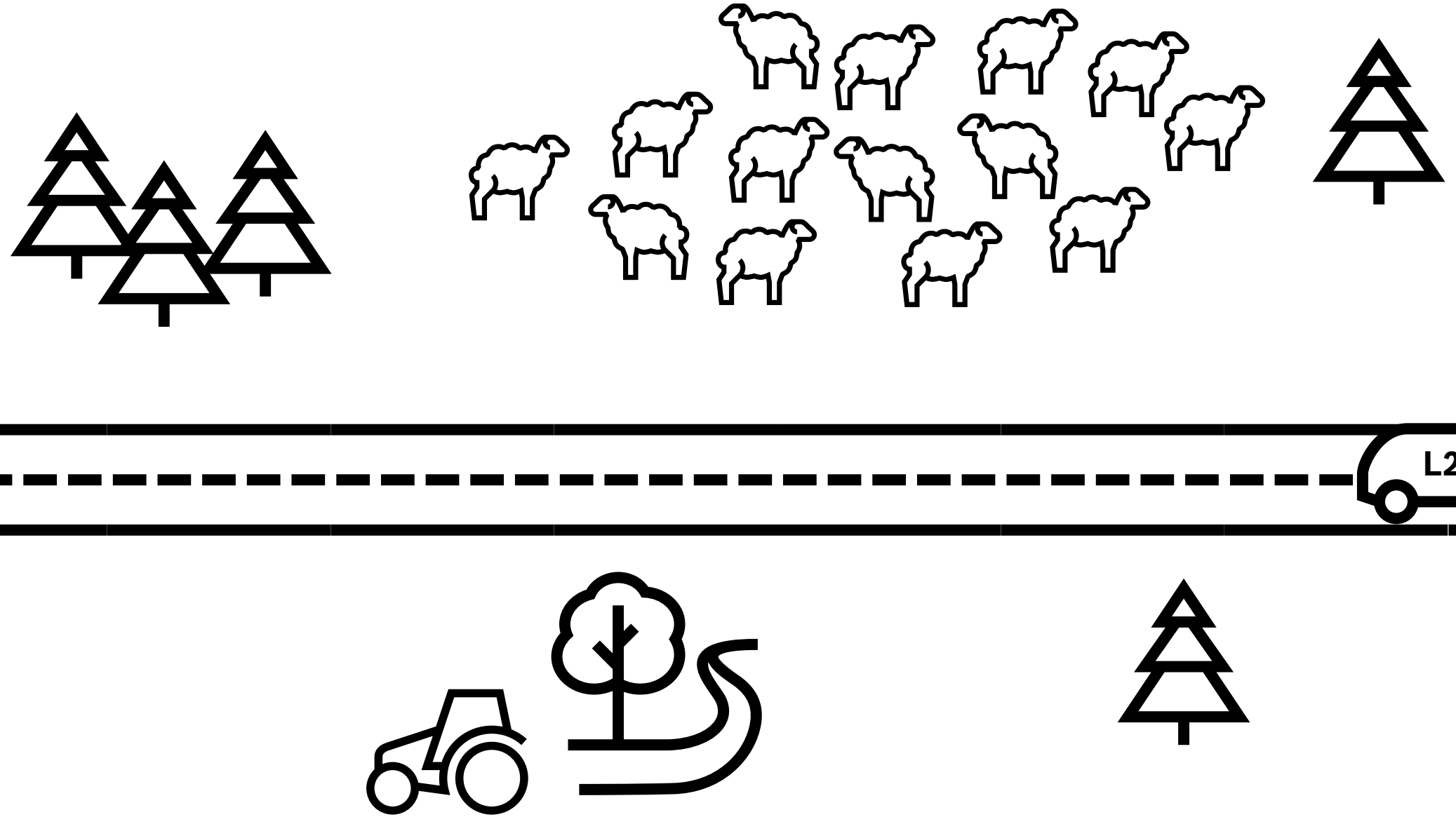

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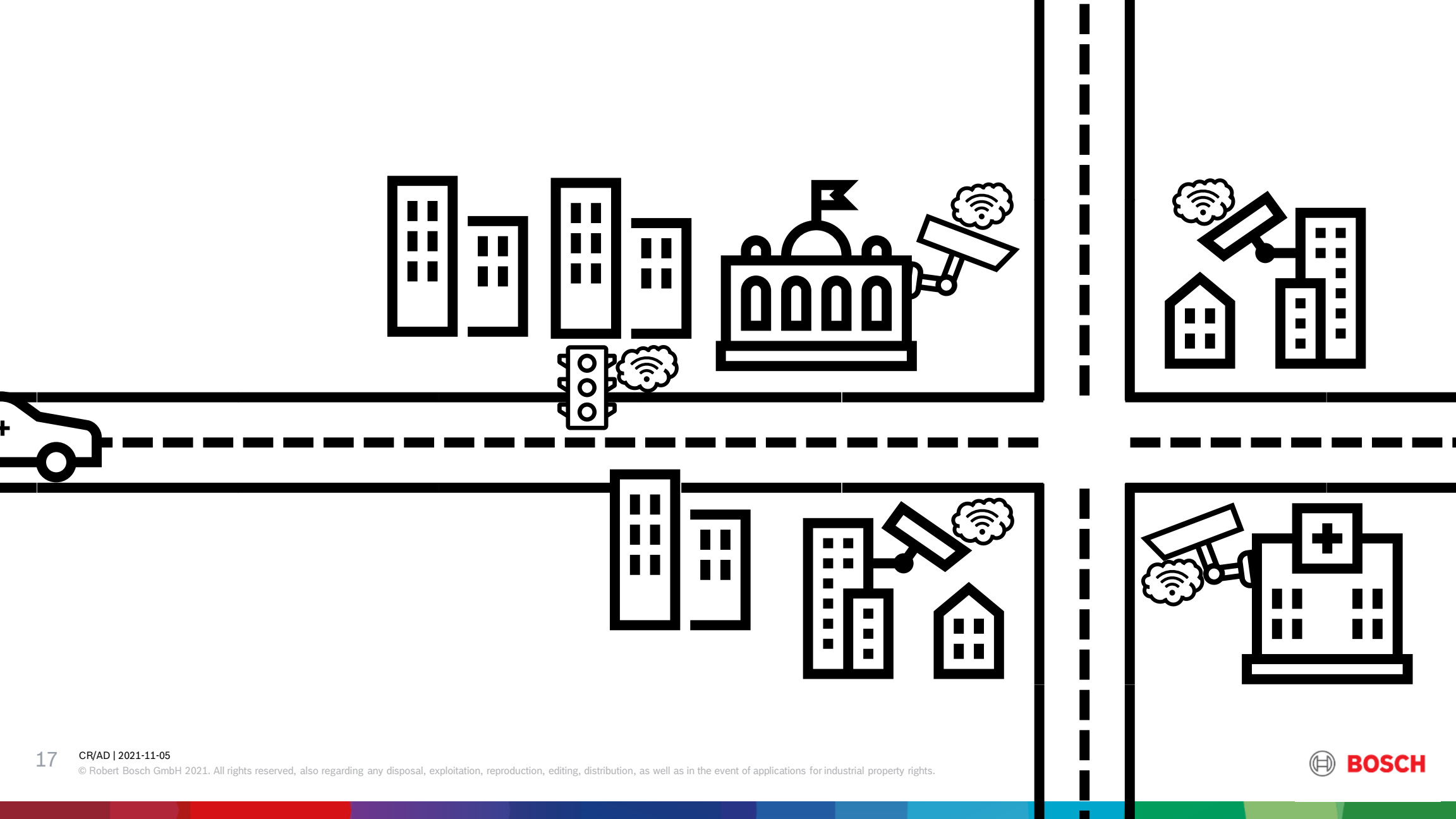

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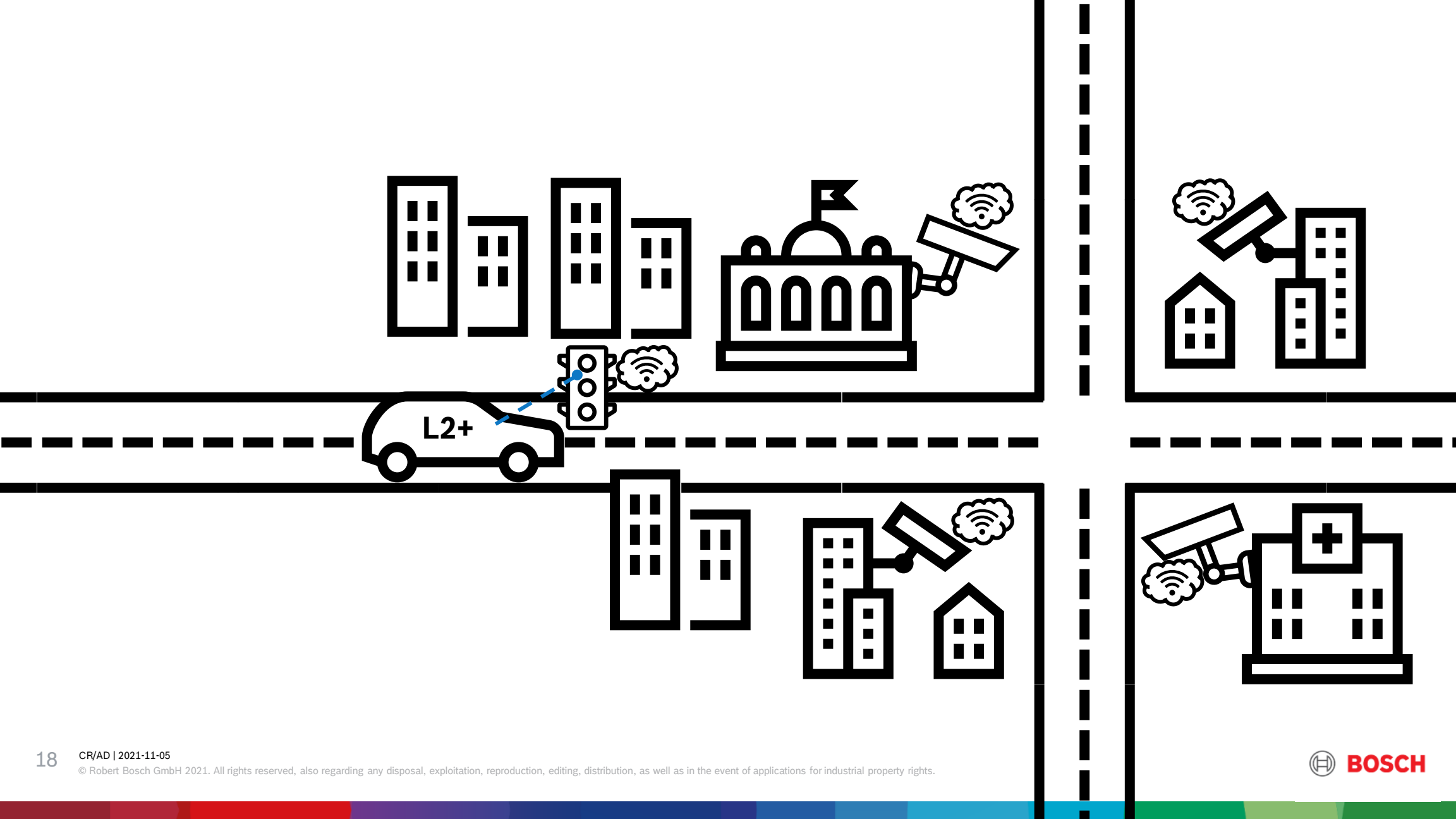

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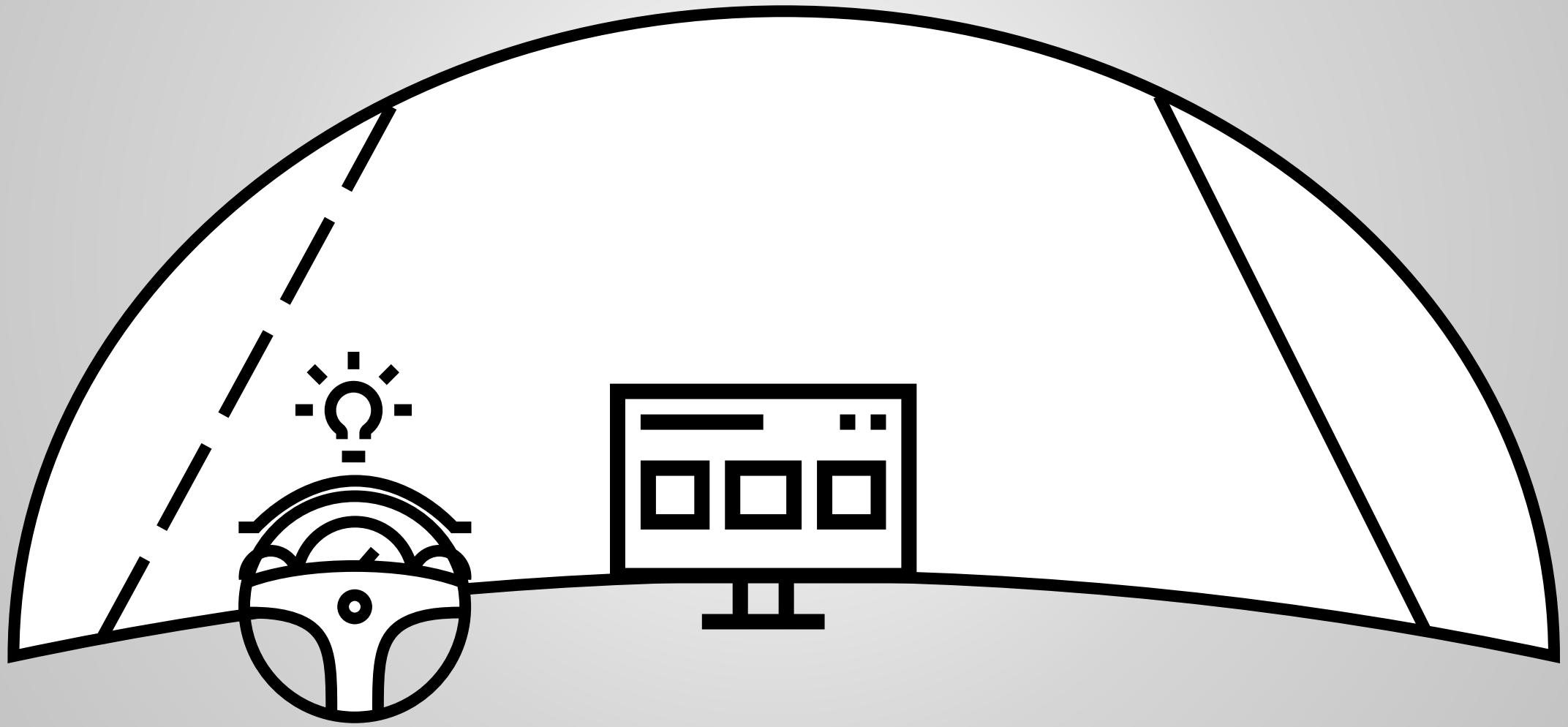
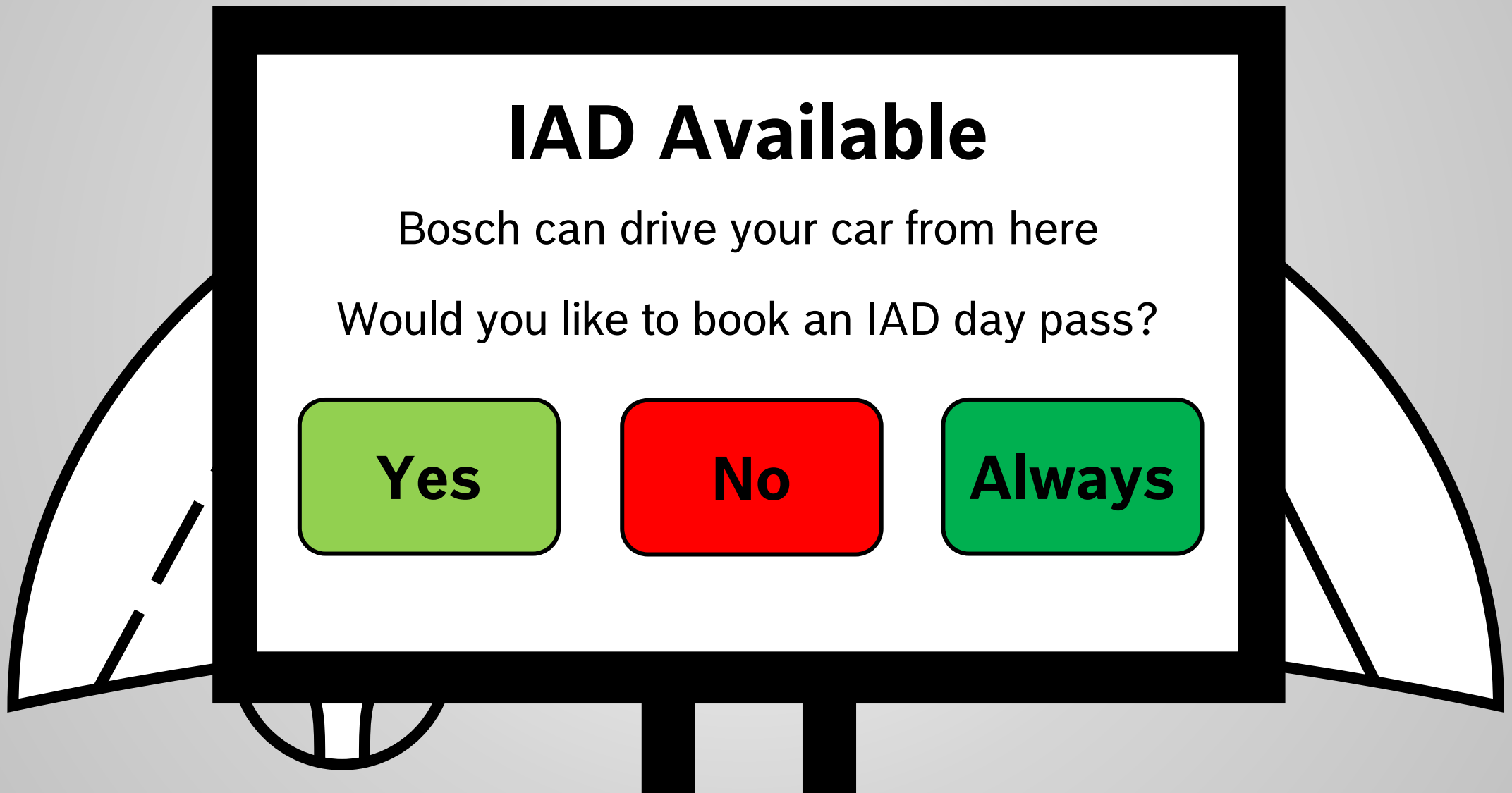
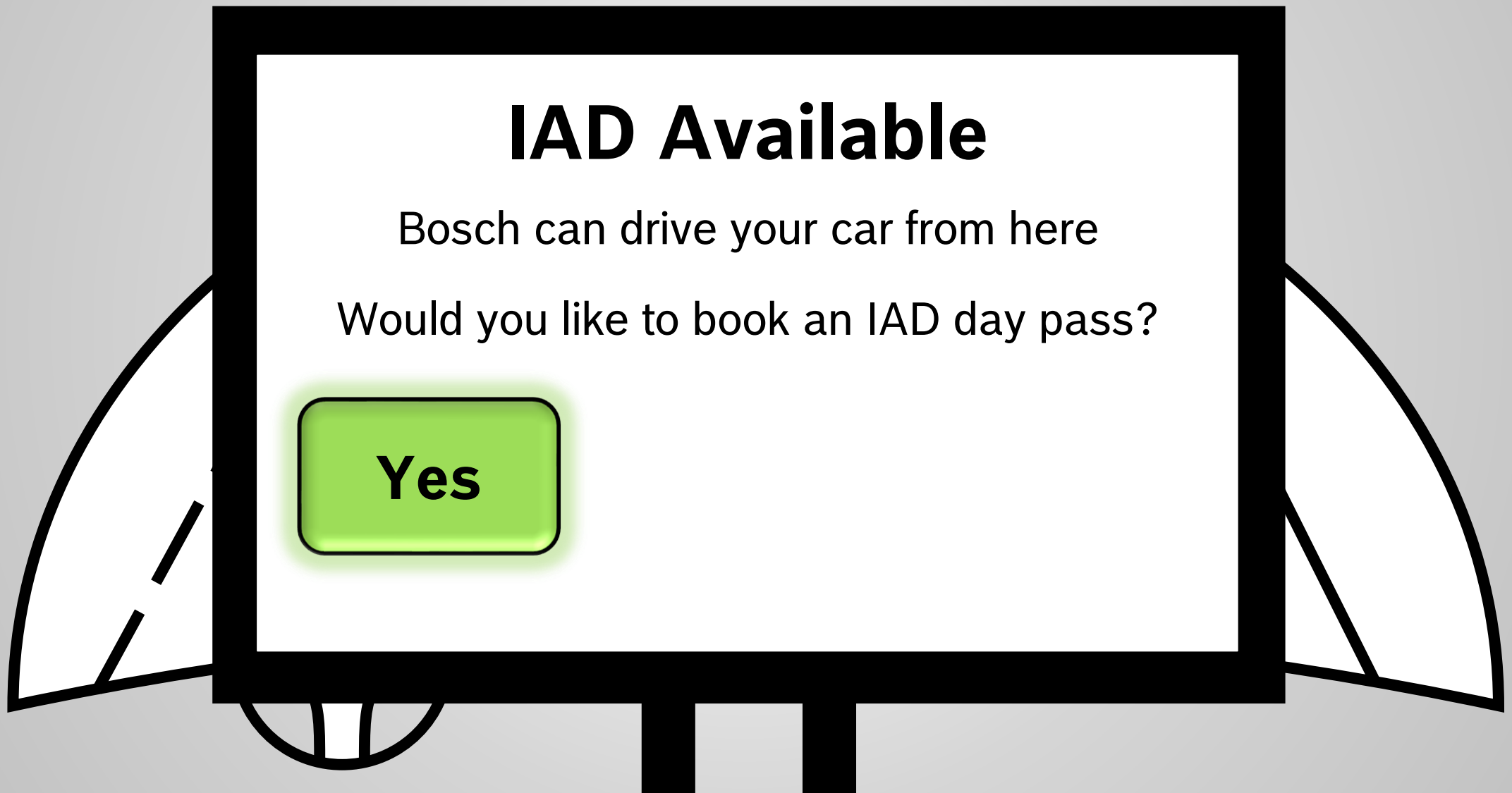
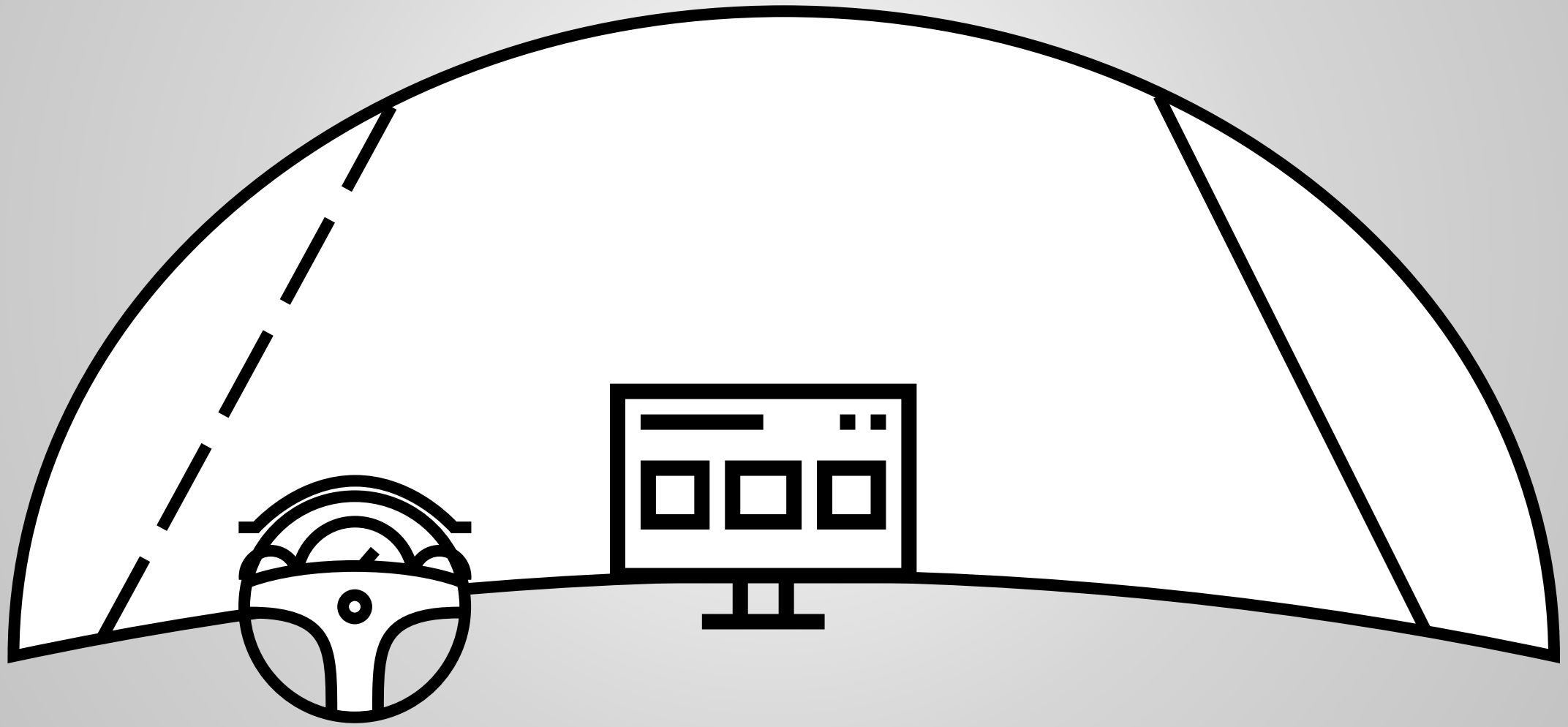
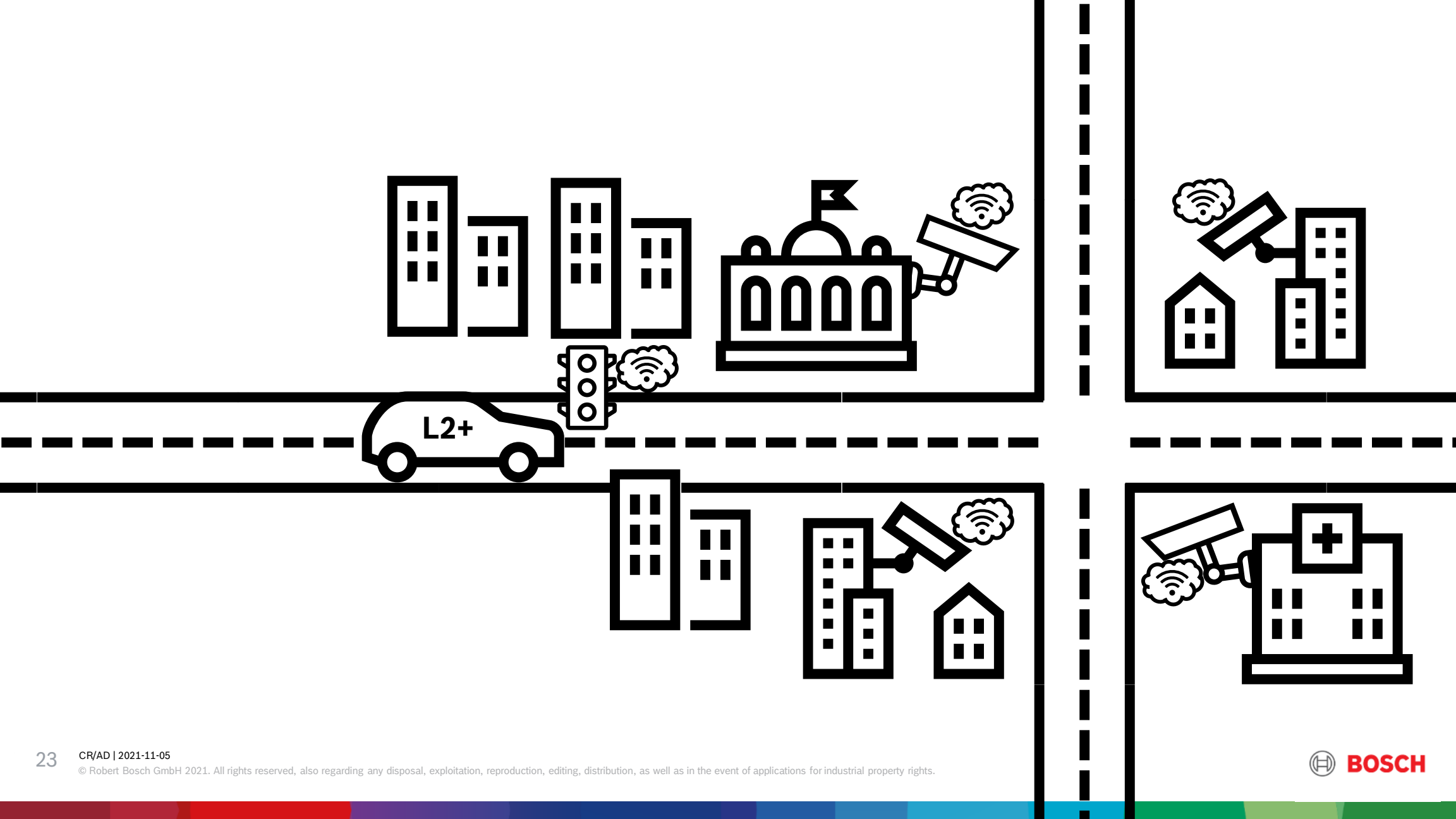



IAD Available
Bosch can drive your car from here
Would you like to book an IAD day pass?
Yes
No
Always


IAD Available
Bosch can drive your car from here
Would you like to book an IAD day pass?
Yes





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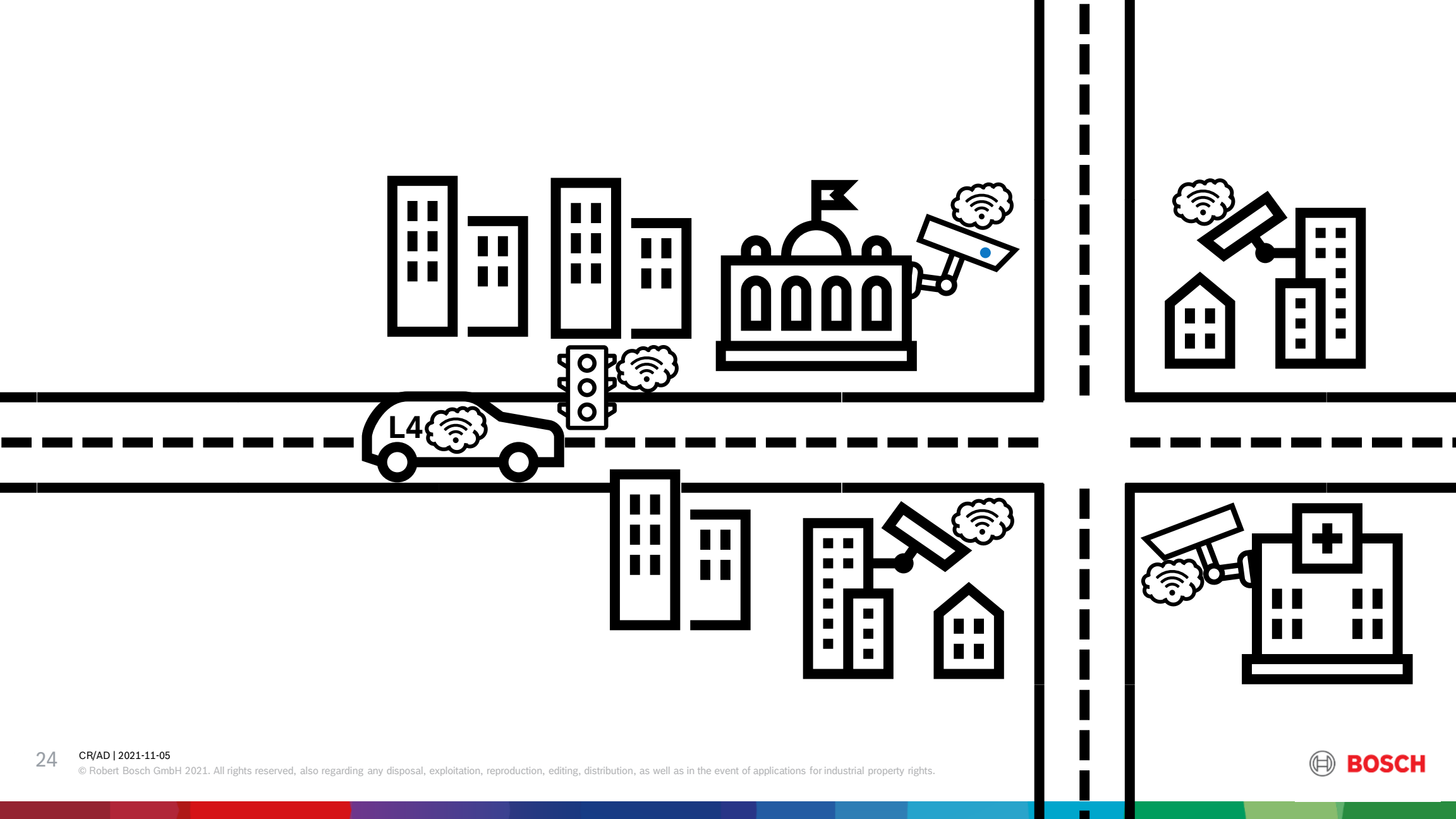

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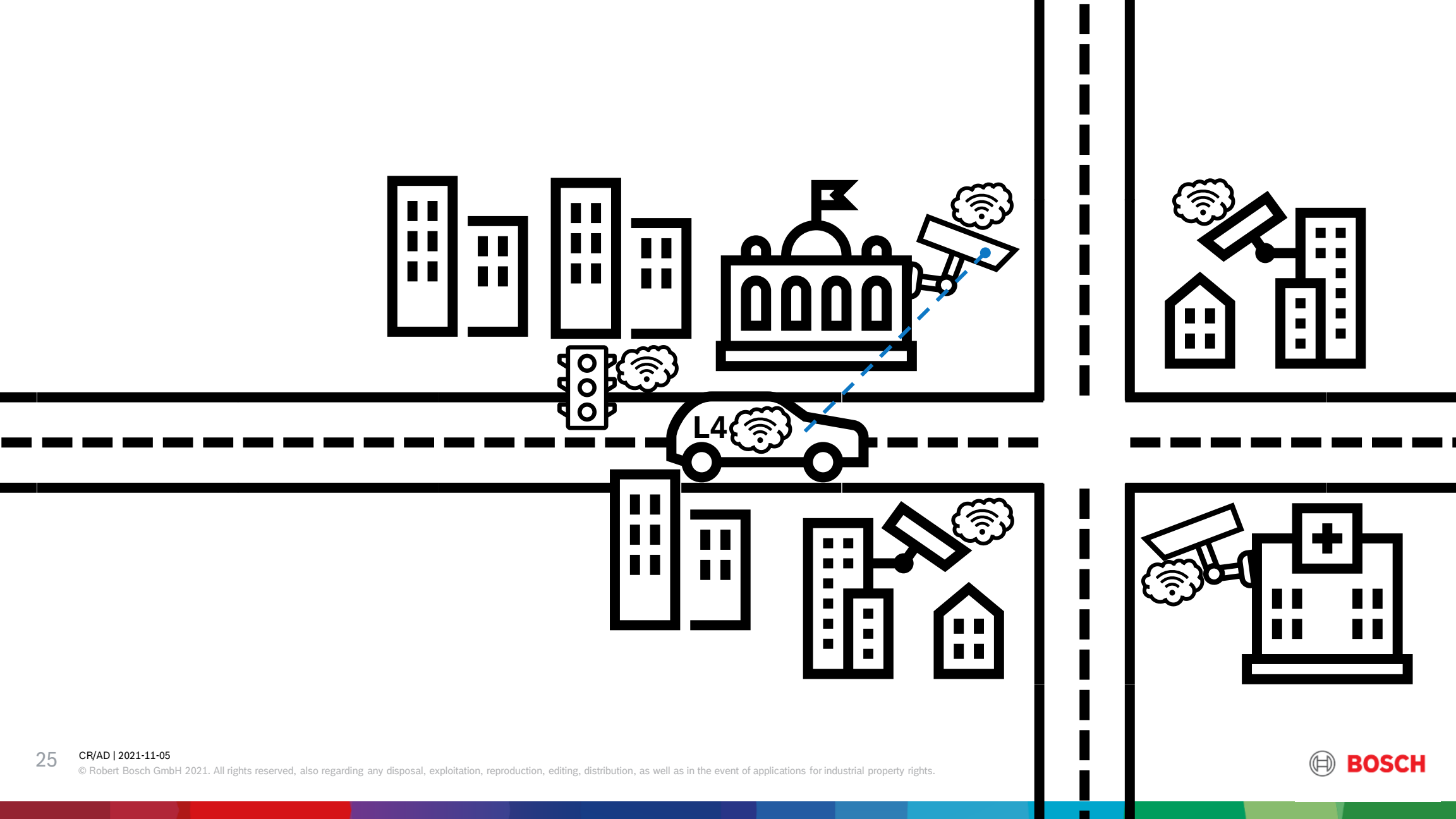

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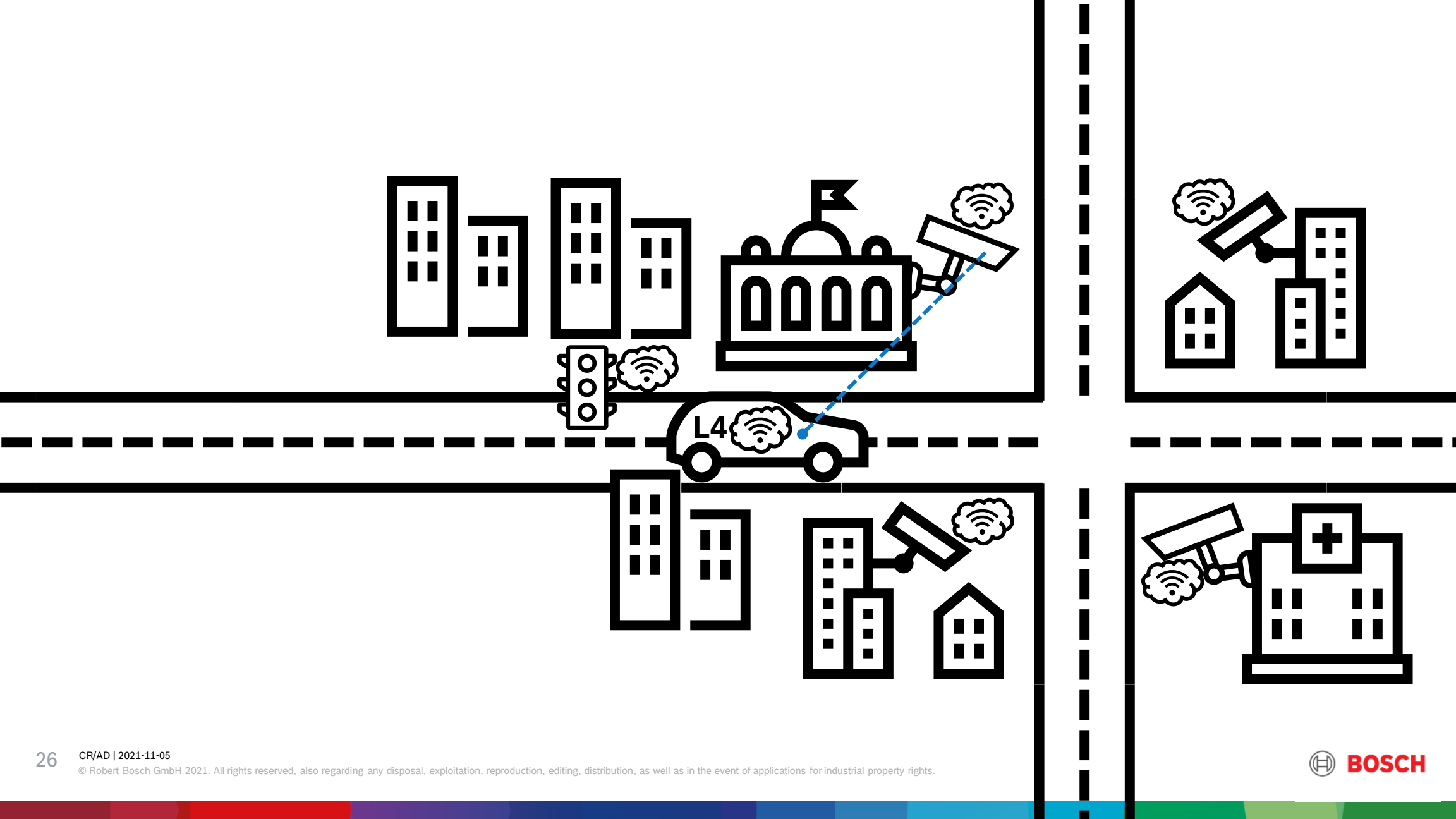

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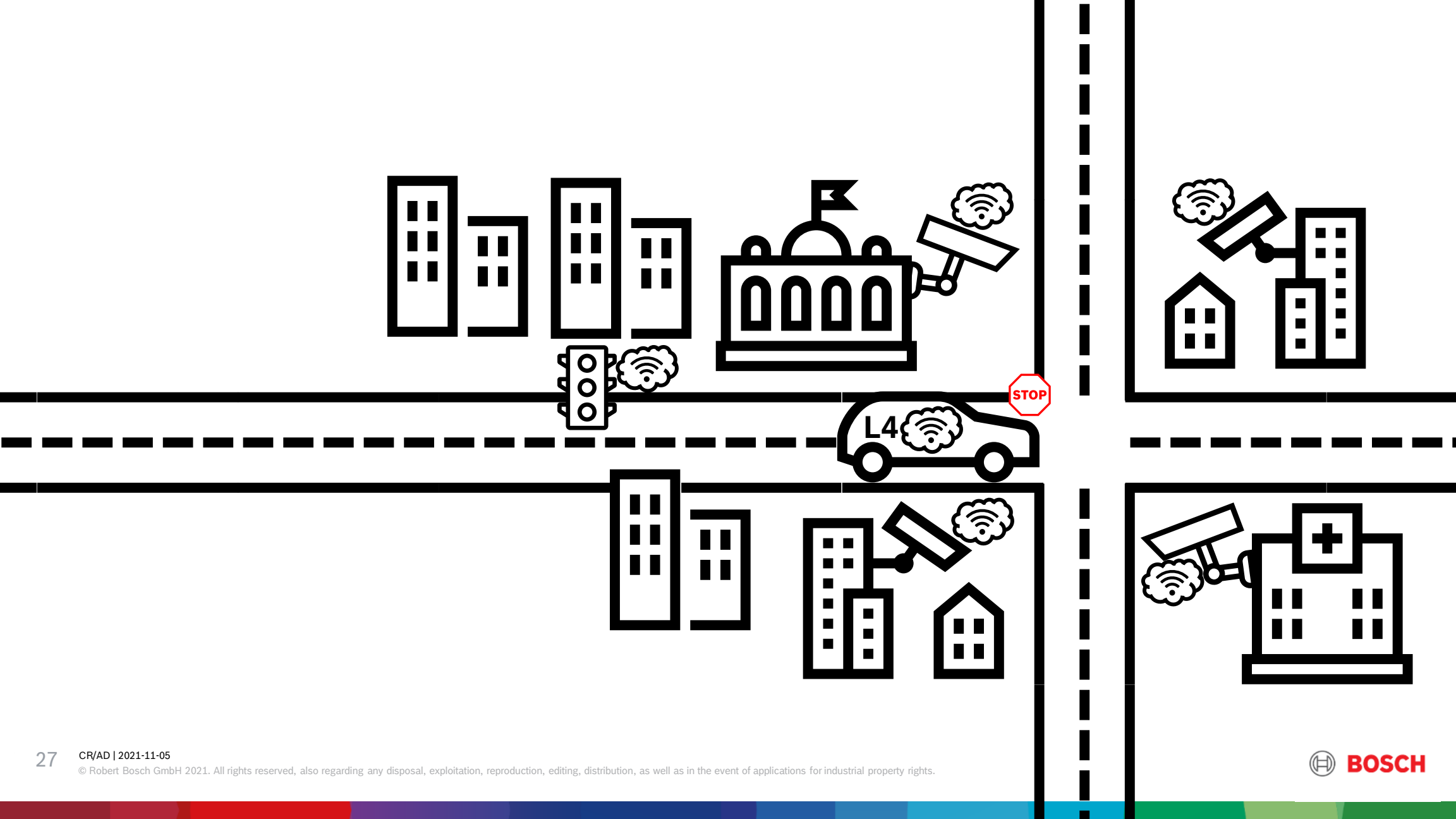

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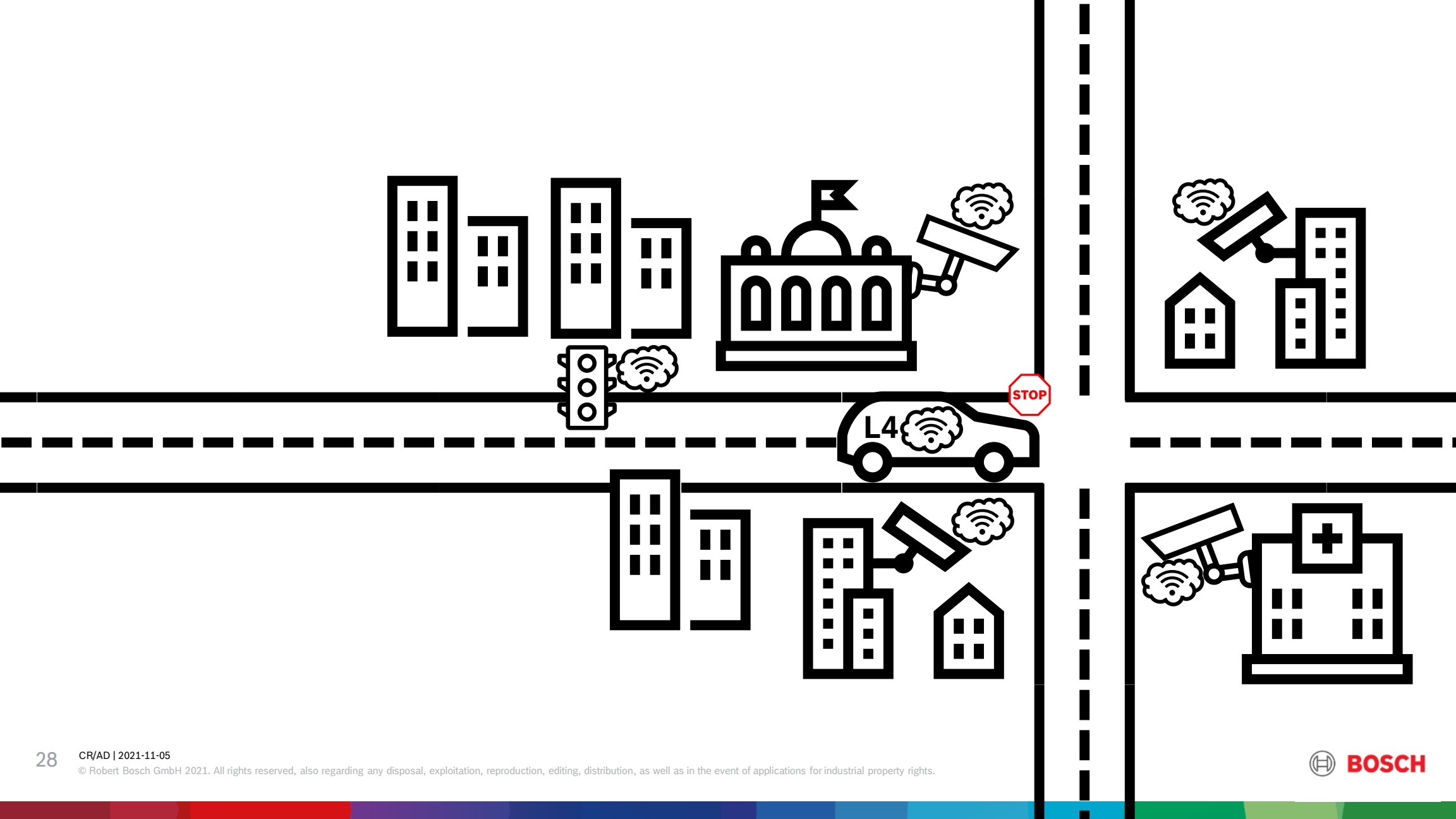

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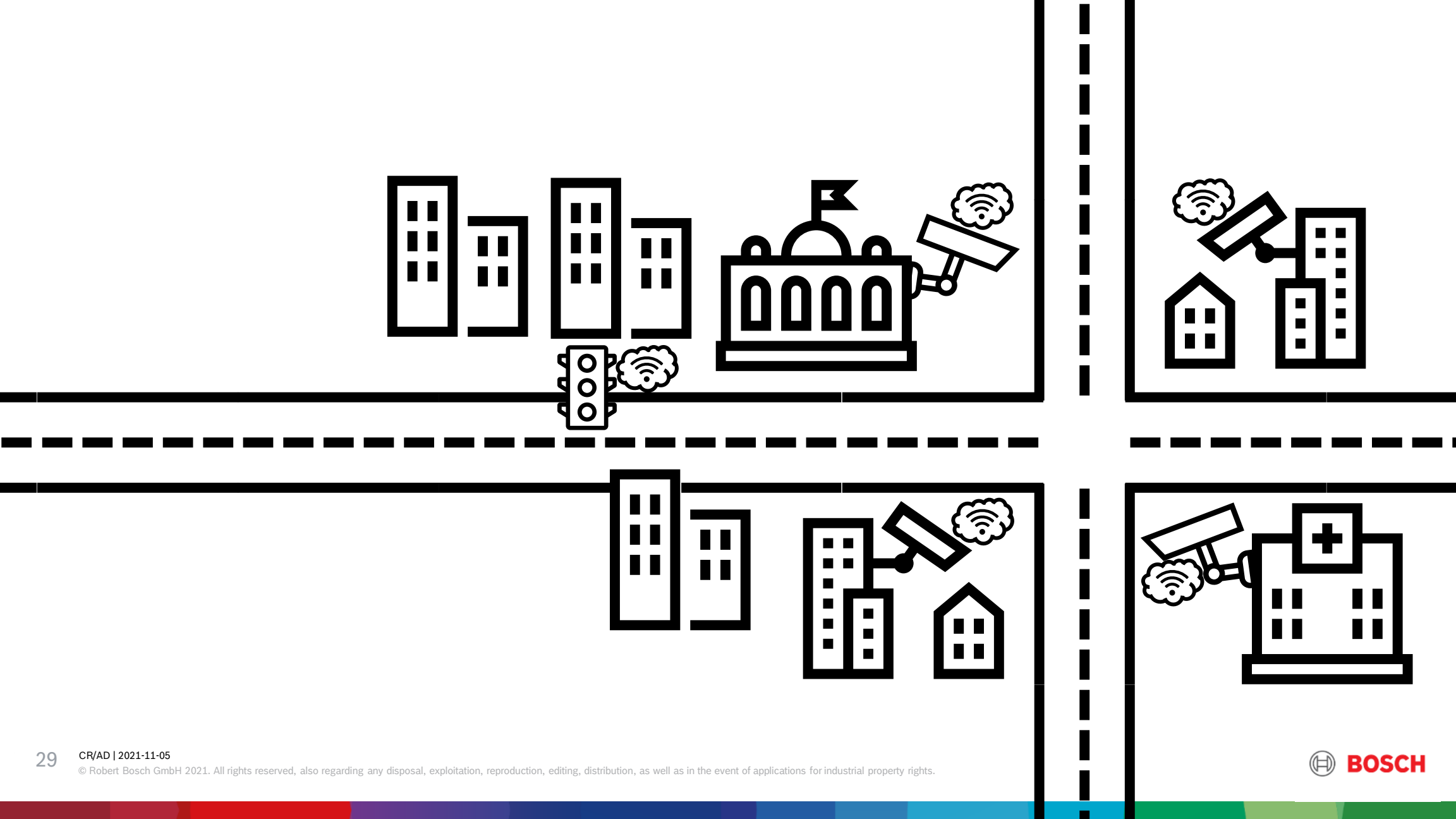

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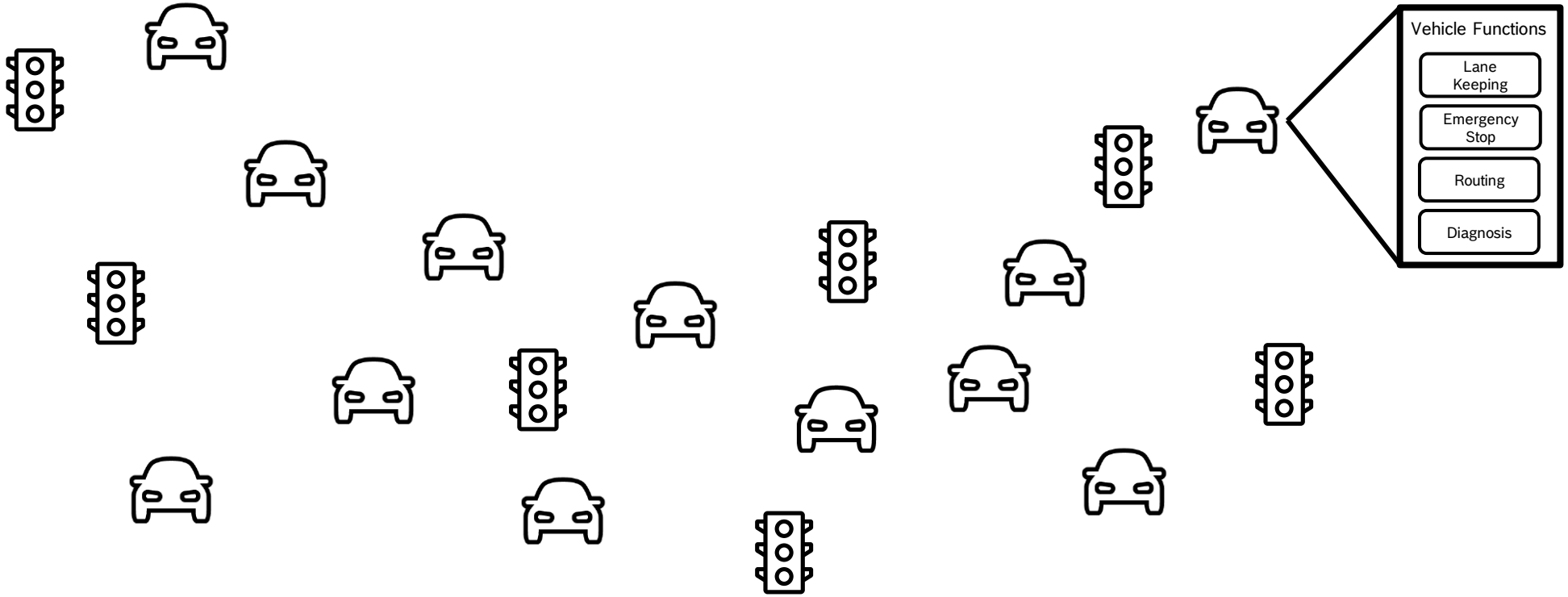
Reliable Distributed Systems (RDS)
Today



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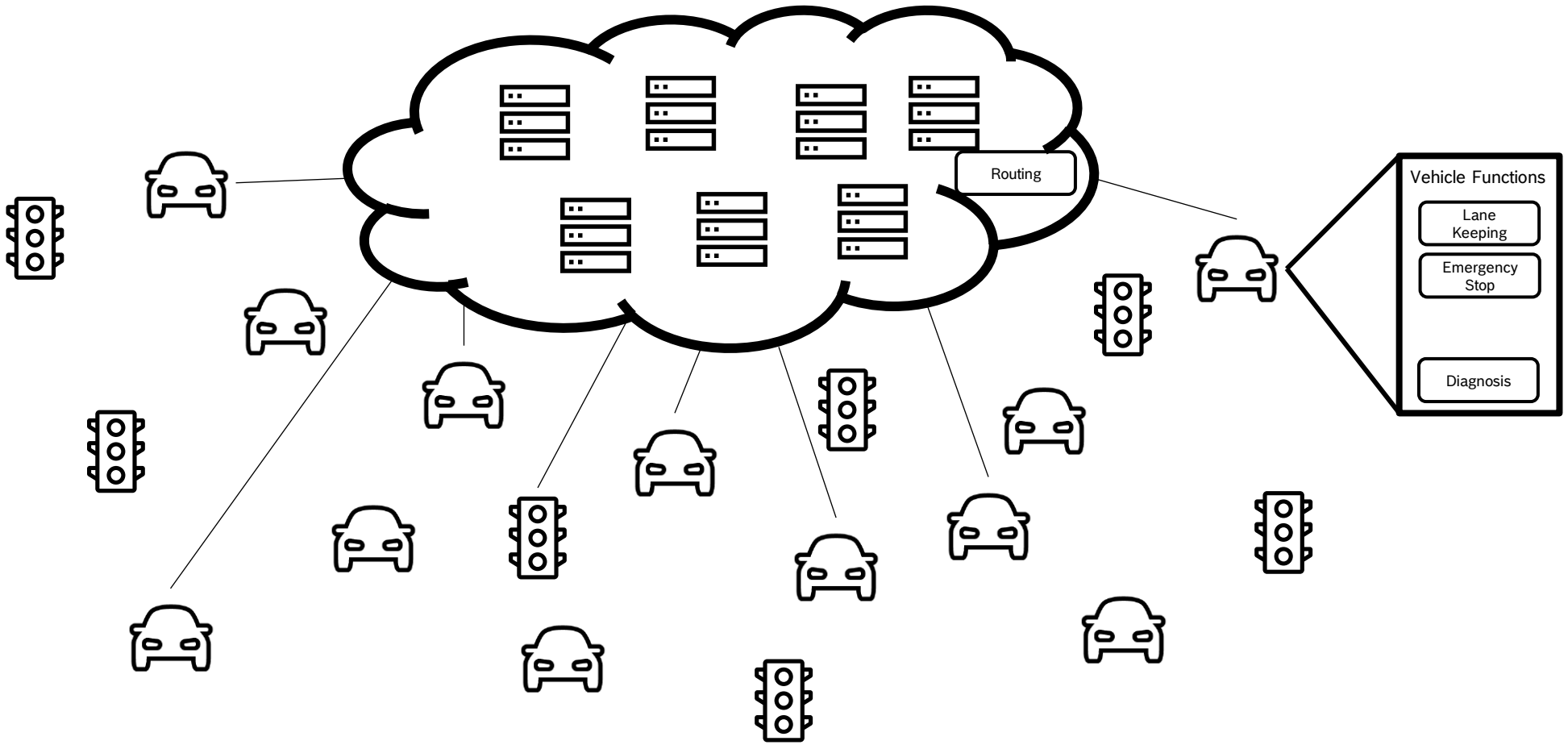
Today



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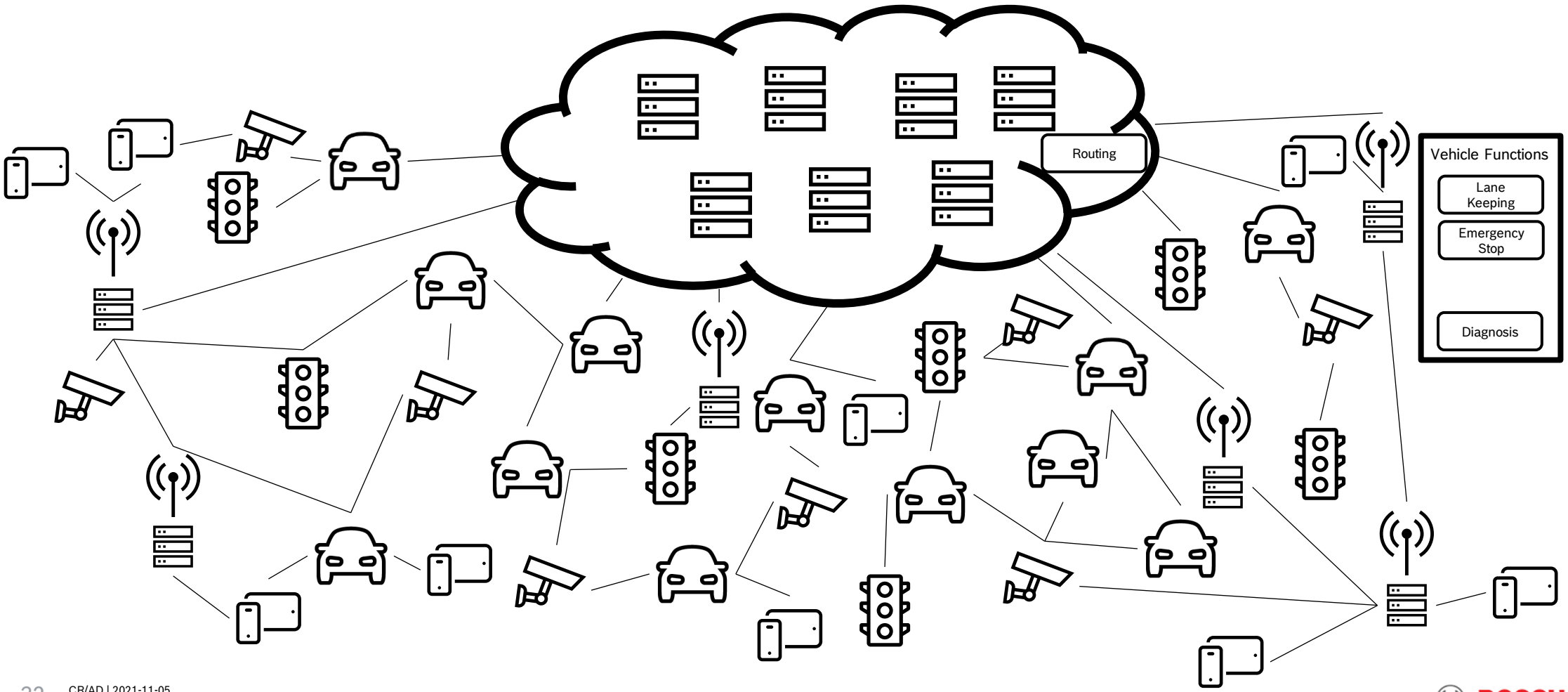
Reliable Distributed Systems (RDS)
The Fabric



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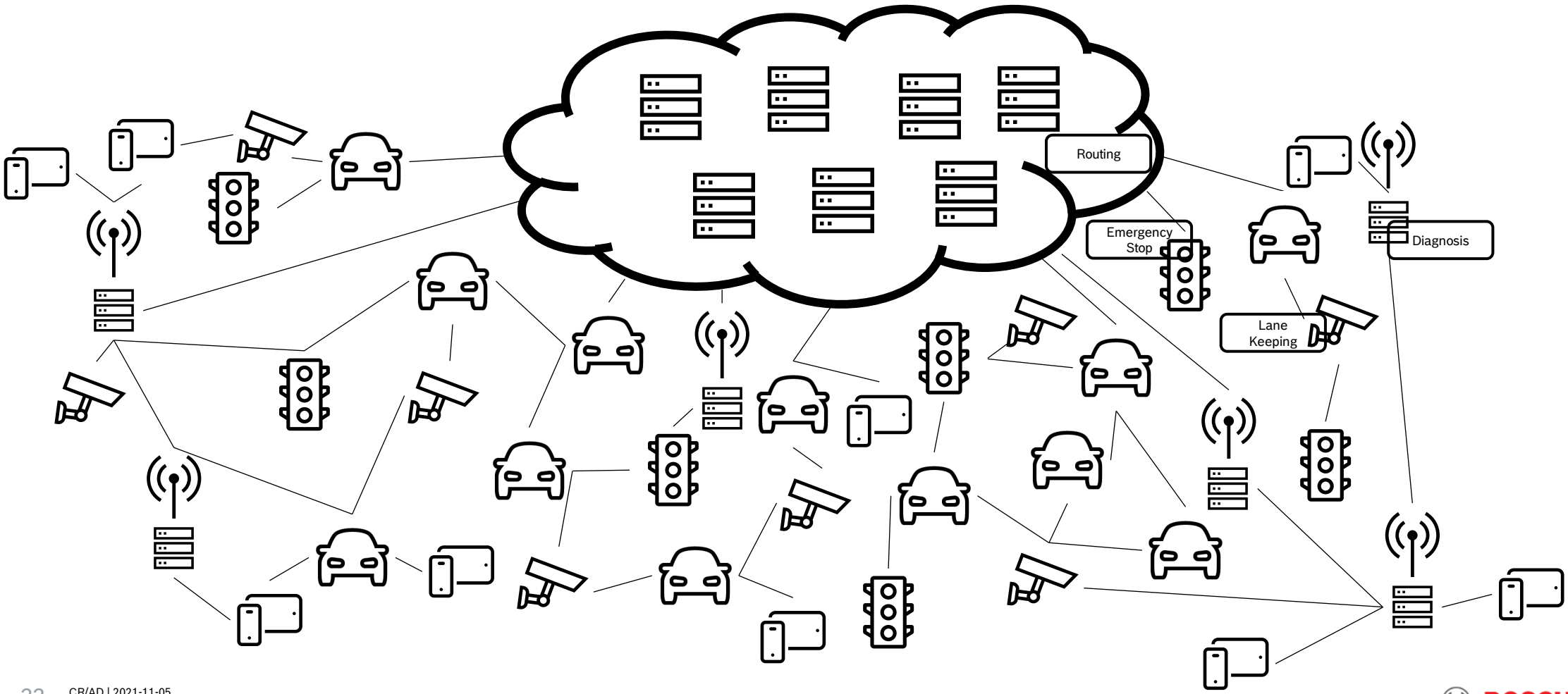
Reliable Distributed Systems (RDS)
The Fabric



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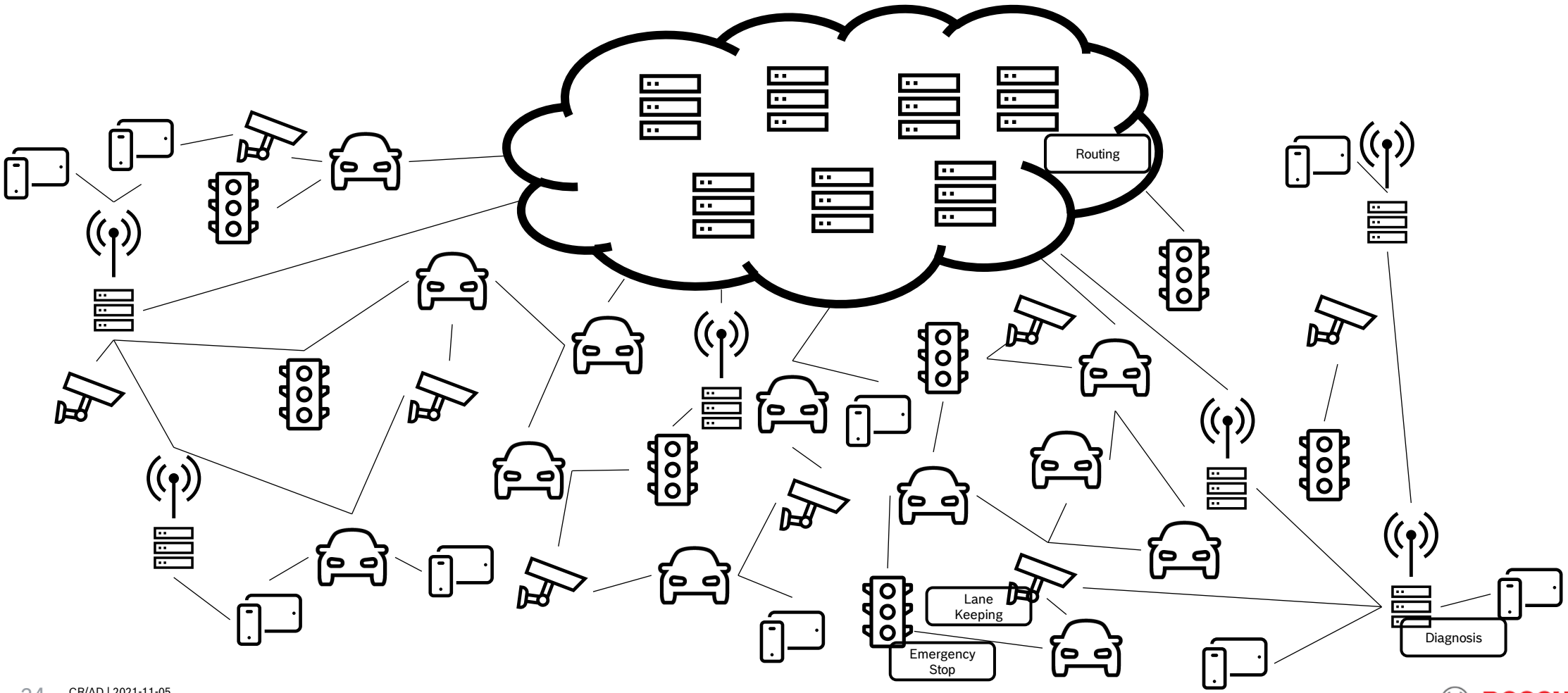
Reliable Distributed Systems (RDS)
The Fabric



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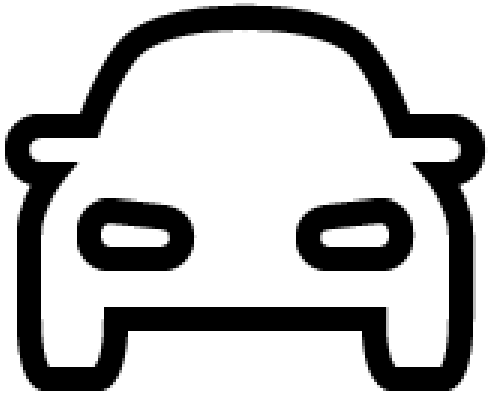
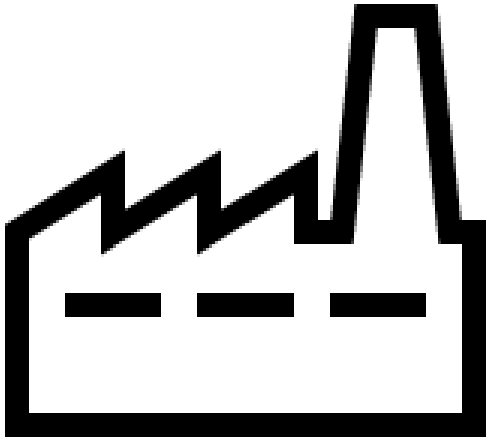
Reliable Distributed Systems (RDS)

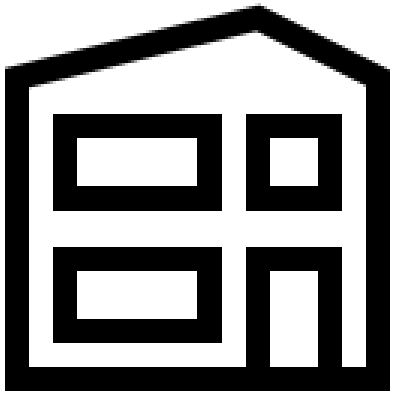
RDS spans multiple domains



Mobility



Manufacturing



Building Technology

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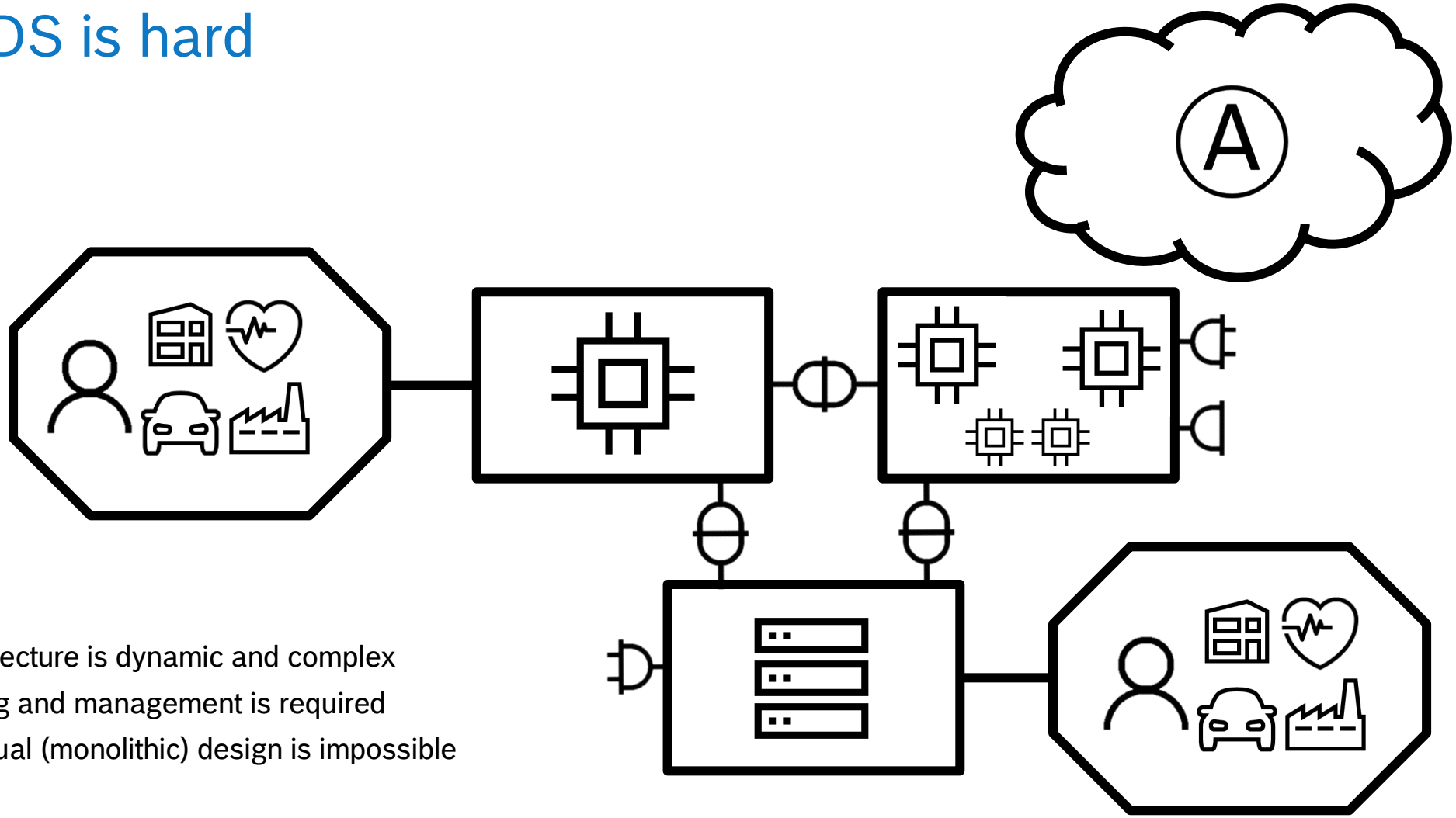
Building RDS is hard



- RDS system architecture is dynamic and complex
- Runtime monitoring and management is required
- Static upfront manual (monolithic) design is impossible

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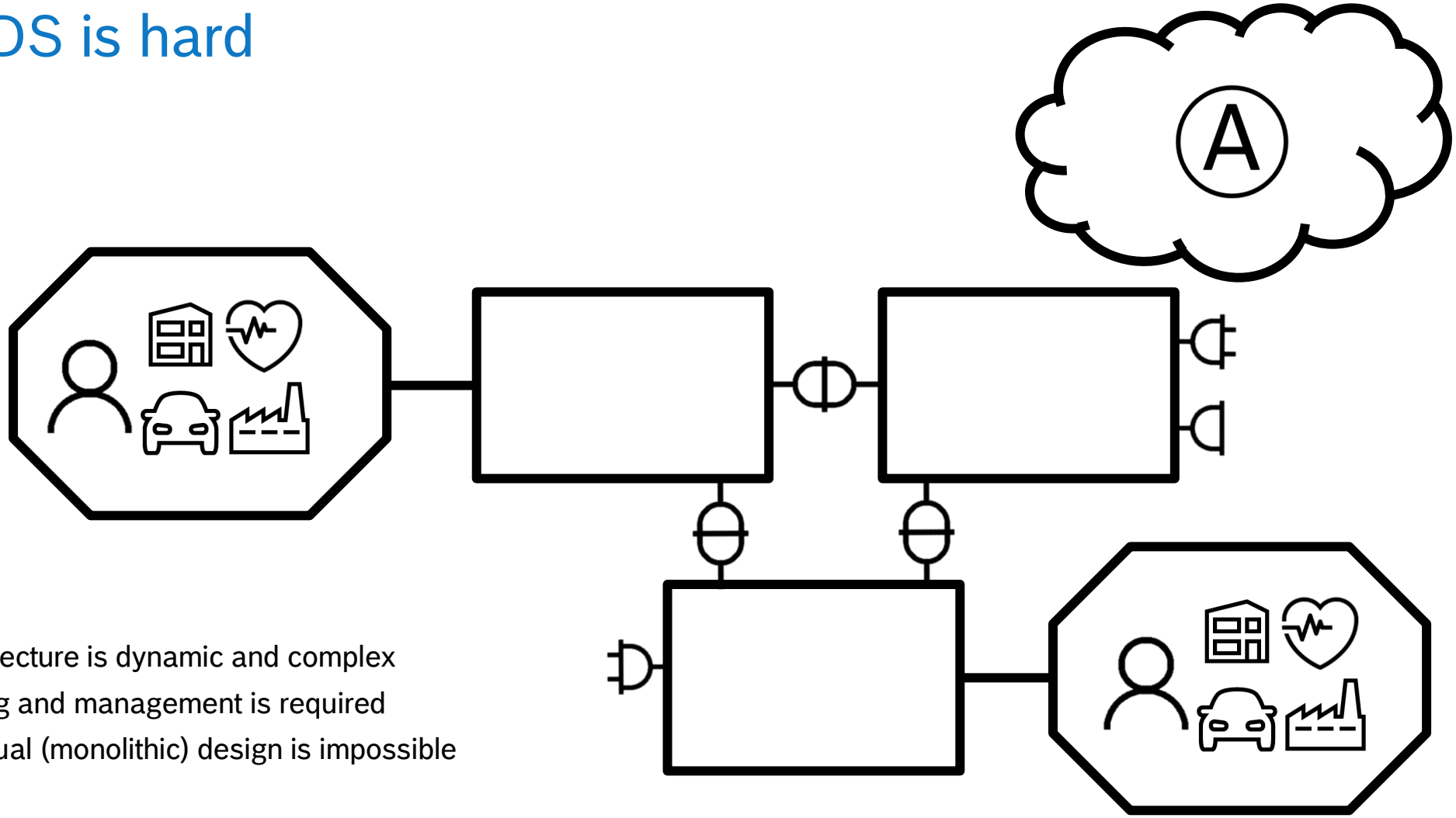
Building RDS is hard



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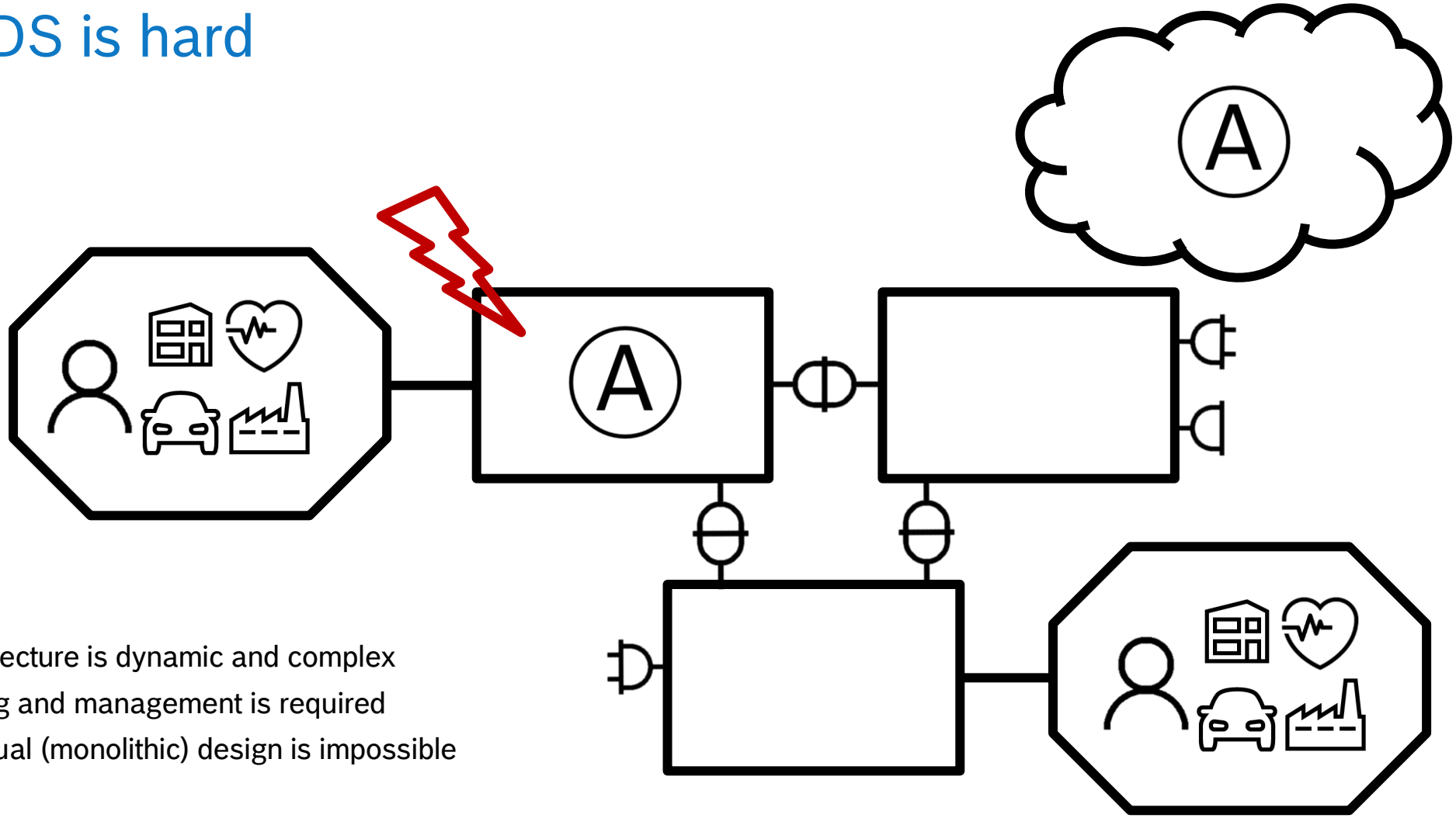

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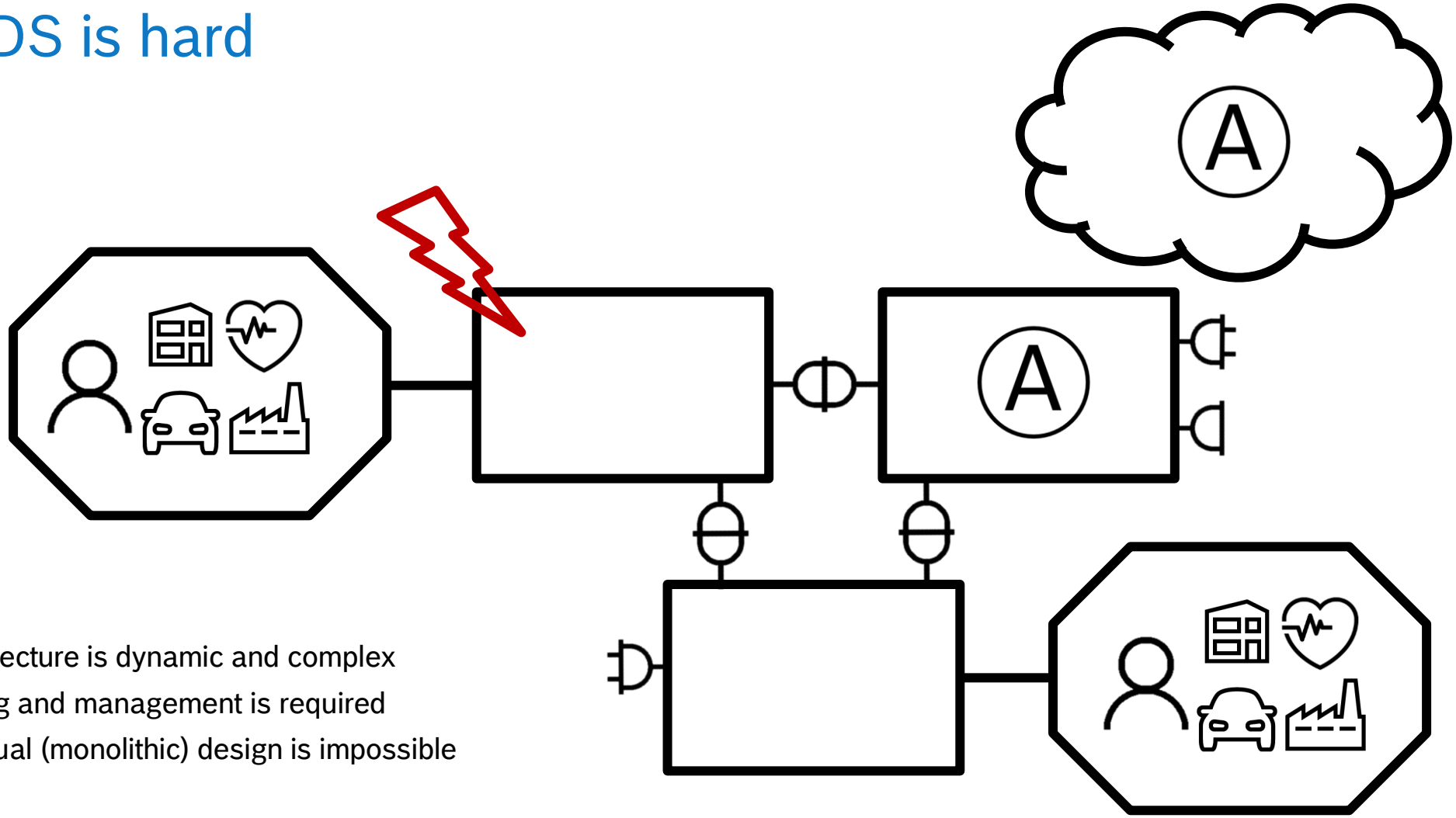

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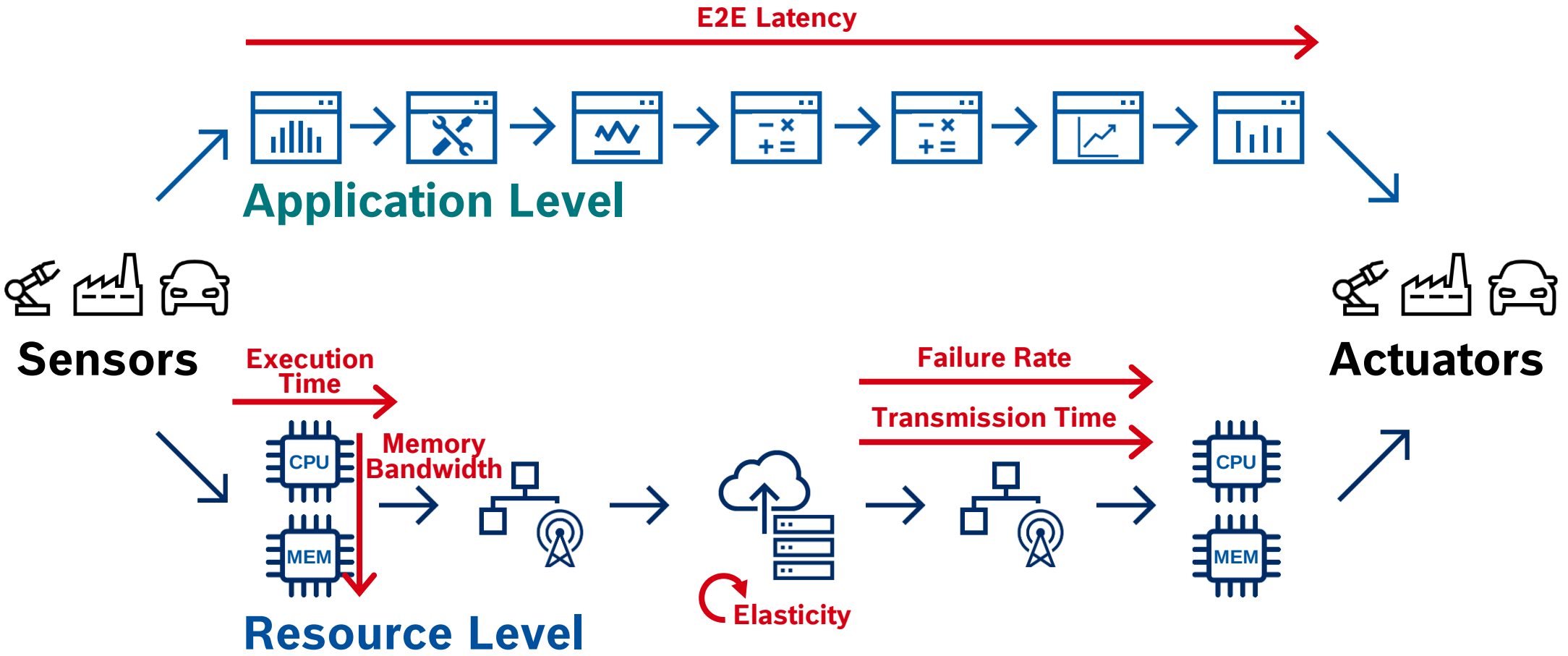
Reliable Distributed Systems (RDS)
Design Automation needed…



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Reliable Distributed Systems (RDS)

First released Level 4 Automated Driving system…

… is a (simple) reliable distributed system.

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Reliable Distributed Systems (RDS)
Summary

Reliable Distributed Systems (RDS) establish the off-board "**Fabric**"

Disruptive approach

- Mature products are impacted significantly
- BUT: Linked to existing technologies
- Compare smartphone: Was created mostly from existing hardware parts, SW makes the difference
- "The whole is greater than the sum of the parts"
  ➔ partnerships and ecosystems required

Research opportunities (examples):

- System-level Safety
  - How to make unreliable compute & sensors usable in reliable systems?
  - How to handle unreliable connections? How to handle ressource conflicts?
- What does the Fabric and, by extension, vehicle architecture look like?
  - Autosar-style + Containers?
- What is the programming model of the Fabric and, by extension, the vehicle?
- How can developers & operators be supported?
  - How are the system, its aspects and capabilities, the application requirements, etc. modeled?
  - How is the fabric monitored and autonomically operated?

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THANK YOU

AND MY CONTRIBUTORS PHILIPP MUNDHENK, DIRK ZIEGENBEIN, ANTHONY ROWE, DAKSHINA DASARI, MICHAEL PRESSLER, DAMIAN DYRBUSCH...

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